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Secretariat Address:
Malaysian Medical Association
4th Floor, MMA House, 124, Jalan Pahang, 53000 Kuala Lumpur.
P.O. Box S-20, 51700 Kuala Lumpur.
Tel: (03) 442 0617, 441 8972, 441 1375 Fax: (03) 441 8187
E-mail: mma@tm.net.my Website: www.mma.org.my

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CONTENTS

Foreword

M A Razak, President, Malaysian Orthopaedics Association

As the President of the Malaysian Orthopaedics Association (MOA), I wish to congratulate the Editorial Board of the Orthopaedics Supplement of The Medical Journal of Malaysia and especially to Y. Bhg. Dato Dr. K S Sivananthan who is also the pioneer to this journal supplement.

The publication of this journal supplement is a historial event and new era in the Development of Orthopaedics in the country. This journal supplement shall be the yard stick to the progress and template to the excellence of the Orthopaedics knowledge in this country. The publication of the journal supplement has long been awaited by the local Orthopaedics community. It gives those in the Orthopaedic field a chance to share their knowledge experiences with their fellow colleague in the same profession and also allows academic and professional discussion regarding local Orthopaedic problems. Orthopaedics is a progressive and dynamic branch of knowledge and we in Malaysia should identify and flow with this current of dynaminism. For this the publication of this journal supplement would be the tell-tale sign of this dynaminism.

As the President of MOA, I hereby would like to request that it is time the Orthopaedic community in this country continue giving their total support in making this publication a success and all future publications. Together we can maintain its high quality and academic excellence par with other international journals.

Finally, I would like to say, syabas to the Editorial Board of the Orthopaedic supplement of the Medical Journal of Malaysia.

"Malaysia Boleh"

EDITORIAL

Orthopaedic Supplement Of The Medical Journal Of Malaysia

K S Sivananthan, FRCS, Fatimah Hospital, Ipoh

The Malaysian Orthopaedic Association was founded in 1970. As of January 1998, the Association has 190 members.

The idea of a Journal for the Malaysian Orthopaedic Association was suggested at the 1997 Annual General Meeting and it was decided that the best option was to have an Annual Orthopaedic Supplement of the Malaysian Medical Journal.

It has now come to fruition.

Why the need for an Orthopaedic Journal when there are so many, international Orthopaedic Journals.

As our country progresses into the new millenium, there has been an explosion of orthopaedic information and advances in the field of orthopaedics and traumatology. We have an ever increasing number of postgraduate orthopaedic students in the country, many of whom are engaged in research.

This journal supplement is primarily a vehicle for publication of this and other research, experience and opinion, to disseminate and share knowledge and expertise, thus promulgating improved orthopaedic practice throughout the nation, benefiting both patients and doctors.

We hope this Orthopaedic Supplement is received and supported by all the members of the Malaysian Orthopaedic Association and doctors of Malaysian Medical Association so that we have a publication of a good standard in this country. In this Orthopaedic Supplement, we have published articles from doctors working in the Universities, Government hospitals and private hospitals.

Halovest Treatment in Traumatic Cervical Spine Injury

M Razak, MS Ortho, T Basir, MD, Y Hyzan, MD, and Z Johari DN, Department of Orthopaedic and Traumatology, Universiti Kebangsaan Malaysia, Hospital Kuala Lumpur

Summary

This is a cross-sectional study on the use of halovest appliance in the Orthopaedic and Traumatology Department, Kuala Lumpur Hospital from June 1993 to September 1996. Fifty-three patients with cervical spine injuries were treated by halovest stabilization. Majority of cases was caused by motor-vehicle accident[38]; others were fall from height at construction sites[6], fall at home[4], hit by falling object[2] and assault[1]. The injuries were Jefferson fracture of C1[7], odontoid fractures[10], hangman fractures[7], open spinous process fracture[1] and fracture body of C2[1], and fracture, and fracture-dislocation of the lower cervical spines[23]. Majority of patients had hospital stay less than 30 days. The use of the halovest ranges from 4 to 16 weeks and the healing rate was 96%. Two patients of lower cervical spine injury had redislocation and one of them was operated. There was one case of non-union of type II odontoid fracture and treated by posterior fusion. Other complications encountered during halovest treatment were minor. They were pin-site infection[5], pin-loosening[3], clamp loosening[2] and neck pain or neck stiffness[6]. This method of treatment enables patient to ambulate early and reduces hospital stay. We found that halovest is easy to apply, safe and tolerable to most of the patients.

Introduction

The use of the halo apparatus for preoperative immobilization of the cervical spine was first described by Perry and Nickel in 1959 (Chan et al., 1983). Since that time, halo immobilization has been adapted to other situations and became a commonly used non-surgical alternative for the treatment of cervical spine injury (Cooper et at, 1979; Lind et al, 1988). Since then, there have been several reports in the literature of the efficacy of the halovest apparatus in the treatment of cervical spine injury and the method is now used all over the world. However, the use of halovest in this country is quite new and there is no local report in this method of treatment.

The purpose of this paper is to report our early experience with the use of the halovest in Orthopaedic and Traumatology Department, Kuala Lumpur Hospital.

Material and Methods

This is a cross-sectional study conducted from June 1993 to September 1996. The cases that included in this study are those patients with traumatic cervical spine injury treated with halovest. The indications for halovest application are unstable cervical spine fracture who are neurologically intact or who had suffered from incomplete cord damage with preservation of trunk sensation. The majority of patients with unstable cervical spine fractures were initially treated with skull traction, using crutch field tongs. Once pulmonary and bowel functions were satisfactory, skull traction was removed and halovest was applied. Halovest were fixed under local anesthesia with or without sedation. Post halovest application radiographs were taken to ensure the reduction achieved by traction was maintained. Neurological assessment also performed before and after the application of halovest. The halovest were applied for about 6 to 12 weeks. The decision to remove the

halovest was made on the basis of plain radiograph with the evidence of union, pain free or minimal pain on the neck, the presence of neurological improvement and in cases with subluxation without fracture, the halovest was removed when ligament healing has occurred. After halo removal, flexion-extension films were obtained to confirm stability. The patients were followed-up 3 weeks for the first months, then 3 to 6 monthly. The patients' follow-up range from 3 months to 2 year and 8 months with an average of 1.4 years.

Results

There were 53 patients all together. Forty-four were male and nine female. They ranged from 17 to 62 years, with the average age of 33.1 years. About 40 percent of patients came from young productive group of 20 to 30 years.

The main causes of trauma were motor vehicle accident (Figure 1). The others were fall from height, fall at home, fall into drain, hit by falling object and assaulted cases. In the case of motor vehicle accidents, the motorcycle tops the list of the vehicle involved. It contributes 60 percent of the cases.

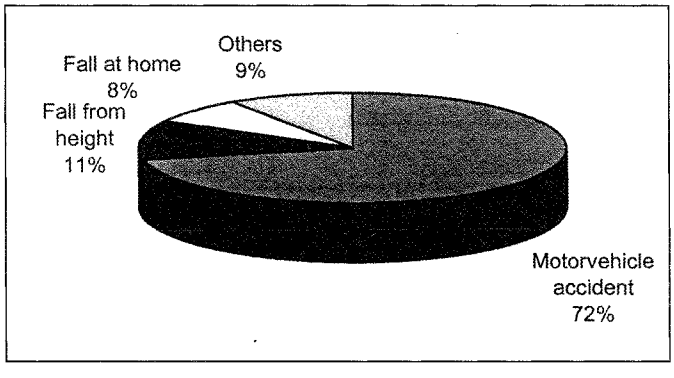

Fig. 1: Mechanisms of Injury

An analysis of the fractures was made. There were 25 cases (47.2 percent) involving upper cervical spine, i.e., C2 and above. Majority were odontoid fractures. There were 28 cases (52.8 percent) in lower cervical spine i.e., below C2 level. There were classified according to Allen classification (1982). Most of the cases are compression flexion and distraction flexion types of injury. The period of halovest application and clinical union are as

Table I
Types of Upper Cervical Spine Injuries and Union Rate

	No.	Halovest Period (weeks)	Clin. Union (weeks)
Jefferson fracture	5	10.6	12.2
Odontiod Fracture			
– type I	0	–	–
– type II	4	8.0	11.5
– type III	7	8.0	10.1
Hangman fracture	7	10.0	10.4
Fracture spinous process of C2	1	5.0	6.0
Fracture Body of C2	1	13.0	13.0
Average		**9.1**	**10.5**

Table II
Types of Lower Cervical Spine Injuries* and Union Rate

	No.	Halovest Period (weeks)	Clin. Union (weeks)
Compression flexion (CF)	10	8.3	10.8
Distraction flextion (DF)	11	7.3	11.4
Vertical Compression (VC)	2	10.5	13.0
Compression extension (CE)	3	6.0	6.6
Distraction extension (DE)	2	5.5	9.5
Average		**7.5**	**10.3**

** Injuries classified according to Allen Classification.*

shown in Table I and Table II. The mean period of halovest applied is 9.1 weeks for upper cervical spinal injury and 7.5 weeks for lower cervical spinal injury. The average clinical union was 10.5 weeks for upper CSI and 10.3 weeks for lower CSI.

The mean period of halovest usage was 8.3 weeks and healing (clinical union) was 10.4 weeks. The healing rate was 96 percent. There were two cases of non-union and were surgically stabilized. The healing rate is comparable with other studies (Table III).

Table III
Healing Rate

	This Study	Chan RC et al., 1983	Lind B et al., 1988
No. of patients	53	188	179
Healing Rate	96%	89%	90%

More than half of the patients stayed in hospital for less than 20 days. Some patients needed to stay longer because of multiple fractures and some elderly patients requested to stay in the hospital as they had no family member to take care of them at home.

The average hospital stay was 21 days in patient without neurological deficit and 34.8 days in patient with neurological deficit. These are much better when compared to previous study in the same hospital in which patients were treated with Minerva jacket (Jamaluddin, 1987).

Table IV
Average Hospital Stay

	Patients with no neurological deficit (days)	Patient with neurological deficit (days)
The Study	21.0	34.8
Jamaluddin (1987)	34.0	66.0

Apart from redislocation of the fracture dislocation, complications encountered were usually minor. They were pin site infection, pin loosening, ring clamp loosening and neck pain or stiffness. There was no serious complication such as dural penetration and CSF leakage.

Discussions

The development of skeletal traction as described by Crutchfield (1933) represented a significant advance in the management of cervical spine injuries. When used as the sole treatment of these injuries, however, traction necessitates hospitalization lasting weeks or months.

The advent of anterior cervical fusion as described by Cloward (1958) allowed early ambulation inmost case. In traumatic entities, whether fusion is performed from anterior or posterior approach, the goal of immediate stability is not always achieved, and a variety of external bracing devices may have to be used post-operatively. In addition, non-union, extrusion or resorption of bone graft, subluxation and angulation may occur in postoperative period.

The disadvantage of prolonged skeletal traction is in large measure eliminated by halo immobilization. The current studies show that the halovest apparatus is a reliable method of treatment for cervical spine injuries (Ekong et al., 1981; Kostuik, 1981; Ersmark & Kalen, 1986; Pringle RG, 1990; Garfin et al., 1987; Fujimura, 1995). It assures a high rate of healing, even in odontoid fractures. However, redislocation did occur and the halovest does not provide total stabilization (Whitehill et at., 1986). Patients acceptance has been high. Although initially distressed by the cumbersome nature and bizarre appearance of the halo, most patients quickly adapt to the device.

The series presented is representative of a common cervical spine injury patient population regarding mechanisms of injury, sex and age distribution, incidence of neurological deficit, and location of the injury within the cervical spine (Lind et at., 1988; Cooper et al., 1979; Ersmark H and Kalen R., 1986).

Motor vehicle accidents were the cause of cervical spine injury in 71% of the case. In the present series it was

interesting to find that more than 60% of MVA cases the vehicle involved were motorcycles. The males out numbered the females by 4:1 and the incidence of cervical spine injury was highest in the 20-30 year age group - they are young productive human resources of the nation, which may be affected because of prolonged treatment and rehabilitation.

Out of 53 patients, only 18 patients had with neurological deficits. The primary neurological deficits and the concomitant injuries were not, on the whole, of a serious nature. Victims with severe neurological deficits and concomitant injuries probably died instantly and never reached the hospital. The healing rate in this series was 96% for the patients who completed the halovest regime period. This is comparable to other series of patients treated with halovest (Chan et al., 1983; Cooper et al., 1979; Esrmark and Kalen 1987) and those treated by skull traction (Cheshire DJE, 1969 and Frankel HL, 1969).

The length of hospital stay was increased when there were systemic injuries, neurological deficit, or difficulty in the reduction of subluxation. Lack of immediate availability of the halovest sets also served to increase the hospital stay for a considerable number of patients. Hospital stay in this series are comparable to others (Cooper et al., 1979; Lind et al., 1988) and are much better compared to previous study in this hospital (Jamaluddin, 1987) in which the patients were treated by Minerva jacket immobilization.

There were two cases of redislocation. One was C5/C6 unifacet fracture dislocation and posterior fusion was performed. The other was C6/C7 unifacet fracture-dislocation but the patient refused operation. There was no neurological deficit. There was one case of non-union and treated with posterior fusion. The other complications identified were pin site infection, pin loosening, clamp loosening and neck pain or neck stiffness.

Conclusions

The halovest treatment in cervical spine injury resulted in high healing rate. The patients' compliance to treatment was good. The complications identified were usually minor. The halovest treatment enables patient to ambulate early and reduces hospital stay. We found that halovest is easy to apply, safe and tolerable to most patients.

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SPINE

Neurological Recovery Following Posterior Decompression of Spinal Secondaries

M Razak, AM, MS (Orth), K Sappani, MBBS, Department of Orthopaedic and Traumatology, Universiti Kebangsaan Malaysia, Kuala Lumpur

Summary

This is a retrospective study comprising 45 patients who underwent decompressive laminectomy due to secondary malignancy in the spine. There were 31 males and 14 females. Two of them had no weakness, one was treated for radicular pain and the other for severe intractable back pain. Forty three patients presented with weakness of the limb of which six patients were able to walk unaided, four with an aid, twenty four were unable to walk of which eleven of them were completely paralysed. Nineteen of the patients had urinary incontinence. Out of 10 patients in Frankel's D, 3 of them regained almost normal power post operatively and were able to walk without any aids at the time of discharge. There were 6 patients in Frankel's C and 2 improved. Of 17 patients in Frankel's B, 6 of them improved and were able to walk with walking aids. Only one out of ten patient from Frankel's A had showed an improvement. A total of three patients deteriorated post operatively and all of them presented with multiple level involvement. There was no change in the post operative status of the two patients who did not have weakness. Overall only 27% of the patient showed improvement following decompressive laminectomy.

Introduction

Malignant disease is frequently viewed as an almost fatal illness. An associated metastatic spinal lesion adds more pain and suffering to the patient. The skeleton is the third most frequent site for distant metastasis following the lung and liver (Jaffe,) 1958). Within the skeletal system the vertebral column is most commonly involved. Jaffe also noted that 70% of patients with cancer had skeletal metastasis and the thoracic spine was most often involved. Other authors too share the same view [(Garland 1954)(Haagensen 1956) and (Fisher et al 1968)}. Constants et al (1983) reviewed 600 cases with spinal metastasis and found that 10% of cancer patients develop spinal metastasis with neurological manifestations. Harrington (1986) cites the spine as the most common site for skeletal metastasis irrespective of the primary tumour involved. The apparent rise in incidence of neoplastic disease in the past three decades couples with advances in diagnostic, surgical and medical services has resulted in an increasing number of patients, with malignant deposits in and around the spinal cord seeking treatment (Smith 1965). With the improved technology available to treat cancer patients the survival will increase further and this would mean a greater number of patients seeking treatment for spinal metastasis.

Laminectomy for resection of a malignant spinal extradural neoplasm was probably firstly performed by Le Cat in 1751 (Markham 1951). Decompression has been the standard operative intervention for patients with progressive neurological symptoms secondary to metastatic spinal lesions. The role of surgery in the management of spinal metastasis continues to be debated since current results of treatment are unsatisfactory, (Gilbert et al 1978). Many other authors have painted grim pictures of the outcome of surgery in spinal metastasis (Kleinman et al 1978, Auld and Buerman 1964.

Material and Methods

This is a retrospective study of forty five patients with spinal column metastasis who had been subjected to posterior decompression of the spinal column by laminectomy from 1975 to 1989 at Kuala Lumpur General Hospital. The surgery were performed in the Orthopaedic and Neuro-surgical unit of the Hospital by numerous surgeons. We adopted a classification/ grouping by Frankel et al (1969) to denote the pre and post operative functional neurological status.

Results

The ages ranged from 13 years to 68 years with an average of 42.2 years. There were 31 males and 14 females, with a M:F ratio of 2.15:1.

In this review 38/45 patients had significant back pain, often not relieved by analgesics, 43/45 patients presented with weakness in the lower limbs of which six patients were able to walk unaided, four patients were walking with an aid, either a walking stick or walker, 24 patients were unable to walk whereas 11 of them were unable to move the lower limbs. 19 of the patients had urinary incontinence. Only one patient had upper limb weakness. Two had no weakness and one of them was treated for radicular pain and the other for severe intractable back pain. Hall and Mackay (1973) attribute poor results in some patients who underwent decompression lamainectomy as due to late referral rather than due to any fault in surgical technique. In this series similar problems of late referral have been encountered.

Two patients did not have any weakness, one presented with intractable back pain and the other had nerve root pain. In both instances the primary lesion was nasophargryngeal carcinoma the remaining 43 patients can be classified according to Frankel et al (1969).

Table I lists the origin of tumour metastasis to the spine. Nasopharyngeal carcinoma, bronchogenic carcinoma and breast carcinoma were the three most common primary tumours. The primary malignancy could not be identified in 20% of the cases.

There were a total of 10 patients with the Frankel's D. The three patients with mild degree of weakness regained almost normal power post operatively and were able to walk without any aid at time of discharge. In one of the patients who had undergone decompressive laminectomy at level of T_2 - T_3, the primary tumour was nasopharyngeal carcinoma. There were 6 patients in the Frankel's C and 2 improved post operatively. The primary tumour in this patient was unknown and he was able to walk with aid at discharge. There were 17 patients in the Frankel's B of whom 6 improved and they were able to walk with walking aids. One of the patients who improved was 21 years old and presented with quadriparesis. His primary tumour was nasophayngeal carcinoma and the lesion was at the level of C_3, 4, 5. The one patient in the Frankel's A who improved to Frankel's D had renal cancer. He also had

Table I
Spinal Metastases location of the primary tumours in 45 patients

No.	Location of Primary Tumour	No. of Cases
1	Nasopharyngeal Carcinoma	11
2	Carcinoma Lung	6
3	Carcinoma Breast	6
4	Renal Carcinoma	3
5	Carcinoma of Cervix	2
6	Hepatocellular Carcinoma	2
7	Carcinoma Cheek	1
8	Lymphomas	2
9	Carcinoma Thyroid	1
10	Adenocarcinoma from GIT	1
11	Prostatic Carcinoma	1
12	Tumours of unknown origin	9
Total		**45**

Table II
Level of vertebral metastases

	Level	Number
1	Cervical	2
2	Upper Thoracic T_1 - T_6	21
3	Lower Thoracic T_7 - T_{12}	15
4	Lumbar	7
Total		**45**

evidence of skeletal metastasis of the right clavicle and proximal tibia. The myelographic block was at T_2 and decompressive laminectomy was done at T_1 and T_2. He was able to walk with walking aids at discharge.

There was no change in the post operative status of the two patients who did not have weakness.

A total of three patients deteriorated post operatively. One was in Frankel's D pre operatively (Table III). The patient in Frankel's C had carcinoma prostate and the level of lesion was from T_4 to T_6 and a laminectomy was done at the level. Post operatively he had severe weakness. The third patient who deteriorated was a 23 years old female with carcinoma of cheek and had extensive secondaries between T_1 to T_7. A decompressive laminectomy was done between T_4 to T_7 following which she become completely paralysed.

Of the 45 patients subjected to posterior decompressive laminectomy improvement of some degree was noted in only 12 patients (27%) Table IV.

Discussion

The incidence here does not reflect the actual incidence of spinal metastatic lesion in either of the sexes because the total group is only group of patients who have been operated upon. The actual incidence may vary if all patients with spinal metastasis are reviewed which would include those operated as well as those who were not. The ration is F:M, 1:2.15. Constans et al (1983) had almost equal ratio of 52.48, males:females. Black (1979) had a preponderance of male 60% and Kakulas (1978) found equal incidence. Black (1979) cites that the age distribution corresponds predominantly to the relatively high cancer risk period of 40 to 65 years. In this series for both sexes the peak ages range between 50 to 60 years.

Most authors have noted that the common primary lesions causing spinal metastasis are i) Lung, ii)Breast, iii) Lymphomas, iv) Renal tumours and v) Prostate, in that order of frequency. In the male lung cancer has been the predominant lesion and in the female breast

Table III
Post operative results analysis depending on pre-operative groupings

Groups by Frankel's Classification	No. of patients	Post operative status		
		Improved	No change	Deteriorated
Frankel' D	10	3	6	1
Frankel' C	6	2	3	1
Frankel' B	17	6	10	1
Frankel' A	10	1	9	-
	43	**12**	**28**	**3**

cancer. However, in this series the tumours noted were as in the present series concurred with the findings of Nather and Bose (1982), who had high incidence of NPC and hepatocellular carcinoma of the liver. Among the eleven patients with nasopharyngeal carcinoma there were seven Chinese, two Kadazans and two Malays. In the ethnic Chinese population there is a higher incidence of NPS compared to the rest of the population. The patients with nasopharyngeal carcinoma were younger, only two out of eleven were in their 5th decade of life and many of these patients already had this disease for a few years before developing symptoms of spinal metastasis. Two of these patients had no weakness, one presented with radiculopathy and the other had intractable pain not relieved by heavy analgesics. There were 3 patients in group D, 2 in group C, 2 in group B and 2 in group A, by classification of Frankel et al (1969).

Nine of the 45 patients who had decompressive laminectomy did not have a histopathological diagnosis of the primary lesion. The number is rather large for a series of 45 patients. This can be explained by the fact that tumour tissue from the lessions being mostly located anteriorly had not actually been included in the material submitted for histopathological examination.

Six patients had carcinoma of lung. In three of these patients diagnosis was only established after laminectomy and tissue biopsy. Most authors have cited that this is the commonest primary tumour to cause metastasis in the male and has a predilection for upper thoracic vertebra. All these six patients had developed metastatic lesions at the mid-thoracic level between T_5 and T_{10}. Dominise (1974) has named this level as "the critical vascular zone of the spinal cord" owing to its tenous blood supply. Therefore surgery in this area is unlikely to produce favourable results. In this series, the

Table IV
Analysis of primary tumour and clinical outcome

Primary tumour	No. of cases	No. of cases improved
Prostatic Carcinoma	1	–
Lung Cancer	6	–
NPC	11	2
Renal Cancer	3	2
Thyroid Carcinoma	1	1
Breast Carcinoma	6	2
Unknown	9	3
Bowel Adenocarcinoma	1	–
Cheek Cancer	1	–
Liver Cancer	2	–
Lymphosarcoma	1	–
Hodgkins Lymphoma	1	1
Cervical Carcinoma	2	1
Total	**45**	**12**

thoracic segment was involved in 80% (30/45) of cases, which comparable to other studies (Livingstone KE and Perrin RG 1978, Nather A and Bose K 1982 and Black 1983).

Only 6 out of 45 patients had carcinoma of the breast as the primary tumour and all the patients were females. In the female patients it is the commonest tumour to produce spinal metastasis (Black 1979, Gilbert et at 1978, Sundaresan et al 1985). In all six patients the diagnosis had been established before decompressive laminectomy. In one of the patients there was radiological sclerosis of the whole of the body of T_{12} vertebra with complete block on myelogram at the same level, whereas in another patient there was extensive lytic destruction of vertebrae between T_3 to T_6 with compression fracture and loss of height of the vertebrae.

Three out of 45 patients had renal carcinoma. The ages of these patients were 34 years, 59 years and 64 years. The man aged 59 also had lytc secondaries in the upper tibia and right clavicle, with pathological fractures. There was evidence of lytic lesion of L_3 vertebra with loss of height of the body of vertebra and narrowing of intervertebral space between L_3 and L_4. Though the patient had a complete myelographic block preoperatively, the block was partially reduced by laminectomy. However, there was some evidence of impingment of the spinal canal due to instability of the body at L3 vetebra.

Back pain was a consistent feature in 81% (38/45) of patients and this concours with the findings of other authors. 93.3% (42/45) of patients presented with some degree of weakness in the lower limbs. The main reason for orthopaedic referral for tumour metastasis in the spine appears to be weakness. As stated by Hall & Mac Kay (1973), poor results in some patients who had undergone posterior decompression laminectomy could be due to the late referral rather than the procedure or the technique employed. Only 27% improved after surgery and this poor results have been noted also by other authors (Auld & Buerman 1964, Gilbert et al, 1978).

Conclusions

There is an apparent rise in incidence of tumour metastasis in the spine in the past three decades. Survival of patients with malignant disease will increase with advancement of cancer therapeutics. Therefore patients with tumour metastasis in the spine have to be adequately diagnosed and treated to maintain or improve quality of life. Early referral and surgery have been found to give better results, therefore, it would be beneficial to inform the general practitioners, of the need for early referral and surgery. Haematological investigations have not been proven to be useful in management of tumuor metastasis in the spine. Plain radiographs, meylographs and other special investigations such as computed tomography and MRI would contribute to determine the exact location of the tumour and the type of surgery required for the patient.

During decompression surgery, it is important to obtain the tumour tissue for histopathological examination to establish a diagnosis, as this would be useful to plan further treatment and in assessing the prognosis and survivability of the patient. When tumour is radiosensitive, radiation therapy or chemotherapy should be the keystone of treatment and surgery should be reserved only for those with spinal instability or with bony impingement of the spinal cord. When the tumour is proven to be radio resistant or resistant to chemotheraphy much consideration should be given to early surgical intervention so that the patient can be treated early before irreversible neurological damage has taken place. Posterior laminectomy is acceptable treatment if the tumour is situated posteriorly whereas when the tumour is situated anteriorly (which is most often) anterior spinal surgery must be considered. A relatively poor clinical results in this series is due to inavailability of posterior instrumentation during the period of the study. From 1990 onwards it has become a policy of the authors to instrument the spine (+/- bone grafting) following extensive laminectomy. Anterior spinal surgery with excision of the tumorous vertebrae and reconstruction with methyl methacrylate provides stability for the spine and reduces the dose of radiation required for treatment. However, not every patient with tumour metastasis in the spine needs surgery as those who are not expected to have a life expectancy of more than four months should not be subjected to such major surgery. Similarly in those with evidence of extensive disseminated metastasis surgery should not be

performed. Surgery for tumour metastasis in the spine is only uncommonly indicated, occasionally patients have controllable local spinal effects that because of anticipated prolonged survival warrant aggressive palliation. Attempts at anterior or posterior decompression carry with them risks of serious complications including worsening of the neurological state, lose of stability and other problems to which systemically debilitated individuals are susceptible. The availability of an operation is not an indication for performing it.

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SPINE

The Surgical Outcome of Degenerative Lumbar Spinal Stenosis

M A Razak, MS (Orth), K P Ong, MBBS, Y Hyzan, MS (Orth), Department of Orthopaedics and Traumatology, National University of Malaysia, Kuala Lumpur

Summary

A retrospective study was conducted to assess the surgical outcomes of degenerative lumbar spinal stenosis. Twenty-five patients treated with decompressive surgery in Hospital Kuala Lumpur between January 1992 and August 1996 were reviewed. There were seven males and eighteen females. The average age was 51 years old (range 33 to 64 years old). The diagnosis of degenerative spinal stenosis was made based on the clinical features and was confirmed by radiographic findings. Ninety two percent of the patients had moderate to severe symptoms preoperatively. The types of surgery consisted of laminectomy (n=15), laminotomy (n=10), and laminoplasty (n=1). The surgical outcomes were assessed based on patients' own assessment of symptoms relieved and functional returned to daily activities at least six months after the surgery. The average follow-up period was fifteen months (range 6 months to 42 months). Of these twenty-five patients, 4 (16%) claimed to have excellent results, 11 (44%) had good results, 8 (32%) reported fair, and 2 (8%) judged their surgical treatment as poor with little or no use. There was no anaesthetic, cardiovascular, or thromboembolic complications seen in this study. Four patients had recurrent claudication, one demonstrated localised arachnoiditis, and two had lumbar instability which were not documented preoperatively. One patient had L4 nerve root avulsion with dura torn and another patient had superficial wound infection. We concluded in this study that decompressive surgery offers satisfactory results in patients with moderate to severe degenerative spinal stenosis in short term follow-up.

Introduction

Degenerative lumbar spinal stenosis is one of the commonest cause of low back and lower extremity discomfort and disability in elderly patients. It is being diagnosed more frequently recently because of widespread use of sophisticated non-invasive imaging techniques. It is defined as a narrowing of the osteoligamentous vertebral canal and/or the intervertebral foramina causing compression of the theca sac and/or caudal nerve roots; at a single vertebral level, narrowing may affect the whole canal of part of it (Postacchini, 1996). Non-operative treatment with corset, anti-inflammatory medication, physiotherapy and epidural injections of corticosteroids may occasionally relieve the symptoms. Generally, conservative treatment is advocated in patients with mild to moderate symptoms or in cases with poor general conditions (Johnsson et al, 1992, Wiltse et al, 1976). Once the patient has severe symptoms from spinal stenosis, surgery seems to be the only solution. Johnsson et al. (1991) suggested expectant observation may be an alternative to surgical treatment as in his study of the natural course of lumbar spinal stenosis in 32 untreated patients, he noted that symptoms in 70% of the cases were unchanged, 15% showed improvement, and 15% worsened. However, decompressive surgery as a treatment modality has been given a satisfactory result in most of the patients as supported by the literature review (Surin et at, 1982, Hall et at, 1985, Johnson et al, 1991, Katz et al, 1991, Turner et al, 1992. Jonsson et at, 1994, Atlas et al, 1996, Katz et al, 1996). There are studies reported that surgery is more superior than conservative treatment (Atlas et al, 1996 Johnson, 1991)

A meta-analysis of seventy-four journal articles was undertaken by Turner et al (1992) to determine the effects of surgery for lumbar spinal stenosis on pain and disability and they found that on average, 64% of patients treated surgically were reported to have good-to-excellent outcomes. Jeffrey N Katz et al (1991) reported 89% of success rate in their assessment of eighty-eight patients who were treated surgically for lumbar spinal stenosis. Bo Jonsson et al. (1994) claimed to have 61% excellent result in his series of 46 patients treated surgically for lumbar spinal stenosis. Johnsson et al (1991) in their another study attempted to compare the results of surgical and non-surgical management of lumbar spinal stenosis and he found that 60% of those treated surgically and 33% of the untreated patients felt better. Steven J Atlas et al (1996) in their study to compare the one year outcomes of surgically treated and untreated patients lumbar spinal stenosis reported that 28% of non-surgically and 55 % of surgically treated patients had definite improvement in their predominant symptoms. A retrospective study was undertaken to assess the results of surgical treatment in patients with degenerative lumbar spinal stenosis between January 1992 and August 1996 in the biggest referral centre in Malaysia, i.e. Hospital Kuala Lumpur.

Material and Methods

The patients who have decompressive surgery done for degenerative lumbar spinal stenosis at General Hospital Kuala Lumpur between January 1992 and August 1996 were reviewed. The diagnosis of degenerative spinal stenosis was made based on the clinical features and was confirmed by radiographic findings. Radiographic confirmation was established by evidence of central or central-lateral compression of the spinal cord or caudal equina by a degenerative lesion of the facet joint, disc, or ligamentum flavum on myelogram, computed tomographic scans with or without myelogram or magnetic resonance imaging. The overall assessment was based on the subjective assessment of the patients. The following categories were used in assessing the surgical outcome of the patients in this study (Surin et al, 1982).

1. Excellent: The patient is symptom-free and had resumed all previous activities.

2. Good: The patient has resumed normal activities but may occasionally after heavy work have recurrent leg or back pain.

3. Fair: The patient has had to reduce his/her previous activities because of persistence of some pain symptoms but non-incapacitating.

4. Poor: The patient is frankly disabled; symptoms have not been reduced at all by surgery.

All the patients in this study were contacted by phone calls or mail and each of them was asked regarding the surgical results based on their own assessment following these four points scale mentioned. The surgical outcomes were assessed at least 6 months after decompressive surgery. The average follow-up period was 15 months.

Results

Patients

There was a total of 25 patients presented with the diagnosis of degenerative lumbar spinal stenosis and were operated on during that period. There were seven males and eighteen females. The Malay constituted majority of the cases (48%), followed by the Chinese (32%), Indian (16%), and foreigner (4%). At the time of surgery, the age range of the patients was 33 to 64 years old. The mean age of the patients was fifty one years old with standard deviation of 9.43. Of the 25 patients, only one was claiming medico-legal compensation.

Clinical Symptoms

Spinal claudication was present in all the patients. Twenty-three (92%) of them has associated low back pain. The symptoms were bilateral in 12 and unilateral in 13 of the patients. None of them has bowel or bladder dysfunction due to spinal stenosis. 16 patients complained of subjective numbness and 14 have subjective weakness. Radicular pain was present in 18 of the patients. The average duration of presenting symptom is 4.6 years (range 2 months to 20 years). The severity of the preoperative symptoms is based on the

claudications distance: 100 metres as severe, 100 to 500 metres as moderate and 500 metres as mild. 9 patients had severe pain, moderate in 14 of them, and mild in the remaining 2.

Radiographic Findings

Preoperative radiographic evaluation consisted of myelography (n=4), computed tomography alone (n=1), computed tomography with myelography (n=11), and magnetic resonance imaging (n=11). A plain radiograph was obtained in all patients. Six patients had degenerative spondylolisthesis of grade 1 to 2. Two patients had lumbar scoliosis. Both central and lateral stenosis were noted radiologically in 15 of the patients, central stenosis only in 6, and lateral stenosis only in 4. The stenosis were distributed among the levels as follows: L2/L3, 1; L3/L4, 4; L4/L5, 16; L5/S1,11.

Indication for Surgery

The main indications for surgery were disabling claudication pain in the performance of daily living (n=23) and progressively limited walking distance or standing endurance in spite of adequate conservative treatment (n=13).

Table I
Preoperative Symptoms

Preoperative Symptoms	Percentage
Spinal Claudication	100%
Low Back Pain	92%
Radicular Pain	72%

Table II
Types of Stenosis

Types of Stenosis	Percentage
Central and Lateral Stenosis	60%
Central Stenosis only	24%
Lateral Stenosis only	16%

Operative Procedures

The types of surgery consist of laminectomy (n=15), laminotomy (n=10), laminoplasty (n=1). 5 patients had disectomy done in addition to laminectomy, one patient had both laminotomy and laminectomy done at different level in same surgery, and one patient had disectomy and foraminotomy combined with laminotomy.

Of these 25 patients, 19 had single level of decompression and 6 patients had two levels of decompression. None of the patients with two levels of decompression had fusion done at the same time. Only one patient was operated for second time. Fusion using autogenous bone graft from the iliac bone was noted in 4 patients and all of them had spondylolisthesis. Of these 4 patients, two demonstrated lumbar instability prior to surgery. Instrumentation using Socon pedicular screws system were done in two patients and both of them had grade 2 spondylolisthesis. The commonest intra-operative findings include ligamental hypertrophy (n=14) and facet joint hypertrophy with osteophytes (n=14), disc herniation was noted in 12 patients. 3 patients had multiple dilated epidural veins, 2 patients had nerve roots adhered to the facets and ligamental flavum. The average duration of stay in hospital post-operatively was 9.3 days (range 4 to 41 days).

Surgical Results

Of these 25 patients, four (16%) claimed to have

Table III
Relationship between type of surgery and results of surgery

Type of Surgery	Rssults of surgery Excellent + Good	Fair + Poor
Laminectomy	8(53%)	7(47%)
Laminotomy	5(50%)	5(50%)
Laminoplasty	1(100%)	0
Total percentage	**54%**	**46%**

excellent results, eleven (44%) had good results, eight (32%) reported fair, and two (8%) judged their surgical treatment as poor with little or no use.

Complications

No anaesthetic, cardiovascular, or thromboembolic complications were seen in this study. 4 patients had recurrent claudication of various degrees and 3 reported worsening of low back pain. Of these 3 patients, one demonstrated localised arachnoiditis in postoperative magnetic resonance imaging, two had lumbar instability which were not documented preoperatively (one of them had grade 2 spondylolisthesis L4/L5). Patient with localised arachnoiditis was treated with ultrasound and she had responded very well to treatment. Superficial would infection manifested as stitch abscess occurred in one patient of which had resolved with removal of stitches and dressing. One patient had L4 nerve root avulsion and dura torn during the decompressive laminectomy, torn dura was repaired and she had only minimal sensory lost at L4 nerve root distribution post-operatively.

Table IV
Complications of Surgery

Complication	No. of patients
Recurrent Claudication	4
Localised Arachnoiditis	2
Lumbar Instability	2
Superficial Wound Infection	1
L4 Nerve Root Avulsion and Torn Dura	1

Factors that may influence the outcomes of surgery

There are several factors that might effect the results of the decompressive surgery in spinal stenosis. A Chi-square test is done to look into the these factors.

Table V
Relationship between occupation and results of surgery

	Results of surgery Excellent + Good	Fair + Poor
OCCUPATION		
Heavy + Moderate	10	3
Light	4	8

P = 0.07. Continuity Corrective Factor = 3.025

The probability (p) is 0.05. The results are shown in the following tables.

The type of work the patients did preoperatively has no definite relationship with the outcome of surgery.

Table VI
Relationship between associated low backache and results of surgery

	Results of surgery Excellent + Good	Fair + Poor
ASSOCIATED LOW BACKACHE		
Yes	3	11
No	11	0

P = 0.5725. Continuity Corrective Factor = 3.025

All the patients who did not have associated low backache have good to excellent result, this suggested that low backache may worsen the outcome of surgery.

Table VII
Relationship between number of level of decompression and result of surgery

	Results of surgery Excellent + Good	Fair + Poor
LEVEL OF DECOMPRESSION		
Single	8	7
Double	6	4

P = 0.9345. Continuity Corrective Factor = 0.007

The number of level of decompression has no significant relationship with the result of surgery.

Table VIII
Fusion and results of surgery

	Results of surgery Excellent + Good	Fair + Poor
FUSION		
Yes	4	0
No	10	11

P = 0.1661. Continuity Corrective Factor = 1.918

All four patients who have fusion done during surgery have good to excellent results, this may indicate that fusion can improve the outcome of surgery.

Both patients who have instrumentation done during surgery have good to excellent results, this suggest that instrumentation may improve the outcome of surgery.

Table IX
Instrumentation and results of surgery

	Results of surgery Excellent + Good	Fair + Poor
INSTRUMENTATION		
Yes	2	0
No	12	11

P = 0.5725. Continuity Corrective Factor = 0.318

Table X
Relationship between lumbar scoliosis and results of surgery

	Results of surgery Excellent + Good	Fair + Poor
LUMBAR SCOLIOSIS		
Yes	0	2
No	15	8

P = 0.2922. Continuity Corrective Factor = 1.110

None of the patients with lumbar scoliosis have excellent to good result, this may suggest that the presence of lumbar scoliosis may worsened the outcome of surgery. Both patients with lumbar scoliosis have decompressive surgery done without fusion and instrumentation.

Discussions

In contrast to other studies (Porter, 1993, 1996), females with degenerative lumbar spinal stenosis are

more common than males in this series. This may be due to the facts that females have a longer life expectancy and they are the larger population in this country. About 40% of the patients are above 56 years old and 60% of the patients above 60 years old have good to excellent results: The elderly patients withstood lumbar spine surgery very well and should not be denied surgical treatment. (Jonsson and Stromqvist, 1994. Wiltse et al, 1976).

All the patients had neurogenic claudication and this formed the diagnostic criteria for spinal stenosis in this study. The symptoms were correlated well with the findings of imaging and the correct level of stenosis was determined before any surgery was considered. The pathogenesis of neurogenic claudication as explained by the hypothesis of two level venous compression by Porter et al., has gained a lot of popularity and is accepted by many surgeons currently (Porter and Ward, 1992. Porter, 1993). This hypothesis was further supported by the experiment done on porcine cauda equina model by Olmaker and Rydevik (1992). Porter et al. (1993) noted that a single level central spinal canal stenosis does not produce neurogenic claudication, as does a single level of the lateral recess or foramina stenosis. It may cause a subtotal canal occlusion with thickening and inflammation of the nerve root and severe root entrapment pain, but not claudication. Patients with neurogenic claudication generally have two or more levels of stenosis (Jonsson, 1993. Porter and Ward, 1992. Porter, 1993). There may be two levels of central canal stenosis or a single level of stenosis in the central canal, and a more distal root canal stenosis. The former tends to give bilateral claudication, and the latter claudication in one leg (Porter and Ward, 1992).

Low back pain is a common associated symptom in degenerative lumbar spinal stenosis, most of the patients had it even before the neurogenic claudication appeared. This finding is consistent with Turner et al's meta-analysis of the literature (1992). The low back pain may be due to the degenerative changes in the spine that has occurred long before the stenosis causes the neurogenic claudication, and is the most unpredictable improved after surgery (Stanley, 1980). It this series, the surgical outcomes are less satisfactory among patients with associated low backache.

None of the patients has severe neurological deficits before surgery. The straight leg raising test was positive in 52% of the patients, this may be due to concurrent disc herniation which was a common findings intra-operatively. However, Boden et at. (1990) demonstrated that by 60 years of age, 36% of asymptomatic subjects have a herniated disc.

CT myelogram and MRI are the commonest imaging methods used to diagnose spinal stenosis and most of their findings are consistent with intraoperative findings. Modic et al. (1986) noted that there was 83% agreement between CT and surgical findings; and 89.4% agreement when CT and myelography were used jointly. The limitation in CT include relatively high dose of radiation involved in a detailed examination of the lumbar spine. Wiesel et al (1984) noted that 36% of an asymptomatic population undergoing limited CT scan were found to have a significant abnormality in the lumbar spine.

Magnetic resonance imaging is a harmless, non-invasive multiplanar method of imaging that provide an effective demonstration of the dural sac. The coronal and parasagital views are capable of demonstrating reduction of epidural fat in the lateral recess that suggests root compression (Crawshaw et al, 1984). Schnebel et at. (1984). Schnebel et al (1989) concluded that MRI and contrast CT are comparable in their abilities to demonstrate spinal stenosis, and MRI is more sensitive in demonstrating disc degeneration (Modic et al, 1984). However, the abnormalities on MRI must be strictly correlated with age and any clinical signs and symptoms before operative treatment is given as there is 21% of asymptomatic patients who are sixty years old or older had abnormal MRI findings (Boden et al, 1990). Both the CT and MRI can be used as complementary study in diagnosing spinal stenosis and the combined results of CT and MRI were as accurate as those of CT myelogram (Modic et al, 1986).

The patient's quality of life remain the key determinant in deciding when to consider surgical intervention (Spengler et at, 1987). The commonest indications for surgery are disabling pain with failed conservative treatment. Progressive weakness and sphincter disturbance are often viewed as an absolute indication for spinal decompression (Nixon, 1993).

Laminotomy or selective decompressive surgery was done by partial undercutting the facets was first introduced by Getty et al. (1981). The stenosis affects only the motion segment and the canal dilates above and below this to its normal dimension, therefore there is no indication for a total laminectomy in the majority of the patients (Nixon, 1993). Laminotomy is preferred for degenerative stenosis when the stenosis is mild or moderate, particularly if excision of disc has been planned (Postacchini, 1996). The major advantage of the laminotomy is to reduce the bone removal and limit concern for postoperative spinal stability (Stanley, 1980. Postacchini, 1996). The spinous process with the attached interspinous and subraspinous ligaments and the pedicles are preserved to maintain the lumbar spinal stability. However, in a laminotomy enough bone must be removed over the nerve root to permit full visualization at the level of pedicle as the nerve roots are often tight when it exits below the pedicle.

Laminectomy is usually the method of choice in severe spinal stenosis and it provides more effective neural decompression (Postacchini, 1996). This technique is more extensive than laminotomy and consists of removing the spinous process, ligamentum flavum, and the lamina until the pedicle can been seen. The interspinous and surpraspinous ligaments are removed by this technique, therefore the spinal stability may be affected.

In contrast to the study done by Katz et al. (1991), there is no significant correlation between the number of level of decompression and the results of surgery in this study. Laminectomy produced 53% of good to excellent result and is slightly better than laminotomy. The result of laminotomy in this study is compatible with Getty et al's study (1981).

Among 6 patients who have degenerative spondylolisthesis of grade 1 to 2 presented with symptoms of spinal stenosis, 4 of them have fusion and decompressive surgery done at the same setting and all of them have good to excellent results. Herkowitz et al. (1991) noted that patients with degenerative spondylolisthesis and spinal stenosis who had had decompression and fusion done demonstrated better symptoms relief than those who had had decompression alone. Yone et al. (1996) also reported that in lumbar spinal stenosis with instability, patients treated by decompression and fusion showed better results than those treated by decompression alone and there is no increased medical complications in elderly patients treated with short segment fusion and decompression. In contrast, Deyo et al. (1993) found that for older patients, lumbar spinal fusion is associated with greater postoperative morbidity, mortality and in-hospital resources than spinal surgery performed without fusion.

The incidence of postoperative posterior spinal wound infections correlate well with the type of spinal procedure. Laminotomy and discectomy carries a risk of infection of less than 1%. Spinal fusion performed without instrumentation has infection rates of 1 to 5% and surgery with instrumentation are associated with a rate of 6% or more (Massie et al, 1992).

One of the patients without fusion done demonstrated lumbar spinal instability that may account for this persistent low backache postoperatively. In patients with no preoperative spondlylolisthesis, an incidence of postoperative spondylolisthesis between 5 and 20% has been reported (Jonsson, 1993). Postoperative spondylolisthesis may occur in as much as 20% of patients who have acquired degenerative spinal stenosis (Spengler et al, 1987). Degenerative spondylolisthesis implies that the facet joints of a motion segment and the supporting capsular ligaments are compromised. Decompressive surgery further destabilises the weakened segment and causes a significant postoperative progressive olisthesis which was associated with a poor surgical results (Herkowitz and Kurz, 1991). Both patients with lumbar scoliosis associated with spinal stenosis have fair and poor results, this suggests that the presence of lumbar scoliosis may worsen the outcome of surgery.

Adhesion of the nerve root to the facet joints and ligamentum flavum was noted in 2 patients, this may account for the accidental dural tear and nerve root avulsion that was seen in one of the patients. The dural tear often results when a small fold of the dura is inadvertently pinched by a bone-biting instrument, it is especially so when there is presence of adhesion in the spinal canal with severe spinal stenosis or in re-operated spine. It can cause the formation of a cerebrospinal fluid fistula with increased risk of meningitis or a subarachroid cyst if watertight closure is not achieved.

Special care has to be taken and it is advisable to use headlight and some form of magnification during decompressive surgery so that neurologic complications can be minimised. Young et at (1988) reported a low incidence of dural tears of 9% with the microsurgical technique.

The possible reasons for persistent pain that were seen in 7 patients include lumbar instability, local arachnoiditis, extradural fibrosis, inadequate decompression, nerve root injury, secondary spinal stenosis and symptomatic arthritis of the facet joint. Arachnoiditis is an inflammation of the pia-arachnoid membrane surrounding the spinal cord or cauda equina. The possible predisposing factors include lumbar spine surgery, previous injection of oil-based contrast material and postoperative infection (Carroll et al, 1992). It often causes back and leg pain after one to six months duration. CT myelogram and MRI enhanced by gadolinium-DPTA can be used to diagnosed arachnoiditis accurately. Ross et al. (1992) reported 96% accuracy in differentiating scar from disc by contrast MRI.

The results from the present study concerning spinal stenosis are in accordance with those from literature review. (Surin et al, 1992. Hall et at, 1985. Johnsson et al, 1991. Katz et al, 1991. Turner et al, 1992. Johnsson et al, 1994, Atlas et al, 1996. Katz et al, 1996). Decompressive surgery offers 60% of good to excellent results in degenerative lumbar spinal stenosis in this series. Ninety two percent of the patients had severe to moderate symptoms before surgery and almost all of them had been treated with adequate conservativel treatment before surgery is considered. The relative low rate of excellent outcomes in this study has several possible reasons. Firstly, classification of the results in this study are based solely on the grading made by the patients which is very subjective. Secondly, most of the patients are elderly and they are more likely to have co-morbid conditions that affect surgical outcomes.

Conclusions

From this study, it can be concluded that decompressive surgery offers satisfactory results in patients with moderate to severe spinal stenosis in short term follow-up. Age should not be the contraindications for surgery as most of the elderly patients can have symptom relief after surgery. Low back pain is commonly associated with degenerative spinal stenosis and it may worsen the outcome of surgery. Besides decompressive surgery, fusion is recommended for patients who have spondylolisthesis and lumbar scoliosis preoperatively.

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TRAUMA

Conservative Management of Femoral Shaft Fractures in Children

T Moses, MS Orth, K L Pan, MS Orth, M Razak, MS Orth, Department of Orthopaedics, Faculty of Medicine, Universiti Kebangsaan Malaysia, Kuala Lumpur

Sumarry

Thirty-two children with femoral shaft fractures were treated conservatively with initial skin traction followed by an additional period in a spica cast. After 12 to 20 months of follow up, none had any pain and all of them were attending school without problems. Shortening of more than 2 cm occurred in 6 (19%) of the 32 patients. The most important factor associated with shortening was an overlap of more than 2 cm of shortening of the fracture ends at the time of cast fitting. The average compensatory overgrowth at final assessment was 7 mm. Angular deformity did not pose a problem. This is a safe, simple and practical method to treat childhood femoral shaft fractures.

Introduction

For more than a century the fracture of the femoral shaft in childhood has been a subject of numerous clinical, experimental and bio-mechanical studies. Bryant's (1885) method of treatment by vertical traction is still considered as a major contribution, although its application has been restricted to the younger age groups for the last 25 years. Today, the standard treatment includes various forms of traction, immediate or subsequent hip spica, cast bracing and rarely, operative treatment. Treatment controversies have increased as a result of the wider treatment options now available. New trends are being set by improved operative techniques, changes in the economics of patient care and reduced patient tolerance of minor residual deformity.

This study reviews 32 patients in whom both the alignment and length are controlled utilizing the principle of skin traction followed by hip spica. It aims to affirm that conservative treatment of femoral shaft fractures of children results in rapid union without significant functional disability and the anticipated overgrowth compensates for the shortening at the fracture site.

Material and Methods

Forty four children with fracture of the femoral shaft were treated at the University unit of the Kuala Lumpur Hospital from January to December 1992. Of these, 9 patients were lost to follow-up and 3 patients were operated upon. One was an 11 year old girl with bilateral fracture; the other was a 9 year old boy with proximal fracture which was comminuted and grossly displaced. The third patient had an open grade 3C fracture in whom a limb salvage procedure was attempted but failed. Subsequently he underwent an above knee amputation. Thus, 32 patients were available for the study.

All these patients were treated initially with a short period of skin traction on a Thomas' splint. Traction was carefully monitored to avoid excessive angulation at the fracture site and to give an overlap of not more than 2 cm. This was confirmed by portable radiographs that were taken regularly while the patient was maintained on traction. The traction was maintained until the fracture had sufficient stability. This was judged by the absence of pain at the fracture site clinically and the appearance of early callus radiologically. A hip spica was then applied. The patients were followed up to an

average of 15 months after injury. The hospital records and radiographs were then reviewed. Information gathered include the age, gender, mechanism of injury, associated injuries, fracture type and location and any associated complications; limitation of activity, presence of a limp, range of motion and limb length inequality.

Results

Thirty two patients whose ages ranged from 2 to 12 years with an average of 7 years were followed up. All had unilateral fractures. Twenty-four were male. There were 7 home accidents, three bicycle injuries, 18 traffic accidents, 4 school accidents, 1 sports injury (soccer) and one playground injury. Associated injuries included 6 closed head injuries, 3 closed abdominal injuries, one undisplaced pelvic fracture and 5 facial abrasions.

Seventeen patients had fracture of the middle third, 10 had proximal third fractures and 5 had distal third fractures; There were 3 spiral fractures, 20 transverse fractures, 4 oblique fractures and 5 comminuted fractures.

The average duration of traction was 17 days (range 12-30 days). The patient with 12 day's traction was a 4 year old girl who had a minimally displaced fracture, whereas the patient with 30 day's traction had concurrent marked post concussion syndrome and facial lacerations that required reconstructive procedures. Skin traction on a Thomas' splint was used. One patient developed allergy to the elastoplast and the skin traction had to be converted to a proximal tibial skeletal traction. Three patients developed pressure blisters due to the Thomas' splint ring. These settled with a change of size of the ring and flavine dressings. Duration of hospitalisation varied from 14 to 30 days, averaging 22 days.

The average duration of casting was 40 days (range 30-50 days). Total duration of treatment (duration of traction and casting) averaged 60 days (range 45-75 days). There was no case of further angulation or telescoping of the fracture fragments in the spica. The spica cast was applied just above the medial and lateral malleolus. This prevented the child from pressing the foot against the bottom of the cast which could cause telescoping of the fracture fragments. At the follow up clinic 8 children were noted to have broken their cast at the hip joint. All that was required was to reinforce the cast at this juncture. No new cast was required. The break in hip spica did not affect the alignment of the fracture. There were no refractures after removal of the spica cast. There were no instances of vascular impairment, pressure neuropathy or pressure sores due to the cast.

The final assessment was done at an average of 15 months (range 12-20 months) after injury. Clinically, all the patients were pain-free, able to squat and were attending school with no difficulty. All had full flexion of the hip joint. Radiologically, the valgus angulation compared with that at the time of casting had decreased in all fractures. Twenty-seven patients had angulation less than 5 degrees. Five patients had angulation of 6-10 degrees (Table I). In the AP plane, no patient had angulation of more than 10 degrees and most had angulation of less than 5 degrees. In contrast, the anterior angulation noted at the proximal third did not remodel very much (Table II). Leg length discrepancies were measured clinically. At the time of cast application, 9 patients had more than 2 cm of overlap. Another 5 patients had 1 to 2 cm of overlap. The remainder 18 patients had 1 cm or less of overlap. At the final assessment, 5 patients with proximal third fractures and 1 patient with mid-shaft fracture had more than 2 cm of shortening. The average overgrowth at final assessment was 7 mm. (Table III).

The average time for clinical union, defined as the time taken for the fracture to become solid and the patients to be able to walk without support, was 7.5 weeks.

Discussion

Femoral shaft fractures in children, unlike those in adults, are generally better treated by non-operative methods. The reasons are that fractures in children heal rapidly; delayed or non-union is extremely uncommon and perfect alignment is unnecessary because of the good remodelling power. Operative treatment is still indicated in specific situations such as polytrauma or fracture associated with severe head injury, or in hyperkinetic children.

Glenn et al[1] (1973) in reviewing children with fracture femur with head injury states that non-operative treatment was much more satisfactory in the non-spastic group than in the patients with excessive muscular movements, clonus and seizures.

Early hip spica immobilisation has had growing popularity as a method of treatment in the past two decades. This was mainly to reduce the stay in the hospital and thus reduce the cost of treatment of these patients. The long term study by Irani et al [2] (1976) of immediate hip spica treatment in 75 children indicated generally good results, with anterior angulation less than 30 degrees and lateral/medial angulation less than 10 degrees, which can be corrected eventually, as well as 2 cm of overriding, which can be corrected by overgrowth of the femur in younger children. They also state that this did not result in residual skeletal deformity or joint stiffness.

Verbeek[3] (1976) and Vijlanto[4] (1975) also agree that less than 30 degrees of angulation will remodel

Table I
Varus/Valgus Angular Deformity and Site of Fracture

	Angular deformity (Varus/Valgus) (No. of patients)							
Site of Fracture	**<5 deg.**		**6 - 10 deg.**		**11 -12 deg.**		**> o deg.**	
	CF	**FA**	**CF**	**FA**	**CF**	**FA**	**CF**	**FA**
Proxima third (10 pts)	5	8	4	2	1	–	–	–
Middle third (17 pts)	10	15	6	2	1	–	–	–
Distal third (5 pts)	2	4	2	1	1	–	–	–

CF: at the time of cast fitting
FA: at the time of final assessments

Table II
Anterior/Posterior Angular Deformity and Site of Fracture

	Angular deformity (Varus/Valgus) (No. of patients)							
Site of Fracture	**<5 deg.**		**6 - 10 deg.**		**11 -12 deg.**		**> o deg.**	
	CF	**FA**	**CF**	**FA**	**CF**	**FA**	**CF**	**FA**
Proxima third (10 pts)	2	3	2	2	3	3	3	2
Middle third (17 pts)	9	11	5	5	3	1	–	–
Distal third (5 pts)	1	3	2	2	2	–	–	–

CF: at the time of cast fitting
FA: at the time of final assessments

satisfactorily. However, in the series by Irani et al. (1976), some cases of significant shortening occurred. Staheli and Sheridan [5] (1977), also reported satisfactory results in early hip spica treatment. McCollough et al [6] (1978) reported application of functional braces for children with femoral shaft fractures. They concluded that bracing for the femoral fracture had limitations.

In this series, the patients were managed with a short duration of continuous traction followed by hip spica application. The fractures had clinically united by seven weeks in children less than 6 years and by eight and a half weeks in children between 7 to 12 years. At this time they were able to walk independently.

Angular deformity does not appear to be an important problem in this series. No patient had varus-valgus angulation of more than 20 degrees and only three patients had anterior angulation of more than 20 degrees at the time of casting. These three patients had proximal femur fractures. All patients showed significant remodelling, and at the time of final assessment one patient with more than 20 degrees angulation had reduced to 15 degrees. In the other two, the angulation reduced but remained more than 20 degrees. This amount to angulation concurs with the findings of other authors who claim that angulation of up to 30 degrees will remodel satisfactorily (Irani et al 1976), Verbeek 1976 and Vijlanto et al 1975).

Limb length descrepancy following femoral fractures in children is always of great concern to parents and orthopaedicts. Shortening of 1.5 - 2 cm was reported by Henderson et al (1984), Irani et al. (1976) and Martinez et al [7] (1991) with early spica treatment and by Gross et al[8] (1983) with early cast bracing. Overgrowth phenomenon of the femur has been well documented in the literature.

The femoral overgrowth was found to be independent of age, sex, level of fracture or type of injury (Edvardsen [9] 1976, Reynolds [10] 1981, Shapiro [11] 1981, Clement and Colton [12] 1986 and Martinez 1991). It is also generally agreed that the amount of overgrowth is about 10 mm. Reynolds (1981) states that within three months of injury the rate of growth was at its maximum. The rate then decreased but remained significantly raised for two years and returned to normal in the femur between 50 and 60 months. Shapiro (1981) states that 80% of overgrowth would take place in the first 18 months. Salter [13] (1980) on the other hand believes that any residual discrepancy in length one year after the fracture is permanent.

In this series, shortening of more than 20 mm occurred in 6 (19%) out of 32 patients. The most important factor associated with shortening appears to be overlap that occurred more frequently in the proximal third could be due to the larger number of patients with

Table III
Relationship between site of fracture and overlap at fracture end

	Overlap in cast and shortening at 1 year					
Site of Fracture	**0 - 10 mm**		**10 - 20 mm**		**> 20 mm**	
	Oc	**Sh**	**Oc**	**Sh**	**Oc**	**Sh**
Proxima third (10 pts)	3	3	–	2	7	5
Middle third (17 pts)	11	15	4	1	2	1
Distal third (5 pts)	4	5	1	–	–	–

CF: Overlap at fracture end in spica cast
FA: Shortening of affected femur at final assessment

oblique and spiral fractures at this level. The other contributory factor could be the larger degree of anterior angulation that occurred at this level. As femoral overgrowth is expected up to about 5 years post injury (Reynolds 1981) some of these patients with more than 2 cm of shortening would probably improve with time.

We require further studies to evaluate the effect of these compounding factors. This is a safe, simple and practical method to treat childhood femur fractures. Complications are minimal but it is stressed that no overdistraction should be allowed and that an overlap should not be more than 2 cm.

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Closed Tibia Fracture

"The effect of an intact fibula and the location of Tibia fracture on fracture union"

M M Ibrahim, R Mohd, R Ruslan, Department of Orthopaedic, Hospital Universiti Sains Malaysia, Kubang Kerian, Kelantan

Tibial fractures are common and complications occur more frequently than any other long bone fractures. The effect of fibula and location of fracture on union of Tibia fracture remain controversial. A retrospective study of unilateral closed tibial shaft fractures without any associated injury was done. From 1988 to 1992, 74 out of 103 patients were available for the study. There were 60 males and 14 females with the age ranges from 3 to 75 years with an average of 29.7 years. The differences of fractures healing were analyses with respect to the status of the fibula and the location of the tibial fracture. This study concludes that the location of the fracture and the status of the fibula have no significant influence on healing ($p>0.05$).

Introduction

Fractures of tibia are associated with high incidents of delayed union, non-union and malunion as reported by many authors (Nicoll, 1964, 1974;Rolando, 1986). Many attempts have been made to find a reliable method of predicting fractures with a higher risk of complications so that appropriate surgical action may be instituted early in an attempt to reduce the overall illness rate and the length of treatment (Oni et al, 1989; Rolando, 1986).

It has long been contended that fractures of the lower third of the tibia or of the junction of the lower and middle thirds heal slowly due to relatively poor blood supply from muscle attachments. However, Weissmann found that the location of the fracture had no significant effect on the time to union and several others authors have come to the same conclusion (Johnson and Pope, 1977: Nicoll, 1969; Sarmiento et al, 1989; Weissmann et al, 1980).

It is widely believed that tibial fractures associated with an intact fibula are predisposed to delayed union and non-union. But this type of fracture, most commonly from low energy force, does not cause significant disruption of the vascular envelope around the fracture. However, an intact or a prematurely united fibula tends to hold the fracture end part, thus promoting delayed and non-union (Clark, 1959;Burwell, 1971).

Objective

To identify factors that influences the union of closed tibia fracture in particular reference to the status of fibula and the location of tibial fracture.

Definition of Terms

A fracture is regarded as clinically healed when all immobilisation aids have been discarded and unrestricted weight bearing is allowed. The radiology shows callus bridging the fracture line (Nicoll, 1964;Oni, 1979, Kenneth, 1987).

Normal healing time is defined as healing within 20 weeks from the date of injury. (Nicoll, 1964; Oni,1979, Kenneth, 1987).

Delayed union is the term used for those fractures that heal after 20 weeks. (Nicoll, 1964;Oni,1979, Kenneth, 1987).

Non-union is the term used for fractures that show no progress towards healing at six months (24.42 weeks) from the date of injury. Non-union applies to the fractures which will not unite without surgical intervention and to those shows radiological signs of non-union at any stage. (Nicoll, 1964;Oni,1979).

The radiological signs of non-union are a radiolucent zone, cupping of the medullary canal and a smooth rounded edge of the fracture.

The tibial shaft is the area below tibial tuberosity and 2.5cm above the horizontal articular surface of the ankle joint.

The tibial shaft equally divided into three parts.

The proximal fractures are those located at the proximal one third.

The distal fractures are those located at the distal one third.

Middle third fractures are situated from the junction of the proximal and middle third to the middle and distal thirds.

Material and Methods

A retrospective analysis of closed tibial fractures associated with an intact or a fractured fibula treated in Hospital University Sains Malaysia, Kubang Kerian, Kelantan was carried out. Case records of patients and x-rays were reviewed with particular references to age, sex, location of fractures, and the association of an intact or fractured fibula. The clinical result of the treatment was then studied in particular with reference to normal healing speed, delayed union and non-union. When case records were lacking, the patients were called for further assessment and x-rays were done whenever necessary.

To minimise variability, only closed unilateral tibial fractures were selected; those associated with other long bone fractures of the upper or lower limbs, spinal injury, chest or abdominal injury were excluded so that all selected patients were able to ambulate with crutches and partial weight bearing as soon as possible.

The standard initial treatment was closed manual reduction under sedation or general anaesthesia whenever necessary, followed by immobilisation in an above knee plaster cast with the knee in 5 to 10 degrees of flexion and the patients were allowed to bear weight as tolerable the very next day. A Patella tendon bearing cast was applied after four to six weeks. Some of the fractures were treated with an orthoplast functional brace after the plaster had been removed.

The differences between fractures with delayed union, non-union and those healing at normal speed position were analysed with respect to age, location of the fractures, and the presence or absence of an intact fibula. The significance of the parameters selected in influencing the results of treatment were assessed with the 'Chi-square Test'. A'p' value less than 0.5 was regarded as significant.

Results

From 1988 to 1992, there were 103 patients with unilateral closed tibial fractures associated with an intact or a fractured fibula. Out of 103 patients, 23 were not available for analysis because of incomplete records, failure to appear for follow-up or refusal of further hospital treatment. A majority of these patients sought alternative treatment from traditional bone setters. Six patients had primary fixation due to unacceptable reduction.

The remaining 74 patients, (60 males and 14 females) were initially treated by the standard method described. Fifty three patients had unilateral closed tibial fractures associated with a fractured fibula and 21 patients had a fractured tibia with an intact fibula. One patient developed a compartment syndrome of the anterior compartment for which immediate fasciotomy was performed and cast treatment was continued after secondary skin closure.

The age of the pateints ranged from 4 to 75 years with an average of 28.87 years for tibial fractures associated with a fractured fibula and from 3 to 73 years with an average of 30.5 years for those with an intact fibula. Statistically, there was no significant difference between the two groups ($p>0.05$).

The influence of the fibula on the union of tibial fracture

A total of 50 (67.5%) patients with and without fibula fractures healed at normal speed, 18 (24.3%) patients had delayed union and 6 (8.1%) developed non-union. Closed fractured tibia associated with fibula fractures had delayed union in 13 (24.5%) patients and non-union in 4 (7.5%). Closed fractured tibia with an intact fibula had delayed union in 5 (23.8%) patients and non-union in 2 (9.5%). The presence of an intact fibula is probably not a significant influence on the speed of union or the development of non-union ($p > 0.05$). The average time of healing for closed tibial fractures associated with a fractured fibula was 3.7 months (15.1weeks) and that with an intact fibula was 4.07 months (16.6 weeks).

All 18 patients with delayed union eventually united with conservative treatment over the next two to four weeks. One patient with non-union refused any surgical intervention for personal reasons. The other five patients were operated on; three with plates and two with intramedullary nails. The patient who refused surgical intervention was followed up for a period of one and half years but still had no radiological sign of tibial union. However the fibula united and the patient was able to walk without pain and managed to continue farming with some difficulty.

The influence of fracture location on the speed of union and non-union

There were 10 patients with proximal tibial fracture; six had normal healing speed, two had delayed union and

Table I
The influence of the fibula on the healing of tibial # in number and percentage

	Normal union	Delayed union	Non-union	Total
# fibula	36(67.9%)	13(24.5%)	4(7.5%)	53
Intact fibula	14(66.7%)	5(23.8%)	2(9.5%)	21
Total	**50(67.5%)**	**18(24.3%)**	**6(8.1%)**	**74**

Chi-square = 0.079 *DF = 2* *p = 0.961*

Table II
Influence of Fracture Location on the Speed of Union and Non-union

Location of Fracture	Normal union	Delayed union	Non-union	Total
Proximal	6(60%)	2(20%)	2(20%)	10
Middle	21(70.0%)	8(26.7%)	1(3.3%)	30
Distal	23(64.7%)	8(23.5%)	3(12.0%)	34
Total	**50**	**18**	**6**	**74**

Chi-square = 4.539 *DF = 4* *p = 0.338*

another two developed non-union. Of thirty patients with middle third fractures; eight of them had delayed union and only one developed non-union. Of thirty four patients with distal third fractures; eight had delayed union and three developed non-union. There was no gross difference in the prevalence of delayed union at different locations. Proximal and distal fractures appeared to have a greater tendency for non-union as compared to middle third fractures. However, these differences are not statistically significant ($p > 0.05$). The location of the fracture probably does not influence the speed of healing and the development of non-union regardless of whether the fibula is intact or fractured as shown in Table IIa and IIb.

The average healing time of tibial fractures in patients with an intact or fractured fibula in relation with the location of fractures shown in Table IIc.

The average time of healing in patients with proximal fractures was 3.87 months (15.7weeks) in fractures associated with a fractured fibula and 3.0 months (12.21 weeks) in patients with an intact fibula. Middle third fractures healed in an average time of 4 months (16.28 weeks) in patients with fibula fractures healed in an average of 5 months (20 weeks) in those with a fractured fibula and in 3.5 months (14.25 weeks) with an intact fibula. Although fracture location had no significant influence on the development of delayed and non-union, distal third fractures seemed to have slower rate of union compared with proximal and middle third fractures especially when the fibula was also fractured.

Table IIa
Influence of Fracture Location on Tibial Union with Associated Fractured Fibula Fracture

Location of Fracture	Normal union	Delayed union	Non-union	Total
Proximal	1	2	1	4
Middle	14	6	1	21
Distal	21	5	2	28
Total	**36**	**13**	**4**	**53**

Chi-square = 3.592 *DF = 4* *p = 0.464*

Table IIb
Influence of Fracture Location on Union of Tabial Fractures with an Intact Fibula

Location of Fracture	Normal union	Delayed union	Non-union	Total
Proximal	5	0	1	6
Middle	6	2	1	9
Distal	2	3	0	6
Total	**14**	**5**	**2**	**21**

Chi-square = 5.5500 *DF = 4* *p = 0.235*

Table IIb
Influence of Fracture Location on Union of Tabial Fractures with an Intact Fibula

Location of Fracture	Normal union	Delayed union	Non-union	Total
Proximal	5	0	1	6
Middle	6	2	1	9
Distal	2	3	0	6
Total	**14**	**5**	**2**	**21**

Chi-square = 5.5500 *DF = 4* *p = 0.235*

Table IIc
Average of Normal Healing Speed of Closed Tibial Fractures in Months

Location of Fracture (Average Age)	Fractured Fibula (weeks)	An Intact Fibula (Weeks)
Proximal (31.6yrs)	15.7	12.21
Middle (22.2 yrs)	16.28	11.8
Distal (35.0yrs)	20	14.25

Discussion

This retrospective study has shown that the prevalence of delayed union and non-union, as defined in this study, of closed tibial fractures treated by closed method is 24.3% and 8.1% respectively. These figures are comparable with the results of other researchers as shown in Table 3.

The difference in the prevalence of delayed union and non-union is due to different definitions of delayed union among different author and to the fact that some series include open fractures (Johnson and Pope, 1971; Sarmiento; Dunn 1973; Weissmann, 1988). The prevalence of delayed union and in isolated tibial fractures was 23.8% which is almost equal to that of fractures with associated fractures of the fibula (Table I). There is no reason to believe that isolated tibia fractures are prone to develop delayed and non-union (>0.05) as claimed by Macnab and Burwell who considered that a displaced tibial fracture with an intact fibula was an absolute for internal fixation (Jackson and Macnab, 1959; Burwell, 1971).

This study is comparable with study done by Sarmiento 1989 as shown in Table IV except that the distal third fractures take slightly longer time for union especially when the fibula was also fractured. Tibia fractures associated with Fibula fractures indicate a more severe soft tissue injury compares to those with an intact fibula and the lacks of muscular envelope in this region, probably explains the slower healing.

Various treatments have previously been recommended for tibial fractures with an intact fibula and for the somewhat analogous situation of fractures in which the fibula has healed, hence, slowing tibia union. Bohler (1965) recommended intramedullary nailing, Dehne

Table III
Healing of closed tibia fracture by conservative treatment. Comparison with other author

Authors	Normal Union	Delayed Union	Non-union	Malunion
E.A Nicoll, 1964 (N=705)	15.9 weeks	22.5%	22.5%	8.6%
Johnson and Pope, 1971 (N=123)	4.2 Mths (17.1 weeks)	4.8%	0%	2.8%
Dunn, 1973 (N=45)	4.2 Mths (14.2 weeks)	–	4.4%	0%
Sarmiento, 1976 (N=32)	3.5 Mths (14.2 weeks)	9.5%	2.5%	8%
Oni, 1988 (N=100)	–	28.8%	–	–
Weissmann, 1988 (N=49)	4.4 Mths (17.9 weeks)	24.5%	–	7.5%
This study 1994 (N=74)	3.88 Mths (15.6 weeks)	23.3%	8.1%	9.2%

Table IV
Average healing time of Closed Tibial fracture at various location and status of fibula

This study 1994 Fractured fibula		Sarmianto 1989 Fractured fibula	
Proximal	15.5 weeks	Proximal	15.5 weeks
Middle	16 weeks	Middle	16.6 weeks
Distal	20 weeks	Distal	16.5 weeks
Intact fibula		**Intact fibula**	
Proximal	12 weeks	Proximal	13 ≥weeks
Middle	11.6 weeks	Middle	14 weeks
Distal	14 weeks	Distal	13 weeks

and Sakellarides (1964) advised fibula osteotomy; however, these treatments did not decrease the time of union of the fractured tibia. Indeed, Uris and Sorenson showed that an osteotomised fibula healed more quickly than did the tibia (Sorenson, 1969; Sharma, 1972). They and others recommended resection of a 2.5 to 4.0cm segment of the fibula to allow healing of the tibia (Fernandez, 1969;Bohler, 1965). Sharma's series showed an average time to tibia healing of 12.8 weeks with primary resection of the fibula (Sharma, 1972).

Fibula resection may convert a closed to an open fracture especially in distal third fractures with varus angulation. This increases the risk of infection, whereas as high per-

centage or tibial fractures with or without a fractured fibula treated conservatively healed within the expected time. For these reasons primary resection of the fibula probably is not justifiable.

Some authors have reported that the location of the fracture in the tibial shaft plays an important role in the speed of union (Ellis, 1958; Allum and Mowbary, 1980). In this study, distal tibial shaft fractures took a month longer to heal than middle or proximal fractures but the location had no significant influence on the development of delayed and non-union ($p>0.05$). Similar finding have been reported by Nicoll (1964) and Sarmiento (1979,1989) whose series included both open and closed fractures. Their belief that the location influences the prognosis of tibial shaft fractures therefore appears unfounded.

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The Results of Surgical Treatment of Tibial Plateau Fractures

G S Ruslan, MS (Orth)*, M Razak, MS (Orth)**, *Institute of Orthopaedic, Hospital Kuala Lumpur, **Department of Orthopaedic and Traumatology, Universiti Kebangsaan Malaysia, Kuala Lumpur

Summary

Thirty-eight tibial plateau fractures were treated with open reduction and internal fixation. The fractures were classified into six groups (Hohl's 1991 Classification) and the clinical results were evaluated using the Rasmussen (1973) criteria. The average follow-up period was 2.07 years. Overall there was one excellent, thirty-four (34) good, three fair and no poor results. In three patients with less than a good score there were other associated ipsilateral injuries and delayed mobilisation of the knee joint. There was no direct association between the type of internal fixation and the end result.

Introduction

Tibial plateau fracture is one of the most common fractures involving a weight bearing joint. The goal of treatment in this fracture is to achieve a stable, well aligned and mobile joint with a minimum of surface irregularity, thereby preventing early degenerative changes.

However, optimal treatment of the tibial plateau fracture continues to be a controversial subject especially the comminuted or bicondylar fractures. Hohl (1956) had 72% satisfactory results following conservative treatment and concluded that an open reduction produced better anatomical reduction but no significant difference in the functional results. Apley (1956) had 80% good and excellent results with the traction mobilisation method of treatment. The purpose of this method was to encourage early knee motion, mould the fracture according to the tibial condyle and promote fracture healing. He believed that the surgical treatment should be restricted to young patients with large fragments that were easy to fix.

Generally most of authors agreed that early mobilisation is an important aspect of treatment either by conservative or operative means. Instability and displaced fractures are the main indications for open reduction and internal fixation. Most authors have about 60% to 80% satisfactory results following open reduction.

Material and Methods

This is a retrospective study of 38 patients with tibial plateau fractures who were treated with open reduction and internal fixation at the Orthopaedic Department of National University at the Kuala Lumpur Hospital from the period of January 1988 till June 1992.

The follow-up period ranged from 6 months to 7 years (mean of 2.05 year). An anteropsoterior and lateral view radiograph of the knees were obtained in all patient during the follow-up. The purpose of this radiograph is to determine the amount of depression, condylar widening, angulation and degenerative changes if any, as part of the assessment. The fracture type was classified according to Hohl's classification. This classification was chosen because it is simple, easily applicable and widely used.

The type of internal fixation done was either a buttress plate or cancellous screws, with or without bone graft.

Assessment were done according to the Rasmussen criteria (1973) which included subjective complaints, such as pain, walking capacity and clinical signs such as extension lag and range of motion of the knee.

The anatomical assessment was done through radiographs taken at the last follow-up (early 1993) to determine the amount of depression, condylar widening, angulation and degenerative changes. These two assessments were given points and the total score was added up. An excellent result was given to the total score of 46-48 points, good for the scores of 32-45 points, fair for scores of 16-31 points and poor if the score was less than 16.

Results

There were 38 patients with ages ranging from 17 to 62 years (average age of 38.7). Mostly were in the third and fourth decades as they were the most active. There were 25 males and 13 females.

There were 37 patients with displaced fractures and among them, 11 were comminuted. These could be attributed due to severity of the injury. About 71.1% had closed fractures and the others were open injuries (Table I).

The lateral plateau (55.3%) is the commonest site followed by bicondylar (28.9%) and medial plateau (15.6%).

Regarding the method of internal fixation; most surgeons in this centre used either buttress plates or cancellous screws with bone graft. 34 of these 38 patients had an internal fixation without bone graft. 2 patients with minimally displaced fracture had surgery of an ipsilateral injury (Table II).

35 (92%) of the 38 patients had satisfactory results (excellent and good) and only 3 patients (8%) had unsatisfactory results. The first of these three patients with unsatisfactory results had a type IV fracture (total condylar compression). After reduction and buttress plating, the patient defaulted follow-up and went on to early weight bearing. As a result, there was a genu varus of more than 10 degrees. Corrective osteotomy was performed and the deformity corrected. The second patient had a type VI fracture (bicondylar). Buttress plating with bone graft was done. However, the patient also had ipsilateral fractures of the shaft of the femur and tibia which were later fixed. The third patient had a type IV fracture (bicondylar). He also had ipsilateral femoral condyle fracture and contralateral fracture of the

Table I
Distribution of type fracture (Hohl's classfication) and type of injury

Type (Fracture)	Open	Closed	Total	(%)
I (minimal displaced)	–	1	1	2.6
II (local compression)	–	8	1	2.6
III (split compression)	1	8	9	23.7
IV (total depression)	2	1	3	7.9
V (split)	3	10	13	34.2
VI (bicondylar)	5	6	11	28.9
Total	**11(28.9)**	**27(71.1)**	**38**	**100**

Table II
Distribution of type fracture in relation to type surgery done

Type (Fracture)/Surgery	B.P.	C.S.	B.P. + B.G.	C.S. + B.G.	Total
I	–	1	0	–	1
II	–	–	1	–	1
III	4	4	–	1	9
IV	2	1	–	–	3
V	5	8	–	–	13
VI	8	1	2	–	11
Total	**19**	**15**	**3**	**1**	**38**

B.P. – *buttress plate*
C.S. – *cancellous screw*
B.P. + B.G. – *buttress plating with done graft*
C.S. + B.G. – *cancellous screw with bone graft*

Table III
The end functional result in relation to type of fracture

Type/Result	Excellent	Good	Fair	Poor	Total
I	–	1	–	–	1
II	–	1	–	–	1
III	1	8	–	–	9
IV	–	2	1	–	3
V	–	13	–	–	13
VI	–	9	2	–	11
Total	**1(2.6)**	**34(89.5)**	**3(7.9)**	**0**	**38**

tibia which were plated. The knee was immobilised for 9 weeks and as a result, of that the patient had a stiff knee and limited range of motion.

There was no obvious difference between the type of internal fixation and end functional outcome as shown in Table 4.

Table IV
The end functional result in relation to type of internal fixation

Surgery/Result	Excellent	Good	Fair	Poor	Total
I	1	17	2	-	20
II	-	14	-	-	14
III	-	2	1	-	3
IV	-	1	-	-	1
Total	**1**	**34**	**3**	**0**	**38**

Table V
The end functional result in relation to the duration of knee bending exercises

Exercise (week)	Excellent	Good	Fair	Poor	Total
0 - 2	-	-	-	-	0
3 - 4	1	13	-	-	14
5 - 6	-	13	1	-	14
7 - 8	-	4	1	-	5
9 - 10	-	3	1	-	4
11 - 12	-	1	-	-	1
Total	**1**	**34**	**3**	**0**	**38**

31 out of 33 patients who started their knee exercises between the 4th and 8th weeks had satisfactory results except for two patients. Those who obtained fair results started their knee exercises after more than 5 weeks of surgery.

Discussion

In this retrospective study of 38 plateau fractures with an average follow up period of 2.1 years, 92% of the patients who had open reduction and internal fixation done had satisfactory result. The results of this study compare favourably with those reported by others Apley (1956), Blokkel et al (1984), Burri et al (1979) and Jensen et al (1990). Blokker (1984) treated 60 patients with an open reduction and internal fixation, obtaining satisfactory results in only 71% of his patients. The most important factor in predicting the outcome was the adequacy of reduction. Laschiewicz (1990) reported 93% of 43 patients had satisfactory results with a mean follow up of 2.7 years. He found that the outcome does not correlate with the type of fracture but it depended on whether bone graft was done. Schatzker (1979), reported 32 patients with an average age of 57 years, who were treated with open reduction. 78% of these patients had acceptable results. The presence of osteoporosis adversely affected the outcome of this study.

The majority of patients in the satisfactory group had spilt compression and split plateau type of fractures (57%) and surprisingly 9 out of 11 bicondylar fracture had satisfactory result. The indication for open reduction in these patients was displacement of the fragments. Most literature report that satisfactory results are from displaced fractures without much comminution. In this study, 82% of comminuted fractures had a satisfactory result. This may be attributed to early knee motion. However, 2 out of 3 patients who had poor result belonged to this group. This was due probably to unstable or inadequate fixation. Fixation of bicondylar fractures with a single buttress plate was obviously inadequate and the final outcome was loss of reduction and varus deformity.

There is no difference in the end functional result in closed and opened injuries. In all open fractures, debridement was done as an emergency with adequate antibiotic cover. One patient had repeated debridement over the fracture site and subcondylar area and finally needed soft tissue cover with a myocutaneous flap. He had good results after 5 years of follow-up.

About 82% of patient who had their knee bending exercise started between 4 to 8 weeks after fixation had satisfactory results. This showed that early knee bending exercises are very important and correlate well with the functional outcome. It played a major role in preventing knee stiffness by promoting cartilage repair and ensuring congruity of the anticular surface (Delamarter and Hohl 1979, Apley 1979). The 3 fair results are associated with relatively delayed in instituting knee bending exercises.

In most series Lasinger et al (1986, Moon et al 1991, Waddel et al (1981), associated fracture around the knee play a major role in the outcome. In this series most of the less than good results (2/3) had associated ipsilateral fractures which may delay knee mobilisation and physiotherapy.

Most of the ligamentous injuries in this series were not very severe and all of them were treated without surgical repair. Treatment of ligament injuries associated with plateau fractures remain controversial. It is generally agreed that late instability following a plateau fracture is the major cause of an unacceptable result. Collateral ligaments should be repaired to avoid this late instability, however, cruciate ligaments are usually very difficult to repair primarily. The incidence of meniscus injury is about 20% (Hohl, 1991) and only 2 (5%) patients had meniscus injury in this study. Both had their menisci partially removed during open reduction.

Methods of internal fixation chosen depended on the type of fracture. 90% of patients fixed with buttress plates had satisfactory outcome compared to 100% satisfactory outcome in patients who had been fixed with cancellous screws. This was because of type of fracture which had been fixed with cancellous screws were either spilt type or were not comminuted in which fixation gave enough stability. Buttress plates are usually indicated in comminuted fractures but some of them are difficult to assemble or fix. It may end up with redepression, loss of reduction position or even incomplete fixation as happened to one of the fractures in this series. The number of patients who had bone grafting in this study was small (4 patients); compared to non grafted patients (34 patients). Most of the non grafted patients has satisfactory results (94%) compare to grafted patients (75%). It is unfair to make an assumption that non grafted procedure will produce satisfactory result as the number is small. However, most literature suggest that bone grafting is indicated in depressed fractures following elevation of the fragment (Blokker 1984, Moore 1987).

There were no major complication in this series except wound infection in one patient which needed repeated debridement and ended up with a myocutaneous flat to cover the wound. Two patients had loss a reduction due to early weight bearing and ended up with varus deformity and subsequently corrective osteotomy had to be done. The other case was due to inadequate fixation of a bicondylar fracture which was fixed with only one buttress plate.

Conclusions

The conclusions that can be deducted from this study are:

1. Period of immobilisation and early knee bending exercise is very important to prevent knee stiffness. It is therefore advisable to start knee bending exercise as early as possible.

2. Associated fractures around the knee do affect the functional outcome as the knee bending exercise may be delayed.

3. The type of fracture will also affect the functional result. Comminuted fractures are technically difficult to fix compared to other types and the result and inferior to simple type of fracture.

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Contributing Factors in Non-Union of the Humeral Shaft Fracture and the Results of Treatments

R Baba, MD*, M Razak, MD**, *Institute of Orthopaedic, Kuala Lumpur Hospital, Kuala Lumpur, **Department of Orthopaedic and Traumatology, Faculty of Medicine, Universiti Kebangsaan Malaysia, Kuala Lumpur.

Summary

Out of 218 fractures of humeral shaft treated in the department, 23 (10.5%) of them developed non-union. 14/23 (60.9%) fracture were located in middle third. Transverse (52.2%), short oblique (17.4%) and comminuted fracture (13.0%) constituted about 82% of all initial fracture pattern. Twelve cases (52.5%) were initially treated with hanging cast. Radial nerve palsy occurred in 4/23 (17.4%) of patient and all of them located at lower third of humerus and only one recovered after eight weeks of injury. Factors such as middle third comminuted opened fractures, soft tissue interposition, improper immobilization and poor patient compliance were found to be directly associated with the non-union. All non-unions healed following plating and bone grafting. Overall 17/23 patient (74%) had good results, 4/23 (17%) fair and 2/23 (9%) with poor functional results.

Introduction

Non-union is a relatively uncommon complication in humeral shaft fractures. Most fractures of the humeral shaft heal without any difficulty. There is general agreement that fractures of the humeral shaft, which constitute one percent of all fractures, usually can be treated successfully with non-operative techniques. A review of the literature revealed that conservative methods of treatment produced good to excellent results in 90-95 percent of patients and the rates of non-union have been low.

Watson-Jones (1955), described the treatment of recent fractures of the humeral shaft as being simple and easy and that of non-united fractures, very difficult. Treatment of humeral shaft fractures is dictated by certain anatomical considerations. The humerus is the most mobile of the long bone and because the freely movable scapulo-humeral articulation minimises torsional stress, rigid immobilisation is not necessary (Holm, 1970). It is not a weight-bearing bone and therefore, compression forces are not a factor and shortening does not significantly lessen the end result (Holm, 1970). Realignment of fracture fragments is facilitated by the physiologic dependent position and by relaxation of its enveloping musculature under the influence of gravity.

Perfect alignment and opposition are not essential. Twenty degrees of anterior and thirty degrees of varus angulation are tolerated without compromising function or appearance (Klenerman, 1996). Union usually occurs rapidly when the humerus is treated by simple traction and splintage, or both, in a dependent position, especially is oblique and comminuted fractures.

Before the current concepts of dependency traction became widespread, the humerus was the most common site of non-union (Scudder and Cotton, 1990; Cubbin, 1933; Stewart and Hundley, 1955; Kennedy, 1957). Caldwell introduced the hanging cast method of closed

treatment and ever since the widespread use of this method, a decrease in the non-union rate was seen, however it did not eliminate the problem of non-union (Watson-Jones, 1960; Holm, 1970). The hanging cast was considered by some to be the treatment of choice for fractures of the humeral shaft, however some feel that in certain circumstances, the hanging cast may be implicated as a contributing factor in non-union (Watson-Jones, 1960; Thompson and Compare, 1965; Coventry and Laurnen, 1970; Holm, 1970).

The incidence of non-union of the humeral shaft fracture reported in the literature varies with series and treatment method. Kennedy and Wyatt (1957) found only one non-union in seventy-eight humeral fractures of the mid-shaft treated in hanging casts, while Klenerman (1966) reported ten cases of delayed union in eight-seven shaft fractures also treated in casts. Fenyo (1971) reported on ninety-eight patients, of whom fifty-five were treated by operation. There was one case (2.2 percent) of non-union of a humeral shaft fracture among forty-three patients treated non-operatively and four cases (7.4%) among fifty-five patients treated by operation. The incidence of non-union from the Vancouver General Hospital series was 3.7 percent (Loomer and Kokan, 1974). The rates of non-union ranged from 0 to 8 percent with non-operative treatment of tracture of the humeral shaft and from 0 to 13 percent with operative methods of treatment.

This retrospective study was performed to identify factors associated with non-union of the humeral shaft fractures in patients that were treated in the Orthopaedic Department, Universiti Kebangsaan Malaysia and assessment of their results following treatment of non-union by dynamic compression plating and cancellous bone graft.

Materials and methods

Between 1985 and 1991, a total of twenty-three cases of traumatic non-union of the humeral shaft fractures were treated surgically in the Orthopaedic Department of the Universiti Kebangsaan Malaysia. These non-union cases were collected from a total of two hundred and eighteen cases of humeral shaft fractures treated in the department during that period. A retrospective review of their case records and radiographs was made. Accurate details of the initial fracture were studied from the case records e.g. the mode of initial injury, type of fracture, site and pattern of fracture, the initial fracture treatment and the centre of primary treatment. Any associated concurrent injuries and underlying medical problems of the patients were noted. Humeral shaft fractures were either isolated or with associated injuries. They are categorised under isolated fracture, multiple-injured patients, with radial nerve or vascular injury and other injuries.

These cases were either primarily treated in the department or referred from neighbouring district hospitals. All the humeral fractures resulted from trauma ranging from mainly motor-vehicle accidents, falls while working and at home, direct blow and pedestrial injury. Pathological fractures were excluded from this study. Cases were either treated conservatively with the use of hanging cast, U-slab and any external immobilisation for closed fractures or surgically treated with initial wound debridement and external immobilisation for open fractures.

Open fractures were classified according to the Gustilo et al (1987). The location of non-union was divided into three areas, namely, proximal, middle and lower third. The original fracture patterns were grouped under transverse, oblique (short or long), spiral, segmental or comminuted.

The humeral shaft fractures as defined by Key (1956) were fractures contained between the superior border of the insertion of the pectoralis major muscle to an area immediately above the supracondylar ridges. Other fractures of the humerus were excluded from this study.

Non-union was defined as a fracture that failed to show clinical and radiological evidence of progressive healing on serial examination and radiographs. The ASIF/AO classification of delayed union (failure to unite in 4-8 months) and non-union (failure to unite in greater than 8 months) was arbitrarily used in this study (Muller, et al, 1979). Clinical union was defined as no motion or pain at the fracture site on examination, coupled with consolidation of callus on the radiograph.

All patients were followed-up after surgery until union

of fracture was determined. Clinical and radiological means of assessment of union were carried out at follow-up in the clinic. A non-union was considered clinically healed when there was no more pain and mobility of stressing the non-union site, and radiologically when the fracture line has been obliterated and the presence of bridging callus at the site of fracture.

The treatment of all these non-unions was by dynamic compression plating with cancellous bone graft. The anterolateral approach of Henry was used in all cases and internal fixation with a narrow AO DC plate (4.5 millimeters). Narrow 4.5 millimeters dynamic compression plates were used due to the narrow diameter of the humeral shafts in our local population. In all the compression plating, at least six points of cortical fixation above and below the non-union were obtained.

Patients were recalled to the clinic and their functional results following surgical treatment of non-union assessed. A part from clinical and radiographic evidence of union, other parameters like time to union, shoulder and elbow range of movements, pain and time taken for patients to return to normal activities prior to the fracture were recorded. Patients were objectively asked regarding pain and the time taken to return to normal activities. This shoulder and elbow range of movements were tested upon healing of the non-union. The alignment of the healed non-union were assessed by the radiographs taken in union.

Functional results were evaluated using the modified Stewart and Hundley (1955) criteria as follow :

Good : No pain, limitation of adjacent joint mobility less than 20 degrees and angulation less than 10 degrees.

Fair : Pain after effort or fatigue, limitation of mobility ranging between 20 degrees and 40 degrees, and angulation greater than 10 degrees.

Poor : Permanent pain, limitation of mobility greater than 40 degrees and non-union.

Results

There were seventeen males and six females. The youngest was nineteen and the oldest patient was eighty-one years. The mean age at injury was thirty-four years. The age at presentation of non-union ranged from nineteen years to eighty-one years with a mean age of thirty-four years. The distribution of non-union according to sex and age showed that majority of the cases were in the age range of twenty-one to forty years with a predominance of male patients.

Out of the total 218 fractures treated, 200 were closed fractures and 18 were open fractures. This give an incidence of 9 percent closed fractures and about 28 percent open fractures developing into non-union.

Seventeen cases were treated primarily in UKM Orthopaedic Department whereas seven cases were treated elsewhere prior to referral. One case was treated traditionally and another was not treated at all for their

Table I
Incidence of non-union in closed and open fractures

Type	Number of non-union	Total number of humeral fracture	Percentage
Closed	18	200	9
Opened	5	18	28

initial humeral shaft fracture. Twelve cases of non-union occurred on the right humerus while eleven cases were on the left humerus. Majority of the cases of humeral fracture resulted from motor-vehicle accidents i.e. seventeen patients in total. Six patients were car passengers and one driver. There six motorcycle riders and four pillion riders. One case resulted from a pedestrial injury. Three causes e.g. logging injury and assault.

Eighteen cases were closed fractures (78.3%) and five open fractures (21.7%). There were one case each of Type I, IIIb and IIIc and two cases of Type II. All open fractures had been managed with immediate wound toilette and debridement under general anaesthesia and appropriate antibiotics. Four cases of these open fractures were treated with hanging casts and one case was managed with external fixators. None of these cases developed into septic non-union. Four of the open fractures were primarily treated in the department and one case was referred following wound debridement.

There was only one (4.3 percent) case of non-union where the initial fracture as in the upper third, fourteen cases (60.9 percent) in the middle third and eight case (34.8 percent) in the lower third humerus.

Twelve cases (52.2 percent) were transverse fractures, four cases (17.4 percent) were short oblique, three (13.0 percent) were comminuted, two (8.7 percent) spiral fractures and one (4.3 percent) each of long oblique and segmental.

There were eighteen isolated humeral fractures, three cases were multiple fractures and one case in a multiply-injured patient (spleen injury with multiple rib fractures and metacarpal fractures). Isolated humeral fractures accounted for 78.3 percent in this series. Two cases were associated with ipsilateral fractures of the olecranon and radius with ulna whereas the other was associated with fractures of the ipsilateral lower limb. In all these cases, the humeral fractures and associated fractures were treated non-operatively, with only one where immediate fixation was done for the associated fracture. Four cases of humeral fractures resulted with initial radial nerve injury. All these fractures with radial nerve injury were at the lower third of the humerus. Three of them had complete radial nerve palsy but one case was a neurapraxia. One patient had a partial brachial plexus injury on the ipsilateral side. Nine patients with other injuries included five patients with cerebral concussion and four patients with multiple laceration wounds.

Twelve cases (52.2 percent) were treated initially with hanging casts and five (21.7 percent) cases with U-slabs. One case of open fracture was treated with an external fixator. Four other cases of open fractures were treated with hanging casts following toilette and debridement of the open wounds. Two referred cases were initially treated with full length plaster casts. One patient with fracture of the upper third of the humerus extending into the greater tuberosity was initially treated with shoulder strapping. One referred patient had his fracture treated traditionally whereas in another case, no treatment was instituted at all.

A total of six patients defaulted their follow-up for the fracture treatment. Three cases were referred cases and three others were primarily treated in UKM. The period of initial immobilisation of fracture prior to default ranged from as early as two weeks to three months.

There were sixteen cases of atrophic non-union (69.9 percent), four hypertrophic non-union (17.4 percent), one oligotrophic non-union (4.3 percent) and two cases of pseudoarthrosis (8.7 percent).

Table II
Mode of primary treatment of fracture

Treatment	Number	Percentage
Hanging cast	12	52.2
U-Slab	5	21.7
External Fixation	1	4.3
Others :		
a. Full length plaster cast	2	8.7
b. Shoulder strapping	1	4.3
c. Traditional treatment	1	4.3
d. No treatment	1	4.3
Total	**23**	**100**

The shortest interval between surgery and union was two months and the longest was seven months, with an average of 3.6 months. The follow-up period following treatment of non-union ranged from four months to forty-eight months. The average follow-up period was nineteen months.

Primary injury to the radial nerve was found in four of the twenty-three patients, a total of 17.4 percent. One case was a neurapraxia which recovered after eight weeks while complete radial nerve palsy was noted in the other three cases. Two of such cases had total transections of the radial nerve. In all the four cases, the fractures were located at the lower third of the humerus.

Post-Operative Complications

In this series there was no case where infection occurred. Post-operative radial nerve neurapraxia occurred in six cases (26.1 percent). All of them recovered fully within six weeks to four months after operation. One patient developed chronic osteomyelitis of the right humerus three years following surgery. The infection was eradicated following removal of plate, debridement and appropriate antibiotics.

Functional Results

All non-unions treated by plating and bone graft healed. The time to union ranged from two months to seven months. These patients were relieved of either their pain, disability, instability or deformity. All patients who attained union returned to their work or activities prior to the fracture. Using Steward and Hundley criteria, seventeen patients had good results (74 percent), four patients fair (17 percent) and two patients with poor results (9 percent).

Discussion

Our series of twenty-three cases of non-union of the humeral shaft were collected from two hundred and eighteen fractures of the humerus treated in the Orthopaedic Department UKM over a period of seven years. The overall incidence of non-union was about 10 percent. Although this study was retrospective and the series small, evaluation of the data and a review of the literature, suggest or identifies factors associated with the development of non-union in fractures of the humeral shaft.

The distribution of the non-unions according to sex and age showed that majority of the cases were in the age range 21-23 and 31-40 years with a predominance of male patients. These findings could be attributed to the majority of these fractures occurring in this age group. More than half the number of cases (17 patients) resulted from road traffic accidents involving mainly younger men.

Fourteen of the twenty-three (60.9 percent) initial fractures were located in the middle third. These fractures were more prone to non-union than fractures of the proximal or distal thirds of the humerus. This may be owing to injury of the main nutrient artery entering at the site of fracture. Laing's (1956) demonstration of a main nutrient artery entering the distal part of the middle third of the humeral shaft suggested that it accounted for the increased incidence of non-union at that level. This may also explain the good prognosis in fractures of the lower third when the proximal fragment has its nutrient vessel intact, and the distal fragment derives its supply from the vessels around the metaphysis.

Transverse (52.2 percent), short oblique (17.4 percent) and comminuted fractures (13.0 percent) constituted about 82 percent of all initial fracture patterns that went into non-union. The association of these fracture patterns with the development of this non-union agreed with that in previously reported series (Campbell, 1937; Klenerman, 1966; Loomer and Kokan, 1974; Mnayanieh et.al., 1963 and Healy et.al., 1987). This probably resulted from problems with small fracture surface area, control of angulation, rotation, translation and soft tissue interposition at the site of the fracture. Typically, spiral and long oblique fractures were not associated with either these problems or non-union. This was because the fracture surface area was larger and there was less overall motion.

Any combination of biologic and mechanical factors e.g. unbridled motion, gap between fragments and loss of blood supply may come together to cause failure of

union. Gaps are frequently present due to distraction, soft tissue interposition or loss of bone substance.

If fractures were comminuted with wedge interposed fragments or were segmental, healing was often delayed. In these fractures, there was damage to nutrient vessels and the soft tissue envelope vascularity by the higher velocity injury. Comminution and open fractures may be considered as added factors in the development of non-union and in this small series open fractures constituted about 21 percent of non-union. Majority of the fractures were closed fractures (78.3 percent).

Twelve cases (52.2 percent) of the original humeral shaft fractures were initially treated with hanging casts. Dependency traction produced by long-arm hanging cast was primarily indicated in displaced fractures of the humeral shaft with shortening and the midshaft of the humerus was best suited for treatment by the hanging cast. These casts can correct fracture alignment but may also distract fracture fragments. The weight of the long-arm cast can result in excessive traction in the preadolescent youth. Distraction of the fracture site was noted in five of the distraction of the fracture fragments were implicated as extrinsic factors in the development of non-union (Holm, 1970).

Distraction is well known as one of the clinically common causes of delayed or non-union (Boyd et.al., 1960 and Sakellarides et.al., 1964). The effect of a gap is influenced markedly by both the age of the patient and the intactness or preservation of the periosteum. The common denominator of distraction with disruption of the periosteum is ingrowth of fibrous tissue or soft tissue interposition.

Soft tissue interposition accompanying distraction seems to act by simple insertion of a tissue barrier with little or no ability to undergo osseous metaplasia. Distraction may also affect bony union adversely by a direct effect on the early callus. Tension present on the tissues proliferating between fracture fragments will affect the growing osseous tissue, turning it into organised fibrous tissue instead of cartilage or bone (Pritchard, 1963).

Hanging arm casts and open reduction have been identified as factors associated with non-unions of the humeral shaft (Campbell, 1937; Christensen, 1976; Loomer and Kokan, 1974; Fattah et.al., 1982). These methods were consequently not recommended as primary treatment for fractures of the humeral shaft. Functional bracing of humeral shaft fractures was effective in large series (Scient. Res. Comm., 1959; Balfour et.al., 1982) and had been the treatment of choice for initial management of humeral shaft fractures (Healy et.al., 1987). None of the patients in this series underwent primary open reduction and internal fixation of the fracture. The cause of non-union in primarily operated cases was inadequate fixation. The operation also caused further damage to the vascular supply of the bone fragments. Internal fixation brings with it stripping of the periosteum if plates are used or injury to endosteal blood supply if intramedullary appliances are used, causing a delay in union if absolute stability is not achieved. Stability will allow revascularisation and union despite avascularity if there are no gaps to be bridged and the fracture is under compression.

A review of the literature comparing operative with non-operative treatment of these fractures suggested that good and excellent results can be obtained with both methods and the time to union was similar in both groups. However, more unions were delayed or failed and there were more complications in the series of patients treated surgically. Fenyo (1971) stated that operatively treated patients had more than double the rate of non-union than patients treated in casts.

The use of an external fixator and Schanz pins to immobilise a fracture, limits gross motion but allows micromotion, which may increase the strain at the fracture and give rise to a delayed or non-union, especially if there is avascularity or a gap (Perren, 1980).

Motion may contribute to the development of non-union by several mechasms. The repeated interruption of small blood vessels create more necrotic tissue in areas where proliferation is most needed to effect bony union. Motion is accompanied by increased amounts of cartilage formation in the callus which is a barrier to bony union. The cartilage formation may be a response to lowered oxygen tension to the tissues, secondary to relative loss of blood supply. It has been documented that lowered oxygen tension seems to favour chondrogenesis at the expense of osteogenesis (Bassett, 1964).

Motion may also introduce tension factors, driving the healing equilibrium towards fibrogenesis.

Other major factors associated with non-union in this series were inappropriate treatment and poor patients'-compliance resulting in inadequate fracture immobilisation. Two referred cases were initially treated with full length plaster casts. Inappropriate treatment also included two patients who had traditional treatment and one with no treatment at all. Six patients (27 percent) had defaulted their follow-up during the fracture treatment.

Humeral shaft fracture with concurrent multiple injury seems to be the most common indication for operative management of a humeral shaft fracture (Durbin et.al., 1983; Foster et.al., 1985). This category includes concurrent head injury with poor patients' cooperation, burns of the upper extremity necessitating bone stabilisation, type II or III open fracture requiring soft tissue stabilisation, injury of the spine, lower extremity and fracture of the ipsilateral humeral shaft and forearm (Roger et.al., 1984; Lange and Foster, 1985). In this series, none of such cases were treated operatively. In one case of ipsilateral humeral shaft fracture and olecranon fracture, an immediate internal fixation was done for the olecranon however the humeral shaft fracture was treated conservatively.

In this series, primary injury to the radial nerve was found in four patients (18.2 percent) with lower third humeral fractures. The occurrence of injury to the radial nerve varies from 3 to 16 percent (Kennedy and Wyatt, 1957; Garcia and Maeck, 1960; Mann and Neal, 1965; Mast et.al., 1975). Damage to the radial nerve most often occurred in the oblique fracture at the juncture of the middle and lower one third of the humeral shaft (Holstein and Lewis, 1963). Radial nerve paralysis associated with humeral shaft fractures is not in itself an indication for early operative treatment (Shaw and Sakellarides, 1967; Kettelkamp, 1967; Foster et.al., 1985). Operative intervention can be considered in cases of open fractures, fractures associated with multiple trauma and progressive nerve palsy after closed reduction. Oblique fractures of the distal end of the humeral shaft (Holstein-Lewis pattern), with or without radial nerve palsy is not considered as an indication for operative intervention unless inadequate reduction due to interposed soft tissue is present (Szalay and Rockwood, 1983; Foster et.al., 1985). In this study two patients with transected radial nerve were treated with delayed tendon transfers.

Most investigators conclusively agreed that compression plating with cancellous bone grafting gave by far the best results in terms of the rate of healing compared to other modalities of treatment (Loomer and Kokan, 1974; Weber, 1976; Muller and Thomas, 1979; Fattah et.al., 1982; Healy et.al., 1987). Rosen (1979) reported twenty-nine cases of non-union of the humeral shaft treated by compression AO plating, supplemented by bone graft in fourteen cases and obtained healing in twenty-five of the cases. He also reported the treatment of 122 non-union of long bones by rigid internal fixation i.e. mostly by compression plates with bone grafts and achieved a union rate of 92.6 percent.

Half of the cases, especially in the well aligned fractures with hypertrophic callus, were treated without bone grafts and without resecting the pseudoarthrosis. Fattah et.al. (1982) in comparing results of treatment of humeral non-unions with three different operative methods, found 100 percent union in 14 cases primarily treated with AO plate and bone graft. Average time of union was 3 months. The average time of union in this series was 3.6 months. Barquet et.al. (1989) analysed 25 cases of aseptic non-union of the humeral shaft treated with a protocol consisting of decortication through an anterolateral or posterior approach, internal fixation with a broad straight DCP ASIF plate and autologous cancellous bone grafting. He obtained non-union healing in 24 cases in periods averaging 6 months with very high rate of good functional results.

Healy et.al., (1987) obtained healing of 24 of 26 (92 percent) non-unions of the humeral shaft in an average of 5.6 months after treatment with dynamic compression plate and bone grafting. Optimal treatment of non-unions of the humeral shaft consists of resecting atrophic non-unions, shortening of the bones, drilling sclerotic areas to encourage revascularisation and apposing bleeding diaphyseal surfaces, using a broad compression plate including at least six points of cortical fixation above and below the non-union, compression of the non-union by means of interfragmentary lag screws, prestressing of the plate, dynamic

compression by the plate, or direct compression by the external compression device, and autogenic cancellous bone grafts.

Phemister (1947) treated non-unions successfully with subperiosteal bone grafts without resecting the pseudoarthrosis. Synovial pseudoarthrosis is a non-union which develops a neoarthrosis with a synovial lining and sometimes with joint fluid in the cleft or cavity. Clinically, there is false motion and a wide gap is seen radiologically. A Technectium-99m bone scan usually shows a cold cleft between hot ends. In treating synovial pseudoarthrosis, resection or excision of the pseudoarthrosis is recommended if there is malposition, gap or avascularity. Bone grafts are indicated in such cases (Rosen, 1990).

All patients treated by this method, returned to their normal work or activities after obtaining union. They were relieved of either their pain, disability or deformity. Assessment of their functional results after union showed that majority of the patients (74 percent) obtained good results, 17 percent fair and only 9 percent with poor results.

In comparing the present series with that of other series (Table III), compression plating supplemented by cancellous bone graft yielded comparable union rate and average healing time for humeral shaft non-unions. In this series, we achieved 100 percent unio- with an average healing time of 3.6 months as cc .d to that of Barquet et.al. (1989), who obtained 9 5 r- -ent union rate and average healing time of 6 r Upon obtaining union, there were seventer percent) patients with good functional results comparable with that of Barquet et.al. (1989).

Table III
Comparison of results of the present study with other studies

Investigator	Year	No. of non-unions treated	No. of Union (percentage)	Average Time to Union (Months)	Functional Results
Loomer and Kokan	1974	10	9(0%)	2.6	N.A.
Fattah et.al.	1983	14	14(100%)	3.0	All were painless, with full ROM at shoulder + elbow
Healy et.al.	1987	26	24(92%)	5.6	Average elbow ROM 12-122° Average shoulder elevation 149°
Barquet et.al.	1989	25	24(96%)	6.0	According to Stewart-Hundley criteria G=21 (84%) F=3 P=1
Present Study	1993	23	23(100%)	3.6	G=17 (74%) F=4 P=2

The method of treatment by dynamic compression plating and bone grafting fulfills the general objectives in the management of humeral non-union. It is by far the most reliable method of treatment and gives best results in terms of the rate of healing as compared to other modalities of treatment shown in the literature. In this study, union was obtained in all twenty-three patients treated by this method and none required more than one operation to obtain union.

Conclusion

The overall incidence of humeral shaft non-union in this study is 10 percent. A retrospective review of the data in this study highlights certain identifiable factors associated with the development of non-union in humeral shaft fracture, such as; an open injury, soft tissue interposition, fracture distraction, improper initial treatment and poor patients' compliance. The high incidence of non-union in the men's age group 21 to 40 years is attributed to the majority of humeral fractures occurring in that group. Treatment of humeral non-union by compression plating and cancellous bone graft gives best results in terms of rate of union, shorter healing time and good functional results.

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TRAUMA

Displaced Supracondylar Fracture of Humerus in Children - Comparative Study of the Result of Closed and Open Reduction

A Yusof, MD*, M Razak, MD**, A Lim, FRCS***, *Department of Orthopaedic and Traumatology, Kuala Lumpur Hospital, **Hospital Universiti Kebangsaan Malaysia, ***Loh Guan Lye Hospital, Penang

Summary

The displaced supracondylar fracture of the humerus in children (Gartland type 3) is a most challenging injury to treat. There is controversy regarding the initial treatment either closed manipulation and splint immobilization or open reduction and internal fixation. This is a retrospective study comparing two groups of patients with displaced supracondylar fracture of the humerus (Gartland 3) treated in the Orthopaedic Unit, Universiti Kebangsaan Malaysia. The first group, 13 patients treated with closed reduction and splint immobilization and a second group, 15 patients treated with open reduction and internal fixation as initial definitive treatment. The results showed a high failure rate of closed reduction and splint immobilization. This was due to difficulty in reduction, loss of reduction post operatively or during follow-up. Open reduction and internal fixation was more advantages with reduced hospitalization time, fewer complications, more stable fixation and better anatomical reduction with minimal complications for type 3 supracondylar fracture of humerus. We would recommend that all Gartland 3 supracondylar fracture of the humerus be treated with open reduction and two K-wire fixation.

Introduction

Supracondylar fracture of the humerus is the second most common limb fracture in children and is one of the most difficult of all fractures to treat (Krurer and Regan, 1990). Closed reduction and immobilization, particularly of type III fractures, without pinning is currently condemned by recent papers and yet must at present remain the most widely used of treatments (Hadlow et.al., 1996). Pironeet et.al. (1988) stated that closed reduction and application of cast is inappropriate in management of a displaced supracondylar fracture of the elbow as either the initial or the subsequent method of treatment. This method is potentially hazardous to the circulation and makes it difficult to control the reduction, resulting in loss of the carrying angle and rotational malalignment of the distal segment.

Various methods of treatment have been used in the management of displaced supracondylar fractures of the humerus in children. The most frequently used methods of treatment are closed reduction and application of a cast, traction (skeletal or skin), closed reduction and percutaneous Kirschner wire fixation and open reduction with internal fixation.

Closed reduction and application of a cast with the elbow in flexion is one of the oldest and most widely used methods of treatment. There is concern about the dangers and difficulties of this method, especially the risk of Volkmann ischemic contracture and high incidence of cubitus varus.

The advantages of surgical treatment include greater potential for accurate reduction, a more stable fixation, and short hospitalization (Kramhoft et. al., 1987).

Shifrin et.al. (1976), found that open reduction and internal fixation to be a preferable approach in all supracondylar humeral fracture in children if the fragments are displaced.

Aims of the Study

There is no controversy about management of the non-displaced or mildly displaced fracture of the supracondylar fracture of humerus in children. The treatment of the displaced supracondylar fracture is a debatable. It involved two distinct elements - obtaining reduction and maintaining reduction. Several different methods of treatment have been advocated in the local practice which includes manipulation under anesthesia followed by plaster splint immobilization, or open reduction and internal fixation. Each method of treatment has its advantages and disadvantages. At this time, few studies describe the best options of treatment for the grade 3 supracondylar fracture of humerus. This is a prospective study comparing two methods of treatment in similar groups of patient with displaced supracondylar fractures. The aim of the study was to see if closed reduction followed by cast immobilization is better than open reduction and internal fixation for the treatment of displaced supracondylar fractures of the humerus in children.

Materials and Methods

This is a randomized prospective study to see if non-surgical treatment with manipulative reduction followed by plaster-of Paris would produce the same results as operative treatment in Gartland type 3 supracondylar fractures of the humerus. All patients admitted to the Universiti Kebangsaan Orthopaedics Unit, Hospital Kuala Lumpur, between July 1994 and July 1995 with Gartland type 3 fractures were admitted to the study. The Kuala Lumpur Hospital is a tertiary hospital and a referral center for the Klang Valley. All the patient's relatives or parents were informed of the choice of the treatment available and only those who agreed were included in this study. There were 28 patients included in this study. The patient was randomized by using balloting box in the emergency unit where the patients were first seen. Each patient was randomized into group 1 in which closed manipulation was done or group 2 where the initial treatment was open reduction. The randomization was done by the on call doctor.

Inclusion criterias were all the patient below age of 12 years old and above 3 years old, with single closed supracondylar fractures and not initially been treated elsewhere. The patients with multiple fractures or open fracture were excluded in this study. Those who presented with neurovascular complications were also excluded.

All patients had pre-operative radiographs to determine fracture type and direction of displacement. On admission after general examination and clinical history, two views of X-rays anteroposterior and lateral were taken. Fractures were classified by degree of displacement according to the classification scheme of Gartland (1954) :-

Gartland Classification :

Type 1 : Fracture are undisplaced

Type 2 : Fracture are partially displaced, but some contacts remain between the proximal and the distal fragment.

Type 3 : The fracture are completely displaced and shown no contact between fragments on the lateral radiograph.

The displacement of the distal fragment either post eromedial or posterolateral was not taken into consideration. Only type 3 supracondylar fracture of the humerus included in this study.

The patients were divided into two groups, according to the initial plan of treatment. In the group 1, all patients had closed reduction and cast immobilization, and in group 2, all patients had open reduction and K-wire fixation.

The closed procedure was considered a failure if : (1) there was not an acceptable reduction after having tried twice, (2) loss of reduction postoperatively or during follow-up period, (3) inability to obtain post-op immobilization in POP backslap of more than 90 degrees without compromise of the circulation or loss of radial pulse. The patients in which were considered failure of closed treatment were planned for open reduction and internal fixation.

On the follow-up examination, the patients were questioned about pain, restriction of motion and satisfaction with appearance of the elbow. The carrying angle and the arc of flexion-extension of both the injured and uninjured elbow were noted. The carrying angle was measured with the elbow extended and supinated. A neurological examination was performed if a neural deficit has been noted previously.

The results of the treatment were assessed using the criteria of Flynn et al (1974), to compare the motion and carrying angle of the injured and the uninjured elbow. The function was graded in five degree intervals of the total arc of flexion and extension, and the cosmetic appearance of the elbow was graded in five degree intervals of change in the carrying angle (Table : I).

Table I
Criteria for Grading Result
(Flynn et al., 1974)

Result	Cosmetic factor: Loss of carrying angle (degree)	Functional factor: Loss of motion (degree)
Excellent	0 - 5	0 - 5
Good	6 - 10	6 - 10
Fair	11 - 15	11 - 15
Poor	> 15	> 15

Results

There were 28 patients included in this study, 13 patients in group 1 and 15 patients in group 2 (Table : II). The patients ranged from 3 years to 10 years with mean of 6.2 years. The age and sex are shown in figures (1 and 2). The highest frequency of fracture was found in the age group 6 and 7 years. In this study, 22 patients were boys and 6 girls. Almost 82% of the patient are from Malay race. 53% of the injuries were in the left elbow and 47% in the right. The mechanism of injury as in figure (3).

Table II
Initial Treatment

	No. of patients
Group 1 (closed reduction and cast)	13
Group 2 (open reduction and fixation)	15
Total	**28**

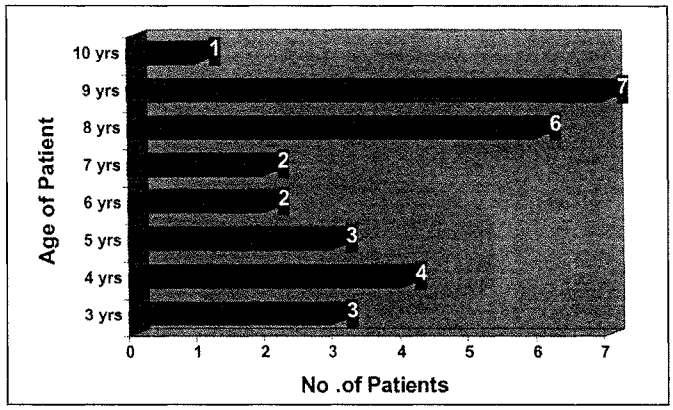

Fig. 1: Age Distribution

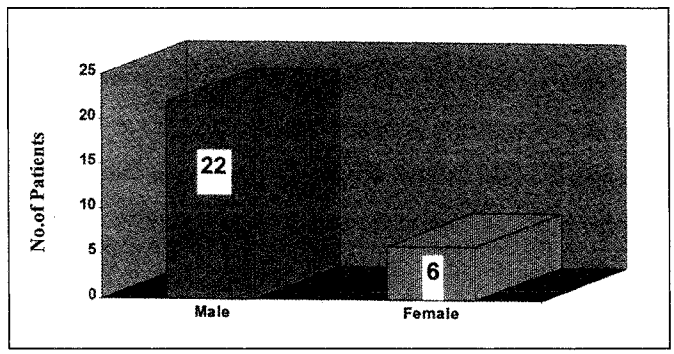

Fig. 2: Sex Distribution

There were 13 patient in group 1. The procedures were done by a Medical Officer or the Specialist on call. Note that the procedure were mainly done by Medical Officer of different experience. Closed treatment had to be discontinued in 12 patients, because either of loss of

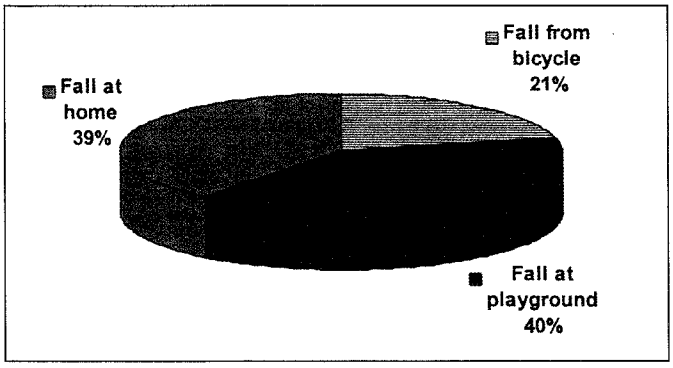

Fig. 3: Mechanism of Injury

reduction, concern about the circulation or not being able to get good reduction after 2 tries. All this patients had an open reduction and internal fixation as definitive treatment. (Table : III).

The 1 patient who had a successful closed reduction, eventually had excellent motion and good alignment.

Table III
Result of treatment - closed reduction

Procedure	No. of Patients
Acceptable reduction	1
Fail CMR	12
Total	**13**

There were fifteen patients in the group 2, treated by open reduction and internal fixation with K-wire. An additional eleven patients had open reduction after unacceptable closed reduction from group 1. Therefore, 26 patients were treated with open reduction and internal fixation as definitive treatment.

Table IV
Approach

	No. of Patients
lateral only	14
lateral and medial	12
Total	**26**

The value for extension-flexion and the carrying angles of the injured and the uninjured elbow were noted for all patients and graded according to the Flynn criteria.

Almost 90 percent patients in this study have carrying angle less than 5 degrees and 73 percent having excellent range of motion.

Discussion

A supracondylar fracture of the humerus is the most common fracture of the elbow in children, and unfortunately, it can also be one of the most difficult fractures

Table V
Result of treatment

Cosmetic Factor : Loss of carrying angle	No. of Patients	Functional Factor : Loss of motion	No. of Patients
Excellent	23	Excellent	23
Good	3	Good	3
Fair	0	Fair	0
Poor	0	Poor	0
Total	**26**	**Total**	**26**

to treat. There are no controversy about management of undisplaced fracture. Closed reduction and cast application, skin traction, skeletal traction, percutaneous fixation and open reduction and internal fixation have been advised. Some authors generally reserve open reduction only for the irreducible fracture, an open injury, and associated with vascular injury, but some authors have recommended routine open reduction for all displaced fracture (Mehserle et al., 1991).

Management of the displaced extension type supracondylar fracture of the humerus (Gartland type 3) is fraught with problem, including neurovascular compromised, difficulty in obtaining or maintaining reduction, cubitus valgus and stiffness of the elbow. The avoidance of complications and the achievement of an excellent functional and cosmetic result are the goal of treatment (Pirone et al., 1988).

More aggressive regimens are urgently needed in order to offer the greatest chance for optimum outcome in a most difficult and demanding fracture (Kurer and Regan, 1990). Shiffin and his associates (1976) have treated all closed displaced supracondylar fractures by open reduction and stated that none of the patients had any residual valgus or varus deformity, or restriction of motion. Open reduction with internal fixation was strongly advocated by McLennan in 1937 in a report from the Royal Hospital for Sick Children in Glasgow.

In this study, almost 90% of failure rate in group that been treated with closed method. This high failure rate was due to difficulty in obtaining and maintaining the reduction, loss of reduction post operatively or during follow-up period, and finally inability to obtain post-op immobilization in POP backslap more than 90 degrees without compromising of the circulation.

The higher percentage of poor percentage of poor results was associated with the failure of closed reduction and application of a cast as the initial treatment of the fracture, regardless of the subsequent definitive treatment. Because of the anatomy of the supracondylar humerus in the susceptible age group, obtaining and maintaining a stable closed reduction on the displaced fracture without internal fixation is difficult (Mehserle and Meehan, 1991).

But Ramsey and Griz (1973) do not advocate routine open reduction of all displaced supracondylar fractures in children but feel that this method is safe and efficacious, and should be considered whenever accurate reduction cannot be maintained by closed methods or if soft tissue problem would dictate a surgical approach. Carcasone et al. (1972) found up to 97.5 percent satisfactory results in a series of 40 children treated by operation,

From the results above, open reduction and internal fixation was appropriate choice of treatment for the severe displace supracondylar fracture of the humerus in children. Nearly 97% of patient had good to excellent result of cosmetic and functional during follow-up according to the Flynn criteria.

In 87 percent of patient in this study, the operation were done through the lateral and medial approach. This approaches give a good exposure and the surgeon is able to visualize the fracture clearly and obtain near anat omical reduction as possible.

Shifrin et al (1976) advocated early surgery through a medial approach and a medial scar is also cosmetically excellent. But many authors agree that a medial and lateral approach produce the best results. Weiland et al (1978) reported difficulties with reduction through a lateral approach with persistent varus tilt giving rise to deformity. Triceps splitting or dividing incisions give rise to loss of extension. Some authors recommended using an anterior approach through the already damaged bracialis muscle; there by protecting the triceps brachii (Carcasone et al, 1972).

Persistent controversy exists, however, as to the technique of pin placement. In the above study crossed medial and lateral pins were used without any problem. Some author demonstrated that crossed medial and lateral pins were biomechanically superior to lateral pins fixation alone. Zionts et al (1994) found that the maximum stability was provided by two crossed pins placed from the medial and lateral condyles, also provided the greatest resistance to gross rotational displacement and this method may be preferable for most fractures. However, the alternative of the three lateral pins, or even two lateral parallel pins, may be considered when marked swelling of the elbow makes safe placement of a medial pin difficult. Fixation with

two lateral crossed pins should be avoided. The Kirsrchner wires should engage the opposite cortex, without penetrating it, in order to avoid migration of the wires. Zionts et al (1994) reported that in an adult cadaver fracture model, parallel lateral pins gave 37% less torsional stability than crossed medial and lateral pin fixation. Pirone et al (1988), in their comparison of various treatment options for supracondylar humerus fractures, noted the mean change in carrying angle to be slightly less with crossed K-wires than with lateral wires but this difference was not statistically significant.

In the study by Brown and Zinar (1995), the radial nerve was most frequently injured (61%), followed by median (28%) and ulnar (11%) nerves palsies. Four of the ulnar nerves injuries and one radial nerve injury were iatrogenic, resulting from both percutenous pinning and open reduction and internal fixation. The incidence of iatrogenic nerve injury after K-wire fixation of the supracondylar fractures was found to be 3%. In the study by Royce et al (1991) the nerve palsies were resulted from use of the a medial K-wires. The ulnar nerve was found to be most susceptible to injury when the medial epicondyle cannot be palpated because of swelling of the elbow. The use of a small incision over the medial epicondyle for medial approach will prevent nerve injury. All the deficits resolved spontaneously within a period of 2 to 6 months. In this study one patient had partial radial nerve involvement and fully recovered after one month. Royce et al (1991) also suggested that to use intraoperative C-arm radiographic imaging to insure proper placement of the medial pin. If such radiographs show malposition of the medial pin, it should be removed and replaced in the correct position. Percutaneous pinning is performed only with smooth K-wires. Postoperative nerve palsies after pinning without direct injury to a nerve should be treated conservatively with observation and repeat examinations.

The most common complication of supracondylar fracture in children is varus angulation but there was no similar complication accounted in this study, it may be due to short term follow-up of the patients. The cause of the deformity is coronal rotation, or tilting of the distal fragment. Wilkins (1990) concluded that horizontal rotation of the distal fragment is the major factor predisposing to tilt. In the study by Weiland et al (1978) inadequate reduction with medial angulation was associated with residual cubital varus deformity in the vast majority of their patients.

Factors contributing to poor reduction are related to the surgical technique, in which only the lateral cortex is visualized directly. But some authors believed that varus deformity is due to epiphyseal growth disturbance or rotation of the distal fragment. Smith and others suggested that residual medial tilt after reduction is the most important factors in varus angulation, with isolated rotational deformities being corrected by compensatory rotation of the shoulder. Some authors advocated that the forearm should be immobilized in pronation after reduction of varus fracture to prevent gunstock deformity (Weiland et al, 1978).

Other complications were pin tract infection, but all healed without problem after removal of pins and local dressing (Table : VI).

Table VI
Complications

	No. of Patients
Pin tract infection	4
Partial nerve involvement	1
Migration of wire	1

Conclusion

The displaced supracondylar fracture is a most challenging injury to treat. More aggressive regimens are urgently needed in order to offer the greatest chance for optimum outcome in a most difficult and demanding fracture. Closed reduction and application of a cast is inappropriate in management of a displaced supracondylar fracture of the elbow, as either the initial or the subsequent method of treatment. The method is potentially hazardous to the circulation and makes it difficult to control the reduction, resulting in loss of the carrying angle and in cubitus varus. The advantages of surgical treatment include greater potential for accurate reduction, a more stable fixation and a short hospitalization period (Kramhoft, 1987). It was strongly suggested that all severely displaced supracondylar fracture of

the humerus in children should be treated with open reduction and internal fixation as the first choice of treatment. The crossed medial and lateral Kirschner wire fixation of the reduced fracture are recommended as the treatment of choice for the displaced fracture.

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The Results of Treatment of Dislocation and Fracture - Dislocation of the Elbow - A Review of 41 Patients

I Azmi, MD*, M Razak, MD**, Y Hyzan, MD**, *Terendak Army Hospital, **Hospital Universiti Kebangsaan Malaysia

Summary

Forty-one patients with 42 elbow dislocations, of which 13 had acute simple dislocations, 21 had fracture-dislocations and 8 had neglected elbow dislocations, were evaluated with regard to limitation of motion, pain, instability and residual neurovascular deficit. All patients with acute simple dislocation were treated with closed reduction, but the duration of immobilization before commencement of active motion varied. Open-reduction was indicated for failed closed reduction and neglected-dislocations. Internal fixation as a primary procedure was only performed for displaced fracture-dislocation. Excision of radial head or tricepsplasty were performed if the reduction was impossible in neglected elbow dislocation.

Despite a good results in acute simple dislocation, 33.07% had flexion contracture of between 5 to 30 degrees. In fracture dislocation, satisfactory results were seen in whom the elbow was immobilized for three weeks or less. Neglected-dislocation is associated with poor functional outcome, 37.5% were good and 62.5% were poor.

Prolonged immobilization after injury was strongly associated with an unsatisfactory result. The results indicate that early properly supervised active motion is a key factor in the rehabilitation of elbow dislocation.

Introduction

Normal use of the hand depends largely on a well functioning elbow joint. The elbow joint serves as a link in the lever arm system that positions the hand, as a fulcrum of the forearm lever, and as a load-carrying joint. Mobility and stability of the elbow joint are necessary for daily, recreational, and professional activities. Loss of elbow function, possibly more than for any other joint, can jeopardize an individual's independent daily existence.

Elbow dislocation is a common injury, but the management of these cases is not standardized and poorly documented. Not until 1969 was the difference in outcome noted between those with and without associated fractures.

The method of immobilization after reduction has often been a plaster splint. The controversies exist in the duration of immobilization. Some authors advocated that the elbow should be immobilized for three to five weeks to allow soft tissue to heal in simple elbow dislocation. However, recent literature advocated early mobilization as soon as the joint is pain free. Their argument is based on the fact that the elbow joint is a stable joint and that the soft tissue will heal despite movement.

In cases of elbow dislocation associated with fracture, the controversies exist whether the fracture and the treatment of the fracture will affect the elbow's stability, and functions. Neglected elbow dislocation usually requires open reduction and extensive soft tissue release, and the functional results are usually poor.

This study reviews the methods of management of acute simple elbow dislocations, fracture dislocations, and neglected elbow dislocations. The results of 41 patients with 42 elbows are presented in this report.

Material and Methods

From Jan 1988 to April 1994, there were sixty-one patients with elbow dislocations admitted to the General Hospital Kuala Lumpur treated by Orthopaedic Unit University Kebangsaan Malaysia. Forty-five case notes were traced and reviewed. Three patients defaulted follow-up and one patient who had open fracture-dislocation were excluded from this study. Forty-one patients with forty-two elbows, (13 simple elbow dislocations, 21 fracture-dislocations and 8 neglected dislocations) were reviewed and studied.

In all acute simple dislocation and fracture-dislocation of the elbow, closed manipulative reduction was attempted, and immobilized in a plaster slab. Surgical reduction was indicated in failed closed manipulation and in neglected dislocation (glossary). Active range of motion exercise was started after varying periods of immobilization.

Each injury was classified according to the direction of dislocation of the radius and ulna in relation to the humerus (Stimson's classification). The mechanism of injury; the involved elbow; the associated fracture and the surgery done; surgical procedures for reduction; and any neurovascular deficit were recorded. The duration of immobilization and the period of follow-up were also recorded.

At the last follow-up, the range of motion was carefully evaluated, with regard to the degree of flexion-extension and flexion contracture, the severity of pain, valgus instability and neurovascular deficit (glossary).

The results of acute simple dislocations and fracture-dislocations were classified into excellent, good, fair and poor for each category. The patients were also assigned on overall composite rating of excellent, good, fair or poor on the basis of the worst of the four categorical ratings (Mehnhoff et.al. 1988). In flexion contracture, loss of extension of less than 5 degrees was rated as excellent, between 5 to 15 degrees (good), between 15-30 degrees (fair) and 30 degrees or more was rated poor. In the post-reduction pain, the results were rated as excellent if there were no pain, good if there was mild pain which did not interfere with activities, fair when the pain did not interfere with normal daily activities but interfered with strenous activites, and poor when the pain interfered with daily routine activites. The post reduction instability was rated as excellent when there was no instability on valgus stress, good if there was mild pain or discomfort on valgus stress, fair when there was pain that required the patient to refuse the valgus stress test, and poor if on valgus stress the elbow demonstrated laxity of the medial collateral ligament or if there

Table I
Ratings of Symptoms in Relation to Post-Traumatic Sequelae
(Mehlhoff et.al., 1988)

Rating	Range of Motion (Flexion Contracture) (Degrees)	Pain (Aching) Contracture)	Instability (Valgus Imposed)	Neurovascular Deficit (Palsy or Ischemic
Excellent	Ext. loss < 5	None	None	None
Good	Ext. loss < 15	Mild	Mild	None
Fair	Ext. loss < 30	Moderate	Moderate	None
Poor	Ext. loss > 30	Severe	Severe or recurrent dislocation	Any

was recurrent dislocation. The neurovascular involvement was rated excellent when there was no neurovascular involvement or if there was neurological involvement but recovered completely during the follow-up period. If there was residual neurological deficit, the rating was poor.

The results of neglected elbow dislocations were rated as good if the flexion range was 90 degrees or more, extension loss of less than 30 degrees and no post-reduction pain or instability. The fair results were rated if the flexion range of 60 to 90 degrees with extension loss of between 30 to 60 degrees, and no post-reduction pain or instability. The poor results were rated if the flexion range was of less than 60 degrees and post-reduction pain or instability were present, according to Krishnamoorthy et. al. (1976) (Table II).

Results

There were thirty three acute posterior dislocations and fracture dislocations, one anterior dislocation, and eight neglected dislocations of the elbow joint (Fig 1). Twenty nine were male, and thirteen were female, aged between 5 to 69 years old with a mean of 31.43 years.

Table II
Rating of Symptoms Post Reduction in Neglected Elbow Dislocation
(Krishnamoorthy et. al., 1976)

Rating	Symptoms
Good	Flexion range > 90° Loss of extension < 30° No pain or instability
Fair	Flexion range > 60° Loss of extension 30 - 60° No pain or instability
Poor	Flexion range < 60° All cases with pain and instability

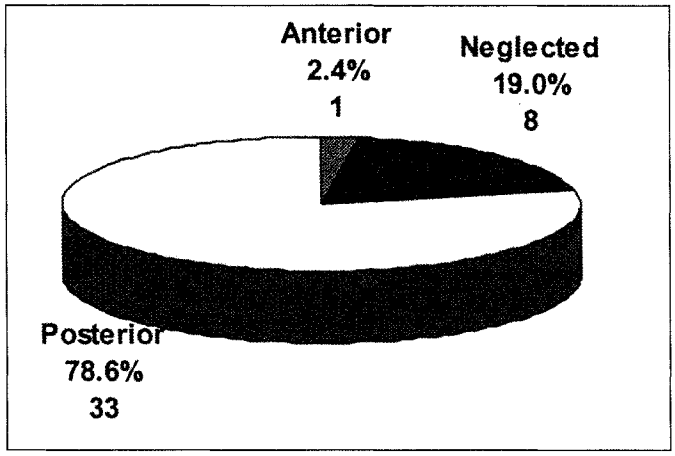

Fig 1: The distribution of cases according to the type of dislocation

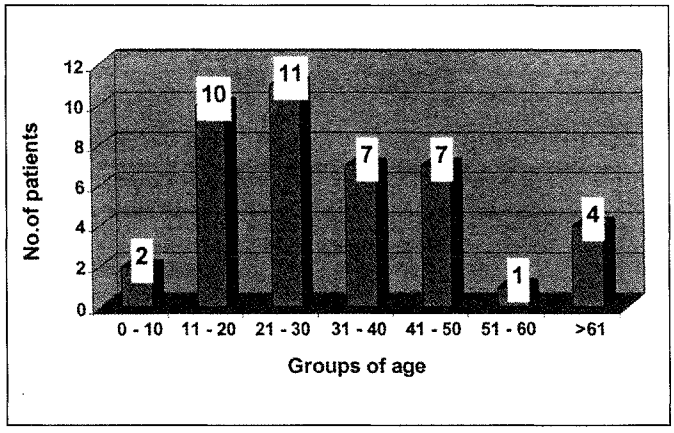

Fig 2: The distribution of cases according to age group

The period of follow-up ranged from one month to thirty six months (mean 6.52 months). The right elbow was involved in 14 cases (33.33%), while the left elbow was involved in 28 cases (66.67%) (Fig 2).

Among the races, Malays were the majority with 23 cases (54.76%), followed by Chinese 10 cases (23.90%), Indian 5 cases (11.40%) and others 4 cases (9.94%) (Fig 3).

A fall was the mechanism of injury in 28 cases (64.44%), while road traffic accident account for the rest, motorcyclist 10 cases (26.67%), and car passenger 4 cases (8.89%).

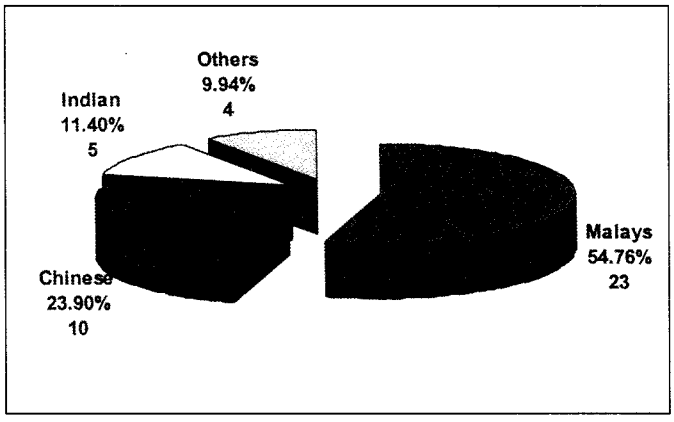

Fig 3: The distribution of cases according to race

Table III
Mechanism of injury

Mode of injury	No of Patient
Motorcyclist	10
Driver	0
Passenger	4
Fall at work/home	28
Total	**42**

Period of immobilization

1. Acute simple dislocation - 13 cases

There were 13 cases of acute simple posterior dislocation. 46.15% (6 cases) were immobilized for 1 to 2 weeks, and 53.85% (7 cases) were immobilized for 3 to 4 weeks before commencement of active motion.

In the group immobilized for 1 to 2 weeks, 100% (6 cases) had an excellent result in the range of motion and post-reduction stability, and 66.67% (4 cases) had an excellent and 33.33% (2 cases) had a good results in post-reduction pain. Overall results showed 66.67% had an excellent with no poor result (Table IV)

However, in the group where the elbows were immobilized for 2 to 3 weeks (7 cases), only 57.14% (4 cases) had an excellent, 28.57% (2 cases) were good, and 14.29% (1 case) had fair result in the range of motion. In relation to post-reduction pain, 71.43% (5 cases) were excellent, 28.57% (2 cases) were good. In the post-reduction stability group, 100% (7 cases) had an excellent result. Overall, 57.14% (4 cases) had an excellent results, and 28.57% were good and 14.29% (1 cases) was fair. There were no poor result (Table V). One case from this group had ulna nerve injury which recovered fully.

2. Fracture-dislocation - 21 cases

Thirteen case were immobilized for 3 weeks and less (Table VI), and the other 8 cases were immobilized for more than 3 weeks (Table VII).

Table IV
Acute simple dislocations
(Immobilization for 1 - 2 weeks - 6 cases)

Rating	Extension Loss	Pain	Instability
Excellent	< 5° (6)	None (4)	None (6)
Good	< 15° (0)	Mild (2)	Mild (0)
Fair	< 30° (0)	Moderate (0)	Moderate (0)
Poor	> 30° (0)	Severe (0)	Serve (0)

Table V
Acute simple dislocations
(Immobilization for 2 - 4 weeks - 7 cases)

Rating	Extension Loss	Pain	Instability
Excellent	< 5° (4)	None (5)	None (6)
Good	< 15° (2)	Mild (2)	Mild (0)
Fair	< 30° (1)	Moderate (0)	Moderate (0)
Poor	> 30° (0)	Severe (0)	Serve (0)

Table VI
Fracture-Dislocation
(Immobilization for 3 or less - 13 cases)

Rating	Extension Loss	Pain	Instability
Excellent	< 5° (11)	None (10)	None (11)
Good	< 15° (2)	Mild (1)	Mild (1)
Fair	< 30° (0)	Moderate (2)	Moderate (1)
Poor	> 30° (0)	Severe (0)	Serve (0)

Table VII
Fracture-Dislocation
(Immobilization for 3 weeks - 8 cases)

Rating	Extension Loss	Pain	Instability
Excellent	< 5° (2)	None (2)	None (3)
Good	< 15° (0)	Mild (2)	Mild (3)
Fair	< 30° (3)	Moderate (3)	Moderate (1)
Poor	> 30° (1)	Severe (1)	Serve (1)

In the group immobilized for 3 weeks and less, 92.39% (11 cases) were excellent, 15.39% (2 cases) were good in terms of extension loss. 84.61% (10 cases) were excellent, 7.78% (1 case) were good and 15.39% (2 cases) were fair in relation to post-reduction pain. 92.39% (11 cases) were excellent, 7.78% (1 case) was good and 7.78% (1 case) was fair in post-reduction stability. Overall ratings showed 84.61% were excellent, 7.78%

Table VIII
Fracture-Dislocation
(Radial Head and Neck Fracture - 8 cases)

Rating	Extension Loss	Pain	Instability	Neurovascular Involvement
Excellent	< 5° (4)	None (4)	None (4)	None (8)
Good	< 15° (2)	Mild (0)	Mild (1)	
Fair	< 30° (1)	Moderate (3)	Moderate (2)	
Poor	> 30° (1)	Severe (1)	Serve (1)	Yes (0)

were good and 15.39% were poor in those with immobilization for 3 weeks or less.

However, in the group which was immobilized for more than 3 weeks, 25% (2 cases) were excellent, 62.50% (5 cases) were fair and 12.50% (1 case) were poor in terms of extension loss. 25% (2 cases) were excellent, 25% (2 cases) were good, 37.50% (3 cases) were fair and 12.50% (1 case) were poor in terms of post-reduction pain. 37.50% (3 cases were excellent, 37.50% (3 cases) were good, 12.50% (1 case) was fair and 12.50% (1 case) was poor in post-reduction stability.

Fracture-Dislocation

1. **Fracture of the radial head (8 patients)**

In grading the degree of extension loss, 50% (4 cases) were excellent, 25% (2 cases) were good, 12.5% (1 case) was fair and 12.5% (1 case) was poor results. 50% (4 cases) had no pain post-reduction, 37.5% (3 cases) had moderate pain and 12.5% (1 case) had severe pain. 4 cases (50%) had no instability, 1 case (12.5%) had mild instability, 2 cases (25%) moderate, and 1 case (12.5%) had recurrent dislocation. All cases had no neurovascular involvement (Table VIII).

Those with severe extension loss (fair and poor results) were mainly those with severe comminution that required excision of the radial head (2 case).

2. Fracture of the coronoid process - 6 cases

Extension loss of less than 5 degrees were seen in 83.33% (5 cases), and between 15 to 30 degrees in 16.67% (1 case). 66.67% (4 cases) had no post reduction pain and instability. Only 2 cases (33.33%) had moderate pain and instability. Composite rating showed 66.67% (4 cases) had an excellent results while the other 33.33% (2 cases) were fair. (Table IX)

3. **Humeral epicondyle fracture**

2 cases had elbow dislocation with lateral epichondylar fracture of the humerus. Both were treated with closed manipulation, and no internal fixation was done. The results, 50% (1 case) was excellent and the other 50% (1 case) was fair (Table X).

4. **Olecranon fracture - 3 cases**

Three cases had elbow dislocation associated with fracture olecranon. Two cases had also humeral fracture with radial nerve injury which recovered completely during the follow-up period. One case had early open reduction and internal fixation for both olecranon and humerus, and the other one was treated with delayed plating and bone grafting.

In the group with extension loss, 33.33% (1 case) was excellent, 33.33% (1 case) was good and 33.33% (1 case) was fair. In terms of post-reduction pain, 33.33% was excellent, 66.67% (2 cases) were good. In

Table IX
Fracture-Dislocation
(Coronoid Process Fracture - 6 cases)

Rating	Extension Loss	Pain	Instability	Neurovascular Involvement
Excellent	< 5° (5)	None (4)	None (4)	None (6)
Good	< 15° (0)	Mild (0)	Mild (0)	
Fair	< 30° (1)	Moderate (2)	Moderate (2)	
Poor	> 30° (0)	Severe (1)	Serve (0)	Yes (0)

Table X
Fracture-Dislocation
(Lateral Humeral Epicondyle Fracture - 2 cases)

Rating	Extension Loss	Pain	Instability	Neurovascular Involvement
Excellent	< 5° (1)	None (1)	None (1)	None (2)
Good	< 15° (0)	Mild (0)	Mild (1)	
Fair	< 30° (1)	Moderate (1)	Moderate (0)	
Poor	> 30° (0)	Severe (1)	Serve (0)	Yes (0)

Table XI
Fracture-Dislocation
(Olecranon Fracture - 3 cases)

Rating	Extension Loss	Pain	Instability	Neurovascular Involvement
Excellent	< 5° (1)	None (1)	None (2)	None (1)
Good	< 15° (1)	Mild (2)	Mild (1)	
Fair	< 30° (1)	Moderate (0)	Moderate (0)	
Poor	> 30° (0)	Severe (0)	Serve (0)	Yes (2)

post-reduction stability, 66.67% (2 cases) were excellent and 33.33% (1 case) was good. 66.67% (2 cases) had neurological injury which were recovered and were rated excellent.

Composite rating showed 33.33% were excellent, 33.33% were good and 33.33% were fair. (Table XI)

Neglected dislocations

Eight cases (19.05%) of neglected elbow dislocation had been reviewed during this period. All of them were neglected posterior elbow dislocation. One patient (a schizophrenic) had bilateral dislocations. The interval between injury and reduction ranged from 17 days to 2 years (Table XII).

All but one required open reduction. Two cases required excision of the radial head and tricepsplasty in order to reduce the dislocation. One case was treated with closed manipulation and reduction.

37.5% (3 cases) had a good result (range of motion > 90 degrees, flexion contracture < 30 degrees, and no pain or instability). All of them were neglected posterior dislocation for 2 months duration. 62.5% (5 cases) had a poor result (flexion range < 60 degrees, or extension loss > 60 degrees, or presence of pain or instability). Most of them were neglected for more than 3 months and either tricepsplasty or excision of the radial head were performed. In one case, closed manipulation was successful and the result was poor even though the delay was for only 17 days.

Complications

Heterotopic ossification was noted in 9 cases (21.43%). The majority of them (6 cases - 66.67%) was in the neglected elbow dislocation group. Three (33.33%) of the cases had fracture-dislocation of the elbow.

Radial nerve injury was noted in two cases, both in elbow dislocation associated with olecranon and humeral shaft fracture. The radial nerve injury, most probably neuropraxia, recovered completely during the follow-up period. One case of posterolateral dislocation had ulnar nerve injury which recovered. In another case, there was anterior interosseous nerve injury, which developed after open reduction and plating of the ulna. This could be due to traction injury during the operative procedure.

Table XII
Neglected elbow dislocation - 9 cases

Age (years)	Type	Neglected Period (Months)	Method of Reduction	Flexion Range (degrees)	Pain	Instability	Rating
26	Post.	2	Open	20 -120	No	No	Good
14	Post.	24	Open/Tricepsplasty	5 - 90	Yes	Yes	Poor
22	Post.	2	Open	5 - 130	No	No	Good
65	Post.	4	Open	30 - 90	Yes	Yes	Poor
26	Post.	3	Open/Rad. Head excision	30 -120	Yes	Yes	Poor
29	Post.	17 days	Closed	30 - 100	Yes	Yes	Poor
44 (R)	Post.	2	Open	10 - 110	No	No	Good
(L)	(Bilat.)		Open/Rad. Head excision	30 -80	Yes	Yes	Poor

Table XIII
Complications of elbow dislocation

Type of dislocation	Heterotopic ossification	Nerve injury	Vascular injury	Deg. Arthritis	Flexion Contracture
Simple Dislocation	0	1 (U)	0	0	3
Fracture Dislocation	3	3 (IA-1) (R-2)	0	0	8
Neglected Dislocation	6	0	0	2	9
Total	**9**	**4**	**0**	**2**	**20**

U : Ulnar nerve
IA : Anterior Interosseous nerve
R : Radial nerve

The nerve recovered completely. There were no cases with vascular injury.

Only 2 case of degenerative arthritis were noted in neglected elbow dislocations. These could be due to short period of follow up.

There were 20 cases with flexion contracture noted. All 8 cases (100%) of the neglected elbow dislocation had flexion contracture ranging from 5 to 30 degrees, while the other 8 cases were from the fracture-dislocation group (38.1% of fracture-dislocation). Only 3 cases (23.0%) which developed flexion contracture were noted from the acute simple elbow dislocation group. Table XIII.

Discussion

Posterior dislocation of the elbow is the commonest form of elbow dislocation. It accounts for 97.6% of elbow dislocation in our review. Only one case of anterior dislocation was noted and there were no divergent elbow dislocation. Bilateral elbow dislocation is very rare. Wilson (1990) reported 3 cases of bilateral elbow dislocation. We noted one case of bilateral neglected elbow dislocation in schizophrenic patient. Elbow dislocation is often seen in the non-dominant upper extremity, perhaps as a result of employment of the dominant arm or unconscious protection of it at the time of injury. In our review, dislocation of the left elbow accounted for 66.67%, comparable to 55.54% (Linscheid and Wheeler 1965), and 60% (Linscheid and O'Driscoll 1993).

Elbow dislocation is the commonest dislocation in children under 10 years old (Letts 1993), but we noted only 3 cases (6.67%). Many of the elbow dislocations in the paediatrics age group go unrecognized because by the time the child reaches the Emergency Department, the elbow has spontaneously reduced, and the only finding on examination is a swollen, tender elbow (Letts 1993).

The period of immobilization plays an important role in the outcome of elbow dislocation. Mehlhoff et. al. (1988), reported that prolonged immobilization after injury was strongly associated with an unsatisfactory result with increased flexion contracture and severity of pain. Six of our patients who had simple dislocation and who were immobilized for 1 to 2 weeks showed no flexion contracture, and 2 cases only had mild pain. However in cases where immobilization was continued up to 4 weeks, 3 out of 7 cases developed flexion contracture between 5 to 30 degrees. Two of them had

mild pain. In fracture-dislocation of the elbow joint, immobilization for more than three weeks gave poor results. Only one case (12.5%) had satisfactory (excellent and good) result, and 7 cases (87.5%) has unsatisfactory (fair and poor) results. However, 76.15% (10 cases) had an excellent result in whom the immobilization was 3 weeks or less. This result indicates that early active motion is the key factor in rehabilitation of the elbow after reduction, and the soft tissue does heal even though the elbow is in active movement.

In fracture-dislocation, the end result is dependent on the severity of the fracture, and it contribution to elbow instability. Simple fractures with minimal displacement usually give good and excellent results, while severely comminuted fractures were usually associated with poor outcome (Durig et. al. 1979), (Broberg and Morrey 1987), (Royle 1991). In our series, two cases had severe comminuted fracture of the radial head which required excision of the radial head and gave unsatisfactory results (fair and poor).

Excision of the radial head which contributed to the valgus instability also resulted in a poor outcome and proximal migration of the radius (Morrey et. al. 1979). We did not note any proximal migration of the radius after excision of the radial head. The radial head should be preserved if possible to prevent severe instability. If the radial head must be resected, torn ligaments and muscles should be sutured (Josefsson et. al. 1989), or temporary use of the radial head prosthesis as a spacer until the soft tissues heal (Knight et. al. 1993).

Internal fixation for the fracture fragments and the associated fracture of the humerus, radius and ulna, improve the stability and the outcome. This is due to the fact that the involved extremity does not require prolonged immobilization, and early active motion can be instituted. It was shown in our result.

Repair of the torn ligaments is not essential in stable elbow dislocation. Josefsson et. al. (1987), repaired the torn ligaments and found no difference. Repairing the torn ligament may be beneficial in unstable fracture-dislocation which require resection of the radial head (Josefsson et. al. 1989).

Neglected dislocation is usually associated with poor outcome. Close reduction should only be attempted with caution and under general anaesthesia. Open reduction usually give better results especially in neglected dislocation of less than 3 months. In our review most of the good results were neglected less than three months and had an open reduction.

Early mobilization is necessary for a good result. Although few authors advocated triceps V-Y plasty to get a better range of motion, it produces an unstable elbow joint which require stabilization with K-wires in order for the triceps tendon to heal. This in turn won't allow early mobilization and will result in a stiff elbow. In our review, only one case of tricepsplasty was performed, and gave a poor result. Recent literature does not support the tricepsplasty for neglected dislocation but it is advocated only for difficult reduction (Krishnamoorthy et. al 1976), (Mahaisavariya et. al. 1993).

In order to achieve immediate stability and early unrestricted movement, Arafiles (1987) advocated a reconstruction procedure using tendon graft stabilization to create a medial collateral and an intra-articular "cruciate" ligament to stabilize the neglected posterior elbow dislocation and allow early motion. This procedure sounds promising and in his hands he was able to improve the range of motion and reduce the instability.

The complications of elbow dislocation can be related to the severity of the injury, and also as a result of treatment. More severe injuries are related to a high incidence of complications. This is reflected by the high incidence of the complications in fracture dislocation compared to simple dislocation. Excessive manipulation will result in a higher incidence of heterotopic bone formation. This is shown by the higher incidence of heterotopic bone formation neglected elbow dislocation, many of whom had received primary treatment from the bone-setter.

Flexion contracture tends to develop in prolonged mobilization and inadequate active motion after immobilization. Early motion is associated with a lower incidence of flexion contracture compared to prolonged

immobilization. The more severe the injury the more it is associated with post reduction pain and the patients will refuse active motion, which indirectly contributes to the higher incidence of flexion contracture. In our review, only 25% (2 cases) in fracture-dislocation had an excellent results after immobilization for more than three weeks, whereas 85.38% (11 cases) had excellent results after immobilization for three weeks or less.

Conclusion

1. Early active motion after reduction of the dislocated elbow is an essential step to achieve full function of the elbow joint. The elbow should not be immobilized for more than three weeks. Internal fixation for fracture-dislocation should only be indicated when it contributes to greater stability and allow early active motion.

2. Severity of the fracture-dislocation is an important factor in determining the functional outcome. The type of the fracture in fracture-dislocation of the elbow does not affect the outcome.

3. Neglected elbow dislocation is associated with a poor outcome especially if the neglected period is more than 3 months.

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Surgical Treatment of Acromio-clavicular Dislocation

H K Leow, MD, Y Hyzan, MS, E C Gan, FRCS, S Hassan, MS, Department of Orthopaedics and Traumatology, 9th Floor, Hospital UKM, Jalan Tenteram, Bandar Tun Razak, 56000 Cheras, Kuala Lumpur

Summary

Acromio-clavicular joint (ACJ) dislocation usually occurs in young adults following trauma or sports injury. Fourteen patients underwent surgical treatment for symptomatic total ACJ dislocation (Rockwood and Matsen Type III-VI) in our unit between January 1996 and June 1997. Eight patients were operated within three weeks of injury and six in the chronic period (after three weeks). In the acute group, two patients had Botsworth procedure and six had Weaver-Dunn operations. All six in the chronic group had Rockwood procedure.

Nine patients achieved excellent outcome with full range of shoulder movement, pain free and return to work within three months of surgery. Two patients had good outcome. Three other patients had satisfactory outcome with tolerable pain and light duty at three months. Two patients developed chronic shoulder pain and one had painful hypertrophic surgical scar. Two patients had screw breakage requiring revision surgery.

In conclusion, surgical treatment for ACJ dislocation produces good results. We suggest that surgical treatment be the treatment of choice for young patients requiring early recovery and good shoulder function.

Key Words: Surgical treatment, Acromioclavicular joint dislocation

Introduction

Acromio-clavicular joint (ACJ) dislocation commonly occurs following trauma or sports. Previously, with the tripartite classification of Tossy et al[1] and Allman[2] conservative treatment was shown to give better results than operative treatment[3,4]. However, the effective treatment of injury to the acromioclavicular joint requires knowledge of the relevant anatomy and the pathoanatomy of its variety patterns of injury. With the introduction of three more subtypes into a total of six by Rockwood[5], understanding of the underlying pathoanatomy is greatly facilitated. Therefore, surgical reconstruction should be reserved for patients with total ACJ dislocation especially Types IV to VI and chronically symptomatic lower grade lesions[6].

Thus, we have studied the outcome of surgical treatment of total ACJ dislocation and compared it with other studies.

Materials and Methods

Between January 1996 to June 1997, 14 patients with total ACJ dislocation (Type III-VI Rockwood 1984) were treated surgically and followed-up in our unit. The patients' age, sex, occupation and manner of injury

were recorded. Standard and weight-bearing radiographs were taken pre-operatively. All patients gave informed consent to be included in the study.

Surgery was performed within three weeks for all acute injuries. Chronic injuries were performed after three weeks. Patients with acute injuries were operated on using Bosworth[7] procedure or modified Weaver-Dunn[8] procedure. Chronically symptomatic patients were operated with Rockwood or modified Weaver-Dunn procedures.

Bosworth procedure includes ACJ reduction, coraco-clavicular ligament repair and screw fixation with 4.0 mm AO malleolar screw. Modified Weaver-Dunn procedure involves resection of 1 cm of the distal end of clavicle, transposition of the acromial end of coraco-acromial ligament with a silver of bone from the acromion tip to the lateral end of clavicle. Rockwood procedure is a combination of the two procedures above.

The operative approach is either a straight "bra-strap" or a curvilinear incision from the posterior edge of the ACJ and brought anteriorly to the coracoid process. The incision is carried down through the subcutaneous tissue to the underlying distal clavicle, ACJ and acromion process. A longitudinal cut is made over the ACJ and brought medially to expose the lateral 3 cm of the clavicle. ACJ is visualised and debrided of its damaged disk. In Bosworth procedure, the coraco-clavicular ligament is inspected. If repairable, stay sutures using Ethibond # 1 is placed over the ends for later tying. Drilling through the clavicle into the coracoid process with a 3.2 mm drill bit and 4.0 mm AO short thread cancellous screw with washer to fix the ACJ.

In modified Weaver-Dunn, 1 cm of the lateral end of the clavicle was excised followed by exposure of the coraco-acromial ligament. This ligament is carefully dissected off from the acromion process with a silver of bone. The medullary cavity of clavicle debrided, two small holes are drilled onto the superior cortex as far medially to hold the coraco-acromial ligament. Using Ethibond sutures # 1, whip stitches are made over the free end of this ligament. The distal end of the clavicle is reduced manually and the two suture ends are passed through the superior drill hole with the silver of bone in the medullary canal.

The wound is irrigated and redivac drain inserted. Care was taken to preserve and repair the investing deltoid and trapezial fascia. The wound is closed in layers. All patients were put on an arm sling post-operatively. Pendulum exercise were started once pain-free within the first two weeks. Full range of motion exercise is resumed within six weeks. Patients with Bosworth procedure have their screws removed at six weeks under local anaesthesia before heavy labour or contact sports are started. Follow-up review were at 6, 12, 18 and 24 weeks post surgery. Post-operative assessment were based on modified Larsen scheme i.e. severity of pain, decrease in motion and strength as well as interval taken to return to work. Complication were recorded and treated accordingly.

Results

Fifteen patients had operative treatment for symptomatic total acromio-clavicular joint dislocation (Rockwood Type II to VI). Fourteen were followed-up for a minimum of six months (longest 15 months). Their age ranged from 20 to 56 years (mean 37 years). Thirteen were male and one female. Eleven were motorcyclists involved in road traffic accidents while two fell off their bicycles and one fell from height.

Eight patients were operated within three weeks of injury and six in the chronic period. Two patients had Botsworth procedure (Figure 1a & b), six had Weaver-Dunn (Figure 2a & b) and six had Rockwood operations. Seven had Type III, one Type IV and six others had Type V injuries. Post-operative assessment was based on modified Larsen's Scheme (Table I).

In our study, nine patients had excellent outcome i.e pain free, full range of motion and return to work at three months post-operatively. Two patients had good results while three had satisfactory outcome. Two patients developed chronic shoulder pain and one had painful hypertrophic surgical scar. Two other patients had screw breakage requiring revision surgery.

Discussion

Injury to the acromio-clavicular joint (ACJ) is common following trauma of sports, in particular contact sports[9]. In our series of patients, motorvehicle accident especially those involving motorcyclists however constitute the majority of such injury.

Most authors agreed that surgical treatment is indicated in patients with acromio-clavicular joint dislocation Type IV-VI and symptomatic Type III especially young patients who are manual labourers. Our results concur with this consensus. These patients showed rapid recovery of shoulder function post-operatively and returned to their work within 6 weeks to 3 months post-surgery.

Although authors in European countries used the classification of AC Joint dislocation by Tossy (1963) and Allman (1967), we found that the Rockwood's classification (1984) to be more effective and comprehensive in managing these injuries.

As for the operative technique, the straight incision gives better cosmesis that the curvilinear incision although their healing rate are equal. All our patients are positioned supine with a small sandbag place under the scapula of the injured shoulder. No difficulty was encountered with this position even though the beach chair position was advocated by most shoulder surgeons.

We did not use the Botsworth 6.5 mm half threaded cancellous screws in our patients due to financial factor. Instead, 4.0 mm AO cancellous screws were used for fixation of the coraco-clavicular joint. This provides equally strong fixation in our patients who are smaller in size and built.

In patients treated with the modified Weaver-Dunn technique, a 2.0 mm in diameter hole was made in the clavicle supero-inferiorly, 1.5 cm from the cut end. Then one end of the Mersilene tape was threaded through this hole and tied to the other end which was passed round the base of the coracoid process and behind the clavicle. This would ensure that tape maintain the coraco-clavicular joint in a reduced position and prevent possible slippage while the bone-to-bone fixation at the distal end of the clavicle heals.

As in other series, screw breakage and dislodgment are common complications encountered in patients with Botsworth and Rockwood's methods. We had two patients with screw breakage due to early mobilisation.

Table I
Modified evaluation scheme (Larsen)

	4 points	3 points	2 points	1 point
Pain	**None**	**Slight**	**Moderate**	**Severe**
Range of motion	Full	130-1400	70-1200	< 700
Strength	90-100%	75-90%	50-75%	< 50%
Period for return to work	6-12 wks	12-24 wks	> 6/12	change of work

Scoring system
Excellent – *14-16 points*
Good – *11-13 points*
Satisfactory – *7-11 points*
Poor – *4-7 points*

One other patient had screw dislodgment due to improper fixation in the immediate post-operative period resulting in redislocation of the ACJ. These were subsequently revised. One of these patients also developed a painful hypertrophic curvilinear scar.

Two of them had chronic shoulder pain without any clinical evidence of impingement. It must be stressed that all these complications occurred in our first few patients when we were still in the learning curve stage.

There were various methods in evaluating treatment outcomes[3,10,11]. In all these evaluation schemes, they evaluate the severity in pain, functional loss, loss of strength and cosmesis. We have modified the evaluation by including the time taken for the patients to return to their previous occupation post-operatively as this would indicate significant improvement or decline in their function.

In view of the wide array of surgical methods in treating these injury, it is almost impossible to compare outcome. The best that one could achieve is to compare with studies that employ the same basic method or combination of methods. Below is a table comparing the various studies that use the same basic methods i.e Weaver-Dunn or Rockwood (Table II).

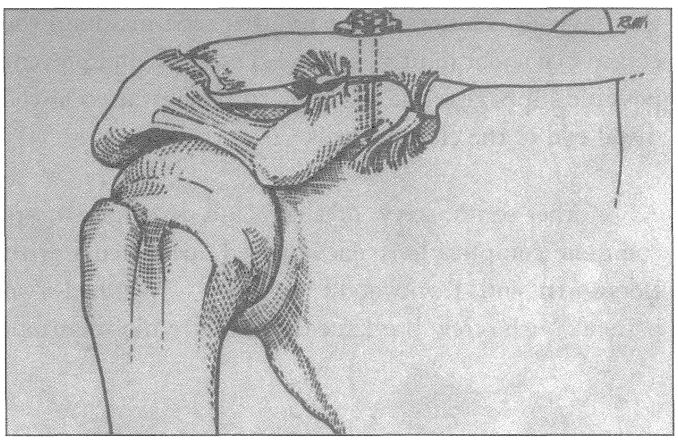

Fig. 1a: Botsworth procedure

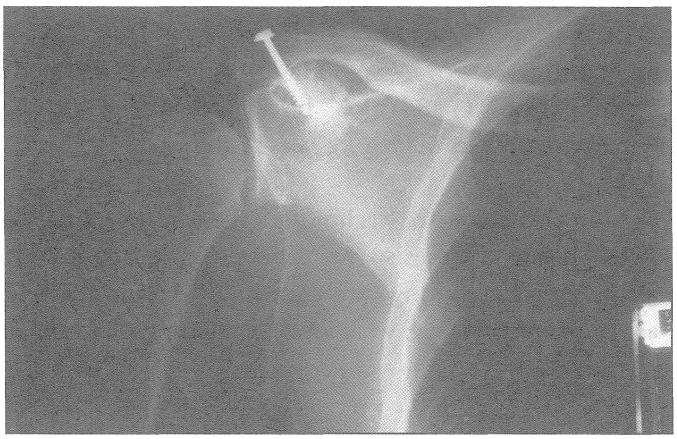

Fig. 1b: Post-operative radiograph of Botsworth procedure

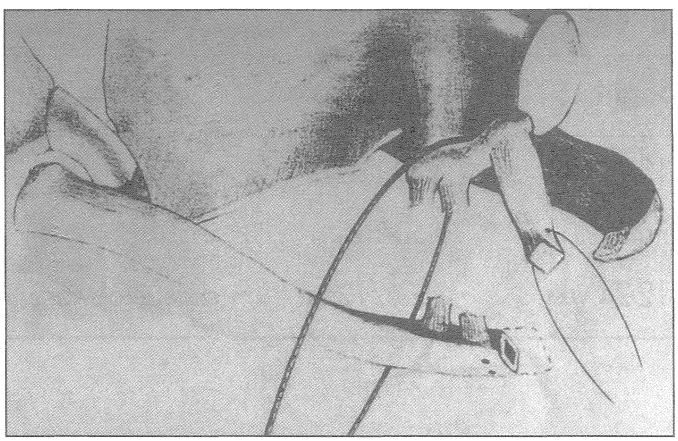

Fig. 2a: Modified Weaver-Dunn technique

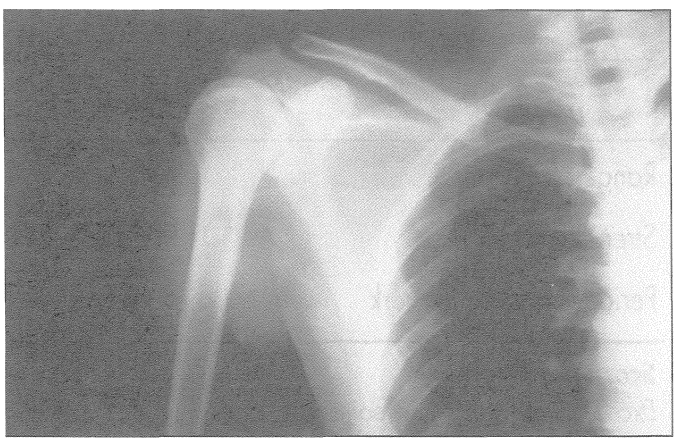

Fig. 2b: Post-operative radiograph of modified Weaver-Dunn technique

Table II
Comparison of outcome of surgical treatment

AUTHORS	METHOD	RESULTS (%)
Kumar et al (1995)	Rockwood	86
Hessmann et al (1995)	AC & CC repair, augment with PDS band	89
Morrison (1995)	Synthetic loop through hole in clavicle and coracoid	86
Weinstein et al (1995)	Weaver-Dunn	89
Fremerey et al (1996)	AC & CC repair, augment PDS band with	98
Leow et al (1997)	Weaver-Dunn and Rockwood	79

Conclusion

Surgical treatment of total acromio-clavicular joint dislocation can be a treatment of choice especially in young manual labourers. Early surgical intervention in patients with acute injury produces good functional outcome and early return to work.

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Reconstruction of Lower Leg Defects Using a Medial Island Fasciocutaneous Flap

B Naresh, FRCS*, S Parameswaran, FRCS**, *Johor Specialist Hospital, Johor Bahru, **Sabah Medical Centre, P.O. Box 13393, 88838 Kota Kinabalu, Sabah

Summary

It is usually a major task providing soft tissue cover to significant defects of the lower leg. A wide variety of flaps and techniques are available, each with its advantages and limitations. Previously described anatomic study of the septocutaneous vessels of the leg have indicated a consistent lower most perforator at 9-12 cm from the tip of the medial malleolus. An island fasciocutaneous flap based on this perforator vessels can be raised subfascially. After the vessels have been dissected clean down to the posterior tibial artery, it can be rotated up to 180° degrees. Successful soft tissue reconstruction was achieved in 18 patients. Most of the tissue loss was due to trauma and were around the ankle and the heel. There were 7 minor complications which resolved completely after 2 months. Its simplicity of design and elevation plus its extensive arc of rotation makes it a reliable and versatile flap in the reconstruction of lower leg defects.

Introduction

Soft tissue coverage of the lower leg tissue is very difficult. It seriously tests the ingenuity of the surgeon searching for a simple technique of reconstruction. The trends in plastic and reconstructive surgery has been characterised by a continuous search for newer and safer flaps. The transition from muscle flaps to micro vascular techniques and then to the fasciocutaneous flap added to the vast armenmentarium of useful flaps[1]. Muscle flaps are unreliable and scarce for coverage of lower leg defects. Likewise micro vascular procedures requires special facilities and good interdisciplinary integration for success which are usually lacking in developing countries.

We describe the use of a medial island fasciocutaneous flap with expanded indications to cover the medial and anterior aspects of the ankle based on the lower most perforator of the posterior tibial vessels.

Anatomical Study

The anatomical study of septocutaneous perforation of the leg have been well described[3,4,9,18]. Shalaby described a constant perforator arising at 9-12 cm above the tip of the medial malleolus in the Egyptian population[18].

We confirmed this by 6 cadavaric dissection in which the septocutaneous perforators arose 9-12 cm above the tip of the medial malleolus. This was to ascertain that the perforators were constant in location as Asians being smaller may vary.

Technique

No doppler or arteriogram was used to identify the patency of the perforator. The operative technique was similar to that reported by Shalaby and performed under

the tourniquet[18]. The lower most perforator was marked 9-12 cm above the tip of the medial malleolus and an island marked around it. The flap dissection began from posterior border making certain the dissection was carried out subfascially. Once the perforator was seen, the rest of the flap was elevated circumferentially. The saphenous vein and nerve will normally be within the flap and could be dissected out meticulously. The sizes of the flap ranged from 10 x 6 cm to 18 x 8 cm. After the dissection was completed, the septocutaneous perforators were carefully skeletonized down to the posterior tibial vessels. The flap was gently rotated around the axis of the vessels 150-180 degrees to cover the defects in Group A to C. The donor site was skin grafted primarily. No specific immobilization was required apart from the fracture fixation.

Methods and Materials

There were 18 patients aged from 10 to 63 years between 1992 and 1993. 15 were males and 3 were females.

They were grouped into three categories depending on the location of the defect :

Group A : Soft tissue defects exposing the tendoachilles

Group B : Soft tissue defects exposing the medial malleolus and ankle joint

Group C : Anterior soft tissue defects exposing the extensor tendons and distal tibia.

There were twelve cases in Group A, four in Group B and two in Group C.

Of the twelve cases in Group A, ten were as a result of traffic accident, one a squamous cell tumour and the other an infected abscess that sloughed off the skin over the heel cord. Of the ten cases of road traffic accident, two had associated fractures of lower end of tibia and fibula. Group B patients all suffered compound 3B fracture dislocations of the ankle. Group C patients had fracture dislocation of ankle, but the soft tissue defects were predominantly anteriorly. All fractures of the ankle were fixed by standard AO techniques and wounds left open.

The two patients in Group A patients with exposed tendoachilles had primary suture of the rupture which became infected. They initially had local treatment only, but when finally seen at our clinic, the superficial aspect of the tendon was necrotic. The squamous cell carcinoma was adhered to the tendoachilles and resection and primary flap coverage was done. The patient with the abscess around the heel cord had circumferential loss of skin exposing the entire heel cord after debridement.

Results

In all the cases, the flaps did well to cover the defects (Table 1). In Group A, 1 flap had superficial necrosis of the tip which healed uneventfully after the eschar peeled off. Two cases had haematoma under the skin graft. Two cases had cellulitis at the distal suture line which responded to antibiotics. Two cases had flap oedema, one the squamous cell carcinoma excision and the other a traumatic soft tissue loss exposing the heel cord. All resolved within 2 months.

Discussion

A diverse variety of methods for closing soft tissue defects about the ankle have been described. Each procedure has inherent advantages and disadvantages. Skin grafts applied on tendon may fail due to wear. Distant flap techniques that mandate the operative field involvement of previously remote uninvolved surface include the cross leg and free flaps[6,19]. Sacrifice of a major artery is seen with the peroneal island or anterior tibial artery flap[17,22]. The dorsalis pedis flap also had marked donor site problems. The medial plantar island fasciocutaneous flap of the foot is small and require the important plantar surface be sacrificed even if it is non-weight bearing[2].

Small defects about the heel can be covered by the lateral calcaneal artery flap. However, this flap is intolerant to dorsiflexion and results in the noticeable skin depression of the flap donor site[8]. Ponten stressed the advantages of fasciocutaneous flaps and its reliability has been confirmed in lower leg

Table I
Data on the patients

Case	Gender Age (Yrs)	Site of Lesion	Type of Wound	Size o flap (cm)	Result
1	M, 24	Posterior ankle	Exposed tendoachilles	6 x 10	Good
2	M, 35	Posterior ankle	Open avulsion # tuberosity calcaneum	5 x 12	Distal sutures sepsis
3	M, 12	Posterior ankle	Wound breakdown tendoachilles	4 x 8	Haematoma
4	M, 30	Anterior ankle	Open # dislocation of ankle	18 x 8	Good
5	F, 30	Posterior ankle & heel	Exposed tendoachilles	14 x 8	Superficial necrosis Haematoma
6	M, 10	Posterior ankle	Exposed tendoachilles	12 x 6	Good
7	F, 32	Posterior ankle	Exposed tendoachilles	10 x 6	Good
8	M, 40	Posterior ankle	Squamous cell carcinoma	15 x 6	Flap edama
9	M, 30	Posterior ankle	Exposed tendoachilles	14 x 8	Good
10	M, 34	Posterior ankle	Exposed tendoachilles	12 x 6	Good
11	M, 20	Anterior ankle	Exposed tibialis anterior tendon & ankle joint	16 x 8	Good
12	M, 20	Posterior ankle	Exposed heel cord	14 x 6	Good
13	F, 24	Posterior ankle	Exposed heel cord	12 x 6	Good
14	M, 63	Medial ankle joint	Open fracture dislocation ankle	6 x 14	Good
15	M, 24	Posterior ankle	Laceration wound with torn tendoachilles	6 x 12	Good
16	M, 50	Anteromedial ankle	Open fracture dislocation ankle	6 x 14	Good
17	M, 35	Medial ankle joint	Open fracture dislocation ankle	6 x 12	Good
18	M, 20	Medial ankle joint	Open fracture medial malleolus	8 x 15	Good

A 50 year old man with an open fracture dislocation of the ankle.

Fig. 1A: Lateral x-rays of the fracture

Fig. 1D: Postoperative view of the flap one month later.

Fig. 1B & C: Anteroposterior and lateral x-rays immediately after fixation

A 40 year old man with squamous cell carcinoma at the posterior aspect of his ankle.

Fig. 2A: Preoperative new of the lesion

Fig. 2B: Postoperative view of the flap 6 months later

reconstruction[3,12,13,14,16,20]. From proximal based flaps, distal based flaps then emerged into the scene,[17,15,17,21].

Shalaby demonstrated that fasciocutaneous flaps could be circumscribed into island based on a consistent septocutaneous perforator arising from the posterior tibial artery. This results from earlier anatomic description of the fasciocutaneous flap[4]. This island could be rotated through an axis of 150-180 degrees to cover distal defects around the posterior aspect of the ankle[4,18].

In most centers, a plastic surgical facility is not available. The requirements of a single flap yet filling important criteria is necessary for emergency situations especially in traumatology. We have found that the mid calf skin is usually preserved in traumatic conditions to the ankle. As such it is possible to raise an island proximally and rotated it 180 degrees to cover distal defects as have been shown in sixteen of the eighteen cases.

The island flap has been extremely useful in the reconstruction of lower leg and ankle defects. It has a simple design and elevation technique. Being in the same operative field makes it convenient for the surgeon and also provides comfort and ease for the patients. Our observation that the proximal skin is usually intact for use in injuries around the ankle makes it an excellent choice for use as an emergency procedure. No doubt we had no total fatalities of the flap but caution has to be exerted in cases of high energy trauma in which the distal third of the tibia is fractured.

Conclusion

We find that the island fasciocutaneous flap is a reliable alternative to cover defects around the ankle. It provides a very wide arc of rotation without compromising the blood supply. Its simplicity in design and elevation makes it a reliable flap for emergency use for the traumatologists dealing with this particular subset of patients.

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A Review of Haematogenous Osteomyelitis in Children in Kuala Lumpur Hospital

M Razak, MD, M M Ismail, MD, A Omar, Dip., Department of Orthopaedic and Traumatology, Faculty of Medicine, Universiti Kebangsaan Malaysia, Kuala Lumpur

Summary

We review 81 cases of acute haematogenous osteomyelitis from 1983 to 1990 to establish current pattern of clinical presentation, modes of treatment and success of therapy. Majority of the patient (70%) presented within a week of symptom and significant number of them came with fever and swelling of the affected limb. Sedimentation rate was found to be raised in all of them. Fifty-four (55%) of them were treated surgically. The average antibiotic time was one week by intravenous administration followed by additional oral therapy for period up to four weeks. Average follow-up was 9 months. Six of them (7.5%) end up with various complication which was believed to be due to delay in getting medical treatment.

Introduction

Infection of the bone has been occurring since antiquity. The oldest human fossil is an approximately 500,000 year old femur of the Javaman which revealed a disease which can be interpreted as the consequence of a bone fracture complicated by osteomyelitis (Bishop, 1996). Though much has been written about the facets of this disease, some controversies still exist especially with regards to the proper mode of treatment. Furthermore, the last 50 years has seen profound changes in both the presentation and management of this disease.

In Malaysia an acute osteomyelitis in children is still presenting, commonly with delay in diagnosis and treatment (Razak, 1994). Though the mortality rate has been markedly reduced with the introduction of antibiotics, the morbidity resulting from this delay in seeking qualified medical treatment is still high (Balakrishnan, 1977).

The goal in this study was to review a recent large series of children with acute haematogenous osteomyelitis to assess; (a) the trend and problems of the infection in this country, and (b) success of the treatment.

Materials and Methods

This is a retrospective study comprise 81 children with acute haematagenous osteomyelitis who were admitted to Department of Orthopaedic, Universiti Kebangsaan Malaysia between 1983 to 1990. The criteria for the diagnosis being clinical feature of acute haematagenous osteomyelitis (bone tenderness with temperature elevation, leucocytosis and elevated sedimentation rate with one or more of the following; (a) operative finding of bone infection (b) positive bacteriology from aspiration and blood culture and (c) specify radiological or bone scan changes. The patient were evaluated by chart review for history, clinical presentation, diagnostic work up, treatment pattern and outcome.

Good results were considered in those wherein the infection had healed completely and regained normal function of affected limb. Those with complications such as chronic osteomyelitis, chronic discharging sinus and some degree of limitation of functional range of motion were graded as poor.

Results

Fifty eight males and twenty three females comprised the group. Majority of them were aged between 2 to 6 years (preschool age). Sixty percent had a chief complaint of pain (swelling 20%, failure to use the extremity 16%, fever 80% and limp 8%). Most (70%) has had less than symptoms for < 1 week and 30% 1 to 2 weeks.

Almost half of them (40 patient) had a history of recent upper respiratory infection, otitis media, skin infection or other remote infection which may have provided a bacteraemia episode.

The most common sites of involvement were in lower extremities. When admitted 16 (20%) had a temperature less than 37.5%, 48 (60%) between 37.5 - 39.0°C and 17 (20%) had fever more than 39.0°C. In most of the cases (68%) WBC lies between 8,000 to 15,000. The highest value was 28,000/cmm. 6 case had value between 4,000 to 7,000/cmm. On admission ESR was abnormal in 90% with an average value of 47 mm/hr. A technitium bone scan was obtained in 5 cases and all showed increased uptake.

A bone aspiration was attempted in 52 (65%) and pus yielded in only 60% of these.

If a patient met the criteria for acute haematogenous osteomyelitis but had a negative bone culture, a positive blood culture was assume to indicate the responsible organism. The predominant organism was Staphylococcus (85%) and group A Streptococcus (10%). 30% of the Staphylococcus infection found to be resistant to Penicilline.

All patients were treated with combination of i.v. therapy followed by oral antibiotics. Intravenous therapy averaged 10 days and oral therapy lasted 26 days. The average hospitalization in this group was 14 days.

Forty-four (55%) patients were surgically treated after failure of initial medical therapy or after pus was obtained at aspiration. Average intravenous therapy for this group was 6 days and followed with oral antibiotic for another 21 days.

Patient were followed an average of 7 months after discharge. Six of them (7.5%) were considered as poor results with 4 developing chronic osteomyelitis which needed further treatment; one developed infected pseudoarthritis of tibia which healed following several debridement and bone grafting and another patient developed pathological fracture which healed by conservative treatment.

All of this patients came late for medical consultation (> 14 days).

Discussion

Results of the study show that the incidence of acute osteomyelitis in children does not exhibit any racial affinity. Its preponderance among the male is in keeping with other series (Trueta and Morgan, 1954; and Blockey and Watson, 1970).

Clinically the majority presented with pain with or without swelling and fever. On average they presented four days after the onset of symptoms. Although this is not as long delay as compare to the other series from developing country (Khazenifar, 1976), however, it is longer than the series from developed countries (Waldvogel, 1980; Cole, 1982). The effect of this delay seem to directly influence the outcome of the treatment.

The majority grew Staph, aureus and 30% of them showed resistant to Penicillin. This finding are akin to the finding from other series (Meyer et.al, 1973, Morrey, 1975, Mollan et.al, 1977 and Nade, 1983).

The sedimentation rate was consistently raised for all patient. Its value in ruling out active infection and helpful in establishing a diagnosis as well as monitoring the progress of the condition and its response to the treatment.

The leucocyte count provided variable and often inconclusive results. There was no predictive significance of elevated leucocyte count in relation to subsequent positive culture.

Administration of more than one antibiotic (Rhodes, 1975, Harris, 1983) was thought at one time to reduce

the incidence of resistant/recurrent but there is no supporting evidence in this series. We agree with the recent literature that a shorter course of antibiotic (1 to 2 weeks I/V plus 3 weeks oral antibiotics) is sufficient to treat an elderly case of acute haematogenous osteomyelitis. However no conclusion can be made on the minimum treatment necessary.

The scope of surgery in acute haematogenous osteomyelitis is largely debatable (Harris 1962, Gillestrie et.al, 1981, Jackson et.al, 1982, Portez et.al., 1982). However from this study the authors believed that the presence of pus subperiosteally or intramedullary is an indication for operation. The early decompression will prevent further progression of infection and pressure necrosis the bone.

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INFECTION

An Epidemiological Study of Septic Arthritis in Kuala Lumpur Hospital

M Razak, MS*, J Nasiruddin, MS**, *Hospital Universiti Kebangsaan Malaysia, **Department of Orthopaedic and Traumatology, Kuala Lumpur Hospital

Summary

Forty-one patients with 42 joint infections were admitted to the hospital between June 1989 and June 1994. An overview on the behaviour of septic arthritis in both children and adults, at presentation and after various types of treatment was done. There were 32 knees, 7 hips, 2 elbows and 1 shoulder. Duration of symptoms, type of organism, type of joint drainage, presence of preexisting joint problems and presence of osteomyelitis are among the important factors with prognostic significance.

Seventy three percent of patients with less than 7 days duration of symptoms had satisfactory results. Whereas when the duration of symptoms exceeded 7 days, 75% of the patients had unsatisfactory outcome. All cases with poor outcome had positive cultures. Staphylococcus aureus was responsible for 77% of the culture-positive cases. All Staphylococcus aureus in this study were penicillin-resistant but sensitive to cloxacillin. There were 3 instances where Staphylococcus became resistant to cloxacillin following recurrence of septic arthritis. However, they were still sensitive to third generation cephalosporin. Staphylococcus aureus was capable of producing poor results even when the case was treated early. Other organisms were gram-negative bacilli which infect patients with suppressed immune system, that is, intravenous drug abuser, systemic steroid theraphy and diabetes mellitus.

Open arthrotomy was the method of drainage used in all hip sepsis. This method was also the most reliable method of joint drainage in other joints compared to aspiration method when frank pus was already present. Most immuno-compromised patients recovered badly from septic arthritis. Associated adjacent osteomyelitis, preexisting chronic arthritis and recent intra-articular fractures were also noted to adversely affect the functional outcome.

Introduction

Septic arthritis is a serious joint disease initiated by a successful bacterial invasion to the cavity and can progress to rapid destruction of the internal joint structures especially the articular cartilage, if unchecked. The condition is a true orthopaedic emergency because undue delay in intervention of the disease process can lead to a permanent functional disability of the joint and hence the function of the limb as a whole (Goldenberg and Reed 1985). The rapidity of the development of complications underscored the importance of rapid detection and initiation of treatment.

The incidence of the disease in children was quoted to be 0.2% by Smith (1974) and 0.17% by Wilson and Paola (1986). Whereas in adults, the incidence ranged from 0.034% to 0.13% (Cooper and Cawley 1986, Esterhai and Gelb 1991). Although the incidence of bacterial infection in general has declined with the improvement of the standard of living, it continues to be a major problem in certain groups of patients.

Patients with extreme age are particularly susceptible to and more likely to develop complications from septic arthritis. As the number of immuno-compromised

patients resulting from diseases, treatments or malnutrition increases, the incidence of septic arthritis will continue to increase. Apparently normal individuals, however, have been seen to be infected (Ho, 1993).

Antibiotics did a great impact in controlling the spread of infection (Gillespie, 1973). However, undue delay in its commencement is still common, well after the infection has been established. This could lead to a permanent structural damage primarily to the cartilage. Beside bacterial factors, enzymes liberated by the degraded polymorphs and chondrocytes also have destructive effect on the joint (Riegels-Nielsen et al, 1987). Hence, proper surgical clearance of the material has a big role in helping these patients.

This study intends to review all clinical aspects of septic arthritis cases in the population covered by the Kuala Lumpur Hospital. It is hoped that some epidemiological data can be derived from it to help primary health care personnels in the initial management of this problem. The predisposing factors as well as prognostic indicators will be identified in the effort to reduce the number of severe cases. Proper antibiotics selection may be appreciated from the pattern of the causative organisms. Areas of weakness in the diagnosis and treatment will be scrutinized. Suggestions will be offered accordingly to improve the quality of care of the sufferers.

Materials and Methods

This is a retrospective study on all confirmed cases of septic arthritis admitted to Orthopaedic Department in Kuala Lumpur Hospital from January 1989 until June 1994. The diagnosis of septic arthritis was made clinically when the joint was painful, swollen and virtually denies any movement, in addition to systemic signs of fever more than 38 degrees Celcius. Further confirmation was made by gross appearance of synovial aspirate (turbid or frank pus) and culture and sensitivity test of the aspirate.

The study included all age groups. Patients were divided into 3 groups according to their age range, children less than 15 years old, adults between 15 and 60 years old. Infective arthritis due to viral, fungus and mycobacteria were excluded. Post-arthroplasty infections were also not included in this series.

Parameters examined included age, gender and race of the patients, preintervention duration of symptoms, clinical manifestations, location of joint involved, TWDC and ESR values, predisposing factors, organisms cultured, treatment regimes, plain X-ray findings and the latest functional outcome. Forty one cases (42 joints) were suitable for review.

On admission, blood samples were sent for cultures, haemoglobin, TWDC and ESR. Additional blood samples such as random serum glucose and renal profile were also send in patients aged more than 40 years old or with associated medical conditions. Plain X-rays of the affected joint were taken. Antibiotics were then started parenterally based on 'best guess principles'. Joint drainage was done either by aspiration only, aspiration and irrigation, open arthrotomy or arthroscopy. Synovial fluid and tissue were sent for analysis. Operative findings were recorded. Postoperatively, the joint was rested in functional position for a few days following which assisted active or gentle passive movements were allowed. The response to treatment was monitored clinically and by serial TWDC and ESR values.

The end-results were divided into 4 grades : (1) Excellent, an asymptomatic joint with full range of motion. (2) Good, an occasionally and mildly painful joint with slight reduction in range of motion. (3) Fair, a moderately painful joint in any activity with moderate reduction in range of motion. (4) Poor, a grossly stiff joint (ankylosis) usually with pain or with recurrent infection (Parisien et al 1992). Excellent and good results were grouped under satisfactory category whereas fair and poor results were grouped under unsatisfactory category. The treatment was considered failure when a repeat joint decompression was needed to abate the symptoms.

Results

Forty one patients (42 joints) were reviewed. Only one patient had two joints affected at the same time (an adult patient with bilateral hip involvement). There 31

male and 10 female patients. Malays were affected more (27 patients) often than Indians (8 patients) and Chinese (6 patients).

Age

The age range was from 17 days to 68 years. There were 15 paediatric cases (15 joints) less than 15 years old. Five patients (5 joints) were infants. Ten patients (10 joints) were between one and 15 years old. Twenty one patients (22 joints) were adults between 16 to 60 years old. Five patients (5 joints) were elderly more than 60 years old. The number of cases in each age group are shown in Figure 1.

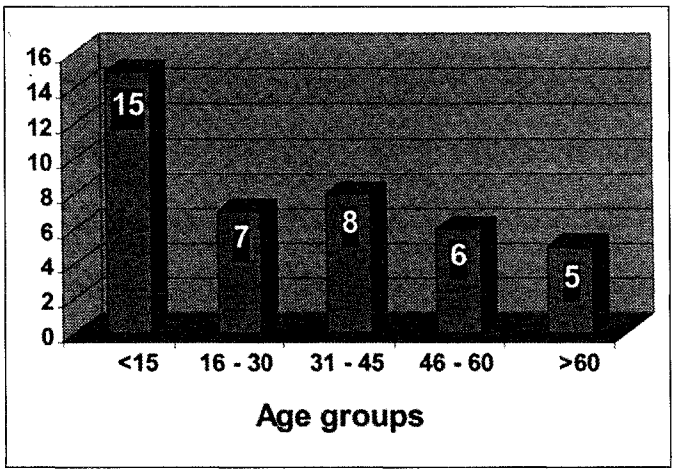

Fig. 1: Age distribution of the cases of septic arthritis

Presentation

All cases presented with classical local signs, that is, pain and limited range of movements or 'pseudo paralysis' in infants with or without fever. Only one patient had bilateral hip joint involvement.

Joints involved

There 32 knees, 7 hips (5 children, 1 adult with two hips involved), 1 shoulder (child) and 2 elbows (both adult).

Duration

The duration of joint symptoms ranged from 24 hours to 5 months. Patients with duration of symptoms less than 3 days were called early presentors while those presented between 3 and 7 days of symptoms were called late presentors and those with more than 7 days of symptoms were called very late presentors in this study. Only 4 cases (10%), all were children, presented within 72 hours.

Twenty two (54%) patients were treated within 3 to 7 days. All children were seen within 7 days, Fourteen cases (34%) came between 8 to 21 days of symptoms. One case (2%) with bilateral hip sepsis was not diagnosed until after 5 months duration of symptoms. All very late presentors were adults. The stage of joint infection at the time of presentation estimated by the duration of symptoms in relation to the age of the patients is depicted in Table I.

Table I
Duration of symptoms at the time of presentation as related to the age

Duration of symptoms (days)	No. of cases according to age groups (years)			
	< 1	1-15	16-20	>60
< 3	2	2		
3-7	3	8	10	1
8-14			7	3
15-21			3	1
> 21			1	

Predisposing factors

Predisposing factors were identified in 36 cases (88%). Six adult patients had two or more predisposing factors each. Table II lists the predisposing factors with the corresponding number of cases. Closed trauma was included as a contributing factor and it was found to be a common association in children. The bacteria caused infection through haematogenous route.

Table II
Predisposing factors with the corresponding number of cases

Predisposing Factors	No. of cases
Distant primary sepsis	3
Adjacent osteomyelitis	3
Closed trauma	13
Open injury	7
Intravenous drug addict	5
Intra-articular steroid injection	1
Post-arthroscopy	2
Diabetes mellitus	5
Malignancy	1
Hepatitis	1
Liver cirrhosis	1
Chronic renal failure	1
Alcoholism	1
Gouty arthritis	1
Systemic steroid therapy	1

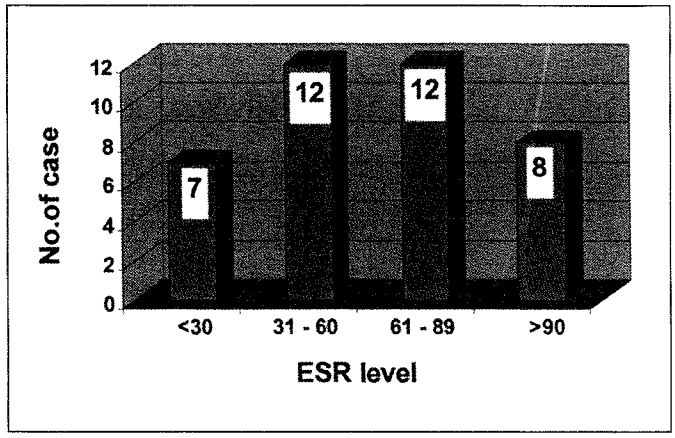

Fig. 2: The ESR levels in the cases of septic arthritis

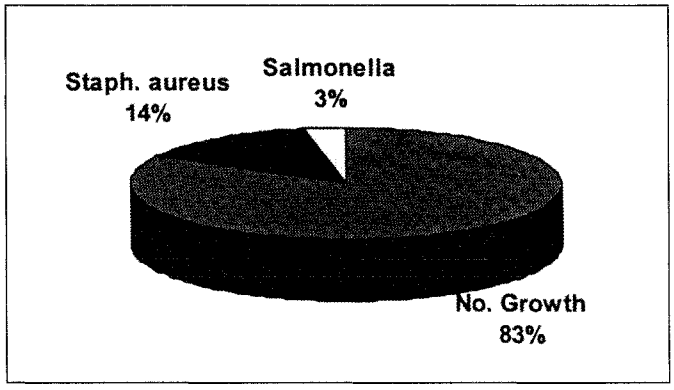

Fig. 3: Organisms retrieved from blood samples

Haematological investigation

Only 12 patients (29%) had a total white blood cell count higher than 14,000 / cu.mm. but all showed a higher polymorphs population of more than 83%. Initial ESR levels ranged from 7 to 168 mm/hr. Thirty-two patients (78%) had initial ESR higher than 30 mm/hr. All the 7 patients who had initial ESR values of less than 30 showed a high value, more than 50 after a few days. ESR levels are charted in Figure 2.

Bacteriology

Blood cultures were positive in only 7 cases (17%). Staphylococcus aureus was isolated in 6 cases and Salmonella species in one case Figure 3. Synovial fluid cultures were positive in 26 joints (62%) (Staphylococcus aureus 20, Salmonella species 3, Proteus 1, Pseudomonas 1, Enterobacter 1).

Figure 4 shows the percentage of organisms cultured from the synovial materials. Gram staining examination was requested in only 3 cases and all showed gram-positive cocci. Staphylococcus aureus coagulase positive grew in 48% of all joints or 77% of the culture-positive synovial materials. All Staphylococcus were resistant to penicillin but sensitive to cloxacillin.

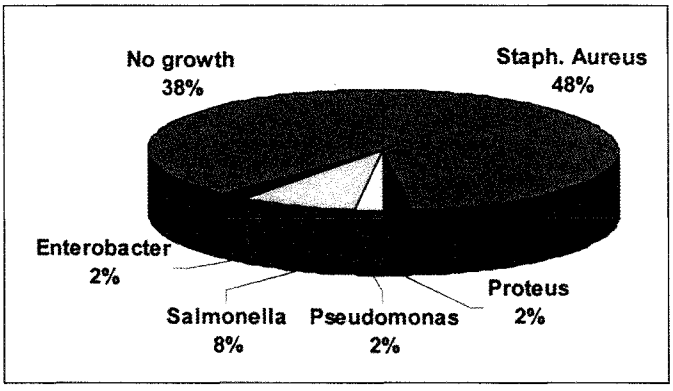

Fig. 4: Organism retrieved from synovial fluid with the frequency of their involvement

However, subsequently, there were 3 cases in which Staphylococcus developed resistant to cloxacillin. Two cases were children with associated osteomyelitis (one hip, one knee) and the other one was an adult who developed sepsis following patellectomy for comminuted patella fracture.

Two patients with septic knees from which Pseudomonas aeroginosa and Proteus mirabilis were isolated were intravenous drug addict. Enterobacter was found in a patient following an open fracture of patella who was also a diabetic. Salmonella species (not typhi) was isolated from a knee in which a sepsis developed one month after an arthroscopic menisectomy. The patient was a diabetic.

Another case who had Salmonella as the causative organism had bilateral hip sepsis secondary to the widespread Salmonella osteomyelitis. The organism was isolated from both blood and synovial fluid specimens. She was on systemic steroid therapy for autoimmune haemolytic anaemia.

Antibiotics

All cases were given appropriate and adequate intravenous and oral antibiotics. Cloxacillin was the most frequently prescribed antibiotic either alone or in combination (33 cases). Other antibiotics used in some cases include cefuroxime, ceftrioxime, gentamycin, netilmycin, fusidic acid and vancomycin. The duration of antibiotics given ranged from 4 to 6 weeks in well responded cases but longer in cases which failed to settle down after single joint drainage procedure.

Methods of joint drainage

The joint drainage methods employed were aspiration with or without lavage in 7 cases (6 kness, one elbow), open arthrotomy in 32 cases and arthroscopic debridement in only one case. There was no case treated with synovectomy. In one case, no procedure was done to the joint though there was strong clinical evidence of septic arthritis of hip. The child presented early with two days history of fever and hip pain and he was initially treated in the Paediatric Medical ward. After 3 days of cloxacillin, fusidic and gentamycin, the symptoms settled down. Since the process had been halted, the joint was allowed to move and he recovered well.

Only 2 of 7 cases (28%) successfully treated with aspiration had excellent outcome. One case was a premature baby who has been in the ward since birth and aged 8 months. His right knee was noted to be swollen and tender on palpation and movement. One ml of turbid synovial fluid was aspirated but did not grow any organism. The other case was a 62 years old man, an alcoholic, suffered from pneumonia 2 weeks before onset of right elbow pain and swelling. Aspiration revealed turbid synovial fluid. The inflammation settled down without morbidity. The other 5 cases treated with aspiration had unsatisfactory outcomes (one fair, 4 poor). All were adults with knee sepsis. Three of them were intravenous drug addicts with reactive Human Immunodeficiency Virus (HIV) antibodies and hence open arthrotomy was deferred.

Two cases grew Staph aureus and had poor outcome. The third case grew Pseudomonas and had fair result.

Out of 33 joints treated with open arthrotomy, 15 had excellent, 5 had good, 3 had fair and 10 had poor recoveries. One or more repeat open drainage procedure was required in one joint with good result (child-knee), 2 joints (adults-knees) with fair results and all the 10 joints with poor results before the disease process was controlled.

The only case treated with arthroscopic debridement was a 33 year-old man who developed fever and pain in the knee one month after an arthroscopic menisectomy. The duration of symptoms was 3 days. The pus grew Salmonella species and successfully controlled with one debridement. During follow up, an arthroscopic release of intraarticular adhesions was done and finally, the knee range of motion was from 0 to 120 degrees (good). Table 3 shows the final functional outcome with various types of treatment.

Outcome in relation to duration of symptoms, type of organisms and joints affected

Finally, there were 18 excellent (43%), 6 good (14%), 4 fair (10%) and 14 poor (33%) results. No patient died of septic arthritis. Table IV shows the relationship between the duration of symptoms and the final outcome of the joints. Table V shows the influence of the various types of organisms on the final outcome.

Discussions

Septic arthritis is a surgical emergency. Prompt recognition and appropriate treatment is very important. The disease can affect all age groups although the incidence is slightly higher in children and infants. This picture is well shown in this study. The process of early recognition of the community-acquired septic arthritis starts from the ability of the patients to seek early first line medical care. This is continued by the high index of suspicion by the medical personnel.

Table III
The various types of treatment with their corresponding final functional outcome of the joints

Type of treatment	Functional outcome of joints			
	Excellent	Good	Fair	Poor
Antibiotic	1			
Aspiration	2		1	4
Open drainage	15	5	3	10
Arthroscopic debridement		1		

Table IV
Relationship between the duration of symptoms and the functional results of the joints

Type of treatment	Functional outcome of joints			
	Excellent	Good	Fair	Poor
< 3	2	1		1
4 - 7	14	3		5
8 - 14	2	2	3	3
15 -21			1	3
> 21				2

Table V
Relationship between the type of causative organisms and the final functional outcome of the joints

Type of treatment	Functional outcome of joints			
	Excellent	Good	Fair	Poor
Staphylococcus aureus	6	3	1	10
Salmonella		1		2
Proteus				1
Pseudomonas			1	
Enterobacter				1
Negative	12	2	2	

Generally, earlier treatment of septic arthritis will result in a better outcome. Few other factors are, however, may inevitably cause poor outcome in these patients (Shaw and Kesser, 1990). Most children developed septic arthritis from a haematogenous spread without pre-existing joint lesion. However, associated closed trauma around the joint was common. In adults, direct innoculation, immunocompromised states and pre-existing joint lesion were commonly observed.

At any age, significant morbidity can result from septic arthritis of the major joints. Septic arthritis has a dreadful complications in neonates because growth may be severely affected (Fabry and Meire, 1983). However, in this series, all 3 neonates (2 knees and 1 shoulder) had excellent results because of early recognition in the neonatal unit. No elderly patients died of septic arthritis. However, as in the young and middle-aged adults, infected joints virtually always profoundly affect the end-results of the joints with pre-existing diseases (Vincent and Amirault 1990).

Knee joint was the commonest joint affected by septic arthritis in this study as in most other series (Ivey and Clark 1985). Fortunately, most of the septic knees recovered well in children. Hip joint involvement usually results in significant morbidity compared to other joints (Shaw and Kesser 1990). However, more than 80% poor results were noticed in any joint where septic arthritis was secondary to an adjacent osteomyelitic focus which burst into the joint cavity (Bennet and Namnyak 1992). In this series both cases with such disease process (one knee and one hip) have resulted in poor joint function.

All infected joints resulting from direct innoculation were observed in adults only, in this series. Hence, in this age group, mostly the superficial joints were involved, such as the knee and elbow. Hip joints were primarily infected via haematogenous route, 5 cases in children and one in adult with widespread Salmonella osteomyelitis.

Early diagnosis and treatment are crucial in determining prognosis. Samilson et al (1958) reported that 77% of all complications in their series were in patients treated seven days or more after the onset of symptoms. Paterson (1970) set the limit at five days. Bennet and Namnyak (1992) concluded that an unsatisfactory outcome was more likely with a delay of more than four days. All children in this series presented within 7 days of symptoms. All fifteen cases except two showed good or excellent results. The two cases with poor result presented early (one day and four days) but they were associated with adjacent osteomyelitis.

Adults, in this series, presented late because of several reasons. Pre-existing joint problems, such as post-fractures, joint procedures (intraarticular steroid injection and arthroscopic examination), osteoarthritis and gout may mask the development of septic arthritis. They came for consultation only when the pain became unbearable. Adult patients with poor results either had symptoms more than 7 days or associated osteoarthritis or osteomyelitis or intra-articular fractures.

Local signs of the affected joint, particularly, a very restricted range of motion with muscle spasm, were more sensitive test to detect the disease than the general symptoms in cases where immunosuppression was suspected. This sign will also help to differentiate septic arthritis from extra-articular focus of infection. Total white cell count was inferior to ESR in detecting the presence of septic arthritis as reported in other series. However, normal values does not exclude the presence of the disease. ESR is also not an accurate parameter for monitoring the disease activity (Goldenberg 1993).

As in other series, Staph aureus was the commonest organism isolated in all age groups. Synovial fluid cultures were positive in all 14 cases with poor results. This could mean that the dose of bacteria initiating the disease process is important in determining the extent of joint destruction. Staphylococcus aureus was the commonest organism isolated in all age groups, account for 77% of culture-positive synovial material. This important organism was found in 72% of joints with poor results. Staph aureus was capable of producing poor results even in cases which were treated early (one case in this series), a finding which was also noted by Lane et al (1990). In this series, gram-negative organisms were found in drug addicts and patients with compromised immune system due to diabetes, malignancy and systemic steroid therapy. Hence, antibiotics which cover gram-negative organisms must be included in treating patients with associated factors that can depress immune system.

Haemophilus influenza which commonly caused septic arthritis in children aged between 6 months and 4 years was not found in this series. This could be due to the difficulty in isolating this organism. It is safer to cover this gram-negative organism in treating septic arthritis in this particular age group. Culture-negative joints were noted to result in a more satisfactory outcomes probably because lower bacterial count tend to stimulate lesser amount of toxic enzyme production.

Intravenous antibiotics can achieve a high concentration, much higher than the minimal inhibitory level, in the joints. Intra-articular antibiotic administration was not only unnecessary but can also cause chemical synovitis (Moller and Nielsen 1987). However, in this series, gentamycin-impregnated beads were used to treat a child with recurrent hip sepsis associated with osteomyelitis of the femoral head and neck, despite adequate antibiotics and debridement.

Joint aspiration for diagnostic purposes still remains the most important step in the management of septic arthritis of any joint. However, its role as the ultimate adequate joint drainage procedure remains cont roversial. In this series, although the number of cases treated with aspiration were small (7 cases), all septic arthritis with the presence of frank pus had unsati sfactory results. Aspiration was found to be inadequate to drain out the toxic substance which consists of enzymes, mediators and granulations.

Open method of joint drainage is the only method advocated in hip sepsis. It is also currently the most reliable method to debride any joint sepsis, particularly when frank pus has already formed (Esterhai and Gelb 1991). Many centres have recently reported superior results with arthroscopic debridement but its use is restricted to knee joint sepsis only. The presence of intra-articular loculations and adhesions, however, can make debridement difficult (Thiery 1989; Ivey and Clark 1985). The indications for arthroscopic debridement depend greatly on the availability of instruments and skill of the arthroscopist (Lane et al 1990).

Conclusion

In order to reduce the complications of a septic joint, one has to treat it as an emergency case. Effort must be made to prevent the establishment of the infection. Aseptic techniques must always be practised in any procedure involving the joints. Rapid identification of the disease needs patient education and high index of

suspicion at the level of primary care personnel. Aspiration of a suspected septic joint is an essential step in the diagnosis. Blood samples and synovial aspirate are ideally taken as soon as possible before antibiotic administration to increase the pick up rate of the causative organism. The correct antibiotic choice is essential in the treatment. Intravenous cloxacillin is still recommended in community-acquired disease in patients with normal immune defense. However, in children between 1 year to 4 years-old, additional ampicillin or cefotaxime alone is needed to cover Haemophilus influenzae. In patients with suppressed immune system, gram-negative organism is a common causative agent and antibiotic must cover it. Open drainage method is still the most reliable treatment, especially in late cases. However, some infected joints can still result in poor function despite aggressive early treatment.

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The Management of Psoas Abscess

H N Bajaj, MS, L T Choong, FRCS, Queen Elizabeth Hospital, Karung Berkunci No 2029, 88586 Kota Kinabalu, Sabah

Summary

The presentation and management of psoas abscess was studied prospectively in 5 patients and retrospectively in 4. 3 patients had bilateral abscesses. All patients had back pain and a mass in loin or iliac fossa. 7 patients had no hip findings. One patient had a perinephric abscess and another had radiological features of tuberculosis of the spine. In the other seven no cause for the abscess could be identified. Ultrasonography demonstrated the abscess in all patients; CT scanning done in 5 patients was confirmatory. Drainage was done by an extraperitoneal route. Biopsy of the abscess wall in 2 patients demonstrated tuberculosis. They, the patient with TB spine and 3 others put empirically on anti-tuberculosis chemotherapy responded well. The perinephric abscess grew Pseudomonas sensitive to gentamycin, but she and two other patients died due to multiorgan failure.

Key Words: Psoas abscess, Tuberculosis spine, Ultrasonography, Extraperitoneal drainage, Backache

Introduction

An abscess of the iliopsoas muscle is primary when it occurs without associated disease of other organs in the retroperitoneum; a secondary psoas abscess results from spread of infection from adjacent organs[1,2]. Involvement of the lumbar spine in tuberculosis and tracking of detritus within the sheath of the psoas results in a cold abscess[3,4].

The clinical features in patients with a psoas abscess consist of back pain, a swelling in the flank and hip pain. There is a fixed flexion deformity of the hip and pain on extension[4]. Radiographs show destruction of adjacent vertebrae and narrowing of the disc space when tuberculosis involves the lumbar spine. Ultrasonography and CT scanning help define the lesion.

We reviewed our experience with this condition in nine patients who had twelve abscess at the Queen Elizabeth Hospital, Kota Kinabalu, Sabah.

Materials and Methods

Five patients with psoas abscesses were studied prospectively while the records of another four were analysed retrospectively. A total of twelve abscesses were present as three patients had bilateral lesions. The age, sex, symptoms and their duration, signs were noted. Radiographs of the chest and lumbar spine were studied. All patients underwent ultrasonography of the abdomen and CT scans of the retroperitoneum were done in 5.

Open drainage of the abscesses was done by an extraperitoneal approach in eight patients. Swabs were taken for culture and sensitivity, and the abscess wall biopsied. When cultures were positive appropriate antibiotics were begun. 6 patients were given antituberculosis chemotherapy.

Results

The nine patients were between 27 and 63 years. Two were females. In eight patients the symptoms were

Table I
Clinical Features and Investigations in 9 Patients with Psoas Abscess

No.	Age	Sex	Side	Duration of symptoms	Mass	Fixed flexion	Hip Movements	Radio-graphs of LS spine	Ultra-sono-graphy	CT Scan
1	42	M	Right	3 years	(R) loin mass	Absent	Normal	Normal	Right psoas abscess	Confirmatory
2	45	F	Right	2 months	(R) loin mass	Absent	Normal	Normal	Perirenal abscess	Confirmatory
3	33	F	Right	2 months	(R) loin mass	Absent	Normal	Normal	Right psoas abscess	Confirmatory
4	63	M	Both	3 weeks	Loin mass	Absent	Normal	Normal	Psoas absces	Confirmatory
5	27	M	Both	2 months	Loin mass	Absent	Normal	Normal	Psoas abscess	Not done
6	59	M	Both	1 week	Loin	Absent	Normal	Normal	Psoas abscess	Not done
7	40	M	Left	1 week	(L) loin mass	Absent	Normal	Normal	Left psoas abscess	Not done
8	44	M	Right	1 week	Mass R.I.F	Present	Painful	Normal	Right psoas abscess	Confirmatory
9	31	M	Left	1 week	(L) loin mass	Present	Painful	Destruction of L2L3	Left psoas abscess	Not done

present from 7 days to two months. One patient had symptoms for 3 years before permitting surgery.

All patients presented with (Table I) low back pain and a mass in the loin or loins when the abscess was bilateral. One patient had a mass in the right iliac fossa and had undergone an appendicectomy as well. He was referred to this hospital when at operation, the surgeon noted the retroperitoneal swelling. Symptoms and signs referable to the hip were completely absent in 7 patients.

Only two patients had a fixed flexion deformity of the hip with pain on hip extension.

Radiographs1 of the chest and lumbar spine were done in every patient. In one patient radiographs of the lumbar spine showed paradiscal bony destruction with narrowed disc space. Radiographs of the lumbar spine were normal in the remaining eight patients. Ultrasonography of the abdomen done in all nine patients revealed the abscess. In addition CT scanning done in five patients delineated the location and extent of the abscess.

Eight patients underwent surgery (Table II). Biopsy of the abscess wall suggested tuberculosis in two patients. In these two and in the patient with radiological evidence of tuberculosis of the spine, anti-tuberculous

Table II
Treatment and Outcome in 9 Patients with Psoas Abscess

No.	Treatment	Causative Organism	Anti Tuberculous Chemotherapy	Outcome
1	Drainage	Biopsy of abscess wall shows TB	Yes	Doing well
2	Drainage	Pseudomonas	No	Died
3	Drainage	None identified	Yes	Doing well
4	Drainage	None identified	Yes	Doing well
5	Drainage	None identified	Yes	Doing well
6	–	–	–	Died
7	Drainage	Biopsy of abscess wall shows TB	Yes	Doing well
8	Drainage	None identified	–	Died
9	Drainage	None identified (Radiographs of LS spine show features of TB)	Yes	Doing well

chemotherapy was started. Three other patients were empirically put on anti-tuberculous treatment. These six patients have had resolution symptoms. There were three deaths. All three patients had progressive deterioration. One patient who had bilateral abscess died before surgery. The second patient presented with a perinephric abscess and a secondary psoas abscess. The abscess was drained and grew Pseudomonas sensitine to gentamycin. Despite adequate antibiotics she too deteriorated over the next month. In the third patient no organism could be identified and he died within three weeks of surgery. In all three patients there was multi organ failure.

Discussion

The psoas major orginates intra abdominally and enters the thigh behind the inguinal ligament to insert into the lesser trochanter. An abscess within the sheath of the muscle is entirely extraperitoneal and follows the course of the iliopsoas muscle.

Specific symptoms and signs of a psoas abscess are pain in the back, loin or pelvic fossa and a mass in these parts; the affected hip is held flexed and externally rotated. Extension and internal, rotation increase the pain.

All our patients had a mass; seven patients, including the three patients with bilateral abscesses had normal hip joints with painless movements. McAuliffe and Clarke[5] have described similar findings in their series. This is in contrast to Bissett's[6] experience who found hip involvement in each patient. The absence of physical signs can lead to a delay in the diagnosis. A high index of suspicion helps. Ultrasonography is of value, and demonstrated the abscess in our series. However, CT scanning demostrates the location and extent of disease better; we know of one patient who had ultrasonography suggestive of psoas abscess but whose CT scan did not reveal any abscess. It is important at decompression[3] to break all the loculi that harbour pus. Closed methods of drainage have been describeds but we have no experience with that. We send curettings of the abscess wall for histology; tuberculosis was reported in two patients who had normal radiographs of the lumbar spine. Only one patient in our series had the classical radiological features of TB of the spine. Because tuberculosis is endemic in Sabah, and in the absence of

any other cause of a psoas abscess we would consider a course of antituberculous chemotherapy. Three of our patients were treated in this way with complete relief of symptoms. However other causes of a psoas abscess must be looked for and excluded. Primary psoas abscesses that occur without associated disease of other organs are caused by haematogenous spread from an occult source and are predominantly seen in children and young adults[1,2]. Secondary psoas abscesses result from spread of infection from adjacent organs, principally from the intestine and are most often polymicrobial. The most common cause is Crohn's disease. While this may be true in western countries, the etiology of psoas abscess shows regional variation in the world[5,6]. This has a bearing on the treatment and the outcome.

A psoas abscess may have a grave prognosis. The surgical mortality rate is about 25%. Factors that contribute to a poor outcome are the presence of pre-existing disease, debilitated patients, and overwhelming sepsis.

Conclusion

A psoas abscess may present as a mass in the flank and without any symptoms or signs referable to the hip joint. A high index of suspicion helps. Ultrasonography demonstrates the abscess. Adequate drainage with breaking of all the loculi that harbour pus is essential. Biopsy of the abscess wall may be of value.

Identification of the causative organism and appropriate antiobiotic therapy are important. The presence of pre-existing disease, debilitated patients and overwhelming sepsis may lead to death.

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Arthroscopy Under Local Anaesthesia

R Ramanathan, Hospital Ipoh, Malaysia

Summary

We studied 95 patients who underwent knee Arthroscopy under local anaesthesia between JANUARY 1995 till 1997. Materials used were 1% Xylocaine and 0.25% Bupivacaine of 20 mls each combined with midazolam 2mg and ivpethidine 30 mgm for sedation. The patients were attached to monitors (pulse Oxymeter, ECG and BP and pulse recorders) and blood less field was created using a tornquet. The procedures lasted about 45 minutes.

90 out of 95 patients completed the procedures successfully without any complications. 2 developed respiratory embrassments and were intubated and ventilated. 3 procedures abandoned and converted to general anaesthesia. The range of procedures done include menisectomy, meniscal repair, synovial biospy, debridement for osteoarthrosis, shaving of osteophytes, drilling of cartilage and bones and removal of loose bodies. This study is to show that knee arthroscopy under LA is a safe alternative in hospitals where GA time is limited.

Key words: Knee joint, Local Anaesthesia (LA), Sedation

Introduction

Why do we choose to do these procedures under local anaesthesia ? It is a well known fact that there is a lack of operating time under general anaesthesia in the government hospitals in Malaysia. The anaesthetist says that he is always "busy" and that arthroscopy is not a life saving procedure. This prompted me to look for alternative methods. "Necessity is the mother of invention".

Materials and Methods

This is a retrospective study involving 95 patients between the periods of January 1995-1997. They are all clinically fit ASA 1 or 2, ages ranging between 20 to 60 years old. Steps have been taken to ensure that all are mentally prepared for the surgery as they will be fully aware of the surroundings and will have a tight torniquet on their thigh.

The usual indications for arthroscopy are used. The portal areas for the scope are shaven in theatre. 20 mls of 1% xylocaine and 20 mls of 0.25% Bupivacaine are mixed and injected medial and lateral to the inferior pole of the patella, infiltrating the skin, subcutaneous tissues, capsule and synovium. This was followed by infiltration of lateral supra patellar space into the joint proper.

Sedation is also given using IV midazolam 3 mgm and IV pethidine 30 mgm boluses. The torniquet is then applied. The patient is monitored regularly (pulse oximeter, ECG, BP and Pulse monitor). The surgeon then scrubs, paints and drapes the knee in the standard manner. The tourniquet is then inflated to compress at 100 mm Hg above the systolic pressure.

The operation is then conducted and the patient may watch the scope screen if he is awake or wishes to. The entire procedure usually lasts for 45 to 60 minutes from the time of injecting the local anaesthesia to the completion of surgery. Steristrips are used to close the wounds. No suturing is done usually.

Results

90 out of 95 patients completed the procedures without any complications. The types of procedures include meniscectomy, meniscal repair, synovial biospy, debridement for osteoarhrosis, shaving of osteophytes, drilling of cartilage and bones and removal of loose bodies. 2 patients developed problems related to sedation. In 1 patient, a new (freshly graduated) houseman and a theatre nurse had misread the labels and administered IV pethidine 200 mg as a bolus and the patient subsequently developed respiratory arrest. He was ventilated and naloxone IV was given immediately. Another patient developed respiratory arrest after IV midazolam 5 mg bolus given with IV 75 mg pethidine and had to be intubated. Both patients recovered fully without any long term sequelae. 3 cases had to be abandoned and done under G.A. at a later date.

Discussion

This study shows that knee arthroscopy is safe to be undertaken under L.A. The type of procedures possible are wide ranged and most patients are comfortable for about 45 minutes.

However, there are some problems which need to be mentioned. Some patients may be restless and uncooperative due to the position of the leg or frightened by the environment. Occasionally we have to top up the L.A. to new sites as the procedure demands. Some patients require topping up of the sedation.

Another problem is that the torniquet is tolerated for about 45 minutes after which it must be released leading to a bloody field, unless the intra articular pressure is maintained using a pump.

2 patients developed respiratory embrassment related to sedation neccessasiting intubation and ventilation, hence a recussitation trolley and a competent doctor must be available. One must be aware that pethidine comes in 2 different preparations (50 mg and 100 mg vials) and care must be taken when checking the doses to avoid such incidents. As a note of precaution, these procedures must not be undertaken without having adequate back up facilities (a doctor capable of intubating, a recussitation trolley and IV naloxone and anexate in hand).

Occasionally, the procedure exceeds 45 minutes and attempts have been made to top up the medications. When these failed, the procedures were abandoned. Patients who are allergic to lignocaine will be done under G. A.

Conclusion

Arthroscopy for the knee can be done safely under local anaesthesia for the above mentioned procedures. This is a practical measure as it can be done at your own leisure without the constraints of anaesthetists' approval. But certain procedures like anterior cruciate ligament reconstruction and intra articular fracture fixation are not suitable to be done under local anaesthesia. Here again, we are at the mercy of the anaesthetists.

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Simultaneous Bilateral Total Knee Replacement

J M Lopez, FRCS*, M Sivanantham, FRCS**, *Tawakal Hospital, Jalan Pahang, Kuala Lumpur, **Kajang Medical Centre, Jalan Bukit, Kajang

Summary

This paper summarises our experience of twenty one patients with degenerative arthritis treated by bilateral simultaneous total knee replacement (BSTKR) in Tawakal Hospital in a period of twenty two months vis. January 1994 to November 1995. The results were analysed according to the scoring system of Hospital for Special Surgery. The preliminary observations were encouraging, 90% excellent, 8% good and 2% fair results. The benefits, safety and cost effectiveness of the procedure as compared to the unilateral staged knee replacement are discussed. We recommend that BSTKR be routinely practised for appropriate situations in all institutions where the expertise and facilities are available.

Key Words: Degenerative arthritis, Routine Bilateral Simultaneous Total Knee Replacement.

Introduction

A perusal of English literature has revealed that very few surgeons resort to Bilateral Simultaneous Total Knee Replacement (BSTKR) even in developed countries, like Europe and America. Even in U.K., only 24% of Orthopaedic surgeons would regularly perform BSTKR[1]. Single knee replacement procedure is currently widely practised with good results in many centres in our country[2]. Whilst the results of the latter procedure are excellent, BSTKR has many advantages over this procedure.

Bilateral Simultaneous Total Knee Replacement has not met with much favour with many surgeons in Malaysia. Our encouraging results of BSTKR have prompted us to present our experience in this paper The obvious cost effective benefits of this procedure coupled with the advantages of avoidance of a second operation and anaesthesia with their attendant risks have convinced us of the practice and value of this procedure. This procedure needless to add has contributed considerably in the reduction of time for hospitalisation and rehabilitation.

Materials and Methods

Twenty one patients with arthritis (one with rheumatoid arthritis and twenty with degenerative arthritis) serve as the materials for study.

From January 1994 to November 1995, twenty one patients, whose ages ranged from thirty five to seventy five years underwent BSTKR followed up for a period of three to twenty five months.

Twenty of this patients had degenerative arthritis. One was female of thirty five years of age with severe seropositive rheumatoid arthritis with global involvement. She was bedridden and had flexion contracture of 45° of both knee joints. The indication in all cases for BSTKR was failure to respond to conservative treatment.

The Install Burstein Type II prosthesis was used in all cases. Four patients had patella replacement whilst seventeen did not have patella resurfacing. General anaesthesia was used in all cases and epidural cathethers

inserted for post operative analgesia. Prophylatic antibiotics was used in all cases. Ceftazimide one gram was given before tourniquet was applied to each leg. Antibiotic was continued till time of discharge.

Each leg was prepared and draped separately. The skin incision was midline and the joint approached through medical parapatellar capsular incision. After preparation of the femoral and tibial surfaces all implants were cemented in position. Only one mix of cement was used. As a routine lateral release of patella was done in all cases. At this stage the touniquet was released and haemostasis was secured. The capsular incision was closed with vicryl. The skin was closed with staples.

The first ten patients had drain as routine. The next eleven had no drains inserted. The whole team rescrubs and a new set of instruments were used for the opposite knee. In all patients the bladder was cathetherised at the end of the operation. The mean duration required for surgery was two hours and thirty two minutes for both knees. The longest time taken was in one case requiring four hours and ten minutes and the delay was due to factors unrelated to surgery. The first pint of blood was started at the end of the first knee replacement in the operating room and a total of four pints was transfused at the rate of one pint in six hours in the ward. With maximum of four pints of blood, the need for further IV fluids did not arise. All patients had post operative epidural analgesia with Fentanyl and Bupivacaine. This was maintained for forty eight hours and was managed by the anaesthetist.

All patients were routinely put on continuous passive motion machines. The range of motion was fixed from zero to twenty degrees at a very slow speed. This was maintained till discharge i.e. when the patients returned to the ward from physiotheraphy they were put back on the machines. All drains were removed at forty eight hours and all bladder and epidural cathethers were removed at the same time. The dressing was also changed at the end of second day. After forty eight hours ambulation was started full weight bearing on both legs, initially parallel bars and later with a walking frame.

Subcutaneous low molecular weight heparin 0.3ml was given at the time on induction of the anaesthesia and was continued for two days till the patients ambulated.

The mean duration of hospital stay was 6.5 days, the shortest being 5 and longest ten. At the end of the second week all skin staples were removed as an outpatient procedure.

All patients were advised to ambulate full weight bearing with a walker as often as possible at home i.e. a few minutes every two hours. Most patients were able to walk independently by six weeks. One patient whose left patella subluxated needed support of one cane after six months.

Results

As per the scoring system of Hospital For Special Surgery New York and excellent score is between eighty five to one hundred, good seventy to eighty four, fair sixty to sixty nine and poor below sixty. Following this system the preoperative score for our twenty one patients ranged from ten to sixty five points, whilst the postoperative score was between sixty six to eighty nine. The overall results are shown in Table I.

Table I
Results of BSTKR

Excellent	38
Good	3
Fair	1
Total	**42**

The lowest preoperative score was a ten in the bedridden rheumatoid arthritis patient with flexion contracture of both knees. Her postoperative score improved to seventy four on both sides and she was capable of attending to all her activities of independent living. The lowest postoperative score was sixty six in the left knee of a sixty nine years old in whom the left patella subluxated after surgery. Her preoperative score was forty eight. None of our cases had deterioration in the HSS score after undergoing BSTKR.

There was no cases of postoperative wound infection or

wound break down in this series. Loosening of implants did not occur in our patients. We did not encounter any case of fractures of femur, patella or tibia. The mean duration of stay in this hospital was 6.5 days.

Discussion

There is striking paucity of reports in the English literature of BSTKR as routine procedure for degenerative arthritis [3,4,5,6,7]. Medline literature search dating to 1983 revealed only thirteen references to date. Single knee replacement procedure on the other hand is currently routinely performed in many institution, both private and public and the existing literature is replete with reports of the procedure [8,9,10,11,12,13,14]. Knee replacement is the only available radical treatment for rheumatoid arthritis and should be done before flexion contracture and axial deviation develops. We concur with the observations of Darochel[15] et al in this context. Our experience has clearly shown that regardless of whether patella resurfacing is done or not, the outcome of the operation is the same. This is in keeping with the experience of Shoji[16].

Deep vein Thrombosis is a common complication in this procedure. The sequele of pulmonary embolism is however rare as reported in the western series[17,18] and was not seen in our experience probably due to effective prophylatic measures. The incidence of infection, a much feared complication of total joint replacement was conspicous by its absence. Loosening, a well known complication, was not seen in our series, this is probably because of our short follow up. Studies by Ritter and Meding (1987)[19] have clearly shown that BSTKR considerably reduced the incidence of complication such as a phlebitis and pulmonary embolism as well as hospital stay. The advantages of BSTKR far out weight the benefits of the currently practised of staged knee replacement. In that the patient undergoes a single operation without having to wait for a considerable period of time with attendant pain and distress sometimes extending to years. Again the advantages would include obviating the need for second surgical and anaesthetic procedure and a significant reduction in the duration of hospitalisaton and rehabilitation.

The value of BSTKR has been amply documented by Ritte et al[19] and Jankiewicz et al[20]. The financial benefits need not be over emphasised. The use of low molecular weight heparin has prevented the incidence of lower limb oedema not uncommonly seen in the patients undergoing Total Knee Replacement. With the use of continous passive motiom machines in our experience, the need of manipulation under anaesthesia to improve the range of motion was not observed as reported by Nadler et al[21]. The use of continuous passive motion machines has proved to be beneficial in our series. Contrary to the experience of Ritte et al[22].

BSTKR is strongly indicated in the management of bilateral degenerative arthritis, as rehabilitation of the replaced knee in unilateral staged knee replacement is adversely affected by the unoperated knee with degenerative arthritis. This has been stressed by Grace et al[23]. Comparative studies like Morrey et al[24] on the complications and morbidity associated with BSTKR or unilateral arthroplasty done as staged procedure in the same hospitalisation or in separate hospitalisation show that there is no great disparity in the results in the different groups. This supports recommendation that BSTKR as a safe procedure and can be routinely practised. This is further corroborated by the reports of Buscemi Jm-Jr[25].

Conclusion

This paper highlights the usefulness and advantages of BSTKR. Limited though the number of cases and duration of follow up of the present series, our future prospective trial with a large number of cases and longer duration of follow up may hopefully throw more light on this procedure. It is hoped that this becomes a routinely acceptable method of treatment in all centres provided the expertise and facilities are available.

Concurring fully the observation of Pitson et al[26] BSTKR is highly effective treatment for arthritis of the knee, reducing pain, increasing mobility and improving the persons emotional state, thus improving the quality of life of the patient.

Acknowledgements

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Anterior Cruciate Ligament Reconstruction Using the Patellar Ligament

A Rauf, MD*, M Razak, MD**, M Ismail, MD***, *Department of Orthopaedic and Traumatology, Kuala Lumpur Hospital, **Hospital Universiti Kebangsaan Malaysia, ***Taqwa Orthopaedic and Sport Injury Centre, Kuala Lumpur

Summary

From January 1992 to January 1996, thirty-three patients with persistent clinical and functional knee instability due to anterior cruciate insufficiency underwent ACL reconstruction using central third of the bone-patellar ligament-bone graft. An early experience was presented with average follow-up of 9.8 months (range six to thirty-three months). There thirty-two male and two females. The average age was twenty-four months. Eighty-three percent were involved in football injury. The average time interval from initial injury to operation was twenty-five months. Majority presented with knee pain and giving way. Meniscal tear was the commonest associated injury in more than 70 percent; the lateral meniscus being more frequently injured (42 percent) than the medial meniscus (15 percent). Using modified criteria by Paterson and Trickey (1986), nine patients (27 percent) had good results and twenty-two (67 percent) has satisfactory results. Two patients (6 percent) who had post-operative infection were graded as poor. Functional stability was achieved in twenty-eight (85 percent) and instability persisted in five (15 percent). There were marked clinical improvement in the Lachman and anterior drawer grading post-operatively. The accelerated rehabilitation programme was effective in obtaining early clinical improvement and in reducing post-operative knee stiffness.

Introduction

The anterior cruciate ligament (ACL) is a special type of ligament conferring stability to the knee joint. More about its properties and function are made known after extensive researches done since 1800's. Despite the extensive research, it remains mystery in some aspect.

Rupture of the ACL is becoming more recognized and is one the commonest sports injuries especially in countries where sport professionalism has become established. Surgical treatment of ACL injuries has become more common especially in the western countries. In Malaysia, more and more ACL injuries have been diagnosed and appreciated with the establishment of professional era in soccer. Despite that, the surgery for reconstruction of the ACL is relatively new and only been performed occasionally.

The treatment of ACL rupture has been conservative in the early decades of the century and surgical reconstruction of the ACL was unpopular due to the outcome which was less than satisfactory. With extensive research pertaining to its structure and biomechanical properties, more surgeons begin to understand the importance of early reconstruction to prevent the knee function from deteriorating.

Many types of surgical procedures have been tried and the results have been reported. However, all the procedures have both their advantages and disadvantages and none so far has been able to replace the original ACL. Nevertheless, the intra-articular procedures using the central third of the patellar ligament has produced more satisfying results as compared to the other procedures. This has since become the gold standard to which other new procedure should be compared with.

In Kuala Lumpur Hospital, reconstruction of the ACL using free central third bone-patellar ligament-bone graft has been done since 1992. Since then, the procedure has become more familiar amongst the orthopaedic surgeons working here. A study was conducted in Kuala Lumpur Hospital within a period from January 1992 to January 1996 to evaluate the results of the reconstructive surgery.

Materials and Methods

From January 1992 to January 1996, 33 patients with the anterior cruciate ligament injuries were operated for unstable knee at Kuala Lumpur Hospital. The data of the patients were obtained from the patients' file records and from the operative notes. Patients who underwent structured rehabilitation program less than six months after operation were excluded from the study. They were called to come to the clinic at the end of January 1996 and reassessed. The average age of the patients at operation was 27.4 years (range 20 to 39 years old). Thirty-two had unilateral anterior cruciate ligament tear and one had bilateral anterior cruciate ligament tear. Majority of the patients had several episodes of knee instability. They were reviewed at an average of 9.8 months (range from six to thirty-three months).

The length of time from injury to operation averaged 25 months (range from one to 120 months). Eighteen right knees and fifteen left knees were operated. Each patient was assessed for symptoms, signs and functional disability and the symptoms was based on the patients'-subjective complaint. Signs of anterior cruciate ligament insufficiency were assessed by performing Lachman test and anterior drawer test. Arthroscopy was done in all patients prior to surgery and the findings were documented. Associated injuries to the other structures were also documented and treated accordingly.

All had undergone reconstructive surgery where the central third of the bone-patellar tendon-bone free graft was used to reconstruct the anterior cruciate ligament (modified Jone's procedure). The procedure was performed through an open method. All operations were operated by a senior orthopaedic surgeon and assisted by an orthopaedic resident. 1 gm of intravenous cefoperazone was given pre-operatively and post-operatively, the dosage was repeated for another two doses. Post-operatively, the patients underwent a structured rehabilitation programme as described by Shelbourne et al (1990) who stressed on early knee motion to prevent knee stiffness. Post-operatively, they were evaluated subjectively and objectively. Subjective criteria as described by Paterson and Trickey (1986) were used but was modified according to the local situation. The result was considered good if all disability has been relieved and the patient was able to return to full activity. A satisfactory result meant that there was improvement, some instability remained or patient was unable to return to full activity. The result was graded as poor when the patient expressed marked dissatisfaction. Post-operative septic arthritis was also regarded as poor result. Objectively the patients were evaluated by performing the Lachman test and anterior drawer test. Objective assessment using KT 1000 or Cybex machine could not be done as they are not available in the hospital.

Results

Age

More than 80% of patient aged less than 36 years old and 45.45% belongs to patient aged between 20 and 25 years old.

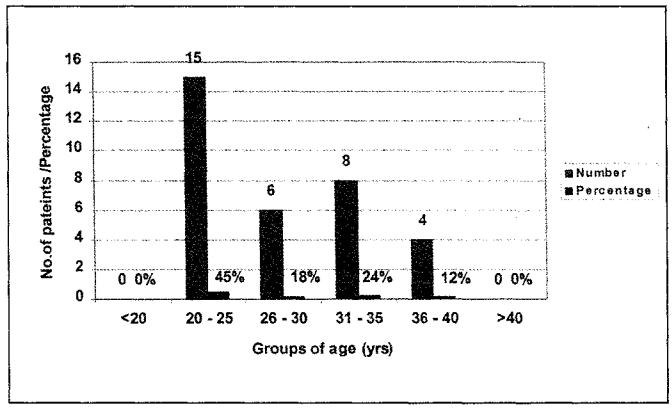

Fig. 1: Age Distribution

Sex

There were 93.94% male and 6.06% female.

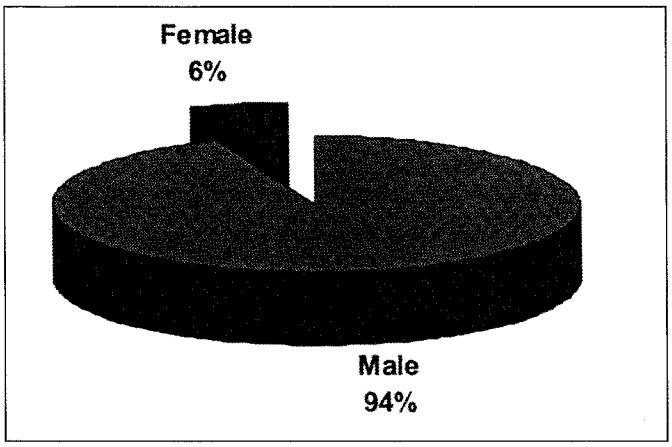

Fig. 2: Sex distribution

Mode of injury

The majority of the ACL injuries (90.9%) occurred during sports.

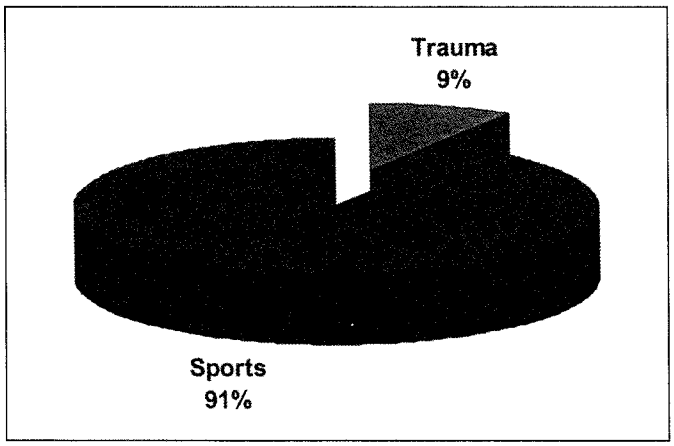

Fig. 3: Mode of injury

Of the sports, 25 out of 30 patients (83.3%) had ACL injury during football game. The only 2 female patients both injured their ACL during netball game. There were two patients who had ACL injury during sepaktakraw game. ACL injury during sepaktakraw game has never been reported in the literature. Both players occupied the so-called the 'apit kiri' position who normally perform the acrobatic 'smash' using the foot which equivalent to smashing in the badminton game. It requires a combination of manouvre of jumping and sommersaulting in the air to smash the sepaktakraw ball into the opponents court.

Table I
Sport distribution

Game	Number	Percentage
Football	25	83.33
Sepaktakraw	2	6.67
Netball	2	6.67
Hockey	1	3.33
	30	**100**

Side of injury

There was one patient who had bilateral ACL rupture and 51.54% involved the dominant leg.

Mechanism of injury

In more than 90%, the exact mechanism of injury was not known but it is interesting to note that hyperflexion was the cause in one patient. Twisting injury occurred in two patients (6.06%).

Duration of injury before operation

The duration of injury averaged about 25 months (range 1 month to 120 months). 63.7% of the patient had the duration of less than 19 months.

Symptoms

The main symptoms were pain, giving way, swelling and locking. The patients may present with either one or combination of them. The commonest symptom was knee pain (40.6%), followed by giving way (35.9%), knee swelling (12.6%) and locking (10.9%).

Table II
Presenting symptoms

Symptoms	Number	Percentage (%)
Pain	26	40.6
Giving way	23	35.9
Knee swelling	8	12.6
Locking	7	10.9

Locking was present in seven patients and bucket-handle tear of the meniscus was found in four of them (57%).

More than half of the patients had more than one symptoms. The most common combination was giving way and pain.

Arthroscopic findings

87.88% of the patients had total rupture of the ACL while 12.12% had partial tear. Isolated injury of the ACL occurred only in 21.21%. The remainder were ACL injuries combined with other knee structures.

The ACL injuries occurred most commonly in combination with lateral meniscus tear (42.39%), followed by medial meniscus tear in 15.38%. Both meniscus tear occurred in 15.38%.

The average follow-up was 9.8 months (range 6 months to 33 months). However majority of the patients (78.79%) had short follow-up duration of less than one year.

Subjective evaluation

Most of the patients rated themselves as satisfactory (69.7%) while and 24.2% considered the result of operation as good. 2 patients who was rated as poor (6.1%) had deep infection post-operation.

Table III
Combined ACL Injuries

Injury	Number	Percentage (%)
ACL and LMT	11	42.6
ACL and MMT	4	15.4
ACL+LMT+MMT	4	15.4
ACL+LCL	1	3.8
ACL+MCL	1	3.8
ACL+LCL+MCL	1	3.8
ACL+MMT+PCL	1	3.8
ACL+OA	1	3.8
ACL+OA+MMT	1	3.8
ACL+MCL+CP	1	3.8
Total	**26**	**100**

Keys : *LMT = lateral meniscus tear*
MMT = medial meniscus tear
LCL = lateral collateral ligament laxity
MCL = medial collateral ligament laxity
PCL = posterior cruciate ligament tear
OA = osteoarthritis
CP = chondromalacia patellae

Table IV
Subjective evaluation

	Number	Percentage (%)
Good	8	24.2
Satisfactory	23	69.7
Poor	2	6.1
Total	**33**	**100**

Objective evaluation

Lachman test

More than 50% of the patients had negative Lachman test post-operatively as compared to none preoperatively. Only 2 patients (6.06%) had Grade III laxity which was due to infection post-operatively as compared to 10 patients (30.3%) who had Grade III laxity pre-operatively.

Table V
Lachman test

	Pre-operation	Post-operation
Normal	0	17
Grade I	7	13
Grade II	16	1
Grade III	10	2

Anterior drawer test

Table VI
Anterior drawer test

	Pre-operation	Post-operation
Normal	0	14
Grade I	8	15
Grade II	13	2
Grade III	12	2

There was improvement in the grading of both Lachman test and the anterior drawer test. Post-operatively majority of the patients had no laxity or only mild laxity.

Complications

The commonest complication was extension loss which occurred in 6 patients (18.18%). However, the loss of extension was not significant when further evaluated. All had extension lag of 5 degrees and less and they did not complain of significant knee problem. Arthrofibrosis occurred only in one patient (3.03).

Discussion

Most studies reported that ACL injuries commonly occurred during sports. In this study there were only three patients (9.1%) who were involved in road traffic accidents. Soccer or football was the most common causes of ACL injuries occurring in 83.33%. Majority of the patients were young, aged at or below 36 years old (87.87%) and the commonest age-group affected was 20-25 years old. There were two female athletes who injured their knees during netball game. Those who played football were injured during competition either at the amateur or semi-professional level. As the era of semi-professional football is going to become more established, it is expected that more of the ACL injuries will be seen and treated. ACL injury during sepaktakraw game (a traditional Malay game) had not been reported before in the literature. Two patients (6.06%) injured in their ACL during the game. Sepaktakraw game is a traditional game of the South East Asia and involves three players. Both patients were the key players of the so-called 'apit kiri'. This position is usually occupied by those who have the ability to perform the acrobatic style to smash the sepaktakraw ball using their feet. It is not an easy manourve which requires the combination of jumping and sommersaulting in the air to hit the ball. We believed that the ACL was injured during the landing part after performing the acrobatic smash which was followed by the twisting strain on the knee. However, the exact mechanism needs to be confirmed by a proper biomechanical study.

Majority of the patients were not able to recall the exact mechanism of the injury. Most were only able to mention that they were tackled and followed by fall. One patient noted that his knee was hyperflexed during the injury, while the other one had twisting knee. Hyperextension or hyperflexion has been described as a mechanism of ACL injury (Warren and Marshall, 1978). The other reported mechanism was rapid deceleration and direction change while running which results in a sudden forceful external rotation of the lower leg on the

femur with a valgus stress upon the knee - forceful valgus-external rotation (Youmans, 1978). When occurring through this mechanism, it is often associated with damage to the medial collateral ligaments and medial supporting structures. Kennedy et al (1974) reported a mechanism where rapid cutting motion on extended knee results in internal rotation of the tibia as a varus force is placed upon the knee. This mechanism usually results in isolated rupture of the anterior cruciate ligament.

The main symptoms were knee pain, giving way, knee swelling and locking. Giving way was interpreted as instability. The most common symptom was pain which was present in 40.6%, followed by giving way (35.9%), knee swelling (12.6%) and locking (10.9%). More than 80% of the patients presented with two or more symptoms and the most common combination was giving way and knee pain. In those with locking, there were associated buckett-handle tear of the meniscus in four patients (57%) and the remainder had associated flap tear of the meniscus, medial collateral laxity and chondromalacia patellae. In the patient with flap tear of the meniscus, the locking was due to a detached flap tear which acted as a loose body. In the others, the exact cause were not known. However, partial tear of the ACL have been reported to be associated with pseudolocking (Farquharson-Roberts and Osborne, 1983).

Examination of the knee under general anaesthesia revealed that the anterior drawer test and the Lachman test were positive in all patients. Majority had Grade II and III. Twenty-five patients (62.7%) had Grade II and III anterior drawer test while twenty-six (79.79%) had Grade II and III Lachman test. The Lachman test has consistently proven to be the most accurate examination for anterior cruciate insufficiency in the acute setting with sensitivity reported from 87% to 98% (Donaldson et al., 1985). The sensitivity of all test maneuvres increases with anaesthesia but the Lachman test is the least influenced by patient relaxation. The arthroscopic examination prior to surgery revealed rupture of the ACL was total in 87.88% and partial in 12.12%. Partial tears of the ACL have been reported to account for 24% to 39% of injuries to the ACL (Noyes, 1983). They have a more favourable prognosis. Isolated ACL injury was found in only 21.21% while the remainder have combined injuries with other knee structures. These findings were equivalent to the findings by Noyes (1980). In this series, 82% had combined ACL injuries. The association between damage to the ACL and meniscal tear has long been recognized. Many of these tears occur at the time of injury, however many others will result from subsequent episodes in the unstable knee. In chronic anterior cruciate deficiency, the incidence of meniscal pathology has ranged up to 91% (Indelicato, 1985). In both acute and chronic injury, the peripheral posterior horns of the meniscus are at the greatest risk for tearing. The medial meniscus was reported to be injured twice as frequently as the lateral meniscus. In this study, however, the ACL ruptures occurred most commonly in combination with lateral meniscus tear (42.39%), followed by the medial meniscus tear (15.38%). Osteoarthritis changes only found in two patients (7.7%). It was mild in one patient and very severe in another. In the severe one, the patient had injured his knee more than 10 years and already had open meniscectomy done in 1980. These findings were quite similar to findings by Noyes (1980) and De Haven (1980). In their series, 62% were associated with meniscal tear, with the lateral meniscus injured more frequently than the medial meniscus. The ACL combined with the posterior cruciate ligament injury was not common in sports injury.

The subjective assessment was done using modified criteria established by Paterson and Trickey (1986). The result was considered as good if all disability have been relieved and the patients were able to return to full activity. A satisfactory result was considered if there was some improvement or the patients were unable to return to full activity. The result was considered as poor if the patient express marked dissatisfaction or there was post-operative knee infection. The criteria is simple and most patients were able to rate themselves accordingly.

Nine patients (27.2%) had good results; four of them had isolated ACL rupture, four had mixed ACL injury and one with ACL and posterior cruciate ligament (PCL) injury. The patient with PCL injury expressed great satisfaction because the surgical procedure had relieved his many limited activities present before the operation. Nevertheless, the duration of follow-up was only 6 months. Whether his satisfaction will remain the same

or decline at longer follow-up is not known. We will follow this interesting patient further to detect any changes in the level of satisfaction and activity. Majority of the patients had satisfactory results (66.7%). This is not surprising as most of them had duration of follow-up of six months. If they followed for longer period it would be expected that the results will improve. With longer and continued physiotherapy they will attain greater thigh muscle strength and will have more confidence to participate in activity. Functional stability was achieved in 28 patients (84.8%) and instability persisted in 5 patients (15.2%). The reasons for instability were weak quadriceps muscle in three patients and post-operative septic arthritis in two. The weak quadriceps was due to inadequate or poor compliance to intensive rehabilitation due to work commitment in two patients. In another one patient, the quadriceps was weak due to chronic knee instability present for more than ten years. The functional stability achieved in this study was slightly less than reported by O'Brien et al (1991), Aglietti et al (1991), and Clancy (1985) who reported 95%, 96% and 100% respectively. In these studies the period of follow-up was more than two years whereas in our study the duration was only 9.5 months.

There are many studies using the central third of the patellar ligament to reconstruct the ACL. The authors used different criteria to assess the subjective and objective improvement. Some used a very comprehensive and strict rating such as the rating system by Noyes (1980). Nevertheless, generally they reported more than 70% improvement in stability providing excellent to good results. Shellbourne et al (1990) reported 93% satisfactory result while O'Brien et al (1991) reported that post-operatively 95% of the patients did not have any episodes of giving way. In this study, there was 93.7% satisfactory result and 27.2% expressed great satisfaction as they could play at preinjury level.

The complications of the surgery were seen in 36 percent of patients. There were 6 patients (18%) with limited full extension and all had 5 degrees and less extension lag and all have duration of follow-up of six months. Nevertheless, all of them do not complain of any knee problems and they were satisfied clinically. Aglietti et al (1992) considered 5 degrees and less extension loss as satisfactory result. We believed that with further physiotherapy and follow-up as they regain more confidence and participating in activity, this amount of extension loss would become minimal. There was one patient having recurrent pain five months after operation which was due to loose body. After removal of the loose body the pain disappeared. There was two patients with severe quadriceps wasting which was due to poor compliance to rehabilitation. Aglietti et al (1991) noted that there was 7 seven patients (out of 76 patients) who had difficulty in attending rehabilitation program, and in 6 of them the final results was unsatisfactory.

There was only one patient (3.03%) who had arthrofibrosis. The range of movement was 20 to 90 degrees. He has quadriceps strength and was advised on further rehabilitation program. O'Brien et al (1991) reported only 6 out of 80 knees developed post-operative stiffness that had not resolved within 6 months. However, after manipulation, they regained satisfactory range of motion. Strum et al (1990) analysed complications of intra-articular anterior cruciate reconstruction of ACL and 12% incidence in patients treated with reconstruction for chronic ACL instability. They were treated by arthroscopic lysis of adhesions at an average of 8.3 months post-operation. All improved with an average improvement in range of motion of 48 degrees. This complication when promptly recognised and expeditiously treated, there was ultimatedly no deleterious effect on the final clinical outcome.

In this study, there were only 7 patients who had limited extension including those who had 5 degrees or less extension loss. There was only one patient with arthrofibrosis. Therefore, we tend to agree with Shelbourne and Wilcken (1990), and recommended the protocol after ACL reconstructive procedure.

Conclusion

This study showed that ACL tear produced significant disabilities limiting the patient life as an athlete or limiting the daily activities. Reconstruction of the ACL using the central third of the patellar ligament produced functional stability in more than 90%. The surgical reconstruction of ACL had improved the static stability

with regards to the Lachman and anterior drawer tests. There were significant difference between the preoperative and postoperative grades of both tests. The commonest associated knee injury was the meniscus tear. Nine patients (27.2%) were able to participate in activity. Our early experience with this procedure (modified Jone's procedure) produced comparable results to other studies with longer duration of follow-up.

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Residual Deformity Following Surgical Treatment of Congenital Talipes Equinovarus

N Simbak, MD*, M Razak, MD**, *Universiti Sains Malaysia, Kelantan, **Department of Orthopaedic and Traumatology, Universiti Kebangsaan Malaysia

Summary

A study was carried out on 24 patients (36 clubfeet) surgically treated at the Orthopaedic Department National University of Malaysia, Kuala Lumpur, over a period of four and half years. Nine feet underwent posterior release, 24 feet underwent posteromedial release combined with Evan's procedure. The overall operative result was 63.3% good, 9.5% fairly and 27.2% poor. Patients who underwent surgery between 3 to 12 months showed a high percentage of good results (66.7%). Metatarsal adduction was found to be the commonest residual deformity (63.9%), followed by heel varus (11.1%), cavus (11.1%) and equinus (5.6%). Inadequacy of primary surgery and post operative period of immobilization resulted in a significant high failure rate.

Introduction

Congenital talipes equinovarus (CTEV) is not an uncommon condition. In Malaysia, clubfeet remains a significant problem with an outcome of treatment that is at times unpredictable, and due to the ignorance of the parents, results in many cases of CTEV not presenting for early treatment.

The management of clubfeet continues to present a formidable difficulty owing to the present views on its pathoanatomy and treatment. The result of any form of treatment vary according to severity of deformity and surgeon's philosophy on this deformity. The aim of treatment is to obtain anatomically and functionally normal feet in all patients (Kite, 1932), but this is unrealistic because in many clubfeet, the deformity of the joints and ligaments of the foot and the ankle are too severe to be corrected.

Conservative treatment of CTEV is well accepted and nearly 90% of all clubfeet can be treated by non-operative treatment (Kite, 1964). However, some of these deformities do recur or are resistant to further conservative treatment.

When the clubfoot demonstrates resistance to non-operative treatment, surgical treatment is indicated. However, opinion diverges as to proper surgical procedure of choice. Argument centres around the nature and the timing of the operation required for the resistant CTEV. Recent trend toward early soft tissue release between 3 - 6 months of age is well supported by many authors (De Puy and Drennan, 1989; Main and Crider, 1978; Mc Kay, 1982; Otremski et. al., 1987; Porat et.al., 1984; Tayton and Thompson, 1979). Findings from these series indicate CTEV is best treated early in order to prevent uncorrected deformity affecting normal growth. There is little doubt that some feet, either because of rigid intrinsic deformity or failure of primary surgical treatment require reoperation.

In developing countries where the patients seek late treatment, the operative procedure become more extensive, rendering an unpredictable final outcome.

Materials and Methods

This is a retrospective study on a series of patients operated in Department of Orthopaedic National

University of Malaysia July 1987 to December 1991. It reviews the result of various operations, factors tha influence the result of surgery and the occurrence of residual deformity.

There were 16 boys and 8 girls with male to female ratio of 2 : 1. Twelve patients had bilateral clubfoot deformity and another 12 had unilateral deformity. There were 18 right and 18 left clubfeet. The indication for surgical correction was persistent deformity despite conservative treatment with manipulation and casting.

Factors including age of the patient at the first presentation, duration of conservative treatment, age of the patient at the time of primary surgery, type of surgical procedures and duration of post operative plaster are considered in the analysis of the results of sugical treatment.

The types of surgical procedures performed primarily are shown in Table I.

Table I
Surgical Procedure

Procedures	No. of Clubfoot (N)
Posterior release	9
Turco's Posteromedial Release (PMR)	24
PMR and Bony procedure	3

Post-operative residual deformity was assessed to analyse the results. A decrease in foot size and calf atrophy are not considered in the assessment because these findings are expected in any child with clubfoot. Radiographic assessment could not be used because they were not routinely taken.

The results of surgery were assessed by a modified Catterall's assessment form (Catterall, 1991) and were rated according to the following criteria :

Good : The feet demonstrated complete correction with relatively normal appearance or mild forefoot adduction. They were asymptomatic without functional weakness or restriction in joint motion.

Fair : A plantigrade foot with only partial correction of the deformity (forefoot adduction), intoeing gait, mild discomfort on exertional activities but did not impair function. Joint motion is good and wear normal shoes.

Poor : The foot appeared uncorrected (not plantigrade, discomfort on daily activities and required second operation).

Results

The mean age at first presentation was 20.5 weeks (ranged from one week to 40 months). All patients were initially treated by manipulation and serial casting. The mean duration of conservative treatment was 6.37 months (ranged from 2 months to 14 months). Primary operation was performed at the mean age of 9 months (ranged from one month to 40 months) and mean duration of post operative casting was 2.85 months (ranged 3 weeks to 8 months). Mean duration of follow was 3.15 years. The above findings are listed in Table II and III.

Table II
Age at Presentation

Age at Presentation (Month)	No. of Patient (N)
< 3	13
3 - 12	9
> 12	2

Table III
Duration of Conservative Treatment

Duration of Conservative Treatment (Month)	No. of Foot (N)
< 3	3
3 - 12	31
> 12	2

Residual deformities following primary surgery are shown in Table IV. Forefoot adduction was the most common deformity followed by heel varus, cavus, equinus and supination. No overcorrected foot was found. Full correction were achieved in 7 feet (19.5%). Two feet had restricted ankle motion (5.6%). Three feet developed wound infection (8.5%).

Patients who had operation performed between 3 months and one year of age obtained high percentage of good / satisfactory result as shown in Table V.

Of 9 patients who initially underwent posterior release, 8 (88.9%) patients required second opinion (7 PMR and 1 Evan procedure). Of 24 feet initially treated by posteromedial release, only 2 (8.3%) required reoperation (as shown in Table VI).

Table IV
Residual Deformity

Residual Deformity	No. of Feet	Percentage
Forefoot adduction	23	63.9%
Heel varus	4	11.1%
Cavus	4	11.1%
Equinus	2	5.6%
Supination	1	2.8%
Restricted ankle motion	2	5.6%
Full correction	7	19.5%

Table VI
Types of Operation

Primary Operation	No. of Feet	Required Reoperation
ETA	9	8 (88.9%)
PMR	24	2(8.3%)
PMR + Evan's Procedure	3	–

Table V
Age of Presentation and End Results

Age of Primary Operations (mths)	No. of Feet	Result Good	Satisfactory	Poor
< 3	2	100%	0	0
3 - 6	18	66.7%	11.1%	22.2%
7 - 12	6	66.7%	16.7%	16.7%
> 12	10	20.0%	10.0%	70.0%

Discussion

The results showed that early surgical treatment less than 1 year of age yielded a high percentage of good result. This finding is consistent with others (De Puy and Drennan, 1989; Main and Crider, 1978; Otremski et.al., 1987; Porat et.al., 1984; Turco, 1981).

Post operative immobilization was found to be very short (2.85 months) compared to other series (Turco, 1981; Carroll, 1988; Simons, 1985). This finding might contribute to the residual deformity. The common residual deformity in this series is adduction deformity. This finding is in agreement with several authors (Aronson and Puskarich, 1990; Lowe and Hannon, 1973; Main and Crider, 1978; Tarraf and Carroll, 1992; Thompson et.al., 1982). This deformity is associated with cavus deformity and hindfoot varus, presenting the first metatarsal touching the ground during walking.

Attenborough (1966) reported 15 to 16 feet resulted residual forefoot deformity. Lowe and Hannon (1973) reported an incidence of 50% while Main and Crider (1978) reported an incidence of 69% of forefoot adduction in 48 patients after a one-stage of posteromedial release operation.

Lau et.al., (1989) reported an incidence of 17% of forefoot adduction. Brougham and Nicol (1988) reported that Cincinnati approach resulted high incidence of forefoot deformity. This adduction deformity tend to increase in severity as the child grows (Porat et.al., 1984). Many authors believed that the adduction deformity resulted from inadequate release of calcaneocuboid joint, because such a release is essential for a successful alignment of the forefoot on the hindfoot (Carroll et.al., 1978; De Puy and Drennan, 1989; Mc Kay, 1982; Porat et.al., 1984; Simons, 1985).

Otremsji et.al., (1987) achieved a 91% correction of forefoot adduction and varus deformity after a Turco Posteromedial Release which they had modified to include full release of the adductor hallucis and short plantar muscle and fascia versus 51% correction with posteromedial release only.

Another frequent finding in this study is heel varus, especially after posterior release procedure which is not a common finding in other study (Tarraf and Carroll, 1992; Thompson et.al., 1982). This indicate inadequate release of tight medial structure.

The fate of a clubfoot is determined by three factors; namely the calcaneocuboid joint alignment, the plantar fascia tightness and calcaneotalonavicular joint alignment. Inadequate release of these structures will result in significant high failure rate (Mc Kay, 1982, 1983l; Otremski et.al., 1987).

Cavus is an another frequent deformity found in this study and other studies (Aronson and Puskarich, 1990; Lowe and Hannon, 1973; Main and Crider, 1978; Tarraf and Carroll, 1992). The plantar fascia, flexor digitorium brevis and adductor digit quint muscle arise from the tuberosity of the calcaneus and insert under the plantar pad which are connected to the base of the proximal phalanges. Contracture of these structures may have contributed to a high rate of cavovarus deformity (Carroll, 1988; Mc Kay, 1983; Sherman and Westin, 1981; Tarrafand Carroll, 1992; Thompson et.al., 1982).

Conclusion

The optimal age for surgical correction of clubfoot deformity is between 3 to 12 months of age. The corrected foot required adequate immobilization postoperatively for at least 4 months, in order to maintain the foot in corrected position. The most common residual deformity after primary surgical correction is forefoot adduction, supination and cavus deformity.

Undercorrection constitutes the main failure of primary operation in this series. This reflects inadequate preoperative assessment and inadequate surgical procedures in term of the extend of soft tissue release. Inadequate postoperative immobilization can also contribute to the failure of surgery.

Based on the findings from this study, there is a need to have a standard protocol in the assessment of clubfoot prior to surgery.

The amount of soft tissue release should be decided at operation, so the consent must be taken as soft tissue release and not as a posteromedial release.

Postoperatively, the corrected foot must adequately immobilised whether in the plaster or splint until there is no sign of relapse.

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Hand Replantation and Revascularization - Six Years Experience in Hospital Kuala Lumpur 1990-1995

A Razana, M Y Hyzan, MD, V Pathmanathan, FRCS, R S Gill, FRCS

Summary

A retrospective study was conducted in 130 patients who underwent replantation or revascularization of 195 amputations in Hand and Microsurgery Unit Hospital Kuala Lumpur from 1990 to 1995. There were 130 patients with 195 amputations in the duration of 6 years study, which were mainly males (111 patients, 85.4%). The commonest age group involved was 19-25 years old (49 cases, 63.7%). There were 146 complete amputations replanted and 49 cases of incomplete amputations were revascularized. The commonest part involved was thumb and index finger (23% of cases each) and majority was caused by industrial accident (60.8%). However in pediatric age group home accident was the leading cause of the amputation (93.8%). The overall survival rate for the amputation was 65.6%. Revascularization had a better survival rate (77.6%) than replantation (61.6%). A clean cut wound and ischaemic time less than 12 hours gave better survival rate. However, there was no significant different chance of survival on distribution of injured parts and ischaemic time (< 12 hours).

Introduction

The first successful case of replantation of completely amputated human digit with microvascular anastomosis was reported by Komatsu and Tamai in 1968[1]. Subsequently, these procedures have been applied to the treatment of amputated extremities by many surgeons[2,3,4,5,6,7,8,9].

With rapid advancement of microsurgical techniques and related knowledge, success rate of 80% to 90% are now achieved. The major emphasis has now shifted to functional recovery of the restored part than mere survival. The initial enthusiasm over survival of the past must be tempered by proper evaluation of the functional results achieved. Evaluation of potential candidate for replantation, factors to be considered[7] include;

- physiodominance of extremity
- number and location of involved digits
- general health and psychological stability of the patient
- the condition of amputated part

Absolute contraindications to replantation are life threatening associated injury

- severe crushing injury of the affected part
- chronic illness or inability to withhold prolonged surgery

Relative contraindication;

- single digit amputation
- avulsion injuries
- lengthy warm ischaemia time > 12 hours
- extreme contamination

The aims of this study are to evaluate the pattern and demographic distribution of the amputations attempted for replantation or revascularization in Hospital Kuala

Lumpur, as the national referral center for Hand and Microsurgery in Malaysia. The factors that influence the survival rate of the amputated part were also studied in detail and the results were compared to the international standard level.

Materials and Methods

A retrospective study was undertaken of the final result in these patients by examination of patient and medical record. During 6 years period, 1990 through 1995, 130 patients underwent replantation or revascularization of 195 amputated parts at Hand and Microsurgery Unit Hospital Kuala Lumpur.

All data were entered and analyzed according to age and sex of the patient, the injured parts, cause and zone of injury, pattern and distribution of the amputation parts has been studied in detail. The influence of age, ischaemic time type of injury and type of wound on the survival rate were analyzed statistically.

Results

Distribution of Patient and Amputation by Year

Hand and Microsurgery Unit Hospital Kuala Lumpur was first started in 1990. When they first started in 1990, there were 10 patients with 13 amputations were attempted for replantation or revascularization, out of 10 patients, 2 patients had multiple amputations. This is shown in Figure 1 and Table I.

The number of the amputations attempted for replantation or revascularization was increased from 13 amputations in 1990 to 62 amputations in 1993. There were a total of 130 patients with 195 amputations, were attempted for revascularization or replantation in Hand and Microsurgery Unit Hospital Kuala Lumpur.

Number of Patient According to Age and Sex

Figure 2 shows that from the total of 130 patients operated in 1990 to 1995, in Hand and Microsurgery Unit Hospital Kuala Lumpur, 111 patients were males and 19 patients were females. The female patients had lower incidence of amputation than the male patients in every year and every age group, and they contributed to

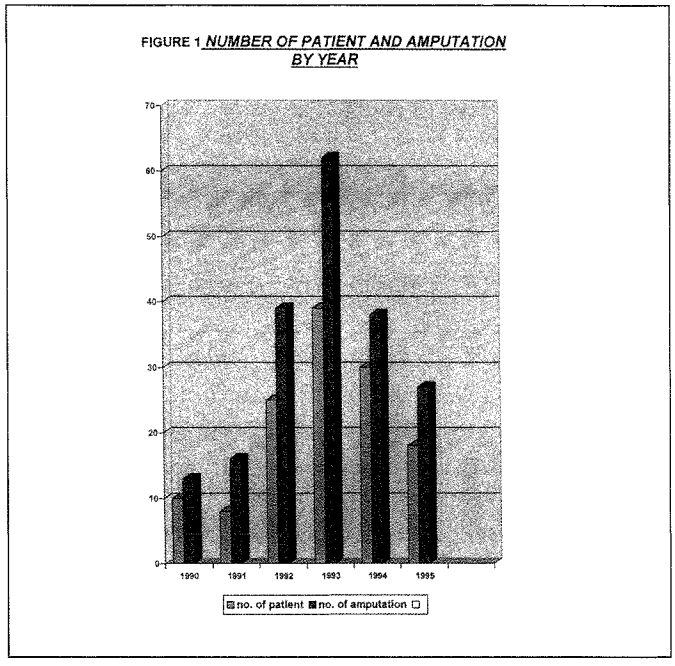

Fig. 1: Number of Patient and Amputation by Year

Table I
Survival Rate by Year

Year	Total No. of Amputations	Survived	Amputation Survival Rate (%)
1990	13	9	69.2
1991	16	11	68.8
1992	39	27	69.2
1993	62	39	62.9
1994	38	21	55.3
1995	27	21	77.8

24.7% (19 cases) of total number of patients. In pediatric age group, (< 12 years old), males had double incidence (11 cases) compared to female patients (5 cases), whereas in other age group (> 12 years old)

female patients involvement in the injury were much lower than male patients, with female : male ratio ranging from 1 : 9 to 1 : 5.

The commonest age group involved with amputations was 19-25 years old where there were 49 cases (63.7%); 44 were males and 5 were females.

In this series of study, the youngest patient that was operated, was 2 years old and the eldest was 48 years old. The mean age was 23.4 years and the median age of 23-year-old. The distribution of age was almost symmetrical, with the commonest age group of 19-25 years old,, (49 out of 130 patients) 63.7% of the cases (Figure 2).

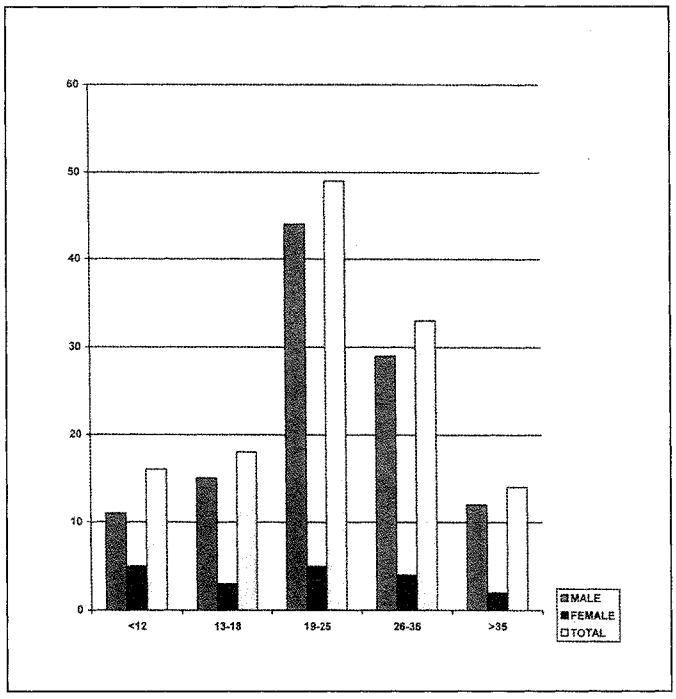

Fig. 2: Number of Patient According to Age and Sex

Type of Injury

A total of 195 amputations attempted for replantation or revascularization, where 146 were complete amputations with replantation done and 49 were incomplete amputations with revascularization done (Table II).

Distribution of Injured Parts

Table III shows the distribution of the injured part in 195 cases of amputations. It shows that index and thumb were the most common amputation attempted, 23% (45 cases of index and 44 cases of thumb amputations) of the total amputations (195 cases). The next commonest amputation attempted were wrist amputation, 14% (28 cases) then followed by middle and ring fingers with comprised of 13% (26 cases of each).

The least common amputation attempted were the extremity and midpalm amputations. They were usually crushed injury with untidy wound which was not suitable for salvage.

The extremity amputation were not very common and they cannot stand for prolonged ischaemic time as they compossed of a lot of muscle, which usually unsalvageable when arrived to hospital if proper storage and transportation were not done. Whereas for midpalm amputation there were 6 cases (3%) and also uncommon amputation attempted for replantation surgery as they were normally crushed injuries and not salvageable.

Cause of Injury

The causes of injuries were studied in 195 cases of amputation and is shown in Table IV.

There was noted that 60.8% of the amputations were caused by industrial accident, which was the commonest cause of the amputations. This observation is expected as the number of factories were increasing. Several factors contributed to the high incidence of industrial accident such as; untrained personnel (especially increase in number of foreign workers), 24 hours-operating factory that's dealing with machinery and negligence of the employees.

Home accident contributed 17.7% (23 cases) and they were normally clean cut injuries and salvageable. Assault cases 14.6% (19 cases) were the next commonest cause. Road traffic accident only contributed 6.2% (8 cases) of the total amputation, even though road traffic accident rate is high in our country.

Table II
Survival Rate of Replantation and Revascularization by Year

	Replantation			Revascularization		
	Total	Survived	Survival Rate	Total	Survived	Survival Rate
1990	8	5	62.5%	5	4	80.0%
1991	9	6	67.0%	7	5	71.4%
1992	34	23	68.0%	5	4	80.0%
1993	48	30	62.5%	14	9	64.3%
1994	25	10	40.0%	13	11	84.6%
1995	22	16	72.7%	5	5	100.0%
Total	**146**	**90**	**61.6%**	**49**	**38**	**77.6%**

Table III
Distribution of Injured Parts and Survival Rate

Amputated Part	Number of Amputation	Survived	Amputation Survival Rate	Replantation Survival Rate	Revasc. Rate
Thumb	44	26	59.1	57.1	66.7
Index	45	30	66.7	65.6	69.2
Middle	26	18	69.2	61.9	100.0
Ring	25	15	60.0	52.6	83.3
Little	16	9	56.3	46.2	100.0
Midpalm	6	3	50.0	33.3	66.7
Wrist	28	24	85.7	85.0	87.5
Extremity	5	3	60.0	66.7	50.0
Total	**195**	**128**	**65.6**	**61.6**	**77.6**

Table IV
Causes of Injuries According to Age Group

Age/Cause of Injury	Industrial Accident	Assault	Home Accident	Road Traffic Accident	Self Inflicted
< 12	–	–	15	1	–
12-18	15	2	1	–	–
19-25	36	6	3	3	1
26-35	21	8	3	1	–
> 35	7	3	1	3	–
TOTAL	**79**	**19**	**23**	**8**	**1**
(%)	**60.8%**	**14.6%**	**17.7%**	**6.2%**	**0.8%**

This was due to road traffic accident usually give dirty and untidy wounds that were not suitable for replantation or revascularization.

There was one case of self inflicted, with amputation of wrist noted in this study. He was a psychiatric patient with suicidal idea.

There were 5 causes of amputations in this series of study. The patients (130) were divided into 5 age group and the causes of injuries were studied accordingly to the age group (Table IV).

The youngest patient was a 2 year old who had thumb amputation after a cut by 'parang' and the eldest patient was a 48 year old who had industrial accident.

For pediatric age group, (< 12 years old), home accident was the commonest cause of amputation. In this series from 16 patients in pediatric age group, (< 12 years old) 15 patients (93.8%) had home accident and one patient (6.2%) had amputation caused by road traffic accident.

In the age group of 12 to 18 years old, there were 18 patients and out of these patients, 15 who had industrial accident were working illegally in the factory.

Table IV shows that in every age group, the commonest cause of amputation was industrial accident, 79 cases (60.8%), except in pediatric age group. The commonest age involved with industrial accident was 19-25 age group where there were 36 cases (45.6%).

Home accident was the second commonest cause of amputations, 17.7% (23 cases) and they mostly come from the pediatric age group. Assault cases 14.6% (19 cases) were mainly patients from 26-35 age group, 8 cases (42.1%), 6 cases (31.6%) and 2 teenagers (10.5%), 12-17 year old age group.

Factors Influencing the Survival Rate

Survival Rate by Year

In the early years of practice in replantation surgery, the emphasis was on survival of replanted parts than on the functional ability of the survived limb.

Table I overall survival rate according to the year of amputations. It shows that, in 1990 when the unit was first operated, they achieved 69.2% of survival rate (9 out of 13 amputations) and it improved to 68.8% in 1991 (11 out of 16 amputations) and 69.2% in 1992 (27 out of 39 amputations).

However, in 1993, more cases were attempted (62 cases) but the survival rate deteriorated to 62.9% (39 out of 62 amputations survived) and further dropped to 55.2% in 1994 (21 out of 38 amputations survived). The unit was more selective in the subsequent year, 1995, where only 27 amputations attempted and 21 cases survived with the survival rate of 77.8%.

The data were further analyzed in detail, to compare the survival rate of complete amputation where replantation done and incomplete.

Survival Rate and Age

In this part of study, the survival rate was calculated according to the age group.

As we know, pediatric patients, have smaller structures and are more difficult to operate on, however these patients can compensate deformity better than adult patients. In view of this, we studied the effect of age on the survival rate of the replanted parts by postulating that the survival rate is dependent on the age of patients.

From this study it showed that the overall survival rate of injured parts in pediatric age group (< 12 years old) was only 55.6% which was poorer as compared to adult age group 62.7% to 75.9% (Table V).

The data was analyzed statistically, and from Chi-square test, there was no statistically significant correlation between age and survival rate ($p>0.05$; p value = 0.165).

Table V
Survival Rate and Age

Age (Year)	Total	No. of Amputation	Survival Rate (%)
< 12	16	18	55.6
12-18	18	29	75.9
19-25	49	75	62.7
26-35	33	54	64.8
> 35	14	19	73.7
TOTAL	**130**	**195**	**65.6**

Survival Rate and Type of Injury

Table II shows the distribution of amputations according to type of injury and the survival rate.

The overall survival rate of amputations attempted for replantation or revascularization was 65.6%.

The data were analyzed in detail, from 146 of complete amputations where replantation were done, 61.6% survived. Revascularizations were done in 49 cases of incomplete amputations and higher survival rate was noted, 77.6%, than replantation survival rate (61.6%).

There was a statistically significant difference in the survival rate of complete and incomplete amputation. Incomplete amputation had a higher survival rate than complete amputation.

Survival Rate and Type of Wound

Table VI shows the detail of type wound in 195 amputations. Clean cut injuries (131 cases) comprised majority of the cases; crushed wounds 52 cases, and 12 cases were avulsed wounds.

The clean cut wound gave the highest survival rate, 72.7% whereas crushed wound 57.7% survival rate and avulsion wound had the lowest survival rate of only 16.7%.

The above observations showed that the clean cut wound had the best prognosis to survive as compared to the other type of wounds. This observation was also supported by statistic Chi-square test. (p value < 0.05).

Table VI
Survival Rate and Type of Wound

Type of Wound	No. of Amputation	Survived	Survival Rate
Cut	31	96	72.7%
Crushed	52	30	57.7%
Avulsed	12	2	16.7%
TOTAL	**195**	**128**	**65.6%**

Survival Rate and Ischaemic Time

Table VII showed the distribution of amputation according to the ischaemic time, < 6 hours, 6-12 hours and > 12 hours; the total number and the number of survived replantation or revascularization from which the survival rates were calculated respectively.

In this series they had 92 cases done less than 6 hours ischaemic time, (earliest surgery was 2 hours of ischaemic time) 87 cases done with 6 to 12 hours ischaemic time and 16 cases done after 12 hours post injury (the longest ischaemic time accepted was 18 hours).

The survival rate, as shown in Table VII, 62.0% of cases done less than 6 hours survived. Whereas for the amputations done within 6 to 12 hours, 68.0% survived and amputations done after 12 hours 75.0% survived.

However from Chi-square test, it showed there was no statistically significant correlation between ischaemic time and survival rate within 12-18 hours of ischaemic time (p value = 0.74).

Survival Rate and Distribution of Injured Parts

In this part of study, the number of amputations were divided according to the zone of injury and the survival rate was calculated respectively following which a statistic test was done to show the significance of the observation.

Table III above showing the distribution of amputated parts according to the survival rate. From the total of 195 amputation parts, 128 cases survived with overall survival rate of 65.5%.

The highest survival rate is noted for the amputation of wrist-hand zone V, 85.0% for replantation and 87.5% for revascularization with overall survival of 85.7%.

The lowest survival rate was midpalm amputation, only 50.0% survived (three case survived from six cases attempted). This was because the complex anatomy in that zone of amputation, where the deep and superficial palmar arch located and give branches to common digital arteries; nerves and veins following the arteries, which give more complex anatomy.

The most common digit amputations attempted for replantation or revascularization surgery were thumb (44 cases) and index (45 cases) amputations. Thumb amputations had 59.1% survival rate, which was slightly lower than index finger (66.7%). Middle finger (26 cases) with survival rate of 69.2% and ring finger (25 cases) with survival rate of 60.0%.

The extremity amputation gave a high survival rate, 60.0% (3 out of 5 cases survived) as the surgeons were more selective, but this finding may not be representative as the sample size was small.

Table VII
Survival Rate and Ischaemic Time

Ischaemic Time	< 6 Hours Total	Survived	Survived Rate %	6 - 12 Hours Total	Survived	Survival Rate %	> 12 Hours Total	Survived	Survival
Replantation	59	33	55.9	74	48	64.9	13	9	92.3
Revascularization	33	24	72.7	13	11	84.6	3	3	100.0
Total	**92**	**57**	**62.0**	**87**	**59**	**68.0**	**16**	**12**	**75.0**

However, from Ch-square test, there was no statistic significant different between the type of injured part and the survival rate (p value > 0.05).

Hence the priority of replantation or revascularization does not depend on the zone of the amputation as it gave same prognosis in term of survival rate, but it depends on the effect of the loss or impairment of the hand function.

For example, a total lost of thumb give impairment of 40% lost of hand function, whereas for index finger only 20%, thus thumb replantation has higher priority than index finger if one have to select, especially in multiple digits amputation in which one may have to salvage the other digit to replant to the thumb stump.

Discussion

Hand and Microsurgery Unit Hospital Kuala Lumpur, first started operating in replantation and revascularization in 1990, where there were 10 patients with 13 amputations attempted with the survival rate of 62.5% in replantation and 80% in revascularization.

The overall survival rate was 69.2%, which was comparable to the international standard[11,15,16]. Klinert, Jablan and Tsai[11] reported in their study survival rate of 70% easily achieved in experienced surgeon.

There was an increase in the number of amputations attempted, from 13 in 1990 to 62 amputations in 1993, as there was an increased in the awareness of the public.

The survival rate of replantation improved from 62.5% to 68% and the survival rate of revascularization remained about 80%. However, the survival rate for amputation dropped in 1993 to 62.9% with replantation survival rate of 62.5% and revascularization of 64.3%. Several reasons can be considered for the drop of the survival rate.

As we can see in Table I, there was an increased number of amputations attempted. They were less selective as there were increased in the demand of the surgery as there was an increased in the awareness of the public with high expectation of the replantation surgery. At the same time, there were an increased number of trainees. From 1994 to 1995, the survival rate had improved to a better survival rate, 77.8%.

Reported studies15,16 showed that the age of the patient did not influence the survival rate of amputation. Similar observation was noted in this study. This is only true if the surgeon had enough experience in microsurgery as the anatomy in pediatric patients is smaller and it is more challenging. However if the ischaemic time taken into consideration, it was noted that the higher the age of the patient and the longer the time of ischaemia, there was an increase in the failure rate.

In general, the survival rate for revascularization was higher than the replantation irrespectively to the ischaemic time. The above findings were consistent with other reported studies[10,15,16].

Clean cut wound was the commonest wound attempted for surgery (131 cases from 195 amputations). Their survival rate was 72.7%; the highest compared to crushed and avulsed wounds. They were normally cut by sharp instruments thus there were less local damage and better chance of survival as compared to crushed and avulsed wounds. This was supported by other studies[6,11,15,16].

In summary, overall amputation survival rate was improved in every year even though there was a slight drop in 1993 and 1994, but it improved dramatically in 1995, with strict patients selection. Revascularization had survival rate compared to replantation survival rate and in 1995 it achieved 100% survival rate, but on the other hand, it had a smaller number of patients than replantation surgery, thus the result may not be representative.

As technique and patient selection have been refined, the survival rate has been improved. Advances are reflected in the better than 90% upper extremity survival rate over the past three years period for properly selected upper extremity injuries.

Ischaemic time as mentioned before, is the time when the blood supply was totally cut (complete amputation)

or inadequate (incomplete amputation), to the time when the circulation is reestablished after vessel anastomosis.

How ischaemic time influence the survival rate ?

When an amputation occurs, the blood supply is inadequate thus the amputated part undergone changes in the metabolism. However, this metabolism rate can be slowed down by proper storage of the amputated part into a cold environment. After the vessel anastomosis and the establishment of circulation, the toxic substances from the amputated parts will circulate back to the systemic circulation. If there is a significant amount of toxic substances circulating in the body, there will be a reaction called "reperfussion syndrome" where the anastomosis site will have vasoconstriction and cause further damage to the amputated part and the replantation fails.

However, if the amputated part is stored properly in a cold environment as recommended, the ischaemic time does not influence the survival rate of replanted or revascularized parts. Some studies even mentioned that they achieved success and functional replanted parts even after > 12 hours of ischaemic time[12,15]. Taking the statement mentioned into consideration, it will be possible to do replantation surgery as semi-emergency operation at a convenient time especially if there is limited number of surgeons, or there are more than two amputations at the same time. This is especially so for digit amputations as they lack of muscle and compose mainly of tendon and bone.

The level and site of the amputation carry the same prognosis in the survival rate and ischaemic time does not influence the survival of the injured parts irrespective to the zone of injury.

Conclusion

In conclusion the survival rate of replantation (61.6%) and revascularization (77.6%) in cases done in Hand and Microsurgery Unit Hospital Kuala Lumpur is almost comparable to the international standard (70% - 80%). Ischaemic time (cold ischaemic time) for amputations of hand and digits, does not influence the survival rate of the replant or revascularization as long as the amputated part is stored properly in cold environment. The level and site of hand and digit amputations carry the same prognosis in the survival rate.

The clean cut wounds have the best survival chance as compared to other types of wounds, (crushed and avulsed), and the age of the patients does not influenc the survival rate of the replanted or revascularized parts.

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Arterial Fibrodysplasia In The Hand

E E Ong, FRCS*, J O'Dowd, MRCPath**, *Gwynedd General Hospital, Bangor, North Wales, **Airedale General Hospital, Keighley, West Yorkshire

Case Report

A 20 month old male infant was referred to the hand clinic with a tender swelling of ten days duration in the palm of his dominant left hand. While he continued to use his hand, it was noticed to cause discomfort. There was no history of trauma and a course of antibiotics failed to resolve the swelling. The child was afebrile and physical examination revealed a tender non-pulsatile mass overlying the fourth ray.

An initial diagnosis of a cyst secondary to a foreign body was made and the hand was explored under a tourniquet with the patient under general anaesthesia.

At surgery a diffusely enlarged ulnar artery from the level of the wrist joint was discovered (Figure 1).

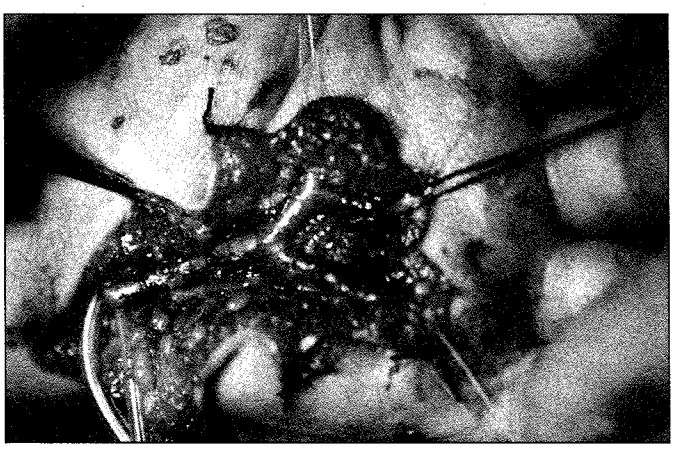

Fig. 1: Dilated ulnar artery and its branches of the left hand at the time of surgery.

One of the terminal digital branches was also noted to have thrombosed giving rise to the palmar swelling. After clamping to establish an adequate collateral circulation the ulnar artery was excised and histopathological examination carried out.

Post-opratively the patient recovered full function of his hand with no evidence of vascular impairment.

Pathological Findings

Macroscopically the tissue comprised of an artery 2.8 cm in length which, in one area, showed thrombosis. On histology this area showed recent organizing thrombus. The remaining tissue showed marked fibro-intimal proliferation affecting the whole circumference of the vessel causing luminal narrowing (Figure 2).

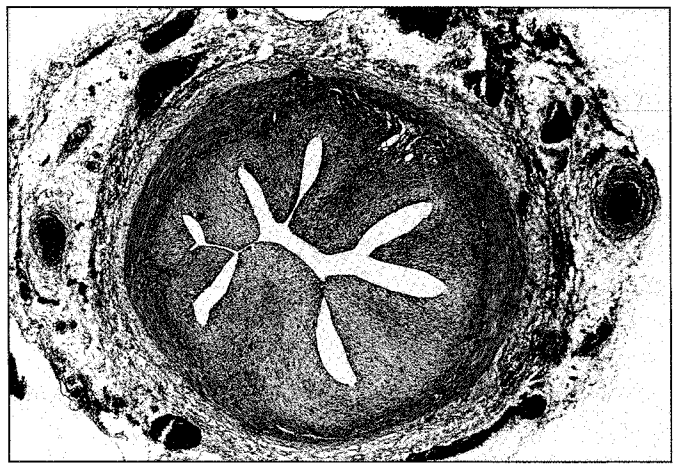

Fig. 2: This low power view of the artery shows a pronounced fibro-intimal proliferation with an essentially unremarkable media. H & E x 40.

The proliferating cells were plump but regular with no mitoses and were set in a focally myxoid ground substance (Figure 3). The internal elastic laminar was intact and the media and adventitia unremarkable. There was no evidence of vasculitis. the appearances are of intimal fibroplasia which is a subgroup of fibromuscular dysplasia.

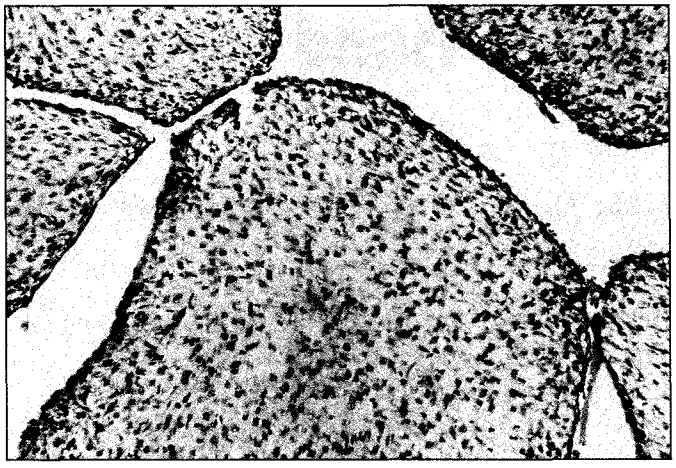

Fig. 3: At high power the intimal proliferation is composed of regular cells set in a myxoid groundsubstance. The proliferation is covered by endothelial cells. H & E x 200.

Discussion

Arterial fibromuscular dysplasia (AFD) in infancy though rare, has been documented (Price Vawter, 1972; Stanley et al, 1975). These authors have reported the presence of AFD in the renal, popliteal, mesenteric and mediastinal muscularly arteries. We believe that this is the first report of AFD occurring in the ulnar artery of the hand in a child.

Intimal fibroplasia represents a small subgroup of AFD accounting for between one and five percent. The most common form is medial fibrodysplasia forming 70 to 95 percent and the third form being periarterial (periadventitial) fibrodysplasia.

The renal artery is the most commonly affected though the internal carotid, vertebral, subclavian, coeliac, superior mesenteric, splenic and iliac arteries have all been reported to have been affected.

Clinically symptoms occur in the third or fourth decade of life. They manifest as renovascular hypertensio, headaches strokes, subaraachnoid haemorrhage, abdominal angina and claudication.

The aetiology of this conditon is unknown though it is postulated to be both congenital and developmental in origin. Humoral, mechanical, genetic and vessel wall ischemia (secondary to occluded vasa vasorum) have been implicated.

There was no further investigations carried out for this patient as our paediatric colleagues viewed this as an essentially benign condition. He will be kept under regular review.

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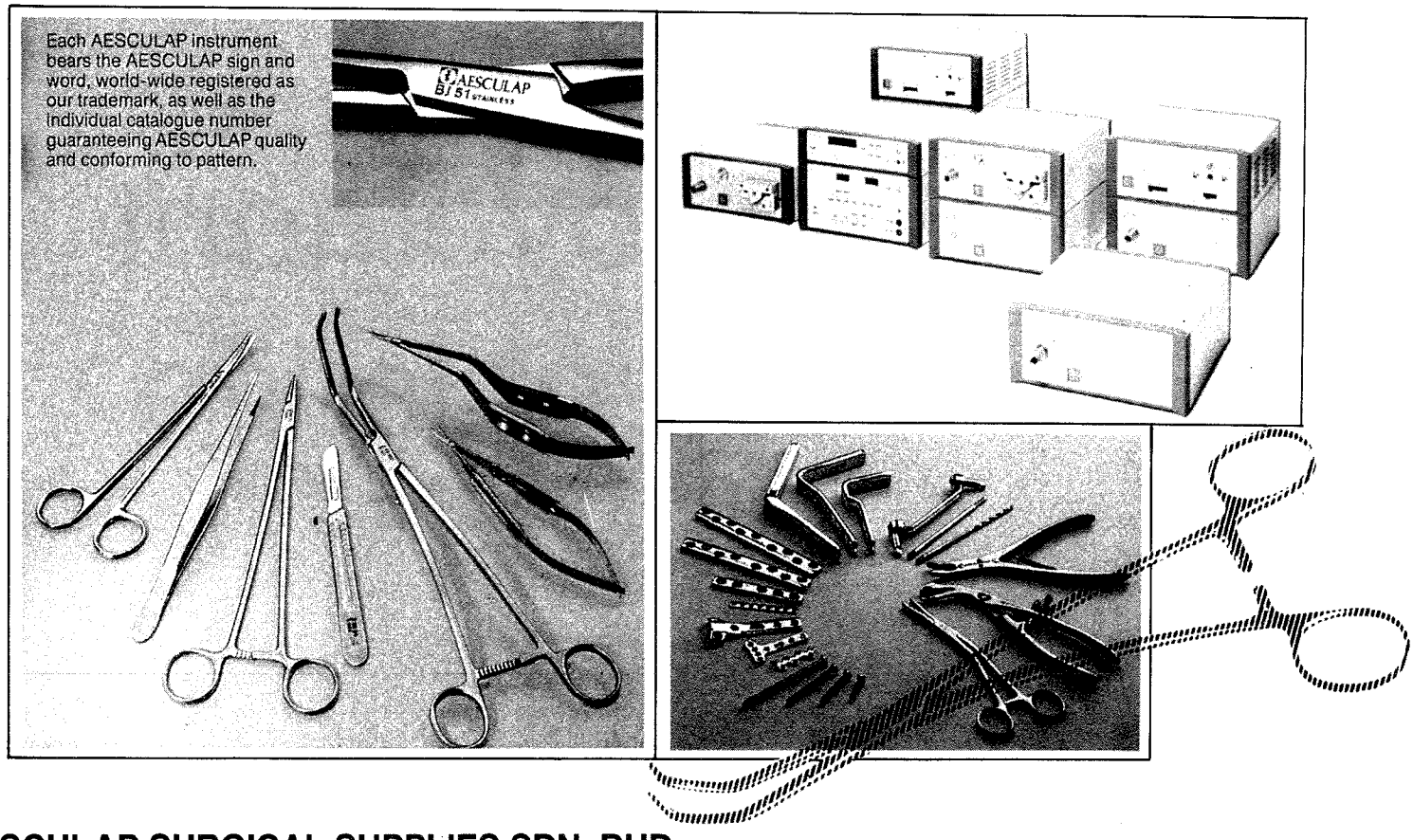

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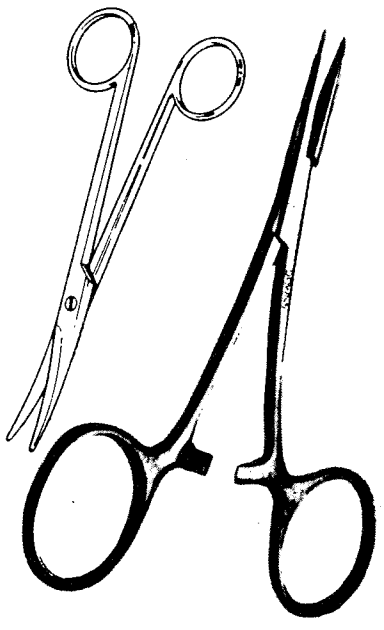

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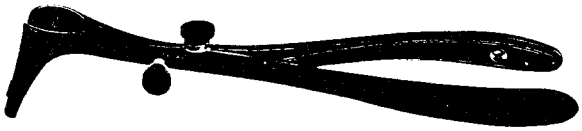

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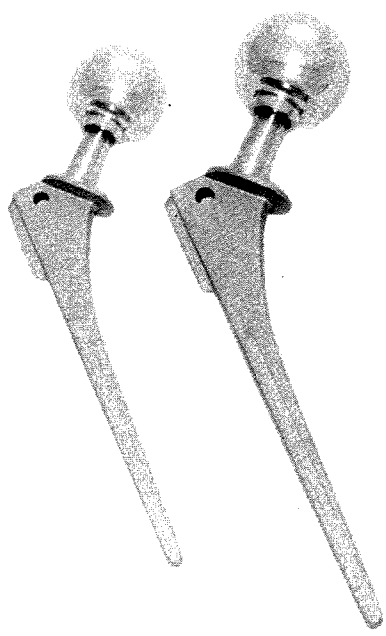

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