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A study of the role of McMurray osteotomy in the management of neglected, ununited femoral neck fractures in young adults in present day orthopaedics

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Abstract

Aim: To evaluate the role of the McMurray Osteotomy in present day orthopaedics in the management of neglected and ununited femoral neck fractures in young adults by assessment of clinical, radiographic and functional results in them.

Material & methods: Young adults within the age group of 15–45 years with ununited, neglected fractures of femoral neck were included in the study. All patients underwent McMurray Osteotomy followed by hip spica immobilization. The osteotomies were not surgically fixed. The post-operative complications and functional recovery was assessed using Charnley's modification of Merle D'Aubigne and Postel hip scoring.

Results: A total of 12 patients were included in the study. The average time of union following the procedure was found to be approximately 8.83 months (SD +/-1.23). There were seven cases of delayed union and no cases of avascular necrosis. Eight patients (66.67 %) had good post-operative functional results and 3 patients (25%) had satisfactory results.

Conclusion: The incidence of ununited femoral neck fractures in young adults, especially those complicated by neglect, is significant. One should develop criteria for opting for head salvage to avoid arbitrarily managing these cases with replacement arthroplasty. Though the McMurray Osteotomy is known to distort proximal femoral anatomy, which may complicate later THR, the 'arm chair effect' conferred by this procedure, makes it suitable in young patients with viable heads and significantly resorbed necks, for painless weightbearing, where chances of union may be improbable if not impossible. Supplemental internal fixation of osteotomy may help early mobilization and get better functional results.

Keywords: Femoral neck fracture, nonunion, neglected, McMurray osteotomy, young adults

Introduction

Management of non-union of femoral neck fractures in young adults continue to test the surgical skills of the treating orthopaedic surgeon even today^[1]. In some series the rate of non-union and avascular necrosis has been shown to be as high as 35% and 45% respectively^[2]. In our country this has been compounded by neglect, where there has been a delay of more than 30 days in seeking medical attention from time of trauma^[3]. This neglect also tends to be associated with a specific group of complications that includes osteopenia, resorption of neck, and avascular necrosis (AVN) which further complicates salvage of the femoral head^[1].

Non-union in these fractures has been attributed to factors such as severity of initial displacement, poor fracture reduction and fixation of fractures with posterior comminution^[4].

The methods of treating nonunion aim either at improving the biology and bone stock (i.e., non-vascularized and vascularized bone grafts, muscle pedicle graft) or improving the biomechanics (i.e., valgus osteotomy)⁽¹⁾. Concept of valgus osteotomy was put forward by Pauwels (1927) correlating with his findings that a high shear force at the fracture resulted from increasing vertical orientation of the fracture line^[5]. This procedure was later modified by Muller^[1].

The McMurray's osteotomy described by TP McMurray was a medial displacement, oblique intertrochanteric pelvic supporting valgus osteotomy^[6]. This was also used in management of advanced osteoarthritis. This procedure has given way to the valgus intertrochanteric osteotomy (VITO) with or without a vascular or non-vascular fibular graft with fixation^[1].

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We conducted a retrospective cohort study to evaluate the role of the McMurray’s osteotomy in present day scenario by assessment of clinical, radiographic and functional results in a series of cases of non-union in neglected femoral neck fractures in young adults, who had undergone this procedure.

Material & Methods

Since the McMurray osteotomy had given way to other forms of valgus osteotomies, we had to conduct a retrospective study using cases which had been done previously at our tertiary care hospital. The cases were traced by using the records at the Medical records department of our hospital. In this manner we were able to assess the out-patient and inpatients records of the subjects. A proforma was designed to note the preoperative, intraoperative and post-operative parameters for each patient selected for the study. Necessary research and ethical committee clearance were obtained prior to commencing the study

Young adults in the age group 15 to 45 years, with non-union of neglected femoral neck fractures (where treatment has been delayed from time of trauma) and those ambulant before trauma were included in the study.

Patient not reporting for assessment on call, those having avascular changes and collapse of femoral head on roentgenograms and those in age group less than 15 years and more than 45 years, were excluded.

All the patients were found to have undergone preop assessment for surgical and anaesthetic fitness. Preoperative skeletal traction was given to all as they had varying degrees of limb shortening. After 7-10 days of traction they were operated. We recorded the mechanism of injury, the interval

between injury and surgery, previous health status and outcome. All the patients included, underwent McMurray’s osteotomy and post-operative hip spica immobilization under anaesthesia. The operative technique has previously been well described in literature [7, 8].

Post-operative immobilization was done in a 1 ½ hip spica. No internal fixation of the osteotomy was done in any of the subjects. After 6 weeks, this was removed and the abduction was corrected and spica was reapplied. At 12 weeks post-operative, the spica was removed and X-rays were taken out of spica and patient was mobilized on crutches once union was seen. Some patients needed more immobilization if union was not satisfactory on X-rays.

Static quadriceps exercises were taught in spica on the first postoperative day. After removal of spica range of movement exercises were started for the hip and knee. Non weight bearing gait training was started using axillary crutches or walker frame.

Preoperative and post-operative X-rays were used to assess bone healing and any avascular changes or collapse were looked for. Functional recovery after surgery was assessed by recording the parameters like pain in the hip and knee, range of hip and knee movements, shortening, deformity, gait and return to preoperative work and lifestyle. This was analyzed using the Charnley’s modification of Merle D’Aubigne and Postel (PMA) hip scoring [8-10].

Data collected was analyzed. Statistical analysis used Chi-square Goodness of fit test, regression and correlation analysis, analysis of variance (ANOVA) and TUKEY test for multiple comparison of means where ever applicable.

Table 1: Pre-operative, operative and rehabilitation parameters observed.

S. No.	Side, Native treatment (YES/NO)	Age	Shortening Traction duration (WK)	Duration Of Surgery (HRS), Blood Loss (ML), Immobilization (WEEKS)	Complication	HK-RM (WK), Qcep Exs (WK), Amb Crt (WK)
1.	RIGHT, YES	20	5CMS, 3WK	2.75, 150, 20WK SPICA	SH 4CMS, DU	20, 1, 20
2.	RIGHT, NO	18	2.5CMS, 4WK	2.75, 150, 22WK SPICA	SH 2.5CMS, DU	21, 1, 21
3.	LEFT, YES	17	3CMS, 4WK	2.75, 150, 20WK SPICA	SH 1.5CMS	20, 1, 20
4.	LEFT, YES	15	2.5CMS, 2WK	1.50, 200, 12 WK SPICA	SH 1CMS	16, 1, 16
5.	RIGHT, YES	25	2.5CMS, 2WK	2.00, 200, 12WK SPICA	SH 1.5CMS, DU	20, 1, 20
6.	LEFT, YES	15	3CMS, 2WK	2.00, 150, 16WK SPICA	SH 1.5CMS, DU	16,1, 16
7.	LEFT, YES	18	3CMS, 2WK	2.00, 150, 20WK SPICA	SH 1CMS, DU	20, 1, 20
8.	LEFT, NO	33	4CMS, 4WK	1.50, 200, 20WK SPICA	SH 3CMS, DU	20, 1, 20
9.	LEFT, YES	40	2.5CMS, 1WK	2.00, 150, 16WK SPICA	SH 1.5CMS, DU	16, 1, 16
10.	LEFT, YES	42	3.0CMS, 3.5WK	1.50, 150, 20WK SPICA	SH 1CMS	12, 1, 12
11.	LEFT, YES	45	2.5CMS, 2WK	2.00, 150, 12WK SPICA	SH 2CMS	12, 1, 12
12.	RIGHT, YES	42	3CMS, 1WK	2.00, 150, 12 WK SPICA	SH 2CMS	12, 1, 12

- 1) HK-RM, QCEP EXS, AMB CRT – Starting hip knee ROM exercises, quadriceps exercises, ambulation on crutches (weeks), DU - delayed union, SH – shortening postop.
- 2) HRS – hours, WK – weeks, CMS – centimetres, ML - millilitres

Table 2: Clinical, radiological, functional parameters and final outcome.

S.No.	RU/CU (Mths)	PW/FW (Mths)	NSA (Deg)	HRM KRM (Deg)	Charnley’s modified PMA hip scoring for functional assessment.						
					HP KP (score)	HRM KRM (score)	GAIT CSQ (score)	VARUS SHT. (score)	RTW (score)	Total	Final outcome
1.	10/12	08/10	115	95/90	4	6	5	2	6	36	Satisfactory
					5	6	2	0			
2.	10/10	06/10	125	85/90	5	5	5	4	4	36	Satisfactory
					5	6	2	0			
3.	08/08	05/08	125	85/90	5	6	5	4	4	39	Good
					5	6	2	2			
4.	08/08	05/08	125	85/85	5	5	5	4	6	43	Good
					5	5	4	4			
5.	08/08	06/08	125	85/85	5	5	5	4	4	38	Satisfactory

					6	5	2	2			
6.	08/08	05/08	125	80/80	5 6	5 5	5 2	4 2	6	40	Good
7.	10/10	06/10	120	75/80	5 6	5 5	5 2	4 4	4	40	Good
8.	12/12	06/12	115	85/05	5 4	4 1	3 0	2 0	2	21	Poor
9.	08/08	05/08	125	100/95	5 6	6 6	5 2	4 2	6	42	Good
10.	08/08	05/08	125	95/95	5 6	6 6	5 4	4 4	6	46	Good
11.	08/08	05/08	125	100/95	5 6	6 6	5 4	4 2	6	44	Good
12.	08/08	05/08	125	95/95	5 6	6 6	5 4	4 2	6	44	Good

1) RU/CU – radiological union/ clinical union, PW/FW – partial weight bearing/ full weight bearing, MTHS – months

2) NSA – neck shaft angle, DEG – degrees, HRM/KRM – hip and knee range of movements, HP/KP – hip and knee pain, CSQ – sitting cross-legged and squatting, SHT – shortening, RTW – return to pre op work and lifestyle.

Results

A series of 12 young patients with neglected nonunion of femoral neck fractures were selected as per the inclusion criteria. An average age of 26.7 years along with a male to female ratio of 11:1 was noted. They consisted of mostly manual labourers involved with heavy work (44.8%). Those involved in light work constituted 17.2%. A fall from height of more than 10 feet accounted for 92% of the cases. The rest were caused by high velocity road traffic accidents. A delay in presentation at the hospital ranging from 1 to 6 months was observed. Three fourth of the subjects presented within 4 months post trauma. Nearly of them had undergone treatment at hands of a traditional bone-setter. In the preoperative assessment 5 subjects were found to have partial neck resorption, 1 had total neck resorption and the rest were normal. Partial avascular changes were noted in 2 subjects and the rest had normal heads. There was no segmental collapse noted in any.

The average time of surgery was 1.88 hours (SD +/- 0.24) with blood loss of 162.5ml (SD +/-1.65). Six of the subjects underwent hip spica immobilization ranging from a period of 12-16 weeks. Five were immobilized for 20 weeks and one for 22 weeks. Shortening ranging from 0.5cm to 2cm were noted in 58.8%. The rest had severe shortening. Mild varus was noted in 58.3% of the subjects. Delayed union were noted in 58.3% and necessitated an extended spica immobilization. Partial weight bearing was started at ranging from 6-8 weeks for 11 of the subjects and the average time taken for full weight bearing was 8 months. The average time for radiological union averaged around 8.83 months (SD +/-1.23) and clinical union around 8.3 months (SD +/-2.03). This was found to be statistically not significant by performing a Tukey test for multiple comparison of means ($p > 0.05$) of the time taken for union.

Functional results

- Pain: - one of the subjects had pain in the hip after some activity which was relieved on rest. The rest had slight to intermittent pain on walking which disappeared with activity. Knee pain on walking was observed in one subject which disappeared on activity. The rest had little or no pain.
- Range of movement: - hip flexion with $>90^\circ$ with abduction of 25° - 40° was observed in six of the subjects. Five subjects had hip flexion of 80° - 90° and minimal abduction of 25° . Knee assessment revealed that 58.34% of the subjects had flexion $>90^\circ$ and 33.33 had flexion of 80° - 90° .

- Squatting and sitting cross-legged: - only one subject was observed to have the ability to sit cross-legged or squat without any difficulty after treatment. Squatting and sitting cross-legged was found painfully restricted in 58.34% of the subjects. Four of the subjects (33.33%) had minimal restriction and minimal pain.
- Deformity: - mild coxa vara was noted in 10 of the subjects (83.33%) and the rest had moderate decrease in neck shaft angle.
- Shortening: - Severe shortening (>2.5 cm) was seen in 3 subjects (25%) and moderate shortening (1.5-2.5cm) was observed in six subjects (50%). The remaining had mild shortening (0.5cm-1.5cm).
- Gait: - eleven of the subjects (91.67%) could walk without a cane but had a slight limp. The one remaining could walk less than 1 hour with a cane, found it difficult to do so without a cane.
- Rehabilitation: - only 68.33% of the subjects could return to pre injury work or lifestyle.
- Final functional results: - following this procedure 66.67% had good results and 25% had satisfactory results

Discussion

This study was conducted with the objective of evaluating the role of McMurray Osteotomy in management of non-union of neglected femoral neck fractures in young adults in present day orthopaedics. Effectiveness of this procedure was attributed to its ability to convert a near vertical fracture line with extreme shear tendency to a near horizontal stable compressed fracture ^[1]. In addition, because of the displacement and valgus alignment the distal fragment of osteotomy is placed below the head of femur this allows weight bearing stress to bypass the fracture site ^[11]. This has been termed as ‘an armchair effect’ which confers the advantage of painless weightbearing even in presence of persistent non-union ^[11]. This procedure thus has also been proposed in cases of non-union of femoral neck fractures in the young with vascular heads and mild to severely resorbed neck of femur, where union may be improbable if not impossible ^[11].

Most studies reporting valgus osteotomy emphasize union but are hampered because of they lack long term follow up and have less than optimal functional outcome ^[1]. The aim to convert the near vertical fracture line to a horizontal one often results in excess valgus leading poor functional outcome caused by biomechanical alterations in the hip ^[12]. So, it is preferred to have definitive indications and contraindications in using valgus osteotomy in femoral head salvage. Here the

size of the proximal fragment (head) and fracture gap have been said to be important, though its measurement is complicated^[13]. Patients having head size less than 2.5 cm are more prone for bad results. As the femoral head size varies with height, sex and ethnicity a ratio called 'Neck resorption ratio' (NRR) may be useful. This is expressed as a ratio of the length of remnant of femoral head on affected side to neck length on sound side. This is not affected by traction or x-ray magnification and easily read on simple anteroposterior view of pelvis. Head salvage is indicated in young active patients with sufficient bone stock and contraindicated in patients with NRR less than 0.5^[14].

High energy trauma was the cause of this injury and complication in young adults. This was attributed to increased frequency of vertical fracture lines with shear in such patients as well as an increased incidence of posterior cortical comminution of femoral neck making these fractures unstable and prone for failure of union^[3].

Our series of patients demonstrated a male to female ratio of 11:1, which could be explained by the fact that most patients were from the rural areas where the males tend to be more active and mobile. Bakshi (1986)^[15] reported a much lower rate of 3.9:2. Delay in treatment averaged around 6 months very similar to Bakshi's report (1986) where he reported a mean of 6.3 months^[15]. A history of native manipulation was present at a ratio 5:1. Huang (1986) reported an incidence of 15:1 in a study in China^[16]. High energy trauma was the cause of this injury in 91.67% of patients in our series, which compared with the report by Meyers *et. al.* (1975)^[17]. The procedure was relatively simple as internal fixation was not used in our series. All were immobilized post-operatively with a hip spica. Thus, the time of surgery was reduced, dissection was less and blood loss was less. Reich (1941) reported on a series of cases where he mentions the procedure as taking approximately 20 minutes to perform^[18]. Coxa vara was noted in all patients in our series. Shortening was also noticed, 41.6% of them being severe. This was attributed to the gross femoral neck resorption seen in them. The valgus osteotomy and medial displacement of the distal fragment helped to counter these complications. Reynolds and Otto (1951) also reported shortening in their cases, even in ones with the best results^[19]. Delayed union was reported in 58.3% of our cases. This was taken care of by extending the period of immobilization in hip spica by 4-6 weeks. No non-union was reported in our series though a 9% non-union rate was reported by Reich (1941) in their series^[18]. There was no case of avascular necrosis reported developing post-operatively unlike a report by Reynolds and Otto (1951) where 7 cases were reported as having developed avascular necrosis after surgery^[19].

Partial weight bearing and full weight bearing in our series of cases were started at a mean of 6.2 months and 8 months respectively. We have been cautious in our study in allowing late weight bearing after noting the pre-operative delay in treatment by the patients and structural issue of femoral neck resorption. Reich (1941) had recommended removal of hip Spica at 6 weeks to allow partial weight bearing if osteotomy showed some union^[18]. A later time for full weight bearing in our series could be explained by the occurrence of 58.3% cases of delayed union. Time for clinical and radiological union was also shown to be 8.8 and 8.83 months respectively, much longer than reported in other studies.

Functional parameters such as residual pain and stiffness and the range of movements in the hip and knee of the affected side, deformity, shortening, gait and return to pre-injury work

and lifestyle were assessed. Our series of patients showed slight intermittent pain in the hip on walking which disappeared on rest with negligible knee symptoms. A report by Reynolds and Otto (1951) revealed 41.2% severely painful and unstable hips in their patients^[19]. Hip stiffness was seen in 50% of cases as compared to 41.25 in a study reported by Reynolds and Otto (1951)^[19]. Only one patient in our series, fully recovered the ability to sit cross-legged or squat. This could be attributed to use of hip Spica as immobilization which would delay early mobilization. Shortening was observed in our study in all patients comparable to the study by Reich (1941) who made the same observation^[18]. A slight limp was observed in all our patients and only 68.33% were able to return to preinjury work and lifestyle. Analysis of these observations were done by using the Charnley's modification of Postel and Merle D'Aubigne (PMA)^[10] hip scoring and good results were observed in 66.67% of patients and 25% had satisfactory results. Most observations were statistically not significant as the sample size was small.

Not using internal fixation and relying on hip spica alone, put one at a disadvantage with regard to early mobilization of the hip and knee and increased chances of stiffness and residual pain. The distortion of the proximal femoral anatomy may compromise future THR which will be made more difficult though not impossible^[1].

Conclusion

The incidence of nonunion complicating these injuries in young adults, is very significant especially when compounded with neglect. In spite of this one should avoid the often-adopted tendency nowadays to opt for a total hip replacement (THR) in the young. This can be done by developing certain criteria for head salvage as against those for considering a replacement arthroplasty.

Though the distortion of the proximal femoral anatomy caused by this procedure is often stated as disadvantage for later THR, failure of the procedure needing a THR is considered uncommon as 'the armchair effect' conferred by this osteotomy makes it suitable in young patients with viable heads and significantly resorbed necks, for painless weight bearing even in cases where fracture may not unite.

The usage of supplemental stabilization, conferred by modern implants such as proximal femoral plates or angled blade plate devices, for the osteotomy, make early mobilization possible and may reduce the morbidities such as stiffness and pain noted in our patients caused by extended spica immobilization.

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