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Original Article

Evaluation of valgus intertrochanteric osteotomy in neglected fracture neck femur in young adults

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ARTICLE INFO

Article history:

Received 18 December 2012

Accepted 23 March 2013

Available online 30 March 2013

Keywords:

Neglected

Valgus osteotomy

Intertrochanteric

ABSTRACT

Background: Femoral neck fractures in young adults have always presented a difficult problem with high rates of non-union and avascular necrosis. At our centre we have been using the traditional Pauwels intertrochanteric osteotomy for neglected un-united femoral neck fractures in young adults. We have made certain modifications in this procedure to suit our resources and so we evaluated the outcome of this procedure at our institute.

Methods: The study included fifty consecutive cases of neglected femoral neck fractures treated at our centre between February 1996 and October 2012. Patients in whom internal fixation had failed were excluded. The average age of the patients was 37 years (range: 17–55 years). Eleven of the patients were female & Thirty-nine were male. Fifteen patients belonged to Pauwels grade 1, Twenty-six patients belonged to grade 2, and nine belonged to grade 3. The interval between the injury and operation ranged from 1 to 12 months (average: 4.3 months). The cases were operated on a normal table using a Watson Jones Approach. The fracture ends were freshened and fixed using a 6.5mm screw followed by a valgus osteotomy which was fixed by a double angle (120 degree) blade plate. **Results:** A fracture union rate of 90% (45 cases) was achieved. Two of the healed cases developed avascular necrosis. Results were graded using Askin and Bryan's criteria. Overall, an excellent result was seen in 35 patients, good in 5, fair in 5 and poor in 5. Of the five patients having poor result (3 non-union, 1 implant breakage, 1 implant cut out), two refused revision surgery. In remaining three, one underwent total hip arthroplasty and in two revision osteotomy was performed.

Conclusion: We believe that intertrochanteric osteotomy provides a good outcome for neglected femoral neck fractures. Performing the procedure on a routine table, with Watson Jones approach and fixing with double angle blade plate is a good option.

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1. Introduction

Femoral neck fractures in young adults have always presented a difficult problem with high rates of non-union and avascular

necrosis.^{1–3} In developing countries many of these fractures present late, often as a result of delayed referral or because of initial management by traditional bone-setters. However, similar difficulties are encountered in the Western world,

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<http://dx.doi.org/10.1016/j.jcot.2013.03.003>

Fig. 1 – (a) Diagram showing fixation using a cancellous screw and plate, and the site of osteotomy. (b) Diagram showing the change in fracture inclination at the completion of the osteotomy.

mainly due to ‘failed’ fixation of femoral neck fractures. These complicated and neglected cases present a challenge to surgeons as it is difficult to achieve a long-lasting solution. The main options have been either procedures designed to retain the femoral head, or procedures to replace or excise the femoral head. At our centre we have been using the traditional Pauwels intertrochanteric osteotomy⁴ for neglected un-united femoral neck fractures in young adults. We have made certain modifications in this procedure to suit our resources and we present our experiences.

2. Materials and methods

The study included fifty consecutive cases of neglected femoral neck fractures treated at our centre between February 1996 and October 2012. Patients in whom internal fixation had failed were excluded. The average age of the patients was 37

years (range: 17–55 years). Eleven of the patients were female & Thirty-nine were male. Fifteen patients belonged to Pauwels grade 1, Twenty-six patients belonged to grade 2, and nine belonged to grade 3.

The interval between the injury and operation ranged from 1 to 12 months (average: 4.3 months). None of the patients had a significant coexisting medical condition but they all gave a history of significant trauma. The fracture site was painless in all except three patients who presented within 2 months of injury. Initial radiographs of the pelvis were taken with both hips in internal rotation in order to assess the degree of neck resorption, the inclination of the fracture surfaces, and to estimate the size of the implant. No evidence of femoral head collapse due to avascular necrosis was observed in any of the femoral heads, probably because of the lack of weight-bearing stress. Six patients required pre-operative skeletal traction in order to bring the femoral neck down to the level of the femoral head.

Fig. 2 – (a) Pre-op X-ray, (b) post-op X-ray of same patient at 2 years, showing good union and no avascular necrosis.

Fig. 3 – Pre-op and post-op (18-month) X-ray of same patient showing good union and no AVN.

The operations were carried out on a normal operating table and the Watson–Jones approach was used to expose the fracture site. Fibrous tissue was excised at the fracture site and the fracture was compressed using a 6.5-mm cancellous screw under visual control. This screw was inserted into the superior aspect of the neck leaving enough space inferiorly for plate fixation. A double-angled blade plate (120°) was then inserted with the blade at 90° to the femoral shaft and crossing the fracture site. Using a template we then removed a wedge of bone at least 1.0 cm distal to the blade and proximal to the lesser trochanter (Figs. 1a and 5). This 30° wedge allowed accurate apposition of the osteotomy (Figs. 1–4).

After operation the patients were mobilised with toe-touch weight-bearing, and then graduated weight-bearing 6 weeks

after operation. Patients were reviewed at 2 weeks, 6 weeks and 3 months after surgery and then at 6-monthly intervals. Individual follow-up ranged from 12 to 54 months (average: 30 months).

3. Results

Results were graded using Askin and Bryan's criteria (Table 1).⁵ Three patients developed non-union and in another the implant failed. In these patients we had failed to correct the inclination of the fracture adequately, and this had resulted in failure to convert shearing forces into compressive forces. In one patient the osteotomy plate had cut out through the femoral head (Fig. 5b). In one patient implant has penetrated into joint (Fig. 5a) but since fracture was united in that case, we removed the implant and patient was then symptom free.

We considered these five patients to have had a poor result. A fracture union rate of 90% (45/50) was observed and the average time for union was 3 months. All the osteotomies united but among the patients with united fractures there were two examples of avascular necrosis. One of these patients had a fair result, the other a poor result. Overall, an excellent result was seen in 35 patients, good in 5, fair in 5 and poor in 5. Of the five patients having poor result (3 – non-union, 1 – implant breakage, 1 – implant cut out), two refused revision surgery. In remaining three, one underwent total hip arthroplasty and in two revision osteotomy performed and fracture united after that.

Fig. 4 – Intra-op photograph showing insertion of cancellous screw followed by blade insertion at about 90° to shaft & removing lateral wedge of bone.

Table 1 – Modified Askin and Bryan criteria.

Excellent	No pain, near normal gait, <20% restriction of ROM, normal activity.
Good	Mild pain & limp, 20–40% restriction of ROM, mild restriction of activity.
Fair	Continuous pain, marked restriction of ROM and activity, need walking aid.

Fig. 5 – (a) Complications like penetration into joint and (b) cut out if screw.

4. Discussion

Femoral neck fractures in young adults continue to present an unsolved problem for orthopaedic surgeons due to their high rates of non-union and avascular necrosis.^{1–3} Similar examples, often associated with delayed presentation of these fractures in developing countries, also tax the ingenuity and imagination of orthopaedic surgeons. In this situation the need to preserve the femoral head has led to the development of various procedures such as valgus osteotomy,^{4,6} fibular grafts,⁷ muscle pedicle grafts^{8,9} and vascularised bone grafts.^{10,11} Some of these procedures are very time consuming and require considerable expertise and technical competence. In the setting of a hospital in a developing country we have used Pauwels' osteotomy which is a time-tested procedure, and we have made a few modifications to suit our specific needs.

Pauwels showed that fractures of the femoral neck present a mechanical–biological problem, and that the prognosis for healing is determined by the size of the shear and thrust forces acting on the fracture surfaces. He showed that after redirection of the plane of the fracture, the negative effect of the shear force could be eliminated and that fracture healing then occurred rapidly as a result of the pure compression force which had resulted.^{4,6}

We use Watson–Jones anterolateral approach to the hip with exposure of the fracture through an anterior capsular incision. This structure is relatively avascular^{11,12} and this approach does not interfere with the vascular supply of the femoral head.¹³ This open exposure allows removal of fibrous tissue from between the fragments thus encouraging vascularisation across the fracture site. It also allows good intra-operative compression of the fracture surfaces which we feel is essential for revascularisation of the femoral head.

While we agree that Pauwels' work provides a sound basis for understanding the mechanism of the treatment of these fractures, we believe that accurate measurement of Pauwels' angle is not reliable enough to be of practical value. Similarly we did not perform a pre-operative bone scan to assess femoral head vascularity as this would not have changed our

indications for the osteotomy. In any case previous reports have suggested an improvement in vascularity of the femoral head after valgus osteotomy.^{6,14,15} We believe that this type of osteotomy is still indicated so long as there is no severe collapse.¹⁵

A 120° double-angled blade plate inserted after removal of a wedge of 30° was used in all our patients. This realignment of the fracture inclination should be sufficient to provide adequate loading forces across the fracture. It would also prevent any chance of avascular necrosis developing from stretching of the ligamentum teres resulting from excessive valgus positioning of the femoral head.^{16,17} Although the artery in the ligamentum teres has only a limited role in providing the blood supply of the femoral head, it is usually the only remaining source of supply after a femoral neck fracture and every attempt should be made to protect it. This technique is relatively easy to use and requires minimal pre-operative planning. However, under-correction was the cause of failure in five of our cases. Great care needs to be taken to insert the blade plate accurately and to avoid any rotational deformity. As this operation is performed under direct vision, no image intensifier is required. Therefore we feel that open exposure of the fracture followed by anatomical reduction and good compression using a cancellous screw, aided by an intertrochanteric osteotomy to alter the mechanical forces acting across the fracture site, is a successful way to treat neglected femoral neck fractures (Figs. 2a,b, 3,4).

Conflicts of interest

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

REFERENCES

1. Massie WK. Fractures of the hip. *J Bone Joint Surg [Am]*. 1964;46:658–690.
2. Protzman RR, Burkhalter WC. Femoral neck fractures in young adults. *J Bone Joint Surg [Am]*. 1976;58:689–695.
3. Zolczer L, Kazar G, Manninger J, Nagy E. Fractures of the femoral neck in adolescence. *Injury*. 1972;4:41–46. 366.
4. Pauwels F. Grundsätzliches über Indikation und Technik der Umlagerung bei Schenkelhalspseudarthrose. *Langenbecks Arch Klin Chir*. 1949;262:404–422.
5. Askin SR, Bryan RS. Femoral neck fractures in young adults. *Clin Orthop*. 1976;114:259–264.
6. Mueller ME. The intertrochanteric osteotomy and pseudarthrosis of the femoral neck. *Clin Orthop*. 1999;363:5–8.
7. Nagi ON, Gautam VK, Marya SKS. Treatment of femoral neck fractures with cancellous screws and fibular graft. *J Bone Joint Surg [Br]*. 1986;68:387–391.
8. Bakshi DP. Internal fixation of ununited femoral neck fracture combined with muscle pedicle grafting. *J Bone Joint Surg [Br]*. 1986;68:239–245.

9. Meyers MH, Moore TM, Harvey Jr JP. Displaced fractures of the femoral neck treated with muscle-pedicle graft: with emphasis on treatment of these fractures in young adults. *J Bone Joint Surg [Am]*. 1974;57:718–720.
10. Chang MC, Lo WH, Chen TH. Vascularised iliac bone graft for displaced femoral neck fracture in young adults. *Orthopedics*. 1999;22:493–498.
11. Howe WH, Lacey TH, Schwartz RP. A study of the gross anatomy of the arteries supplying the proximal portion of the femur and the acetabulum. *J Bone Joint Surg [Am]*. 1950;32:856–865.
12. Trueta J, Harrison MHM. The normal vascular anatomy of the human femoral head in adult man. *J Bone Joint Surg [Br]*. 1953;35:442–461.
13. Gautam VK, Anand S, Dhaon BK. Management of displaced femoral neck fractures in young adults (a group at risk). *Injury*. 1998;80-B:474–475.
14. Huang CH. Treatment of neglected femoral neck fractures in young adults. *Clin Orthop*. 1986;206:117–126.
15. Marti RK, Schuller HM, Raaymakers ELFB. Intertrochanteric osteotomy for non-union of femoral neck. *J Bone Joint Surg [Br]*. 1989;71:782–787.
16. Aseem Taneja, Hemant Sharma, Gupta JP. Evaluation of results of intertrochanteric valgus osteotomy in ununited fracture neck femur. *J Clin Orthop Trauma*. 2011;2(1):29–34.
17. Frangakis EK. Intracapsular fractures of the neck of the femur: factors influencing non-union and ischemic necrosis. *J Bone Joint Surg [Br]*. 1966;48:17–30.