

Mukesh Kalra · Sanjeev Anand

Valgus intertrochanteric osteotomy for neglected femoral neck fractures in young adults

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Abstract Twenty cases of neglected (more than 1 month old) displaced femoral neck fractures in young adults were treated with a valgus intertrochanteric osteotomy. A fracture union rate of 85% (17 cases) was achieved. Two of the healed cases developed avascular necrosis. After 30 months 15 patients (75%) had achieved good to excellent results. We believe that intertrochanteric osteotomy provides good alternative management for neglected femoral neck fractures.

Resumé Vingt cas de fractures du col fémoral déplacées et négligées chez l'adulte jeune ont été traités avec une ostéotomie de valgisation intertrochanterienne. Dix sept fractures ont consolidés. Deux des cas consolidés ont développé une nécrose avasculaire. Quinze patients avaient un bon ou excellent résultat avec une moyenne de suivi de trente mois. L'ostéotomie intertrochanterienne est une bonne alternative pour le traitement des fractures du col fémoral négligées.

Introduction

Femoral neck fractures in young adults have always presented a difficult problem with high rates of non-union and avascular necrosis [9, 14, 16]. 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, 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 osteotomy [13] 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.

Materials and methods

The study included twenty consecutive cases of neglected femoral neck fractures treated at our centre between February 1996 and October 1999. 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 male and nine were female. 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. All the fractures showed a varying degree of neck resorption, but this did not always correlate to the length of time since injury. 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.

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 (Fig. 1a). 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 (Fig. 1a). This 30° wedge allowed accurate apposition of the osteotomy (Fig. 1b).

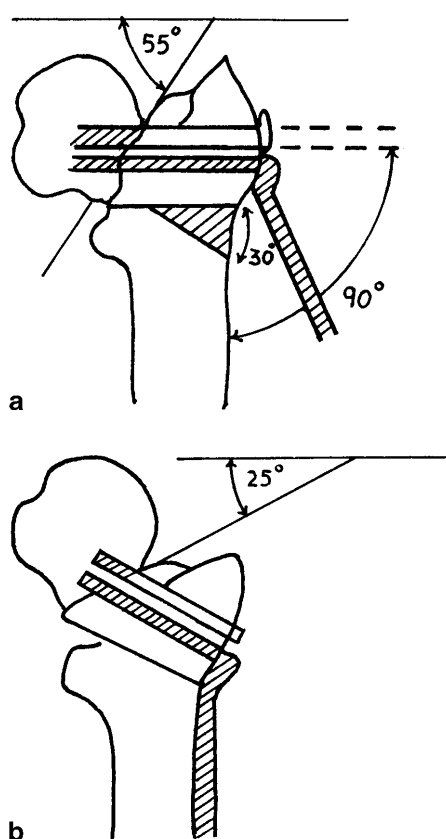
After operation the patients were mobilised with toe-touch weight-bearing, and then graduated weight bearing 6 weeks after operation. Patients were reviewed at 2 weeks, 6 weeks and 3 months after surgery and then at 6-monthly intervals. Individual follow-up ranged from 12 to 54 months (average: 30 months).

M. Kalra · S. Anand (✉)
Department of Orthopaedics, Maulana Azad Medical College,
New Delhi 110002, India
e-mail: sanjeevanand65@hotmail.com
Tel.: +44-208-4780622

S. Anand
9, Henley Road, Ilford, Essex, IG1 2TT, UK

Table 1 Details of patients treated by valgus osteotomy

S. no.	Age	Sex	Duration (months) ^a	Preoperative traction	Follow-up (months) ^b	Complications	Results ^c	Comments
1	38	M	5	+	54	–	E	–
2	47	M	3.5	–	47	Avascular necrosis	P	THR
3	17	M	3	–	45	–	E	–
4	52	F	9	+	43	Avascular necrosis	F	No re-operation
5	49	F	1	–	39	Superficial infection	E	–
6	46	M	4	–	37	–	E	–
7	28	F	3	–	36	–	G	–
8	17	F	7	+	33	Non-union	P	THR
9	44	M	6	+	31	–	G	–
10	37	M	12	+	30	Non-union	P	Implant cut-out, THR
11	29	F	3	–	26	Deep vein thrombosis	E	–
12	26	F	2.5	–	26	–	G	–
13	35	M	4	–	25	–	E	–
14	42	M	3	–	24	–	E	–
15	51	F	3.5	–	22	Non-union	P	Implant failure, THR
16	32	M	4	–	20	–	G	–
17	29	F	1.5	–	18	–	E	–
18	37	M	3	–	18	–	E	–
19	55	F	5	+	16	–	E	–
20	29	M	3	–	12	–	E	–

^a Averaged to nearest fortnight^b Averaged to nearest month^c As per Askin and Bryan's criteria [1]**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

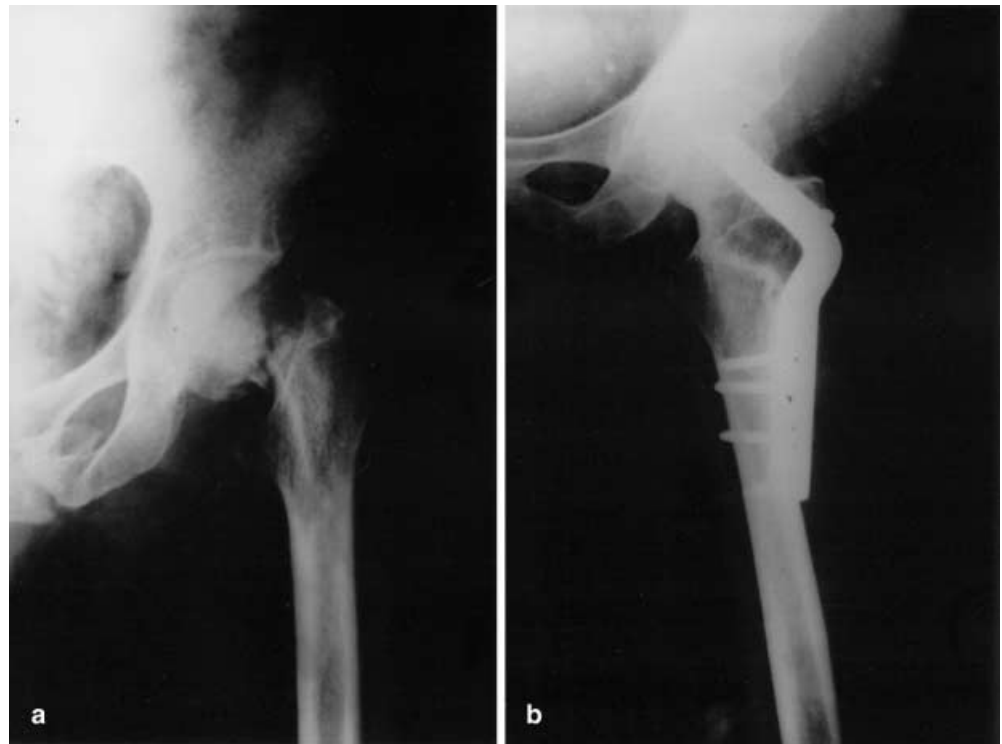
Results

Results were graded using Askin and Bryan's criteria [1]. One patient developed non-union and in another the implant failed. In both 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. We considered these three patients to have had a poor result. A fracture union rate of 85% (17/20) 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 11 patients, good in four, fair in one and poor in four (Table 1).

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 [9, 14, 16]. 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 [11, 13], fibular grafts [12], muscle pedicle grafts [2, 10] and vascularised bone grafts [3, 6]. 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

Fig. 2 **a** Preoperative X-rays of a patient (case 6, 46 years, male). **b** Postoperative X-rays of the same patient at 2 years, showing good healing and no avascular necrosis



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 [11, 13].

We use Watson-Jones anterolateral approach to the hip with exposure of the fracture through an anterior capsular incision. This structure is relatively avascular [6, 15] and this approach does not interfere with the vascular supply of the femoral head [5]. 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 [7, 8, 11]. We believe that this type of osteotomy is still indicated so long as there is no severe collapse [8].

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 [4]. 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 two of our cases (cases 8 and 15). 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 (Fig. 2a,b).

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