TRANSTROCHANTERIC ANTERIOR ROTATIONAL OSTEOTOMY FOR AVASCULAR NECROSIS OF THE FEMORAL HEAD

LONG-TERM RESULTS

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We reviewed 18 hips in 17 patients at a mean of five years after performing Sugioka's transtrochanteric anterior rotational osteotomy for avascular necrosis. The results were satisfactory in only three hips (17%). Twelve hips had been revised by hip replacement, revision was pending in one and two others were unsatisfactory. Hip replacement was not compromised by the previous Sugioka osteotomy.

Fifteen hips (83%) had shown further collapse of the femoral head, and we conclude from this and from isotope scans that the osteotomy may have impaired the residual blood supply of the femoral head. It seems that ethnic origin may be a factor in the outcome of this procedure; we have abandoned its use.

J Bone Joint Surg [Br] 1993; 75-B:597-601.

Received 4 January 1993; Accepted 17 February 1993

The aims of treatment of avascular necrosis of the femoral head are to prevent collapse of the subchondral bone and to slow the progress of degenerative changes. These objectives are not reliably achieved by currently available operations. The natural history of avascular necrosis is not clear, but once collapse has occurred, joint destruction usually follows. Any procedure that would delay collapse would be useful.

Core decompression is of questionable value and is not indicated when necrosis has progressed beyond stage I or at most stage II of Ficat and Arlet (1980), and arthroplasty is reserved for advanced disease. Many different osteotomies have been advocated for the intermediate stages II and III. Sugioka (1978) reintroduced the concept of rotational osteotomy previously

described by Merle D'Aubigné et al (1965). The Sugioka osteotomy is at transtrochanteric level, and either anterior or posterior rotation of the head moves the affected area from the weight-bearing part of the joint, bringing unaffected joint surface into position for weight-bearing. In theory, the unaffected surface has normal cartilage and subchondral bone, and is able to prevent collapse of the femoral head.

In 1984, Sugioka reported excellent or good results in 86% of the hips of 274 patients at a follow-up of 2 to 11 years.

We have made a prospective study of this procedure since 1981, and now report our results.

PATIENTS AND METHODS

From 1981 to 1983, we performed transtrochanteric rotational osteotomy on 21 hips in 19 patients. Two patients were excluded from the study because of inadequate follow-up; 18 hips in 17 patients were therefore reviewed. They all had anterior rotational osteotomy with a mean rotation of 79° (65° to 95°). The cause of avascular necrosis was alcohol abuse (6 hips), trauma (4), idiopathic (4), steroids (3) and Perthes' disease (one). The hips were graded for avascular necrosis using the stages of Ficat and Arlet (1980): 3 had stage IV, 12 had stage III, and 3 had stage II. No patient with hips in stage I was included.

All the osteotomies were performed by the same surgeon (MEC), after assessment by plain radiography, tomography, and ^{99m}Tc bone scanning. The neck-shaft angles were measured before and after operation to record any valgus or varus change.

Surgical technique. Cephalosporin 1 g was given to each patient. A lateral incision over the greater trochanter allowed the fascia lata to be split in line with the femur. The external rotator muscles were detached from the proximal end of the greater trochanter, which was osteotomised to allow it and the attached abductor muscles to be retracted proximally.

A circumferential capsular incision was made at the level of the labrum. Under radiographic control, two

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0301-620X/93/4610 \$2.00

Table I. Details and results of 19 patients treated by transtrochanteric anterior rotational osteotomy for avascular necrosis of the hip

Case	Side	Age (yr)	Ficat stage	Cause	Rotational correction (degrees)	Follow-up (mth)	Result				Collapse of femoral head		Overall result	Revision to total hip arthroplasty
							Pain	Range of motion	Limp	Joint narrowing	Before	After		
1	Right	44	IV	Alcoholism	70	48	Moderate	Good	Severe	Yes	Yes	Yes	Poor	Yes
2	Left	41	IV	Idiopathic	90	101	Severe	Poor	Severe	Yes	Yes	Yes	Poor	Pending
3	Left	26	III	Steroids	70	52	Severe	Poor	Severe	Yes	No	Yes	Poor	Yes
4	Left	17	II	Traumatic	80	106	Mild	Poor	Mild	Yes	No	Yes	Good	No
5	Right	37	II	Idiopathic	75	62	Moderate	Good	Moderate	No	No	Yes	Poor	No
6	Right	24	III	Idiopathic	80	19	Severe	Good	Severe	Yes	No	Yes	Poor	Yes
7	Right	49	III	Alcoholism	75	68	Moderate	Good	Severe	Yes	No	Yes	Poor	Yes
8	Left	22	IV	Perthes' disease	90	30	Severe	Poor	Severe	Yes	Yes	Yes	Poor	Yes
9	Right	38	III	Idiopathic	70	55	Moderate	Good	Slight	Yes	No	Yes	Poor	Yes
10	Right	33	III	Alcoholism	—	27	Moderate	Poor	Slight	No	No	Yes	Poor	Yes
	Left		III	—	65	30	Severe	Poor	Severe	Yes	No	Yes	Poor	Yes
11	Right	49	III	Alcoholism	85	24	Severe	Poor	Severe	Yes	No	Yes	Poor	Yes
12	Right	36	II	Steroids	75	60	Severe	Poor	Severe	Yes	No	Yes	Poor	Yes
13	Right	30	III	Steroids	80	96	None	Good	None	Yes	No	Yes	Good	No
14	Left	57	III	Trauma	75	60	None	Good	Mild	No	No	No	Good	No
15	Left	46	III	Alcoholism	75	60	Moderate	Good	Severe	No	No	No	Poor	No
16	Right	23	III	Trauma	95	18	Severe	Poor	Severe	No	No	No	Poor	Yes
17	Right	29	III	Trauma	90	44	Severe	Good	Severe	Yes	No	Yes	Poor	Yes
18*	Right	32	III	Steroids	90	12	—	—	—	—	—	—	—	—
	Left		III	—	90	6	—	—	—	—	—	—	—	—
19*	Right	42	III	Alcoholism	85	3	—	—	—	—	—	—	—	—

*lost to follow-up

Kirschner wires were driven through the centre of the cut surface of the femur perpendicular to its neck and aimed at the lesser trochanter. Double osteotomy was then performed using a reciprocating saw: the first cut was in the plane of the Kirschner wires and the second was made on the medial side of the femur at the level of the lesser trochanter, perpendicular to the first, as described by Sugioka (1978).

The proximal fragment was then rotated anteriorly, about the axis of the femoral neck, so that the involved portion of the femoral head was removed from the weight-bearing surface. This position of rotation was held temporarily by a Kirschner wire, and the osteotomy was fixed by a Richards sliding screw device with a side plate. In addition, a 6.5 mm cancellous screw was placed across the osteotomy to control rotation. Compression was then applied to the sliding screw to achieve solid fixation. The wires used to align the osteotomy were removed, the capsule was repaired, and the trochanter reattached by 18-gauge wire. The wound was then

thoroughly irrigated with sterile saline and two deep drains were placed in position. The fascia lata was approximated with absorbable sutures and the skin and subcutaneous tissues closed.

Three days after the operation, patients were allowed to walk with crutches, touch weight-bearing on the affected side, and they continued to do so after leaving hospital until there was radiographic evidence of solid union.

Follow-up averaged 57 months (18 to 106). In patients who did not require arthroplasty, it averaged 81 months; in those who required arthroplasty it was taken to be the interval between osteotomy and the subsequent operation.

For 15 patients follow-up included clinical examination performed by the senior author (MEC) and radiography. The other two patients had had hip replacements at other institutions, and were reported by them.

The grading of clinical results was based on pain,

Fig. 1a

Fig. 1b

Fig. 1c

Case 10. Figure 1a - Radiograph of a 33-year-old man with bilateral, alcohol-induced, stage III avascular necrosis of the femoral heads. Figure 1b - Anteroposterior view of right hip six months after transtrochanteric anterior rotational osteotomy. The early result was satisfactory. Figure 1c - Lateral view.

Fig. 2

Case 10. *Left*, ^{99m}Tc bone scan before operation. *Middle*, two weeks after operation. *Right*, six months after operation. There is a reduction in isotope uptake in the head and neck of the femur.

limp (none, mild, moderate, or severe), and range of motion (excellent, good, or poor).

RESULTS

For all 21 hips, total blood loss averaged 600 ml and the average operating time was 182 minutes. Hospital stay ranged from 8 to 14 days. The average time to union of the osteotomy was 10 weeks.

At review, 12 of the 18 hips had required total arthroplasty for continued pain, or progression of symptoms (Table I). The mean time to revision for these 12 hips was 39 months, by which time all showed further narrowing of the joint space or progression of femoral head collapse (Figs 1 to 4). The previous Sugioka osteotomy did not cause problems at revision arthroplasty.

One other patient has a poor clinical and radiographic result and is awaiting total hip replacement. At their latest follow-up two other patients had moderate to severe pain and radiological evidence of collapse of the

femoral head and degenerative changes.

This leaves only three patients with satisfactory results. The first was a 17-year-old boy with stage II post-traumatic avascular necrosis. Nine years after osteotomy he has only mild pain and a slight limp, but the range of motion is limited and there is radiographic joint narrowing.

The second patient, a 57-year-old woman with post-traumatic avascular necrosis in stage III, has an excellent clinical and radiographic result at five years. She has good range of motion, no pain, and only a mild limp with no evidence of joint-space narrowing or further collapse (Figs 5 to 8). The third patient, a 30-year-old man with steroid-induced avascular necrosis in stage III, has no pain or limp eight years after osteotomy. His range of hip motion is good, but radiographs show some further collapse of the femoral head and joint-space narrowing.

One of three patients with stage II disease had a satisfactory result; 10 of 11 patients (12 hips) with stage III disease and all 3 with stage IV had poor results. The ^{99m}Tc bone scans of all patients showed additional and

Fig. 3

Fig. 4

Case 10. Figure 3 – 3.5 years after operation. There are degenerative changes and collapse of the femoral head. Figure 4 – Conversion to an uncemented hip replacement arthroplasty gave a satisfactory outcome.

Fig. 5a

Fig. 5b

Fig. 6a

Fig. 6b

Case 14. Figure 5a – Post-traumatic stage III avascular necrosis of the femoral head in a 57-year-old woman. Figure 5b – ^{99m}Tc bone scan before operation. Figure 6 – Anteroposterior (a) and lateral (b) views one month after operation. The anterior translation of the necrotic area can be seen.

Fig. 7

Fig. 8

Figure 7 – ^{99m}Tc bone scan three months after the operation showing reduced uptake at the head and neck of the femur. Figure 8 – Anteroposterior view of the hip five years after operation. The patient had a satisfactory result with few symptoms.

persistent impairment of the vascular supply to the femoral head soon after the operation (Fig. 2).

The neck-shaft angles averaged 133° before and 142° after operation. The angle increased in 18 hips (valgus) and decreased in three (varus), but the achievement of a varus neck-shaft angle did not correlate with a better result.

In summary, of 18 hips, only three (17%) had a satisfactory clinical result and two of these three showed ominous radiological signs.

There were no postoperative complications of clinical significance. One patient had respiratory distress soon after surgery, but this responded to treatment. There were no postoperative infections and there were no cases of malunion or nonunion. At follow-up, 10 of the 18 had loss of joint motion at some stage, there was radiological evidence of progressive collapse in 13, and 11 showed increased joint-space narrowing.

DISCUSSION

In the last published study of the procedure Sugioka, Katsuki and Hotokebuchi (1982) reported 86% good or excellent results in 274 patients at follow-up of 2 to 11 years, and in 1991 Sugioka, Hotokebuchi and Tsutsui presented similar results at the Annual Meeting of the American Academy of Orthopaedic Surgeons.

Other Japanese surgeons have reported less satisfactory results. Masuda et al (1988), using Sugioka's technique, reported 69% satisfactory results in 52 patients followed for five years. Saito, Ohzono and Ono (1988) reported 15 patients with a follow-up of 2 to 14 years. They found absence of further collapse of the femoral head in nine patients, but had three fractures of the femoral neck and two cases of late varus deformity, a complication rate of 33%.

Eyb and Kotz (1987) published the results of 39 Sugioka procedures with 23 good or excellent results, but they had a 46% incidence of postoperative complications which they related to the fixation device. We fixed all our osteotomies with a screw-plate because of concern with the poor fixation we achieved in preliminary work in the cadaver with the crossed wood screws proposed by Sugioka. We had no cases of malunion or nonunion.

Tooke, Amstutz and Hedley (1987) reported 17 patients at a mean follow-up of 39 months; seven (41%) had had revision to hip replacement, three had virtual ankylosis, and three patients were dissatisfied. Only four patients (24%) had excellent clinical results and one of these showed further radiographic collapse of the femoral head. These results, after a shorter follow-up, are similar to ours. The results of ^{99m}Tc bone scanning in our study indicate that the remaining vascular supply of the femoral head is reduced by the operation.

There are several possible reasons for the striking differences between our results and those of Sugioka. First, we did not advise avoidance of weight-bearing

after the osteotomies had healed; Sugioka's postoperative regimen apparently included a prolonged period without weight-bearing. Secondly, many of our osteotomies ended in a valgus rather than a varus position, but this did not seem to make any difference to the result.

The third and potentially most important reason may be that there are race-dependent differences in the anatomy of the hip capsule. In all our cases at osteotomy, we observed that anterior rotation of the femoral head stretched the quadratus femoris. The posterior collum branch of the medial circumflex artery which lies within this muscle may have become flattened and obstructed. It is possible that in Japanese patients, the posterior capsule of the hip is more lax and allows anterior rotation of the neck without compromising flow through this artery.

We abandoned the Sugioka anterior rotational osteotomy in 1983 and believe that it should not be performed in Caucasian patients. It does give satisfactory early pain relief, perhaps through joint denervation produced by the capsulotomy, but the procedure appears to compromise further the blood supply of the femoral head and to increase both collapse of the femoral head and secondary degenerative changes.

We found that the Sugioka procedure did not affect the results of subsequent total hip arthroplasty, partly because we performed the osteotomy with particular care to preserve the anatomy of the intertrochanteric area of the femur.

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.

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