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A new fibular osteotomy in association with high tibial osteotomy (a comparative study with conventional mid-third fibular osteotomy)

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Abstract A new technique for dividing the fibula when performing a high tibial osteotomy is described. The head of the fibula is enucleated and morselized. The technique is simple and safe with a low complication rate.

Résumé En cas d'ostéotomie supérieure du tibia, nous décrivons une nouvelle technique d'ostéotomie péronière avec énucléation et morcellement de la tête du péroné. On peut employer pour ce faire la même incision cutanée que pour l'ostéotomie du tibia. L'incidence de complications est faible.

Introduction

High tibial osteotomy is a common procedure for the treatment of medial osteoarthritis of the knee; and in order to obtain an appropriate correction the fibula is usually divided. Complications include delayed union of the tibial osteotomy, peroneal nerve palsy and discomfort at the tibial osteotomy site [2, 5, 7, 10, 12]. Since 1991 we have used a new fibular osteotomy procedure which involves enucleation and morselization of the head of the fibula (Figs. 1, 2). In this paper we describe the technical details of the procedure and compare the outcome with that using a conventional osteotomy of the mid-third of the fibular.

Patients and methods

Between 1984 and 1993 125 knees in 99 patients were treated with high tibial osteotomy. A curved "dome-type" osteotomy and external fixation were used as described by Maquet [8]. The knees were divided into two groups according to the type of associated fibular osteotomy: the enucleation and morselization group (group A) and the osteotomy of the mid-third of the fibular group (group B). The clinical details of the two groups are set out in Table 1. The external fixator was retained until adequate union had been achieved. Some patients required immobilisation with plaster of Paris (POP) thereafter. The mean follow-up was 4.3 (2–10.5) years and union of the tibial osteotomy occurred in every case.

One-way analysis of variance was used to analyse the period of time of retention of the external fixator. Chi-square analysis was used for the rest of the analysis. All differences were considered to be significant at a probability level of 95% ($P<0.05$). Statistical analysis was performed on a personal computer (Power Macintosh 8600/200; Apple Computer, Cuppertino, Calif., USA) using Statview IV (Abacus Concepts, Berkeley, Calif., USA).

Results

The factors relating to union of the tibial osteotomy are shown in Table 2. The average time of the requirement for external fixation was 49.7 days in group A and 59.7 days in group B ($P<0.01$). In eight cases in group A a further period of POP immobilisation was required after removal of the external fixator for a mean time of 2.3 (1–4) weeks. In 13 cases in group B a further period of POP immobilisation was required for a mean time of 3 (1–12) weeks. One case in group A required a secondary bone graft procedure to obtain union; and five cases in group B required a secondary bone graft procedure. Thus bony union occurred earlier in group A than in group B.

Transient paralysis of the extensor hallucis longus and tibialis anterior muscles was seen in one case in group A. Complete recovery occurred 2 months after the removal of the external fixator. Sensory disturbance without loss of motor function in the peroneal nerve region was seen in one case. However, in 11 cases in group B there was paralysis of the extensor hallucis longus muscle and sensory disturbance in the peroneal nerve region. In ten cases there was complete recovery after removal of the external fixator; persistent paralysis of the extensor hallucis longus muscle occurred in one case.

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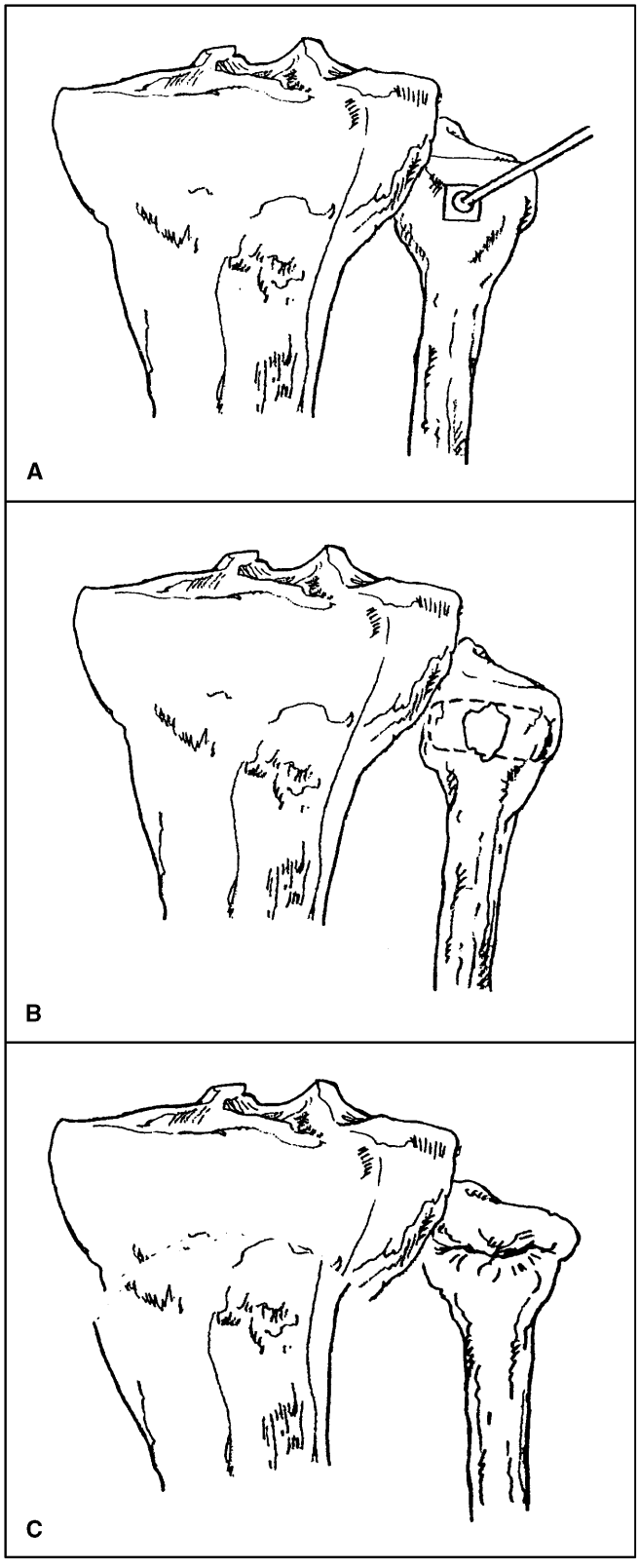

Fig. 1A–C The enucleation and morselization method. **A** Fenestration of the cortical bone of the anterior portion of the fibular head is carried out with an osteotome. **B** After removal of the cancellous bone, the cortical bone of the medial, lateral and posterior portion of the fibular head was trimmed using an air drill and a curette. Care should be taken not to deeply break and penetrate the postero-lateral part of the cortex to avoid damage to the peroneal nerve. **C** The fibular head can be deformed and morselized while varus deformity of the tibia is corrected

Fig. 2 An example of postoperative radiograph. The fibular head is morselized and deformed with correction of varus deformity

Bony union at the fibular osteotomy site was seen in all cases in group A, with no local discomfort at 1 year after operation. However, in group B a bony union was seen in only 28 cases. In 38 cases there was atrophic non-union and in 14 cases a hypertrophic non-union. Pain and tenderness at the osteotomy site in this group were seen in two cases and five cases, respectively (Table 3).

Discussion

Several techniques for performing fibular osteotomy in association with high tibial osteotomy have been described [1, 3, 11]. Osteotomy within the proximal one-third of the fibular has a high instance of peroneal nerve

Table 1 Patient data

Type of fibular osteotomy (years)	No. of patients	No. of knees	Mean age (years)	Male/female	Mean correction angle (deg)
Group A: fibular head enucleation and morselization (1990–1993)	36	45	62 (range 23–74)	8/28	15 (range 8–25)
Group B: mid-third fibular osteotomy (1984–1990)	63	80	62 (range 29–76)	12/51	15 (range 7–25)

Table 2 Factors related to bone union of the tibia after osteotomy

Technique of fibular osteotomy	Group A (enucleation and morselization)	Group B (mid-third osteotomy)
No. of knees	45	80
Duration of immobilization with an external fixator	49.7±11.3 days*	59.7±18.2 days*
Cases requiring additional cast application	8 knees	13 knees
Cases requiring additional bone graft	1 knee	5 knees

*$P<0.01$

Table 3 The rate of peroneal nerve palsy, fibular bone union and fibular osteotomy site pain

Technique of fibular osteotomy	Group A (enucleation and morselization)	Group B (mid-third osteotomy)
No. of knees	45	80
Incidence of peroneal nerve palsy	2 knees	11 knees
Rate of bone union	45 knees*	28 knees*
Spontaneous pain	None	2 knees
Tenderness at the fibular osteotomy site	None	5 knees

*$P<0.001$

palsy and is not recommended [4, 6, 9, 13]. The technique of morselization of the head of the fibula described here is a modification of a technique commonly used in Singapore (personal communication). There are various advantages of this procedure. It may be carried out through the same incision as the high tibial osteotomy. The fibular artery and vein arise from the posterior tibial artery at a mean distance of 8.3 (7.5–9) cm distal to the head of the fibula and run along the shaft of the fibula and may easily be damaged during osteotomy of the mid-third of the fibula [9]. Although there is no risk of damage to the fibular artery and vein when performing enucleation and morselization of the head of the fibula, care should be taken not to damage the common peroneal nerve which lies directly posterior to the head of the fibula. In this technique all cortical bone does not need to be divided, but it should be prepared enough to deform when the varus deformity of the tibia is corrected. Fenestration of the anterior aspect of the fibula head is performed with an osteotomy and the cancellous bone is removed with a curette. The cortical bone of the medial, lateral and posterior aspects of the head of the fibula is prepared from within using a curette and an air drill. The medial aspect is thinner than the lateral and posterior aspects and care is required posterolaterally due to the proximity of the common peroneal nerve. The "dome-type" tibial osteotomy is performed after preparation of the fibula.

When performing an osteotomy within the mid-third of the fibula, the proximal portion of the fibula usually moves medially after correction of the varus deformity of the tibia [1], and this shift is more prominent when the correction angle of varus is larger. It is suggested that the movement medially of the fibula causes traction and compression of the surrounding soft tissues which may cause a peroneal nerve palsy. The displacement of the proximal fibula at the osteotomy site increases the incidence of non-union with local symptoms. Some authors recommend an osteotomy within the distal third [1, 6, 9], but there is a similar incidence of non-union. Since union was achieved in all cases in group A, tenderness at the osteotomy site was not found. Union of the tibial osteotomy was achieved 10 days earlier on average in the fibular head enucleation and morselization group ($P<0.01$). The better union of the tibial osteotomy in this group may be due to stability and early union at the fibular osteotomy site. When performing enucleation of the head of the fibula it is not necessary to sacrifice the proximal tibiofibular joint, the attachment of the lateral collateral ligament or the biceps femoris tendon as reported in the description of high tibial osteotomy by Coventry in 1973 [3]. As the common peroneal nerve

runs from posterior to anterior around the neck of the fibula, it is at risk during any surgical procedure involving the proximal fibula [11]. However, the enucleation and morselization technique described in this report does not require wide local soft tissue dissection. Soejima et al. [11] reported difficulty in correction of a severe varus deformity with osteotomy of the neck of the fibula. The greatest angle of correction associated with the technique presented in this study was 25 deg, indicating that the head of the fibula may be deformed as much as is required to achieve an adequate correction by high tibial osteotomy.

In summary: the enucleation and morselization of the fibular head in association with a high tibial osteotomy have the following advantages: there is no need for a separate skin incision; there is no risk of damage to the fibular artery and/or vein; bony union at the fibular osteotomy site is achieved in all cases; the incidence of peroneal nerve palsy is low, although extreme care should be taken when preparing the postero-lateral aspect of the head of the fibula; and the incidence of delayed union of the tibia is low.

References

1. Aydogdu S, Yercan H, Saylam C, Sur H (1996) Peroneal nerve dysfunction after high tibial osteotomy. An anatomical cadaver study. Acta Orthop Belg 62:156–160
2. Cameron HU, Welsh RP, Jung YB, Noftall F (1993) Repair of nonunion of tibial osteotomy. Clin Orthop 287:167–169
3. Coventry MB (1973) Osteotomy about the knee for degenerative and rheumatoid arthritis. Indications, operative technique and results. J Bone Joint Surg [Am] 55:23–48
4. Curley P, Eyres K, Brezinova V, Allen M, Chan R, Barnes M (1990) Common peroneal nerve dysfunction after high tibial osteotomy. J Bone Joint Surg [Br] 72:405–408
5. Georgoulis AD, Makris CA, Papageorgiou CD, Moebius UG, Xenakis T, Soucacos PN (1999) Nerve and vessel injuries during high tibial osteotomy combined with distal fibular osteotomy: a clinically relevant anatomic study. Knee Surg Sports Traumatol Arthrosc 7:15–19
6. Jokio PJ, Ragni P, Lindholm TS (1986) Management of the fibula in high tibial osteotomy for arthritis of the knee. Union times and complications. Ital J Orthop Traumatol 12:41–52
7. Kirgis A, Albrecht S (1993) Palsy of the deep peroneal nerve after proximal tibial osteotomy. An anatomical study. J Bone Joint Surg [Am] 74:1180–1185
8. Maquet PG (1976) Biomechanics of the knee. Springer, Berlin Heidelberg New York
9. Rupp RE, Podeszwa D, Ebraheim NA (1994) Danger zones associated with fibular osteotomy. J Orthop Trauma 8:54–58
10. Schatzker J, Burgess RC, Glynn MK (1985) The management of nonunions following high tibial osteotomies. Clin Orthop 193:230–233
11. Soejima O, Ogata K, Ishinishi T, Fukahori Y, Miyauchi R (1994) Anatomic considerations of the peroneal nerve for division of the fibula during high tibial osteotomy. Orthop Rev 23:244–247
12. Wildner M, Peters A, Hellich J, Reichelt A (1992) Complications of high tibial osteotomy and internal fixation with staples. Arch Orthop Trauma Surg 111:210–212
13. Wootton JR, Ashworth MJ, Macla CA (1995) Neurological complications of high tibial osteotomy – the fibular osteotomy as a causative factor: a clinical and anatomical study. Ann R Coll Surg Engl 77:31–34