Lengthening osteotomy of the fibula for post-traumatic malunion

Indications, technique and results

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Summary. *Relative shortening of the fibula may occur after any type of ankle fracture when the lateral malleolus is involved. Patients complain of pain and restriction of their daily and sporting activities. Clinically, there is valgus of the hind foot due to abduction and lateral rotation of the talus. The goal of treatment is to restore the initial length of the fibula by a horizontal or Z-osteotomy, which will also correct the malposition of the talus. This study shows that the operative reconstruction of a widened mortise is a relatively safe procedure, independent of the type of osteotomy used. Lengthening of the fibula is an important step in the treatment of the painful ankle when the fibula is short after trauma, even when degenerative changes of the joint are already present.*

Resumé. *Nous avons analysé six cas de raccourcissement posttraumatique du péroné. Différents types de fracture et de traitement ont menés à cette situation, qui, cliniquement se caractérise par des douleurs au niveau de la cheville et une déviation en valgus et rotation externe du pied. Tous les péronés ont été corrigés par des ostéotomies d'allongement (ORP), soit horizontalement ou en forme de "z". Nos résultats montrent que la reconstruction opératoire d'une mortaise élargie constitue une intervention relativement simple qui donne de bon résultats et qui peu ralentir ou même arrêter la progression d'une arthrose posttraumatique. En conséquence l'ORP devrait constituer le traitement de choix dans les cas de raccourcissement posttraumatique même si des signes de dégénérescence arthrosique sont présents.*

Introduction

The importance of the lateral malleolus for the correct functioning of the talocrural joint has been described [3, 4, 8, 9, 12, 15, 17, 20, 21, 22, 23, 24]. When shortening of the fibula occurs after trauma, malrotation and lateral talar tilt is present. The articular surfaces can be made congruent by different types of lengthening procedures. A technique was described by Weber in 1981 [22].

We present the late results of 6 patients with this condition treated by a lengthening osteotomy of the fibula.

Materials and methods

Between 1984 and 1992, 7 patients with persistent pain due to malunited fractures of the ankle associated with a shortened fibula were referred to our institution for further treatment. One patient was not available for follow-up. Six were evaluated clinically and radiologically. There were 3 males and 3 females with an average age at reconstruction of 44 years (range 24 to 64 years). The interval between trauma and the first operation, and lengthening osteotomy of the fibula was 36 months (range 5 to 60 months). The mean follow up averaged 4.3 years (range 2.3 to 8.3 years). Three of the six patients were managed by the horizontal osteotomy described by Weber [22] (Fig. 1a, b), which restores the initial length and also corrects the lateral rotation of the malleolus which is always present in these cases. Any scar tissue was removed. The distal fibula was osteotomised horizontally, lengthened by 4–5 mm and rotated until the malleolus fitted anatomically into the fibular groove of the tibia. The fragments were fixed with a 3.5 mm reconstruction plate (Fig. 2a, b). The osteotomy gap was filled with a corticocancellous bone graft taken from the medial aspect of the distal tibia in one case, or by local regional cancellous bone in 2 cases.

The other 3 patients underwent a Z-osteotomy of the fibula, performed in the frontal plane (Fig. 3a, b) so that gliding lengthening of 4 to 5 mm could be obtained. Derotation was also carried out and the osteotomy was fixed with AO-ASIF plates. A cancellous graft was not necessary for these cases.

Fig. 1a, b. Diagrams of the right ankle showing **a** an horizontal osteotomy of the fibula, and **b** the lengthening after distraction

Fig. 3a, b. Diagram of the right ankle showing **a** a Z-osteotomy of the fibula, and **b** the lengthening after distraction

Fig. 2a, b. Anteroposterior radiographs of case 3 (Table 1), 5 months after osteosynthesis for a fracture of the tibia and fibula. There is widening of the medial joint space; the lateral joint space irregular, with involvement of the talofibular joint. **b** The same patient 6 days after lengthening of the fibula by an horizontal osteotomy. The ankle joint has been restored to normal

Postoperatively, active motion and partial weightbearing with a maximal load of 5 kg was begun and continued for 6 weeks in 5 cases. One patient required an additional tibiocalcaneal external fixator for distraction of the ankle because of a limited joint space and adhesions which followed infection after open reduction and internal fixation of a pilon fracture.

The follow-up consisted of clinical and radiological evaluation, estimation of professional and sports activities, pain, dependence on anti-inflammatory drugs and satisfaction with the operation (Table 1).

Results

No difference was noted in the postoperative outcome regarding the type of osteotomy performed. Radiographs showed that all the osteotomies, except one, healed within 12 weeks. One patient with a Z-osteotomy and a tube-plate fixation needed a second intervention for fixation with lag screws. At follow-up, radiographs of 2 patients showed no increase in their

Table 1.

Patient	Sex	Age	Fracture	Radiograph po	Delay OT	Type OT	Ex/FI-1	Compl	Ex/FI-2	Radiograph pOT	Outcome
1	m	21	Trimalleolar	Slight	60 m	Z	5/0/40		5/0/30	Moderate	good
2	fm	50	Trimalleolar	Slight	36 m	Z	0/0/20	*	2/0/15	Discrete	moderate
3	fm	36	Lower leg	None	5 m	H	10/0/40		10/0/40	None	very good
4	fm	40	Fibula+pilon	Moderate	28 m	Z	5/0/20	**	0/0/10	Ankylosis	good
5	m	62	Prox+dist fib.	None	24 m	H	10/0/30		15/0/35	None	very good
6	m	37	Weber type C	Moderate	60 m	H	0/0/30	***	5/0/25	Important	poor

po=postoperative and pOT=post-osteotomy radiographic osteoarthritis changes – slight, osteophyte scarcely visible – moderate, clearly visible osteophyte – severe, osteophytes and joint narrowing; type OT=type of osteotomy, Z – Z-osteotomy, H – horizontal osteotomy; delay OT=interval between initial osteosynthesis and fibular osteotomy; Ex/FI 1/2 joint mobili-

ty=joint mobility before (1) and at last follow up (2); compl=complications after fibular osteotomy; *=adhesions after initial operation and osteotomy, **=infection after initial operation, external fixator used after osteotomy and painless ankylosis, ***=arthrolysis when the plate was removed and osteoarthritis

degenerative changes; one patient had only very slight additional arthritic changes at 4 years postoperatively. Three patients, who had degenerative changes in the preoperative radiographs showed slight progression of these. The patient who was treated with additional external fixation for severe articular cartilage damage after an infected pilon fracture, developed spontaneous fusion of the ankle joint in a functional position with a good clinical outcome. The 3 patients with arthritic changes showed restricted ankle movement, while 2 of the 3 others regained almost the same movement as was present on the contralateral side. No patient needed anti-inflammatory drugs more than once a month. Four patients returned to full work, 3 of them in their previous occupations (driving instructor, nurse, secretary). One patient had to change to a less active occupation. The patient with a painful neuroma works half-time as taxi-driver. One patient, 72 years of age, was retired and was very satisfied (Table 1).

Discussion

Malunion of the distal fibula with shortening and lateral rotation may occur after open or closed treatment of malleolar fractures and this will interfere with the normal function of the ankle joint. Even a displacement of as little as 1 mm will change the mobility of the talus and fibula, and the distribution of load in the talofibular and talotibial articulations [1, 5, 7, 8, 11, 12, 13, 15]. Recent experimental studies on cadaveric ankles showed that 30° of lateral rotation deformity decreases the tibiotalar contact area by 30 to 50% [2, 12], and this may lead to abnormal stress on the cartilage and underlying bone [19].

A dynamic fibular function has also been described by Scranton and others [18, 20]. During the late stance and early push-off phase of gait, the fibula is pulled distally by the flexors of the foot as they contract to support the arch. This downward movement of the fibula deepens the mortise and tightens the interosseous membrane, pulling the fibula medially. The deepened mortise and taut interosseous membrane provide additional firm lateral support for the ankle during stress. The fibula and interosseous membrane thus provide lateral stability for the ankle during stance and push-off phases [18].

Several different procedures for correction of malunited malleolar fracture and the clinical outcome have been described [6, 10, 14, 16, 21, 22]. The age of the patient, the type of initial treatment and the delay from initial to final reconstruction either did not influence the outcome, or only affected it very slightly.

The factor determining the clinical end result seemed to be the presence of degenerative arthritis at the time of the osteotomy. In these cases the osteoarthritis progressed, resulting in a poor clinical outcome. We confirmed this observation, but in our cases even those who had progressive degenerative changes in their corrected ankles benefited from the

procedure in terms of reduction of pain and improved function at work. Lengthening of the fibula by osteotomy slowed, or even stopped, their progressive arthritis which we considered as stabilised in every case. We therefore, recommend carrying out the osteotomy even when there are already osteoarthritic changes, and we only consider arthrodesis or total ankle replacement when the clinical result is poor.

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References

1. Close RJ (1956) Some applications of the functional anatomy of the ankle joint. *J Bone Joint Surg* 38:761–781
2. Curtis MJ, Michelson JD, Urquhart MW, Byank RP, Jinah RH (1992) Tibiotalar contact and fibular malunion in ankle fractures. A cadaver study. *Acta Orthop Scand* 63:326–329
3. Debrunner HU (1985) *Biomechanik des Fußes*. Enke, Stuttgart, pp 96–107
4. Decker S (1984) Häufigkeit und Entstehungsmechanismen der verschiedenen Formen der Malleolarfrakturen. In: Hackenbroch MH, Refior HJ, Jäger M, Plitz W (Hrsg) *Funktionelle Anatomie und Pathomechanismen des Sprunggelenkes*. Thieme, Stuttgart New York, pp 160–163
5. Hendrich V, Widmer K-H, Eisele H (1984) Experimentelle intraartikuläre Druckmessungen am oberen Sprunggelenk. In: Hackenbroch MH, Refior HJ, Jaeger M, Plitz W (eds) *Funktionelle Anatomie und Pathomechanik des Sprunggelenkes*. Thieme, Stuttgart New York, pp 48–51
6. Hughes JL (1976) Corrective osteotomies of the fibula after defectively healed ankle fractures. *J Bone Joint Surg [Am]* 58:728
7. Hughes JL, Weber H, Willenegger H, Kuner EH (1979) Evaluation of ankle fractures: non-operative and operative treatment. *Clin Orthop* 138:111–119
8. Kimizuka M, Kurasawa H, Fukubayashi T (1980) Load-bearing pattern of the ankle joint. *Arch Orthop Trauma Surg* 96:45–49
9. Lambert KL (1971) The weight-bearing function of the fibula. *J Bone Joint Surg [Am]* 53:507–513
10. Marti RK, Raaymakers ELFB, Nolte PA (1990) Malunited ankle fractures. The late results of reconstruction. *J Bone Joint Surg [Br]* 72:709–713
11. Martinek H, Egkher E (1978) Untersuchungen zur Biomechanik des oberen Sprunggelenkes bei Verkürzungen des Außenknöchels. *Arch Orthop Trauma Surg* 91:39–43
12. Moody ML, Koenemann J, Hettinger E, Karpman RR (1992) The effects of fibular and talar displacement on joint contact areas about the ankle. *Orthop Rev* 21:741–744
13. Nerlich M, Zenker H (1984) Möglichkeiten der Früherkennung von posttraumatischen Spätschäden am oberen Sprunggelenk. In: Hackenbroch MH, Refior HJ, Jäger M, Plitz W (eds) *Funktionelle Anatomie und Pathomechanik des Sprunggelenkes*. Thieme, Stuttgart New York, pp 174–177
14. Offierski CM, Graham JD, Hall JH, Harris WR, Schatzker JL (1982) Late revision of fibular malunion in ankle fractures. *Clin Orthop* 171:145–149
15. Ramsey PL, Hamilton W (1976) Changes in tibiotalar area of contact caused by lateral talar shift. *J Bone Joint Surg [Am]* 58:356–357
16. Roberts C, Sherman O, Bauer D, Lusskin R (1992) Ankle reconstruction for malunion by fibular osteotomy and lengthening with direct control of the distal fragment: a re-

- port of three cases and review of the literature. *Foot Ankle* 13:7–13
17. Schon LC, Ouzounian TJ (1991) The ankle. In: Jahss MH (ed) *Disorders of the foot and ankle*. Saunders, Philadelphia, pp 1417–1460
 18. Scranton PE, McMaster JH, Kelly E (1976) Dynamic fibular function. *Clin Orthop* 118:78–81
 19. Tillmann B, Bartz B, Schleicher A (1985) Stress in the human ankle joint: a brief review. *Arch Orthop Trauma Surg* 103:385–391
 20. Wang Q, Whittle M, Cunningham J, Kenwright J (1996) Fibula and its ligaments in load transmission and ankle joint stability. *Clin Orthop* 330:261–270
 21. Ward AJ, Ackroyd CE, Baker AS (1990) Late lengthening of the fibula for malaligned ankle fractures. *J Bone Joint Surg [Br]* 72:714–717
 22. Weber BG (1981) Lengthening osteotomy of the fibula to correct a widened mortice of the ankle after fracture. *Int Orthop* 4:289–293
 23. Wiltse LL (1972) Valgus deformity of the ankle. A sequel to acquired or congenital abnormalities of the fibula. *J Bone Joint Surg [Am]* 54-A:595–606
 24. Yablon IG, Heller FH, Shouse L (1977) The key role of the lateral malleolus in displaced fractures of the ankle. *J Bone Joint Surg [Am]* 59:169–173