Treatment of checkrein deformity of the hallux

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We studied 11 patients with checkrein deformities of the hallux who underwent surgical treatment. Six had lengthening of the flexor hallucis longus tendon by Z-plasty in the midfoot, and five underwent release of adhesions and lengthening of the tendon by Z-plasty at the musculotendinous junction at the fracture site.

All six patients who underwent Z-plasty at the midfoot showed complete correction of the deformity without recurrence. Of the five who had release of adhesions and Z-plasty of the tendon at the fracture site, two showed partial and one showed complete recurrence.

The checkrein deformity describes tethering of the flexor hallucis longus (FHL) tendon after fracture of the lower limb and is seen as a dynamic flexion deformity of the hallux. When the ankle is passively dorsiflexed, the flexion deformity becomes more prominent, but on passive plantar flexion the deformity is corrected completely.

It has been suggested that the deformity is the result of entrapment of the FHL in scar tissue or callus at the fracture site,¹ but others feel that it results from contracture of the muscles after a subclinical compartment syndrome.²

Surgical treatment of the checkrein deformity has included simple release of adhesions at the fracture site,³⁻⁶ lengthening of the tendon of FHL at the fracture site by Z-plasty with release of adhesions² and Z-plasty of the tendon at the midfoot without release of adhesions.⁷

We have assessed this deformity in 11 patients in terms of the aetiology, the clinical and anatomical findings, the methods of treatment, the results following operation and recurrence.

Patients and Methods

We treated 11 patients with a checkrein deformity who underwent surgery between 2002 and 2006. There were six men and five women with a mean age of 36 years (19 to 60). Initially, six patients had sustained a fracture of the distal tibia and fibula, one a midshaft fracture of the tibia and fibula, one a trimalleolar fracture, one a bimalleolar fracture, one a pilon fracture and one a

severe soft-tissue injury without fracture. Treatment was by intramedullary nailing in four patients, fixation with a plate in two, external fixation in one, both external fixation and fixation with a plate in one, both intramedullary nailing and fixation with a plate in two and one was managed conservatively. The mean interval between injury and the development of the deformity was 3.5 months (2 to 7). Examination revealed a typical checkrein deformity, as when the ankle was dorsiflexed the interphalangeal joint of the hallux flexed sharply; on plantar flexion of the ankle, the interphalangeal joint extended completely. Five patients also had similar deformities on the second and third toes and in one the first and second toes were affected.

Lengthening by Z-plasty at the midfoot. A longitudinal incision was made along the upper border of abductor hallucis muscle of the midfoot. The tendons of FHL and flexor digitorum longus (FDL) were identified. If there were deformities on the second and third toes pre-operatively the tendinous interconnections between the FHL and the FDL were divided. This improved the deformities in those toes without further procedures. Lengthening of the tendon of FHL was performed by Z-plasty to allow full extension of the interphalangeal and metatarsophalangeal joint with the ankle in a neutral position. After operation a short removable splint was applied for two weeks to protect the procedure but movement of the ankle and toe was allowed immediately.

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Table I. Details of 11 patients with checkrein deformity

Patient	Gender	Age (yrs)	Fracture	Mechanism of injury	Treatment		Onset of deformity after injury (mths)	Affected toes	Follow-up (mths)	Lengthening site	Recurrence	Secondary operation
					Fracture management							
1	M	23	Distal fracture of tibia and fibula	Sporting injury	Intramedullary nailing		2	1	40	Above ankle	None	None
2	M	49	Midshaft fracture of tibia and fibula	Car traffic accident	Intramedullary nailing		3	1	25	Above ankle	None	None
3	F	37	Distal fracture of tibia and fibula	Fall	External fixation only		3	1, 2, 3	22	Above ankle	Partial recurrence*	None
4	F	22	Open fracture of distal tibia and fibula	Motorcycle traffic accident	Intramedullary nailing		2	1, 2, 3	14	Above ankle	Partial recurrence	None
5	F	60	Open segmental fracture of distal tibia and fibula	Pedestrian traffic accident	Plate fixation + intramedullary nailing		4	1, 2	10	Above ankle	Complete recurrence†	FHL‡ lengthening (at midfoot)
6	M	37	Pilon fracture of the ankle	Snowboarding	External fixation + plate fixation		3	1	8	Midfoot	None	None
7	M	25	Trimalleolar fracture of the ankle	Direct blow	Plate fixation		3	1, 2, 3	10	Midfoot	None	None
8	F	45	Distal fracture of the tibia and fibula	Motorcycle traffic accident	Plate fixation + intramedullary nailing		7	1	24	Midfoot	None	None
9	M	48	Soft-tissue injury without fracture	Jet skiing	Conservative treatment		2	1, 2, 3	20	Midfoot	None	None
10	F	31	Open bimalleolar fracture of the ankle	Pedestrian traffic accident	Plate fixation		6	1	43	Midfoot	None	None
11	M	19	Open fracture of the distal tibia and fibula	Motorcycle traffic accident	Intramedullary nailing		4	1, 2, 3	8	Midfoot	None	None

* partial recurrence, some improvement in symptoms but some residual deformities

† complete recurrence, a return to the same pre-operative status

‡ FHL, flexor hallucis longus

Lengthening of the flexor hallucis longus tendon at the fracture site by Z-plasty with release of adhesions. A posteromedial approach was made to expose the tendon of FHL. Fibrous scar tissue was removed from the musculotendinous junction. After complete release of the adhesions the tendon was lengthened by Z-plasty. The post-operative management was the same as that following Z-plasty at the midfoot.

Results

The mean follow-up was 20.4 months (8 to 43). There was no recurrence of the deformity in the six patients who had lengthening by Z-plasty at the midfoot. Of the five patients who had a release of adhesions and lengthening by Z-plasty above the ankle, two showed partial and one a complete recurrence of the deformity. The two patients with partial recurrence showed gradual improvement and did not wish to have a further operation. The one with a complete recurrence had a further lengthening by Z-plasty on the medial

side of the midfoot which resulted in complete resolution (Fig. 1).

In one of the patients who had a lengthening of FHL above the ankle the tendon was not adherent to the fracture site but the involved muscle seemed to be ischaemic, suggesting a subclinical compartment syndrome.

At the last follow-up, nine of the 11 patients had lost some flexion of the interphalangeal joint, but none had loss of function. The power of flexion at the metatarsophalangeal joint was normal and the ability to raise the heel was intact.

Discussion

The checkrein deformity is a dynamic flexion deformity of the tendon of FHL and usually occurs after fracture of the tibia. When the ankle is passively dorsiflexed the flexion deformity of the interphalangeal joint becomes more prominent. Because the FHL tendon has some interconnection to the tendons of FDL, deformities of the lesser toes are sometimes seen.

Fig. 1a

Fig. 1b

Fig. 1c

Fig. 1d

A 60-year-old woman with a checkrein deformity of the hallux, a) pre-operative radiograph showing a segmental fracture of the tibia and fibula, b) post-operative radiograph taken 22 months after the initial operation, c) the deformity recurred after release of adhesions and Z-plasty lengthening above the ankle at the fracture site. The checkrein deformity became more prominent when the ankle was passively dorsiflexed and d) correction after a second Z-plasty lengthening of the flexor hallucis longus tendon at the midfoot.

Since Clawson⁵ first described claw toes following fractures of the tibia in 1974, checkrein deformity has been observed in other circumstances.⁶ Carr¹ observed entrapment of the tendon of FHL after fractures of the calcaneum, and computerised tomography has demonstrated entrapment of the tendon in fracture fragments. Leitschuh et al³ noted a flexion deformity of the hallux secondary to entrapment of the tendon of FHL after a fracture of the fibula. The tendon was found to be adherent at the site of the healed fracture.³

The muscle bulk of the FHL is bigger than that of the FDL behind the distal tibia which may be one of the reasons that the FHL is involved more commonly.

Most of our patients sustained fractures of both the distal tibia and fibula. Fracture of the tibial shaft or the distal fibula may produce scarring of the FHL rather than more distant muscle tendon units. A typical checkrein deformity has been described after a concomitant fracture of the distal fibula.^{3,6,7} Encouragement of early movement of the toes

after injury is important especially with an associated fracture of the distal fibula.

The surgical management of checkrein deformity has included release of adhesions at the fracture site and lengthening of the FHL.⁴ Sanhudo and Lompa⁷ suggested that lengthening of the tendon at the level of the midfoot is better than at a site posterior to the ankle. Feeney et al² stated that lengthening of the FHL alone is sufficient to treat concomitant checkrein deformity of the lesser toes because there are tendinous interconnections between the FHL and the FDL.

We prefer to carry out lengthening of the tendon of FHL by Z-plasty in the foot in preference to above the ankle as the surgical fields are relatively simple and are free of scar tissue. There is, therefore, less chance of recurrence of adhesions. In addition, separate lengthening of the FHL and FDL is sometimes needed, and operation in the foot allows division of the tendon interconnection between FHL and FDL. Meanwhile, operation at the site of fracture requires a large incision with dissection of neurovascular structures.

In summary, we found that lengthening of the tendon of FHL by Z-plasty in the foot provided relatively good clinical results and appeared to offer the best surgical treatment for checkrein deformity.

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