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Modified fracture brace for tibial fracture with varus angulation: a case report

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Abstract
Sarmiento introduced the functional fracture brace for the management of tibial shaft fracture in 1963. However, tibial angulation with varus deformity cannot be prevented or corrected by such a device. In this paper, a case of tibial shaft fracture with varus angulation treated with a modified below-knee fracture brace was reported.

Introduction

The goals of management in tibial shaft fracture are to obtain union, to preserve ankle and knee motion, and to maintain alignment. Management of tibial shaft fracture by functional fracture bracing has been known for many years (Sarmiento, 1967 and 1970; Sarmiento *et al.,* 1980). However, varus angulation is a frequent occurrence especially in the presence of an intact fibula (Sarmiento *et al.,* 1989; Teitz *et al.,* 1980).

In the management of tibial fracture, non-operative treatment may offer the advantage of low incidence of infection (Sarmiento *et al.,* 1989). In 1963, Sarmiento introduced the functional cast for the management of fracture of the tibial shaft (Sarmiento *et al.,* 1967), and eventually modified the procedure to the use of a prefabricated functional fracture brace. His serial reports showed such bracing was an effective alternative for treatment of selected fractures of the tibia (Sarmiento, 1970; Sarmiento *et al.,* 1984; Sarmiento *et al.,* 1989). A fracture brace of such type is particularly well suited for the weather in Taiwan. Many patients with a tibial shaft fracture treated by cast fixation developed skin problems due to humid weather. However, shortening of the injured limb and the tendency for tibial angulation may still occur, especially with an intact fibula. This device cannot prevent or correct tibial angulation. Moreover, such complications were also observed by other investigators. Some researchers even concluded that single tibial fractures with an intact fibula presented an insidiously dangerous fracture pattern, particularly in patients more than twenty years old (Teitz *et al.,* 1980). When tibial angulation occurs during bracing, the brace should be discontinued and replaced by casting. Sometimes, tibial angulation should be corrected by surgical intervention (Bohler, 1965; Fernadez-Palazzi, 1969; Lottes, 1965; Sharma, 1972; Sorensen, 1969).

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Case Presentation

A 30-year-old woman fell down accidentally in downhill skiing on December 25, 1990. She was found to have a closed comminuted fracture at the lower third of the right tibial shaft with medial malleolar fracture (Figs. 1 and 2). A temporary long-leg cast was given for travelling, and changed to a functional fracture brace of Orfit material on the fifth day after injury. However, a varus angulation of 10° in the right tibia was noted ten days later after bracing (Fig. 3). To reduce and to maintain the

Fig. 1. Picture showing patient's right tibial shaft with closed comminuted fracture and medial malleolar fracture.

Fig. 3. Picture of x-ray showing varus angulation (10°) in the right tibia ten days after fitting with conventional below-knee fracture brace.

Fig. 2. Close-up view of right medial malleolar fracture.

alignment of the tibia, a modification in moulding technique of the fracture brace was introduced.

Modification

A wooden rod (1.5cm in diameter, 23cm in length, 45gm in weight) was embedded at the under-side of the anterior shield of the brace, just between the tibia and fibula. Trimming of the rod was undertaken for comfortable fitting. The ankle was fixed in the neutral position for the medial malleolar fracture. The brace was moulded directly to the right lower leg using thermoplastic material (Orfit, Luxilon, 3.2mm in thickness, 55-60°C in moulding temperature) after the rod was fixed snugly between the tibia and fibula by elastic bandage. The tightness of the brace was adjusted by five velcro straps at different positions (Figs. 4, 5 and 6).

Results

Roentgenographic examination showed a significant immediate correction of the varus angulation of the tibia to less than 5° by fitting of this modified fracture brace (Fig. 7). The

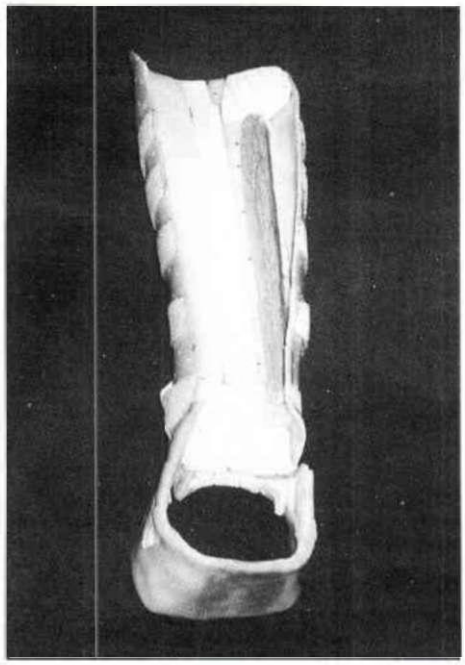

Fig. 4. Modified fracture brace was made by embedding a wooden rod at the underside of the anterior shield between the tibia and fibula.

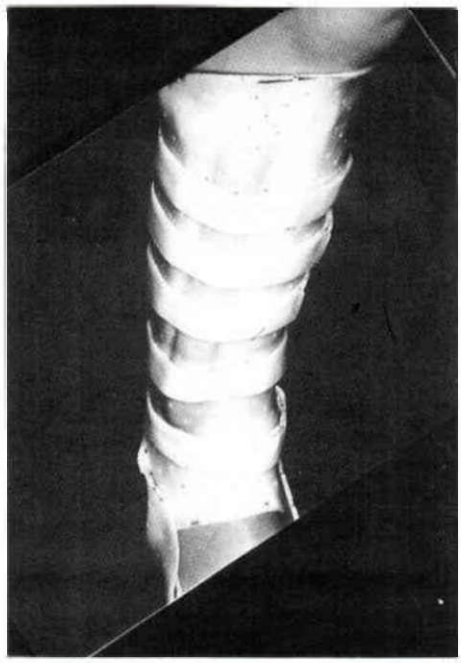

Fig. 6. The tightness of the brace was adjusted by five velcro straps.

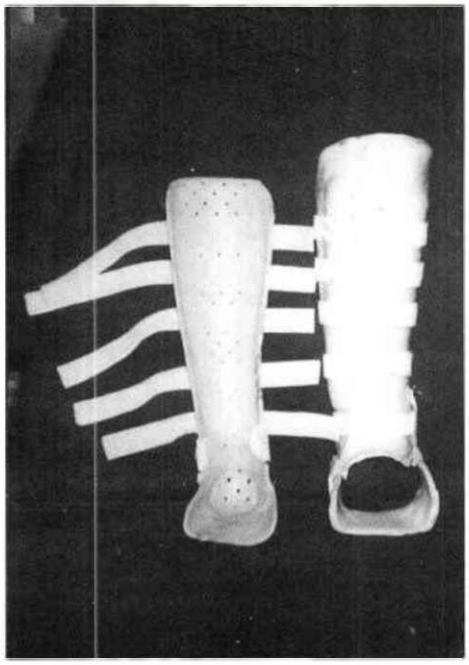

Fig. 5. The ankle was fixed at neutral position for medial malleolar fracture.

patient walked with axillary crutches with non-weight bearing of the right leg until the sixth week. Satisfactory bridging callus formation with sound alignment of the tibia was found in X-ray film at the twentieth week (Fig. 8), and the patient could walk with full weight bearing on the leg without pain. At the thirty-second week, the fracture brace was discarded. She had full range of motion at the right knee and ankle. Mild to moderate degree of muscle atrophy in the right leg was noted, but still with good muscle power. Radiographs taken one year after of the right tibia showed nearly complete bone healing with no late varus deformity (<5°) at the fracture site (Fig. 9). All joints of the right lower limb had full range of motion and no shortening of leg length was noted.

Discussion

In this paper, the patient developed a varus deformity after fitting with conventional fracture brace for ten days. However, the angulation was successfully controlled by the modified fracture brace with satisfactory maintenance of alignment. The time course for subsequent bone healing and clinical recovery

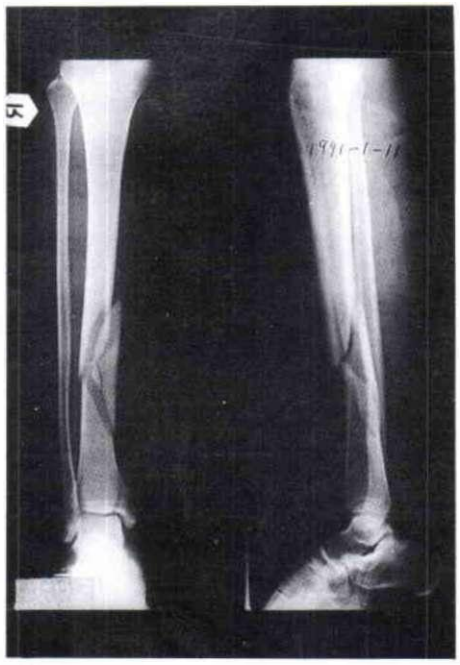

Fig. 7. Roentgenographic examination showed a good correction of the varus angulation of the right tibia (5°) immediately after fitting of the modified fracture brace.

Fig. 8. Picture showing bridging callus formation with sound alignment at twentieth week.

Fig. 9. Picture showing near complete healing at one year.

for the patient was consistent with those results reported by Sarmiento in 1989. She ambulated well consequently without any significant sequelae.

The modified fracture brace proposed in this paper was developed from the authors' successful applications of plastic anterior ankle foot orthoses (AFO) (Wong *et al.*, 1992). The fracture brace is the combination of the anterior and posterior leaf AFO (Teufel style orthosis) together as one unit (Lehmann *et al.*, 1985). The length of that brace anteriorly and posteriorly is similar to that of the patellar tendon-bearing othosis (Fishman *et al.*, 1985). This design might conform to the hydraulic principles which prevent shortening of the injured limb (Sarmiento, 1970). The embedding of the light wooden rod at the lateral underside of the anterior leaf AFO provides a constant transverse strain onto the varus angulation. It is believed that it was this straining effect that prevented the recurrence of varus deformity.

Although satisfactory results were achieved in this case with the modified fracture brace. Further investigation is needed to prove the consistency of the result.

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