

Percutaneous Gallagher nail stabilisation for fragility ankle fracture

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Abstract Osteoporotic fragility fractures of the ankle in the elderly present a difficult challenge for the orthopaedic surgeon. There is a high incidence of complications with both operative and non-operative treatment. We have treated nine such fractures by closed reduction and percutaneous ankle stabilisation using a transarticular Gallagher nail introduced via the calcaneum and directed through the talar dome into the tibia. The median patient age was 81 years (range 60–101 years). Mean duration of patient follow-up was 34 months. All the fractures maintained satisfactory alignment and healed without delay. Pain-free transfer with assistance was possible in all patients by 8 weeks post-operatively. Nails were removed in eight patients. Six patients returned to pre-fracture mobility status. Union was achieved in eight cases. No wound complications occurred. Gallagher nail percutaneous transcaneal stabilisation provides a means of sole definitive fixation in the management of unstable osteoporotic ankle fractures in the elderly.

Keywords Fragility fracture · Ankle · Percutaneous nail · Osteoporotic bone · Gallagher nail

Background

Osteoporotic fragility fractures of the ankle in the elderly are inherently unstable, and this, combined with osteopaenia, makes their treatment extremely challenging to the orthopaedic surgeon. The incidence of low-energy ankle fractures in the elderly is increasing [3, 5, 11, 12]. A further 3-fold increase in incidence is projected over the next 30 years [12]. There is a paucity of literature on the subject. Optimal treatment in an elderly population is uncertain and controversial.

A fragility ankle fracture has been defined as one that occurs in persons above 60 years of age resulting from minimal trauma [13]. They occur predominantly in elderly osteoporotic women [3]. The fracture pattern is either bi- or tri-malleolar at the level of the ankle, or supra-malleolar in the tibia and fibula, just proximal to the syndesmosis, in bone of low mechanical strength. The mechanism of injury, if recalled, is usually trivial.

In fragility fracture, open reduction and internal fixation (ORIF) is frequently technically difficult owing to extensive comminution at the fracture site. High incidence of skin breakdown, infection and failed fixation have all been cited as complications of ORIF [2]. The reported incidence of loss of reduction after internal fixation is 4–13% [4, 15]. Many elderly patients present with bone and skin that are manifestly unsuitable for standard surgical fixation using plates and screws. In these patients, the mainstay of treatment is non-operative treatment with manipulation under anaesthesia (MUA) and plaster cast application. However, holding ankle mortice reduction can often prove difficult in these cases. Failure rate of 27.5% and a 17.2% re-intervention rate have been reported for patients with displaced ankle fractures managed with MUA [18]. Non-union is reported to

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occur in 48–73% of ankle fractures in patients older than 60 years of age [1, 6, 9].

Where MUA has failed and ORIF is contra-indicated, an alternative technique for stabilisation of unstable fractures of the ankle is reported using an intramedullary transarticular Steinmann pin, with or without supplemental fixation. This technique is well documented in the literature [7, 10, 15, 17]. Childress obtained acceptable results using this technique as sole fixation in osteoporotic ankle fractures in the elderly [7]. We report a modification of this technique using the Gallagher Nail. This is a 4.7-mm diameter nail with a blunt proximal rounded tip and an expanded proximal threaded portion. This nail was originally used at our institution for osteosynthesis of fractures of the proximal humerus. This is the first report of a nail with an expanded threaded proximal end used for this pattern of ankle fracture.

We report a case series of nine fragility fractures managed with percutaneous transarticular nail ankle stabilisation using this technique. In all nine cases, good results have been achieved at radiological and clinical follow-up.

Methods

This report is an analysis of nine cases of fragility ankle fracture treated over a ten-year period (1996–2005). All patients had failed ankle fracture reduction in plaster cast and had percutaneous Gallagher nail stabilisation for this indication performed by a single surgeon. In all cases, ORIF was contra-indicated owing to the local or general condition of the patient. Failure of reduction in cast was classified either as ‘early’ (less than 1 week) or ‘late’ (greater than 1 week). Patient follow-up was by outpatient clinical review and telephone contact.

Once reduction was lost by radiological criteria, the decision was made to stabilise the ankle using a Gallagher nail. The Gallagher nail is a 4.7-mm diameter nail. The proximal end is expanded as a threaded screw (9.5 mm diameter \times 22 mm) (Fig. 1). This serves to anchor the nail flush with the cortex of the calcaneum in osteoporotic bone and prevents proximal nail migration. This is supplemented by an additional anchoring washer proximally to prevent proximal nail migration (o.d. = 17.5 mm; i.d. = 8.8 mm).

Operative technique

In our technique, with the patient prone, the leg is placed on a sandbag with the ankle held in slight equinus. This position aids in obtaining and maintaining reduction and causes the nail to penetrate the posterior portion of the dome of the talus. Thus, when normal weight bearing is resumed with the ankle in the standing position, the nail



Fig. 1 Gallagher nail, illustrating proximal expanded threaded portion. An additional washer is used to prevent proximal migration of the nail

hole in the talus is displaced posteriorly, away from the articulating talar surface, and apposition with the corresponding hole in the tibia is consequently avoided. Tourniquet is not used. Once reduction is achieved, a 1- to 1.5-cm skin incision is made on the plantar aspect of the calcaneus. A 4.7-mm diameter 26-cm-long Gallagher nail is introduced via the calcaneum and directed proximally through the talar dome up into the tibia, giving stable reduction and fixation (Fig. 2). This is performed under fluoroscopic control. The threaded portion in the proximal part of the nail is advanced flush with the cortex of the

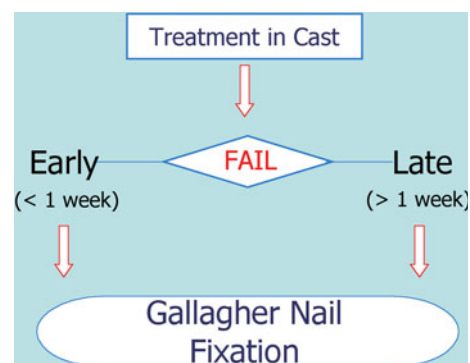


Fig. 2 Treatment algorithm for fragility ankle fracture with failed reduction in plaster



Fig. 3 Pre-operative (a) AP and (b) lateral X-rays of displaced bi-malleolar fragility ankle fracture

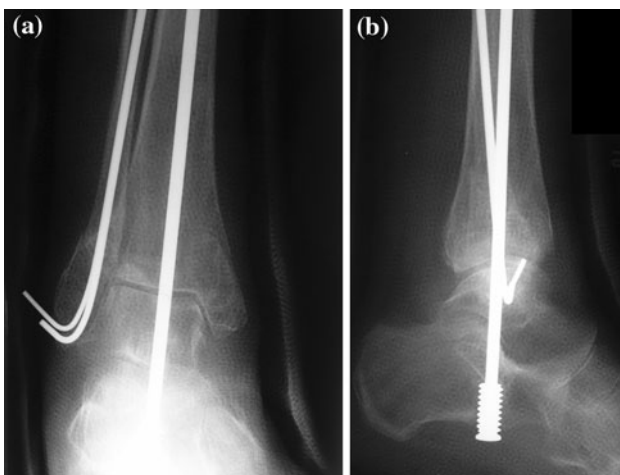


Fig. 4 Post-operative (a) AP X-ray and (b) Lateral X-ray ankle: Mortise reduction maintained at 6 weeks post-operatively following Gallagher nail insertion. Kirschner wires have been introduced into the lateral malleolus to stabilise the reduction

calcaneus and buried deep to the skin. Where reduction of a lateral malleolar fracture is not achieved, Kirschner wires are introduced into the lateral malleolus to stabilise the reduction. Pre-operative (Fig. 3a, b) and post-operative (Fig. 4a, b) X-rays illustrate one of the cases. A 1.5 g dose of cefuroxime is given at the induction of anaesthesia and continued for 24 h post-operatively.

Post-operatively, all patients receive a back slab until wounds are healed. Patients are mobilised with two crutches allowing weight bearing as tolerated, under the supervision of a physiotherapist. Once the fracture has united, the nail is removed under general anaesthesia. To our knowledge, this procedure has not been described in the literature previously.

Results

Nine cases were identified from the database, 8 women and 1 man. The median age of patients in our series was 81 years (range 60–101). Mean follow-up was 34 months. Five patients had bimalleolar fractures, three patients had trimalleolar fractures and one patient had a fracture dislocation of the ankle. The fractures were of both pronation and supination types. All patients presented with poor soft tissue around the fracture site, exaggerated by the swelling caused by the underlying fracture. In five patients, Gallagher nails were inserted to treat early failure of reduction by conservative management. In the remaining four patients, Gallagher nail insertion was used as a salvage procedure after late failure of reduction.

Outcome parameters are presented in Table 1. No intra-operative complications occurred. All patients commenced full weight bearing with a walking frame on day one post-operatively, with assistance as required. All wounds healed within 7 days with no complications recorded. There were no cases of plantar nerve injury. Nail removal was performed in eight of nine patients at a median of 6 weeks. Nail removal was refused by one patient, despite our recommendation. One patient did not attend for radiological and clinical follow-up evaluation owing to medical comorbidity. Post-operative mobility status for this patient was obtained from her General Practitioner. Union was achieved by clinical examination and radiological criteria in the remaining eight patients. There were no cases of delayed union or talar shift.

Pain-free transfer with assistance was possible in all patients by 8 weeks post-operatively. Six of nine patients returned to their previous mobility status post-op (Table 1). Two of the remaining three patients required a walking frame, where as they previously had used a walking stick. Another patient, previously mobile with a walking frame, required assistance of one to mobilise.

Although numbers are small in each treatment group, no difference was observed in terms of radiological or clinical outcome between patients who had early loss of reduction in plaster followed by nail insertion ($n = 5$), compared with patients who had a nail inserted as a later salvage procedure ($n = 3$).

Discussion

Adequate reduction of unstable fractures and dislocations of the ankle is important, but maintenance of that reduction is even more critical. Bimalleolar and trimalleolar fractures are unstable, and the tendency is towards operative treatment with open reduction and internal fixation. Although non-operative treatment in cast may present a viable

Table 1 Patient outcome

Case	Age gender	Fracture pattern	Operative procedure		Complications		Walking aids		
			Early/late	Nail removed	Wound	Fracture union	Pre-fracture	Follow-up	Pain
1	60, F	Fracture dislocation	Early	Y	None	Y	Stick	Stick	N
2	89, M	Bimalleolar	Early	Y	None	Y	Stick	Walking frame	N
3	62, F	Trimalleolar	Late	Y	None	Y	Stick	Stick	N
4	82, F	Bimalleolar	Early	Y	None	Y	Independent	Independent	N
5	90, F	Bimalleolar	Early	Y	None	Y	Stick	Stick	N
6	80, F	Bimalleolar	Late	Y	None	Y	Independent	Independent	N
7	101, F	Bimalleolar	Late	Y	None	N*	Assistance of 2	Assistance of 2	N
8	76, F	Trimalleolar	Late	Y	None	Y	Stick	Walking frame	N
9	81, F	Trimalleolar	Early	N	None	Y	Walking frame	Assistance of 1	N

* Did not attend for follow-up owing to medical co-morbidity

alternative solution in the elderly, poor mechanical bone quality dictates a high rate of subsequent failure of reduction. Furthermore, there are occasions, predominantly due to localised vascular and neural deficits that mandate immediate reduction and its maintenance. Elderly patients are frequently unable to comply with weight-bearing instructions after stabilisation, either jeopardising their outcome, or rendering them immobile until union of the fracture occurs.

By simple percutaneous insertion of a single nail upward through the heel, we have shown that a dependable temporary stabilisation of the ankle and subtalar joints is obtained. The Gallagher nail provides immediate stability, permitting early weight bearing out of plaster. Regaining early mobility is critical in the management of elderly patients. A key advantage of the Gallagher nail is that the ankle is not fused and regains motion after nail removal. There is little published evidence against which to compare our results.

Advantages of this minimally invasive technique are that operative time and blood loss are decreased. The role of the overlying soft tissues in determining definitive treatment in patients with fragility fracture cannot be over emphasised. Skin contusions, blisters and necrosis frequently accompany elderly osteoporotic ankle fractures and make open reduction hazardous or impractical. These complications are magnified by diabetes, longstanding steroid treatment, vascular insufficiency, all of which increase the risk of failure of osteosynthesis due to poor bone and skin quality [11]. In this case series, no patients had wound complications, despite poor skin condition at time of initial fracture. Gallagher nail insertion is effectively a closed procedure requiring only a 1–1.5 cm incision to introduce the nail and no additional stab incisions for insertion of screws or locking bolts. The Gallagher nail additionally has the advantage that the proximal threaded

portion of the nail is inserted flush with the plantar aspect of the calcaneus. This eliminates the need for protruding metal through skin, which can act as a potential conduit for infection.

Childress has reported successful outcome following insertion of a vertical transarticular Steinmann pin for unstable ankle fractures [7, 8]. They stabilised 24 patients older than 65 years with a Steinmann pin, inserted for approximately 6 weeks [7]. Immediate and reliable fixation at the ankle is achieved by the drilling of a single pin across the joint. The principal reported indication for insertion was displaced ankle fracture in the elderly patient with relatively short life expectancy. Childress reported only two complications in a series of 92 cases [7]. Complications included one case of proximal nail migration and one case of spontaneous ankle fusion. In contrast to the Steinmann pin [7], the Gallagher nail has the unique advantage of a threaded screw mechanism at the proximal end which effectively prevents proximal migration of the nail. Prevention of proximal pin migration is particularly important in manifestly osteoporotic bone.

In our technique, criticism might be levelled at the violation of a basic orthopaedic principle, by nail penetration of the cartilaginous surfaces of a major weight-bearing articulation. Childress reports no radiological evidence of post-operative osteoarthritis in patients following insertion of 3.1-mm Steinmann pin in 92 patients, suggesting that arthritis does not occur with narrow diameter nails [7]. To further lessen the risk of osteoarthritis and post-operative pain, we have inserted the nail in equinus, to ensure that the nail holes across the joint are not in apposition in the standing position following nail removal. Furthermore, low life expectancy and limited future weight-bearing requirements in this patient cohort reduce the impact of this concern considerably. Lemon et al. report successful closed reduction and stabilisation of fragility

ankle fractures using 13.5-mm expandable humeral nails [14]. They reported no clinical or radiological evidence of osteoarthritis at a mean follow-up of 67 weeks. Intuitively, the potential for osteoarthritis from a large diameter nail across the ankle joint would be much greater than that of a narrow-diameter nail, and it is probably erroneous to infer that the same low incidence of osteoarthritis should occur following insertion of a large diameter fixation nail [14, 16].

Gallagher nail percutaneous trans-calcaneal stabilisation provides a viable alternative in the management of unstable osteoporotic fractures in the elderly. We advocate its use both as a primary and late salvage procedure after loss of ankle fracture reduction in plaster cast, where open reduction and internal fixation is contraindicated owing to the local or general condition of the patient. In this setting, we believe it provides a means of fixation superior to any alternative fixation method. Further studies on this technique are warranted.

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