



# The management of ankle fractures in the elderly

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**Summary**<sup>1</sup> In recent years, the incidence and severity of ankle fractures in the elderly population have increased. Although surgical fixation has gained wide acceptance for younger ankle fracture patients, controversy exists within the orthopaedic community with respect to the optimal way to manage these fractures in the geriatric patient population. Although some authors categorise ankle fractures in the elderly as fragility fractures associated with osteoporosis, it appears that risk factors such as increased weight, poly-pharmacy and propensity for falls play larger roles than poor bone quality. The presence of osteoporosis may increase the level of difficulty involved with the surgical management of these patients, leading some authors to alter their standard operative technique. Early studies cited high complication rates and poor outcome following operative intervention, however, more recent investigations have demonstrated successful functional outcomes following surgical management and appropriate postoperative rehabilitation. Based on the current evidence, the literature appears to support surgical fixation of displaced ankle fractures in the elderly patient population.

## Introduction

Recent clinical studies have identified a significant increase in the incidence and severity of ankle fractures in the elderly population. Kannus et al reported that between 1970 and 2000 there was a 3-fold increase in the number of ankle fractures among Finnish patients over 70 years old [12]. In addition, the authors demonstrated an increase in the more severe Lauge-Hansen supination-eversion stage 4 fracture, compared to more stable ankle fracture patterns in this elderly patient population. In the United States, ankle fractures have been reported to occur in as many as 8.3 per 1000 Medicare recipients, a figure that appears to be rising steadily [13].

There continues to be controversy within the orthopaedic community regarding the optimal man-

agement of geriatric ankle fractures. Operative fixation has been proven to be a safe and effective method of managing unstable ankle fractures in younger patients [23]. However, certain authors have recommended conservative treatment in older patients, based on poor surgical outcomes secondary to osteoporosis, diabetes, peripheral vascular disease and skin issues commonly seen with advanced age [3, 19, 27, 29]. Recommendations on appropriate management also appear to differ based on geographical location, evidenced by a recent study by Koval et al [13]. The authors demonstrated that the percentage of ankle fractures in patients older than 65 treated with surgical stabilisation varied considerably in different regions of the United States.

The current paper reviews the complex issues associated with ankle fractures affecting the geriatric patient population, focusing on risk factors for fracture and surgical versus nonsurgical management.

<sup>1</sup> Abstracts in German, French, Italian, Spanish, Japanese, and Russian are printed at the end of this supplement.

### Risk factors for ankle fracture in the elderly

Predictors of ankle fracture in the elderly population typically include female gender, obesity and diabetes [7]. The frequency of fracture observed in postmenopausal women has led a number of investigators to include ankle fractures under the heading of osteoporotic fragility fractures [9, 15]. However, clinical studies have suggested that the incidence rates of ankle fracture increase until the age of 65, then they either plateau or decline, which contradicts the association between fracture risk and bone strength [2, 4, 7, 22, 26, 28]. Thus, the overall increase in the number of ankle fractures is potentially secondary to an increasing number of active, elderly patients rather than a result of aging and the presence of osteoporosis. Recent clinical studies have been undertaken in an effort to more clearly define the risk factors for ankle fractures in the elderly and to determine the relationship bone mineral density has with fracture incidence (Table I).

Seeley et al evaluated lifestyle factors, functional status and bone mineral density in 9,704 women over the age of 65 in an effort to identify risk factors for ankle fracture [28]. The authors found that after adjusting for age, the risk of ankle fracture was increased in heavier women, those with a history of falls in the previous year, those who used their arms to rise from a chair and women who either engaged in strenuous physical activity or who rarely left their homes. Patients within the

cohort who reported taking oestrogen or vitamin D supplements had a lower age-adjusted risk of fracture. Evaluation of peripheral bone mineral density did not show a significant relationship to the incidence of ankle fracture. However, patients with a distal radius bone mass one standard deviation below the mean had a slight increase (15%) in the risk of ankle fracture. Based on their findings, the authors concluded that ankle fractures occurring in elderly women had risk factors different from the typical osteoporotic fragility fractures seen in the hip, proximal humerus or distal radius.

In a comparison of 103 women aged 50–80 years with ankle fractures to 375 women of similar age without ankle fracture, Greenfield et al used DEXA scanning and quantitative ultrasound to evaluate the presence of osteoporosis and its relationship to ankle fracture risk [9]. The authors demonstrated no significant difference in bone mineral density between patient cohorts, except for the trochanteric region where patients with ankle fracture had a higher bone density than the population-based group. Based on these findings, the authors concluded that ankle fracture was not a typical fracture of osteoporosis and those patients sustaining an ankle fracture were not at an increased risk for other fragility fractures. The authors did show that the ankle-fracture population was significantly heavier, with a higher body mass index, than the population-based cohort,

Study	Number of patients/ ankle fractures	Identified risk factors for ankle fracture	Findings/conclusions
Seeley et al (1996)	9,704 women older than 65 years	Increased weight, history of prior falls, use of arms when rising from a chair, patients engaged in strenuous physical activity, sedentary individuals	Ankle fractures occurring in elderly women had risk factors that were different from the typical osteoporotic fragility fractures seen in the hip, proximal humerus and distal radius.
Greenfield et al (2001)	103 women age 50–80 with ankle fractures compared to 375 age-matched women without ankle fracture	Higher body mass index	No difference in bone mineral density between patient cohorts. Ankle fractures in the elderly are not typical fragility fractures.
Valtola et al (2002)	11,798 elderly finnish women	Smoking, multi-pharmacy, fracture history, increased weight	Smoking had a dose-response relationship with ankle fracture risk.
Hasselmann et al (2003)	9,704 elderly white women	Younger age, increased weight, history of prior falls	Appendicular bone mineral density was not different between ankle fracture patients and age-matched controls.

Table 1: Risk factors for ankle fracture in the elderly

leading them to believe that by increasing the forces applied to the ankle during a fall, increased body weight contributed to the development of a fracture about the ankle.

Hasselmann et al, in a report based on a multicentre evaluation of 9,704 elderly, white women, demonstrated that women who sustained an ankle fracture tended to be younger, heavier and had a history of prior falls compared to those who did not have an ankle fracture during the 10-year observation period [10]. Evaluation of bone mineral density in this study showed that appendicular bone mineral density was not significantly different between these two groups. The data from this large clinical study

support the idea that ankle fractures in the elderly population are attributable more to the biomechanical factors associated with increased weight and a propensity for falls than to decreased bone quality secondary to osteoporosis.

As part of the Kuopio osteoporosis risk factor and prevention (OSTRPRE) study, Valtola et al investigated lifestyle and other risk factors for ankle fracture in a population of 11,798 older Finnish women [30]. The authors found four independent predictors for ankle fracture in this population, including smoking, multi-pharmacy, fracture history and overweight status. Interestingly, smoking had a dose-response relationship with respect to ankle fracture risk with



Figure 1: Anteroposterior, mortise and lateral views of the left ankle demonstrating a displaced SE-IV fracture in a 69-year-old female sustained during a fall.



Figure 2: Postoperative anteroposterior and lateral views of the left ankle demonstrating surgical fixation of the left ankle fracture with posterior fibular plating and supplemental intramedullary K-wires.

the hazard ratio increasing from 1.73 for those smoking less than one pack per day to 2.94 for those smoking more than one pack.

## Management of ankle fractures in the elderly

The goals of managing geriatric ankle fractures centre around providing the patient with a functionally stable ankle joint, enabling them to resume activi-

ties of daily living while avoiding the deterioration associated with bed rest [27]. Currently, there is a lack of consensus within the orthopaedic community on the appropriate operative indications for this patient population. Much of the controversy can be attributed to early studies that demonstrated high complication rates associated with surgical intervention. Recently, several clinical investigations have been conducted evaluating the efficacy of surgical management versus conservative treatment for ankle fractures in the elderly with variable results (Table II).

Study	Number of patients/ ankle fractures	Management	Findings/conclusions
Beauchamp et al (1983)	126 patients older than 50 years with ankle fracture	55 patients treated with cast immobilisation versus 71 treated surgically	At 2 years follow up, there was no significant difference in symptoms or ankle range of motion between treatment groups. Surgical treatment led to an increased incidence of complications.
Ali et al (1987)	100 ankle fracture patients older than 60 years	50 patients treated surgically versus 50 patients treated non-surgically	Significantly higher rates of malunion and nonunion following conservative management. Patient satisfaction was significantly higher after operative treatment.
Salai et al (2000)	84 patients older than 65 years with displaced ankle fractures (65 available for follow-up)	16 patients treated conservatively versus 49 treated surgically	Nonoperative patient cohort had higher AOFAS scores at 3 years of follow up. 33% of patients treated surgically required removal of hardware.
Makwana et al (2001)	47 ankle fracture patients older than 55 years (43 available for follow up)	21 treated operatively versus 22 treated with cast immobilisation	Patients treated operatively had higher functional outcome scores, less swelling and better range of motion compared to those managed with cast immobilisation, however surgical management was associated with a higher complication rate.
Srinivasan and Moran (2001)	74 ankle fracture patients older than 70 years	open reduction and internal fixation	84% of patients returned to their pre-injury ambulatory status.
Pagliari et al (2001)	23 patients older than 65 years with displaced ankle fractures	open reduction and internal fixation	100% of cases achieved union. 2 patients had significant postoperative complications leading to amputation.
Davidovitch et al (2004)	56 ankle fracture patients older than 60 years compared to 313 ankle fracture patients younger than age 60	open reduction and internal fixation	Although functional recovery in the geriatric patient population occurred at a slower rate than that seen in the younger patient population, steady improvement was seen during the first postoperative year. AOFAS scores were similar between groups at 3, 6 and 12 months postoperatively.

Table 2: Management of ankle fractures in the elderly

Beauchamp et al compared the outcomes of surgical and nonsurgical management of ankle fractures in 126 patients over 50 years [3]. 55 patients were treated conservatively with closed reduction and cast immobilisation while 71 underwent open reduction and internal fixation. At a mean of two years of follow up, the authors noted no significant difference in symptoms or ankle range of motion between the treatment groups. Surgical treatment, however, led to an increased incidence in complications, especially in the older female patient. Based on these findings, the authors concluded that although surgical treatment resulted in superior fracture reduction, the lack of improved outcome and the higher complication rate favoured conservative management in this patient population.

In a prospective, randomised trial involving 84 patients over 65 years with displaced ankle fractures, Salai et al evaluated surgical versus conservative management [27]. At a mean follow up of 37.5 months, the authors found that the patient cohort managed nonsurgically had a significantly higher AOFAS (American Orthopedic Foot and Ankle Society) score than those treated surgically (91.37 versus 75.22). Furthermore, approximately one-third of patients in the operative arm required reoperation for removal of hardware and the total cost of treatment per patient was 4.5 times higher in those managed surgically. The authors concluded that their data lent significant support to the idea that when reducible, geriatric ankle fractures should be treated conservatively.

Other investigators have found that operative intervention leads to improved outcome compared to nonsurgical treatment. In a retrospective review of 100 ankle fracture patients over 60 years, Ali et al compared the outcomes between operative and conservative management [1]. The authors demonstrated significantly higher rates of malunion and nonunion following conservative treatment (36.3% versus 8.7% and 13.6% versus 0.9%, respectively). In addition, subjective assessment of satisfaction significantly favoured surgical intervention with 95% of patients reporting satisfaction after surgery compared to 66.7% after treatment with cast immobilisation.

Makwana et al conducted a prospective, randomised trial comparing surgical and nonsurgical treatment in 47 patients older than 55 years with displaced ankle fractures [20]. The authors found that at a mean follow up of 27 months, patients treated surgically had significantly higher functional outcome scores, less swelling and better range of motion than those treated nonsurgically. Ability to achieve an anatomical reduction was significantly less reliable and loss of reduction was significantly

more common in the ankle fractures treated with cast immobilisation compared to those managed surgically. However, there was a significantly higher complication rate in the ORIF cohort (42%) compared to the nonsurgical group (12%). Based on these findings, the authors concluded that ankle fractures in patients older than 55 are best treated with open reduction and internal fixation.

A retrospective review of the results after open reduction and internal fixation for 74 ankle fracture patients over 70 years was recently performed by Srinivasan and Moran [29]. 84% of the patients in this series returned to their pre-injury ambulatory status. The complication rate in this study was low, with 1% of patients with postoperative wound infection and 9% with delayed wound healing due to wound edge necrosis. Pagliaro et al similarly reviewed outcomes after surgical management in 23 patients older than 65 years [23]. In this series, a union rate of 100% was achieved, however, two patients had significant postoperative complications leading to below the knee amputations, both of which were attributed to pre-existing systemic disease. The authors felt that their data supported operative intervention as a safe and efficacious treatment modality for older ankle fracture patients.

In a recent study from our institution, Davidovitch et al (paper presentation 2004 OTA and AAOS) compared the functional outcome after surgical stabilisation of ankle fractures between an elderly patient population (older than 60 years) and a non-elderly population (younger than 60 years). The authors found that although functional recovery in the geriatric ankle fracture patient occurred at a slower rate than that seen in the younger patient population, a steady improvement was noted during the first postoperative year. Total AOFAS scores were similar between the two groups at three, six and twelve months postoperatively. Based on these findings, the authors believe that surgical fixation of unstable ankle fractures in the elderly provides a reasonable postoperative functional result.

## Treatment strategies

It is important to acknowledge the potential difficulties associated with surgical management of ankle fractures in osteoporotic bone. Some authors have advocated modifications of the standard surgical management of ankle fractures in the presence of poorly mineralised bone [6]. Koval et al reported on the surgical management of 20 patients over 50 years with comminuted or osteopenic ankle fractures in which two intramedullary K-wires were used to aug-

ment fracture fixation with a contoured lateral plate [14]. The authors found that all of the fractures in the 19 patients available for follow up healed without any loss of reduction, with approximately 90% of the patients reporting either no or mild pain. Biomechanical evaluation of cadaveric fibulas treated with this augmented construct demonstrated 81% greater resistance to bending compared to fibulas stabilised with a lateral plate alone. Furthermore, the augmented treatment group had twice the resistance to torsional loading.

Intramedullary fracture fixation has the advantage of providing stable fixation with minimal disturbance of the fragile skin and soft tissue often seen about the ankle in the elderly patient, potentially limiting the incidence of postoperative wound complications. Intramedullary ankle fracture stabilisation can be accomplished through a small incision without a significant amount of soft tissue stripping. Ramasamy et al, in a review of eleven Weber type B ankle fractures in elderly osteoporotic patients treated with fibular nailing, reported good to excellent results in 88% of cases [25]. In this clinical series, the authors had no postoperative wound complications associated with the insertion site.

In a randomised clinical trial involving 50 elderly patients, Pritchett et al compared treating geriatric ankle fractures with intramedullary Rush rods compared to standard plates and screws [24]. The authors found that 88% of the patients managed with Rush rods had a good or fair functional result at follow up compared to 76% of those treated with plate fixation. In addition, patients in the Rush rod treatment group were able to resume full weight bearing six weeks earlier than those in the plate and screws cohort.

Lemon et al recently described the use of a retrograde calcaneotibial expandable nail in a series of 12 ankle fractures occurring in elderly, osteoporotic women [17]. The authors reported that all study patients were able to fully weight bear on the first postoperative day following the surgery and there were no wound complications. At a mean follow up of 67 weeks, all of the fractures had healed and the mean Olerud functional score was 61, compared to a mean pre-injury score of 70.

Locked plating systems where the screws lock directly into the plate, acting as a fixed angle device, may improve fixation in osteoporotic bone and be useful in the treatment of the elderly ankle fracture patient. The advantages of locked plates include better resistance against the bending and torsional forces associated with the toggling and pull out of conventional screws. In addition, locked plates do not need to be compressed onto bone, preserving the local blood supply and limiting the risk of primary

loss of fracture reduction [31]. The ability to improve fixation in poor quality bone will likely increase the use of locked plating systems in osteoporotic ankle fractures, but at the present time this relatively new technology has yet to be adequately investigated in this patient population.

Screw purchase in osteoporotic bone may be improved with the use of cement augmentation. Calcium phosphate cement augmentation has been used successfully in the management of hip and calcaneus fractures in patients with poor bone quality. Once injected, the cement hardens without producing a significant amount of heat, filling bony defects and improving the holding strength of inserted screws [16]. Recent animal studies have shown that calcium phosphate cement augmentation of orthopaedic hardware significantly increases screw pullout strength and load required for failure [11, 18]. By improving fixation strength and stability, the addition of cement augmentation may allow for a more rapid return to weight bearing, improving the overall outcome after surgical repair.

## Postoperative rehabilitation

Common postoperative rehabilitation protocols include starting range-of-motion exercises with a physiotherapist shortly after surgery [6]. Patients are allowed to bear weight 6 weeks postoperatively, adjusted to their own comfort level. The addition of a postoperative immobilisation with a cast for protection is subject to surgeon preference. We place all of our surgically treated geriatric ankle fracture patients into a removable fracture brace and begin early passive and active range-of-ankle motion with isometric strengthening of the lower extremity allowed. A coordinated rehabilitation programme may provide the older ankle fracture patient the best opportunity for a quick return to function.

## Postoperative complications in the elderly ankle fracture patient

Although relatively infrequent, complications following surgical management of ankle fractures in the elderly can be devastating, significantly impacting treatment outcomes. The most common complications reported after surgical intervention include painful prominent hardware, wound healing problems, infection and malunion. The medical comorbidities affecting the older ankle fracture

patient play an important role in both the incidence and type of postoperative complication.

Diabetes mellitus, a common medical problem affecting the elderly patient population, has been shown to significantly increase the risk of complication after surgical ankle fracture management. In a case-control study of 26 diabetic ankle fracture patients matched for age, fracture type and method of management, McCormack and Leith reported a 31.6% incidence of major postoperative complications [21]. Complications included one case of malunion, one case of wound edge necrosis requiring a flap, and two cases of deep infection. The two patients in this series who developed deep infections required amputation and both subsequently died. Similarly, Bibbo et al, in their review of postoperative complications following operative ankle fracture repair, reported that 46% of their patients with diabetes mellitus developed postoperative complications [5].

Flynn et al, in their review of 98 ankle fracture patients (25 diabetics and 73 non-diabetics) found that the risk of infection amongst their diabetic patients (32%) was four times higher than in the non-diabetic patients (8%) [8]. For surgically managed patients, the infection rate in the diabetic patient group was more than twice that of the non-diabetic patient cohort. In addition, four out of six diabetic patients (67%) treated with cast immobilisation developed an infection compared to no infections in the five non-diabetics treated conservatively. The authors found that comorbid peripheral vascular disease increased the risk of infection in their diabetic population.

## Conclusion

The aging of the American population has been accompanied by a significant increase in the incidence of ankle fractures in the elderly. Controversy exists within the orthopaedic community regarding the best way to manage these fractures in this potentially complex patient population. Although some authors categorise ankle fractures in the elderly as fragility fractures associated with osteoporosis, it appears that risk factors such as increased weight and propensity for falls play a larger role than poor bone quality. However, the presence of osteoporosis may increase the level of difficulty involved with surgically managing these patients, leading some authors to modify their standard surgical technique. Where early studies cited high complication rates and poor outcome following surgical intervention, more recent investigations have demonstrated successful functional outcomes following surgical management

and appropriate postoperative rehabilitation. Careful attention to the surgical wound must be paid to the elderly ankle fracture patient, especially those with comorbid diabetes and peripheral vascular disease, in response to the relatively high risk for postoperative complications in this patient subset. Based on the current evidence, the literature appears to support surgical fixation of displaced ankle fractures in the elderly patient population.

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