Geriatric Orthopaedic Surgery & Rehabilitation
Volume 12: 1-6

DOI: 10.1177/2151459321997765
journals.sagepub.com/home/gos
SAGE

The Surgical Outcomes of Unstable Ankle Fractures in Patients Aged >65 Years

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Abstract

Aim: To evaluate the surgical outcomes and complications of patients over 65 years of age, with unstable ankle fractures. **Material and Method:** The study included 111 patients (73F/38 M) operated on between January 2015 and February 2019 and followed up for a mean of 21.2 months (range, 6-62 months).Demographic characteristics, comorbidities, fracture type, and mechanisms of injury were evaluated. Relationships between postoperative complications and comorbidities were examined. In the postoperative functional evaluations, the AOFAS score was used and pre and postoperative mobilization (eg, use of assistive devices) was assessed. **Results:** The mean age of the patients was 70.5 $\pm$ 6.1 years (range, 65-90 years). The mechanism of trauma was low-energy trauma in 90.1% of the fractures and high-energy trauma in 9.9%. The fractures were formed with a SER injury (supination external rotation) in 83.7% of cases and bimalleolar fractures were seen most frequently (85/111, 76%).Complications developed in 16 (14.4%) patients and a second operation was performed in 11 (9.9%) patients with complications. Plate was removed and debridement was performed in 5 of 6 patients due to wound problems. Nonunion was developed in the medial malleolus in 4 patients. Revision surgery was performed because of implant irritation in 2 patients and early fixation loss in the medial malleolus fracture in one patient. Calcaneotibial arthrodesis was performed in 3 patients because of implant failure and ankle luxation associated with non-union. A correlation was determined between ASA score and DM and complications, but not with osteoporosis. The mean follow-up AOFAS score was 86.7 $\pm$ 12.5 (range, 36-100).A total of 94 (84.7%) patients could walk without assistance postoperatively and 92 (82.9%) were able to regain the preoperative level of mobilization. **Conclusion:** Although surgery can be considered an appropriate treatment option for ankle fractures in patients aged >65 years, care must be taken to prevent potential complications and the necessary precautions must be taken against correctable comorbidities.

Keywords

comorbidities, complications, geriatric, elderly, ankle fracture

Submitted January 27, 2021. Revised January 27, 2021. Accepted February 03, 2021.

Introduction

With increased life expectancy, ankle fractures are the third most commonly seen fractures after hip and wrist fractures in the elderly osteoporotic population.[1] In recent years there has been an increase in the prevalence and severity of ankle fractures in the elderly, especially of unstable bimalleolar and trimalleolar fracture types in females.[2] Although epidemiological studies have shown that ankle fractures are often seen in young adults, the frequency of these fractures has been shown to reach a second peak in the 65-84 years age group (145-248/100,000), and this peak is more evident in females.[3]

Modern ankle fracture treatment in the general population to obtain good functional healing and early mobilization is achieved with anatomic restoration of the ankle mortise and stable fixation.[4] Excellent results are predicted with open reduction and internal fixation of unstable ankle fractures.[5] However, because of various comorbidities such as diabetes, osteoporosis, peripheral vascular disease and cardiac problems, the results cannot be accurately predicted.[6] It is important to

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obtain satisfactory results after unstable ankle fractures in the geriatric population because reduced ambulation will worsen the severity of pre-existing comorbidities and decrease the possibility of independent living.[7]

Although ankle fractures in the elderly are frequently seen, the treatment method and results have not been evaluated in literature as comprehensively as for hip and wrist fractures.[3]

The aim of this study was to evaluate the results, complications and relationships between complications and comorbidities of patients operated on for an unstable ankle fracture with the current literature.

Material and Method

The study included patients aged >65 years who underwent surgery because of an ankle fracture between January 2014 and January 2020. Patients' demographic characteristics such as age, gender, trauma mechanism, etc. were analyzed.

The exclusion criteria of the study; pilon fractures, concomitant lower extremity fractures, revision surgeries, patients who are not able to walk and did not attend follow-up examinations.

The mechanism of fractures was classified according to the Lauge-Hansen classification, and fracture types were classified as lateral, medial, bimalleolar, and trimalleolar. Whether or not there was luxation of the ankle was examined on the first radiographs taken.

The patients were evaluated in respect of comorbidities (diabetes, osteoporosis, chronic renal failure) and ASA scores.[8]

Bone mineral density measurements were examined using dual-energy x-ray absorptiometry (DEXA) bone scanning. The spine or hip bone mineral density of healthy individuals of below mean -2.5 or greater standard deviation (T-score $\leq$ -2.5) was accepted as osteoporosis.[9]

In the preoperative history, abnormally elevated glycolized hemoglobin (>6.1%) documented in the medical records was categorized as diabetes mellitus (DM).[10]

Chronic renal failure (CRF) was defined using the history, glomerular filtration rate (GFR) and the Guidelines for Renal Disease Outcomes Quality Initiative Committee guidelines.[11] All the operations were performed according to the AO/ASIF principles and techniques[12] by 3 surgeons, each with at least 5 years of experience in foot and ankle surgery.

In the fixation of lateral malleolar fractures, a locking plate was applied laterally, and in the fixation of medial malleolar fractures, headless screws, cannulated screws or the tension band technique were applied.

Antibiotic prophylaxis of IV cefazolin sodium was started half an hour preoperatively and was continued for 24 hours postoperatively. Low-molecular weight heparin (LMWH) as thromboembolism prophylaxis was administered starting from during hospitalization and was continued for 4 weeks postoperatively.

A short-leg cast was applied routinely postoperatively until the 14th day, when the sutures were removed. For patients with uncertain fracture stability during the operation, the short-leg cast was continued for 6 weeks. During the follow-up period, ankle AP-lateral and mortise radiographs were taken. The decision for weight-bearing was made according to stability obtained in the operation and the clinical and radiological follow-up examinations. When full weight-bearing started, the brace was not used.

A record was made of complications and secondary operations performed because of complications. Relationships between postoperative complications and comorbidities were examined. The American Orthopedic Foot and Ankle Score (AOFAS) was used for functional evaluation of the patients in the follow-up examinations. The patients were also evaluated in respect of return to the preoperative mobility level and the level of postoperative mobility (unassisted- use of a stick-with assistance and wheelchair).

Statistical Analysis

Data obtained in the study were analyzed statistically using the IBM SPSS vn. 22.0 software. Descriptive statistical methods were used (mean $\pm$ standard deviation) and in the comparison of quantitative data showing normal distribution, the Student's t-test was used. The McNemar test was applied in the preoperative-postoperative comparisons. In the comparisons of qualitative data, the Chi-square test, Fisher's Exact test and Continuity Correction (Yates) test were used. A value of $p < 0.05$ was accepted as statistically significant.

Results

A total of 178 patients aged >65 years with an ankle fracture were identified. After exclusion of patients who did not meet the study criteria, retrospective evaluation was made of 111 patients, comprising 38 males and 73 females with a mean age of 70.52 $\pm$ 6.11 years (range, 65-90 years) and mean follow-up period of 21.2 months (range 6-62 months). The fractures had occurred as a result of low-energy trauma in 90.1% of cases and high-energy trauma in 9.9%. Four patients had Gustilo Anderson type 1 open fracture.

When the patients were classified according to the Lauge-Hansen classification system of the fracture mechanisms, there were 93 SER (supination-external rotation), 6 SAD (supination-adduction), 6 PER (pronation-external rotation), and 6 PAD (pronation-adduction) type fractures.

Complications developed postoperatively in 16 (14.4%) patients, and a second operation was performed on 11 (9.9%) patients because of complications. In 3 patients with ankle luxation as a result of non-union and implant failure, arthrodesis was performed with retrograde tibiocalcaneal intramedullar nails (Figure 1a/b, 2a/b). In 6 patients, wound site infection developed over the lateral malleolus. Plate removal and debridement was applied to 5 and in one patient healing was achieved with antibiotic treatment only. A split-thickness graft was applied to cover the skin defect in one patient.

Non-union developed in the medial malleolus of 4 patients and as there were no active complaints, no additional operation

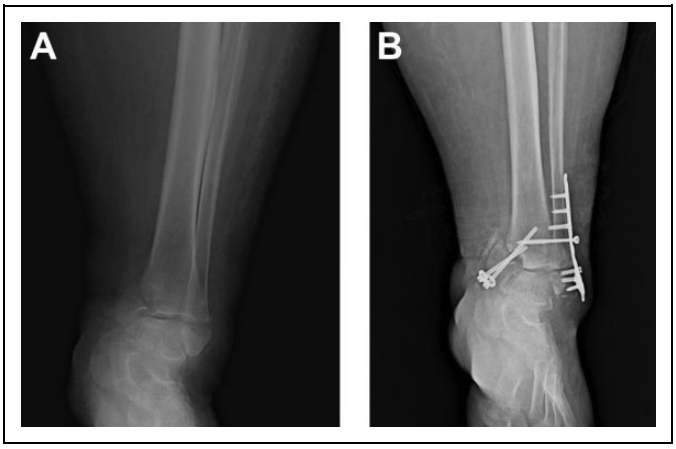

Figure 1. A: 70/female bi-malleoler fracture. B: Implant failure.

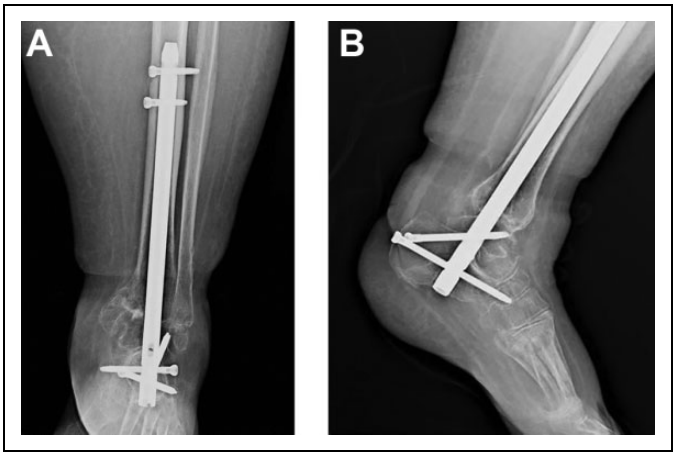

Figure 2. A: Calcaneotibial arthrodesis AP view. B: Calcaneotibial arthrodesis lateral view.

was performed. In 3 of these 4 patients, as the non union medial malleolar fragment was small, it did not affect the ankle stability, and in the other patient, arthrosis was seen to have developed in the follow-up examinations. Revision was done to one patient seen with early implant failure in the medial malleolus fixation, and union was subsequently achieved. Due to implant irritation, the implant was removed after union in 2 patients.

Complications (medial malleolar non-union and lateral wound problem) were seen in 2 of the 4 patients with CRF, and these 2 patients also had DM. In 1 of 2 patients with peripheral vascular problems, the plate was removed because of a lateral wound site problem (Table 1).

According to ASA scores, 16 (14.4%) patients were ASA1, 60 (54.1%) patients were ASA 2 and 35 (31.5%) were ASA 3.

We also investigated the relationship between various factors such as age, gender, DM, ASA scores and osteoporosis with complications (Table 2).

At the final follow-up examination, the mean AOFAS was 86.7 $\pm$ 12.5 (range, 36-100). A total of 94 (84.7%) patients were able to walk unassisted, 15 (13.5%) with a stick, 1 (0.9%) with the help of another person, and 1 (0.9%) was mobilized with a wheelchair. A statistically significantly higher rate of patients were able to return to the preoperative level of mobility(n:92, 82.9% vs. n:19, 17.1%, $p < 0.001$).

Discussion

Ankle fractures are among the most frequently seen lower extremity injuries, and are a source of significant morbidity in both young and old patients. Recent studies have shown a significant increase in the incidence and severity of ankle fractures in the elderly population.[13] In the USA, 8.3% of 1000 healthcare insurance claims have been reported to be related to ankle fractures.[5]

Although ankle fractures in young patients are seen more in males, the frequency in post-menopausal females is greater than in males.[14] Court-Brown et al reported that the highest incidence of ankle fractures was in females aged 75-85 years.[15] Studies by Lynde et al[5] and Srinivasan and Moran[16] reported female predominance at 159/216 (73%) and 58/74 (78%) respectively, and in the current study there was also a greater number of females than males (73/111, 65%). Higher rates of fixation failure and complications in females because of osteoporosis have been reported in literature, and although proportionally more complications were seen in females in the current study, the difference from males was not statistically significant (p:0.09).[17]

In literature, it can be seen that a high rate of ankle fractures in elderly patients are low-energy, SER and bimalleolar fractures. Consistent with these findings in literature, 90.1% of the fractures in the current study were low-energy, 93 (83%) were SER injuries and 85 (76%) were bimalleolar fractures. Despite this rate of low-energy fractures, luxation was determined in 21.6% on the first radiographs.

In a cadaver study conducted on elderly osteoporotic fibula bones, locking plates were seen to be superior to non-locking plates.[18] In contrast, Michael reported no difference between the 2 types of plate in respect of fixation.[5] Moreover, plating with an angle of 90 degrees to each other and with 2 intramedullary K wires were used to increase the stability in plating for the fixation of fibula fractures. Stability has been shown to be increased with the application of multiple screws from the fibula to the tibia over the plate, such as the syndesmosis screw. In order to prevent skin problems after plating in elderly patients, locked intramedullary fibula nails have recently been used. There are also applications where screw fixation is performed together with bone cement or calcium phosphate/sulphate grafting to increase stability.

Nowadays, there have been improvements in the field of implant choices, however, in multiple fragment fractures and intraoperative iatrogenic fractures, the combination of k-wire and external fixator may be the only option to prevent joint luxation and fracture fixation.

Kleczkowski and Szymczyk used no external immobilization in patients where stable fixation was achieved with surgical treatment.[19] The low rate of failure in the current study was attributed to the use of locking plates and the continued

Table 1. Complication and Second Operation After Ankle Fracture Surgery.

Complication	n	Second operation	n
Wound site infection	6	Plate removal/debridement	5
Medial malleolus non union	4	-	0
Implant irritation	2	Implant removal	2
Early fixation loss (medial malleol fixation with headless screw)	1	Revision with threaded cancellous screw	1
Implant Failure/luxation	3	Tibiocalcaneal arthrodesis	3

Table 2. Evaluation of the Relationship Between Comorbidities and Complications.

		Complication (-)	Complication(+)	
		Mean ± SD	Mean ± SD	p
Age (year)		70.19 ± 5.79	72.50 ± 7.67	**[1]0.163**
		n; %	**n; %**	
Gender	**Female**	59; 62.1	14; 87.5	**[3]0.090**
	Male	36; 37.9	2; 12.5	
DM	**No**	77; 81.1	7; 43.8	**[4]0.003****
	Yes	18; 18.9	9; 56.3	
ASA	**1**	16; 16.8	0; 0	**[2]0.001****
	2	56; 58.9	4; 25	
	3	23; 24.2	12; 75	
Osteoporosis	**No**	17; 81.1	10; 62.5	**[4]0.109**
	Yes	18; 18.9	6; 37.5	

[1]Student t test [2]Ki-Kare test [3]Continuity Correction test [4]Fisher's Exact test.
***p < 0.01 *p < 0.05.*

application of a short-leg cast for up to 4-6 weeks in patients with unreliable stability. In our clinic, in cases with stable fixation, a short-leg cast is generally used for up to 2 weeks until soft tissue heals and the sutures are removed, and no additional brace is used subsequently for weight-bearing.

Following surgical treatment of ankle fractures in elderly patients, complications are seen at a high rate.[14] Non-union rates have been reported as 0%-19% following open reduction and internal fixation.[20] Despite the rate of 0% malunion and non-union reported by Leach and Fordyce, while non-union was not seen in the fibula in the current series, non-union was seen at the rate of 3%(n:4) in the medial malleolus.[21] In medial malleolus fractures with non-union, 4.00 mm threaded cancellous screw was used. Many fixation methods have been described, including Kirschner wire, suture anchors, intraosseous wire loop fixation, antiglide plating, fully threaded headless compression screws, partially threaded compression screws, and tension-bend wiring.[3-8]. Vertically oriented medial malleolar fractures generally fixed with lag screws perpendicular to the fracture, an antiglide plate, or an antiglide plate with additional lag screws through the plate. In osteoporotic bone, screws placed into cortical bone have better resistance to pullout than those placed into trabecular bone. The purchase of 2 tibial cortices with lag screws for transverse fractures of the medial malleolus has been previously described and shown to improve the pullout strength of the fixation construct compared with 4.0-mm, cancellous, partially threaded screws.[22] Therefore, it can be considered appropriate to use bicortical screws in osteoporotic medial malleolar fractures.

Anderson et al.[23] reported wound site problems in 5 (20%) of 25 operated patients, skin necrosis developed in 1 and skin graft was applied. Wronka reported superficial infection in 13 (14%) patients, all of which were treated with antibiotherapy.[24] In a study by Vioreanu, superficial wound infection was reported at 4.1% and severe wound problems developed in 3 patients (1 amputation – 2 wound dehiscence).[7] In the current series, wound site problems were seen in 6 (5.4%) patients and all of these patients had comorbidities which could create wound site problems.

As diabetes affects the functions of immune component cells, such as leukocytes and fibroblasts, infection and other complications can be seen more in diabetic patients.[4] If hemoglobin A1c is >7, the rate of complications seen is increased.[25] Complications reported after ORIF in diabetic ankle fractures include non-union, Charcot arthropathy, infection, wound complications, loss of movement, amputation and even death.[22] In a series of 94 patients, Wronka[24] reported wound site problems in only 1 of 9 patients with DM. In another study by Michael of

a series of 216 patients, no significant relationship was found between DM and postoperative complications.[5] Pagliaro[2] stated that were reasons such as DM underlying the complications seen in patients, and that of 23 patients, DM was present in 3, of which 1 developed deep infection and below-the-knee amputation was applied. In the current study, DM was present in 9 of the 16 patients with complications. Wound site problems were seen in 4 patients with DM, medial malleolar non-union in 2, union-implant failure in 2, and early medial malleolar failure in 1. A statistically significant correlation was determined between diabetes and complications (p:0.003).

Even in a mild form, CRF can have a negative effect on phosphorus and calcium metabolism, and through demineralization and reduced bone quality, leads to an increase in insufficient bone healing and fractures.[22] Of the 4 patients in the current study diagnosed with CRF, complications developed in 2 (wound site infection- medial malleolar non-union), and these 2 patients also had DM. In a study by King et al,[22] the complication of medial malleolar non-union was reported in 1 of 2 patients with CRF. In the current study, it was not possible to make any comment about the relationship between complications and CRF as the number of patients was not sufficient.

In a cohort study of more than 9000 elderly females by Seeley et al,[26] no relationship was found between bone mineral density and ankle fractures. It was stated in that study that osteoporosis increased the risk of fracture, and typically the fixation and healing results of these weak bones were different from those of young patients.[26] However, Beauchamp and Litchfield reported that stable fixation was not affected by osteoporosis.[6,27] Michael found no correlation between osteoporosis and complications, and reported that there was osteoporosis in 2 of 6 patients who were progessing to failure.[5] In the current study, osteoporosis was determined in 24 of 111 (21.6%) patients, and in 6 patients who developed complications, but no statistically significant relationship was found between implant failure and osteoporosis (p:0.10).

The ASA classification is known to be a general indicator of a patient's health during surgical treatment.[28] In the study by Wronka, 16% of the group applied with ORIF were ASA III and IV, whereas in the current study, there were no ASA IV patients and the rate of ASA III patients was 31.5%.[24] As the ASA grade increased, there was seen to be an increase in the complication rate (p:0.001).

In a study by Costigan et al,[29] 10 (83.33%) of the patients with peripheral vascular disease were seen to develop a surgical complication. In the current study, 1 of the 2 patients with vascular failure developed a wound site problem.

Wronka et al[24] evaluated patients treated conservatively and surgically, and reported that 62% of 94 patients treated surgically regained their preoperative walking capacity, and 11 (12%) required an assistive device for mobilization. Of patients treated surgically, Viorenau et al[7] reported that 72%, and Srinivasan and Moran[16] that 84% regained preoperative capacity, and 10% of those who were able to do return to their preoperative work required assistance. In the current study, 82.9% of the patients regained the preoperative level of mobility.

In the postoperative evaluation of 84 patients aged >65 years applied with conservative or surgical treatment, Salai et al[3] reported AOFAS scores of mean 91.4 in the conservative group and 75.2 in the surgical group. In the current study, the mean AOFAS score at the final follow-up examination was found to be 86.7 $\pm$ 12.5 (range, 36-100). It was thought that these postoperative results may have been higher as the elderly Turkish population is less active than those of western countries.

Limitations

That the study was retrospective in design and there was no control group can be considered the main limitations of this study. Although DM, osteoporosis and comorbidities other than ASA were examined, as the numbers were insufficient no statistical evaluation could be made. In addition, body mass index, which can affect complications was not evaluated.

Conclusion

Surgical treatment of ankle fractures in patients aged >65 years can be considered appropriate as sufficient union and good functional results are obtained. The functional results could be improved by taking precautions against preventable comorbidities to minimize complications that may develop postoperatively.

Authorship Contribution

Adem Sahin: Main author of manuscript, Study design, Data collection and analysis.
Anıl Agar: Study design, Data collection and analysis.
Deniz Gulabi: Study design, Data collection and analysis.
Cemil Erturk: Interpretation of study material, Senior author.
All authors read and approved the final manuscript.

Ethical Standards

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. Informed consent was obtained from all patients for inclusion in the study.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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