Postoperative Complications and Reoperation Rates Following Open Reduction and Internal Fixation of Ankle Fracture

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Joints 2018;6:110–115.

Abstract

Purpose The purpose of this study was to determinate the overall postoperative complication and reoperation rates related to open reduction and internal fixation (ORIF) of ankle fractures.

Methods All patients who had undergone an ankle fracture operation at our institution from January 2005 through December 2013 were identified by querying the hospital surgical procedure database for diagnoses codes. Medical records, surgical procedure, and outpatient control reports were reviewed to collect pre-, intra-, and postoperative details. All data obtained were retrospectively analyzed by the authors to evaluate the postoperative complications and the type of further surgical treatment required to treat them.

Results A total of 378 consecutive patients were included in the study. Overall complications rate was 36.0%. Minor complications (4.5%) were represented by superficial infection (1.3%) and impaired wound healing (3.2%). All these patients required advanced wound care and prolonged oral antibiotics. Major complications (31.5%) included: residual pain (17.2%), deep infection (3.4%), malunion (2.4%), posttraumatic ankle osteoarthritis (5.0%), implant breakage (0.3%), complex regional pain syndrome (1.3%), and arthrofibrosis (1.9%). Note that 21.7% of major complications required further surgical procedure. Reoperations included arthroscopic debridement (15.1%), hardware removal and debridement of all necrotic tissue (4.5%), and ankle fusion (2.1%). Surgery was necessary mainly for pain removal and function recovery.

Conclusion Ankle fracture ORIF represents a satisfying surgical treatment. Nevertheless, postoperative complications are not uncommon. Minor complications can be easily managed with medications and repeated outpatient controls. Reoperation is occasionally required to treat major complications. Revision surgery is mandatory to ensure pain relief and function improvement.

Level of Evidence Level II, retrospective cohort study.

Keywords
- ankle fracture
- open reduction and internal fixation postoperative
- complication
- reoperation

received
September 1, 2017
accepted after revision
April 8, 2018
published online
May 21, 2018

DOI https://doi.org/10.1055/s-0038-1653949.
ISSN 2282-4324.

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Introduction

Surgical treatment of ankle fracture is one of the most commonly performed orthopaedic procedures.[1,2] Furthermore, ankle fracture incidence have increased significantly in the last decades and young patients and workers are often involved.[2–4] Open reduction and internal fixation (ORIF) represents the gold standard for the treatment of ankle fractures to restore anatomical alignment and articular congruity of ankle mortise to avoid altered loading of the tibiotalar joint and subsequent poor functional outcomes.[5,6] Although results are generally favorable, postoperative complications are not uncommon and have a considerable impact on postoperative morbidity, life quality worsening, and health care costs.[7–9] Despite that, the literature is poor of studies that report the overall complication rates following ORIF of ankle fractures, rates varying from 1 to 40%.[3,10,11] The purpose of this study was to determinate the overall postoperative complication and reoperation rates related to ORIF of ankle fractures.

Methods

Study Design

This study was designed as a retrospective cohort study. Medical records, surgical procedure, and outpatient control reports were reviewed to collect pre-, intra-, and postoperative details. All data obtained were retrospectively analyzed to evaluate the postoperative complications and the type of further surgical treatment required to treat them.

The study fulfills the criteria of the Declaration of Helsinki and has been approved by the Institutional Review Board of our institution.

Patient Selection

All patients who had undergone an ankle fracture operation at our institution from January 2005 through December 2013 were identified by querying the hospital surgical procedure database for diagnoses codes with International Classification of Diseases – 9th revision –Clinical Modification (ICD-9-CM)[12] for ankle fracture: medial malleolar fracture, closed (824.0) and open (824.1); lateral malleolar fracture, closed (824.2) and open (824.3); bimalleolar fracture, closed (824.4) and open (824.5); trimalleolar fracture, closed (824.6) and open (824.7); and unspecified ankle fracture, closed (824.8) and open (824.9). Diagnoses codes with ICD-9-CM for closed ankle dislocation (837.0) and open ankle dislocation (837.1) were also searched for ankle fracture identification.

Inclusion criteria were: patients 18 years of age or older, unilateral, isolated closed or open ankle fracture/ankle fracture dislocation, and all patients had to be definitively treated with ORIF, with minimum 12-month outpatient follow-up. Exclusion criteria were: associated fractures of the fibula, tibia, or talus and polytrauma.

Treatment Protocol

A standardized operative and postoperative protocol was used at our institution during the period under investigation. Preoperative and 24-hour postoperative prophylactic intravenous antibiotics, as specified in the hospital formulary, were used in all cases. Generally, a spinal anesthesia was conducted; only in case of contraindication to the use of local anesthetic, a general anesthesia was performed. All operations were performed using a pneumatic ischemia under tourniquet control. All fractures were treated using the same approach and surgical technique based on Arbeitsgemeinschaft für Osteosynthesefragen (AO) principles.[13] Fluoroscopic intensifier was used to perform the surgical procedure and to evaluate the fracture reduction and the stability of fixation in all cases. Wound was closed using the same three-layer method (peroneal fascia, subcutaneous tissue, skin).

A standard postoperative care protocol was followed as a rule. During first 2 weeks after surgery, a posterior short leg splint with the foot at 90° was applied and no weight-bearing was permitted to improve wound healing. Two weeks postoperatively, sutures were removed. According to fracture patterns and wound state, a rehabilitation program with passive and active range of motion (ROM) exercises and partial weight-bearing of up to 10 to 15 kg was allowed to favor fracture healing. Full weight-bearing and full normal activity was authorized once the bone and ligamentous healing was assured (6 weeks postoperatively), depending on the fracture pattern and follow-up X-ray findings.

In case of syndesmotic tear, no weight-bearing was allowed until the removal of the positioning screw; the latter was performed after 8 weeks in young and active patients and after 12 weeks in very unstable fractures, diabetic patients, and smokers. Full weight-bearing and full normal activity were allowed after screw removal.

Clinical Evaluation

Medical records were reviewed to identify baseline characteristics including age, gender, body mass index, type of injury (closed or open), delay to surgery, and days to discharge.

Outpatient control reports were analyzed to collect postoperative data including: functional outcome measurement, clinical fracture healing, residual pain, ROM, and wound inspection.

Functional outcome measurement and clinical fracture healing for the management of complications were evaluated at 6-month outpatient follow-up using the American Orthopaedic Foot and Ankle Society Ankle-Hindfoot Scale (AOFAS-AHS)[14] and the Olerud–Molander Ankle Score (OMAS).[15] AOFAS-AHS covers three categories: pain, function, and alignment. OMAS scale is based on nine different items: pain, stiffness, swelling, stair climbing, running, jumping, squatting, supports, and works/activities of daily living. Both score systems have result ranging from 0 (totally impaired) to 100 (completely unimpaired).

Residual pain was assessed using the subjective Visual Analogue Scale pain scale with result ranging from 0 (no pain) to 10 (worst pain). Total ROM of the ankle joint was measured using a goniometer to identify limitation. Wound inspection was performed within 4 weeks postoperatively to identify wound closure problems or surgical site infection (SSI) and results were recorded by applying the criteria of the

Center for Disease Control and Prevention.[16] SSIs were classified into superficial and deep infection.

Radiological Evaluation

Radiological evaluation was performed on anteroposterior, mortise, and lateral view. Preoperative X-rays were observed to describe ankle fracture patterns following anatomic/descriptive classification. The type of fracture was identified according to the Danis–Weber criteria.[17] Radiographic criteria[15] were applied on postoperative X-rays including: ankle joint congruency, radiological fracture healing, and osteoarthritis (OA) grade. Several radiographic grading systems have been developed for the ankle OA evaluation.[18] Moon et al[19] compared the van Dijk scale,[20] the modified Kellgren–Lawrence scale,[21] and modified Takakura scale,[22] and concluded that all these scales were reliable and valid.[18] In clinical practice, patients with Kellgren–Lawrence 1, 2, or 3 and van Dijk 1 or 2 scales are diagnosed in an early-stage ankle OA and those with Kellgren–Lawrence 3 or 4 and van Dijk 3 scales in an advanced-stage ankle OA.[23]

Complications

Clinical and radiographic outcomes were observed during 24-month outpatient follow-up after ankle fractures. Postoperative complications and further surgical treatment required after ORIF ankle fracture were recorded.

Superficial infection and impaired wound healing were considered *minor* complications. Deep infection, residual pain, OA, malunion, arthrofibrosis, complex regional pain syndrome (CRPS), and implant breakage were considered *major* complications.

Results

We identified 1,112 consecutive closed and open ankle fractures/fracture dislocations that were diagnosed at our institution between January 2005 and December 2013. Out of 426 fractures that were definitively treated with ORIF, 36 were excluded before surgery because they mismatched the inclusion criteria, 4 were excluded during surgery for iatrogenic fracture or intraoperative associated fracture identifications, and 8 were excluded after surgery for unplanned or independent hardware removal. Overall, 378 patients (378 fractures) were included in the study. Of these, 264 patients were males (69.8%) and 114 females (30.2%) and the mean age was 47.2 years. A mean of 2.7 days from injury to surgery and a mean of 2.2 days to discharge after surgical treatment were recorded. Baseline characteristics of the included patients are reported in ►**Table 1**. The number of treating surgeons was 21, including residents and orthopaedic surgeons.

Fracture patterns are shown in ►**Table 2**. Bimalleolar fractures (45.8%) were the most frequent ankle fracture followed by isolated medial and isolated lateral fractures (19.6 and 15.9%, respectively). Twenty-two cases (5.8%) were ankle fracture dislocations and 20 cases (5.3%) were open ankle fractures. According to the Danis–Weber criteria,[17] 110 (29.1%) A-type fractures, 216 (57.1%) B-type fractures, and 52 (16.8%) C-type fractures were identified (►**Table 3**).

Table 1 Baseline characteristics of included patients[a]

Age (y)	47.2 (18–64)
Gender[b]	
Male	264 (69.8%)
Female	114 (30.2%)
BMI	22.6 (18.5–35.4)
Time from injury to surgery (d)	2.7 (0–13)
Discharge time (d)	2.2 (1–4)

Abbreviation: BMI, body mass index.
[a]Values are expressed as mean (range) unless otherwise specified.
[b]Values are expressed as number of patients and (percentage).

Table 2 Fracture patterns[a] (anatomic/descriptive classification)

	Closed fracture	Open fracture
Isolated lateral	60 (15.9%)	–
Isolated medial	74 (19.6%)	–
Bimalleolar	157 (41.5%)	16 (4.3%)
Trimalleolar	47 (12.4%)	2 (0.5%)
Fracture dislocation	20 (5.3%)	2 (0.5%)
Total	358 (94.7%)	20 (5.3%)

[a]Values are expressed as number of fractures and (percentage).

Table 3 Type of fractures[a] (Danis–Weber classification)

A-type (infrasyndesmotic)	110 (29.1%)
B-type (transsyndesmotic)	216 (57.1%)
C-type (suprasyndesmotic)	52 (13.8%)
Total	378

[a]Values are expressed as number of fractures and percentage.

All fractures healed at the expected time. The mean AOFAS-AHS and OMAS scores after surgery at 6-month follow-up were 83.2 (range, 80–96) and 89 (range, 76–100), respectively. Outcomes were negatively influenced by complications. Particularly, worse categories were represented by pain in the majority of patients (115 subjects), stiffness in 27 patients, and swelling in 50 patients.

Complications were recorded in 136 cases (36%) (►**Table 4**). Minor complications were recorded in 17 patients (4.5%), superficial infection in 5 patients (1.3%), and impaired wound healing (dehiscence, edge necrosis, blistering) in 12 patients (3.2%). All these patients required advanced wound care and prolonged oral antibiotics performed in outpatient controls.

Major complications were found in 119 patients (31.5%): residual pain in 65 patients (17.2%), deep infection in 13 patients (3.4%), malunion in 9 patients (2.4%), advanced posttraumatic ankle OA in 19 patients (5.0%), implant breakage in 1 patient (0.3%), CRPS in 5 patients (1.3%), and arthrofibrosis in 7 patients (1.9%). According to the van Dijk[20] and modified Kellgren–Lawrence criteria,[21] advanced

Table 4 Postoperative complication rates[a]

Major complications	
Residual pain	65 (17.2%)
Advanced posttraumatic OA	19 (5.0%)
Deep infection	13 (3.4%)
Malunion	9 (2.4%)
Arthrofibrosis	7 (1.9%)
Complex regional pain syndrome	5 (1.3%)
Implant breakage	1 (0.3%)
Minor complications	
Superficial infection	5 (1.3%)
Impaired wound healing	12 (3.2%)
Total	136 (36.0%)

Abbreviation: OA, osteoarthritis.
[a]Values are expressed as number of complications and percentage.

Table 5 Advanced posttraumatic OA related to fracture type[a] (Danis–Weber classification)

Fractures	Advanced OA
A-type (infrasyndesmotic)	0/110 (0.0%)
B-type (transsyndesmotic)	12/216 (5.5%)
C-type (suprasyndesmotic)	7/52 (13.5%)
Total	19/378 (5.0%)

Abbreviation: OA, osteoarthritis.
[a]Values are expressed as number of fractures and percentage.

posttraumatic ankle OA were identified in 12 (5.5%) B-type fractures and in 7 (13.5%) C-type fractures (►**Table 5**).

Eighty-two patients (21.7%) affected by major complications required further surgical procedure. ►**Table 6** shows reoperation rates related to fracture type according to the Danis–Weber classification.[17] Open debridement of all necrotic and fibrous tissue and hardware removal was indicated in 17 cases (4.5%) for malunions, infections, extra-articular impingement, and implant breakage; arthroscopic debridement was necessary in 57 cases (15.1%) for residual pain, intra-articular impingement, arthrofibrosis, and early posttraumatic ankle OA; and ankle fusion was needed in 8 cases (2.1%) for advanced posttraumatic ankle OA. Surgery was necessary mainly for pain removal and function recovery. During the study, eight patients underwent unplanned or independent hardware removal. No complications were recorded in these cases, but they were excluded from the study.

Discussion

Overall complication rates following ORIF of ankle fractures widely vary in the literature, ranging from 1 to 40%.[3,10,11] These data are comparable to 36.0% of overall complication rate reported in this study. Residual pain, SSI, advanced posttraumatic ankle OA, and wound dehiscence are common postoperative complications of ankle fracture, as reported in different studies.[1,8,11,24–31]

Postoperative wound infection is one of the most common complications of ankle fracture surgery.[25] Overall SSI rate reported in the literature varies from 1.4 to 13.0%.[6,27,28] In detail, prevalence ranges between 3.0 and 10.0% in case of superficial infection[9,27] and between 1.0 and 6.8%[6,9,27] in case of deep infection. These reported values are slightly higher than those reported in this study (4.7% for overall SSIs, 1.3 and 3.4% for superficial and deep infection, respectively).

Goost et al[32] and Lindsjö[33] reported an advanced posttraumatic ankle OA in 10.0 and 14.0% of the cases, respectively. These rates were higher than that reported in this study. Lübbeke et al[34] reported an advanced ankle OA at 18-year follow-up in 53 and 31% of Weber-C and Weber-B cases, respectively. Fleischer and Warncke[35] reported OA 8 years after ankle fracture osteosyntheses in 46 and 28% of Weber-C and Weber-B fractures, respectively. Lindsjö[33] reported advanced OA 2- to 6 years after ankle fracture dislocations in 33 and 12% of Weber-C and Weber-B fractures, respectively. Müller et al[36] reported an advanced OA in 38% of Weber-C fractures and in 14% of Weber-B fractures at 4 to 12 years postoperatively. These reported prevalence data are higher than that observed in this study (13.5 and 5.5% in Weber-C and Weber-B fractures, respectively). Discrepancy might be explained with duration of follow-up.

In our series, pure residual pain after ankle fracture ORIF was found in 17.2% of patients. Postoperative ankle residual pain is also frequently related to chondral injuries and soft-tissue impingement,[7,26,37–39] as well as posttraumatic neuromas,[40] arthrofibrosis,[41] malreduction, loss of reduction, and malunion.[6,42,43]

Table 6 Reoperation rates related to fracture type[a] (Danis–Weber classification)

Reoperations	*N* (%)	Fracture type		
		A-type	B-type	C-type
Open debridement and hardware removal	17 (4.5)	4 (23.5%)	6 (35.3%)	7 (41.2%)
Arthroscopic debridement	57 (15.1)	5 (8.8%)	24 (42.1%)	28 (49.1%)
Arthrodesis	8 (2.1)	0	1 (12.5%)	7 (87.5%)
Total	82 (21.7)	9 (11%)	31 (37.8%)	42 (51.2%)

[a]Values are expressed as number of reoperations and percentage.

Brown et al[37] reported 32% of postoperative residual pain related to soft-tissue impingement with overlying plate or screw implants.

Redfern et al[40] identified the presence of a neuroma as cause of postoperative residual pain in 15.0% of their patients. Neuroma was due to transaction of the superficial peroneal nerve during ankle lateral approach. In our experience, no cases of neuroma were found.

Utsugi et al[41] described postoperative arthrofibrosis in 73.0% of the cases during consecutive arthroscopic examinations performed at the time of implant removal. In our study, implant removal and ankle arthroscopy were not performed routinely, but only in case of complications and this explains our smaller incidence (1.9%).

Srinivasan and Moran[42] and Leach and Fordyce[43] described ankle fracture malunion in 5 and 7.9% of the cases, respectively. These rates are higher than that reported in this study (2.4%).

In our experience, reoperations were represented by open debridement and hardware removal, arthroscopic debridement, and ankle fusion. Open debridement of all necrotic and fibrous tissue and hardware removal in case of malunions, infections, extra-articular impingement, and implant breakage represented a valid solution to pain relief and joint motion improvement.

Arthroscopic joint debridement is the gold standard to remove loose bodies, osteophytes, and bone spurs causing intra-articular impingement in early posttraumatic ankle OA (Kellgren–Lawrence 1, 2, or 3 and van Dijk 1 or 2 grade) as well as inflamed synovial tissue, around the joint. This is particularly effective in young and active patients with significant successful rates in terms of pain relief and joint motion.[37,41–46]

Ankle fusion remains the treatment of choice for advanced posttraumatic ankle OA (Kellgren–Lawrence grade 3 or 4 and van Dijk grade 3). The goal of the procedure is to reduce pain by eliminating motion in the osteoarthritic joint.[47,48] Although arthrodesis is a successful operation in adult or elderly patients, young and active patients do not bear ankle fusion.

We observed impaired wound healing as dehiscence, edge necrosis, and blistering of wound in 3.2% cases. Also, this prevalence differs from the literature data, which vary from 5.2 to 9.0%.[10,42]

Finally, CRPS had similar incidence to that reported in the literature.[49–51]

Our study has some limitations. This study is not a multicenter or registry study and all data were collected from medical records, surgical procedure, and outpatient control reports.

In conclusion, ankle fracture ORIF represents a satisfying surgical treatment; nevertheless, postoperative complications are not uncommon. Minor complications can be easily managed with medications and repeated outpatient controls. Reoperation is occasionally required to treat major complications. Revision surgery is mandatory to ensure pain relief and function improvement.

Conflict of Interest

None.

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