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Original Research

Postoperative Reoperations and Complications in 32,307 Ankle Fractures With and Without Concurrent Ankle Arthroscopic Procedures in a 5-Year Period Based on a Large U.S. Healthcare Database

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ABSTRACT

Residual symptoms often persist even after successful operative reduction and internal fixation (ORIF) of ankle fractures. Concurrent ankle arthroscopic procedures (CAAPs) have been proposed to improve clinical outcomes; however, a dearth of evidence is available supporting this practice. The purpose of the present study was to investigate the reoperation and complication rates after ORIF of ankle fractures with and without CAAPs. Reoperations and complications after ORIF of ankle fractures were identified using the PearlDiver database from January 2007 to December 2011. The CAAPs included bone marrow stimulation, debridement, synovectomy, and unspecified cartilage procedures. Reoperation procedures consisted of ankle fracture repeat fixation, arthroscopic procedures, osteochondral autograft transfers, and ankle arthrodesis. Of the 32,307 patients who underwent ankle fracture fixation, 248 received CAAP and 32,059 did not. No significant difference was found in the reoperation rate between the 2 groups (7.7% versus 8.6%; odds ratio 0.89; 95% confidence interval 0.55 to 1.42; $p = .61$). Of the 248 patients in the CAAP group, 19 (7.7%) underwent reoperation, of which 13 (68.4%) were arthroscopic debridement and 6 were either ankle refixation or osteochondral autograft transfer. For the non-CAAP group, 3021 reoperation procedures were performed, consisting of ankle refixation in 83.2%, arthroscopic procedures in 14.3%, and ankle arthrodesis in 2.5%. The complication rate in the non-CAAP group included wound dehiscence in 2.4%, wound surgery in 0.4%, deep vein thrombosis in 0.8%, and pulmonary embolism in 0.4%. No complications were detected in the CAAP group. Ankle fracture fixation with CAAPs did not increase the postoperative reoperation rate compared with ankle fracture fixation without CAAPs.

Ankle fractures are common orthopedic injuries with an estimated annual incidence of 187 per 100,000 (1,2). Operative reduction and internal fixation (ORIF) is typically performed for fractures with an unacceptable degree of displacement to restore the anatomic position. Nevertheless, even after successful operative treatment, up to one half of these patients will develop residual ankle pain (3–6). One explanation for the persistence of symptoms is the presence of intra-articular pathologic lesions (7–9).

Concurrent ankle arthroscopic procedures (CAAPs) performed with ORIF for ankle fractures have recently been advocated (7–13). In an effort to identify and treat these intra-articular lesions, CAAPs can

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provide both better visualization and less morbidity to the surrounding soft tissue compared with the extensive exposure required to view intra-articular pathology compared with ORIF (13) Nevertheless, despite these potential advantages, CAAPs are not typically performed with ankle fracture fixation. One large U.S. database study revealed that only 313 (1.0%) of 32,307 patients underwent CAAPs with ankle fixation from January 2005 to December 2011 (14).

To date, a paucity of clinical evidence is available demonstrating improved clinical outcomes after CAAPs for ankle fracture as an adjunct to ORIF. Although several clinical studies have recommended the use of CAAPs, most of their conclusions have been based on case series without comparisons to control groups (7–9,15–19). To the best of our knowledge, to date, only 3 clinical studies compared the outcomes after ORIF with and without CAAPs, and these have reported inconsistent results (10–12).

The primary aim of the present study was to identify the rate of reoperation and postoperative complications after ankle fracture fixation with and without CAAPs using a large healthcare database to elucidate whether CAAPs affect the outcomes after ankle fracture fixation. Our hypothesis was that the CAAP group would have a lower reoperation rate than the non-CAAP group.

Materials and Methods

The reoperation and complication rates after ankle fracture fixation with and without CAAPs were investigated using the United Healthcare Orthopedic (UHC) data set from January 2007 to December 2011 (PearlDiver Technologies, Inc., Fort Wayne, IN). In this database, the de-identified and Health Insurance Portability and Accountability Act–compliant patient records contain information on diagnoses, primary procedures, secondary procedures, and postoperative complications. The Current Procedural Terminology (CPT®; American Medical Association, Chicago, IL) codes and International Classification of Diseases, Ninth Revision (ICD-9), codes (World Health Organization, Geneva, Switzerland) were used to capture the relevant data. The Table lists the relevant CPT® and ICD-9 codes used in the present study. Two of us (C.W.H., A.M.) independently reviewed the patient-reported outcomes in the database and recorded the outcomes using a standardized data sheet. All discrepancies were discussed until resolution. The senior author (J.G.K.) was consulted if any disagreement persisted.

Table
Common Procedural Terminology and International Classification of Diseases, 9th revision, codes used for database search

Classification	Code
Primary surgery	
Ankle fracture fixation	
Medial malleolus fracture	CPT® 27766
Lateral malleolus fracture	CPT® 27769, 27792
Bimalleolar fracture	CPT® 27814
Trimalleolar fracture	CPT® 27822, 27823
Arthroscopic procedures (CAAP)	
Bone marrow stimulation	CPT® 29891
Debridement	CPT® 29897, 29898, 29894
Synovectomy	CPT® 29895
Unspecified cartilage procedures	CPT® 29892
Reoperation	
Ankle fracture fixation	Same as primary surgery
Arthroscopic procedures	Same as primary surgery
Autologous autograft	CPT® 28446
Wound dehiscence	
Disruption of internal operation (surgical) wound	ICD-9 99831
Disruption of external operation (surgical) wound	ICD-9 99832
Disruption of traumatic injury wound repair	ICD-9 99833
Nonhealing surgical wound	ICD-9 99883
Wound surgery	
Incision and drainage complex postoperative wound infection	CPT® 10180
Treatment of superficial wound dehiscence with packing	CPT® 12021

Abbreviations: CAAP, concurrent ankle arthroscopic procedure; CPT®, Current Procedural Terminology; ICD-9, International Classification of Diseases, Ninth Revision.

Patients who had undergone primary ankle fracture fixation with and without primary CAAPs were first identified by the corresponding CPT® and ICD-9 codes (Table). The fracture types included fibular fractures, medial malleolus fractures, bimalleolar fractures, and trimalleolar fractures. Pilon-type fractures were not included in the present study cohort. Primary CAAPs included arthroscopic bone marrow stimulation, debridement, synovectomy, and unspecified cartilage procedures. The reoperation procedures and postoperative complications after primary surgery were also identified for these patients using the corresponding CPT® and ICD-9 codes (Table). Reoperation procedures were defined as ankle fracture refixation, arthroscopic procedures, osteochondral autograft transfers, and ankle arthrodesis. The postoperative complications identified from the database included wound dehiscence, wound surgery, deep vein thrombosis (DVT), and pulmonary embolism (PE).

Statistical Analysis

Statistical analysis was performed using a commercially available contemporary statistical software package (SAS, version 9.3; SAS Institute, Cary, NC). The χ^2 test was used to determine significance regarding the postoperative reoperation rate for patients undergoing ankle fracture fixation with CAAPs compared with ankle fracture fixation without CAAPs. The α value was set at 0.05.

Results

Primary Surgery

A total of 32,307 patients underwent ankle fracture fixation during a 5-year period. Of the 32,307 patients, only 248 (0.77%) had also undergone CAAPs. The fracture types in the group that received concurrent CAAPs were medial malleolus in 19%, lateral malleolus in 53%, bimalleolar in 19%, and trimalleolar in 9.5%. For these 248 patients, a total of 338 CAAPs were performed, consisting of bone marrow stimulation in 15.4%, debridement in 70.7%, and synovectomy in 13.9%.

The group without CAAPs included 32,059 patients. The fracture patterns for this group were medial malleolus in 10.4%, lateral malleolus in 37.4%, bimalleolar in 31.0%, and trimalleolar in 21.1%.

Postoperative Outcomes

Reoperation

Of those 248 patients treated with CAAPs, 19 (7.7%) underwent reoperation. Of the 32,059 patients in the group without CAAPs, 2763 (8.6%) underwent reoperation. No significant difference was found in the reoperation rate between the 2 groups (7.7% versus 8.6%, odds ratio 0.89, 95% confidence interval 0.55 to 1.42, $p = .61$; statistical power 6.3%).

Of the 19 patients who underwent CAAP and subsequent reoperation, 13 (68.4%) underwent arthroscopic debridement. The remaining 6 patients were treated with either ankle refixation or osteochondral autograft transfer (Fig. 1). Owing to an inherent limitation in the database, the exact number could not be determined because <10 patients were in each category. In the 2763 patients in the non-CAAP group who underwent reoperation, a total of 3021 reoperation procedures were performed. The reoperation procedures for this group included ankle refixation in 83.2%, arthroscopic procedures in 14.3%, and ankle arthrodesis in 2.5% (Fig. 2).

Complications

The complication rate in the 32,059 patients undergoing ankle fixation without CAAPs included an incidence of wound dehiscence in 2.4%, wound surgery in 0.4%, DVT in 0.8%, and PE in 0.4%. In the 248 patients with CAAPs, no wound complications were identified, and the database could not show the exact number of patients who developed wound dehiscence, DVT, or PE owing to the database limitation that it cannot distinguish the exact incidence rate if the number is <10.

Discussion

The value of concurrent ORIF and arthroscopic procedures for ankle fractures is currently unclear. Three previous clinical studies have

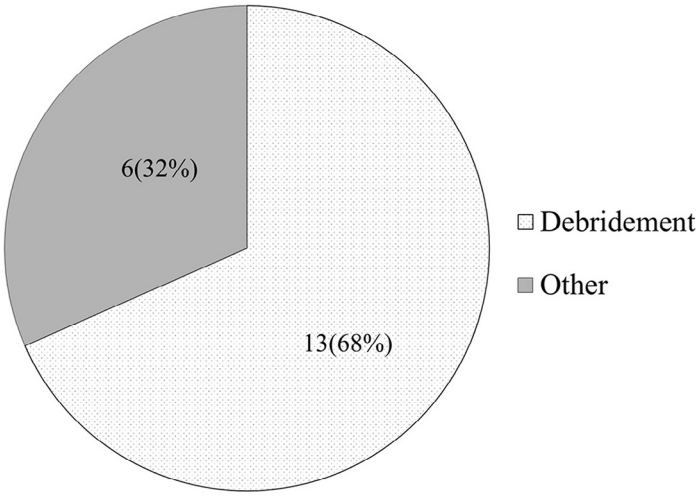

Fig. 1. Breakdown of reoperation procedures in concurrent ankle arthroscopic procedure group. The other reoperation group included both ankle refixation and osteochondral autograft transfer.

examined this topic. Takao et al (11) noted significantly better functional outcomes in patients who had undergone ORIF with arthroscopy compared with ORIF alone. However, 2 other studies found no statistically significant differences in functional outcome between the 2 groups (10,12). In 2015, a systematic review analyzing existing clinical evidence related to CAAPs for ankle fracture fixation proposed that randomized studies with large numbers of patients are necessary to demonstrate the utility of arthroscopic intervention (13). The findings from the present study, which analyzed a total of 32,307 cases and found no statistically significant difference in the reoperation rate between the CAAP and non-CAAP groups (7.7% versus 8.6%, 95% confidence interval 0.55 to 1.42, $p = .61$), help to fill the current knowledge deficit regarding the efficacy of CAAPs.

The primary outcome measure of the present study was the reoperation rate after ankle fracture fixation. In contrast, functional outcomes measures were used in the 3 comparative studies (10–12).

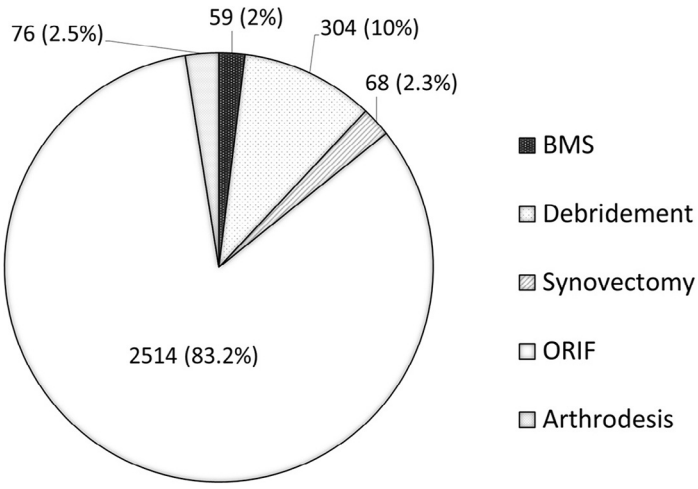

Fig. 2. Breakdown of reoperation procedures in the group without concurrent ankle arthroscopic procedures. BMS, bone marrow stimulation; ORIF, open reduction and internal fixation.

Of the existing studies, Fuchs et al (12) used a validated clinical evaluation tool for the foot and ankle (20) and found that concurrent arthroscopic procedures did not improve functional outcomes after ORIF. Owing to the limitation of the UHC database, the functional outcomes after primary ankle fixation could not be elucidated. Nevertheless, we believe that the reoperation rate after primary ankle fracture fixation is a useful measure for evaluating the effect of CAAPs because patients who experience persistent residual pain after ORIF might be more likely to undergo reoperation when conservative treatment has failed. The reoperation rate observed in the present study was consistent with that reported in previous studies, which have ranged from 1.0% to 17.6% (21–27).

The pathologic features that make reoperations in a posttraumatic ankle joint necessary are diverse and include ligament disruption, cartilage injury, malunion, nonunion, and posttraumatic ankle arthritis (19,27–29). In the present study, 68.4% of the reoperation procedures in the CAAP group were arthroscopic debridement, and 83.2% of the reoperation procedures in the non-CAAP group were ankle refixation. These results indicate that it is possible that arthroscopic procedures decreased the need for more invasive revision surgeries. One potential explanation is that the concurrent arthroscopic procedures provide better visualization of intra-articular lesions and intra-articular congruency of fragments during the primary procedure (30).

Postoperative complications are important outcome parameters for evaluating the safety and utility of CAAPs. Although arthroscopic procedures are minimally invasive, the complication rate after anterior ankle arthroscopy has been reported to be as great as 9.0% (31–34). In the present study, the complication rate in the non-CAAP group was <2.4% overall and were consistent with those reported in previous studies (35). Although the complication rate for the CAAP group was estimated to be 4% at most (if the maximum possible number of complications is 10 based on the UHC database limitation; 10 of 248 total patients equals 4%), we could not draw any conclusions regarding the difference in the postoperative complication rate between the CAAP and non-CAAP groups without more precise data. Despite this, to date, ours is the largest study to examine the outcome of CAAPs performed concurrently with ORIF.

The database used in the present study has inherent limitations, including the lack of patient-specific information (age, comorbidity, body mass index, smoking history, interval from injury to operation, and details of the operative procedure and rehabilitation process) and potential coding errors that might have resulted at billing. Finally, the database does not show an exact value if the number of cases is between 1 and 10. For these cases, the database shows the value as "–1," as we encountered in our search for complications in the CAAP group. Owing to the nature of the database, it was not possible to stratify those with bimodal and trimodal fractures, which are more likely to require syndesmotic fixation. Additionally, it was not possible to assess the surgical indication for arthroscopy; thus, some surgeons might have only performed arthroscopy in the setting of a confirmed osteochondral lesion. In addition, owing to the use of a large insurance-based database, the analysis is subject to the inherent biases in patient selection, because the ICD and CPT® codes were used for patient inclusion. Additionally, the complications reported are only those that required a return to the operating room and would not include minor complications such as superficial infection or chronic nerve pain. Despite these shortcomings and to the best of our knowledge, the present study is the largest analysis to date to compare the reoperation rate and postoperative complications after ankle fracture fixation with and without CAAPs.

In conclusion, the present large database analysis of patients undergoing ankle fracture fixation with and without CAAPs revealed that CAAPs, at a minimum, do not increase the complication rate. We believe our findings will help guide the design of future prospective studies

and randomized controlled trials to more clearly elucidate the risks and benefits of CAAPs.

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