Research Article

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Postoperative Pain After Surgical Treatment of Ankle Fractures: A Prospective Study

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Abstract

Background: Postoperative pain after fixation of ankle fractures has a substantial effect on surgical outcome and patient satisfaction. Patients requiring large amounts of narcotics are at higher risk of long-term use of pain medications. Few prospective studies investigate patient pain experience in the management of ankle fractures.

Methods: We prospectively evaluated the pain experience in 63 patients undergoing open reduction and internal fixation of ankle. The Short-Form McGill Pain Questionnaire was administered preoperatively and postoperatively (PP) at 3 days (3dPP) and 6 weeks (6wPP). Anticipated postoperative pain (APP) was recorded.

Results: No significant differences were found between PP, APP, and 3dPP; however, 6wPP was markedly lower. Significant correlations were found between PP and APP and between preoperative and postoperative Short-Form McGill Pain Questionnaire scores. PP and APP were independent predictors of 3dPP; however, only APP was predictive of 6wPP. Sex, age, and inpatient versus outpatient status were not notable factors. No statistically significant differences were found in pain scores between fracture types.

Conclusions: Both preoperative pain severity and anticipated postoperative pain are predictive of postoperative pain levels. Orthopaedic surgeons should place a greater focus on the postoperative management of patient pain and expectations after surgical procedures.

Pain control in the postoperative patient can have a notable effect on the overall outcome of the patient and surgical procedure. Orthopaedic surgeries are among the most painful surgical procedures, and patients are at high risk of inadequate postoperative pain control.[1-3] Among ambulatory procedures, ankle surgeries in particular have been found to be among the most painful.[2] Patients undergoing open treatment for ankle fractures are at risk for long-term pain and disability.[1-4] However, few studies exist

Table 1

Patient and Fracture Characteristics	
Sex	
Women	29
Men	34
Average age (y)	41 (range, 18-85)
No. of inpatients	36
Average hospital stay (d)	1.9 (range, 1-15)
No. of outpatients	27
Nonsyndesmotic injuries	51
Lateral malleolus	30
Medial malleolus	3
Bimalleolar	18
Medial/lateral	17
Posterior/lateral	1
Trimalleolar	2
Syndesmotic injuries	12
Isolated	4
Lateral malleolus	5
Bimalleolar	3
Medial/lateral	2
Posterior/lateral	1

in the literature assessing postoperative pain and management in the ankle fracture patient.

In a prospective study of patients undergoing a variety of foot and ankle surgeries, Chou et al showed that the preoperative pain level was predictive of patient-anticipated postoperative pain and actual postoperative pain.[5] In addition, anticipated postoperative pain was an independent predictor of postoperative pain in the early postoperative period.

The purpose of this study was to characterize the preoperative and postoperative pain experienced by patients undergoing open reduction and internal fixation (ORIF) of ankle fractures, relatively common injuries that frequently require surgical reduction and fixation. We hypothesized that ankle fracture patients would have substantial postoperative pain at three days and six weeks after surgical treatment and that their preoperative anticipated level of pain would correlate with the severity of postoperative pain. By understanding the pain experience after ankle fracture surgery, orthopaedic surgeons are better equipped to educate patients about expected pain after surgery, as well as to optimize the treatment regimen for pain during the postoperative period.

Methods

Patients

After institutional review board approval, 63 consecutive patients were asked to participate in this study before undergoing ORIF of ankle fractures. The study period was December 2006 to April 2010. All patients provided informed consent to participate. Patients who declined participation, did not speak English, or had a history of chronic opioid or substance abuse were excluded from the study. All patients were treated by one of two orthopaedic foot and ankle specialists at a single institution. One patient did not return for follow-up and therefore did not complete the study.

Patient demographics and fracture characteristics are listed on Table 1. A total of 29 women and 34 men were included. The average age was 41 years (range, 18 to 85 years). No other surgical injuries sustained at the time of the ankle fracture injury. No patients with polytrauma or patients with open fractures were included. Fifty-one fractures that did not require syndesmotic repair were as follows: 30 isolated lateral malleolus fractures, 16 bimalleolar fractures (ie, medial and lateral malleoli), 3 isolated medial malleolar fractures, and 2 trimalleolar fractures. Twelve injuries involved the syndesmosis that required repair: five in conjunction with a lateral malleolus fracture, four isolated tibial-fibular syndesmosis injuries, and three bimalleolar fractures (ie, two medial and lateral malleoli and one posterior and lateral malleoli).

Twenty-seven patients were treated as outpatients, 23 patients were kept for 23-hour observation as outpatients, and 13 patients were admitted to the hospital. The inpatients were admitted to the hospital for a mean of 1.9 nights (range, 1 to 15 nights). For outpatients, postoperative pain was managed by the patient with oral

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analgesics using a standard regimen. Most outpatients were given prescriptions for acetaminophen with hydrocodone postoperatively, except where specific indications existed for the use of an alternative medication. Inpatients were treated with patient-controlled analgesia with hydromorphone. On discharge from the hospital, all patients were given prescriptions for acetaminophen with hydrocodone. Forty-nine of the 63 patients were administered regional nerve blocks.

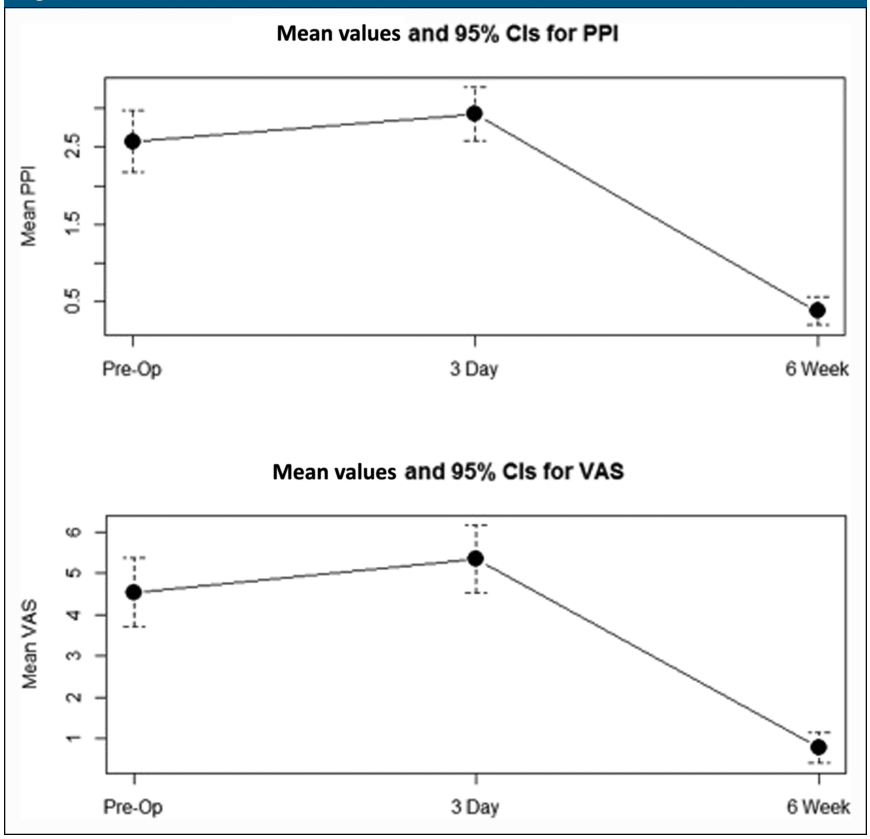
Pain Assessment

The Short-Form McGill Pain Questionnaire (SF-MPQ) was used. The SF-MPQ is sufficiently sensitive to reflect differences because of treatment.[6] It includes the Present Pain Intensity (PPI) of the Standard McGill Pain Questionnaire and a visual analog scale (VAS). The PPI is scored on a categoric scale of 0 to 5 as no pain (0), mild (1), discomforting (2), distressing (3), horrible (4), and excruciating (5). The VAS is measured on a continuous scale between 0 and 10 cm.

In addition, the questionnaire lists 15 descriptors of pain (ie, 11 sensory and 4 affective), which are rated on an intensity scale as 0 = none, 1 = mild, 2 = moderate, or 3 = severe. Three pain scores are calculated from the sum of the intensity rank values for sensory (SPRI, maximum score 33), affective (APRI, maximum score 12), and total (TPRI = SPRI + APRI, maximum score 45).

Patients were given an SF-MPQ at each of the three different time points: (1) at the preoperative visit 1 to 7 days before the surgery (PP), (2) 3 days after the surgery (3dPP), and (3) 6 weeks after the surgery (6wPP). At their preoperative visit, they were also asked to rate their anticipated postoperative pain (APP) using the SF-MPQ. The surveys were filled by the patient with the assistance of one of the investigators in person or over the telephone.

Figure 1



Graphs showing mean VAS and PPI scores. The mean VAS and PPI outcome scores are shown for preoperative pain and postoperative pain at 3 days and 6 weeks. PPI = Present Pain Intensity, VAS = visual analog scale

Statistical Analysis

Power analysis indicated that a sample size of 25 would be sufficient for statistical significance with our primary outcome variable.

Mean values, SDs, and 95% confidence intervals (CIs) for each type of pain score at respective time intervals were calculated. Pearson correlations were calculated using StatView v5.1 to determine the predictive value of PP and APP with respect to 3dPP and 6wPP.

Multivariate linear regression models were performed to assess predictors of postoperative pain scores with respect to sex, age, and inpatient vs. outpatient status. ANOVA was used to evaluate for significant differences in pain scores at each time interval depending on the fracture type.

Results

Pain was most severe at the 3-day postoperative assessment and had decreased markedly by 6 weeks postoperatively. At the 6-week postoperative assessment, most patients felt little or no pain. This was true for both the PPI and VAS pain scores (Figure 1).

The mean PPI and VAS scores were calculated at each time point (Table 2). On the PPI scale, PP was 2.49 (SD, 1.57; 95% CI, 2.10 to 2.89), APP was 2.75 (SD, 1.08; 95% CI, 2.47 to 3.03), 3dPP was 2.91 (SD, 1.34; 95% CI, 2.56 to 3.26), and 6wPP was 0.35 (SD, 0.71; 95% CI, 0.17 to 0.53). On the VAS scale, PP was 4.35

Table 2

Outcome Scores for PPI and VAS

	Mean	SD	95% CI
PPI			
Time of score			
Preoperative pain	2.49	1.57	2.10-2.89
APP	2.75	1.08	2.47-3.03
3-d postoperative pain	2.91	1.34	2.56-3.26
6-wk postoperative pain	0.35	0.71	0.17-0.53
VAS			
Time of score			
Preoperative pain	4.35	3.31	3.53-5.17
APP	5.75	2.68	5.06-6.44
3-d postoperative pain	5.25	3.17	4.43-6.06
6-wk postoperative pain	0.63	1.48	0.32-0.95

APP = anticipated postoperative pain, CI = confidence interval; PPI = Present Pain Intensity; VAS = visual analog scale

Table 3

Pearson Correlation Coefficients Between Time Intervals on the PPI Scale and VAS

Correlations	Pearson Coefficient	*P* Value
PPI		
PP versus APP	0.45	<0.001
PP versus 3dPP	0.27	<0.05
PP versus 6wPP	0.29	<0.05
APP versus 3dPP	0.32	<0.05
APP versus 6wPP	0.34	<0.01
VAS		
PP versus APP	0.59	<0.001
PP versus 3dPP	0.34	<0.01
PP versus 6wPP	0.29	<0.05
APP versus 3dPP	0.53	<0.001
APP versus 6wPP	0.36	<0.01

3dPP = 3 days postoperatively; 6wPP = 6 weeks postoperatively; PP = postoperatively; PPI = Present Pain Intensity; VAS = visual analog scale

(SD, 3.31; 95% CI, 3.53 to 5.17), APP was 5.75 (SD, 2.68; 95% CI, 5.06 to 6.44), 3dPP was 5.25 (SD, 3.17; 95% CI, 4.43 to 6.06), and 6wPP was 0.63 (SD, 1.48; 95% CI, 0.32 to 0.95). Overlap was found in the 95% CI between PP, APP, and 3dPP on both the PPI and VAS scales, indicating no significant differences in these values. The 6wPP was markedly lower than PP, APP, and 3dPP on the PPI and VAS scales.

Using Pearson coefficients, PP was compared with APP, 3dPP, and 6wPP. APP was also compared with 3dPP and 6wPP (Table 3). PP and APP ratings were strongly correlated. This correlation was found to be significant for preoperative and anticipated VAS, PPI, Sensory Present Pain Intensity (SPRI), Affective Present Pain Intensity (APRI), Total Present Pain Intensity (TPRI), and PPI (r = 0.59, 0.45, 0.54, 0.64, and 0.56, respectively, $P < 0.001$). On the VAS scale, APP was more strongly correlated with 3dPP and 6wPP (r = 0.53, $P < 0.001$ and r = 0.36, $P < 0.01$, respectively) than PP was correlated with 3dPP and 6wPP (r = 0.34, $P < 0.01$ and r = 0.29, $P < 0.05$, respectively). On the PPI scale, PP and APP were significantly correlated with 3dPP (r = 0.27 and 0.32, respectively, $P < 0.05$), but only APP was correlated with 6wPP (r = 0.34, $P < 0.01$).

Multivariate linear regression analysis found that both PP and APP VAS scores were independent predictors of 3dPP and 6wPP VAS scores. APP but not PP was a notable predictor of 3dPP and 6wPP PPI scores. Sex, age, and inpatient versus outpatient status were not found to be markedly associated with VAS or PPI at the 3-day and 6-week postoperative assessments.

Analysis of variance (ANOVA) was used to compare pain scores between the different fracture types at each time interval. Single malleolar fractures (lateral and medial malleolus only, n = 33), bimalleolar fractures (n = 18), and syndesmotic injuries with or without associated fracture (n = 12) were compared. Trimalleolar fractures were not included in this analysis because only two samples were available. No significant differences were found between the fracture types on either the PPI or VAS scale at any time point.

Discussion

Pain control after open repair of ankle fractures requires appropriate management of patient expectations and medication use in the perioperative period. Chung et al[1] found that more than 10% of ambulatory surgery patients undergoing ankle

procedures have severe pain in the post-anesthesia care unit. These patients frequently require large amounts of narcotics and are at risk of long-term use of pain medications. Among ambulatory surgery patients, postoperative pain is associated with prolonged post-anesthesia care unit stay, an increased rate of unanticipated admission or readmission after surgery, and increased cost.[1-4,7,8]

Chou et al found that among patients undergoing orthopaedic foot and ankle surgeries, patients experienced greater postoperative pain than anticipated and that preoperative pain and anticipated pain were highly predictive of postoperative pain.[5] However, their study evaluated patients undergoing a broad variety of foot and ankle procedures, which may result in a spectrum of pain experiences.

In patients undergoing ORIF of ankle fractures, pain levels were highest preoperatively and in the early postoperative period, and no significant differences were found in PP, APP, and 3dPP. Pain scores were markedly decreased by 6 weeks. PP and APP were predictive of 3dPP, whereas only APP was predictive of 6wPP.

Patients with isolated lateral malleolus fractures had lower levels of pain. In fact, 14.3% (5/35) had a preoperative VAS score of zero. By 6 weeks, 71.4% (25/35) had a VAS score of zero, and no patient had a 6-week VAS score of more than 3.8. Isolated lateral malleolar fractures have demonstrated improved outcomes compared with other ankle fracture types.[9]

Previous studies have demonstrated that patients who require syndesmotic stabilization in addition to malleolar fixation have poorer functional outcomes after surgical treatment compared with patients who require malleolar fixation alone.[10,11] In a retrospective review of 347 patients who underwent surgical fixation of unstable ankle fracture, Egol et al[7] found that the syndesmotic injury group (n = 79) had markedly greater dysfunction and worse AOFAS scores compared with the nonsyndesmotic injury group (n = 268).[10] This finding was independent of the presence of fracture-dislocation, suggesting that syndesmotic injury in itself is predictive of more severe injury and worse outcomes. The authors also compared the syndesmotic injury subgroup who had broken or electively removed screws (n = 26) with the group without syndesmotic injury (n = 268) and found that the nonsyndesmotic injury group reported markedly less pain at 1-year follow-up. These findings are limited by the retrospective nature of the study and the small sample size of patients with broken or electively removed screws.

In this study, no statistically significant difference was found in pain scores between nonsyndesmotic and syndesmotic ankle fractures. However, when isolated syndesmotic injuries without associated fracture (n = 4) were evaluated separately, the average preoperative pain score and APP were higher than the overall mean pain scores on the VAS scale (PP syndesmosis 9.06 versus overall 4.35, APP syndesmosis 9.53 versus overall 5.75) and PPI scale (PP syndesmosis 3.75 versus overall 2.49, APP syndesmosis 4.25 versus overall 2.75). Postoperative pain scores at 3 days and 6 weeks were similar to overall average scores. A larger sample of patients is necessary to determine whether these differences are statistically significant.

The patients who sustained trimalleolar fractures in our study were not included in statistical comparisons between fracture types because of the small sample size (n = 2). However, they both exhibited high preoperative pain scores (VAS 10.5 and 9.4, respectively) and persistently high pain scores at 6-week follow-up (VAS 3.5 and 7.0, respectively). Tejwani et al demonstrated in a prospective study of surgically treated unstable ankle fractures that trimalleolar ankle fractures had markedly worse outcomes compared with other fractures types.[12] Studies have also shown that worse outcomes are associated with larger posterior malleolar fragment size.[13,14] Additional studies with a larger number of patients are necessary to determine whether trimalleolar fractures are associated with markedly higher pain scores in the perioperative period.

Although most focus in practice is placed on postoperative pain control, our findings suggest that postoperative pain levels are closely associated with preoperative and anticipated pain levels. This finding has been described in many types of orthopaedic procedures. Desai and Cheung found a similar association in shoulder and elbow surgery patients.[15] Using the SF-MPQ, they found that both PP and APP were independent predictors of postoperative pain levels at 3 days and 6 weeks. These findings highlight the importance of the preoperative period in predicting postoperative pain, as well as preparing and educating the patient. The phenomenon of central sensitization, the priming of nociceptive pathways to a heightened level of excitability and responsiveness, has been implicated in the association between the preoperative and postoperative pain levels[16,17] and may direct future efforts to preemptively treat pain.

The patient's own perception of how severe their pain will be postoperatively independently predicted pain at both early and extended postoperative intervals, and it was a better predictor than the preoperative pain level. Although this may reflect a patient's own self-awareness and ability to predict their pain, this may also point to the complex interactions of various mediators on the actual pain experience. Studies have demonstrated that American patients are more frequently prescribed narcotics postoperatively

and experience less satisfaction with their pain relief compared with patients of other countries. Lindenhovious et al found higher rates of narcotic use in both inpatient and outpatient settings in American versus Dutch patients.[17] Whereas 98% of American patients used narcotics during their hospitalization, 64% of Dutch patients used narcotics. Similarly, although 82% of American patients were prescribed narcotic pain medication after hospital discharge, only 6% of Dutch patients were discharged with narcotics. The same group showed that American patients had higher pain ratings and less satisfaction with their pain relief compared with Dutch patients.[18] Nationality and use of opioid medications were independent predictors of higher pain levels. These studies indicate that sociological and psychosocial factors play a notable role in the pain experience.

The findings of this study should be interpreted in light of certain limitations. Although most patients received the same postoperative pain management protocol, some variation was observed in the use of regional blocks and the duration and amount of postoperative opioid use. Current opioid use was not measured at follow-up. Although this may introduce some bias into the study, opioid use has been shown to be associated with worse pain, rather than ameliorating pain.[18] Although patients with a history of chronic opioid or substance abuse were excluded, we did not obtain a history of previous pain experiences, such as previous injury or surgery. A second limitation was that some of the postoperative evaluations were conducted via telephone interview, which may confound some of our data. Telephone interviews were conducted by one of the authors, who assisted the patient in completing the SF-MPQ form. The completed form was then brought in at the patient's follow-up clinic visit. A third limitation was that the total number of patients with ankle fractures treated at this institution was not collected. A fourth limitation was that the patients who received regional nerve blocks were not taken into account with the overall pain experience. The aim of this study was to evaluate preoperative and postoperative pain experienced by patients undergoing surgical treatment of ankle fractures, This was done as an initial study, and future studies will include regional anesthesia effects.

Perhaps the greatest limitation of this study is the small number of patients in each fracture category, which could result in under-powering of some of our statistical comparisons. Furthermore, although we grouped all patients with syndesmotic injuries together, some of these patients had more severe injury patterns than others and may experience greater pain. Interestingly, in our study, it was the patients with isolated syndesmotic injuries who appeared to have greater preoperative pain than the syndesmotic injuries with associated fractures. However, the significance of this finding is not clear without a larger sample of patients. Finally, we had only two patients with trimalleolar fractures and were not able to include their data in statistical comparisons. Future studies should focus on these particular subsets of patients.

Conclusion

Our results demonstrate that both preoperative pain intensity and the pain levels that patients anticipate experiencing postoperatively are highly correlated with the postoperative pain experience after surgical treatment of ankle fracture. In addition, most patients experience notable pain immediately after ankle fracture fixation despite commonly used opioid regimens, indicating that current methods may not be sufficient. Anticipation of postoperative pain is important for patient counseling, formulating the postoperative pain control regimen, and estimating the duration of hospital stay. However, most patients also have little to no pain by 6-week follow-up. The pain experience is shaped by a complex milieu of neurologic, cultural, and psychosocial factors. The most effective methods may require supplementation of current regimens with regional blocks and opioid adjuvants, in addition to implementing preemptive, cognitive, and behavioral strategies.[19] Additional studies are needed to determine whether these data apply to other foot and ankle and orthopaedic procedures.

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