

## Effect of Post-Operative Toradol Administration on Bone Healing After Ankle Fracture Fixation

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**Introduction/Purpose:** Ketorolac has been reported to delay bone healing when administered after spine surgery, and there is hesitancy to use non-steroidal anti-inflammatories (NSAIDs) in the fracture setting despite its reliable ability to relieve surgical pain. The effect of ketorolac administration after foot and ankle surgery has not been well-defined in the literature to date. The purpose of this study is to report clinical and radiographic outcomes for patients treated with a perioperative ketorolac regimen after open reduction and internal fixation (ORIF) of ankle fractures. A secondary purpose is to determine whether there are other patient factors that affect radiographic healing in this population. We hypothesize that the time to radiographic healing with ketorolac use after ORIF of ankle fractures is no different than a historical control.

**Methods:** A retrospective chart review was performed on all patients that received perioperative ketorolac at the time of lateral malleolar, bimalleolar, and trimalleolar ankle ORIF by a single surgeon between 2010 and 2016 with minimum 4 months follow-up. Patients were prescribed 5 days of 10 mg ketorolac every 6 hours. Radiographs were evaluated independently by two blinded fellowship-trained foot and ankle surgeons to assess for radiographic healing of lateral malleolus, medial malleolus, and posterior malleolus fractures at 6, 12, and 16 weeks post-operatively. Two hundred and ninety-four patients were included with an average age of 50 years with 138 males (47%). Literature review was performed to determine an appropriate historical control of time to radiographic healing after ankle ORIF for comparison. Statistical analysis consisted of a linear mixed-effects regression which was performed to estimate the effect of time and covariates, taking into account repeated measurements on the same subject.

**Results:** Radiographic healing was demonstrated by 16 weeks in 221 of 281 (79%) lateral malleolus fractures, 105 of 132 medial malleolus fractures (80%), and 53 of 57 (93%) posterior malleolus fractures (see Figure 1). Median healing times were 12, 11, and 6 weeks for lateral, medial, and posterior malleoli fractures respectively. There was no significant difference in time to radiographic healing of lateral malleolus when compared to a historical control of 16.7 weeks to union. Active tobacco use was an independent risk factor for delayed radiographic healing ( $p < 0.05$ ). Diabetes mellitus and age greater than 50 years were independent factors associated with faster healing of the lateral malleolus fractures ( $p < 0.05$ ). Rheumatoid arthritis, oral steroid use, and obesity had no effect on radiographic healing.

**Conclusion:** Perioperative ketorolac use did not affect radiographic healing of ankle fractures after ORIF. As expected, active tobacco use was associated with slower radiographic healing. There is no evidence that ketorolac use further delayed union in smokers, but this may warrant further study. We unexpectedly identified diabetes mellitus and older age as factors associated with faster healing which also warrants further study. This is the first study to date examining the effect of ketorolac on radiographic time to union of ankle fractures. Further study may help determine whether ketorolac helps reduce opioid consumption and improve pain following ORIF of ankle fractures.

Figure 1- Time to Union After ORIF Ankle Fracture with Perioperative Ketorolac

		Total Fractures	Fractures United by 16 Weeks	% Union	Median Time to Union (weeks)
<b>All Fractures</b>					
	Lateral Malleolus	281	221	79%	12
	Medial Malleolus	132	105	80%	11
	Posterior Malleolus	57	53	93%	6
<b>Subgroup Analyses</b>					
<i>Diabetes</i>	Lateral Malleolus (not diabetic)	252	194	77%	12
	Lateral Malleolus (diabetic)	27	26	96%	9
	<b><math>p = 0.0014</math></b>				
<i>Age</i>	Lateral Malleolus (age $\leq$ 50)	135	102	76%	12
	Lateral Malleolus (age $>$ 50)	145	119	82%	11
	<b><math>p = 0.0044</math></b>				
<i>Tobacco Use</i>	Lateral Malleolus (current smokers)	37	23	62%	12
	Lateral Malleolus (former smokers)	35	31	89%	12
	Lateral Malleolus (non-smokers)	209	167	80%	12
	<b>Current vs Former Smoker, <math>p = 0.0194</math> Current vs Non-Smoker, <math>p = 0.0109</math></b>				