# The Failed Pilon: Factors Associated with Delayed Amputation, Arthroplasty, or Arthrodesis after Open Reduction and Internal Fixation

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## Introduction

Tibial pilon fractures are high-energy axial injuries with metaphyseal comminution, multiple articular fragments, and significant soft tissue injury. Ruedi and Allgower in 1969 reported a successful series of pilon fractures treated with open reduction and internal fixation (ORIF), describing 4 principles that remain keystones to modern surgical treatment: restitution of the correct length of the fibula, reconstruction of the articular surface of the tibia, cancellous autograft, and medial support by a buttress plate.[1] Early studies evaluating immediate ORIF of pilon fractures yielded very high wound complications,[2,3] which led to the development of current two-stage treatment protocols—early external fixation followed by soft tissue rest, then delayed definitive ORIF.[4,5] Despite a reduction in the soft tissue complications with modern protocols, pilon fractures continue to have high reported rates of post-traumatic arthritis, stiffness, persistent pain, and poor functional outcomes.[6] The purpose of this study was to assess failure of pilon fractures treated with ORIF, comparing demographic and injury factors associated with delayed amputation, arthroplasty, or arthrodesis.

## Materials and Methods

Study design was a case control with 1:1 matching for controls, by date of surgery. Inclusion criteria included: age $> 18$, OTA type 43B or 43C tibial plafond fractures treated with ORIF at a single institution. For the cases, "failure" was defined as amputation, arthrodesis, or arthroplasty performed at greater than 3 months post-ORIF. For controls, a minimum of 3 months of follow-up was needed. Demographic variables were collected, which included: age, gender, race, BMI, marital status, diabetes, vascular disease, smoking, alcohol, worker's compensation. Injury variables were collected, which included: open vs. closed injury, OTA type, vascular injury, radiographic severity score, radiographic alignment, bone loss, impaction, anterior plafond impaction, fibula fracture location. Operative variables were collected, which included: single vs. two stage treatment of the pilon component, and need for flap coverage. Complications of minor infection (requiring oral antibiotics) or major infection (requiring operative debridement or intravenous antibiotics) were recorded. Univariate analysis was performed for each variable, with odds ratios reported, and significance at $p > 0.05$. Results were entered into stepwise logistic regression for variables with $p > 0.1$.

## Results

Between January 2000 and May 2014, 1560 43B or 43C injuries were treated with ORIF. 37 met the inclusion criteria for failure (21 fusion, 9 amputation, 7 arthroplasty) and 37 controls were matched. The average length to follow-up was 764 days (cases) and 452 days (controls). Factors associated with failure were: OTA type (C-type OR 5.6, $p > 0.01$), two-stage management (OR 5.44, $p = 0.02$), minor infection (OR 7.9, $p = 0.01$), major infection (OR 12.6, $p > 0.01$), radiographic overall severity ($p > 0.001$), radiographic articular severity ($p > 0.001$), plafond impaction (OR 8.14, $p > 0.001$), and anterior plafond impaction ($p > 0.001$). Stepwise logistic regression demonstrated major infection ($p = 0.03$), overall radiographic severity ($p = 0.01$), and anterior impaction ($p = 0.006$) to be most predictive of pilon failure.

## Discussion

Multiple injury factors, including anterior impaction, overall radiographic severity and major infection were associated with failure of ORIF of tibial pilon fractures, which required delayed amputation, arthrodesis, or arthroplasty. Early recognition of the injury factors and early intervention, perhaps at the time of injury with a salvage procedure, may improve the reportedly high rates of poor outcomes following these injuries.

## References

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