

# The Effect of Plate Position on Symptomatic Hardware Removal and Infection Risk Following Open Reduction Internal Fixation of Closed 43C Pilon Fractures

Thirushan Wignakumar<sup>1</sup>, Loïck P Noordhoff, Duco W.P.M. Laane, Anne M van Rossum du Chattel<sup>1</sup>, Matthew J Gluck, Robert Wagner, Jeffrey Olson, Arvind Gabriel Von Keudell, Michael John Weaver

<sup>1</sup>Orthopaedic Surgery

**INTRODUCTION:** Tibial plafond (OTA/AO 43C) fractures are high-energy injuries that remain challenging to treat due to their complexity and associated soft tissue compromise. Even in closed injuries, high complication rates persist, including infection and symptomatic hardware irritation. Plate positioning is guided primarily by fracture morphology, but the tibia's subcutaneous nature raises concerns about soft tissue tolerance to implants. While medial plates are more prominent subcutaneously, the potential effect of primary plate location or accessory plating on postoperative outcomes remains controversial. We aimed to determine whether primary plate position or use of accessory plates independently affects rates of hardware removal for irritation or infection following ORIF of closed 43C pilon fractures.

## **METHODS:**

We conducted a retrospective cohort study of skeletally mature patients with closed OTA/AO 43C pilon fractures treated with open reduction and internal fixation (ORIF) at two Level I trauma centers between 2002 and 2023. Patients were included if they had at least 6 months of clinical follow-up or experienced a primary outcome event before that point. Data collected included demographics, injury characteristics, fixation details, and postoperative outcomes. The primary plate was defined as the longest plate in the distal tibial fixation construct. Patients were grouped by primary plate location: medial (n = 140), anterolateral (n = 130), posterior (n = 16), or anterior (n = 12). Analyses were limited to the medial and anterolateral groups due to limited sample size in the posterior and anterior cohorts.

The primary outcomes were hardware removal for symptomatic irritation and postoperative infection. Both univariate and multivariable logistic regression analyses were performed. Propensity score matching (PSM) using nearest-neighbor methods was selected as the primary analytic approach to adjust for confounders including age, sex, smoking status, high-energy mechanism, and accessory plate use. For sensitivity analysis, alternative weighting strategies were applied using covariate balancing propensity scores (CBPS) and entropy balancing (EBAL) to assess robustness across modeling approaches. Model fit was evaluated using the Akaike Information Criterion (AIC).

## **RESULTS:**

A total of 298 patients were included in the final analysis. Patients in the anterolateral group were more likely to use tobacco (p = 0.01), but other covariates were well balanced following matching and weighting. Hardware removal for symptomatic irritation occurred significantly more often in patients with medial plates compared to those with anterolateral plates (25.7% vs. 9.2%, p < 0.001). This association remained significant in the nearest-neighbor matched analysis.

Postoperative infection was less frequent overall. Medial plate location was not significantly associated with infection in the matched model (OR = 1.18, p = 0.56) or in the entropy-balanced (OR = 1.44, p = 0.20) and CBPS-weighted (OR = 1.44, p = 0.07) models, though CBPS suggested a potential trend. The presence of an accessory plate was not significantly associated with infection in any model. In a secondary analysis evaluating infection-related hardware removal, EBAL suggested a possible increased risk with medial plates (OR = 2.43, p = 0.05), but this was not confirmed in CBPS weighting (OR = 1.93, p = 0.11). Interestingly, accessory plating was associated with significantly reduced risk of infection-related removal in the EBAL model (OR = 0.09, p < 0.001), though the confidence interval was wide.

## **DISCUSSION AND CONCLUSION:**

Primary medial plating in closed 43C pilon fractures was associated with a significantly higher risk of symptomatic hardware removal compared to anterolateral plating. This finding was consistent across multiple analytic models. In contrast, medial plating was not consistently associated with increased postoperative infection risk. While entropy balancing suggested a potential association with infection-related hardware removal, results varied by weighting method and should be interpreted cautiously. Accessory plating did not increase infection risk and may be protective in select contexts, though further study is warranted.

These findings suggest that while plate position may not influence infection risk, it significantly impacts rates of hardware removal due to symptomatic irritation. Surgeons should be aware of the increased likelihood of hardware removal for irritation with medial plating and should appropriately counsel the patient and set appropriate postoperative expectations.