

Induced Membrane Technique Is Effective for Both Metaphyseal and Diaphyseal Fractures with Acute Bone Loss

Lillia Steffenson, MD; Stephen Wallace, MD; Alexander Roszman, MD; Clay A. Spitler, MD; Michael Githens, MD; Justin Haller, MD
University of Utah, Salt Lake City, UT, United States

Purpose: The induced membrane (IM) (Masquelet) technique is a two-stage procedure that was originally described for reconstructing diaphyseal defects. There is currently no literature guiding the usage of this technique for metaphyseal defects. Given the differences in bony structure and vascular supply between the diaphysis and metaphysis of a long bone, the purpose of this study was to compare outcomes of metaphyseal and diaphyseal fractures with acute bone loss treated with IM technique.

Methods: Patients acutely treated with IM technique for traumatic bone loss in the lower extremity at three Level I trauma centers between 2010 and 2020 were retrospectively reviewed. Patient demographics and fracture characteristics were collected. Fracture union was the primary outcome and was defined as radiographic healing on at least three cortices without clinical symptoms. Secondary outcomes measured were infection rate, revision grafting, time to union, or amputation. Patients were followed to union or a minimum of 12 months. χ^2 and Wilcoxon rank sum tests were performed on categorical and continuous variables, respectively. Multivariate regression was used to compare successful union across fracture zone while controlling for patient age.

Results: Six patients underwent lower extremity amputation due to soft-tissue compromise or infection prior to receiving the second stage surgery and were excluded from analysis, leaving 96 patients with an average follow-up of 24 months. 43 had diaphyseal IM (DIM) and 53 patients had metaphyseal IM (MIM). Metaphyseal patients were significantly older (43 years) than diaphyseal patients (32 years) ($P = 0.004$). Demographic and fracture characteristics including gender, tobacco use, open fracture, number of tibia fractures, defect size, and follow-up were similar between groups. After controlling for age, there was no difference in final union rate between the diaphyseal (39 of 43, 93%) and metaphyseal cohorts (44 of 53, 83%) (odds ratio [OR] 0.95, $P = 0.91$). Similarly, there was no difference in time to union from second stage (DIM 13.8 months, MIM 10.8 months, $P = 0.20$), infection (DIM 30%, MIM 25%, $P = 0.53$), revision grafting (DIM 16%, MIM 15%, $P = 0.86$), or amputation (DIM 5%, MIM 7.5%, $P = 0.52$) between groups.

Conclusion: This study represents the largest series of lower extremity fractures treated acutely with the IM technique. Induced membrane for acute fractures with bone loss had an overall success rate of 86%. There was no difference in rates of successful union or complications between diaphyseal fractures and metaphyseal fractures treated with the IM technique.