First Clinical Results with Micromotion Intramedullary Nailing of Tibial Fractures

Hannah L. Dailey, PhD; ***James Anthony Harty, FRCS (Ortho)***
Cork University Hospital, Cork, Ireland

Purpose: The objective of this study was to assess clinical outcomes for tibial shaft fractures treated with a new intramedullary (IM) nailing system that produces controlled axial interfragmentary micromotion. Clinical outcomes were compared to the current standard of care (tibial nail with static interlocking).

Methods: All patients were treated in a Level I trauma center over a 2.5-year period. Group allocation was not randomized; both the micromotion nails and static locking nails (control group) were commercially available in the center and selected at the discretion of the surgeons on call. All micromotion patients were prospectively recruited. The control group was a mixed prospective-retrospective design to ensure accurate reporting of the nonunion rate. Patient and injury characteristics were recorded, and Nonunion Risk Determination (NURD) scores were calculated. Radiographic progress was assessed every 6 weeks until clinical union. Low-dose CT scans were acquired at 12 weeks and virtual mechanical testing was performed on each fracture to objectively assess virtual torsional rigidity (VTR). VTR is expressed as a percentage, where 0% indicates no healing and 100% indicates structural equivalence with the patient's intact tibia.

Results: A total of 98 primary tibial fractures were evaluated. Of these, 39 patients were treated with micromotion and there were 37 complete records (1 lost to follow-up, 1 suspended due to COVID-19). The control group included 59 patients and there were 46 complete records (8 lost to follow-up, 5 suspended due to COVID-19). There were no significant differences between the micromotion and control groups in terms of median age (40 vs 35 years, $P = 0.996$), gender (70% male both groups), the proportion of open fractures (22% vs 19% open, $P = 0.752$), or median NURD score (3 vs 1, $P = 0.157$). There were no nonunions in the micromotion group versus five (11%) in the control group. There were no deep infections in either group. The proportion of fractures united was significantly higher in the micromotion group compared to controls at 12 weeks (54% vs 30% united, $P = 0.043$), 18 weeks (81% vs 59%, $P = 0.034$), and 24 weeks (97% vs 74%, $P = 0.005$). Considering all injury types and comorbidities together, there was no difference in average VTR score at 12 weeks with micromotion compared to control (100% ± 18% vs 95% ± 25%, $P = 0.467$). However, considering the subset of only closed fractures, patients with biological comorbidities such as smoking and diabetes had significantly higher VTR scores with micromotion than without (closed comorbidities subset: micromotion VTR = 103% ± 12% [N = 11] vs control VTR = 81% ± 13% [N = 7], $P = 0.008$).

Conclusion: In this pilot clinical series, micromotion fixation was associated with reduced nonunion and improved healing compared to standard tibial nailing. Further prospective clinical studies will be needed to assess the potential benefits of micromotion fixation in IM nailing of the tibia.