Performance and Complications of the Precice Internal Lengthening Nail: A Retrospective Review of 286 Bone Lengthening Events

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INTRODUCTION:
Femur and tibia lengthening are routinely performed with internal lengthening nails. The Precice (NuVasive, San Diego, CA) nail in particular has revolutionized the field of limb lengthening with its ease of use and reliable distraction. Prior studies of the implant are either small, heterogeneous, or focus on a single type of lengthening. The purpose of this study was to analyze a large sample of bone distractions with meaningful subgroup analyses to evaluate key differences in outcomes and complications.
METHODS:
A retrospective chart and radiographic review of all the Precice internal lengthening nails implanted at one institution from 9/1/2012 – 9/1/2020 were reviewed. Each lengthening event was considered separately from the time of implantation to the end of consolidation. Demographic data, preoperative bone deformity, operative approach (antegrade femur [AF], retrograde femur [RF], antegrade tibia [T]), acute deformity correction (coronal, sagittal, rotation), and the use of blocking screws was recorded. The outcome data calculated included the lengthening achieved (cm), the distraction index (DI, mm/day), the bone healing index (BHI, months/cm), reliability (number of successful treatment/implants required), postoperative joint orientation angles, mechanical axis deviation (MAD), and date of implant removal. Consolidation of the lengthening site was determined on biplanar radiographs when three of four cortices contained bridging bone two millimeters thick. Complications were recorded including neurovascular injury, infection (superficial or deep), premature consolidation, nonunion or delayed consolidation, contracture requiring surgery, lengthening induced bone deformity (outside 5 lateral to 12 medial MAD), deep vein thrombosis, and pulmonary embolus. Implant related complications included: failure to distract, crown fracture, locking screw/bolt migration or breakage, and nail fracture. ASAMI bone and function scores were recorded.
RESULTS:
There were 286 femur and tibia lengthening procedures performed, including 164 AF with mean age 29.7 (SD 14), 67 RF with mean age 36.2 (SD 13.7), and 55 T with mean age 35.8 (SD 13.6) (Table 1). Forty of the procedures were bilateral (31 AF, 5 RF, 4 T). Forty-two were in patient less than or equal to 16 years of age (35 AF, 4 RF, 3 T). Congenital causes lead to lengthening in 50 AF, 18 RF, and 20 T, acquired causes (trauma, neoplasm, growth arrest, dysplasia, failed arthroplasty) in 52 AF, 43 RF, and 27 T, and stature lengthening in 62 AF, 6 RF, and 8 T. Acute deformity correction was performed in 23 (14%) of AF, 53 (79%) RF, and 19 (34.5%) T and blocking screws were utilized in 9 (5.5%) AF, 60 (89.5%) RF, 44 (80%) T. Lengthening achieved via AF averaged 4.43cm (SD 2.13) with DI 0.99 (SD 0.12) and BHI 0.89 (SD 0.68), via RF 3.44cm (SD 2.02) with DI 0.92 (SD 0.23) and BHI 1.21 (0.70), via T 3.86cm (SD 1.53) with DI 0.71 (SD 0.18) and BHI 1.47 (SD 1.03).
On multivariate analysis, nail type (p=0.001, younger age (p=0.001), and lengthening only (no deformity correction, p=0.001) were associated with lower BHI. The reliability of AF was 92.7, RF 93.1, and T 94.8. ASAMI bone and function scores averaged 3.99 and 3.93 for AF, 3.97 and 3.76 for RF, and 3.98 and 3.79 for T. Deformity was induced in 8 (4.9%) AF, 2 (3.0%) RF, and 5 (9.1%) T. Additional operations for any reason were needed in 15 AF, 7 RF, and 6 T. There was a total of 3 nail that failed to distract. Implant or crown fracture occurred in 15 AF, 4 RF, and 1 T.
DISCUSSION AND CONCLUSION:
Lengthening with the Precice nail is a reliable technique for small to large lengthening events that is well tolerated by patients, can be combined with other deformity correction, and leads to excellent clinical and functional outcomes. The bone healing indices are comparable to or better than external fixation. Antegrade lengthening, younger age, and lengthening without acute deformity correction leads to lower bone healing indices. Lengthening must be monitored closely because complications can occur, including implant or crown fracture, locking bolt migration, or delayed consolidation leading to exchange nailing.