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## Case Reports and Series

### Mini-Invasive Treatment for Brachymetatarsia of the Fourth Ray in Females: Percutaneous Osteotomy With Mini-Burr and External Fixation—A Case Series

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## ABSTRACT

Brachymetatarsia is a rare disease defined by metatarsal shortening and characterized by a painful disarticulation with or without pain. The aim of our study was to evaluate the outcomes of fourth ray brachymetatarsia treated with percutaneous osteotomy using a mini-burr and gradual lengthening with external fixation. A total of 7 females were recruited for the study; 6 (85.7%) of whom had a bilateral deformity. In a total of 13 feet affected by fourth ray brachymetatarsia, percutaneous diaphyseal osteotomy with a mini-burr followed by metatarsal elongation was performed. Metatarsal lengthening was measured as the difference between the preoperative and postoperative length at external fixation removal. The American Orthopaedic Foot and Ankle Society scores for metatarsophalangeal-interphalangeal score, patient satisfaction, restoration of Lefevre parabola, and treatment time were evaluated. Numerical data are reported as the mean  $\pm$  standard deviation and 95% confidence intervals. The Mann-Whitney U test was used to compare the changes in the AOFAS score with a level of significance of  $p < .05$ . The mean metatarsal lengthening was  $17.46 \pm 4.89$  [95% confidence interval (CI) 14.8 to 20.12] mm and the mean treatment time was  $90.23 \pm 8.53$  [95% CI 84.50 to 101.87] days. The mean American Orthopaedic Foot and Ankle Society scores for metatarsophalangeal-interphalangeal score improved significantly from  $36.38 \pm 2.66$  [95% CI 34.77 to 38.03] preoperatively to  $86.46 \pm 1.45$  [95% CI 84.85 to 88.07] postoperatively ( $p < .01$ ) in 12 of 13 feet (92.3%). The Lefevre parabola was restored, and the patients were satisfied with the clinical outcomes. The results of our study demonstrate that percutaneous osteotomy with the mini-burr and external fixation is an effective treatment for lengthening of fourth ray brachymetatarsia. Furthermore, we found good clinical and functional outcomes, high patient satisfaction, and a similar duration of treatment compared with other gradual lengthening procedures.

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Brachymetatarsia is a rare foot deformity caused by the premature closure of the metatarsal epiphysis that leads to a shortened metatarsus (Figs. 1 and 2). Several factors seem to play a role in the etiology of this foot condition, including traumatic, iatrogenic, and congenital, with or without an association with systemic syndromes (1). This deformity is characterized by a wide range of clinical patterns from aesthetic dissatisfaction to severe pain. By definition, it is the presence of  $\geq 1$  metatarsals ending 5 mm below

the parabolic metatarsal arc (2). It is more frequent in females (23:1), and the fourth ray is the most frequently affected (3), with an incidence of 0.02% to 0.05% (4). In 75% of cases, it presents as a bilateral condition (5).

Several procedures have been proposed for the surgical correction of this deformity to restore the Lefevre parabola. Gradual lengthening by distraction elongation (6) and one-stage elongation seem to be the most commonly used procedures. One-stage elongation is usually combined with hyponagittal (7) or bone grafting (8) and, when necessary, is completed with an adjacent metatarsal and phalange shortening osteotomy (9).

In our retrospective case series, we describe the results of gradual metatarsal lengthening performed with mini-burr percutaneous osteotomy followed by external fixation.

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