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Fifth Metatarsal Osteotomies for Treatment of Bunionette Deformity: A Meta-Analysis of Angle Correction and Clinical Condition

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ABSTRACT

We assessed which type of osteotomy would be most suited for correcting an increased fourth to fifth intermetatarsal angle (IMA) and metatarsophalangeal angle (MPA) and would have the best results regarding the clinical condition and satisfaction. The study design was a systematic review and meta-analysis. The main outcome measures were the IMA, MPA, and American Orthopaedic Foot and Ankle Society Lesser Metatarsophalangeal–Interphalangeal scale and satisfaction scores. A systematic search was performed in Medline, Embase, Cochrane, SPORTdiscus, and CINAHL up to September 2016. Prospective and retrospective studies that had evaluated the outcomes of fifth metatarsal osteotomies to correct a bunionette deformity at all patient ages were included. The outcomes were determined from clinical or radiographic evaluations. The search yielded 28 studies suitable for inclusion in our meta-analysis. All groups of osteotomies achieved significant IMA changes, with proximal osteotomies resulting in significantly greater changes than diaphyseal or distal osteotomies. The overall effect of osteotomies on the MPA was of a significant reduction. Proximal and diaphyseal osteotomies both resulted in significant differences in MPA correction compared with distal osteotomies. The incidence of major complications was the least in the distal osteotomy group. The overall mean success rate of bunionette surgery was 93%. The patients were most satisfied with proximal osteotomies, followed by distal and diaphyseal osteotomies (100% and 92%, respectively). In conclusion, every type of osteotomy has the capability of significantly reducing the fourth to fifth IMA and MPA. The fewest complications occurred with distal osteotomies, and the greatest satisfaction score was achieved with proximal osteotomies. However, only 1 study evaluated these results for proximal osteotomies. Distal osteotomies resulted in a high satisfaction rate and were the most represented osteotomy in our meta-analysis. Thus, when major IMA and MPA reduction is not required, the distal osteotomy could be the treatment of choice owing to its low complication rate.

A bunionette, or tailor's bunion, is a painful lateral prominence of the fifth metatarsal head (1). Patients will present with a history of pain of the lateral bunion, plantar callous, and pain that increases with constrictive shoe wear. These symptoms can have profound effect on activities and employment. The exact etiology of a bunionette deformity is not known, although multiple reasons have been suggested, including biomechanical and anatomic variations (2,3).

Historically, bunionette deformities were more common among tailors because they worked in a crossed-legged sitting position, with their hips rotated externally and the lateral sides of their feet resting on the bench. This supposedly led to hypertrophy of the tissue overlying the lateral side of the fifth metatarsal, bursal thickening, and hyperkeratosis, resulting in deformity of the fifth metatarsal head, axis, or diaphysis. Currently, tight and narrow shoe wear can lead to a similar pathogenesis (4,5). Anatomic variations consist of a large or dumbbell-shaped metatarsal head (type 1), lateral deviation at the metadiaphyseal junction (type 2), and an increased fourth to fifth intermetatarsal angle (IMA) (type 3), as described by Coughlin (4). In addition, Fallat et al (6) described a type 4 abnormality, which is a combination of ≥2 of these abnormalities.

The initial treatment of bunionette deformity should be conservative and includes the use of a semirigid shoe insert, metatarsal pads, nonsteroidal oral analgesics, and corticosteroid injections. If conservative treatment fails, surgical intervention is indicated for relief of

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a painful bunionette deformity. Surgical interventions consist of simple lateral condylar excision and metatarsal osteotomies at different sections of the bone (metaphyseal or diaphyseal). Metaphyseal osteotomies can be categorized into those at the proximal and distal level. A proximal osteotomy is suitable for type 3 and 4 deformities because of its ability to correct a severe IMA (6–8). Another advantage of a proximal osteotomy is maintenance of metatarsophalangeal joint function and the ability to perform this procedure in pediatric cases because the approach avoids the epiphyseal plates (8,9). However, owing to the possibility of intra- and extraosseous vessel interruption at the base of the fifth metatarsal, nonunion and/or delayed union have been more common (10). Other disadvantages include the technical demands of the procedure, the risk of transfer metatarsalgia due to metatarsal elevation or shortening, and that postoperative management requires non-weightbearing for several weeks (8,9). Distal osteotomies are used for type 2 and 3 deformities and have the advantages of usually being technically easier and more stable, contributing to the satisfactory results. Postoperative disability is reduced because weightbearing can be allowed after a distal osteotomy. The disadvantages include the possibility of inadequate correction owing to the small width of the fifth metatarsal head and transfer metatarsalgia resulting from fifth metatarsal shortening or excessive dorsiflexion (8,9).

A diaphyseal osteotomy is recommended if more correction is required than would be achieved using a distal osteotomy. Diaphyseal osteotomies have more bone–bone surface and will not disrupt the intra- or extraosseous vessels. Conflicting conclusions have been reported concerning bone union (4,11). The disadvantage with this type of osteotomy is that more dissection is required, which can result in longer postoperative convalescence and non-weightbearing for several weeks (8,9).

Given the great number of different types of osteotomies for correcting a bunionette deformity, we conducted a meta-analysis to address 2 essential questions. First, which type of osteotomy would be most suitable for correction of an increased fourth to fifth IMA; and second, which type of osteotomy would provide the best results concerning the clinical condition, complications, and patient satisfaction.

Materials and Methods

We used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement as a guideline for the present study. The protocol for our systematic review and meta-analysis was registered in the PROSPERO International prospective register of systematic reviews with registration number CRD42016050411.

Eligibility Criteria

Every prospective and retrospective study that had evaluated the outcomes of fifth metatarsal osteotomies to correct a bunionette deformity at all ages was included. The outcomes were determined from clinical or radiographic evaluations. The radiographic evaluation consisted of preoperative and postoperative measurements of the IMA and metatarsophalangeal angle (MPA) on full weightbearing anteroposterior and lateral radiographs. The American Orthopaedic Foot and Ankle Society (AOFAS) Lesser Metatarsophalangeal–Interphalangeal scale was used as an outcome measure to evaluate the clinical condition of the patients preoperatively and postoperatively. Patients' subjective satisfaction was assessed using the Coughlin classification (4) and other satisfaction outcomes on the results of their surgery.

Literature Search and Study Selection

A systematic search was performed in Medline, Embase, Cochrane, SPORTdiscus, and CINAHL in September 2016 to identify all studies of bunionette treatment. The search terms for each database included "tailor's bunion," "tailor's bunions," "tailor bunion," "tailor bunions," "bunionette," and "bunionettes." The search was independently performed by 2 of us (H.M., I.S.). The search strategies are listed in the Appendix.

Full-text reports were included based on the titles, relevance of the abstract using the eligibility criteria, availability in the English language, and follow-up duration of >6 months. We set no restrictions on the publication date or patient age. Finally, we searched manually for additional eligible studies by cross checking the reference lists of all included studies.

Data Extraction

Data were extracted from each included study by 1 of us (H.M.) and cross-checked by another 1 of us (I.S.). Data extraction was performed using data collection forms for each study. The study design (prospective, retrospective), study characteristics (year of conduct, country where the study was conducted, number of patients), patient characteristics (age, sex), treatment characteristics (proximal, diaphyseal, or distal osteotomy and use and type of fixation), treatment outcomes (AOFAS scale score, IMA, MPA, and subjective satisfaction score), follow-up duration, and complications were recorded.

The AOFAS scale scores were only extracted for analysis if both pre- and postoperative results had been reported. To avoid bias resulting from the use of other procedures, the AOFAS scale scores were not included for analysis if additional forefoot surgery, such as hallux valgus or hammertoe correction, had been performed.

The success rate of bunionette surgery was determined using the subjective satisfaction ratings of patients on their surgery results. These ratings were graded as excellent, good, fair, or poor according to classification by Coughlin (4). Success was defined as good to excellent Coughlin scores. If no Coughlin classification score was reported, patient satisfaction with their results was used. If the Coughlin satisfaction rates had been determined using the AOFAS scale scores, we excluded these studies from the success rate and satisfaction rate analyses.

All complications reported by the individual studies were extracted. Two of us (H.M., P.N.) reviewed the complications and subsequently allocated them into predetermined categories: major and minor complications and wound complications, surgical complications, bone complications, joint complications, revision surgery, symptomatic plantar callosities, and other. Disagreement was resolved by discussion.

Synthesis of Results

The mean difference (MD) and 95% confidence interval (CI) for each study was calculated using the preoperative and postoperative mean, standard deviation, and number of patients. If the standard deviation had not been provided, we used the method by Walter and Yao (12), which estimated the standard deviation if a mean and range were reported. The standard deviation was estimated by dividing the length of the 95% CI by 3.92, multiplied by the square root of the sample size (13). To allow for pooling and comparing the outcomes of the studies, standardized MDs were calculated as the difference between the preoperative and postoperative mean score divided by the pooled standard deviation of outcome for all patients.

We used RevMan, version 5.3 (Cochrane Reviews, London, UK), to combine the individual study results to perform the meta-analysis. The combined effect size and between-study variance was calculated approximately using the restricted maximum likelihood method. Heterogeneity between the studies in effect measures was assessed using both the χ^2 test and the I^2 statistic. An I^2 value >50% was considered indicative of substantial heterogeneity (14).

Quality Assessment of Included Studies

To assess the quality of studies we used the methodologic index for nonrandomized studies (MINOR) criteria (15). The MINOR is an instrument to assess the methodologic quality of nonrandomized studies, comparative and noncomparative. It consists of 8 methodologic items for nonrandomized studies. These individual items receive a score of 0 points if nothing has been reported, 1 point if reported but inadequate, and 2 points if reported and adequate. Therefore, the score for nonrandomized studies can range from 0 to 16. The methodologic quality assessment was performed independently by 2 of us (H.M., I.S.). Disagreement was resolved by discussion.

Results

Search Results

The search of Medline, Embase, Cochrane, Sportdiscus, and Cinahl yielded 307 records. Of these records, 158 remained after removing the duplicates. After screening the titles for relevance, 87 records were excluded because they did not meet our criteria. The abstracts of the remaining 71 records were screened for potential relevance and 31 were excluded because they did not meet the inclusion criteria. The remaining 40 full text records were screened for eligibility, resulting in 28 studies eligible for inclusion in our meta-analysis (Fig. 1) (11,16–42).