Percutaneous bunionette correction: Results of a 49-case retrospective study at a mean 34 months’ follow-up

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A B S T R A C T

Introduction: Bunionette consists in a lateral prominence of the head of the fifth metatarsal (M5), inducing a callus, Toe malpositioning determines the varus, supr Varius or infravarius form.

Hypothesis: A percutaneous method without osteosynthesis was assessed in 38 patients suffering from this pathology.

Patients and methods: A continuous single-operator multicenter series operated on between May 2005 and January 2012 was analyzed with mean follow-up of 34 months. The inclusion criterion was bunionette with or without varus deviation. Al patients were operated on percutaneously without tourniquet, on a day-care basis. All were clinically assessed, preoperatively and at latest FU, by visual analog pain scale (VAS), AOFAS and Coughlin scores, and callus status. Standard radiological assessment comprised monitoring of intermetatarsal (M4M5) and metatarsophalangeal (M5P1) angles.

Results: VAS decreased from 8 (range, 6–9) preoperatively to 0.3 (range, 0–1) out of 10 at follow-up.

AOFAS score increased from 58 (range, 52–75) to 97 (range, 80–100) out of 100. According to the Coughlin score, 97.5% of patients were satisfied or very satisfied. Deformity correction was systematic, with disappearance of preoperative callus. M4M5 and M5P1 angles decreased respectively from 10° (range, 6–13°) and 16.2° (range, 8–24°) preoperatively to 5.5° (range, 4–8°) and 4.3° (range, 2–9°). There was 1 case of complex regional pain syndrome and 1 delayed consolidation.

Discussion: This procedure appeared reliable for correcting all types of bunionette deformity. Other minimally invasive methods with comparable results use pin fixation. The advantages over conventional techniques are the quality of results, low morbidity and absence of osteosynthesis material. The percutaneous technique should, we believe, be widely adopted in this indication.

Level of evidence: IV.

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1. Introduction

“Bunionette” deformity consists in lateral prominence of the 5th metatarsal (M5) head, often resulting in a callus on the lateral or plantar side. Its frequency is 3 to 6 times greater in female than male subjects [1]. Like in hallux valgus, there is no exostosis of the metatarsal head, but rather lateral migration, sometimes with associated morphologic abnormality. M.J. Coughlin, developing the work of H.L. Du Vries, distinguished 3 types of bunionette according to M5 aspect (Fig. 1): type 1, with increased M5 head volume and prominent lateral condyle (16–33%); type 2, bow deformity inducing symptomatic prominence of the lateral condyle (10%); and type 3, with increased M4M5 angle (normal angle, <12°) with no particular distal M5 deformity (57–74%) [2,3]. There may be associated, usually congenital, 5th toe varus overlap, in infraducratus or supravarius.

The principal objective of the present retrospective study was to analyze functional and radiological results in a cohort of patients with bunionette or 5th toe infraducratus or supravarius varus undergoing percutaneous surgery. The secondary objectives were to assess morbidity and define the role of percutaneous surgery in this indication.

2. Patients and methods

2.1. Design

The series comprised cases of bunionette undergoing primary percutaneous surgical treatment by a single operator (OL) in
2 centers between May 2005 and January 2012. Inclusion criteria were type 1, 2 or 3 bunions and with or without 5th toe infraeductus or supraductus varus, not relieved by non-operative management. Exclusion criteria were previous history of surgery, hindfoot varus, rheumatoid inflammatory pathology, multiple deformity syndrome and local evolutive infection.

2.2. Series

Forty-nine cases were operated on in 38 patients: 34 female; mean age, 50 ± 19 years. There was no loss to follow-up. On the Du Vries classification, there were 34 type 1 (69.4%), 5 type 2 (10.2%) and 10 type 3 (20.4%) bunions. Preoperative static pedometry found 7 cases (14%) of hindfoot valgus, systematically associated with hallux valgus, all other hindfeet being neutral. Footprints showed pes cavus in 12% of cases and flat-foot in 27% and were normal in 61%. Dynamic testing found no cases of supine gait.

Thirteen patients (35.1%) were operated on bilaterally, including 4 one-step surgeries. The right foot was involved in 30 cases. All patients were under locoregional anesthesia, completed in 5% of cases by general anesthesia. The distribution of procedures is shown in Table 1. Mean 5th ray surgery time including dressing was 14 ± 4 minutes. All patients were followed up, at a mean 34 ± 22 months (range, 24–61 months).

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Number of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>M5 metatarsal osteotomy</td>
<td>49</td>
</tr>
<tr>
<td>M5 lateral condylectomy</td>
<td>37</td>
</tr>
<tr>
<td>Dorsal extensor longus and brevis tenotomy</td>
<td>9</td>
</tr>
<tr>
<td>Plantar flexor longus tenotomy</td>
<td>11</td>
</tr>
<tr>
<td>Selective MP medial arthrolysis</td>
<td>38</td>
</tr>
<tr>
<td>Proximal P1 osteotomy P1 (same plantar approach as for flexor)</td>
<td>7</td>
</tr>
<tr>
<td>Proximal P1 osteotomy P1 (dorsal approach)</td>
<td>33</td>
</tr>
</tbody>
</table>

2.3. Surgical technique

Surgery was on a day-care basis, under locoregional anesthesia: popliteal block in was used in one center and ankle block in the other. The patient was positioned supine, with the foot to be operated on over the edge of the table for fluoroscopy, without tourniquet, and the contralateral lower limb in 90° flexion. In 21 cases (42.8%), there were one or more associated procedures, either on the hallux (14.3%), in some cases further associating one or more percutaneous lateral osteotomies (12.2%), or an isolated lateral procedure (16.3%).

For associated minimally invasive 1st ray surgery (26.5%), a tourniquet was implemented secondarily. Depending on the lateral prominence of the head (type 1) and the size of the M4M5 angle, surgery began by lateral M5 condylectomy via an incision to the lateral plantar corner of the head with the blade parallel to the bone until bone contact was reached [4]. A work chamber was created using an elevator, and resection was performed using a short Shannon burr (8 × 2 mm) with a “wiper” movement to obtain a flat surface (Fig. 2). The main step consisted in metatarsal osteotomy, at a location depending on the type of deformity.

Osteotomy used a long Shannon burr (12 × 2 mm) in contact with the medial side of M5 and was performed from distal dorsal to proximal plantar at 45°, preserving a lateral hinge (Fig. 3). The location was at the summit of the arc in type 2 deformity and more distal in type 1; in the latter case, it was complete (Fig. 4). In supraductus, percutaneous dorsal osteotomy of the long and short extensor tendons was performed; conversely, in infra ductus, percutaneous osteotomy of the long flexor tendon was performed on a plantar approach adjacent to the proximal metaphysis of the proximal phalanx. In 5th toe adduction, selective medial metatarsophalangeal arthrolysis was performed via a dorsomedial incision; if that proved insufficient, or in case of rotation of the toe, complete proximal metephysal osteotomy of the proximal phalanx (Fig. 4) was performed, using a short Shannon burr via the plantar approach used for flexor tenotomy or via a dorsolateral approach [5]. The various skin incisions were not sutured; figure-of-eight dressing maintained correction, with the toe in a position opposite to the initial deformity, with particular care to close the M4M5 angle, which was checked on fluoroscopy. Dressings were renewed between postoperative days 10 and 15. Depending on the severity of the initial deformity and the need to maintain correction up to week 6, self-adhesive bands and/or a customized silicone elastomer orthoplasty were applied as of day 15; these devices allowed the patient to shower and rehabilitate to be initiated after the 3rd week. Protected weight-bearing in a flat orthopedic shoe was advised for 3 to 4 weeks. Antithrombosis prophylaxis was implemented only in case of risk factors as defined by the French Society of Anesthesia and Intensive Care (Société française d’anesthésie-réanimation [SFAR]) [6,7]. Type-1 regional pain syndrome prophylaxis used vitamin C on Besse’s protocol [8].

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2.4. Assessment criteria

Preoperative and last-follow-up functional assessment was based on the American Orthopaedic Foot and Ankle Society (AOFAS) Lesser Toe Metatarsophalangeal-Interphalangeal Scale [9]. Satisfaction was assessed on M.J. Coughlin's scale [2] (very satisfactory, satisfactory, disappointing, unsatisfactory) and pain on VAS. Open chain 5th metatarsophalangeal ranges of motion were assessed on goniometry. Resolution of preoperative plantar callus was noted. Return to "normal" footwear, including all kinds of shoewear and notably boot-type shoes with 3–4 cm heels, was noted, according to associated procedures.

Bone fusion and M4M5 and M5P1 angles were assessed on AP and lateral weight-bearing radiographs preoperatively, and at immediate postoperative, 6-week, 3-month and last follow-up. Clinical and radiologic assessment at last follow-up was performed by an independent observer (BMB). Pedometry included type of footprint, hindfoot axis and gait abnormality. Quantitative data were analyzed on Student test (SAS® 9.2 software). The significance threshold was set at 5%.

3. Results

3.1. Complications

There was 1 case of complex regional pain syndrome, which resolved without sequelae after adapted curative treatment (Fig. 5, namely c–e). There was 1 case of delayed fusion in a diaphyseal metatarsal osteotomy performed in a 1-step bilateral procedure; bone fusion was observed at postoperative month 10 (Fig. 6, namely e–g). There were no cases of recurrence of deformity, transfer metatarsalgia, non-union or thrombophlebitis. No revision procedures were required.
3.2. Clinical and functional results

Pedometry found slight normalization of flat footprints (16%, versus 27% preoperatively), no change in pes cavus (12%), and almost no change in hindfoot axis (4 versus 7 in valgus, all others being neutral). Dynamic testing found no gait disorder. Deformity correction and resolution of callus was systematic. Metatarsophalangeal range of motion increased from a mean 90.5° ± 9.2° (range, 50°–120°) to 93.7° ± 8.5° (range, 50°–120°).

Seven patients experienced pain during the first 3 postoperative months. All reported overall reduction in pain, the mean VAS score falling from 8 ± 1 (range, 6–9) preoperatively to 0.3 ± 0.6 (range, 0–1) by last follow-up. Ninety-seven percent of patients were satisfied or very satisfied with their result. Mean AOFAS score improved significantly from 58 ± 5 (range, 52–75) to 97 ± 5 (range, 80–100) at last follow-up (P < 0.05). Return to boot-type footwear with 3-cm heel was achieved at a mean 100 ± 27 days (range, 75–135); return to normal footwear, including heels > 6 cm, was achieved at a mean 150 ± 38 days (range, 130–195), including patients with associated hallux and/or lateral procedures.

Mean time off work for working patients was 54 ± 8 days.

3.3. Radiology results

Regular radiologic follow-up consistently found development of a callus, which was hypertrophic in 6 cases. All cases showed fusion by month, except for 1 in which fusion was delayed until month 10. Mean M4M5 and M5P1 angles were reduced respectively from 10.0° ± 2.7° (range, 6°–13°) to 5.5° ± 1.9° (range, 4°–8°) and from 16.2° ± 3.8° (range, 8°–24°) to 4.3° ± 2.4° (range, 2°–9°) (P < 0.05).

![Fig. 6. Bilateral type 1 bunionette. a: preoperative AP view (standing; left; right); b: pressure-platform image showing infraductus of the toe; c, d, e: full weight-bearing postoperative AP views at 4 months after fusion (c–e) (standing; left; right) and (f) aspect on pressure platform(f).](image)

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4. Discussion

The present study demonstrated excellent clinical and functional results with percutaneous surgery for bunionette, with almost no morbidity and using no osteosynthesis material. The possible study limitations lie in the retrospective design and associated procedures (in 43% of cases), although only results regarding M5 were analyzed. It remains, however, one of the few studies reporting results of percutaneous surgery in this indication.

A variety of conventional surgical techniques have been described in this pathology, including resection of the phalanx or metatarsal head with varying extension into M5 [10–15]. Simple lateral condylectomy leaves residual pain in up to 23% of cases, although patient satisfaction is good [13]; the procedure is insufficient and the recurrence rate is high. There is therefore unanimity in preferring metatarsal osteotomy, and several variants have been described. Proximal variants provide good correction but may impaire bone vascularization and lead to non-union [16]. Diaphyseal osteotomy respects metatarsal head vascularization and does not induce transfer metatarsalgia, but is occasionally associated with delayed fusion [17]. Distal osteotomies consolidate quickly, with less displacement [18–21]; excessive displacement may cause migration under M4 or discomfort due to the proximal fragment bone spur, requiring resection [19]. Also, more vertical osteotomies are less stable [22]. Each technique has its own complications: cutaneous, infectious and osseous (stability of the osteotomy assembly used, non-union or vascular necrosis); authors generally recommend restricting displacement during the consolidation period [23]. Osteosynthesis needs to respect the soft tissue, to avoid scarring issues and postoperative skin retraction.

Percutaneous techniques are inspired by Boesch’s 1st-ray technique of osteosynthesis using a console pin or by Isham’s technique, which was popularized in Europe by De Frado followed by GRECMIP [24–30]. Only one report could be found in the literature using the present percutaneous technique [31]. Minimal invasiveness seems to reduce morbidity, especially with regard to cicatrization, none of the previous studies reporting any such complications. The absence of any osteosynthesis material, and notably pins, provides a definite advantage over other minimally invasive techniques, most of which are associated with superficial infection. The present technique applies the concept of self-adjusting osteotomy without fixation, using tendon tension to achieve “customized” bone axis normalization. Postoperative dressing is thus of prime importance, stabilizing the osteotomy over the period in which the dressing is maintained. This need for rigorous follow-up is one hindrance to the development of the technique, despite its being well-accepted by the patients.

AOFAS scores improved significantly, from 57 to 97, in line with those for comparable techniques (Table 2). The significant reduction in M4M5 and M5P1 angles was comparable to that in certain other reports (Table 3).

The main complication was a case of delayed metatarsal osteotomy fusion (Fig. 6, namely a–h); the osteotomy was too proximal with respect to the contratralateral side, and took 10 months to consolidate (Fig. 6, namely h). We believe surgeons should resist patients’ requests to be operated on bilaterally, as this induces displacement or even rupture of the hinge even if orthopedic footwear is worn. The 45° angle of the cut ensures a certain stability despite the absence of osteosynthesis, underlining the mechanical interest of a horizontal cut [22].

The pain experienced by 7 patients during the first 3 months was systematically due to a hypertrophic callus. Magnan reported the same finding; it is exacerbated, compared to conventional open surgery, by the relative instability of the metatarsal osteotomy, even when pinned [27]. In comparison with classical osteosynthesis, the progressive resorption of hypertrophic calluses in non-fixed osteotomies is familiar to teams using these techniques and usually takes less than 6 months, with resultant regression of symptoms [25,29,31,32].

As in other procedures, the present technique allows “à la carte” surgery according to the type of deformity: condylectomy can be performed if the M5 head is large, in type-1 bunionette, but is not systematic since the correction provided by closing wedge osteotomy performed using a 2-mm burr is about 10° on the bone axis; it is greater in bicortical osteotomy. We consider M5 osteotomy to be the fundamental procedure, which we perform in all cases [17].

5. Conclusion

Percutaneous surgery for 5th ray deformity appears to be reproducible and effective in terms of subjective, clinical and radiological results. The radiological results were consistently excellent and comparable to those obtained with more conventional techniques, without soft tissue lesion, and were in agreement with the only other report concerning the same procedure. Taken together, the soft tissue and bone procedures achieve a new balance, with reliable correction and minimal aggression. All types of bunionette deformity can be treated in this way. The absence of osteosynthesis appeared to be an advantage, but we recommend 2-step surgery in bilateral indications. This pathology is probably the best indication for percutaneous treatment.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

No funding for this study.

References


Table 3

<table>
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<tr>
<th>Series</th>
<th>Preoperative M4M5</th>
<th>Postoperative M4M5</th>
<th>Gain</th>
<th>Preoperative M5P1</th>
<th>Postoperative M5P1</th>
<th>Gain</th>
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<td>9.2°</td>
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<td>Wetzel et al., 2007 [28]</td>
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<td>8.1°</td>
<td>5.9°</td>
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<td>1.5°</td>
<td>16.1°</td>
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<td>12°</td>
<td>6.7°</td>
<td>5.3°</td>
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<td>0.8°</td>
<td>9.8°</td>
<td>16°</td>
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<td>Present series</td>
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<td>5.51°</td>
<td>4.47°</td>
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