

ORIGINAL ARTICLE

Long term results of percutaneous osteotomy of the distal metatarsal (modified Bösch technique) for hallux valgus correction

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Received November 8, 2009; accepted January 15, 2010

KEYWORDS

Hallux valgus;
Osteotomy;
Percutaneous;
Foot;
Bösch

Abstract

Objective: To evaluate the clinical and radiological results of a subcapital osteotomy of the first metatarsal using a percutaneous technique in the treatment of mild-to-moderate *hallux valgus* deformity.

Material and methods: We performed a retrospective study of 70 osteotomies using a modified Bösch technique for the treatment of the painful *hallux valgus*, in 50 patients, all women, with an average follow-up of 7.5 years. We assessed the pre- and postoperative clinical outcome according to the American Orthopaedic Foot and Ankle Society (AOFAS) scale and radiological outcome by measuring the intermetatarsal (IMA) and the *hallux valgus* (HVA) angles.

Results: According to the AOFAS scale, we obtained a global preoperative score of 42.09 and postoperative of 87.81 points. The postoperative radiological findings showed an average IMA of 7.3° and HVA of 13.7°. There were two cases of deep infection satisfactorily treated with antibiotics and 3 cases of wire intolerance.

Conclusions: The percutaneous technique is a minimally invasive procedure that is useful for the correct execution of a distal linear osteotomy of the first metatarsal for the correction of the painful *hallux valgus*. The clinical results appear to be comparable with those obtained by traditional open techniques, with substantially shorter operating times, and reduced risk of surgery-related complications.

Level of evidence: IV

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PALABRAS CLAVE

Hallux valgus;
Osteotomía;
Percutánea;
Pie;
Bösch

Resultados a largo plazo de la osteotomía percutánea del metatarso distal (técnica de Bösch modificada) para la corrección del hallux valgus

Resumen

Objetivo: Evaluar los resultados clínicos y radiológicos de una osteotomía subcapital del primer metatarsiano con el uso de una técnica percutánea para el tratamiento del hallux valgus leve y moderado.

Material y métodos: Estudio retrospectivo de 70 osteotomías según la técnica de Bösch modificada como tratamiento del hallux valgus doloroso en 50 pacientes, todas mujeres, con un seguimiento medio de 7 años y medio. Se realizó una valoración clínica preoperatoria y postoperatoria con la escala funcional de la American Orthopaedic Foot and Ankle Society y una valoración radiográfica mediante la medición de los ángulos intermetatarsiano y del hallux valgus.

Resultados: Según la escala American Orthopaedic Foot and Ankle Society, se obtuvo una puntuación global preoperatoria de 42,09 puntos y una puntuación global postoperatoria de 87,81 puntos. Los resultados radiográficos postoperatorios fueron un ángulo intermetatarsiano medio de 7,3° y un ángulo hallux valgus medio de 13,7°. Hubo 2 casos de infección profunda tratada con antibiótico satisfactoriamente y 3 casos de intolerancia a aguja.

Conclusiones: La técnica percutánea es un procedimiento mínimamente invasivo y es útil para realizar una osteotomía lineal distal del primer metatarsiano y corregir un hallux valgus doloroso. Los resultados son comparables al de otras técnicas con tiempos operatorios más cortos y con menor riesgo de complicaciones.

Nivel de evidencia: IV.

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Introduction

The indication for the correction of hallux valgus is pain associated with deformity. A distal first metatarsal osteotomy can be used to achieve correction of mild and moderate hallux valgus^{1,2} with an intermetatarsal angle (IMA)³ of 10-20°. An osteotomy can be performed using a minimally invasive percutaneous approach,⁴⁻⁸ taking into account proper technical execution and a secure stabilisation of the osteotomy site. The advantages of a minimally invasive approach are a reduction in the surgical time and dissection of the tissues, the possibility of carrying out a bilateral procedure with fewer complications, the possibility of using distal anaesthetic block techniques and allowing for a fast recovery.⁵⁻⁸ The purpose of this study is to evaluate the results of a subcapital distal osteotomy of the first metatarsal with the use of a percutaneous technique performed by the same team of surgeons.

Patients and methodology

From 1993 to 2006, 70 percutaneous distal osteotomies of the first metatarsal were performed for the treatment of mild-moderate hallux valgus pain in 50 women. Patients were evaluated with a clinical and X-ray protocol, with an average 7½ years of follow up (range: 3-15 years).

The conservative treatment (comfortable modified footwear, use of soles and skin care) for at least 3 months failed in all patients. The procedure was performed bilaterally in 20 patients. Of these, 10 were performed in

the same surgical procedure and the 10 remaining in an interval of 11 months on average between the two interventions.

The average age of the patients at the time of surgery was 57 years (range: 45 to 78 years). No previous surgery had been performed in either foot and all of them had pain and deformity in the metatarsal head area. Transfer metatarsalgia was associated with 63 patients (70%).

The study used the scale proposed by the American Orthopaedic Foot and Ankle Society (AOFAS),^{3,9-11} with a score range of 0 to 100 points, which considers objective and subjective elements such as pain (maximum score of 40 points), functional capacity (maximum score of 45 points) and alignment of the hallux (maximum score of 15 points). Other factors evaluated clinically were any daily or recreational limitations, the type of shoes that the patient wore, the stability of the metatarsophalangeal and interphalangeal joints and the presence of calluses.

Anteroposterior and lateral X-rays of the feet while standing were taken preoperatively and 3 months after surgery to verify bone healing in the osteotomy site with the aim of measuring the angles of hallux valgus (AHV) and IMA, as recommended by the AOFAS.¹² The position of the sesamoids was also evaluated.

Surgical technique

The patient was placed in a supine position with the knee extended and the foot on the edge of the operating table for a more convenient use of the fluoroscope. The operation

was performed using a distal ankle block anaesthesia or spinal anaesthesia. We performed the nearly 1cm skin incision proximal to the first metatarsal head that reached directly to the bone and cut the periosteum equidistant from the dorsal and plantar region to avoid the neurovascular bundle (fig. 1). We conducted the dorsal and plantar periosteal release with the use of a small periostome inserted through the skin incision (fig. 2). In this step we avoided cutting the soft tissue surrounding the metatarsal. We then performed the osteotomy through the subcapital region using a drill bit with a diameter of 2.5mm or less. The cut was previously verified through imaging. The osteotomy was performed perpendicular to the longitudinal axis of the first metatarsal in the sagittal plane. To avoid damaging the drill bit, we performed a sequence of small perforations in the medial cortex and osteoclasia (fig. 3). We inserted a 2mm diameter Kirschner needle from the medial edge of the base of the distal phalanx of the first toe to its visualisation through the incision. It is important to place the needle in an extraperiosteal position to allow for lateral movement of the capital fragment after the

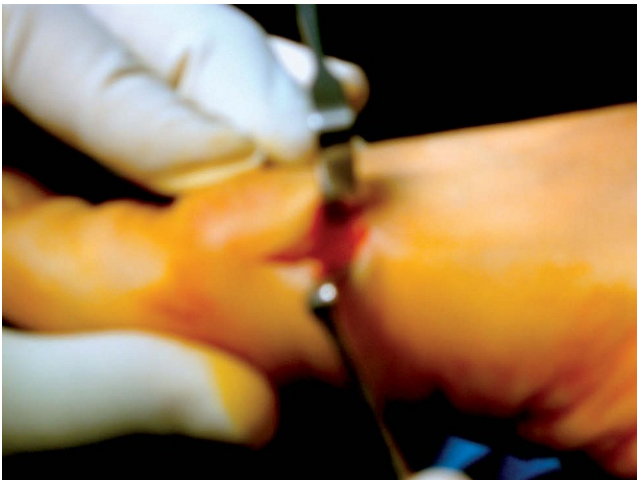


Figure 1 Skin incision of about 1cm proximal to the first metatarsal head.



Figure 2 Periosteal release.

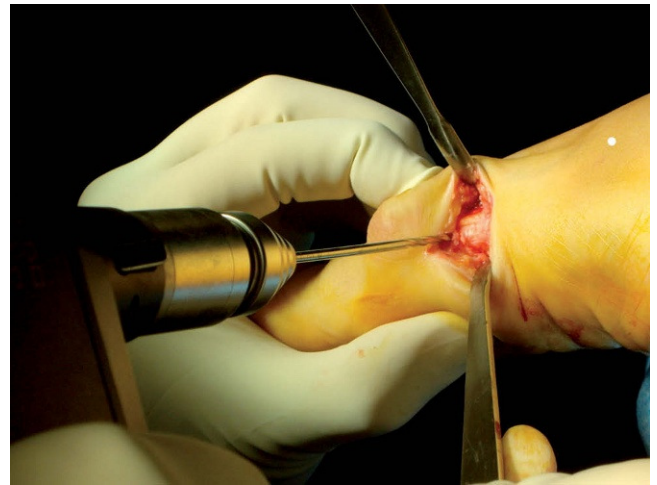


Figure 3 Perforations of the medial cortex to facilitate further osteoclasia.

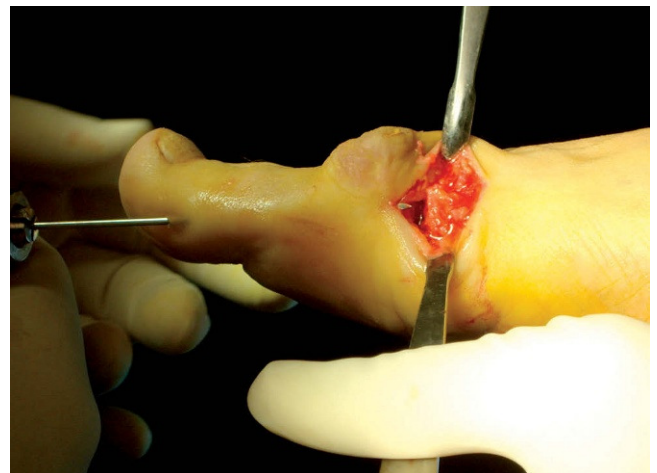


Figure 4 Kirschner needle placed in an extraperiosteal position to allow for displacement.

osteotomy and to center the needle in the dorsoplantar direction. In this way, the hallux itself will guide the correction and constitute one of the most important biomechanical aspects of the technique (fig. 4).

To achieve the correction, a grooved probe (or similar) was introduced in the diaphysis of the first metatarsal to guide the Kirschner needle manually until the point of the needle was observed using fluoroscopy to reach the base of the first metatarsal. Correcting the alignment of the metatarsophalangeal articulation was achieved through lateral displacement of the metatarsal head by means of the needle guided by the surgeon's hand. The correction achieved needed to be reviewed again under fluoroscopy (fig. 5). We consider the correction to be satisfactory when contact is achieved between the medial aspect of the metatarsal head and the lateral cortex of the metatarsal neck in the frontal plane. We always attempted to leave a slight overcorrection.

The osteotomy was stabilised by the manual conduction of the needle with a hammer from the distal to the proximal, through the medullary canal of the first metatarsal. The

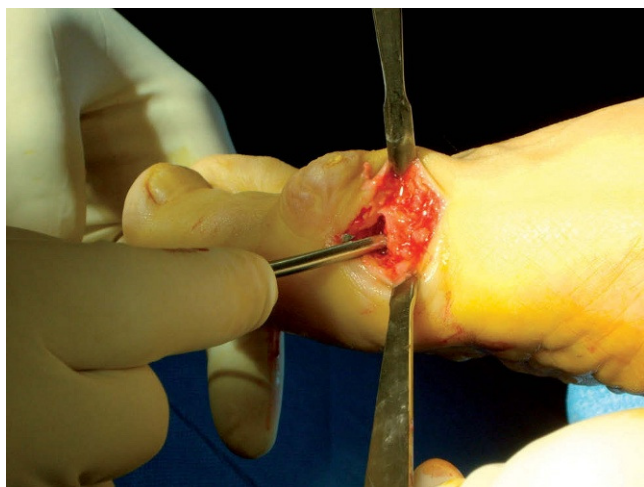


Figure 5 Correction by lateral displacement of the capital fragment.



Figure 6 Bandaging and padding plantar metatarsal heads.

Kirschner needle was brought to the base of the first metatarsal and we proceeded to ensure its stability. No procedures associated with soft tissues were performed in any of the cases.

Once finished, we once again verified the position of the Kirschner needle by means of fluoroscopy. The soft tissues of the skin incision were released and the Kirschner needle was bent before cutting it. The wound was closed with 1 or 2 sutures.

Postoperative care. The first toe was bound with elastic adhesive tape and the head of the metatarsals was cushioned for 6 weeks. A mild overcorrection of the hallux was attempted with the bandaging in order to prevent recurrence of the deformity (fig. 6). The patients were allowed to walk the day after surgery with the use of a shoe with a stiff sole. After removing the bandage 6 weeks later, they were encouraged to move the metatarsophalangeal articulation with special care to achieve a complete dorsiflexion in 4 to 6 weeks.

In the statistical analysis we consider the significance of the changes in the AHV and the IMA during the follow up,

which were compared with the preoperative values, as well as the values obtained by the AOFAS scale. We used the SPSS 12.0 program employing the Student's t-test for paired samples.

Results

All patients were evaluated and in all cases pain disappeared or had decreased after the intervention. In 81.82%, the pain had completely disappeared and in only 18.18% was the pain mild. No patient had daily or moderate-severe pain.

The mean AOFAS for pain prior to intervention was 16.06 of the 40 maximum points on the AOFAS scale. The statistical analysis showed statistically significant differences ($p < 0.001$) between pain prior to the osteotomy and pain after the intervention, which reached 38.18 on average. The functional capacity of the hallux, which was evaluated using the 6 different items on the AOFAS scale, presented statistically significant differences ($p \leq 0.005$) in each one of the items.

In the end, the postoperative alignment was considered to have the highest score in 63.64% of the cases and non-symptomatic in 24.24%. These values show a statistically significant difference with the alignment results prior to surgical intervention. The average score for hallux alignment was 11.48 points. The total average of the postoperative AOFAS scale was 87.81 points with a range of 67 to 100 points.

The patients were satisfied with the results in 91% of the 70 procedures and were dissatisfied with the results in only 9%.

With regard to the X-ray findings, the average final IMA achieved was 7.3° (SD: 2.7°) and the average AHV was 13.7 (SD: 6.7°). Plantarisation was not assessed as such, but instead the absence of metatarsalgia, and transfer metatarsalgias were avoided in 90% of the cases during the previously mentioned follow-up period.

We had 2 cases of deep infection at the site of the osteotomy, which required intravenous antibiotic treatment and were resolved in 2 weeks. In both cases, the Kirschner needle was withdrawn to avoid a recurrence of the infection. There were also 3 cases (4.28%) of intolerance to the needle necessitating its withdrawal before 6 weeks. We had no cases of pseudoarthrosis or of necrosis of the metatarsal head. Recidivism of the hallux valgus occurred in 4 cases (5.71%) and we encountered 13 cases of stiffness in the metatarsophalangeal joint. However, this stiffness did not cause pain while walking.

Discussion

Percutaneous distal osteotomy allows the orthopaedic surgeon to achieve good long-term corrections of mild and moderate deformities of the hallux valgus. The positive changes in the X-rays measured after the consolidation at the osteotomy site meet the biomechanical requirements for distal osteotomies of the first metatarsal as well as clinical results comparable with the results published by other authors with open or minimally invasive techniques.¹³⁻¹⁷ The only contraindications for this procedure are hallux

rigidus with joint stiffness and periarticular osteophytes that cannot be treated with this technique and those feet that have had a prior Keller-Brandes-Lelièvre osteotomy.

The type of fixation is an important element of the surgical technique, since the 2mm diameter Kirschner needle is inserted periosteally in the distal to proximal direction in the proximal phalanx and in the first metatarsal in order to later introduce it into the medulla and reach the base of the first metatarsal or even the cuneometatarsal articulation. This needle must be kept in for at least 4 weeks. The consolidation of the osteotomy was confirmed by X-rays in all patients within the first 6 months. A good angle correction was observed, similar to that of standard open techniques despite the slight overcorrection at the time of intervention.

The deep infection rates reach 3.5% in some series in which percutaneous techniques were used. Our 2 cases fall within this range that was achieved by the strict adherence to the postoperative protocol, which required clinical examination at weekly intervals, of vital importance in reducing problems in the needle insertion area.

There has been no report and no occurrence in our series of hallux varus overcorrection, which may be due to the fact that it does not affect soft tissues, given that the displacement of the head over the diaphysis tends to be up to 80-90% with respect to the transverse diameter of the osteotomy. This causes a substantial relaxation of the tendon of the adductor hallucis muscle. It seems that the lack of soft tissue surgery does not affect the prevalence of recurrent hallux valgus, perhaps because the realignment of the metatarsal head and the reduction of the head on the sesamoids were the primary objectives to be achieved.

The stiffness of the metatarsophalangeal joint is one of the most feared results in the surgery of hallux valgus and affects the overall clinical outcome. The percutaneous distal osteotomy theoretically respects this joint, however, we believe that the reduction of its range of movement in 13 of the 70 osteotomies may be due to pre-existing degenerative osteoarthritis or a failure of the recommended rehabilitation program following the withdrawal of the Kirschner needle and bandage. Furthermore, the needle that stabilises the metatarsophalangeal joint may create a risk of postoperative stiffness. While the majority of our patients maintained the same degree of joint movement after the intervention, all patients should be informed that hallux valgus may cause a loss of mobility in the metatarsophalangeal joint.

As for the bone medial corner of the metatarsal diaphysis, it generally reshapes over time. However, it may remain clinically evident for a more or less long period and may require revision surgery to smooth that edge. We have not observed that problem in our series.

The results of our study show that subcapital distal osteotomy of the first metatarsal by percutaneous technique and stabilisation with Kirschner needle, without soft tissue surgery, is an effective method of treating mild or moderate hallux valgus. The result seems to be comparable with that of traditional open techniques and has the advantages of a

minimally invasive procedure. These advantages include the simplicity of the process in the hands of an expert surgeon, decreased surgical time, decreased risk of complications and the ability to carry out the operation using anaesthetic block techniques.

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