Percutaneous Treatment of Grade I/II Hallux Rigidus in Active Patients: Surgical Technique and Outcomes

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ABSTRACT

Introduction: Hallux rigidus is the most common degenerative condition affecting the foot. This study aims to present the outcomes of a percutaneous surgical technique designed to improve range of motion and relieve pain in active patients. **Materials and Methods**: We conducted a retrospective review of all patients diagnosed with mild to moderate hallux rigidus who underwent minimally invasive/percutaneous surgery, involving dorsal cheilectomy of the first metatarsal combined with a dorsal wedge osteotomy of the first metatarsal and proximal phalanx of the hallux, between June 2019 and June 2022. The minimum follow-up period was 12 months, with a maximum of 36 months. **Results:** A total of 15 patients (19 feet) were included, with a mean age of 54 years (range: 38–71). The visual analog scale (VAS) score decreased from 7 preoperatively to 0.7 postoperatively ($p < 0.05$). Mean dorsiflexion increased from 30° to 49° ($p < 0.05$), while plantarflexion improved from 14° to 20° ($p < 0.05$). The mean AOFAS score increased from 60 (range: 52–68) preoperatively to 85 (range: 81–89) at the final follow-up ($p < 0.001$). **Conclusions**: The minimally invasive approach—dorsal cheilectomy combined with dorsiflexion osteotomy of the distal metatarsal and proximal phalanx—appears to be a reliable long-term treatment for grade I/II hallux rigidus. This technique offers a safe and effective alternative for active patients, achieving optimal functional outcomes with minimal pain and only minor, common complications.

Keywords: Hallux rigidus; minimally invasive surgery; percutaneous surgery; cheilectomy; dorsal wedge osteotomy.
Level of Evidence: IV

Tratamiento percutáneo del hallux rigidus grado I/II en pacientes activos. Técnica quirúrgica y resultados

RESUMEN

Introducción: El hallux rigidus es la enfermedad degenerativa más frecuente del pie. El objetivo de este artículo es comunicar los resultados de una técnica quirúrgica percutánea para mejorar el rango de movilidad y eliminar el dolor en pacientes activos. **Materiales y Métodos:** Se realizó una revisión retrospectiva de todos los pacientes con diagnóstico de hallux rigidus leve o moderado que se habían sometido a una cirugía mínimamente invasiva/percutánea: queilectomía dorsal del primer metatarsiano más osteotomía en cuña dorsal del primer metatarsiano y la falange proximal del hallux, entre junio de 2019 y junio de 2022, con un seguimiento mínimo de 12 meses y máximo de 36 meses. **Resultados:** Se incluyó a 15 pacientes (19 pies) con una edad promedio de 54 años (rango 38-71). El puntaje en la escala analógica visual era 7 antes de la cirugía y 0,7 después ($p <0,05$). La dorsiflexión promedio aumentó de 30° a 49° ($p <0,05$) y la flexión plantar, de 14° a 20° ($p <0,05$). El puntaje promedio de la AOFAS aumentó de 60 (rango 52-68) antes de la operación a 85 (rango 81-89) en el último control ($p <0,001$). **Conclusiones:** La técnica mínimamente invasiva: queilectomía dorsal asociada a osteotomía dorsiflexora en el metatarsiano distal y la falange proximal puede ser un tratamiento confiable a largo plazo para el hallux rigidus grado I/II, es una alternativa segura y efectiva en pacientes activos; se logran resultados funcionales óptimos, con escaso dolor y complicaciones leves habituales.

Palabras clave: Hallux rigidus; cirugía mínimamente invasiva; cirugía percutánea; queilectomía; osteotomía en cuña dorsal.
Nivel de Evidencia: IV

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INTRODUCTION

Hallux rigidus is defined as a degenerative condition affecting the first metatarsophalangeal (MTP) joint and the sesamoid complex. It is characterized by pain, restricted range of motion, and periarticular osteophytosis.[1,2] It is the second most common disease of the first MTP joint after hallux valgus and represents the most frequent form of osteoarthritis in the foot and ankle. It affects 2.5% of the population over 50 years of age,[2,3] is more prevalent in women, and in two-thirds of cases, there is a family history. Additionally, 95% of patients present with bilateral involvement.[2]

Several etiologies have been proposed, though no definitive cause has been established. These include trauma (the most frequently cited in the literature), elevation of the first metatarsal (metatarsus primus elevatus), muscle-tendon imbalance, inflammatory and infectious causes, metabolic conditions, iatrogenic factors, and osteochondritis of the first metatarsal head in adolescents, among others.

Currently, no demonstrable relationship has been found with hypermobility of the first ray, metatarsal length, contracture of the Achilles tendon or gastrocnemius, structural foot deformities (e.g., pes planus), hallux valgus, elevation of the first metatarsal, adolescent onset, occupation, or type of footwear.[1] However, there do appear to be several documented factors associated with hallux rigidus, such as female sex, interphalangeal hallux valgus, metatarsus adductus, flat or chevron morphology of the first tarsometatarsal joint,[2] bilateral symptoms in patients with a family history, and unilateral symptoms in those with a history of trauma.[1]

In adults, the most commonly diagnosed condition is degenerative arthropathy, which causes mechanical joint pain, decreased maximum dorsiflexion, and increased pain during toe-off while walking.[1,2] Pain typically occurs with forced dorsiflexion and lateral deviation of the hallux. Initially, pain presents only at the end of dorsiflexion, but as the condition progresses, it may appear mid-range, indicating more extensive joint involvement and complicating conservative treatment.[2] As it advances, plantarflexion also becomes compromised, eventually leading to complete joint immobility, ankylosis, and persistent pain.[4]

The primary objective of this article is to present a percutaneous surgical technique for treating hallux rigidus with mild to moderate symptoms in patients classified as grade I/II according to the Coughlin and Shurnas classification (Table). The technique involves a combination of cheilectomy and dorsal wedge osteotomy of the first metatarsal, along with a dorsal wedge osteotomy of the proximal phalanx, combining percutaneous dorsiflexion-inducing techniques.[5] The secondary objective was to evaluate the long-term clinical outcomes of this joint-preserving approach, with a minimum follow-up of 36 months.[6]

Table. Coughlin and Shurnas Classification.

Grade	Dorsiflexion	Radiographic findings	Clinical findings
0	40-60°	Normal	- No pain - Moderate stiffness
1	30-40°	Mild dorsal osteophyte, normal joint space	- Intermittent pain at extremes of dorsiflexion - Mild stiffness
2	10-30°	Moderate dorsal osteophyte,<50% joint space narrowing	- Moderate to intense pain and stiffness - Pain at extremes of dorsal and plantar flexion
3	<10°	Severe dorsal osteophyte, >50% joint space narrowing	- Near constant pain - Stiffness at extreme ROM
4	<10°	Same as grade III	- Constant pain and stiffness - Pain at mid-range of motion of passive dorsiflexion

MATERIALS AND METHODS

A retrospective review was conducted of all patients diagnosed with mild to moderate hallux rigidus who underwent minimally invasive/percutaneous surgery—specifically, dorsal cheilectomy of the first metatarsal combined with dorsal wedge osteotomy of the first metatarsal and proximal phalanx of the hallux—between June 2019 and June 2022. All patients had a minimum follow-up of 12 months and a maximum of 36 months.

Clinical assessments included preoperative and postoperative evaluation of the range of motion according to the Coughlin and Shurnas classification, as well as the visual analog scale (VAS) for pain.

Surgical Technique

The patient is placed in the dorsal decubitus position under sedation. A local anesthetic block of the forefoot is administered, and a tourniquet is applied at the ankle.

Dorsal cheilectomy. A 4 mm medial incision is made approximately 2 cm proximal to the first MTP joint of the hallux. The capsule is then detached from the exostosis both medially and dorsally. An aggressive cheilectomy is performed using a Wedge Burr.

Distal osteotomy of the first metatarsal. Through the same percutaneous portal, a dorsal wedge osteotomy is performed using a long Shannon burr. Osteoclasis is then performed to close the osteotomy, followed by fixation with a compression screw, placed from proximal to distal and from medial to lateral through the head of the first metatarsal, without breaching the articular surface (Figure 1).

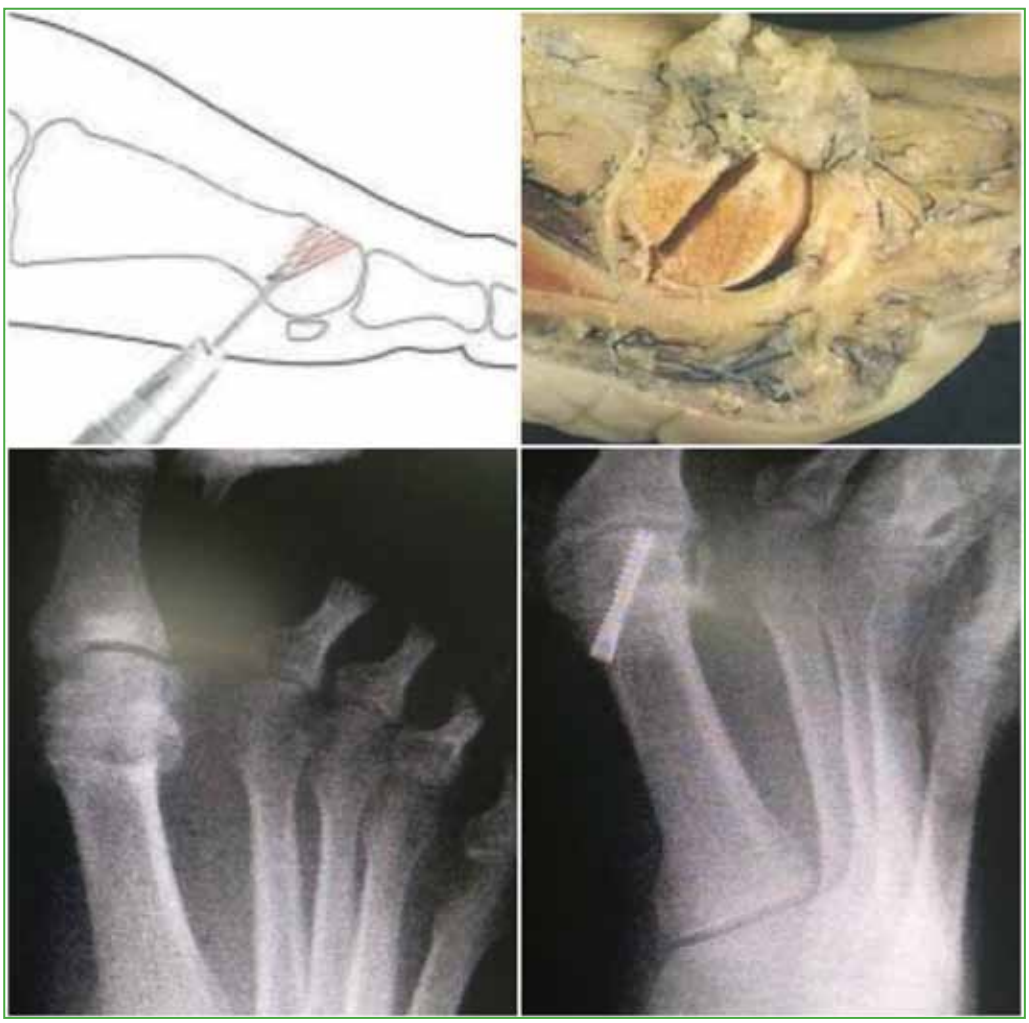

Figure 1. Metatarsal osteotomy.

Osteotomy of the proximal phalanx. A 4 mm medial percutaneous incision is made over the proximal phalanx, 1 cm distal to the first MTP joint. Desperiostization is performed, followed by dorsal wedge osteotomy using a long Shannon burr. Osteoclastic closure is then achieved, and fixation is performed with a compression screw, placed from proximal to distal and from medial to lateral, without compromising the articular surface of the phalanx (Figure 2).

Figure 2. Phalangeal osteotomy.

A bandage is applied with the hallux in slight hyperextension, and immediate weight-bearing with a postoperative sandal is indicated. Screw fixation allows early initiation of joint mobility and physical therapy exercises (Figure 3). Return to impact and sports activities is permitted three months postoperatively.

Figure 3. Early mobilization.

RESULTS

Prospectively collected data from a series of 15 patients (19 feet) treated between June 2019 and June 2022 were analyzed.

The outcome of the procedure was evaluated using the Coughlin and Shurnas[7] clinical classification for the MTP/interphalangeal joint of the hallux and the visual analog scale (VAS) for pain.[7-9]

Fifteen patients (19 feet), with a mean age of 54 years (range 38–71), were included. The mean preoperative VAS score was 7, which improved to 0.7 postoperatively ($p < 0.05$). Mean dorsiflexion increased from 30° to 49° ($p < 0.05$), and plantarflexion improved from 14° to 20° ($p < 0.05$).

The most common postoperative complications were edema and swelling, occurring in 42% of cases. No cases of nerve injury, extensor hallucis longus damage, or infection were observed.

The average time to return to regular footwear was three weeks, following the established protocol.

DISCUSSION

In this study, a percutaneous joint-preserving surgical technique performed in young patients was analyzed. Both the Visual Analog Scale (VAS) and American Orthopaedic Foot and Ankle Society (AOFAS) scores improved, and significant functional improvements in joint range of motion were observed.

Minimally invasive forefoot surgery has become a reality; over the past decades, it has been shown to offer several advantages over open techniques, with favorable outcomes for patients, such as fewer complications and shorter surgical times.[6,10-14]

Most studies highlight the benefits of minimally invasive cheilectomy compared to open surgery. Morgan et al.[13] conducted a prospective study comparing open and minimally invasive cheilectomy and found greater improvements in pain, function, and social interaction in the minimally invasive group. In the open surgery group, three failures were reported, all of which required conversion to arthrodesis.

Razik and Sott[14] evaluated 47 patients with a minimum follow-up of one year (22 underwent minimally invasive surgery and 25 open surgery). Pain scores improved in all patients according to the VAS; however, fewer infections and complications occurred in the minimally invasive group.

Despite these encouraging results, several issues related to the technique have been reported.

Complications associated with the minimally invasive approach include incomplete resection, need for revision surgery, and joint complications due to residual debris and loose bodies.

Stevens et al.[15] reported a similar reoperation rate (12.8%) in the minimally invasive group, due to issues directly related to the technique, such as injury to the dorsal medial cutaneous nerve and tear of the extensor hallucis longus tendon.

Teoh et al.[16] reported a 12% reoperation rate: seven patients required arthrodesis, four underwent revision cheilectomy for residual impingement, and one had a loose body removed via open surgery.

In our study, the mean VAS score improved from 7 preoperatively to 0.7 postoperatively ($p < 0.05$). All patients were satisfied with the outcome and would undergo the procedure again. Joint range of motion improved from a mean of 14° of plantar flexion and 30° of dorsiflexion preoperatively to 20° and 49°, respectively, postoperatively.

All patients began immediate weight-bearing with a postoperative sandal and transitioned to athletic shoes at three weeks postoperatively, following the established protocol. At an average final follow-up of 24 months, no wound infections, tendon injuries, or nerve damage were observed.

This study is not without limitations. One limitation is the relatively small sample size, including only 19 feet. Furthermore, cases where range of motion did not improve as significantly as others could be investigated in the future to determine the presence of bony or cartilaginous debris or synovitis via direct arthroscopic visualization.

CONCLUSIONS

The minimally invasive technique—dorsal cheilectomy combined with dorsiflexion osteotomy of the distal first metatarsal and proximal phalanx—may represent a reliable long-term treatment for grade I/II hallux rigidus. It appears to be a safe and effective option for young, active patients. Functional outcomes are optimal, pain levels are low, and mild complications are common.

Conflict of interest: The authors declare no conflicts of interest.

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