

## Systematic Review

# Percutaneous surgery in the treatment of Haglund syndrome: a systematic review

Marília Agostinho de Lima Gomes<sup>1,2</sup> , Gabriel Freire Monteiro<sup>1,2</sup> , José Fernandes Arteiro Neto<sup>2</sup> 

1. Instituto de Medicina Integrada Professor Fernando Figueira, Recife, PE, Brazil.

2. Real Hospital Português de Beneficência em Pernambuco, Recife, PE, Brazil.

### Abstract

**Objective:** The present study aimed to verify the state of the art of minimally invasive percutaneous surgical treatment for Haglund syndrome.

**Methods:** This systematic review of the literature was based on a bibliographic survey in the PubMed, Medline and Embase databases. The descriptors “Haglund syndrome”, “Haglund”, “Achilles”, “Minimally invasive”, “Percutaneous surgery” and “Osteotomy” were used, in addition to the filters “Randomized Controlled Trial”, “Randomized Clinical Trial”, “Meta-Analysis”, “Systematic Reviews”, “Reviews”, and “Clinical Trial”.

**Results:** A total of 37 articles were included. The total number of patients with Haglund syndrome treated in the included studies was 831 and 920. The mean patient age was 46.6 years (range, 28.7 to 61) and 58% were men. A higher success rate and a lower rate of complications were reported in men, and physically active patients had better treatment results. The mean success rate for minimally invasive percutaneous procedures was 83.4% (range 66 to 100%). Overall patient satisfaction was 77.5% (range 60 to 95%) and the complication rate was 6.3% (range 0 to 23%).

**Conclusion:** Despite a lack of studies with the recommended evidence level, minimally invasive and percutaneous surgical treatments seem to be a good option for patients with Haglund syndrome when conservative treatment fails.

**Level of Evidence III; Therapeutic Studies; Systematic Review of Level III Studies.**

**Keywords:** Achilles tendon; Minimally invasive surgical procedures; Treatment outcome; Systematic review.

### Introduction

Haglund syndrome is a triad of posterosuperior prominence of the calcaneus (Haglund deformity), retrocalcaneal bursitis and insertional Achilles tendinopathy. It is usually bilateral, affects middle-aged people and has a higher incidence in women. The most common symptoms are heel pain, swelling, redness and post-static dyskinesia<sup>(1-5)</sup>.

Most often, the condition is diagnosed by associating a clinical evaluation with imaging tests. Radiography is the most commonly used test for diagnostic confirmation, although MRI is indicated in doubtful cases. Recently, several studies have suggested that ultrasonography has 100% specificity but only 50% sensitivity for diagnosing retrocalcaneal bursitis, and it is even less sensitive in determining whether the

superficial Achilles tendon bursa is involved. Differential diagnoses include traumatic causes, such as a stress fracture of the calcaneus or a malunited “tongue-like” fracture of the calcaneus. There are also infectious causes, such as tuberculosis of the calcaneus, neoplastic causes, such as osteochondroma of the calcaneus, and inflammatory causes, such as negative spondyloarthropathies<sup>(2-9)</sup>.

The treatment of choice is usually conservative, with the following indications: rest, shoe modification, a change of habit regarding impact sports and the use of non-steroidal anti-inflammatory drugs. Although many cases are resolved without surgical intervention, in patients who have persistent signs and symptoms after six months of conservative treatment, surgery is indicated<sup>(2-13)</sup>.

Study performed at the Real Hospital Português de Beneficência em Pernambuco, Recife, PE, Brazil.

**Correspondence:** Marília Agostinho de Lima Gomes. 300 dos Coelhos St., Boa Vista, Recife, PE, Brazil, Zip Code: 50070-902. **E-mail:** [marilialimagomes@gmail.com](mailto:marilialimagomes@gmail.com)

**Conflicts of interest:** No. **Source of funding:** Own. **Date received:** August 28, 2020. **Date accepted:** November 09, 2020. **Online:** December 21, 2020

**How to cite this article:** Gomes MAL, Monteiro GL, Arteiro Neto JF. Percutaneous surgery in the treatment of Haglund syndrome: a systematic review. *J Foot Ankle.* 2020;14(3):285-92.



Surgical treatment has improved in recent decades, mainly due to a better understanding of the pathophysiology of Haglund syndrome. There has also been recent discussion about the best techniques and approaches, including endoscopy, minimally invasive surgery or techniques for repairing the tendon to the bone with suture anchors. Many changes have occurred since the Zadek osteotomy was introduced, in which catgut was used for osteosynthesis. Percutaneous screws with reliable and stable fixation are now available, as are modern techniques that allow functional recovery with less tissue injury due to smaller portals<sup>(6-19)</sup>, even minimally invasive surgery and endoscopic treatment.

In this context, the objective of the present review was to systematize the minimally invasive percutaneous surgical treatments for Haglund syndrome.

## Methods

This evidence-based systematic review followed Joanna Briggs Institute practices, including a comprehensive synthesis without bias using a sample of relevant studies to synthesize the existing knowledge in order to assist healthcare decision-making<sup>(20)</sup>. To determine the components of the review, a research question was formulated based on PICO (Population, Intervention, Comparison and Results) criteria<sup>(21)</sup>.

This review was guided by the PRISMA recommendations: database search for material, determining inclusion and exclusion criteria, extracting information from the selected manuscripts, and evaluation and interpretation of the content<sup>(22)</sup>.

### Database, search strategy and study selection

The PubMed, Medline and Embase databases were searched. The Boolean search used the connector “and” to find manuscripts with more than one of the terms. The following health descriptors were generated from the U.S. National Institutes of Health MeSH on Demand: “Haglund syndrome”; “Haglund”; “Achilles”; “Minimally invasive”; “Percutaneous surgery”; and “Osteotomy”. The following filters were used to arrive at the expected final result: “Randomized Controlled Trial”; “Randomized Clinical Trial”; “Meta-Analysis”; “Systematic Reviews”; “Reviews”; “Clinical Trial”.

### Eligibility and selection criteria

The following inclusion criteria were used in the study selection process:

- Studies related to the theme;
- Studies with an evidence level of I or II; if this level of evidence could not be found, lower levels were included;
- Studies published in indexed journals;
- Articles published in English, Spanish or Portuguese;
- Research carried out on humans;
- Articles with a full version available.

The exclusion criteria were:

- Simple case report studies;
- Theoretical essays.

### Investigated variables and extracted data

A database was created with the following information: article identification, study type, objectives, methodological procedures, data sources and main results.

## Results

### Exclusion and inclusion process

The database search found 112 studies, whose design and relevance were again assessed according to the study type and inclusion criteria filters. After reading the titles, abstracts and keywords, 56 articles underwent a more rigorous selection process<sup>(22)</sup> (Figure 1).

After the exclusion and inclusion process shown in figure 1, eight studies were excluded and a total of 37 articles were selected for the present review<sup>(1-19,23-40)</sup>.

### Identification and characteristics of the studies

Table 1 presents an overview of the study design, objectives and clinical outcomes of the 37 selected articles, including the main characteristics and findings. Many of the studies were systematic reviews and/or meta-analyses based on clinical evidence (48.65%). The other studies were retrospective (21.62%), clinical (18.92%) and prospective (10.81%), as shown in figure 2. A total of 86.49% of the tested treatments had positive results (Figure 3).

### Population characteristics

The total number of treated Haglund syndrome patients in the 37 included studies was 831 and 920 feet. The mean patient age was 46.6 years (range, 28.7 to 61) and 58% were men. A higher success rate and a lower rate of complications were reported in men, and physically active patients had better treatment results.

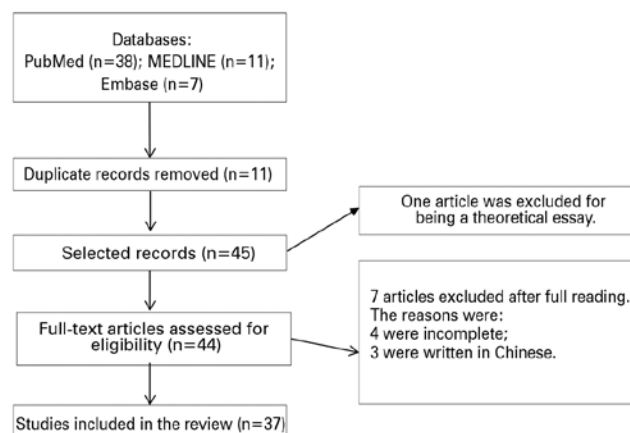


Figure 1. Flowchart of article identification, selection and inclusion.

**Table 1.** Characterization of the selected articles

Study	Study design	Objective	Clinical outcomes
Tian et al. (2020)	Clinical study	To compare the open Giftbox technique with a peritendon fixation technique called the "Locking Block Modified Krackow" (LBMK) technique using a simulated early rehabilitation protocol.	After the first loading stage, the mean tendon gapping was $0.76 \pm 0.44$ mm in the LBMK group and $0.86 \pm 0.47$ mm in the Giftbox group ( $P=0.620$ ). After the second loading test, the average gapping measures of the LBMK and Giftbox groups were $3.8 \pm 1.9$ mm and $4.2 \pm 2.2$ mm, respectively ( $P=0.466$ ). Finally, the catastrophic load to failure was $732.8 \pm 138$ N in the LBMK group and $645.5 \pm 121$ N in the Giftbox group. The difference was statistically significant ( $P=0.023$ ).
Ge et al. (2020)	Retrospective	To compare the clinical results of dorsal wedge calcaneus osteotomy (DCWCO) and posterosuperior prominence resection to treat Haglund syndrome.	Both groups exhibited a significant increase in their AOFAS and VISA-A scores after surgery. The DCWCO group had lower AOFAS scores than the PPR group at 6 months ( $77.6 \pm 5.1$ vs. $82.8 \pm 7.8$ ; $P=0.037$ ) but had higher scores at the latest follow-up ( $98.2 \pm 2.3$ vs. $93.4 \pm 6.1$ ; $P=0.030$ ). The DCWCO group had lower VISA-A scores at 3 months ( $56.9 \pm 13.9$ vs. $65.2 \pm 11.0$ ; $P=0.044$ ) but higher scores at the latest follow-up ( $98.2 \pm 2.6$ vs. $94.3 \pm 5.0$ ; $P=0.010$ ) than the PPR group. Both groups exhibited significant changes in the Fowler-Philip angle and Bohler's angle after surgery. The postoperative Fowler-Philip angle of the DCWCO group was greater than that of the PPR group ( $35.9^\circ \pm 4.9^\circ$ vs. $31.4^\circ \pm 6.2^\circ$ ; $P=0.026$ ). However, there was no statistically significant difference in any other angle of the two groups postoperatively.
Lughi (2020)	Clinical study	To correlate the most reliable and reproducible treatment possible with the variables of Haglund syndrome.	The group of patients that participated to the study was heterogeneous in age and functional requirements therefore presenting different anatomopathological characteristics. For these reasons considerations with correct statistical meaning are not possible. Despite different post-operative programs, patients demonstrated optimal clinical and functional recovery. There were no local neurological or skin complications.
Yang et al. (2020)	Retrospective	To evaluate the effect of intraoperative ultrasound assistance for minimally invasive repair of acute Achilles tendon rupture.	All patients were followed up for at least 12 months. No sural nerve injury or other complications was found intraoperatively and postoperatively. All the patients returned to work and light sporting activities at a mean of $12.78 \pm 1.40$ weeks and $17.28 \pm 2.34$ weeks, respectively. The Mean American Orthopaedic Foot & Ankle Society (AOFAS) scores improved from $59.17 \pm 5.31$ preoperatively to $98.92 \pm 1.63$ at the time of 12 months follow-up. There was statistically significant difference ( $P < 0.001$ ). No patient complained of negative effects on their life.
Chegini Kord et al. (2019)	Retrospective	To present a modified technique for minimally invasive repair of Achilles tendon rupture using gift-box sutures, including preliminary clinical and functional results for several patients.	After two years, the mean scores of American Orthopaedic Foot and Ankle Society and the Achilles tendon rupture score were obtained at $83 \pm 4$ and $81.9 \pm 6.3$ , respectively. Approximately 87.5% of patients regained their previous level of activity. The mean visual analog scale score was $7.7 \pm 0.9$ regarding the satisfaction with the outcomes. Moreover, isokinetic testing of plantar flexion and dorsiflexion strength were $82.7 \pm 5.8$ and $87.7 \pm 4.1\%$ , respectively, compared to those of the normal side. The calf atrophy was not statistically significant. The range of operated ankle motion decreased significantly, compared to that of the other side; however, the differences were not significant functionally. There was no patient with wound complications, nerve injury, or complaints about footwear problems.
Liu et al. (2019)	Clinical study	To determine whether modified minimally invasive repair (MMIR), which provides direct visualization of the proximal tendon stump without specialized equipment could provide comparable functional and surgical results to the Achillon system.	There was no significant difference between groups in demographic characters. There was no statistical difference between both groups regarding to time return to work and ATRS at 3rd, 6th, 12th, and 24th month, respectively. Five reruptures and two Achilles tendons tethering to skins were found in the Achillon group, and two reruptures and one sural nerve injury in the MMIR group. No wound infection and dehiscence occurred. Overall complication rate in the Achillon group is higher ( $16.3\%$ vs. $4.4\%$ , $p=0.044$ ). The operation time of Achillon is less than MMIR ( $34.84$ vs. $39.71$ , $p < 0.001$ )
Barg & Ludwig (2019)	Literature review	To review surgical strategies for insertional Achilles tendinopathy.	Insertional Achilles tendinopathy often results in pain relief and functional improvement. However, complete rehabilitation, including a return to sports, is often postponed until 1 year postoperatively.
Lui et al. (2019)	Literature review	To address minimally invasive treatment and endoscopy for Haglund syndrome.	Most surgical treatment options for Haglund syndrome can be performed endoscopically or with minimally invasive approaches.
Xu et al. (2018)	Prospective	To develop a method that can solve the problem of partial rupture of the Achilles tendon insertion	The arthroscopic approach is a reliable technique and indicated in the treatment of Haglund syndrome.
Vega et al. (2018)	Literature review	To describe endoscopic calcaneoplasty with increased anchor suture of the Achilles insertion area and its results in patients at high risk of Achilles tendon rupture after calcaneoplasty.	Endoscopic calcaneoplasty is reproducible and safe, with the advantages of the endoscopic technique.

continue...

...Continuation

**Table 1.** Characterization of the selected articles

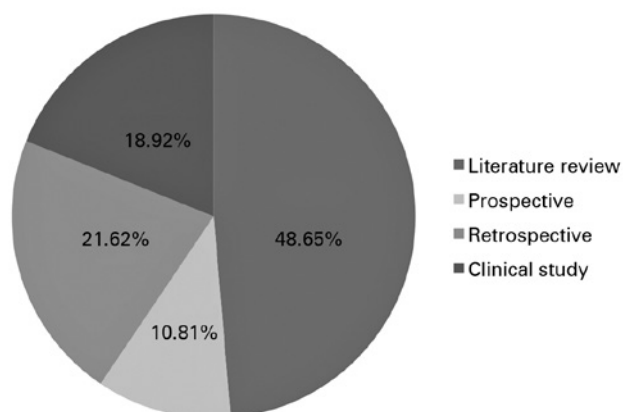
Study	Study design	Objective	Clinical outcomes
Alfredson et al. (2018)	Retrospective	To present the effects of clinical and surgical treatment of chronic Achilles tendon disorders.	Patients with high pain scores were the most common. Plantar tendon involvement is a frequent observation. Pathology in the subcutaneous and retrocalcaneal pouch, Haglund deformity and distal Achilles tendinopathy/tendinosis were more frequent reasons for insertion Achilles tendinopathy.
Shakked et al. (2017)	Prospective	To analyze a case of posterior injury to the tibial nerve after arthroscopic calcaneoplasty.	The objective of the case report was to raise awareness of this possible complication to ensure early recognition and referral to a peripheral nerve specialist. The results illustrate the importance of surgical technique and arthroscopic calcaneoplasty to prevent lesions in the neurovascular bundle.
Xia et al. (2017)	Retrospective	To evaluate the surgical outcomes of correcting Haglund's triad using a central tendon-splitting approach.	Haglund prominence and Achilles tendon replacement provide effective treatment, providing pain relief, functional improvement, and overall improvement in patient health. Sex and BMI do not affect surgical results.
Holtmann et al. (2017)	Literature review	To show that gastrocnemius recession leads to increased ankle movement.	The benefits of better Foot Function Index scores, patient satisfaction, pain relief and increased function far outweigh the possible complications.
Shakked et al. (2017)	Literature review	To demonstrate the effects of Achilles tendinopathy debridement.	Insertional tendinopathy repair is a successful procedure, allowing a quick return to activities.
Vaishya et al. (2016)	Literature review	To demonstrate that Haglund syndrome is a common cause of back foot pain in adults, but it is still a poorly understood clinical condition.	Haglund syndrome is a common cause of hindfoot pain in adults, but it is still a poorly understood clinical condition. Conservative management is generally effective in most cases, and surgery is needed only in resistant cases.
Huh et al. (2016)	Retrospective	To highlight the characteristics of Achilles sleeve avulsions and present the outcomes of operative repair using suture anchor fixation.	Avulsions of the Achilles tendon sleeve occurred predominantly in middle-aged men with pre-existing insertional disease while involved in athletic activity. The fixation of the suture anchor with concomitant insertion was a reliable and safe technique for the operative management of the Achilles tendon sleeve avulsion. Most patients returned to pre-injury levels of work and recreational activity.
Caudell (2016)	Literature review	To demonstrate the effects of local bone graft for Evans calcaneal osteotomy to correct flat feet and valgus deformity.	The iliac crest autograft or allograft can be used for treating stage II flat foot deformity. The authors describe a new method of obtaining bone graft locally from the calcaneus and, therefore, avoiding the complications and morbidity associated with iliac crest grafts.
Syed et al. (2016)	Literature review	To present a staging system for minimally invasive treatment of Haglund syndrome with percutaneous and endoscopic surgery.	Modern techniques allow anterior functional recovery with less tissue damage, whether minimally invasive surgery or endoscopic treatment of heel conditions. The principle of osteotomy is the same, but its execution is different.
Vernois et al. (2015)	Literature review	To demonstrate the effects of minimally invasive calcaneal osteotomy surgery and minimize soft tissue injuries.	They concluded that percutaneous surgery minimizes soft tissue damage and preserves the soft tissue envelope, which allows a wider range of surgical procedures.
Carreira & Ballard (2015)	Literature review	To review various endoscopic techniques for treating equinus contracture, Achilles rupture, Haglund's deformity and noninsertional Achilles tendinopathy.	Minimally invasive treatment of equine contracture, Achilles rupture, Haglund deformity and non-institutional Achilles tendinopathy produce good clinical results, and the technique has the advantages of any minimally invasive procedure. A thorough understanding of anatomy and endoscopic techniques minimizes complications.
Ahn et al. (2015)	Clinical study	To show the operative treatment of Haglund syndrome with a central splitting approach to the Achilles tendon.	The central tendon-splitting approach appears to be safe and satisfactory for intractable Haglund syndrome. Future comparative studies may be needed to investigate the significance of the association between Haglund syndrome and cavity deformity.
Jerosch et al. (2015)	Prospective	To determine the most typical surgical technique and intraoperative findings, as well as medium and long-term results of endoscopic calcaneoplasty.	Endoscopic calcaneoplasty is an effective and minimally invasive procedure treating calcaneus exostosis. After a brief learning curve, endoscopic exposure is superior to the open technique, has less morbidity, a shorter operating time and almost no complications. In addition, the pathology can be better differentiated.
Ettinger et al. (2015)	Retrospective	To evaluate the outcome of a transtendinous approach to insertional Achilles tendinopathy.	The transtendinous approach allowed access to all pathologies associated with insertional Achilles tendinopathy. The technique had relatively few complications and good clinical results.
Bulstra et al. (2015)	Clinical study	To determine whether heel overhang can be measured and whether Haglund's deformity can be assessed through radiography.	A significant difference was found in women ( $p < 0.00$ ) but not men ( $p < 0.48$ ). Women with Haglund deformity have a higher calcaneal pitch angle than those without it. Calcaneal pitch angle differed between the Haglund and non-Haglund groups, although mainly in women.

continue...

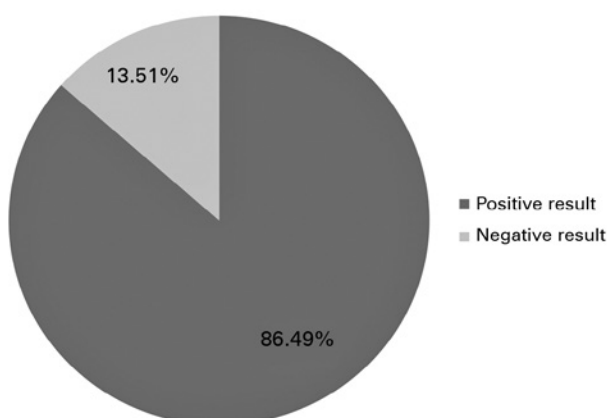
...Continuation

**Table 1.** Characterization of the selected articles

Study	Study design	Objective	Clinical outcomes
Weinfeld (2014)	Literature review	To present an overview of Achilles tendon disorders.	Complete repair of 4 cm tendons is generally possible. In major defects, tendon integrity can be restored with a V-forward procedure or the central sliding opening.
Sundararajan et al. (2014)	Clinical study	To investigate radiographic, clinical and MRI analysis of insertion Achilles tendinopathy.	The results of the present study confirmed the absence of morphological variation in the calcaneus and the presence of angular changes in the calcaneus in symptomatic patients. Both clinical examination and MRI revealed a 25% frequency of Haglund syndrome in the insertion Achilles tendinopathy group. As these two diagnoses are clinically and radiographically divergent, their surgical interventions justify different objectives using separate methods. By understanding the abnormality, the surgeon can reduce the correction in a precise and specific for insertion Achilles tendinopathy patients.
Madarevic et al. (2013)	Clinical study	To reduce morbidity and recovery time by introducing an ultrasound-assisted technique for calcaneoplasty.	Ultrasound-assisted calcaneoplasty allows for precise resection of the posteroanterior part of the calcaneus and the removal of the retrocalcaneal impact. This method may become clinically relevant, as it allows the effective treatment of Haglund deformity, and the results of this study showed rapid functional recovery.
Rigby et al. (2013)	Literature review	To review early weight bearing using the Achilles suture bridge technique for insertional Achilles tendinosis.	The findings supported the use of the Achilles tendon suture-bridge technique for replacing the Achilles tendon in the surgical treatment of insertion Achilles tendinosis.
Rakovac et al. (2012)	Prospective	To introduce the “cello technique”: a new technique for ultrasound-assisted calcaneoplasty.	It is possible to resect the posterosuperior part of the calcaneus under direct ultrasound control with the patient in the prone position, with a dorsally positioned ultrasound probe, in line with the Achilles tendon fibers (sagittal line), and with the abraded in the posteromedial working portal. We describe in detail the technique for this new procedure in foot and ankle surgery. This innovative technique offers the possibility of expanding the indications for ultrasound-guided surgery in other fields of orthopaedic surgery.
Kang et al. (2012)	Literature review	To analyze the characteristics of Haglund deformity in patients with and without insertion Achilles tendonitis to see if there was a correlation.	A Haglund's deformity was not indicative of insertional Achilles tendinitis and was present in asymptomatic patients. Also, a majority of the insertional Achilles tendinitis patients had calcification at the tendon insertion. We believe it is possible removing the Haglund's deformity may not be necessary in the operative treatment of insertional Achilles tendinitis.
DeVries et al. (2009)	Retrospective	To present surgical correction of Haglund's triad using complete detachment and replacement of the Achilles tendon.	Surgical correction of Haglund's triad using complete detachment and replacement of the Achilles tendon, exostectomy and retrocalcaneal bursectomy provided patient satisfaction with limited complications.
Frey (2009)	Literature review	To discuss technical and diagnostic points about advanced uses of arthroscopy in athletes.	The present study shows advances in surgical techniques that have expanded the use of arthroscopy as a viable alternative to open procedures in the evaluation and treatment of common foot, ankle and tendon injuries. These techniques can result in a shorter and more comfortable recovery, decreased postoperative pain and fewer complications.
Lee et al. (2008)	Literature review	To review posterior impingement syndromes of the ankle.	Although surgery is occasionally necessary, the radiologist can contribute to treatment, using ultrasound or fluoroscopy to assist in the accurate placement of steroid/local anesthetic injections. Therefore, the radiologist plays a crucial role not only in diagnosis, but also in the management of posterior ankle impingement syndrome.
Jardé et al. (1997)	Literature review	To report on Haglund disease treatment through a simple resection of the calcaneus tuberosity.	Simple resection of the tuberosity of the os calcis showed good results in 73% of the cases, with a mean follow-up of 6 years and 9 months.
Reinherz et al. (1990)	Literature review	To present an overview of pathologic Haglund deformity.	Pathological conditions behind the calcaneus are common and may initiate during early childhood. Radiographic and clinical evaluation is considered.
Miller & Vogel (1989)	Literature review	To present a retrospective analysis of Keck and Kelly osteotomy in conjunction with resection of the bone prominence.	Results have been gratifying, with no complications experienced with healing of the osteotomy and no recurrence of the deformity.



**Figure 2.** Number of articles according to the study design.



**Figure 3.** Articles reporting positive and negative results for the involved treatments.

### Preoperative treatment

Preoperatively, all patients underwent conservative treatment for at least three months. Conservative treatments included immobilization, eccentric exercise, stretching, cryotherapy, ultrasound therapy, laser therapy, orthoses, extracorporeal shock wave therapy, sclerosing injections and anti-inflammatory drugs.

### Percutaneous surgical technique

The mean success rate for minimally invasive percutaneous procedures was 83.4% (range 66 to 100%). Overall patient satisfaction was 77.5% (range 60 to 95%) and the complication rate was 6.3% (range 0 to 23%). The most frequently mentioned reasons for surgical procedures were the need for surgical revision (5.8%) and rupture of the tendon during rehabilitation (0.5%). The main evaluations were: pain according to the EVA scale and subjective patient satisfaction.

### Discussion

This study systematically evaluated the literature regarding the effectiveness of percutaneous treatment in Haglund syndrome patients. The analyses were based on success rates, patient satisfaction and complication rates.

The most relevant finding of this review is that it supports minimally invasive operative treatment as an option for this syndrome. Most surgical treatment options for Haglund syndrome can be performed endoscopically or with minimally invasive approaches. This finding is in line with the results of other recent reviews<sup>(3-8,12-15,30-32)</sup>.

Depending on the technique used, success rates varied between 73 and 100%, although the reviewed literature does not definitively describe the pathological stage of the treated tendons. More advanced stages of Achilles tendon degeneration could lead to more complex surgical treatments. Consequently, different stages of Achilles tendon injuries may differ in response to a specific surgical technique<sup>(41)</sup>.

Most of the minimally invasive techniques concentrate on peritendinous tissues in order to eliminate neovascularization and its accompanying nerves as the cause of pain and disease progression. Thus, minimally invasive approaches, in principle, address pain, while open techniques aim to treat degenerated tendon tissue. It should be declared that there was a selection bias regarding the results for the different operating techniques (subgroups analysis)<sup>(4-18,29-33)</sup>.

Considering these limitations, this systematic review does not indicate differences in success rate and patient satisfaction between open surgical techniques and a minimally invasive percutaneous approach (78.1% vs. 78.5%; P=0.211). Nevertheless, the complication rate tended to be higher after open surgery (10.5% vs. 5.3%; P=0.053).

Random comparisons between open and minimally invasive procedures regarding the same severity/degree of Achilles tendinopathy and other pathologies associated with Haglund syndrome are still lacking and should be carried out in the future (42). Likewise, meta-analyses are necessary to definitively demonstrate the value of different techniques. Despite attempting to detect all relevant articles in the search algorithm, some studies may have been excluded due to their choice of terminology.


A similar criticism applies to postoperative treatment, since the short follow-up period used in several studies is another concern. Some studies on conservative treatment had follow-up periods of more than five years, while the shortest in our sample was only six months. To classify their results, the authors often used questionnaires that had neither been validated nor were specific to the anatomical region, which could also have influenced the results and should be adequately addressed in future research.

Future studies should use valid, reliable and sensitive outcome measures, such as the VISA-A questionnaire, in longitudinal studies to evaluate the effects of their interventions. Randomized controlled trials focusing on the single effect of operative treatments are essential, since they provide evidence about the most applicable treatment for specific Haglund syndrome patients.

## Conclusion

Despite a lack of studies with the recommended evidence level, minimally invasive and percutaneous surgical treatments seem to be a good option for patients with Haglund

syndrome when conservative treatment fails. However, given that this is a literature review, the results should be carefully evaluated, since the choice of databases limited the selected studies. Although a rigorous search strategy was employed, relevant articles may have been overlooked.

**Authors' contributions:** Each author contributed individually and significantly to the development of this article: MALG \*(<https://orcid.org/0000-0001-8325-4986>) conceived and planned the activities that gave rise to the study, wrote the article, participated in the review process, approved the final version; GFM \*(<https://orcid.org/0000-0001-6285-4771>): participated in the review process, approved the final version; Neto JFAN \*(<https://orcid.org/0000-0003-0551-1435>): participated in the review process, approved the final version. \*ORCID (Open Researcher and Contributor ID) .

## References

- Barg A, Ludwig T. Surgical strategies for the treatment of insertional Achilles tendinopathy. *Foot Ankle Clin.* 2019;24(3):533-59.
- Lui TH, Lo CY, Siu YC. Minimally invasive and endoscopic treatment of Haglund syndrome. *Foot Ankle Clin.* 2019;24(3):515-31.
- Xu JH, Ding SL, Chen B, Wu SC. Modified Bunnell suture expands the surgical indication of the treatment of Haglund's syndrome heel pain with endoscope. *Exp Ther Med.* 2018;15(6):4817-21.
- Vega J, Baduell A, Malagelada F, Allmendinger J, Dalmau-Pastor M. Endoscopic Achilles tendon augmentation with suture anchors after calcaneal exostectomy in Haglund syndrome. *Foot Ankle Int.* 2018;39(5):551-9.
- Shakked RJ, Raikin SM. Insertional tendinopathy of the Achilles: debridement, primary repair, and when to augment. *Foot Ankle Clin.* 2017;22(4):761-80.
- Xia Z, Yew AKS, Zhang TK, Su HCD, Ng YCS, Rikhray IS. Surgical correction of Haglund's triad using a central tendon-splitting approach: a retrospective outcomes study. *J Foot Ankle Surg.* 2017; 56(6):1132-8.
- Holtmann JA, Südkamp NP, Schmal H, Mehlhorn AT. Gastrocnemius recession leads to increased ankle motion and improved patient satisfaction after 2 years of follow-up. *J Foot Ankle Surg.* 2017; 56(3):589-93.
- Alfredson H, Spang C. Clinical presentation and surgical management of chronic Achilles tendon disorders - A retrospective observation on a set of consecutive patients being operated by the same orthopedic surgeon. *Foot Ankle Surg.* 2018;24(6):490-4.
- Vaishya R, Agarwal AK, Azizi AT, Vijay V. Haglund's syndrome: a commonly seen mysterious condition. *Cureus.* 2016;8(10):e820.
- Huh J, Easley ME, Nunley JA 2nd. Characterization and surgical management of Achilles tendon sleeve avulsions. *Foot Ankle Int.* 2016;37(6):596-604.
- Caudell GM. Insertional Achilles tendinopathy. *Clin Podiatr Med Surg.* 2017;34(2):195-205.
- Syed TA, Perera A. A proposed staging classification for minimally invasive management of Haglund's syndrome with percutaneous and endoscopic surgery. *Foot Ankle Clin.* 2016;21(3):641-64.
- Vernois J, Redfern D, Ferraz L, Laborde J. Minimally invasive surgery osteotomy of the hind foot. *Clin Podiatr Med Surg.* 2015; 32(3):419-34.
- Carreira D, Ballard A. Achilles tendoscopy. *Foot Ankle Clin.* 2015; 20(1):27-40.
- Huh J, Easley ME, Nunley JA 2nd. Characterization and surgical management of achilles tendon sleeve avulsions. *Foot Ankle Int.* 2016;37(6):596-604.
- Jerosch J, Sokkar S, Dücker M, Donner A. [Endoscopic calcaneoplasty (ECP) in Haglund's syndrome. Indication, surgical technique, surgical findings and results]. *Z Orthop Unfall.* 2012;150(3):250-6.
- Ettinger S, Razaq R, Waizy H, Claassen L, Daniilidis K, Stukenborg-Colsman C, Plaass C. Operative treatment of the insertional Achilles tendinopathy through a transtendinous approach. *Foot Ankle Int.* 2016;37(3):288-93.
- Bulstra GH, van Rheenen TA, Scholtes VA. Can we measure the heel bump? radiographic evaluation of Haglund's deformity. *J Foot Ankle Surg.* 2015;54(3):338-40.
- Weinfeld SB. Achilles tendon disorders. *Med Clin North Am.* 2014; 98(2):331-8.
- Aromataris E, Munn Z. JBI systematic reviews. In: Aromataris E, Munn Z, editors. *JBI manual for evidence synthesis* [Internet]. Adelaide: Joanna Briggs Institute; 2020. Chap 1. Available from: <https://doi.org/10.46658/JBIMES-20-02>
- Aromataris E, Fernandez R, Godfrey C, Holly C, Khalil H, Tungpunkom P. Umbrella reviews. In: Aromataris E, Munn Z, editors. *JBI manual for evidence synthesis* [Internet]. Adelaide: Joanna Briggs Institute; 2020. Chap 10. Available from <https://doi.org/10.46658/JBIMES-20-11>.
- Liberati A, Altman DG, Tetzlaff J, Mulrow C, Gøtzsche PC, Ioannidis JPA, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *J Clin Epidemiol.* 2009;62:1-34.
- Sundararajan PP, Wilde TS. Radiographic, clinical, and magnetic resonance imaging analysis of insertional Achilles tendinopathy. *J Foot Ankle Surg.* 2014;53(2):147-51.
- Madarevic T, Rakovac I, Ruzic L, Tudor A, Gudac Madarevic D, Prpic T, et al. Ultrasound-assisted calcaneoplasty. *Knee Surg Sports Traumatol Arthrosc.* 2014;22(9):2250-3.
- Rigby RB, Cottom JM, Vora A. Early weight bearing using Achilles suture bridge technique for insertional Achilles tendinosis: a review of 43 patients. *J Foot Ankle Surg.* 2013;52(5):575-9.
- Rakovac I, Madarevic T, Tudor A, Prpic T, Sestan B, Mihelic R, et al. The "cello technique": a new technique for ultrasound- assisted calcaneoplasty. *Arthrosc Tech.* 2012;1(1):e91-4.
- Kang S, Thordarson DB, Charlton TP. Insertional Achilles tendinitis and Haglund's deformity. *Foot Ankle Int.* 2012;33(6):487-91.
- DeVries JG, Summerhays B, Guehlstorf DW. Surgical correction of Haglund's triad using complete detachment and reattachment of the Achilles tendon. *J Foot Ankle Surg.* 2009;48(4):447-51.

29. Frey C. Surgical advancements: arthroscopic alternatives to open procedures: great toe, subtalar joint, Haglund's deformity, and tendoscopy. *Foot Ankle Clin.* 2009;14(2):313-39.
30. Lee JC, Calder JD, Healy JC. Posterior impingement syndromes of the ankle. *Semin Musculoskelet Radiol.* 2008;12(2):154-69.
31. Jardé O, Quenot P, Trinquier-Lautard JL, Tran-Van F, Vives P. [Haglund disease treated by simple resection of calcaneus tuberosity. An angular and therapeutic study. Apropos of 74 cases with 2 years follow-up]. *Rev Chir Orthop Reparatrice Appar Mot.* 1997;83(6):566-73.
32. Reinherz RP, Smith BA, Henning KE. Understanding the pathologic Haglund's deformity. *J Foot Surg.* 1990;29(5):432-5.
33. Miller AE, Vogel TA. Haglund's deformity and the Keck and Kelly osteotomy: a retrospective analysis. *J Foot Surg.* 1989;28(1):23-9.
34. Pincus AI. Haglund's disease; an analytical review of the syndrome with the report of two surgical cases. *J Natl Assoc Chirop.* 1948; 38(8):13-23.
35. Chegini Kord M, Ebrahimpour A, Sadighi M, Chehrassan M, Nazari L, Najafi A, et al. Minimally Invasive Repair of Acute Achilles Tendon Rupture Using Gift Box Technique. *Arch Bone Jt Surg.* 2019;7(5):429-34.
36. Tian J, Rui Y, Xu Y, Yang W, Xu T, Chen X, et al. Achilles tendon rupture repair: Biomechanical comparison of the locking block modified Krackow technique and the Giftbox technique. *Injury.* 2019;51(2):559-64.
37. Liu JY, Duan WF, Shen S, Ye Y, Sun YQ, He W. Achillon versus modified minimally invasive repair treatment in acute Achilles tendon rupture. *J Orthop Surg (Hong Kong).* 2020;28(1):230949 9020908354.
38. Ge Z, Ma L, Tang H, Yang M, Yang A, Yuan C, et al. Comparison of dorsal closing wedge calcaneal osteotomy versus posterolateral prominence resection for the treatment of Haglund syndrome. *J Orthop Surg Res.* 2020;15(168):1-8.
39. Lughy M. Haglund's Syndrome: endoscopic or open treatment? *Acta Biomed.* 2020;91(4-S):167-71.
40. Yongliang Y, Honglei J, Wupeng Z, Shihong X, Fu W, Bomin W, et al. Intraoperative ultrasonography assistance for minimally invasive repair of the acute Achilles tendon rupture. *J Orthop Surg Res.* 2020;15(1):258.
41. Oliveira RL, Martins JS, Silva PHM. Minimally invasive repair of acute Achilles tendon injury: description of technique and evaluation of outcomes. *J Foot Ankle.* 2020;14(1):62-7.