

EFFICIACY OF MINIMALLY INVASIVE SURGERY ON HALLUX VALGUS : A SYSTEMATIC REVIEW

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Abstract

Introduction: *The terms "Hallux valgus" or "hallux abducto-valgus" are the medical terms most commonly used in relation to a bunion anomaly. These deformities can result from foot or joint abnormalities, but the most common cause is wearing too-small or too-large shoes. High heels cause the body to bend forward, which puts pressure on the toes. The type of surgery depends on the bones involved, their angular connection, the joint injury, and other deformities.*

The aim: *This article describe about efficiacy of minimally invasive surgery on hallux valgus.*

Methods: *By comparing itself to the standards set by the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020, this study was able to show that it met all of the requirements. So, the experts were able to make sure that the study was as up-to-date as it was possible to be. For this search approach, publications that came out between 2013 and 2023 were taken into account. Several different online reference sources, like Pubmed and SagePub, were used to do this. It was decided not to take into account review pieces, works that had already been published, or works that were only half done.*

Result: *In the PubMed database, the results of our search brought up 89 articles, whereas the results of our search on SagePub brought up 62 articles. The results of the search conducted for the last year of 2013 yielded a total 33 articles for PubMed and 17 articles for SagePub. In the end, we compiled a total of 19 papers, 12 of which came from PubMed and seven of which came from SagePub. We included seven research that met the criteria.*

Conclusion: *MIS measures for HV surgery can be considered effective with a reoperation rate of less than 20%. Both the radiological and clinical outcome of the minimally invasive osteotomy and the open method are on par with one another.*

Keyword: *Anatomy; Hallux valgus; Minimally invasive surgery; Radiological*

INTRODUCTION

The feet function as organs of support for the body, regulator of balance and for mobility. Often without realizing it, we have demanded the feet to always be able to perform their functions without adequate care. The terms "Hallux valgus" or "hallux abducto-valgus" are the medical terms most commonly used in relation to a bunion anomaly, where "hallux" refers to the large toe, "valgus" refers to the abnormal angulation of the big toe commonly associated with bunion anomalies, and "abductus" refers to an abnormal hovering or inward tilt of the big toe towards the second toe, which is also commonly associated with bunions.¹

These deformities can arise from anomalies in the function of the foot or the joints, but the most common cause is the wearing of shoes that are too small or too large. When wearing shoes with heels that are excessively high, the body weight is forced to lean forward, which puts pressure on the toes. Conversely, if the shoe is excessively loose or too tight, particularly if it has a tapered toe, this might induce the foot to begin to conform to the contours of the toe of the shoe. It appeared as though their toes were being constricted inside the shoe, which resulted in the initial sole of the bone sticking out.^{2,3}

The majority of bunions are caused by hereditary predisposition, and they consist of the muscles, ligaments, and the structures that support the metatarsals.² It is a biomechanical anomaly that can be produced by a range of disorders that are inherent to the structure of the foot, such as flat feet, excessive flexibility of the ligaments, atypical bone structure, and certain neurological conditions.⁴ Flat feet are one of the most common causes of this ailment. Bunions are a frequent form of deformity that manifest themselves when the muscles and ligaments that are responsible for keeping the first metatarsal bone in place get weakened and allow the bone to shift away from the other toes.^{5,6}

If bunion symptoms do not respond to conservative measures or if the bunion has progressed beyond a threshold where the above measures are ineffective, bunion surgery may be needed to correct the joint shape and remove the bunion. A variety of surgical procedures are available and the choice will depend on such things as the bones involved, the angular relationship between the different bones, the amount of damage to the joint and the presence of deformities other than bunions.⁵⁻⁷ This article showed efficiency of minimally invasive surgery on hallux valgus.

METHODS

The author of this study made sure it met the standards by following the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020 rules. This is done to make sure that the results of the investigation are correct. For the objective of this literature review, we showed efficiency of minimally invasive surgery on hallux valgus. As the primary objective of this piece of writing, demonstrating the relevance of the identified challenges will occur throughout its entirety.

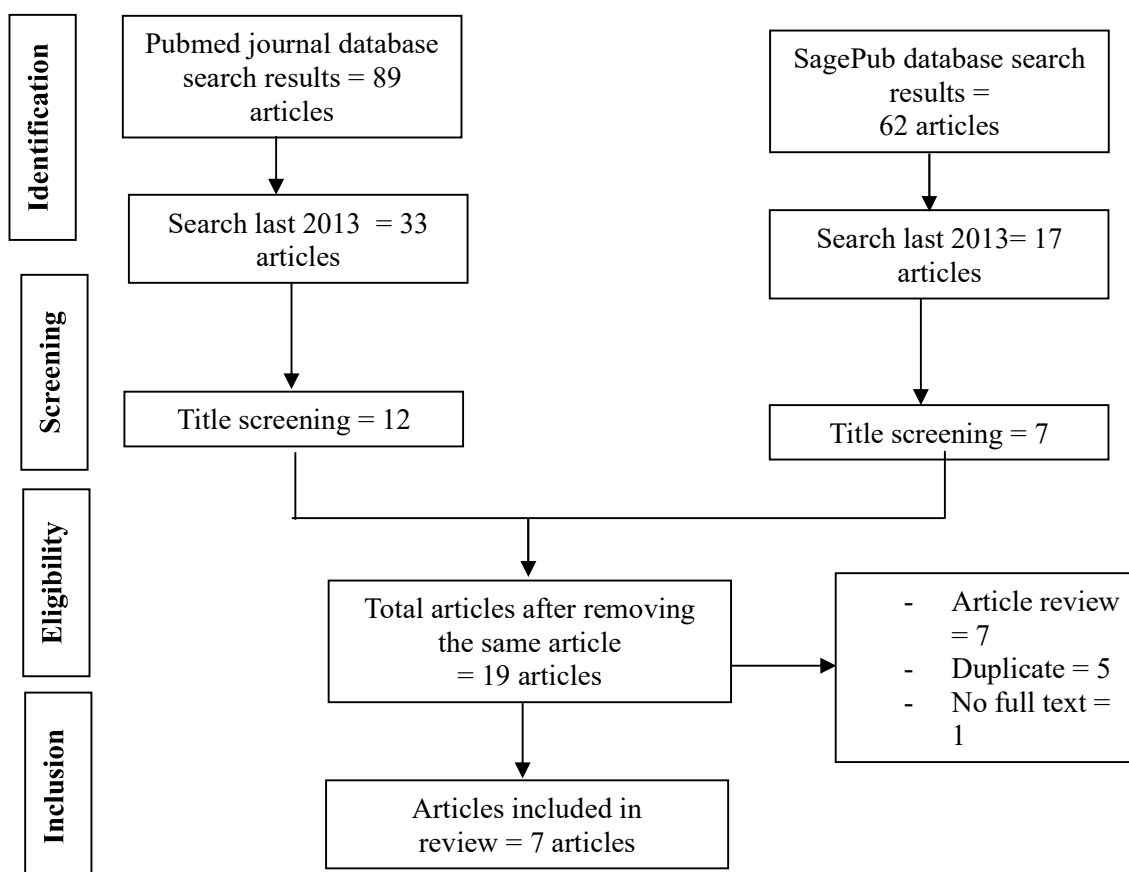


Figure 1. Article search flowchart

In order to participate in the study, researchers were required to meet the following requirements: 1) The paper must be composed in English and will focus on efficiency of minimally invasive surgery on hallux valgus. For the manuscript to be considered for publication, it must satisfy both of these conditions. 2) Several of the examined papers were published after 2013, but prior to the time period deemed pertinent by this systematic review. Examples of studies that are not permitted include editorials, submissions without a DOI, previously published review articles, and entries that are essentially identical to previously published journal papers.

We used “efficiency”; “minimally invasive surgery” and “hallux valgus” as keywords. The search for studies to be included in the systematic review was carried out from July, 28th 2023 using the PubMed and SagePub databases by inputting the words: *(("minimally invasive surgical procedures"[MeSH Terms] OR ("minimally"[All Fields] AND "invasive"[All Fields] AND "surgical"[All Fields] AND "procedures"[All Fields]) OR "minimally invasive surgical procedures"[All Fields] OR ("minimally"[All Fields] AND "invasive"[All Fields] AND "surgery"[All Fields]) OR "minimally invasive surgery"[All Fields]) AND ("hallux valgus"[MeSH Terms] OR ("hallux"[All Fields] AND "valgus"[All Fields]) OR "hallux valgus"[All Fields])) AND (y_10[Filter]) AND (clinicaltrial[Filter]))* used in searching the literature.

After perusing the abstract and title of each study, the authors conducted an evaluation to determine if the study met the inclusion criteria. The authors then determined which previous studies would serve as sources for the article and chose those studies. This conclusion was reached after examining a variety of studies that all appeared to indicate the same trend. All submissions must be written in English and must not have been previously published.

For the systematic review, only those papers that satisfied all inclusion criteria were considered. This narrows the search results to only those that are relevant to the query. We do not take into account the findings of any study that does not meet our standards. Following this, the research findings will be analysed in depth. As a consequence of the research conducted for the purpose of this study, the following information was uncovered: names, authors, publication dates, location, study activities, and parameters.

Before deciding which publications to investigate further, each author conducted their own research on the research included in the title and abstract of the publication. The next stage is to evaluate all of the articles that meet the review's inclusion criteria. Then, based on the findings, we will choose which articles to include in the review. This criterion is utilised in the selection of documents for further evaluation. To facilitate the process of selecting papers for evaluation as much as possible. This section discusses which earlier studies were conducted and what aspects of those studies made it appropriate to include them in the review.

RESULT

In the PubMed database, the results of our search brought up 89 articles, whereas the results of our search on SagePub brought up 62 articles. The results of the search conducted for the last year of 2013 yielded a total 33 articles for PubMed and 17 articles for SagePub. In the end, we compiled a total of 19 papers, 12 of which came from PubMed and seven of which came from SagePub. We included seven research that met the criteria.

Table 1. The literature include in this study

Author	Origin	Method	Sample Size	Result
Dragosloveanu, 2022⁸	Romania	Randomized controlled trial	26 cases in the open chevron osteotomy group (24 female, 2 male) and 24 in the MIS group (24 female, 0 male)	This study reveals that minimally invasive chevron osteotomy achieves results that are comparable to open chevron osteotomy, despite the fact that the amount of time spent in surgery and the amount of radiation exposure are much more. It is necessary to conduct additional research in order to assess the potential for problems and recurrences.
Torrent 2021⁹	Spain	Randomized controlled trial	58 patients	The minimally invasive scarf (MI scarf) gives a clinically and radiologically identical outcome to open scarf for the treatment of HV with reduced operating time and immediate postoperative VAS for pain; nevertheless, it is accompanied with a minor increase in radiation exposure.
Kaufmann, 2019¹⁰	Austria	Randomized controlled trial	47 patient underwent minimally invasive chevron osteotomy	The radiological and clinical outcome of the minimally invasive

			technique (MIS group) and open correction (OC)	chevron osteotomy is comparable to that of the open procedure.
Jowett, 2017¹¹	Australia	Prospective cohort study	120 consecutive feet underwent minimally invasive Chevron Akin	Despite this, the outcomes are encouraging, and the learning curve is on par with that of open hallux valgus surgery.
Mahadevan, 2016¹²	United Kingdom	Prospective cohort study	84 patients (109 feet)	When it came to correcting intermetatarsal angle (IMA) in hallux valgus deformity, the modified chevron osteotomy proved to be more effective than the scarf osteotomy.
Brogan, 2016¹³	United Kingdom	Retrospective cohort study	Eighty-one consecutive feet (49 MIS and 32 open distal chevron osteotomies)	In patients with symptomatic mild to moderate hallux valgus, the results of this third-generation technique reveal that it was a safe treatment with favourable clinical outcomes and that it is comparable to previous open techniques. These results were found midterm.
Giannini, 2013¹⁴	Italy	Prospective cohort study	641 patients	This study showed that the simple, effective, rapid, inexpensive (SERI) method is a good way to treat mild to moderate hallux valgus, both in terms of relieving symptoms and making the foot work better. This method was able to fix the main parts of the deformity, with long-lasting clinical and x-ray results at the six-month follow-up.

Dragosloveanu, et al (2022)⁸ showed both groups improved in terms of IMA and HVA at the last follow-up, with no significant differences between groups at the final assessment. The MIS group had significantly improved post-operative results at discharge ($p < 0.001$), 3 weeks ($p < 0.001$), 6 weeks ($p < 0.001$), and 6 months ($p = 0.004$). The AOFAS revealed no statistically significant alterations before or after surgery. Three of the four documented cases of screw prominence belonged to the MIS group. In the OC group, only one case of metatarsalgia was discovered.

Torrent, et al (2021)⁹ showed the mean follow-up was of 21 (range, 12-38) months. Radiologic measurements (postoperative hallux valgus angle, first-to-second intermetatarsal angle, and distal metaphyseal articular angle) were similar in both groups and showed statistically significant improvement from preoperative measures. The mean operative time for the MI group was 16.7 vs 26.1 minutes in the open group, a statistically significant difference. Radiation exposure was 14 times higher in the MI group when compared to the open group (mean: 34 vs 2.4 mGy/cm², $P < .001$). There were no major complications in either group.

Kaufmann, et al (2019) conducted a study with 47 cases (25 minimally invasive chevron osteotomy technique [MIS group]; 22 OC group). Both operative techniques achieved significant correction of the hallux deformity. The intermetatarsal angle (IMA) improved from 15.1° to 5.8° in the OC and from 14° to 6.8° in the MIS group, whereas the hallux valgus angle (HVA) improved from 28.3° to 8.5° in the OC versus 26.4° to 6.9° in the MIS group. No significant differences were observed between the groups by any of the determined outcome parameters. Regarding patient satisfaction, statistically significant differences were found between MIS and open surgery 12 weeks post-operatively in favour of the MIS group ($p = 0.022$).

Jowett, et al (2017)¹¹ showed mean American Orthopaedic Foot and Ankle Society score improved from 56 (range 23-76) preoperatively to 87 (range 50-100) postoperatively ($p < 0.001$). The mean HV and intermetatarsal angles preoperatively were 29.7° (range 12-46°) and 14.0° (range 8-20°). The corresponding postoperative angles were 10.3° (range 0-25°) and 7.6° (range 3-15°; $p < 0.001$). The patients were satisfied with the results of surgery in 87% of cases. The incidence of reoperation was 14%. These are the only reported results for this technique. They display a steep associated learning curve. Brogan, et al (2016)¹³ showed clinical and radiologic scores in all domains were much better for both groups ($P < 0.001$) after surgery, but there was no statistically significant difference between the open and MIS groups in any domain ($P > 0.05$). There were no big changes between the two groups in terms of complications (> 0.5). The midterm results of this third-generation method show that it was safe, had good clinical results, and was about the same as traditional open techniques for mild to moderate hallux valgus with symptoms.

Giannini, et al (2013)¹⁴ showed the American Orthopaedic Foot and Ankle Society (AOFAS) score went from 46.8 ± 16.7 before surgery to 89 ± 10.3 . Radiographic follow-up showed that the osteotomy had completely healed and that the metatarsal bone had changed shape. It has been said that complications happen rarely. This study showed that the SERI method is a good way to treat mild to moderate hallux valgus, both in terms of relieving symptoms and making the foot work better. This method was able to fix the main parts of the deformity, with long-lasting clinical and x-ray results at the six-month follow-up.

DISCUSSION

The terms "Hallux valgus" or "hallux abducto-valgus" are the medical terms most commonly used in relation to a bunion anomaly, where "hallux" refers to the large toe, "valgus" refers to the abnormal angulation of the big toe commonly associated with bunion anomalies, and "abductus" refers to an abnormal hovering or inward tilt of the big toe towards the second toe, which is also commonly associated with bunions. It is important to state that "hallux abducto" refers to the movement of the thumb moving away from the midline of the body.¹

Hallux valgus causes widening of the foot as the base of the big toe protrudes from the foot. A deviation of the big toe also occurs, so that the big toe points beyond the smaller toe. This results in a bump on the edge of the toe, where the head of the metatarsal meets the base of the big toe. Beneath this lump is a bursa (a fluid-filled sac). The bursa becomes irritated by friction with shoes, causing swelling of the bursa under the bump, thereby increasing the size of the lump – this is called a bunion. Continued irritation of the bunion by friction with shoes causes increased bone growth and further swelling of the bursa, enlargement of the bunion and further widening of the foot.¹

Bunions associated with hallux valgus generally have some degree of metatarsal varus pares. Arises early as a predisposing controversy with spread to other areas. If the bunion is associated with degenerative changes of the MTP joint, the Keller procedure is the procedure of choice. Silastic implants are also an alternative. The most common controversy is the direct hallux valgus deformity of various joints. Procedures for normal MTP by shortening or removing soft tissue, such as the McBride procedure for a combination of soft tissue adjustment and osteotomy. A number of procedures may yield good results, provided therapy is advocated for a short hypermobile first ray or a long abnormal first ray.^{1,15}

Studies about the effects of minimally invasive hallux valgus surgery showed MIS had good clinical outcomes in the middle term and after ten years of follow-up. Also, the radiological results showed good results. But so far, there have been no prospective, randomised studies compare a MIS chevron method to an open chevron technique.^{13,14,16} This problem was also brought up by Trnka et al., who couldn't make a clear recommendation in their systematic review analysis because most of the studies seemed to be level IV studies done at centres that mostly do minimally invasive hallux valgus surgery and there haven't been any prospective randomised studies done yet.¹⁷

Also, most of the studies that have been published looked at what happened after straight distal metatarsal osteotomies, which could change the joint line.¹⁵ Iyer et al. found that people with pathological joint lines had a higher rate of recurrence, and another study showed that there was a chance of a metatarsal misload after Reverdin-Isham treatments.¹⁸ Other researchers have shown that a minimally invasive chevron method has good clinical and radiological results, but our study is the first to compare a minimally invasive chevron type and an open chevron osteotomy in a random way.^{11,13} We think the chevron type is better than linear osteotomy methods because the joint line is more likely to stay the same and the metatarsal head is more likely to be in the coronal plain.

The correction of an individual's average intermetatarsal angle (IMA) was used as a marker to estimate the corrective potential of a metatarsal osteotomy. It is expected that complete relocation of the sesamoids would follow after the IMA has been completely reduced. There is a correlation between IMA and sesamoid location in hallux deformity as well as after hallux valgus correction, according to recent research published in the medical literature.^{13,19} According to our understanding, the IMA provides an indication of whether or not the shift of the metatarsal head is sufficient.^{12,20}

Analyses of the hallux valgus angle (HVA), which are quite similar to those of the intermetatarsal angle, discovered a comparable correction, with only a minuscule percentage of correction being lost in either group. When seen from this perspective, a phalangeal osteotomy and the quality of the lateral release have a direct impact, whereas a metatarsal osteotomy only has an indirect result. The angle of the hallux valgus was rectified in our study in a way that was in good concordance with the results that have been reported in the literature. This concordance was achieved by adjusting the angle of the hallux valgus.^{12,20}

CONCLUSION

MIS measures for HV surgery can be considered effective with a reoperation rate of less than 20%. Both the radiological and clinical outcome of the minimally invasive osteotomy and the open method are on par with one another.

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