



Efficacy of Chevron Osteotomy Versus SERI Method for Moderate Hallux Valgus treatment: A Non-Randomized Clinical Trial

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Abstract

Introduction: Hallux valgus is a prevalent deformity of the forefoot, characterized by deviation of the great toe (hallux) toward the second toe and prominence of the metatarsal, along with the formation of a bony structure known as a bunion on the medial edge of the foot. The purpose of this retrospective study was to compare the efficacy, VAS pain scale scores, and patient satisfaction between the Chevron and SERI (Simple, Effective, Rapid, Inexpensive) surgical techniques in the correction and treatment of moderate hallux valgus.

Method: This was a non-randomized clinical trial of 70 patients who underwent surgery for correction of hallux valgus using one of two techniques (Chevron technique, n = 35; SERI technique, n = 35) at Baqiyatallah Hospital in the second half of 2022. The hallux valgus angle (HVA) and intermetatarsal angle (IMA) were measured preoperatively and one year after the operation using radiographic and medical records. Patient pain levels were evaluated using the Visual Analog Scale (VAS), and subjective satisfaction was also assessed. Both parameters were evaluated and documented in patients' medical records. Data were analyzed using SPSS software version 26, with comparisons made using the t-test and chi-square test.

Result: In the preoperative evaluation, the mean intermetatarsal angle (IMA) was 12.97 ± 1.70 (range: 11.27–14.67) in the SERI group and 12.08 ± 1.24 (range: 10.84–13.32) in the Chevron group. The mean preoperative hallux valgus angle (HVA) was 32.80 ± 3.26 (range: 29.54–36.06) in the SERI group and 32.17 ± 1.94 (range: 30.23–34.11) in the Chevron group. At the one-year postoperative follow-up, the mean IMA was 8.14 ± 1.50 (range: 7.64–10.64) in the SERI group and 9.37 ± 1.03 (range: 8.34–10.40) in the Chevron group. The mean postoperative HVA was 10.28 ± 1.60 (range: 8.68–11.88) in the SERI group and 14.4 ± 1.41 (range: 12.99–15.81) in the Chevron group. Postoperative HVA and IMA measurements showed a statistically significant difference between the two groups ($P < 0.05$). The SERI group experienced significantly lower pain levels compared to the Chevron osteotomy group ($P < 0.05$). Additionally, patient satisfaction was significantly higher in the SERI group compared to the Chevron group ($P < 0.05$).

Conclusion : The results of this study demonstrate that the SERI technique provides higher patient satisfaction and lower pain levels compared to the Chevron technique at the one-year follow-up. This study showed better surgical outcomes with the SERI technique for moderate hallux valgus.

Keywords: Osteotomy, Hallux Valgus, SERI, Chevron.

Introduction

Hallux valgus is a common foot disorder. The existence of several surgical treatments has led to uncertainty regarding the optimal surgical method¹. The prevalence is 1.6% in adolescents, while another study reported a prevalence of 22% to 46%

². The female-to-male ratio ranges between 4:1 and 9:1, and familial prevalence has also been discussed³. Genetic history, familial incidence, muscular strength imbalance, obesity, abnormal metatarsal rotation, medial deviation of the first metatarsal,

lateral foot deviation, and equinus deformity of the ankle are the most important predisposing factors⁴.

Hallux valgus deformity primarily involves the first metatarsophalangeal joint (MTPJ), which leads to lateral displacement of the big toe with or without valgus rotation and medial shifting of the first metatarsal, often resulting in joint subluxation⁵. Hallux valgus is a progressive deformity that may ultimately lead to osteoarthritis of the first MTPJ, with higher risk in patients over 50 years of age². It is also the most common condition affecting the great toe. Prevalence is higher in the elderly and may be seen in 12% to 65% of individuals over 65 years old^{6,7}. Studies have shown that hallux valgus has an adverse effect on quality of life.⁸

Beyond aesthetic concerns, hallux valgus may be significantly painful and impact daily function, ultimately making walking impossible if left untreated. Non-surgical treatments include proper footwear, toe spacers, and protective pads, which may help reduce toe deviation. However, if these conservative measures fail to correct the deformity, surgery may be necessary. Conservative and non-surgical treatments are most effective in the initial stages of the disease.⁹

Hallux valgus imposes a significant burden on healthcare resources. Over 200,000 surgeries are performed annually in the United States for this condition^{10,11}. This intervention is the fifth most common orthopedic surgery in Finland¹² and the most frequently performed surgery on the forefoot in Sweden¹³. Studies have confirmed that surgical correction is more effective than orthotic treatment or watchful waiting¹⁴ and that surgery improves quality of life¹⁶. Generally, the severity of the deformity determines the surgical method¹⁵. The most common evaluation for the severity of hallux valgus involves weight-bearing radiographs, particularly measuring the hallux valgus angle (HVA) and the intermetatarsal angle (IMA) between the first and second metatarsals¹⁵.

Research indicates that these radiographic angles are correlated to some extent with the clinical manifestation of hallux valgus; higher HVA and IMA values correspond to greater deformity severity.¹⁵

Minimally invasive procedures are becoming more common in orthopedic surgery due to advantages such as smaller incisions, shorter recovery time, lower costs, and higher patient satisfaction¹⁶. Some studies conducted in Europe have utilized minimally invasive techniques for hallux valgus correction, yielding favorable results^{17,18}. However, traditional techniques such as V-shaped distal metatarsal osteotomy (Chevron osteotomy) remain popular and competitive with minimally invasive methods due to their availability and reliability¹⁹. The Chevron osteotomy method is generally recommended for mild to moderate deformities²⁰. This surgical method involves a distal V-shaped osteotomy of the first metatarsal, which allows the surgeon to perform lateral displacement of the metatarsal head, narrow the forefoot, and reduce the IMA^{21,22}. Some surgeons have modified the Chevron osteotomy by extending the plantar limb, theoretically expanding its application to moderate-to-severe hallux valgus deformities.²³

For moderate-to-severe deformities, SERI osteotomy is generally preferred²⁴. It is commonly believed that SERI osteotomy achieves greater IMA reduction than Chevron osteotomy, making it suitable for patients with larger IMA values^{25,26}. From a technical perspective, SERI osteotomy may require broader soft tissue dissection, larger bony resections, and greater fixation, which may lead to higher costs and theoretically more complications.²⁶

To date, there have been insufficient studies directly comparing these two common osteotomies for hallux valgus correction. Furthermore, no conclusive evidence confirms that SERI osteotomy

results in significantly greater IMA correction than Chevron osteotomy. Therefore, the aim of this study is to evaluate the angular correction achieved by Chevron and SERI osteotomies to determine their relative efficacy in reducing IMA, particularly in cases requiring long plantar arm modifications. The findings of this study will help optimize treatment protocols for hallux valgus correction in the future.

Methods

This study is a non-randomized clinical trial comparing outcomes of two surgical methods (Chevron vs. SERI osteotomy) for hallux valgus correction. Data were collected from medical records of patients diagnosed with hallux valgus who underwent Chevron or SERI osteotomy at Baqiyatallah Hospital in the second half of 2022. All operations were performed by a senior orthopedic surgeon (M.A.).

Chevron osteotomy is a distal metatarsal osteotomy used for correction of mild-to-moderate hallux valgus, characterized by a V-shaped cut at the metatarsal head, lateral displacement of the fragment, and fixation with screws or K-wires. This method utilizes a dorsomedial approach. In contrast, the SERI method is a minimally invasive distal linear osteotomy performed through a small medial incision proximal to the metatarsal head, followed by temporary K-wire fixation.

Inclusion criteria for the investigation were as follows: (1) diagnosis of hallux valgus; (2) no previous surgical treatment for hallux valgus other than the surgery performed at this center; (3) undergoing surgery using Chevron or SERI osteotomy between July and December 2022; (4) complete preoperative and postoperative radiographic and medical records; and (5) at least one year of postoperative follow-up.

Exclusion criteria were as follows: (1) history of previous foot trauma; (2) history of other orthopedic surgeries on the foot or ankle; (3) incomplete medical records; (4) presence of joint infection; and (5) systemic conditions affecting the musculoskeletal system.

A total of 134 patients met the inclusion criteria. Of these, 25 had a history of foot trauma, 13 had a history of surgical intervention on the foot or ankle, 9 had incomplete medical records, and 17 were excluded due to joint infection or systemic conditions affecting the results. Ultimately, 70 patients met all eligibility criteria

and were divided into two groups based on the surgical method: Chevron osteotomy (n = 35) and SERI osteotomy (n = 35).

HVA and IMA were measured preoperatively and one year postoperatively, and the results were compared between the groups. Pain levels were assessed using the Visual Analog Scale (VAS), and patient satisfaction was evaluated using the Bonney and Macnab criteria, staged as excellent, good, fair, or poor.²⁹

Data were analyzed using SPSS software version 26, with t-tests and chi-square tests. A P-value of < 0.05 was considered statistically significant.

Results

A total of 70 patients were divided into two groups for comparison in this study: 35 patients underwent SERI osteotomy, and 35 patients underwent Chevron osteotomy.

Preoperative Hallux Valgus and Intermetatarsal Angles
We compared the preoperative hallux valgus angle (HVA) and intermetatarsal angle (IMA) between the two groups. The investigation showed no statistically significant difference between the groups before surgery for either HVA (P = 0.331) or IMA (P = 0.199) (Table 1).

Postoperative Hallux Valgus and Intermetatarsal Angles

We compared HVA and IMA one year after surgery. The postoperative HVA and IMA were considerably lower in the SERI group compared to the Chevron group (P = 0.001). This indicates that SERI osteotomy resulted in a greater degree of correction of the hallux valgus deformity compared to Chevron osteotomy (Table 2).

Postoperative Pain Assessment (VAS Score)

Mean postoperative pain scores were assessed using the Visual Analog Scale (VAS) and recorded in medical records. The SERI group had significantly lower pain levels compared to the Chevron group (P = 0.001), suggesting better pain relief following SERI osteotomy (Table 3).

Patient Satisfaction

We investigated patient satisfaction levels one year after the operation. Patients in the SERI group reported significantly higher satisfaction compared to the Chevron group ($P = 0.044$). Notably, a greater number of SERI osteotomy patients rated their results as "excellent" or "good," while the Chevron group had a higher number of "fair" and "poor" satisfaction ratings.

Surgical Complications and Postoperative Issues

In the SERI group, only one patient experienced complications, specifically a superficial pin site

infection. This patient was treated with one week of oral antibiotics, and the pin was removed two weeks earlier than planned. There were no other complications, such as decubitus ulcers, recurrence, dorsal malunion, or nonunion, and no additional procedures were required.

In the Chevron group, two patients experienced recurrence, diagnosed through radiographic evaluation. However, due to the absence of symptoms, no additional procedures were necessary. Additionally, one patient from this group reported stiffness, but this was deemed unremarkable. There were no signs of nonunion or avascular necrosis (AVN) detected in either group.

Table 1. Comparison of Preoperative Hallux Valgus and Intermetatarsal Angles in two groups

	Group	Cases	Mean	± SD	P value
Preoperative HVA	Chevron	35	32.17	1.94	0.331
	SERI	35	32.8	3.26	
Preoperative IMA	Chevron	35	12.08	1.24	0.199
	SERI	35	12.97	1.7	

Table 2. Comparison of Postoperative Hallux Valgus and Intermetatarsal Angles Between Groups

	Group	Cases	Mean	± SD	P value
1-year postoperative HVA	Chevron	35	14.4	1.41	0.001
	SERI	35	10.28	1.6	
2-year postoperative IMA	Chevron	35	9.37	1.03	0.001
	SERI	35	8.14	1.5	

Table 3. Comparison of Postoperative Pain Scores Between Groups (VAS Scale)

	Group	cases	Mean	± SD	P value
VAS	Chevron	35	7.08	0.78	0.001
	SERI	35	6.17	0.7	

Table 4. Comparison of Patient Satisfaction Between Groups

Satisfaction	Group		P value
	Chevron	SERI	
Excellent	5(7.1)	14(20)	0.044
Good	17(24.3)	14(20)	
Fair	10(14.3)	7(10)	
poor	3(4.3)	0(0)	

Discussion

Pain alleviation, deformity correction, and enhancement of foot functionality are the goals of hallux valgus treatment. Additionally, the surgical approach seeks to restore normal alignment as measured radiographically²⁷. Over 150 surgical procedures have been documented for hallux valgus treatment, yet none is universally recognized as the gold standard, as each possesses its own set of advantages and disadvantages²⁸. Furthermore, numerous studies have shown successful outcomes for the surgery of mild to moderate hallux valgus, irrespective of the chosen surgical method or the type of osteotomy or fixation technique employed²⁹. An analysis of the literature demonstrates that patient satisfaction rates for all surgical procedures are consistently above 80%. However, there is no definitive evidence demonstrating the superiority of any single technique. A significant paucity of sufficient data remains, making it difficult to assert the clear dominance of one method over another²⁸.

While the SERI technique for minimally invasive hallux valgus correction is not entirely novel, as this technique performs an osteotomy and employs a stabilization method that has been previously documented³⁰, it offers significant versatility and efficacy by combining the strengths of previously described procedures. This results in a technique that boasts unique characteristics such as minimal invasiveness, simplicity, versatility, and excellent construct stability²⁸. Numerous studies have demonstrated positive surgical outcomes with the SERI technique. Although some studies have compared its results with other techniques such as SCARF (28), to the best of our knowledge, very few reports have examined its outcomes in comparison to the commonly used Chevron technique.^{31,29}

Palmanovich et al. conducted a study comparing the SERI technique and the standard Chevron technique. This study randomized 21 patients to the

SERI group and 15 to the Chevron group. Both groups showed notable improvement based on radiographic evaluation and postoperative morphology. The authors did not find a significant difference in IMA and HVA between the two groups at follow-ups conducted at two weeks and one-year post-operation²⁹. Similarly, the Marmotti study's radiological results suggested that both surgical methods are successful for hallux valgus deformity treatment, with no major differences in outcomes between the methods³¹. However, according to the current study, the correction results for HVA and IMA angles were significantly better in the SERI group.

Similar results were observed in terms of pain reduction and improved patient satisfaction. Despite previous studies showing similar outcomes between the two groups, the current study found that the VAS score was significantly better after surgery with the SERI technique compared to the Chevron technique, and patients were also more satisfied with the SERI technique.

Regarding complications, patients undergoing surgery with non-minimally invasive methods generally have a greater potential for various complications due to increased surgical scarring and soft tissue manipulation. Lee and Lam, for instance, reported incision lengths of 10.7 cm and 10.8 cm, respectively, for the Scarf-Akin procedure^{24, 32}. Radwan et al. reported sensory loss after surgery in the medial part of the great toe in approximately 13% of patients following distal Chevron osteotomy. This complication likely arises from damage to the dorsomedial sensory nerve of the great toe, which is vulnerable as it courses through the dorsal skin flap created during the incision³³. Furthermore, MTP joint stiffness has been reported to range from 0% to 37.8% when using open techniques with capsulotomy³⁴. In the present study, there was one case of stiffness in the Chevron group, accounting for 2.8% of patients. Regarding infection rates, there is a 2% rate of deep infection when using screw fixation for Chevron osteotomy. For the Scarf procedure, infection rates

range from 5% to 10%, including superficial wound infections.^{35,28}

On the other hand, complications have been less frequent with the SERI technique. The SERI method was designed to reduce wound complications and facilitate a faster recovery process for patients²⁹. Radwan et al. reported no cases of avascular necrosis (AVN) of the first metatarsal head, as they preserved the insertion of the joint capsule and avoided over-penetration of the lateral cortex, which minimized the risk of AVN³³. However, it is crucial to ensure close patient follow-up to prevent recurrence and complications related to percutaneous pin fixation. According to Bahaeddini et al., the rate of pin site infection in the SERI method for hallux valgus is approximately 3.2%³⁶. This is consistent with our findings, where 1 out of 35 cases (2.8%) experienced pin site infection.

The SERI method is relatively simple because it involves only a single K-wire (KW) for fixation, which is a less expensive device. It does not require lateral release or removal of the medial eminence. This technique is performed by making a 1-cm medial incision that permits direct control of the osteotomy and displacement, as well as stabilization. It is capable of overcoming concerns expressed about other minimally invasive methods that require a steep learning curve and the use of fluoroscopy for correction³⁷. Skin burning, reported in a study to occur in up to 13% of cases following minimally invasive surgery, is attributed to the lengthy learning curve associated with these methods.²⁰

The operative time for the SERI procedure is reported to be approximately 7–15 minutes, with an additional 5–7 minutes for closure and bandaging²⁹. This is significantly faster compared to other minimally invasive methods, which take around 43 minutes, and the Scarf-Akin method, which takes about 60 minutes³⁷. These attributes make the SERI technique particularly suitable for patients with medical complications, such as diabetes, who

present with hallux valgus deformities. Additionally, when comparing the SERI method with other minimally invasive techniques, the high rate of implant removal operations is notable. In minimally invasive Chevron Akin (MICA) surgery, this rate ranges from 8% to 24%^{20, 38-40}. In minimally invasive surgery (MIS), Kaufmann et al. reported that 16 out of 25 feet required implant removal⁴¹.

Conclusion

The results of this study demonstrate that the Simple, Effective, Rapid, and Inexpensive (SERI) technique provides significantly higher patient satisfaction and lower pain levels compared to the Chevron technique during a one-year follow-up period. Specifically, patients who underwent the SERI technique reported greater satisfaction and experienced less pain. This study highlights the effectiveness of the SERI technique for treating moderate hallux valgus, demonstrating that it leads to improved patient experiences and outcomes compared to the traditional Chevron osteotomy.

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This study has been approved by the Baqiyatallah University of Medical Sciences. All the experiments of this study were conducted in accordance to the relevant guidelines and regulations or in accordance to the Declaration of Helsinki. Written informed consent was obtained from all participants.

Conflict of Interest Disclosures

The authors have no relevant financial or non-financial interests to disclose.

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Authors' Contributions

Not cleared.

Ethical Statement

The study protocol was reviewed and approved by the Local Ethics Committee of the Baqiyatallah

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Declaration of Generative AI and AI-assisted technologies

None.

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