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Original Paper

[Translated article] Soft tissue fixation using sutures for the Akin osteotomy in forefoot pathology: Can we abandon fixation with osteosynthesis?

La fijación mediante sutura de partes blandas para la osteotomía de Akin en la patología del antepié. ¿Podemos abandonar la fijación con osteosíntesis?

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ABSTRACT

Objectives: To provide information regarding the safety and effectiveness of soft tissue suturing as a fixation method for the Akin osteotomy (AO).
Materials and methods: We present a retrospective study involving 42 patients with hallux valgus who underwent a first metatarsal (MTT) procedure, all of whom additionally received an AO. The fixation method consisted of soft tissue suturing, supplemented with a cohesive bandage. We recorded the time to bone healing in all patients, as well as the length of the proximal phalanx of the hallux (P1) preoperatively, and at 1, 3, and 6 months postoperatively.
Results: In our series, 100% of AO fixed using soft tissue suturing achieved bone consolidation within an average of 4.5 months (SD: 0.3). No statistically significant differences were found ($p > 0.5$) between the P1 length measured at one month postoperatively (2.56 mm; SD: 0.04) and at the final radiographic evaluation (2.57 mm; SD: 0.04). Similarly, there were no significant differences between the postoperative distal articular set angle (DASA) (2.20; SD: 1.05) and the value at 6 months post-surgery (2.36; SD: 1.34).
Conclusions: Fixation of the AO using soft tissue suturing represents a simple, safe, reproducible, effective, and low-cost technique for maintaining the desired initial correction, while also avoiding complications associated with conventional osteosynthesis systems. To the best of our knowledge, this is the first reported series evaluating the efficacy of this type of fixation as a method of osteosynthesis for the AO.

Palabras clave:
Osteotomía de Akin
No instrumentado
Sutura de partes blandas

RESUMEN

Objetivos: Aportar información sobre la seguridad y la eficacia de la sutura de partes blandas, como método de fijación de la osteotomía de Akin (OA).
Material y métodos: Presentamos un estudio retrospectivo de 42 pacientes con hallux valgus, intervenidos mediante un procedimiento en el primer metatarsiano (MTT), asociando a todos ellos una OA. El método de fijación consistió en una sutura de partes blandas, al que asociamos un vendaje cohesivo. Registramos el tiempo hasta la consolidación en todos los pacientes, así como la longitud de la primera falange (F1) del hallux preoperatorio, al mes, a los 3 meses y a los 6 meses tras la intervención.

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Resultados: En nuestra serie, el 100% de las OA fijadas con sutura de partes blandas consolidaron con una media de 4,5 meses (DE: 0,3), sin diferencias estadísticamente significativas (p > 0,5) entre la longitud de la F1 en la radiografía al mes postoperatorio (2,56 mm; DE: 0,04) y en la radiografía final (2,57 mm; DE: 0,04); ni tampoco entre el valour del ángulo de desplazamiento articular distal (DASA) al mes posquirúrgico (2,20; DE: 1,05) respecto al de los 6 meses de la cirugía (2,36; DE: 1,34).
Conclusiones: La fijación de la OA mediante la sutura de partes blandas consiste en un procedimiento sencillo, seguro, reproducible, eficaz y de bajo coste, a la hora de mantener la corrección inicial deseada, evitando además las complicaciones propias de cualquier sistema de osteosíntesis.
Hasta donde conocemos, somos la primera serie que estudia la capacidad de este tipo de fijación como osteosíntesis de la OA.

Introduction

Akin osteotomy (AO), first described in 1925 by Akin,[1] is a procedure that involves a medial closure osteotomy in the metaphyseal–diaphyseal area of the proximal phalanx (PP) of the hallux. Since then, it has been used alongside osteotomies on the first metatarsal (M1) as an integral part of corrective treatment for hallux valgus (HV), as it adds correction of the distal articular set angle (DASA).

Numerous studies have been published that highlight the usefulness of this procedure in both open[2–5] and percutaneous[5–10] HV correction.[2–9] Several fixation methods for this osteotomy have also been described, including staples, bicortical screws,[11] Kirschner wires, and locked plates.[11–13]

In recent years, several authors have started using soft tissue sutures as a method of fixing the osteotomy[11,12,14,15] to avoid complications associated with the use of osteosynthesis material, during and after surgery.[11–13] To achieve this, bone tunnels are created.[11,12,14,15]

Recently, a soft tissue suture technique[16] has been published that would allow osteotomy correction to be maintained without the need for bone tunnels, due to the risk of lateral cortical fracture during their creation.[15]

Currently, there is still no consensus on the best fixation method for this osteotomy.[17]

Our study aims to evaluate the safety and efficacy of soft tissue suturing after AO as a stable, long-lasting fixation method that provides sufficient stability until consolidation.

Material and methods

We conducted a retrospective study of all patients with moderate HV who underwent surgery at a single centre (a tertiary hospital) by the same surgical team between 2021 and 2023.

The inclusion criteria were:

- Age between 18 and 80.
- A follow-up period of more than 6 months.
- Moderate HV: defined as a metatarsophalangeal (MTP) angle between 20° and 40° and an intermetatarsal angle between 12° and 16° on an anteroposterior (AP) weight-bearing foot radiograph (X-ray).
- Hyperpronation of the first toe on physical examination.

Patients with a history of rheumatological conditions (e.g., rheumatoid arthritis, systemic lupus erythematosus, or gout), those who had previously undergone forefoot or rearfoot surgery, those with any type of peripheral neuropathy and those with significant osteoarthritis in the MTP joint of the first toe on a weight-bearing foot X-ray were excluded.

We collected demographic data such as sex, age, and laterality. The time to consolidation was also recorded for all patients, as well as the length of the PP of the hallux and the DASA angle on the AP weightbearing foot X-ray, taken preoperatively, at one month, and 6 months after the intervention. We also recorded any intraoperative (lateral cortical fracture) and postoperative (surgical wound infection) complications. We did not record functionality or satisfaction scales in our patients.

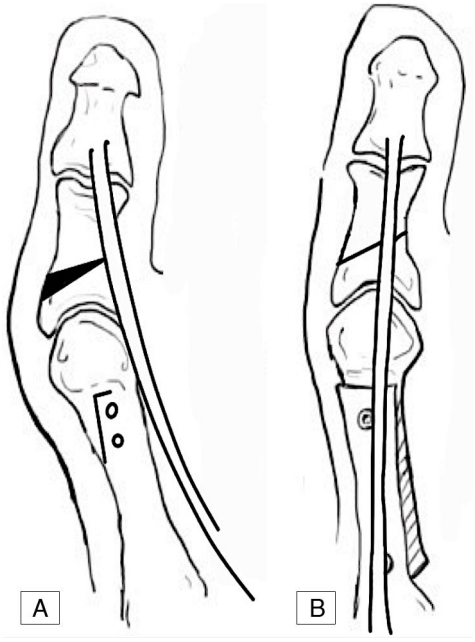

Fig. 1. Diagram showing surgical HV correction with a Scarf osteotomy combined with AO. (A) Medial substraction osteotomy in P1. (B) Medial closure of AO.

Two members of staff from the foot and ankle unit collected the data. We performed the statistical analysis using SPSS v25 software, employing the Kolmogorov–Smirnov and Student's *t*-test methods for paired data.

Surgical technique

Patients underwent surgery in the supine position under local anaesthesia combined with sedation, after ischaemia was induced at the supramalleolar level using a tourniquet on the ankle.

In all cases, we performed a Scarf osteotomy to correct the intermetatarsal and MTP angles, both of which were associated with AO. The latter was performed as described by Barouk et al.[18]

We performed a medial base subtraction osteotomy at the base of the PP after making two cuts with a saw. The first osteotomy cut was located 10 mm from and parallel to the joint surface, while the second cut was located distally and obliquely to the first, between 2 and 4 mm away (depending on the desired degree of correction), and converged at the level of the lateral cortex without penetrating it (Fig. 1). The wedge was then removed, and the osteotomy was closed by osteoclasia (Fig. 2).

Next, we performed an 'X' suture technique using a number 0 Polysorb suture (Fig. 3), passing proximally through both the MTP joint capsule (Fig. 3A) and the periosteum of the proximal part of the PP. Distally, we included the soft tissues attached to the distal part of the PP and the periosteum itself (Fig. 3B), in a manner similar to that recently described by Zaragoza et al.[16] It is crucial to maintain the correct

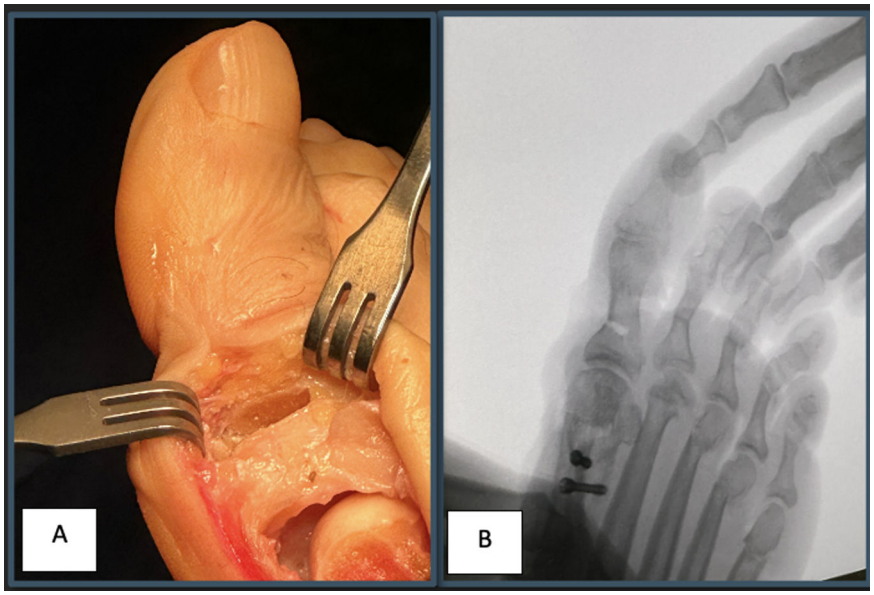

Fig. 2. (A) Intraoperative image showing the AO after wedge removal, following osteoclasia. (B) Radiographic control showing the AO closed by osteoclasia.

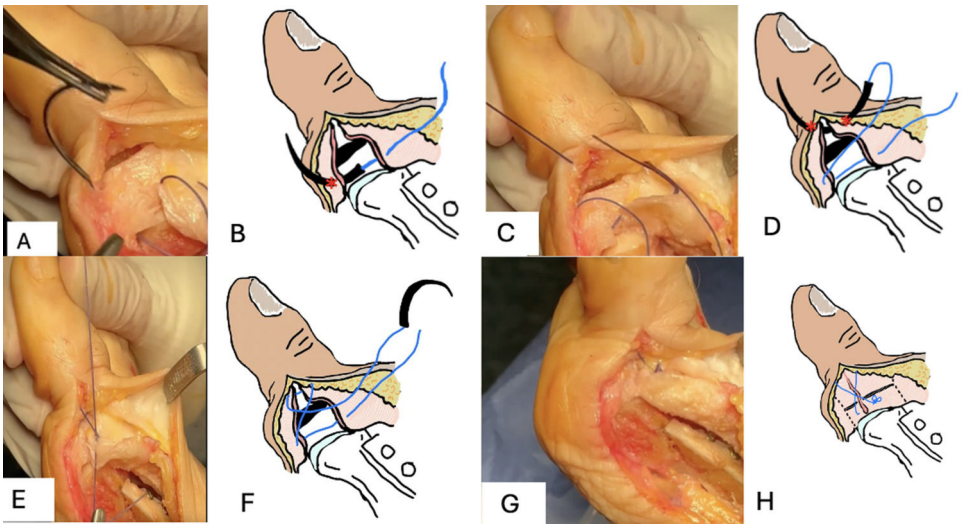

Fig. 3. Intraoperative and schematic image of AO fixation using soft tissue suture, with Polysorb 0 and an 'X' stitch. (A and B) Suture passing through the joint capsule of the MTP joint of the first toe proximal to the AO. (C and D) Suture with an 'X' stitch, proximally through the joint capsule and distally in the tissue surrounding the distal region of the PP. (E and F) Tensioned stitch, closing the AO. (G and H) Knotted and cut stitch.

position of the first toe when fixing the suture, ensuring that the varus and pronation of the first toe are corrected when closing it (Fig. 3C and D). To ensure the effectiveness of this suture technique, it is essential to take a conservative approach to debriding both the MTP joint capsule and the distal area of the PP, while respecting the surrounding soft tissues to enable the closure to be performed with high-quality tissue. Once the AO has been closed with the above-described stitch, the usual medial capsular plication will be performed on the Scarf osteotomy.

Finally, we closed the wound and applied a tie-over bandage to the first toe using adhesive tape made of fabric or silk to maintain the correction obtained by the osteotomy (Fig. 4A–C). After 5–7 days, this bandage was changed for a cohesive thread bandage, maintaining the tie-over bandage for the first toe. This bandage was changed periodically every week or two until 6 weeks had passed.

Once the effect of the locoregional block had worn off, usually 24–36 h, we allowed immediate weight-bearing on the operated foot.

Depending on pain tolerance, weightbearing was protected with crutches and a post-op shoe with a rigid sole for the HV for the first 2 or 3 weeks. After removing the bandage at the sixth week, we allowed the patient to wear their usual footwear, emphasising the importance of shoes with a wide last.

Results

We obtained a sample of 62 feet (36 right and 26 left) from 58 patients who underwent surgery for moderate HV. Of these patients, eight were men (14%) and 50 were women (86%). The mean patient age was 62 years (range 45–79 years). AO was performed in all cases to achieve varisation and pronation of the PP, with soft tissue suturing used to stabilise the osteotomy.

There were no cases of lateral cortical fracture, nor any major post-surgical complications such as surgical wound infection. Three cases (.05%) presented with superficial skin necrosis in the proximal region of the surgical wound without dehiscence occurring. These were all treated with periodic dressings at the clinic, and prophylactic antibiotic

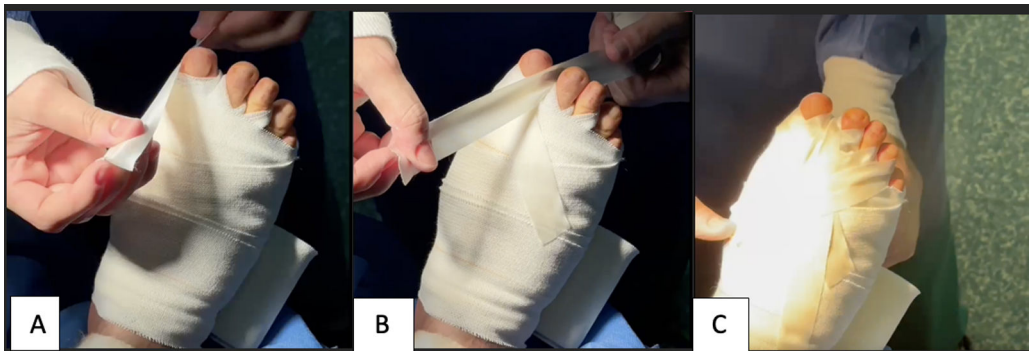

Fig. 4. Intraoperative image of cohesive bandage. (A and B) Fabric adhesive tape is applied to maintain control of the AO. (C) Complete cohesive bandage with fabric adhesive tape on minor radii in a patient who underwent MIS on same.

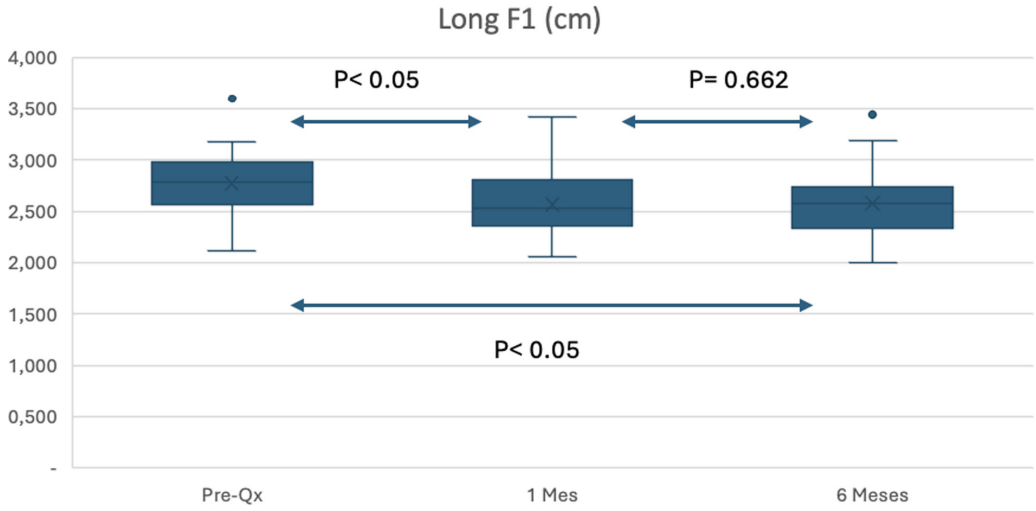

Fig. 5. Whisker plot with the measurement of the DASA angle preoperatively, one month and 6 months after surgery. Long: longitude; PP: proximal phalange.

therapy (ciprofloxacin 500 mg orally) was prescribed until the wound had completely healed.

In our series, all the AO fixed with soft tissue sutures consolidated within an average of 4.5 months (SD: .3). For the patient presenting with a superficial surgical wound infection, the time to osteotomy consolidation was 4.6 months.

The mean preoperative PP length was 2.78 cm (SD: .037); one month after surgery, this decreased to 2.56 cm (SD: .037); at 6 months, it increased slightly to 2.57 cm (SD: .040) (Fig. 5).

Statistically significant differences were obtained between the preoperative DASA (4.33°, SD: 1.15) and one month after surgery (2.20°, SD: 1.05) ($p = .0001$). In contrast, no differences were observed between DASA values one and 6 months after surgery (2.36°, SD: 1.34) ($p = .773$) (Fig. 6).

Thus, we can see that there are statistically significant differences ($p < .05$) in both PP length and DASA values in the preoperative measurements compared to the control at one month, but no statistically significant differences ($p = .662$) between these and the measurements taken 6 months after surgery.

Discussion

In our series, all of the AO fixed with soft tissue sutures consolidated, which is similar to that published in a recent series that also used this type of fixation,[16] as well as in other series in which sutures were performed using transosseous tunnels.[11,19] In our sample, however, we found that the correction obtained during surgery (a statistically significant difference in PP length measurements and the preoperative DASA value compared to at one month following surgery) was maintained after AO consolidation (there were no statistically significant differences in PP length and DASA value at one month compared to measurements 6 months after surgery).

As mentioned in the section on surgical technique, it is essential to perform conservative and careful surgical dissection of the tissues adjacent to the PP in order to create a quality biological remnant at the time of wound closure that will allow for proper suturing and maintain the initial correction obtained with our AO.

It is important to highlight the importance of a thorough physical examination of the patient prior to surgery, both during the consultation and intraoperatively, especially in cases of dystonia or hyperactivity of the extensor hallucis longus, as this would entail a high risk of secondary displacement during the postoperative period of our osteotomy if it is fixed only with absorbable sutures. Excessive traction in extension of the distal part of our PP osteotomy (insertion of the extensor and flexor in the distal phalanx) could not be effectively counteracted by our suture and cohesive tie-over bandage. Conversely, if a very significant varus correction is required, necessitating a medial wedge removal of >4 mm, this could lead to unstable AO requiring osteosynthesis. To provide greater stability, we opted to fix the osteotomy using a cannulated screw or a staple instead of using only soft tissue sutures in both cases.

A series of cases has recently been published comparing AO fixation using plates with soft tissue sutures.[16] The postoperative DASA angle was 1.18° (SD: 2.15) in the group fixed using locked plates and 1.5° (SD: 2.8) in the group fixed using soft tissue sutures. The authors compared the effectiveness of soft tissue suturing with locking plates as a

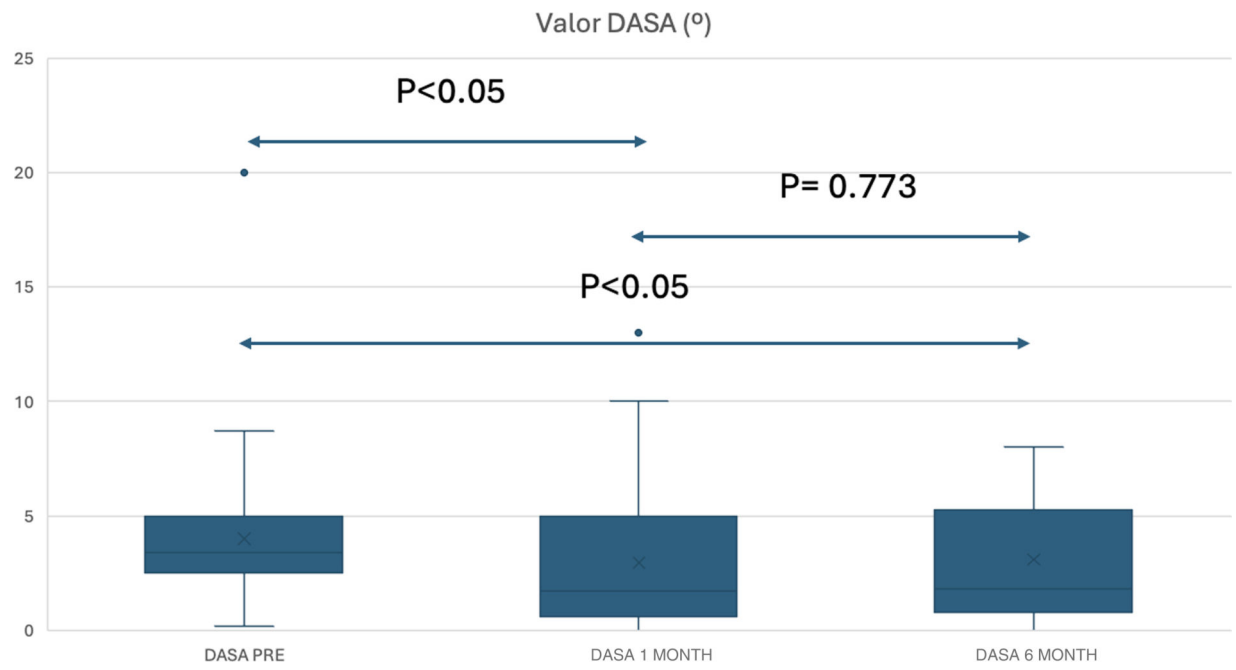

Fig. 6. Whisker plot with the measurement of the DASA angle preoperatively, one month and 6 months after surgery.

method of AO fixation, as they found no statistically significant difference (p = .454) in the correction obtained in DASA angle (6.43° and 7.36°, respectively).

However, unlike in our series, Zaragoza et al.[16] did not analyse whether soft tissue suturing could maintain the correction achieved during surgery. This is because they did not compare measurements taken at two different points during follow-up within the group fixed using soft tissue suturing.

In our patients, the mean time to osteotomy consolidation was 4.5 months. This is similar to the time to consolidation reported by Herrera et al.[20] in their series, in which they observed a delay in AO consolidation when it was performed percutaneously, with a mean time to consolidation of 4.7 months. Like them, we did not perform osteosynthesis of the osteotomy using any implants. In series in which AO fixation is performed using transosseous suture or percutaneous screw, the time to consolidation is somewhat shorter at around 3 months.[11,16,19]

We did not present any cases of lateral cortical fracture during soft tissue osteotomy, which has been reported in various series as a risk factor for secondary displacement and malunion of the osteotomy.[11,21] However, if this were to occur, we believe that the stability provided by our suture technique, combined with the cohesive bandage we apply, would probably prevent any loss of correction.

In cases of skin necrosis, it should be noted that these were proximal to the PP osteotomy and therefore resolved with antibiotic treatment and superficial dressings. However, any dehiscence in the AO area would not have exposed the osteosynthesis material.[16] Zaragoza et al.[16] reported an episode of superficial infection in the group in which they performed fixation using locking plates. This would be consistent with the lower infection rate recorded in series in which fixation is performed using transosseous sutures[11,19] compared to those in which fixation is performed using interfragmentary screws.[22]

One advantage of not using osteosynthesis material is avoiding complications such as mobilisation, implant breakage, and exposure in the event of dehiscence, as well as pain caused by implants.[11–13]

While this is not a cost-effectiveness study, the savings achieved by fixing the osteotomy with an absorbable suture are worth mentioning, as they are greater than those achieved using any type of osteosynthesis available on the market.[11,23] Liszka and Gądek[11] observed lower costs with their transosseous suture technique than with any alternative osteosynthesis system, while Sinnet et al.[23] recorded an overall increase in costs of around £7000 for patients undergoing osteosynthesis. However, none of these studies included the costs of possible second surgeries due to complications related to the osteosynthesis material or its removal. Nor do they include the savings in surgical time resulting from not having to perform osteotomy synthesis with any type of osteosynthesis material.

Limitations

This is a retrospective study with a small sample size, conducted by a single professional at a single centre, so the level of scientific evidence is limited.

Although we only measured the PP in the coronal plane (AP weight-bearing foot X-ray), we believe that variation in the sagittal plane would also be reflected in shortening of our measurement. During clinical follow-up of patients in the clinic, we did not record any loss of correction of pronation of the first toe, thanks to the control primarily exercised by soft tissue suturing and, secondarily, by postoperative tie-over bandages.

Since our intention is to demonstrate the usefulness of soft tissue suture fixation in maintaining the correction obtained through AO, without the creation of bone tunnels, we did not record any radiographic values for the intermetatarsal angles, either preoperatively or postoperatively. Numerous previous publications document the effectiveness of this type of osteotomy within the therapeutic algorithm for HV deformity.[2–10]

Conclusions

As a method of fixing AO, soft tissue suturing is safe, reproducible, quick, and low-cost; it also allows the intraoperative correction to be maintained during the consolidation period, thus avoiding the complications inherent in any osteosynthesis material.

This series demonstrates this type of fixation's ability to maintain the AO correction while the osteotomy consolidates.

To our knowledge, this is the first study to examine the efficacy of this fixation method for AO.

In the future, we believe that randomised clinical trials or multicentre studies with larger sample sizes that include functional scales would be very useful. These studies would confirm and strengthen the validity of the results presented here, thus contributing to a more robust and reliable body of scientific evidence on this technique.

Level of evidence

Level of evidence iv.

Ethical responsibilities

Protection of humans and animals The authors declare that no experiments on humans or animals were performed for this research.

Data confidentiality The authors declare that no patient data appear in this article.

Right to privacy and informed consent The authors declare that no patient data appear in this article.

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Conflict of interests

The authors have no conflict of interests to declare.

References

1. Akin OF. The treatment of hallux valgus: a new operative procedure and its results. *Med Sentin*. 1925;33:678–679.
2. Lai MC, Rikhraj IS, Woo YL, Yeo W, Ng YCS, Koo K. Clinical and radiological outcomes comparing percutaneous Chevron-Akin osteotomies vs open Scarf-Akin osteotomies for hallux valgus. *Foot Ankle Int*. 2018;39:311–317.
3. Kaufmann G, Hofer P, Braito M, Bale R, Putzer D, Dammerer D. Effect of Akin osteotomy on hallux valgus correction after Scarf osteotomy with hallux valgus interphalangeus. *Foot Ankle Int*. 2019;40:1182–1188.
4. Kaufmann G, Hofmann M, Braito M, Ulmer H, Brunner A, Dammerer D. Need for concomitant Akin osteotomy in patients undergoing Chevron osteotomy can be determined preoperatively: a retrospective comparative study of 859 cases. *J Orthop Surg Res*. 2019;14:277.
5. Schilde S, Delank KS, Arbab D, Gutteck N. Minimally invasive vs open Akin osteotomy. *Foot Ankle Int*. 2021;42:278–286.
6. Kurashige T, Suzuki S. Effectiveness of percutaneous proximal closing wedge osteotomy with Akin osteotomy to correct severe hallux valgus determined by radiographic parameters. *Foot Ankle Spec*. 2017;10:170–179.
7. Lewis TL, Ray R, Robinson P, et al. Percutaneous Chevron and Akin (PECA) osteotomies for severe hallux valgus deformity with mean 3-year follow-up. *Foot Ankle Int*. 2021;42:1231–1240.
8. Lam P, Lee M, Xing J, Di Nallo M. Percutaneous surgery for mild to moderate hallux valgus. *Foot Ankle Clin*. 2016;21:459–477.
9. Díaz Fernández R. Percutaneous triple and double osteotomies for the treatment of hallux valgus. *Foot Ankle Int*. 2017;38:159–166.
10. Kaufmann G, Handle M, Liebensteiner M, Braito M, Dammerer D. Percutaneous minimally invasive Akin osteotomy in hallux valgus interphalangeus: a case series. *Int Orthop*. 2018;42:117–124.
11. Liszka H, Gądek A. Comparison of the type of fixation of Akin osteotomy. *Foot Ankle Int*. 2019;40:390–397.
12. Matsumoto T, Takeda R, Maenohara Y, et al. Comparison between suture and staple fixations as internal fixation techniques for Akin osteotomy. *Foot Ankle Surg*. 2022;28:100–106.
13. Montiel V, Suárez Á, Riera L, Villas C, Alfonso M. Akin osteotomy: is the type of staple fixation relevant? *Int Orthop*. 2020;44:1435–1439.
14. Cullen NP, Angel J, Singh D, Burg A, Dudkiewicz I. Fixation of an Akin osteotomy with a tension suture: our results. *Foot (Edinb)*. 2009;19:107–109.
15. Roy SP, Tan KJ. A modified suture technique for fixation of the Akin osteotomy. *J Foot Ankle Surg*. 2013;52:276–278.
16. Zaragoza JM, Wahab Zuriarrain S, López Hervás S, Gamba C, Álvarez Gómez C. A new suture fixation technique for the Akin osteotomy of the proximal phalanx: you don't need any implant. *Foot Ankle Surg*. 2022;28:1399–1403.
17. Eldessouky AH, Khattak MU, Srour AM. Akin osteotomy: a review of modern fixation techniques. *Cureus*. 2024;16:e57026.
18. Barouk LS, Barouk P, Baudet B, Toullec E. The great toe proximal phalanx osteotomy: the final step of the bunionectomy. *Foot Ankle Clin*. 2005;10:141–155.
19. Liszka H, Gądek A. Percutaneous transosseous suture fixation of the Akin osteotomy and minimally invasive Chevron for correction of hallux valgus. *Foot Ankle Int*. 2020;41:1079–1091.
20. Herrera-Perez M, De Prado-Serrano M, Gutiérrez-Morales MJ, Boluda-Mengod J, Pais-Brito JL. Increased rates of delayed union after percutaneous Akin osteotomy. *Foot Ankle Surg*. 2018;24:411–416.
21. Douthett SM, Plaskey NK, Fallat LM, Kish J. Retrospective analysis of the Akin osteotomy. *J Foot Ankle Surg*. 2018;57:38–43.
22. Kerr HL, Jackson R, Kothari P. Scarf-Akin osteotomy correction for hallux valgus: short-term results from a district general hospital. *J Foot Ankle Surg*. 2010;49:16–19.
23. Sinnett T, Fang Y, Nattfogel E, O'Gorman A, Charalambides C. Suture fixation of an Akin osteotomy: a cost-effective and clinically reliable technique. *Foot Ankle Surg*. 2017;23:40–43.