



OPEN VERSUS ARTHROSCOPIC POST TRAUMATIC SUBTALAR JOINT FUSION: A COMPARATIVE STUDY

Mohamed A. Mahmoud Ettawey¹, Hala Abdelaal Ahmed², Ahmed
M. Elhalwagy³, Marwan Shams Eldin Mohamed Yousief⁴

Article History: Received: 10.05.2023

Revised: 28.06.2023

Accepted: 02.07.2023

ABSTRACT

Objectives:

The aim of the study is to compare short term results between open and posterior arthroscopic post traumatic subtalar joint fusion.

Methods: It is a prospective comparative randomized control study of 40 patients suffering from post-traumatic subtalar arthritis admitted to orthopedics and traumatology department of Kasr ALAiny school of medicine, cairo university from January 2018 till January 2020. 20 patients were managed by open fusion (**Group 1**) another 20 patients were managed by arthroscopic fusion (**Group 2**).

Results and conclusions: The present study results demonstrate that both open and arthroscopic techniques are effective for the treatment of post traumatic subtalar joint arthrodesis with minimal complication in both technique. In our study there was marked improvement in The American orthopedic foot and ankle society (AOFAS) score in both groups with P value (0.0001). In our study the mean time for union was (9.85±1.69) in open surgery while in arthroscopic method was (14.05±1.53) with significant P value (<0.0001).

Key words: subtalar arthritis, open fusion, arthroscopic fusion

1 Department of Orthopaedics, Faculty of Medicine, Sohag University, Sohag, Egypt.

2 Department of Microbiology and Immunology, Faculty of Medicine, Sohag University, Sohag, Egypt.

3 Department of Anesthesia and Pain Management- Faculty of Medicine Sohag University, Sohag Egypt.

4 Department of Orthopaedics, Faculty of Medicine, Sohag University, Sohag, Egypt.

*Corresponding author: ettawym@gmail.com

DOI: 10.48047/ecb/2023.12.8.539

Introduction

Subtalar joint arthritis is defined as the degeneration of the posterior articular surface between the talus and calcaneus. Traumatic incidents such calcaneus fractures, talus fractures, and persistent ankle injuries are the most typical causes of subtalar joint arthritis⁽¹⁾. Other reported causes include inflammatory arthritis and primary subtalar joint arthritis. Patients typically complain of subtalar joint pain and edema, which are made worse by uneven surfaces when walking⁽²⁾.

When arthritic changes are present, conservative management which includes activity restriction, the use of drugs (oral NSAIDs or intra-articular steroid injection), comfort footwear, and orthotics is the first line of treatment. When all other treatments fail, surgical intervention is advised⁽³⁾. The accepted procedure is open subtalar arthrodesis using the sinus tarsi technique⁽⁴⁾. Over the past ten years, posterior arthroscopic subtalar arthrodesis has grown in popularity because it requires less downtime and has better cosmetic results and fewer

problems⁽²⁾. however, The literature currently available, is scant on data comparing the results and side effects of open and posterior arthrodesis.

Aim of the Work

The purpose of this study is to compare the short term clinical , radiological and functional results of patients suffering from post traumatic subtalar joint arthritis whose undergoing either open subtalar arthrodesis or posterior arthroscopic arthrodesis.

Material and methods

The current study is a prospective comparative randomized control study of patients admitted to orthopedics and traumatology department of Kasr ALAiny school of medicine, cairo university. The study was conducted on 40 patients suffering from post-traumatic subtalar joint arthritis from January 2018 till January 2020. 20 patients were managed by open fusion(**Group 1**) another 20 patients were managed by arthroscopic

fusion(**Group 2**) Simple randomization method was used which is shuffled deck of card (eg , even=**group 1** and odd=**group 2**).

Patient included in the study were post traumatic subtalar arthritis (Type 1 and 2 according to Zwipp and Rammelt classification of malunited

fracture calcaneus ⁽⁵⁾ Right , left or bilateral and male or female . With exclusion of patients with Inflammatory arthritis , Neuromuscular dysfunction , Talo calcaneal coalation , Subtalar impingement ,deformity , local sepsis and Skeletally immature patients . An

Operative Technique

Open method

Anesthesia and positioning

The patient was given appropriate preoperative antibiotic within 1 h of incision time.

Spinal or General anesthesia were used. A tourniquet was placed on the upper thigh. The patient was positioned in the lateral decubitus position.

Approach and exposure

Bony landmarks are marked out on the skin with a marker, and a curvilinear incision was marked out from the distal aspect of the fibula down toward the base of the fourth metatarsal. The skin was

incised with a 15-blade scalpel. Electrocautery was used to go through crossing veins. The extensor digitorum brevis was then encountered; this is carefully elevated with a distally based flap/pedicle so as to preserve its blood supply. The peroneal tendons was retracted posteriorly and distally. Access to the sinus tarsi was then possible. A rongeur was used to remove the fat from this area. At this point, the interosseous talocalcaneal ligament was visible and should be removed to allow greater distraction and visualization of the joint. The subtalar joint can then be entered and distracted. A lamina spreader or Hintermann distractor using Kirschner wires (K-wires) can be used.



Figure (1): Intraoperative photography showing skin incision and joint preparation of open method.

Joint preparation

All articular cartilage of the posterior and middle facets must be removed. The soft tissue and the cortical bone of the sinus tarsi should also be removed, creating a greater surface area for fusion, which is accomplished with a combination of curettes and the use of an osteotome to remove the subchondral bone. The joint is then thoroughly irrigated to remove all debris and small cartilage segments . A drill is then used to penetrate the bony surfaces down to bleeding bone. Bone graft can then be used.

The patient was brought to the operative theater and placed prone on the table. Preoperative prophylactic antibiotics were administered within 1 h of incision time. Patient received either general or spinal anaesthesia. A thigh tourniquet was placed.

Arthroscopic method

Surgical Instruments and Implants :

The arthroscopic equipment necessary to perform this procedure includes a 4 mm, 30 degree arthroscope with camera and appropriate video equipment, shavers, burrs, curettes, osteotomes, an image intensifier, and 6.5or 7.3 cannulated compression screws.

Portals

Two portals was created on either side of the Achilles tendon .The distal tip of the lateral malleolus was identified, and a line was drawn parallel to the sole of the foot from the lateral malleolus across the Achilles tendon. The portals were placed immediately proximal to this line just medial and lateral to the Achilles .

Anesthesia and positioning

Exploration and joint surface preparation

Identification of the joint line starting on the posterolateral portal which was performed with a skin incision and a blunt dissection of the subcutaneous tissue with a mosquito clamp or a trocar directed towards the big toe. Then posromedial portal was performed .The most important anatomical landmark was the flexor

hallucis longus tendon, which marks the medial boundary of the working area with this technique. This tendon was easier to visualize after first identifying the belly of the muscle immediately proximal to the posterior talar process .

The cartilage was resected by alternating between the blade, burrs, curette, and chisels. The

entire posterior subtalar surface is progressively visualized, in a posterior to anterior direction, until inter-osseous talo-calcaneal ligament was reached. The surfaces were prepared down to the subchondral bone. Once fully prepared, the surfaces were perforated to promote bone fusion .

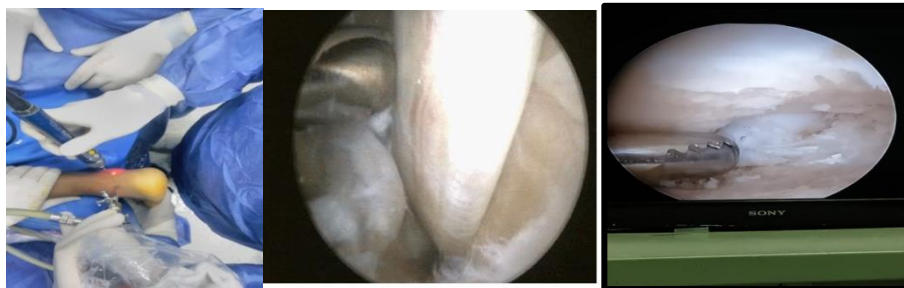


Figure (2): Intraoperative photography showing portals of posterior arthroscope , FHL tendon and joint preparation

Fixation

Regardless of the technique used either open or arthroscopic , fixation was achieved with two cannulated screws 6.5 or 7.3 inserted into the calcaneus and talus in a neutral position or 5 degree valgus .Two pins were inserted into the calcaneal

tuberosity , in an upwards and anterior direction, to the superior surface of the calcaneus, under fluoroscopic guidance. The goal was to obtain a direction perpendicular to the posterior subtalar surface in order to maximize the compressive forces.



Figure (3): AP , lateral and axial view final follow up (6 month) open method



Figure (4): Ap , lateral view final follow up(6 month) arthroscopic method.

Postoperative Protocol:

Weeks 0 to 2: the patient is immobilized and kept non-weight bearing in a short leg splint. The

wounds are checked at 10 to 14 days and the sutures removed.

Weeks 3 to 6: the patient is kept non-weight bearing in below knee cast. At 6 weeks, the patient was seen

in the office and radiographs are obtained (AP, lateral, and mortise views of the ankle)

Weeks 7 to 12: as long as adequate healing was suspected at the 6-week postoperative visit, the patient was allowed to begin progressive partial weight bearing in a boot. Physical therapy was started after the 6-week visit. The patient was seen in clinic again at 12 weeks after surgery, and repeat

radiographs were obtained. If solid fusion was noted, full weight bearing was allowed out of the boot and the patients could return to daily activities. Follow up x-ray is done at 6 weeks, 12 weeks and 6 months.

Postoperative assessment is done using AOFAS scoring system after 6 months as a final assessment of patient post operatively.

Results:

Statistical analysis

Data was analyzed using STATA version 14.2 (Stata Statistical Software: Release 14.2 College Station, TX: Stata ++Corp LP.). Quantitative data was represented as mean, standard deviation, median and interquartile range. Data was analyzed using student t-test to compare means of two groups if data was normally distributed. When the data was not normally distributed, or data was ordinal scale Kruskal Wallis test for comparison Mann-Whitney test was used. Wilcoxon matched pairs signed rank test was used to compare preoperative and post-operative data. Qualitative data was presented as

number and percentage and compared using either Chi square test or fisher exact test. Graphs were produced by using Excel or STATA program. P value was considered significant if it was less than 0.05.

The mean age of our study was (36.25±12.02). 28 patients (70%) were males and 12 patients (30%) were females. Most of the cases suffering from post-traumatic sub talar joint arthritis (fracture calcaneous) either right side 21 patients and left side 19 patients. About (55%) of our patients were smokers and the rest were nonsmokers(45%).

Table 1: Characteristics of studied population

Variable	Summary statistics
Age/years Mean (SD) Median (IQR)	36.25±12.02 34 (27.5:46)
Gender Female Male	12 (30.00%) 28 (70.00%)
Smoking No Yes	22 (55.00%) 18 (45.00%)
DM No Yes	30 (75.00%) 10 (25.00%)
Side of fracture Left Right	19 (47.50%) 21 (52.50%)
Type of surgery Arthroscopic Open	20 (50.00%) 20 (50.00%)

SD=standard deviation, IQR=interquartile range

The mean age in case open fusion were 39.25±11.76 ranging from 17 years to 55 years . While the mean in case arthroscopic fusion

33.25±11.80 ranging from 17 years to 55 years. In both groups 14 patients (70 %) were males and 6 patients (30 %) were females .In open method 10

patient were smokers and another 10 patient were nonsmokers while in arthroscopic method 8 patients only were smokers. In open method 10 patients were suffering from subtalar joint arthritis in the left side and 10 patients in right side while in arthroscopic method 9 patients in left side and 11 patients in right side.

The mean operative time as regard open surgery 84.8 ± 8.39 ranging from (70 min to 100 min) while the mean operative time as regard arthroscopic surgery 98.75 ± 6.04 ranging from (90 in to 110 min).

P value showed significant variation between both procedure (<0.0001).

In our study there was marked improvement in the American orthopedic foot and ankle society (AOFAS) score in both groups with P value (0.0001).

In our study the mean time for union was (9.85 ± 1.69) in open surgery ranging from (7weeks to 13 weeks) while in arthroscopic method was (14.05 ± 1.53) ranging from (12 to 18 weeks). With significant P value (<0.0001).

Table 2: Comparison between arthroscopic and open surgery as regard patient characteristics

Variable	Arthroscopic surgery N=20	Open surgery N=20	P value
Age/years Mean (SD) Median (IQR)	33.25 ± 11.80 31.5 (25:41)	39.25 ± 11.76 40 (31:49.5)	0.10
Gender Female Male	6 (30.00%) 14 (70.00%)	6 (30.00%) 14 (70.00%)	1.00
Smoking No Yes	12 (60.00%) 8 (40.00%)	10 (50.00%) 10 (50.00%)	0.53
Side of fracture Left Right	9 (45.00%) 11 (55.00%)	10 (50.00%) 10 (50.00%)	0.75

Table 3: Comparison between arthroscopic and open surgery

	Arthroscopic surgery N=20	Open surgery N=20	P value
operative time	98.75 ± 6.04 100 (95:100)	84.8 ± 8.39 84 (80:91.5)	<0.0001
Pre-operative total score Mean (SD) Median (IQR)	36.95 ± 12.88 32 (25:49)	39.9 ± 12.56 39.5 (28:49.5)	0.46
Post-operative total score Mean (SD) Median (IQR)	83.15 ± 8.16 85 (76.5:91)	82.85 ± 6.32 83.5 (79.5:88.5)	0.71
P value compared post-operative and pre-operative	0.0001	0.0001	
Difference in total score (post-pre) Mean (SD) Median (IQR)	42.2 ± 10.65 47 (38:52)	42.95 ± 10.46 45.5 (35:51.5)	0.58
Time till union/week Mean (SD) Median (IQR)	14.05 ± 1.53 14 (13:15)	9.85 ± 1.69 10 (8:11)	<0.0001

In our study 14 cases (70.00%) case showed no complication in case of open group and 16 cases(80.00%) cases in arthroscopic group showed no complication . While 6 cases (30.00%) in open group showed complication in form of

Infection(2 cases), Nerve injury(1 cases) , Painful scar (1 cases) and painful screws(2cases). While in arthroscopic group 4 cases (20.00%) showed complication in the form of Delayed union(2 cases) and Painful screws (2cases)

Table 14: Comparison between arthroscopic and open surgery as regard complications

Variable	Arthroscopic surgery N=20	Open surgery N=20	P value
Complication			
No	16 (80.00%)	14 (70.00%)	0.49
Yes	4 (20.00%)	6 (30.00%)	
Type of complication			
Delayed union	2 (10.00%)	0	0.11
Infection	0	2 (10.00%)	0.11
Nerve injury	0	1(5.00%)	0.65
Painful scar	0	1 (5.00%)	0.65
Painful screws	2 (10.00%)	2(10.00%)	0.00

Discussion

Subtalar fusion is the treatment of choice for subtalar arthritis when conservative management fails. The procedure can be performed arthroscopically or through the open lateral sinus tarsi approach. The arthroscopic technique is less invasive and is associated with rapid recovery, but it is more technically challenging ⁽⁶⁾.

The present study results demonstrate that both open and arthroscopic techniques are effective for the treatment of post traumatic subtalar joint arthritis.

In our study the mean time for union was (9.85±1.69 weeks) in open surgery ranging from (7weeks to 13 weeks) while in arthroscopic method was (14.05±1.53 weeks) ranging from (12 to 18 weeks).With significant P value (<0.0001). The union time was significantly shorter in the open group than in the arthroscopic group.

These results are against *Davies et al* , *Flemister,etal* and *Mann,etal* that reported a union time of 12 to 16 weeks with the open technique ^(7,8,9) and *Amendola,etal*, *Beimers,etal* , *Lee,etal* , *Oliva,etal* , *Rungprai,etal* and *Tasto,etal* reported

that union time was 6 to 15 weeks with the arthroscopic technique ^(10,11,12,13,14,15). This may be due to The sinus tarsi approach yielded significantly greater total subtalar joint preparation compared to the arthroscopic approach.

This is not surprising due to the nature of the open technique, which provides greater accessibility to the joint. This may be a consequence of a lack of distraction applied to the joint, limited visualization with use of only two portals during the arthroscopic procedure, or inherent difficulty with reaching the anterolateral corner of the calcaneus for preparation due to its topographic irregularity and in open method we can use bone graft to enhance fusion rate .

The technical demand is comparable between both techniques, as determined on the basis of operative time. In the present study, The mean operative time as regard open surgery 84.8±8.39 min ranging from (70 min to 100 min) while the mean operative time as regard arthroscopic surgery 98.75±6.04 min ranging from (90 in to 110 min). P value showed significant variation between both procedure (<0.0001).

The longer operative time with the arthroscopic technique can be attributed to the debridement of the posterior soft tissue or large osteophyte that blocks the entry to the posterior part of the subtalar joint which is very common in cases of post traumatic arthritis and The learning curve might be steep during early periods of practice; however, the feasibility of performing the procedure with appropriate operative time increases as surgeons gain experience ⁽⁶⁾.

Both open and arthroscopic techniques led to significant improvements in all functional outcomes compared to the preoperative status; however, there was no significant difference between the 2 techniques in these outcomes. In our study there was marked improvement in The American orthopedic foot and ankle society (AOFAS) hind foot score in both groups where the mean score pre-operative was (39.9±12.56) and final follow up became (82.85±6.32) in open group, while in arthroscopic group the mean score was(36.95±12.88) and became(83.15±8.16) . **Flemister,etal** , **Carranza-Bencano,etal**, **Easley,etal**, **Yildirim,etal** reported that the mean improvements following the open technique were 31 to 75 points in the American Orthopaedic Foot & Ankle Society (AOFAS) hindfoot score ^(8,22,4,16). Furthermore, **Amendola,etal**, **Lee,etal**, **Albert,etal**, **Bevernage,etal** reported that the mean improvements following the arthroscopic technique were 31 to 75 points in the AOFAS hindfoot score ^(10,12,17,18).

Both arthroscopic and open subtalar arthrodesis are successful treatments for subtalar arthritis and are associated with minimal complications. **Easley,etal** ,**Walter RP ,etal** , and **Scranton PE Jr** reported that wound infection in open technique of 1.3%, sural nerve injury rate of 1.3% to 11%,and screw head irritation rate of 4% to 24% ^(4,19,20) .

The complication rate observed in the open group in the present study is similar to that reported in a previous study in which 2 cases (10 %) experienced hardware irritation, necessitating screw removal; all patients were pain free after screw removal. In addition, 2 (10%) patient developed superficial wound infection, which resolved after 2 weeks of oral antibiotic treatment; furthermore, 1 (5%) patients experienced sural nerve dysesthesia and another case (5 %) had a painful scar . Careful dissection of the soft tissue must be performed to prevent damage to the sural nerve. However, the nerve might have been injured due to traction or manipulation, resulting in dysesthesia. however their condition spontaneously resolved within 6 months.

Lee,etal , **Thaunat , etal** , **Easley,etal** and **Scranton PE Jr** reported that arthroscopic subtalar *Eur. Chem. Bull.* **2023**,12(issue 8), 6699-6706

fusion have a wound complication rate of up to 6% ⁽¹²⁾ tibial nerve injury rate of 7%, ⁽²¹⁾ and screw head irritation rate of 6% to 13% ^(4,20) .

In the present study (10%) patients experiencing hardware irritation in the arthroscopic group required hardware removal but all patients were pain free after screw removal and another (10%) showed delayed union.

No neurovascular injuries or other wound complications following arthroscopic fusion were observed in this study. To prevent injury to the neurovascular structures while performing posterior subtalar arthroscopy, surgeons must always identify and use the FHL tendon as the medial-most boundary and not pass any instruments, use cautery, or perform debridement beyond this tendon. In addition, screw head irritation can be prevented by using a countersunk screw and inserting it into non weight bearing areas; however, screw head irritation remains the most common complication and is correlated with the type and level of postoperative activity ⁽⁶⁾.

Conclusion:

The present study results demonstrate that both open and arthroscopic techniques are effective for the treatment of post traumatic subtalar joint arthrodesis. The union rate was 100% in both technique but The union time was significantly shorter in the open method. Both open and arthroscopic techniques led to significant improvements in all functional outcomes , including the American Orthopedic Foot & Ankle Society (AOFAS) hind foot score , compared to the preoperative status; however, there was no significant difference between the two techniques in these outcomes. Both arthroscopic and open subtalar arthrodesis are successful treatments for post traumatic subtalar arthritis and are associated with minimal complications.

References:

1. Ficke J, Byerly DW. Anatomy, Bony Pelvis and Lower Limb, Foot. InStatPearls 2021 Aug 11. StatPearls Publishing. Accessed 7 June 2022.
2. Rungprai, C., Phisitkul, P., Femino, J. E., Martin, K. D., Saltzman, C. L., & Amendola, A. (2016). Outcomes and complications after open versus posterior arthroscopic subtalar arthrodesis in 121 patients. *JBJS*, 98(8), 636-646.
3. Joseph D, et al. Ankle Arthrodesis Nailing System. [Internet]. Stryker Trauma GmbH 2009.
4. Easley, M. E., Trnka, H. J., Schon, L. C., & Myerson, M. S. (2000). Isolated subtalar arthrodesis. *JBJS*, 82(5), 613.
5. Zwipp, H., & Rammelt, S. (2003). Posttraumatic deformity correction at the foot. *Zentralblatt für Chirurgie*, 128(3), 218-226.

6. Rungprai, C., Jaroenarpornwatana, A., Chaiprom, N., Phisitkul, P., & Sripanich, Y. (2021). Outcomes and Complications of Open vs Posterior Arthroscopic Subtalar Arthrodesis: A Prospective Randomized Controlled Multicenter Study. *Foot & Ankle International*, 42(11), 1371-1383.
7. Davies, M. B., Rosenfeld, P. F., Stavrou, P., & Saxby, T. S. (2007). A comprehensive review of subtalar arthrodesis. *Foot & ankle international*, 28(3), 295-297.
8. Flemister, A. S., Infante, A. F., Sanders, R. W., & Walling, A. K. (2000). Subtalar arthrodesis for complications of intra-articular calcaneal fractures. *Foot & ankle international*, 21(5), 392-399.
9. Mann, R. A., Beaman, D. N., & Horton, G. A. (1998). Isolated subtalar arthrodesis. *Foot & ankle international*, 19(8), 511-519.
10. Amendola, A., Lee, K. B., Saltzman, C. L., & Suh, J. S. (2007). Technique and early experience with posterior arthroscopic subtalar arthrodesis. *Foot & ankle international*, 28(3), 298-302.
11. Beimers, L., De Leeuw, P. A., & Van Dijk, C. N. (2009). A 3-portal approach for arthroscopic subtalar arthrodesis. *Knee Surgery, Sports Traumatology, Arthroscopy*, 17(7), 830-834.
12. Lee, K. B., Park, C. H., Seon, J. K., & Kim, M. S. (2010). Arthroscopic subtalar arthrodesis using a posterior 2-portal approach in the prone position. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*, 26(2), 230-238.
13. Oliva, X. M., Falcão, P., Cerqueira, R. F., & Rodrigues-Pinto, R. (2017). Posterior arthroscopic subtalar arthrodesis: clinical and radiologic review of 19 cases. *The Journal of Foot and Ankle Surgery*, 56(3), 543-546.
14. Rungprai, C., Phisitkul, P., Femino, J. E., Martin, K. D., Saltzman, C. L., & Amendola, A. (2016). Outcomes and complications after open versus posterior arthroscopic subtalar arthrodesis in 121 patients. *JBJS*, 98(8), 636-646.
15. Tasto, J. P. (2006). Arthroscopy of the subtalar joint and arthroscopic subtalar arthrodesis. *Instructional*
16. Yildirim, T., Sofu, H., Çamurcu, Y., Özcan, Ç., Öner, A., & Şahin, V. (2015). Isolated subtalar arthrodesis. *Acta Orthop Belg*, 81(1), 155-60.
17. Albert, A., Deleu, P. A., Leemrijse, T., Maldague, P., & Bevernage, B. D. (2011). Posterior arthroscopic subtalar arthrodesis: ten cases at one-year follow-up. *Orthopaedics & Traumatology: Surgery & Research*, 97(4), 401-405.
18. Bevernage, B. D., Goubau, L., Deleu, P. A., Gombault, V., Maldague, P., & Leemrijse, T. (2015). Posterior arthroscopic subtalar arthrodesis. *JBJS Essential Surgical Techniques*, 5(4).
19. Walter RP, Walker RW, Butler M, Parsons S. Arthroscopic subtalar arthrodesis through the sinus tarsi portal approach: a series of 77 cases. *Foot Ankle Surg*. 2018;24(5):417-422.
20. Scranton PE Jr. Comparison of open isolated subtalar arthrodesis with autogenous bone graft versus outpatient arthroscopic subtalar arthrodesis using injectable bone morphogenic protein-enhanced graft. *Foot Ankle Int*. 1999;20(3):162-165.
21. Thaunat M, Bajard X, Boisrenoult P, Beaufile P, Oger P. Computer tomography assessment of the fusion rate after posterior arthroscopic subtalar arthrodesis. *Int Orthop*. 2012;36(5):1005-1010.
22. Carranza-Bencano, A., Tejero-García, S., Del Castillo-Blanco, G., Fernández-Torres, J. J., & Alegrete-Parra, A. (2013). Isolated subtalar arthrodesis through minimal incision surgery. *Foot & Ankle International*, 34(8), 1117-1127.