

tps://doi.org/10.21608/zumj.2025.360379.3840

Manuscript ID: ZUMJ-2502-3840 DOI:10.21608/zumj.2025.360379.3840 ORIGINAL ARTICLE

# Clinical and Radiological Outcomes of Isolated Subtalar Arthroereisis in Pediatric Flexible Flatfoot: A Prospective Cohort Study

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\* Department of Orthopedics, Zagazig University, Zagazig, Egypt. Corresponding author: ABSTRACT

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Submit Date:15-02-2025 Revise Date:19-02-2025 Accept Date:20-02-2025 **Background:** Painful flexible flat foot is a common pediatric foot problem result in longstanding arthritic changes in subtalar joint complex. Use of subtalar arthroereisis screw can prevent excess calcaneal eversion and restore normal subtalar biomechanics. **Methods:** Thirty feet in 15 patients with symptomatic flexible flat feet between 5-12 years (11males and 4 females). Subtalar arthroereisis screw was used in all cases through direct lateral mini-sinus tarsi incision. We used the AOFAS and VAS for clinical evaluations. The talo-calcaneal angle, Meary's angel, calcaneal valgus angle and calcaneal pitch angle were used for radiological evaluations.

**Results:** Thirty feet were followed up for 18 months, preoperative pain was improved from  $3.29 \pm 1.49$  to  $0.45 \pm 0.49$  postoperative according to the Visual analogue scale (VAS) also the American orthopedic foot and ankle score (AOFAS) was improved from 70.87  $\pm$  2.69 to 95.4  $\pm$  3.55 postoperative. Postoperative complications: one foot with screw subluxation after 4 weeks and one foot with superficial infection treated with proper antibiotics.

**Conclusion**:Subtalar arthroereisis screw is a mini-invasive procedure effective in treating symptomatic flexible flat foot with correction of heel valgus and restoration of the foot arch.

Key words: Outcomes, Subtalar, Arthroereisis, Pediatric, Flatfoot.

# **INTRODUCTION**

Flat foot is a common pediatric problem in which there is collapse of the medial longitudinal arch together with forefoot abduction and heel valgus. Mobility of the subtalar joint complex is the most important factor in treatment strategy than the shape of the foot. Restoration of the medial longitudinal arch with heel raising or with dorsiflexion of big toe the deformity is considered flexible (1).

Many treatment strategies are present for management of symptomatic flexible flat foot, soft tissue procedures (as peroneus brevis and Achilles tendon lengthening) usually done with bony re-alignment osteotomies (as anterior calcaneal osteotomy). Triple arthrodesis is used for flat foot associated with arthritic changes of the subtalar joint complex (2-5). The use of peg screw in sinus tarsi through small incision either inserted in calcaneus supporting talus (calcaneal stop screw) or through the tarsal canal (Subtalar arthroereisis; in Greek letter arthro means joint and ereis means to raise up. So this screw is introduced in subtalar joint to raise and support the talus to realign the medial foot arch and correct the flat foot), the subtalar arthroereisis screw aim to prevent excess calcaneal eversion and talar adduction and planter flexion during weight bearing (6).Our hypothesis is that the arthroereisis screw can prevent excess calcaneal external rotation and support talus during weight bearing thus restoring the normal biomechanics of the subtalar joint. The aim of this study to evaluate the clinical and radiological outcomes of subtalar arthroereisis in pediatric patients with symptomatic flat foot.

# Methods

Thirty feet of symptomatic flexible flat feet between 5 to 12 years after failure of conservative treatment measures for 6 months without any foot and ankle osteoarthritic changes and no previous ankle and foot surgeries were included in this study from June 2017 and November 2022 with a mean follow up period of 18 months. Patients younger than 5 years and older than 12 years, patients with rigid flat foot or post-traumatic flat foot, cases with associated neuromuscular or neurological diseases were excluded from this study. A cannulated T.Carefix® titanium made subtalar arthroereisis screw is used in all cases (figure 1).

*Ethical consideration:* A written informed consent was taken from the patient's parents with explanation of the procedure, possible hazards& IRB in our institution approval was attained (993 /1-1-2025).

Follow up technique: All patients will be subjected to the following: A complete and detailed history taking, clinical evaluation: The American orthopedic foot and ankle score (AOFAS), Visual analogue scale for pain subtalar and ankle joints mobility, (VAS), forefoot abduction, heel valgus, and Achilles tendon shortening And radiological evaluation: Standing X-ray (AP & lateral views) for ankle joint and foot for evaluation of Talo-calcaneal angle (the angle between the longitudinal axis of talus and longitudinal axis of the calcaneus), Meary's angel (the angle between the longitudinal axis of talus and longitudinal axis of first metatarsal in lateral X-ray of foot), Calcaneal valgus angle (the angle between the calcaneal bisector line and the tibial middiaphyseal line)) and Calcaneal pitch angle (the angle between the calcaneal inclination axis and the horizontal surface) (figure 2). CT scan of the ankle and foot for screw position, subtalar correction and detection of any possible complications(osteolysis, arthritis or screw displacement). Evaluation was done monthly for the first 6 months then every 3 months for 18 months.

*Surgical technique:* Under spinal anesthesia, pre-operative antibiotic prophylaxis for all

patients, pneumatic tourniquet is applied to the thigh. The patient is placed in lateral decubitus position with the operated side above. Achilles tendon is tested for shortening, if short gastrocnemius recession is done through posterior midline skin incision.

A straight skin incision is made over sinus tarsi marked with the C arm. Dissection of the deep fascia then the extensor digitorum brevis muscle is dissected and retracted. Blunt dissection of the sinus tarsi, guide wire is inserted in sinus tarsi from lateral to medial under c arm guide. Then the trial is made until suitable size is reached allowing for 4-5 degree of subtalar joint eversion (figure 3). The final position of the screw is checked under C arm (in lateral view centered in sinus tarsi, in AP view the screw shouldn't extend beyond the midline of talus and 1-1.5 cm from lateral calcaneal wall) (figures 4& 5). The foot is locked in valgus and the screwdriver is removed (to prevent the screw from coming out). The wound is closed in layers. Postoperative: Soft bandage for the foot without casting, removal of sutures after 2 weeks. passive ankle motions were encouraged from the first day. Assisted weight bearing is allowed at 2 weeks by the patient, full weight bearing at 3 to 4 weeks. Clinical and radiological evaluations were done 2 weeks post-operative and then monthly for 6 months then every 3 months (table 1) & (figure 6).

**STATISTICAL ANALYSIS**: The collected data were presented using the mean  $\pm$  standard deviation (SD) and range for quantitative variables, while frequency and percentage were used for qualitative variables. All statistical analyses were performed using SPSS software version 21 (SPSS Inc., Chicago, IL, USA).

# RESULTS

Thirty feet in 15 patients (11 males and 4 females) with flexible flat foot underwent surgical treatment with subtalar arthroereisis after failure of conservative measures (weight reduction, foot insole and muscle strengthening exercises especially on gastrocnemius and peroneal muscles). Lateral decubitus position and standard lateral approach was used in all cases about 2 cm over sinus tarsi. Sutures were

#### https://doi.org/10.21608/zumj.2025.360379.3840

removed at  $12\pm 2$  days except in one foot with superficial infection (removed at  $16^{\text{th}}$  day) treated by repeated dressing and antibiotics. We start partial weight bearing at 2 weeks and full weight bearing at 4 weeks, strenuous activities after 3 months all patients retain to sport activities within  $9\pm 2.1$  months. All cases were followed for a mean of 18 months, and preoperative pain was reduced from  $3.29 \pm 1.49$ to  $0.45 \pm 0.49$  postoperative according to VAS. Clinical evaluations were improved from 70.87  $\pm 2.69$  to  $95.4 \pm 3.55$  postoperative according to the AOFAS system (table 1). based on radiological data preoperative mean of RT side

Meary's angle was improved from  $18.77 \pm 6.76$ to  $9.6 \pm 5.1$  postoperative (table 2), and LT side from 19.60  $\pm$  6.88 to 9.84  $\pm$  4.98, also data preoperative mean of RT side Talo-calcaneal angle was improved from  $34.15 \pm 5.99$  to 24.16 $\pm$  5.1 postoperative and LT side mean was improved from  $37.33 \pm 6.90$  to  $26.85 \pm 4.9$ postoperative. As regard postoperative complications one foot presented with superficial infection and one foot with screw back slippage after one month treated with readjustment again.

**Table 1:** Clinical evaluations at preoperative period compared to final follow up data.

Clinical score	Pre-operative	Post-operative
	Mean ± SD	Mean ± SD
VAS	3.29 ± 1.49	0.45 ± 0.49
AOFAS	70.87 ± 2.69	95.4 ± 3.55

**Table 2:** Preoperative radiological data collect and compared with postoperative results.

Radiological angles	Side	Pre-operative	Post-operative
		Mean ±SD	Mean ±SD
Meary's angle (°)	RT	18.77 ± 6.76	9.6 ± 5.1
	LT	19.60 ± 6.88	9.84 ± 4.98
Talo-first metatarsal angle in AP view (°)	RT	14.2 ± 3.2	4.2 ±2.3
	LT	15.12 ± 2.2	4.9 ± 3.4
Talo-calcaneal angle (°)	RT	34.15 ± 5.99	24.16 ± 5.1
	LT	37.33± 6.90	26.85 ± 4.9
Calcaneal valgus angle (°)	RT	17.2 ± 5.9	6.66 ± 4.1
	LT	16.96 ± 5.9	4.56 ± 3.1



**Figure (1):** A cannulated T.Carefix® titanium made subtalar arthroereisis screw, B: Arthroereisis screw instrument set.Standing lateral X-ray of foot and ankle shows collapse of medial arch with increased both Meary's angle(the angle between the longitudinal axis of talus and longitudinal axis of first metatarsal) and Talo-calcaneal angle(the angle

between the longitudinal axis of talus and longitudinal axis of the calcaneus) and reduced calcaneal pitch angle (the angle between the calcaneal inclination axis and the horizontal surface): (A: Tibio-talar angle, B: Meary's angle, C: Talo-calcaneal angle and D: Tibio-calcaneal angle)



Figure (2): A dilator is inserted in sinus tarsi over a guide wire



.Figure (3): Final screw position that allow for 5 degree of calcaneal eversion



Figure (4): Screw position in AP ankle view should not extend beyond the talar midline.



#### Figure (5): CT scan of ankle with ideal screw position with no displacement or talar osteolysi

#### DISCUSSION

Children with flexible flat foot having more mobility in subtalar joint resulting in exaggerated valgus position of heel and stretched medial ligaments, more collapse of medial arch, talonavicular lateral sublaxation and abduction of the forefoot (7).Many previous operations aim to prevent excess calcaneal eversion and hind foot valgus as, Chambers 1946 who used implant autologous bone\_in sinus tarsi and Grice 1952, with extra-articular subtalar fusion in children. But all these maneuvers block the subtalar motion and produce degenerative changes in subtalar joint (7).

The aim of the arthroereisis screw is to limit excess subtalar motion, bony and soft tissue realignment during patient's development. At least two years is needed for this process to happen, so it is advised under the age of 12 years for enough time for bony remodeling (8).

All patients in this study conservative treatment is tried first for 6 months. All patients were instructed for activity modifications, weight reduction in obese patients, soft foot insole and physiotherapy strengthening and stretching gastrocnemius and peroneal muscles.

We use crepe bandage without cast in postoperative period, early ankle and foot motion is encouraged. Partial weight bearing is started at 2 weeks and full weight bearing was at 4 weeks. All patients retrain to sport activities at a mean of  $9 \pm 2.1$  months.

We use a T.Carefix® titanium made arthroereisis screw (with high tensile strength, low modulus of elasticity, corrosion resistance, remarkable biocompatibility and suitable for later MRI evaluation if needed) with a conical shape to be fitted well in tarsal canal.

In our study clinical evaluation is done by pain grade with VAS system and function by AOFAS. according to VAS pain was reduced from preoperative  $3.29 \pm 1.49$  to  $0.45 \pm 0.49$  postoperative. Foot function was improved from 70.87  $\pm$  2.69 preoperative to 95.4  $\pm$  3.55 postoperative.

Early screw removal may affect the final degree of foot correction to some extent but without loss of corrected foot position with good final result (9).

Position of the screw and its size is an important factor for deformity correction and development of complication, suitable size screw allow for 4-5 degree of calcaneal eversion and its ideal site must be checked with C arm in lateral and anteriorposterior views (8)

Radiological parameters in this study were improved during the postoperative follow up period. The preoperative mean of RT Meary's angle was improved from  $18.77 \pm 6.76$  to  $9.6 \pm 5.1$  postoperative, and LT mean side from  $19.60 \pm 6.88$  to  $9.84 \pm 4.98$ . The RT side preoperative mean of Talo-calcaneal angle was improved from  $34.15 \pm 5.99$  to  $24.16 \pm 5.1$  postoperative and LT side mean was improved from  $37.33 \pm 6.90$  to  $26.85 \pm 4.9$ 

Volume 31, Issue 4, April . 2025

postoperative. Based on the preoperative mean of Calcaneal valgus angle of RT side was improved from  $17.2 \pm 5.9$  to  $6.66 \pm 4.1$  postoperative also LT side mean was improved from  $16.96 \pm 5.9$  to  $4.56 \pm 3.1$  postoperative. At final follow up the RT talonavicular coverage angle mean was improved from  $10 \pm 1.2$  to  $5.9 \pm 1.9$  postoperative also LT side mean was improved from  $11 \pm 2.0$  to  $6.1 \pm 2.1$  postoperative.

In their comparative study of treating 30 children with symptomatic flat foot (15 patients with subtalar arthroereisis & 15 patients with calcaneal stop screw)between 2019 to 2021 S.M. Zahid et al (2021) reported that VAS in patients with subtalar arthroereisis was improved from preoperative 3.03  $\pm$  1.54 to be 0.47 0.52 in postoperative follow up and was improved from 70.87  $\pm$  3.68 to 94.2  $\pm$  3.53 as regard to RT side Meary's angel it was improved from 21.63  $\pm$  6.35 to 12  $\pm$  4.5 and LT side from 21.93  $\pm$  6.11 to 11.93  $\pm$  5.82 also RT side Calcaneus valgus angle was improved from 15.13  $\pm$  5.93to 5.53  $\pm$  3.23and LT side from 16.4  $\pm$  6.82to 3.33  $\pm$ 2.99(10).

In their group of 30 children with flatfeet treated with the subtalar arthroereisis and medial soft tissue reconstruction between 2016 to 2018 Li B et al 2021 reported that the Meary angles were improved from  $17.5^{\circ} \pm 4.4^{\circ}$  to  $4.1^{\circ} \pm 1.2^{\circ}$ , AOFAS score was improved from  $66.6 \pm 5.8$  to  $88.6 \pm 7.9$  and pain according to VAS was reduced from  $6.6 \pm 0.6$  to  $1.7 \pm 0.3$ . As regard to postoperative complications: one case with screw displacement treated by reimplantation again, no infection or osteolysis or fracture were reported during the follow up period (8)

As regard to S.M. Zahid et al (2021) the vas was better in arthroereisis group than that of calcaneal stop screw, also improvement of Meary's angel in postoperative follow up was superior in arthroereisis group (10).

B. van Ooij et al 2012 found that the postoperative complications of subtalar arthroereisis is up to 40% ranging from over- or under correction to screw displacement or even fracture and the suitable solution was implanting removal (11).S.M. Zahid et al (2021) in their subtalar arthroereisis group of patients one patient was complaining from talar osteolysis and screw subluxation. And two patients with calcaneal stop screw, one with fracture around the screw and the other case with loosening. Thus, the arthroereisis complications were inferior to that of stop screw (10).Subtalar irritation together with the improper screw size was the triggering factors of subtalar pain(12). No vascular or neurological insult or fracture were reported with subtalar arthroereisis(13)Complications: One foot was complaining from superficial infection after 8 days treated with repeated dressing and broad-spectrum antibiotics and delayed suture removal at 16<sup>th</sup> day. Screw subluxation appeared in one foot after one month treated with screw readjustment.

limitation of this study include small sized patient sample, short follow up period and lack of control group. So in future studies we will increase the number of the study group, increase the follow up period and we will do additional medial soft tissue (tibialis posterior and spring ligament) plication especially in older patients (more than 10 years old) and with sever valgus heel.But this study provide highlight on this minimal invasive procedure that allow for correction of flexible flat foot with early weight bearing as compared with the other surgical procedures.

**Conclusion:** Subtalar arthroereisis is a minimal invasive surgical procedure can be effectively used in all cases symptomatic flexible flat foot that can efficiently correct calcaneal eversion and talar rotation restoring the normal mechanics of subtalar joint complex.

# **Conflict of interest**

Regarding this article's subject matter, the writers have no relevant competing interests to disclose.

# Financial disclosure

The authors declare that they did not receive any funding for this research. All work was conducted independently without financial support from any organization

# REFERENCES

- P.Kellermann, S.Roth, K.Gion, K.Boda, K.Tóth, Calcaneo-stop procedure for paediatric flexible flatfoot. Arch Orthop Trauma Surg.vol.131(10), pp.1363–70.
- Mosca VS. Calcaneal lengthening for valgus deformity of the hindfoot. Results in children who had severe, symptomatic flatfoot and skewfoot. J Bone Joint Surg Am 1995;77(4):500–12.
- Rathjen KE, Mubarak SJ. Calcanealcuboid-cuneiform osteotomy for the correction of valgus foot deformities in children. J Pediatr Orthop 1998;18(6):775–82.
- 4. Bouchard M, Mosca VS. Flatfoot deformity in children and adolescents: surgical indications and management. J

Am Acad Orthop Surg 2014;22(10):623–32.

- 5. Anderson AF, Fowler SB. Anterior calcaneal osteotomy for symptomatic juvenile pes planus. Foot Ankle 1984;4(5):274–83.
- Smith SD, Millar EA. Arthrorisis by means of a subtalar polyethylene peg implant for correction of hindfoot pronation in children. Clin Orthop Relat Res 1983;(181):15–23.
- Fernández de Retana P, Alvarez F, Viladot R. Subtalar arthroereisis in pediatric flatfoot reconstruction. Foot Ankle Clin. 2010. 15:323–35.
- Li B, He W, Yu G, Zhou H, Xia J, Zhao Y, Zhu H, Yu T and Yang Y Treatment for Flexible Flatfoot in Children with Subtalar Arthroereisis and Soft Tissue Procedures. Front. Pediatr.c. 2022. 9:656-78.
- 9. S.Roth, B.Sestan, A.Tudor, Z.Ostojic, A.Sasso, A.Durbesic, Minimally invasive

calcaneo-stop method for idiopathic, flexible pes planovalgus in children. Foot ankle Int.2007.28(9):991–5.

- S.M. Zahid, M, S. Abou Zied and M.A. Abdel Aziz. Calcaneal stop versus subtalar arthroereisis in treatment of pediatric flexible flat foot. BJAS. 2006. 6(1):1-6.
- 11. B. van Ooij, CJS.Vos, R.Saouti, Arthroereisis of the subtalar joint: an uncommon complication and literature review.Jfootankle Surg.vol.2012.51(1):114–7.
- 12. RL.Needleman, Current topic review:
- subtalar arthroereisis for the correction of flexible flatfoot. FAI. 2016.26(4):36–46.
  13. B.Vogt, G.Toporowski, G.Gosheger,
- B.Vogt, G.Toporowski, G.Gosheger, JD.Rölfing, D.Rosenbaum, F.Schiedel, et al. Subtalar Arthroereisis for Flexible Flatfootin Children—Clinical, Radiographic and Pedobarographic Outcome Comparing Three Different Methods. Children. 2021.8(5):359-66.

# Citation

sadek, S., Imam, A., ElAttar, M. Clinical and Radiological Outcomes of Isolated Subtalar Arthroereisis in Pediatric Flexible Flatfoot: A Prospective Cohort Study. *Zagazig University Medical Journal*, 2025; (1691-1698): -. doi: 10.21608/zumj.2025.360379.3840