Original Article

Evaluation Of Subtalar Arthroereisis In Management Of Flexible Flat Foot

Atef Mohamed Morsy[1], Hassan Magdy El Barbary[2], Ahmed Gaber[1], Karim Ahmed Abd El Fatah

[1]Department of orthopedic surgery, Faculty of Medicine – Beni Suef University
[2]Department of orthopedic surgery, Faculty of Medicine – Cairo University

Email: karimkady22@gmail.com
DOI: 10.47750/pnr.2023.14.02.86

Abstract

Background Deformities of the lower limbs are very common in children, mostly physiological and need no treatment at all. Ninety percent of clinic visits for foot problems are due to flatfoot, **Aim and objectives** was to test validity and efficacy of subtalar arthroereisis technique in treatment of pediatric and adolescents' flexible flatfeet that was operated at orthopedic department Beni Suef University Hospital, **Subjects and methods** A prospective study was carried out on 19 patients (30 feet) with painful idiopathic flexible flatfeet in the period between June 2019 and June 2021. All cases were selected from the foot and ankle outpatient clinic of Beni Suef University hospital, **Result** One patient (3.3%) had Persistent sinus tarsi pain with backing out of the screw, 6 months following surgery, which improved following screw removal and the foot maintained correction, one patient (3.3%) had Screw backed out 2 months following surgery and revision was done with a larger screw , **Conclusion** The subtalar arthroereisis technique is able to improve the clinical and radiological parameters with a minimal invasive surgery and fewer complications.

keywords: Subtalar arthroereisis, Flexible flat foot**.**

INTRODUCTION

Deformities of the lower limbs are very common in children, mostly physiological and need no treatment at all. Ninety percent of clinic visits for foot problems are due to flatfoot [1]. Flatfoot rarely causes disability, however it is still one of the major concerns of parents. In general it is believed to lead to gait disturbances later [2]. The flatfoot has three elements: sagging of the medial arch, valgus of the heel and forefoot abduction. Flattening of the medial longitudinal arch is a common finding in patients with flatfoot that is found in both pediatric and adult populations [3].

Clinically flatfeet can occasionally cause pain, with more specific complaints after having exercises or long walks. The pain is present and diffuse in the feet and lower legs. The researchers found that the adolescent patients who are complaining of a moderate to severe flatfoot demonstrated nearly double the rate of anterior knee pain and intermittent back pain [4].

Despite of high presence of pediatric and adolescents flatfoot, there is no universal agreement on the best way of treatment of this disorder. Many ways are used nowadays for management of pediatric and adolescents with flexible flatfeet, conservative in the form of analgesics, footwear selection and modifications, foot orthoses and stretching and strengthening exercise. Many operations are used if failed conservative treatment such as Evans calcaneal osteotomy, double calcaneal osteotomy, subtalar arthroereisis and subtalar arthrodesis [5].

The natural history of the flatfoot is difficult to be studied as most affected patients are asymptomatic and don't seek medical attention. Furthermore, because clinical or radiographic criteria are not established to define the flatfoot, the true prevalence of the deformity is unknown. Traditionally, the description of the flatfoot was decreased or absence of longitudinal arch with presence of hind foot in excessive valgus alignment. The present general agreement is that flexible flatfoot is present from birth and exhibits good mobility of the joint and normal function of the muscle [6].

In despite of high-quality research is deficient, it is obvious that most children with flatfoot deformity are flexible, painless and treatment is not required [7].

Gould et al studied children at age of beginning of walking and followed them up to 4 years. All of them had flatfeet which revealed by photographical and radiological parameters. Regardless of wearing of footwear , arches developed. The arch developed faster in children who had arch support. In 77.9 % of 5y years old children, hyperpronation was evident [8].

Garcia-Rodrigues and colleagues had a study about the predominance of flexible flatfeet in school children aged from 4 to 13 years old in Malaga, Spain. They made a sample of 1181 children from a total people of 198,858 primary school children. Three age groups was made and classified according to their footprint to 3 degrees of flatfeet. The presence of flatfeet was found about 2.7% of the sample of 1181 children.Obese children of age 4-5 years old group had increased incidence of flatfeet. Their results suggested that the excessive number of the children within the study group were being over treated [9].

Patients and Methods

Study design This prospective study included 19 patients (30 feet) with planovalgus foot deformity , All cases presented by symptomatic flexible pes planovalgus and were managed by arthroereisis of the subtalar joint using a Bio-arc implant at Beni suef university hospital .The current study started in June 2019 and ended in June 2021. Written detailed informed consents were obtained from parents, Patients' age at the time of surgery ranged from 6 years to 16 years.Follow up duration was 18 months.

Inclusion criteria Flexible flat foot , Age: from 6 years to 16 years.

Exclusion criteria Patients with flexible flatfoot associated with any other congenital foot anomaly, Rigid flatfoot, Previously surgically managed patients, Patients with neuromuscular disorders.

Methods

Preoperative assessment History, Presentation Complaints, Clinical assessment and Radiographic assessment.

Surgical intervention Patient Positioning and Operative procedure.

Postoperative assessment Immediate postoperative care, Follow up visits and Final follow up

Data management and statistical analysis Data were collected, coded, revised and entered to the Statistical Package for Social Science (IBM SPSS) version 20. The data were presented as number and percentages for the qualitative data, mean, standard deviations and ranges for the quantitative data with parametric distribution and median with inter quartile range (IQR) for the quantitative data with non-parametric distribution.

Results

This study was done on 19 patients (30 feet) with age at time of surgery between 7 - 16 years with follow up period 18 months

Table (1) Demographic data

		No	**%**
Sex	Female	10	52.6%
	Male	9	47.4%
Age	Mean± SD	11.79	3.33
	Range	7	16

This table showed that there were 9 males (47.4%) and 10 females (52.6%), Mean of age was 11.79 with range from 7 to 16.

Table (2) Side and soft tissue procedures (Tendoachilles lengthening /gastrocnemius recession)

		No	**%**
Side	Left	3	15.8%
	Right	5	26.3%
	bilateral	11	57.9%
Soft tissue procedures	No	10	33.3%
	Yes	20	66.7%

This table showed that 3 patients (15.8%) were left side, 5 patients (26.3%) were right side and 11 patients (57.9%) were bilateral. 20 feet (66.7%) had additional soft tissue procedures,10 of them had tendoachilles lengthening and the others had gastrocnemius recession.

Table (3) AOFAS ankle-hindfoot score and Talar head coverage angle in degrees preoperative and postoperative at final follow up peroid

		Min	Max	Mean	SD
AOFAS ankle-hindfoot score	Pre-operative	66	74	68.62	2.93
	Post operative	86	100	96.55	4.48
Talar head coverage angle	Pre-operative	12.4	58.1	23.98	8.58
	Post operative	1	12	5.94	3.34

This table showed that

1. Mean of AOFAS ankle-hindfoot score was 68.62 in pre-operative and 96.55 in post-operative.
2. Mean of Talar head coverage angle was 23.98 degrees in pre-operative and 5.94 degrees in post-operative

Table (4) Comparison between pre and post operative results

	Pre-operative		Post-operative		Paired t Test	
	Mean	SD	Mean	SD	t	p value
AOFAS ankle-hindfoot score	68.62	2.93	96.55	4.48	-38.299	<0.001
talar head coverage angle	23.98	8.58	5.94	3.34	12.900	<0.001
Talo-Calcaneal angle in AP view	26.34	5.88	20.14	4.59	7.483	<0.001
Meary's angle	23.62	7.74	2.98	3.27	16.334	<0.001
calcaneal pitch angle	8.49	2.30	15.47	1.79	-14.721	<0.001

Angles were measured by degrees

This table showed that there was statistically significant increase AOFAS ankle-hindfoot score and calcaneal pitch angle in post-operative and statistically significant decrease in talar head coverage angle,AP Talo-Calcaneal angle and Meary's angle in post-operative.

Table (5) Complications

		No	%
Complicatios	None	28	93.3%
	Persistent sinus tarsi pain with backing out of the screw which improved following removal 6 months following surgery and the foot maintained correction	1	3.3%
	Screw backed out 2 months following surgery and revision was done with a larger screw	1	3.3%

This table showed that one patient (3.3%) had Persistent sinus tarsi pain with backing out of the screw which improved following screw removal 6 months following surgery and the foot maintained correction, one patient (3.3%) had Screw backed out 2 months following surgery and revision was done with a larger screw as a complication.

Case presentation

Case 1

Fig (1) screw backed out

1. History : Male patient with bilateral painful flexible flat feet
2. Examination : loss of medial arch , forefoot abduction and valgus deformity of heel
3. Age at surgery : 16 years
4. AOFAS ankle-hindfoot score : preoperative was 74 / postoperative is 100
5. Both sides were done with 6 months interval

Fig (2) pre-operative clinical photos

Fig (3) preoperative x ray lateral view of ankle with calcaneal pitch angle 7.8 degress

Fig (4) 2 years postoperative x ray lateral view of ankle in standing position with Meary's angle zero degree

Case 2

1. History : female patient with left painful flexible flat feet
2. Examination : loss of medial arch , forefoot abduction and valgus deformity of heel
3. Age at surgery : 14 years
4. AOFAS ankle-hindfoot score : preoperative was 70 / postoperative is 100

Fig (5) preoperative clinical photo

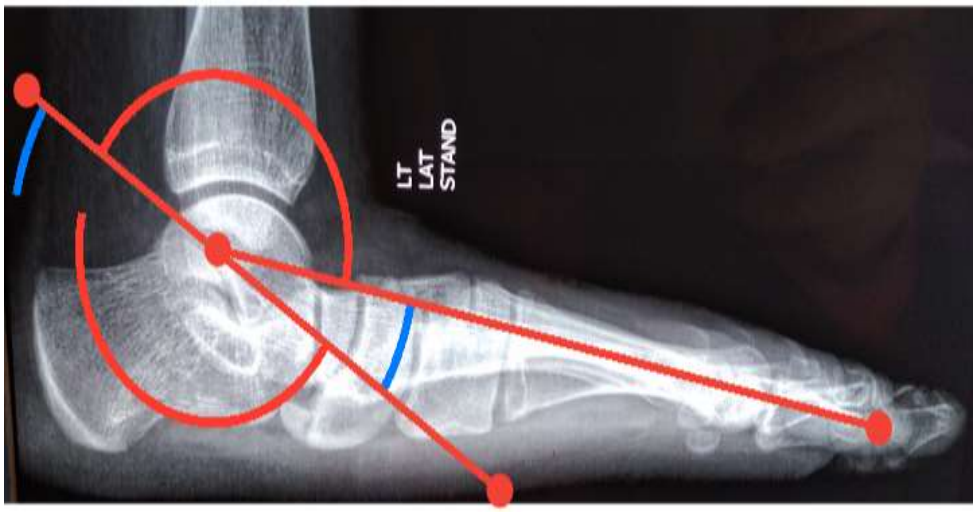

Fig (6) preoperative X-ray lateral view of ankle with Meary's angle 2.1.4 degrees

Fig (zero degree.

Discussion

Pediatric flatfoot is a common cause of parents' visits to pediatric and foot clinics due to their concern about shape of foot, sometimes about abnormal gait, pain or easy fatigability of the child. Commonly flexible flatfoot doesn't require surgery except those doesn't respond to conservative management. There is no universal agreement about ideal method of surgical management of pediatric and adolescent flexible flatfoot.(10)

Subtalar arthroeisis considered the least invasive surgical technique in treatment of flexible flatfoot. Early Pioneers of arthroereisis thought to achieve joint motion preservation by means that control subtalar joint hypermobility.(10)

Our study included 30 feet, 9 of them were males (47.4%) and 10 of them were females (52.6%). Operation was done at RT side in 5 cases (26.3%), Lt Side in 3 cases (15.8%) and bilateral in 11 cases (57.9) with follow up for 18 months. The age ranged from 6 to 16 with mean (11.79 ± 3.33). Revision was done in one case, due to displacement of the implant , by larger size. We use the AOFAS ankle and

hindfoot Scale for clinical evaluation which improved form (68.62 ± 2.93) preoperatively to (96.55 ± 4.48) at final follow up with p value <0.001.

Radiological improvement was found in all cases. We found improvement in the mean of AP TaloCalcaneal angle from preoperative 26.34 ± 5.88 degrees to 20.14 ± 4.59 degrees at final follow up. The Ap Talar head coverage angle was also improved from preoperative 23.98 ± 8.58 degrees to 5.94 ± 3.34 degrees at final follow up. In lateral weight-bearing view of the foot we found improvement in calcaneal pitch angle from preoperative mean of 8.49 ± 2.30 degrees to final follow up mean of 15.47 ± 1.79 degrees and also improvement of Meary's angle from mean of 23.62 ± 7.74 degrees to mean of 2.98 ± 3.27 degrees at final follow up.

In our study the number of patients 19 (30 feet) in agreement with **Jay, R. M. et al 2013**[99] **,** superior to **Chong D. Y. et al 2015**[102] and **Cao, L. et al 2017** [101] and in contrast to **Scharer, B. M. et al 2010** [11].

In agreement with **Cao, L. et al 2017** [12] and **Scharer, B. M. et al 2010** [100], the age of cases at time of surgery ranged from 6 to 16 years old with mean of 11.79 ± 3.33 years old and in contrast to **Jay, R. M. et al 2013** [13].

In our study the AOFAS score of ankle and hindfoot was significantly improved in agreement with **Fernandez De Retana et al, 2010** [14] and in contrast to **Jay, R. M. et al 2013** [99] and **Cao, L. et al 2017** [15].

The AP talocalcaneal angle had excellent improvement in our study in agreement with **Scharer, B. M. et al, 2010** [11]. We also found in our study significant improvement of AP talar head coverage angle from the preoperative mean of 23.98 ± 8.58 degrees to 18 months postoperative mean of 5.94 ± 3.34 degrees in contrast to **Scharer, B. M. et al, 2010** [11].

In our study, Meary's angle had very good improvement in agreement with **Cao, L. et al, 2017** [15] and in contrast to **Chong D. Y. et al, 2015** [12]. The calcaneal pitch angle was also improved form the preoperative mean of 8.49 ± 2.30 degrees to 15.47 ± 1.79 at end of follow up in agreement with **Cao, L. et al, 2017** [15] and in contrast to **Chong D. Y. et al, 2015** [12].

STA-peg was the first non-silicone device when used in 1974 and reported in 1984 which fixed directly into calcaneus [16, 17]. Formation of intraosseous cyst had been reported following STA-peg arthroereisis. CT and subsequent operative inspection erosion of the calcaneus at the implant interface with cyst formation within the talar neck [18].

Advancement in arthroereisis devices came with introduction of cannulated cementless systems that requiring minimal operative technique. Langford et al published a paper regarding Valente procedure which employed polyethylene implants of varying sizes which could be matched intra operatively to the patients' clinical picture [19]. Two cadaver studies showed the relationship between device size and limitation of joint motion supporting clinical finding [20,21]. Limitations of these studies include a failure to account for muscle function during testing and uniform loading [95,96].

Thus the adopted technique proved effectiveness in correcting FFF deformity with no recurrence of either associated symptoms or any of the components of the deformity provided it is done meticulously in the proper indication of pure flexible type of flat foot. However, a long term follow up of these cases is recommended to ensure maintenance of correction and absence of recurrence. The current study thus provides a detailed description of a simple procedure to correct all the components of the deformity of FFF in one sitting. A satisfactory correction can be achieved by this technique whatever the severity of the deformity and can be conducted successfully in young and old children. Good result is supposed to occur in a properly selected patient, if the technique is done meticulously with adherence to the details of the operative steps and good postoperative care and follow up. The supposed degenerative joint changes can be avoided and the need for arthrodesis later in life can be eliminated. Limitation of this study was the lack of a patient's satisfaction survey after surgery and lack of a control group of children with FFF. removal of the screw should be 2 years postoperative or after skeletal maturity and the rate of relapse should be documented. So long term follow up after screw removal and documentation of the rate of relapse could be studied.

Conclusion

Flexible flatfoot is very common between children. Surgical intervention is indicated only in children when the pain is not responding to conservative treatment. The subtalar arthroereisis method is one of surgical methods in treatment of this condition.

The aim of the work is to test validity and reliability of subtalar arthroereisis in management of pediatric and adolescents flexible flatfoot.

A prospective study was carried out on 19 patients (30 feet) with painful idiopathic flexible flatfeet in the period between June 2019 and June 2021. All cases were selected from the foot and ankle outpatient clinic of Beni Suef University hospital.

This study had 30 cases.The range of age was between 6 and 16 years old with mean age 11.79 years old and all patients were followed up for 18 months.

Data were collected, coded, revised and entered to the Statistical Package for Social Science (IBM SPSS) version 20.

References

1. Fabry, G., Static, axial, and rotational deformities of the lower extremities in children. Eur J Pediatr, 2010. 169: p. 529-534.
2. Evans, A.M., H. Nicholson, and N. Zakarias, The paediatric flat foot proforma (p-FFP): improved and abridged following a reproducibility study. Journal of foot and ankle research, 2009. 2(1): p.
3. Pfeiffer, M., et al., Prevalence of flat foot in preschool-aged children. Pediatrics, 2006. 118(2): p. 634-639.
4. Yeagerman, S.E., et al., Evaluation and treatment of symptomatic pes planus. Current opinion in pediatrics, 2011. 23(1): p. 60-67.
5. Kwon, J.Y. and M.S. Myerson, Management of the Flexible Flat Foot in the Child: A Focus on the Use of Osteotomies for Correction. Foot and Ankle Clinics, 2010. 15(2): p. 309-322.
6. Mosca, V.S., Flexible flatfoot in children and adolescents. Journal of children's orthopaedics, 2010. 4(2): p. 107-121.
7. Bouchard, M. and V.S. Mosca, Flatfoot deformity in children and adolescents: surgical indications and management. Journal of the American Academy of Orthopaedic Surgeons, 2014. 22(10): p. 623-632.
8. Gould, N., et al., Development of the child's arch. Foot & ankle, 1989. 9(5): p. 241-245.
9. García-Rodríguez, A., et al., Flexible flat feet in children: a real problem? Pediatrics, 1999. 103(6): p. e84-e84.
10. Subotnick, S.I., The subtalar joint lateral extra-articular arthroereisis: a preliminary report. J Am Podiatry Assoc, 1974. 64(9): p. 701-11.
11. Ortiz CA, Wagner EA, Wagner PA. Arthroereisis: What Have We Learned? Foot Ankle Clin. 2018;23(3):415–34.
12. Needleman RL. Current topic review: Subtalar arthroereisis for the correction of flexible flatfoot. Foot Ankle Int. 2005;26(4):336–46.
13. De Pellegrin M, Moharamzadeh D, Strobl WM, Biedermann R, Tschauner C, Wirth T. Subtalar extra-articular screw arthroereisis (SESA) for the treatment of flexible flatfoot in children. J Child Orthop. 2014;8(6):479–87.
14. Rockett AK, Mangum G, Mendicino SS. Bilateral intraosseous cystic formation in the talus: A complication of subtalar arthroeresis. J Foot Ankle Surg. 1998;37(5):421–5.
15. Green D WM. Arthroereisis. In: J. S, editor. Mcglamry's comprehensive textbook of foot and ankle surgery. 4th ed. Philadelphia: Lippincott Williams & Wilkins; 2013. p. p.675-87.
16. Grady, J.F. and M.W. Dinnon, *Subtalar arthroereisis in the neurologically normal child.* Clin Podiatr Med Surg, 2000. 17(3): p. 443-57, vi.
17.Metcalfe, S.A.; Bowling, F.L.; Reeves, N.D. Subtalar joint arthroereisis in the management of pediatric flexible flatfoot: A critical review of the literature. *Foot Ankle Int.* 2011, *32*, 1127–1139.
18.Bernasconi, A.; Lintz, F.; Sadile, F. The role of arthroereisis of the subtalar joint for flatfoot in children and adults. EFORT Open Rev. 2017, 2, 438–446.
19.Langford, J.H., H. Bozof, and B.D. Horowitz, Subtalar arthroereisis. Valente procedure. Clin Podiatr Med Surg, 1987. 4(1): p. 153-61.
20.Husain, Z.S. and L.M. Fallat, Biomechanical analysis of Maxwell-Brancheau arthroereisis implants. J Foot Ankle Surg, 2002. 41(6): p. 352-8.
21.Christensen, J.C., N. Campbell, and K. DiNucci, Closed kinetic chain tarsal mechanics of subtalar joint arthroereisis. J Am Podiatr Med Assoc, 1996. 86(10): p. 467-73.