Therapeutic Options in Management of Pediatric Flexible Flatfoot

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Abstract: Background: Flatfoot is a common foot deformity affecting mainly children. Flexible and rigid are the two main categories of Flatfoot. Flexible flatfoot is identified by the normal arch with non-weight bearing flattening on stance. In contrast, rigid flatfoot is known as a stiff, flattened arch whether non-weight bearing or standing. Most of flexible flatfeet actually are physiologic, asymptomatic and requiring no therapy. However, symptomatic pes planus usually require either conservative or surgical treatment intervention. **Objective:** appraisal of complementary role of rehabilitation program in conjugation with either conservative or surgical management of paediatric flexible flat foot. **Patients and Methods:** This study was performed on 40 cases of idiopathic flexible flatfeet their ages range from 8-18 years at period of about 24 months between May 2015 and May 2017. Patients classified according to the line of treatment into 2 groups. Group 1: Twenty cases with 36 feet (16 cases bilateral and 4 cases unilateral) treated conservative in the form of therapeutic exercises, corrective foot wear and electrical stimulation, Group 2: Twenty cases with 32 feet (12 bilateral and 8 unilateral) were treated surgically by calcaneo-stop procedure after exhausting a total of 6 months of conservative methods. All Patients were selected from the outpatient clinics of physical medicine, Rheumatology and Orthopedic surgery departments in Tanta University Hospitals. Results: There was significant improvement of pain by VAS and activity of daily living by FAAM score after conservative treatment, with significant difference between both groups after treatment and insignificant difference between both groups after 1 year of follow up. There was significant improvement of navicular index after surgical treatment, with significant difference between both groups after treatment and after 1 year of follow up.
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1. Introduction:

Flat foot is a deformity in which the arch on the inner foot is more flat than usual, the whole foot sole enters into almost complete or full contact with the soil. (1)

It may occur at any age, but in children this deformation is more prevalent. Flatfoot can be divided into two types, flexible and rigid. Flexible flatfoot is identified by a normal arch on non-weight bearing flattening on stance. while, rigid one is known by a stiff, flattened arch whether non weight bearing or standing. (2)

A gradual onset of medial foot or ankle pain is usually the typical presentation of flat foot. While lateral pain can occur in the late stage as a result of subfibular impingement, painful callosities, ankle instability and difficulty with shoe wear. (3)

the diagnosis of flatfoot essentially requires adequate history taking with physical examination as well as diagnostic imaging including weight bearing radiographs beside the footprints. (4)

Management includes conservative and surgical treatment. A major concern with the conservative treatment in our society is the high cost of using special shoes and sole inserts also the patient compliance with the treatment and attendance of physiotherapy sessions for prolonged periods. Another problem with the conservative treatment is difficulty of wearing closed shoes for most of the day in our hot and humid weather. The aforementioned difficulties render surgical intervention. (5)

Arthroereisis means mechanical block of joint motion in certain direction through the insertion of a screw into the calcaneus in contrast to arthrodesis which is the term for joint fusion the arthroereisis leave a mobile joint. Implant removal was not associated with a foot reversal. The pediatric patient usually adapts very well to the Arthroereisis with low incidence of implant failure in this age. (6)

2. Subjects and methods:

This study was performed on 40 cases of idiopathic flexible flatfeet their ages range from 8-18

years at period of about 24 months between May 2015 and May 2017. All the Patients were selected from the outpatient clinics of physical medicine, Rheumatology and Orthopedic surgery departments in Tanta University Hospitals.

Inclusion criteria:

1- Idiopathic pediatric flexible flat foot.
2- Age of patients lie within the range of 8-18 years old.
3- Unsatisfactory results after 6 months of conservative treatment for surgical treated group.

Exclusion criteria:

1- Secondary flat foot.
2- Spastic flat foot.

Patients classified according to the line of treatment into 2 groups:

Group 1: Twenty cases with 36 feet (16 cases bilateral and 4 cases unilateral) treated conservative in the form of therapeutic exercises including stretching and strengthen exercises of small muscles of the foot as in figure 1-8, Faradic stimulation 0.1 – 1 MS and frequency in between 50 – 100 Hz, used for the stimulation of gastrocnemius muscle three times weekly for 6 months and corrective foot wear including medial longitudinal arch supports for all patients by medial longitudinal arch insert or Thomas heel.

Group 2: Twenty cases with 32 feet (12 bilateral and 8 unilateral) were treated surgically by calcaneo-stop procedure after exhausting a total of 6 months of conservative methods. At which blocking the motion of the joint in a certain plain specifically eversion to prevent the deformity on weight bearing, it acts like an internal orthotic device.

Surgical procedure:

- After optimum prepping, draping the lower limb, incision of skin and subcutaneous tissue is gently done exactly over the sinus tarsi about 2 cm just below the lateral malleolus and for about 1.5 cm long. Blunt dissection of soft tissue is done then the foot is manipulated in the corrected position.
- Using the 3.5 mm drill pit to drill the path of the arthroereisis screw after confirming the entry site which is located at the junction between anterior 1/3 and posterior 2/3 of sinus tarsi under image intensifier.
- Then a 6.5 mm cancellous screw is advanced under image control while the subtalar joint is inverted.
- After confirming correction (eversion block of the subtalar joint, and maintained arch) irrigation of the wound, layered closure is done and postoperative wrapping in a bandage.

All patients were subjected to complete history taking, clinical examination including general and local, assessment of pain by VAS, assessment of function of foot ADL by FAAM score, assessment of flat foot severity according to navicular index and foot print before and after treatment and after 1 year of follow up.

Stretching exercises

Stretching Gastrocnemius

Figure 1: Stretching Gastrocnemius

Golf Ball Roll

Figure 2: Golf ball roll

Towel stretch

Figure 3: Towel stretch

Strengthening exercises

Calf Raises

Figure 4: Calf rises

Towel Curls

Figure 5: Towel Curls

Marble Pickup

Figure 6: Marble Pickup

Statistical analysis of the data

Data were collected and analyzed using IBM SPSS software package version 20.0**. (**Armonk, NY: IBM Corp**).** [(73)] Using number and percent, qualitative data were usually described. While, quantitative data were described using range (minimum and maximum), mean, standard deviation and median. The Kolmogorov-Smirnov test was used to check the normality of distribution. The significance of obtained results was judged at the 5% level.

Ankle Dorsiflexion/Plantar Flexion

Figure 7: Ankle Dorsiflexion/Plantar Flexion

Ankle Eversion/Inversion:

Figure 8: Ankle Eversion/Inversion

3. Results:

Table (1): Comparison between the two studied groups according to demographic data

	Group I (n=20)		Group II (n=20)		Test of sig.	P
	No.	%	No.	%		
Sex						
Male	10	50.0	8	40.0		0.525
Female	10	50.0	12	60.0		
Age (years)						
Min. – Max.	8.0 – 13.0		9.0 – 14.0		t=0.792	0.435
Mean ± SD.	10.5 ± 1.90		11.0 ± 2.1			
BMI (kg/m^2)						
Under weight (<18.5)	0	.0	0	.0		^{MC}p= 0.652
Normal (18.5 – 24.9)	8	40.0	6	30.0		
Overweight (25 – 29.9)	12	60.0	14	70.0		
Obese (30 – 34.9)	0	0.0	0	0.0		

There was no statically significant difference between the two studied group regarding to age, sex, and BMI

Table (2): Comparison between the two studied groups according to visual analogue score after activity (15 minutes of walking)

Visual analogue score	Group I (n=36)	Group II (n=32)	U	P
Before treatment				
Min. – Max.	1.0 – 6.0	1.0 – 6.0	140.0	0.094
Mean ± SD.	3.10 ± 1.25	2.50 ± 1.28		
After treatment				
Min. – Max.	0.0 – 4.0	1.0 – 5.0	87.50*	0.002*
Mean ± SD.	1.65 ± 1.18	2.95 ± 1.10		
After 1 years				
Min. – Max.	0.0 – 3.0	0.0 – 2.0	197.0	0.929
Mean ± SD.	0.75 ± 0.91	0.65 ± 0.67		

There was significant improvement in pain by VAS in group I after conservative treatment with statically significant difference between both group but after 1 year of follow up there was no significant difference between both group.

Table (3): Comparison between the two studied groups according to activity of daily living (FAAM)

Activity of daily living (FAAM)	Group I (n=36)	Group II (n=32)	T	P
Before treatment				
Min. – Max.	70.0 – 90.0	50.0 – 95.0	0.849	0.401
Mean ± SD.	82.0 ± 8.18	79.25 ± 11.95		
After treatment				
Min. – Max.	75.0 – 95.0	60.0 – 90.0	2.778*	0.008*
Mean ± SD.	87.0 ± 7.15	80.25 ± 8.19		
After 1 years				
Min. – Max.	80.0 – 100.0	80.0 – 100.0	1.122	0.269
Mean ± SD.	91.50 ± 7.27	94.0 ± 6.81		

There was significant improvement in foot function by faam in group I after conservative treatment with statically significant difference between both group but after 1 year of follow up there was no significant difference between both group.

Table (4): Comparison between the two studied groups according to navicular index

Navicular index	Group I (n=36)	Group II (n=32)	T	P
Before treatment			0.074	0.942
Min. – Max.	6.40 – 7.40	6.50 – 7.60		
Mean ± SD.	6.75 ± 0.26	6.96 ± 0.29		
After treatment			19.057*	<0.001*
Min. – Max.	6.30 – 7.40	5.30 – 5.80		
Mean ± SD.	6.65 ± 0.29	5.46 ± 0.13		
After 1 years			20.497*	<0.001*
Min. – Max.	6.20 – 7.30	5.10 – 5.75		
Mean ± SD.	6.56 ± 0.26	5.38 ± 0.15		

There was significant improvement of navicular index in group II after surgical treatment and after 1 year of follow up with statically significant difference between both groups after treatment and after 1 year of treatment.

4. Discussion

In our study, 20 children in group I their age lie within the range of (8.0 – 13.0) years and 20 child in group II were from (9.0 – 14.0) years with no significant difference between both group regarding flat foot distribution (Table 1).

These result were in agreement with Ukachukwu, (2016) [7] who found that the highest prevalence was in children (28.3%) and the lowest was in adults (20.0%). the flexible flatfoot was the commonest form (73.8%).

A study by Chen and Lou, (2010) [8] discovered that greater joint laxity, male gender, obesity and younger age were associated with a risk for flatfoot.

The detection of the flatfeet prevalence among children was affected by the different samples of examined children, the methods of assessment and the criteria for classifying flat versus non flat.

Regarding gender, in our study 20 child in group I they were 10 female and 10 male and 20 Child in group II they were 8 male and 12 female. Girls were more than boys with no significance difference between both sex regarding distribution of flat foot (table 1).

These results were in agreement with Reihane et al., (2013) [9] who found a none significant difference between girl and boy students regarding the prevalence of flat foot.

On the other hand Kamali et al., (2008) [10] found the prevalence percentages of flat feet in male was 11.6% and in females was 12.1%. Another result from Eluwa et al., (2009) [11] reported a higher prevalence among females than males. In both above mentioned researches, females showed also a higher incidence of severe flat foot. This can be explained by a greater laxity of female joints.

Regarding BMI 20 child in group I they were 6 normal weight and 14 were overweight and 20 child in group II they were 8 normal weight and 12 were overweight (Table 1).

These result were in agreement with Villarroya et al., (2009) [12] who were found significant correlation between increased body weight and flat foot in adolescent children. In addition, Sadeghi-Demneh et al., (2016) [13] observed that more overweight children had more flatter feet, more pronated heel, less dorsiflexion range and higher reported pain within physical activity.

Also Mickle et al., (2006) [14] evaluated 38 children for determination if flat feet in are due to the presence of a thicker midfoot plantar fat pad or due to a lowering of the longitudinal arch. They found that midfoot fat pad thickness was not significantly different between obese/overweight and normal children with a significantly lower plantar arches in overweight/obese children compared to normal.

Our study showed that the group 1 of the pediatric flexible flatfoot significantly improve the visual analogue score after treatment comparative to the effect of surgical treatment but follow up after 1 year showed no significant difference in visual analogue score between the two groups (Table 2).

In agreement with Powell et al., (2005) [15] who evaluated 40 children, aged 5 to19 years diagnosed with pes planus with pain treated with the custom-made orthoses over three months compared to the result that achieved with the shoes only (control group). The primary outcome measure was pain reduction using a Pediatric Pain questionnaire, measured by VAS. Secondary outcome measures included the Physical Functioning subscale of the Pediatric Quality of Life that found a significantly improvement. Against our study Whitford and Esterman, (2007) [16] who evaluated self-perception, exercise efficiency, and pain over 12 months in 3 groups of children with bilateral flexible excess pronation who received no treatment, non custom

orthoses, or custom-made orthoses and did not find any significant difference between them in any outcomes measure.

Regarding surgical group our results were in agreement with Pavone et al., (2013) [17] who reported an improvement in clinical evaluation, and radiologic assessment among 242 patients treated by the calcaneo-stop procedure. The children were followed for a mean duration of 6 months and 4 years and this result is agreed with our study that found improvement of visual analogue score in surgical group during follow up after 1 year.

Improvement of visual analogue score for pain after 6 month of conservative treatment may be caused by decrease tension and pressure in the medial longitudinal arch, correction of abnormal biomechanics, strengthen of foot muscle help to restore medial longitudinal arch and Stretching exercises lengthen the Achilles tendon and posterior calf muscles, as a tight Achilles tendon tends to pronate the foot can provide pain relief and reduce rear foot eversion, but immediately after surgery may be some inflammation from the surgical procedure which delay the improvement of pain but pain improved after resolution of inflammation.

Our study showed that the group 1 of the pediatric flexible flatfoot effectively improve activity of daily living (FAAM) after treatment comparative to the effect of surgical treatment but follow up after 1 year showed no significant difference in activity of daily living (FAAM) between the two groups (Table 3).

Similar to our study, Riccio et al., (2009) [18] showed that proper rehabilitation exercises program can enhance the effectiveness of therapy in pediatric flexible flatfoot and improve function of the foot. Also Needleman, (2005) [19] suggested that the improvement seen in functional scores and symptom relief after the conservative management are biomechanical in nature.

In our study improvement of foot function by FAAM score may be the result of improving the pain and the flexibility of the medial longitudinal arch so the function improved while immediately after calcaneo – stop procedure pain from the procedure delay the improvement in FAAM which improve after follow up.

Our study showed significant improvement of navicular index in group II after surgical treatment and after 1 year of follow up with statically significant difference between both groups after treatment and after 1 year of treatment (Table 4).

In agreement with Koning et al., (2009) [20] and Viladot et al., (1992) [21] who demonstrated a significant radiographic improvements in arch height and joint congruency after arthroereisis.

Similarly Vito and Gianluca, (2013) [22] followed up 410 flatfeet children treated by the calcaneo-stop procedure for two years and reported a satisfactory outcome in 397 feet (96.83%) showing this procedure as a simple and reliable technique that allows realignment of the talus and calcaneus.

Also Maurizio et al., (2014) [23] found a good outcome in approximately 94 % of flexible flat foot patients treated with arthroeresis even after screw removal.

Conclusion:

Conservative management and rehabilitation program improve pain and function of the foot in paediatric flexible flat foot.

The calcaneostop procedure followed by rehabilitation program is a safe, convenient procedure for treatment of idiopathic flexible flatfoot and has the advantage of giving comparable results to the conservative treatment regarding the correction of foot arch and navicular index.

Surgical procedure for paediatric flexible flat foot should be followed by rehabilitation program.

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