UNTREATED FLEXIBLE FLAT FOOT DOES NOT DETERIORATE GAIT PATTERN DURING ADULTHOOD

TEDAVİ EDİLMEMİŞ FLEKSİBLE DÜZTABANLIĞIN ERİŞKİN DÖNEMDE YÜRÜME PATERNİNE ETKİSİ

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ABSTRACT

Aim: There is a great deal of controversy regarding whether flat foot (FF) is only a problem of static alignment of the ankle and foot complex, or the consequence of a dynamic functional change of the lower extremity and may lead biomechanical impairment in adulthood. The aim of this study was to assess the long term impairment in gait characteristics of adults who had FF since their childhood but never treated.
Methods: Participants were 34 patients (25 female) with bilateral flexible FF and 34 age, gender height and weight matched normal subjects. Mean±SD age of the patients with FF was 43.7±9.7 years. Lateral talometatarsal and talocalcaneal angles were measured and recorded. Flat feet was diagnosed if lateral talometatarsal angle is>4°, and talocalcaneal angle is>30°. Three-dimensional gait analysis and concomitant videorecordings of all subjects were performed.
Results: The mean±SD lateral talometatarsal and talocalcaneal angles were 6.3±2.5 and 56.1±8.6 degrees, respectively. The difference between the groups in terms of time-distance parameters, kinematic and kinetic characteristics of the hip, knees and ankles in the sagittal, coronal plane and transverse plane was not statistically significant.
Conclusion: The gait pattern of the patients with untreated flexible FF in their fourth decade was not different than age matched able body controls'. Untreated flexible flat foot does not deteriorate gait pattern in adulthood.
Key words: Flexible flat foot, gait, kinematics, kinetics

ÖZET

Amaç: Düztabanlığın sadece ayak bileği ve ayağı etkileyen statik bir dizilim sorunu mu yoksa alt ekstremitenin, erişkinlikte biyomekanik sorunlara da yol açabilecek, dinamik fonksiyonel değişiminin sonucu mu olduğu tartışmalı bir konudur. Bu çalışmanın amacı çocukluğundan beri fleksible düztabanlığı (FD) olup hiç tedavi edilmemiş erişkinlerde yürüme özelliklerinde uzun dönem morbiditenin değerlendirilmesidir.
Metod: Denekler bilateral FD olan 34 kişi (25 kadın) ve yaş, cins, boy ve kilo açısından eşleştirilmiş 34 normal bireydi. Lateral talometatarsal ve talokalkaneal açılar ölçüldü ve kayıt edildi. Düztabanlığı olan hastaların yaş ortalaması 43.7±9.7 yıldı. Lateral talometatarsal açı >4° ve talokalkaneal açı >30° ise düztabanlık tanısı kondu. Tüm deneklerin üç boyutlu yürüme analizi ve eş zamanlı videokayıtları yapıldı.
Bulgular: Ortalama±SD lateral talometatarsal ve talokalkaneal açılar sırasıyla 6.3±2.5 ve 56.1±8.6 derece olarak ölçüldü. Gruplar arasında ölçülen zaman-uzaklık değişkenleri, kalça, dizler ve ayak bileklerinin sagital, koronal ve transvers planda kinematik ve kinetik özellikleri açısından fark bulunmadı.
Sonuç: Tedavi edilmemiş ve yaşamının dördüncü dekatında bulunan FD'li erişkinlerin yürüme paterni yaşça eşleştirilmiş normal deneklerden farklı değildi. Tedavi edilmemiş FD erişkin dönemde yürüme paternini bozmaz.
Anahtar sözcükler: Fleksible düztaban, yürüme, kinematik, kinetik

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INTRODUCTION

The incidence of flexible flatfeet (FF) in young generation is very high. The reported incidence ranges from 3 to 90 percent due to variations in disease classifications and evaluation methods (1). The FF in children can be divided as "developmental" and "static". The first one is visible in children immediately after starting walking and disappears spontaneously. The second one is associated with generalized but not pathologic soft tissue laxity. It is confirmed, that both do not need treatment. Nevertheless, the tendency for overtreatment of deformity by exercises, insoles and special shoes is observed. This kind of treatment results in costs and low effectiveness as well as psychological problems in patients (2).

Flexible flat foot may be asymptomatic, or may present pain in the foot, calf, even at legs, and formation of bunion, hammertoes and calluses at the feet causing severe and disabling pain at the lower extremities. On the other hand, Cappello et al. reported that FF rarely causes disability, and asymptomatic children should not be burdened with orthotics or corrective shoes (3). There is a controvery regarding the treatment of FF as it may be selfcorrecting in early childhood and may resolve spontaneously without treatment (4). Flexible flatfeet with tight heelcords may become symptomatic and can be addressed with a stretching program. Surgical intervention for flexible flatfeet is reserved for patients who have persistent localized symptoms despite conservative care. A 3 year study by Niedzielski et al. included 469 children with flat feet in preschool and school age from a section of the town of Lodz (5). In 2 separate age groups the influence of exercises and/or hindfoot supinating inserts on the deformity regression has been assessed. The results were compared at every stage of the study with the deformity evaluations in control group of not treated children. The best results were recorded in children doing exercises and wearing insertsin 50 percent the deformity retreated. It has been suggested that subjects who fall outside the normal range of biomechanics require some form of treatment (6, 7).

Short term outcome of children, younger than 11 years, with FF has been studied (8,9). It has been reported that children with FF had more difficulty in tasks of motor perfomance and had significantly different gait characteristics at ankle and knee. In spite of the studies performed during childhood, to our knowledge, there are no reports about long term morbidity of flexible FF at adult ages. This prospective, controlled study was designed to assess the long term impairment in gait characteristics of adults who had FF since their childhood but never treated.

METHOD

Subjects

Subjects were 34 adult patients (25 female, 9 male) with bilateral flexible FF. The mean ± age was 43.7 ± 9.7 years. None of them were overweight. They had no history of foot and ankle surgery, use of foot orthotics, trauma or inflammatory joint disease. All of them complained of mild to moderate calf pain when they walked more than their usual distance. Physical examination and radiographs of the feet were performed. Lateral talometatarsal and talocalcaneal angles were evaluated. Flat foot was diagnosed if lateral talometatarsal angle was > 4°, and talocalcaneal angle was > 30° (10).

Gait analysis

Threedimensional gait data were collected with the Vicon 370 systema and processed by the Vicon Clinical Manager software. Anthropometric data including height, weight, leg length, and joint width of the knee and ankle were collected. Fifteen passively reflective markers were placed on standard and specific anatomic landmarks: sacrum, bilateral anterior superior iliac spine, middle thigh, lateral knee (directly lateral to axis of rotation), middle shank (the middle point between the knee marker and the lateral malleolus), lateral malleolus, and heel and forefoot between the second and third metatarsal head. After subjects were instrumented with retroreflective markers, they were instructed to walk at a selfselected speed over a 10m walkway during which data capture was completed. Five cameras recorded (at 50Hz) the 3dimensional spatial location of each marker as the subject walked. The best data of three trials were used in analysis. The trial, in which all the markers were clearly and automatically identified by the system, was determined as best data.

Data analysis

Data analysis was performed using SPSS for Windows version 9.0. Timedistance parameters (walking velocity, cadence, stride length, stride time), kinematic (joint rotation angles of pelvis, hip, knee and ankle in sagittal and coronal planes) and kinetic variables (moments of knee and ankle in sagittal and coronal planes, power generated by ankle flexors, peak scaled ground reaction forces) of the patients with FF and agesex matched normal controls were compared with "paired t test", setting the significance level at less than 5%.

Table-I

Characteristics of the patients

Age (mean ± SD)	43.7 ± 9.7 years
Gender (Female/male)	25 / 9
Lateral talometatarsal angle (mean ± SD)	6.3 ± 2.5 degrees
Talocalcaneal angles (mean ± SD)	56.1 ± 8.6 degrees

RESULTS

Characteristics of the patients were presented in Table 1. The mean lateral talometatarsal and talocalcaneal angles were 6.3 ± 2.5 and 56.1 ± 8.6 degrees, respectively. No significant difference could be detected between the groups in terms of assessed time distance, kinematic and kinetic gait characteristics (Table 2).

DISCUSSION

The findings of this study revealed that untreated FF for a mean of 40 years did not impair time distance, kinematic and kinetic gait characteristics in our group of patients. Our results supported previous reports which suggested that children should not be burdened with orthotics or corrective shoes as FF rarely cause disability during adulthood (3). Although the exact incidence of FF in children is unknown, it is a common finding and we hope our results may decrease the excessive number of unnecessary orthopaedic and orthotic treatments.

Short term outcome of children under 11 years old with FF has been studied (8,9). It has been reported that children with FF had more difficulty in tasks of motor performance and had significantly different gait characteristics at ankle and knee (8).

Table-II

Comparison of the groups in terms of gait characteristics (values are in (mean ± SD))

Variable	FF	Normal	P
Walking Velocity (m/s)	1.18 ± 0.08	1.11 ± 0.05	.523
Stride time (s)	1.42 ± 0.12	1.40 ± 0.14	.625
Stride length (m)	1.32 ± 0.07	1.34 ± 0.07	.379
Pelvic excursion (degrees)	3.1±1.5	2.9±0.9	.497
Hip excursion (degrees)	38.9±3.4	37.4±4.4	.481
Knee excursion (degrees)	52.2 ± 8.1	54.3 ± 3.5	.553
Ankle excursion (degrees)	18.6±5.1	19.6±4.4	.559
Peak ankle plantar flexion moment	1.2±0.1	1.3±0.3	.549
Peak ankle power	1.5±0.8	1.6±0.7	.108
First peak of vertical ground reaction force	95.2±6.6	96.0±3.8	.423

Most children who present to a physician for evaluation of flatfoot will have a flexible flatfoot that does not require treatment. Nevertheless, the examining physician must rule out other conditions that do require treatment, such as congenital vertical talus, tarsal coalition, and skewfoot (1). Untreated, congenital vertical talus may result in an awkward gait; manipulation and casting have been tried, but most authors now agree that surgical treatment is required. Although parents are often concerned about pediatric flatfoot, the child is usually found to be asymptomatic, and no treatment is indicated. Sullivan et al suggested that in most instances, the best treatment is simply taking enough time to convince the family that no treatment is necessary (1).

Main limitation of this study was that we did not evaluate the muscle activity during gait and cannot rule out adaptations in muscle recruitment. It has been shown that in contrast to the normal foot, support of the medial longitudinal arch during standing is supplemented in the asymptomatic FF by activity of extrinsic muscles such as peroneus longus and tibialis anterior (11). Muscle control might be able to provide additional support to the foot (12) and thus compensate for an inadequate skeletal framework in FF (13). It is possible that people with FF who experience symptoms during conditions of normal walking are those who are less able to compensate for the passive insufficiencies. Further studies may investigate muscle activation of adults with FF while walking to rule out compensations.

REFERENCES

1. Sullivan JA. Pediatric flatfoot: evaluation and management. J Am Acad Orthop Surg. 1999 Jan;7(1):44-53.
2. Walczak M, Napiontek M. Flexible flatfoot in children--a controversial subject Chir Narzadow Ruchu Ortop Pol. 2003;68(4):261-7.
3. Cappello T, Song KM. Determining treatment of flatfeet in children. Curr Opin Pediatr. 1998 Feb;10(1):77-81.
4. Wenger DR, Diego S, Mauldin D, Speck G, Morgan D. Corrective shoes and inserts as treatment for flexible flatfoot in infants and children. J Bone Joint Surg 1989;71:800-10.
5. Niedzielski K, Zwierzchowski H. Evaluation of the effect of therapeutic exercise and supination shoe insert on static flatfoot in children. Chir Narzadow Ruchu Ortop Pol. 1993;58:46-51.
6. Rao, UB; Joseph, B. The influence of footwear on the prevalence of flat. foot. J Bone Joint Surg 1992;74:525-7.
7. Rose GK, Welton EA, Marshall T. The diagnosis of flat foot in the child. J Bone Joint Surg 1985; 67:71-8.
8. Lin CJ, Lai KA, Kuan TS, Chou YL. Correlating factors and clinical significance of flexible flatfoot in preschool children. Journal of Pediatric Orthopaedics 21: 378-82, 2001.

9. Leung AK, Mak AFT, Evans JH. Biomechanical gait evaluation of the immediate effect of orthotic treatment for flexible flat foot. Prosthetics and Orthotics International 1998;22:25-34.
10. Younger, AS; Sawatzky, B; Dryden, P. Radiographic assessment of adult flatfoot. Foot Ankle Int 2005;26:820-5.
11. Gray, EG; Basmajian, J. Electromyography and cinematography of leg and foot ("normal" and flat) during walking. Anat Rec 1968; 161:1-15.
12. Ferris, L; Sharkey, NA; Smith, TS,Matthews, DK. Influence of extrinsic plantar flexors on forefoot loading during heel rise. Foot Ankle Int 1995;16:464.
13. Kaye, RA; Jahss, MH.Tibialis posterior: a review of anatomy and biomechanics in relation to support of the medial fractures. Foot Ankle 1991;11:244-7.

SUPPLIERS

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Bertec Corp, Colombus, OH, USA

Version 9.0; SPSS Inc, 233 S Wacker Dr, 11th Fl, Chicago, IL 60606.