Eskisehir Medical Journal
Eskişehir Tıp Dergisi

Eskisehir Med J. 2023; 4(supp): 227-231
doi: 10.48176/esmj.2023.137

Araştırma Makalesi / Original Article

THE RELATIONSHIP BETWEEN PES PLANUS, TRIGGER POINTS AND MUSCLE STRENGTH
PES PLANUS, TETİK NOKTA VE KAS GÜCÜ ARASINDAKİ İLİŞKİ

FULYA BAKILAN[1], BURCU ORTANCA[1], AYŞE EKİM[2], ARMAĞAN ONUR[1]

[1] Department of Physical Medicine and Rehabilitation, Eskişehir Osmangazi University, Eskişehir, Turkey
[2] Special Clinic in Physical Medicine and Rehabilitation, Eskişehir, Turkey

ÖZET

Giriş: Bu çalışmanın amacı, pes planusu olan ve olmayan hastalarda tetik nokta görülme oranını, lokalizasyonunu ve kas güçlerini kıyaslamaktır.

Yöntemler: Toplam 88 kadın hasta çalışmaya alındı ve pes planus varlığı (yaş ortalaması: 32.50±7.95) (n=52) ve yokluğuna (yaş ortalaması 33.5±7.80) (n=36) göre iki gruba ayrıldı. Kas gücü el kavrama gücü ve bacak-bel gücü ile değerlendirildi. Tetik noktaların varlığı (var/yok), tetik noktaların bölgesi (masseter kası, servikal/torasik/lumbar bölge, üst/alt ekstremite), ağrı yoğunluğu için Vizüel Analog Skala değerlendirildi.

Bulgular: Tetik nokta görülme oranı pes planus grubunda istatistiksel olarak anlamlı şekilde yüksek idi: masseter kası (p=0.042), üst ekstremite (p=0.006), servikotorasik bölge (p=0.020), lumbar bölge (p=0.014) ve alt ekstremiteler (p=0.020). Pes planuslu hastaların %98.1'inde en az bir tetik nokta saptandı. Tetik noktaların ağrı yoğunluğu da, pes planus grubunda anlamlı düzeyde yüksek saptandı (p=0.037). Ancak kas güçleri istatistiksel olarak gruplar arasında benzer bulundu.

Sonuç: Pes planus ile tetik nokta görülme oranı arasında sadece alt ekstremite ve lumbar bölgede değil, maaseter, üst ekstremiteler ve servikotorasik bölgede de istatistiksel olarak anlamlı bir ilişki bulundu. Ancak pes planus ve kas gücü arasında herhangi bir ilişki bulunmadı.

Anahtar Kelimeler: Fasya, Pes planus, Tetik nokta, El kavrama gücü

ABSTRACT

Introduction: The objective was to compare the rate and localization of trigger points and muscle strength in patients with and without pes planus.

Methods: A total of 88 female patients were divided into two groups according to the presence (with the mean age of 32.50 ± 7.95) (n=52) or absence of pes planus (with the mean age of 33.5 ± 7.80) (n=36). Muscle strength was evaluated with handgrip-strength, leg-back strength. The presence of trigger points (present/absent), the pain region of trigger points (masseter muscle, cervical/thoracic/lumber regions, upper/lower extremity) and the Visual Analog-Scale for pain severity were detected.

Results: The rate of trigger points was significantly higher in the pes planus group in all regions: in the masseter muscle (p=0.042), upper extremities (p=0.006), cervicotorasic region (p=0.020), lumbar region (p=0.014), and lower extremities (p=0.020). 98.1% of the patients with pes planus were found to have at least one trigger point. The pain severity of trigger points was significantly higher in pes planus group (p=0.037). However muscle strength were found to be significantly similar between the groups.

Conclusion: A significant relationship was found between pes planus and the rate of having trigger points not only in lower extremities and lumbar region, but also in masseter, upper extremities and the servicotorasic region in females. However, any relationship were not found between pes planus and muscle strength.

Keywords: Fascia, Hand grip strength, Pes planus, Trigger point

Corresponding author: Burcu Ortanca
E-mail: burcu-ayik@hotmail.com
ORCID: 0000-0001-5421-0116
Submission date: 17.07.2023 **Accepted date:** 02.10.2023

Cite as: Bakılan F, Ortanca B, Ekim A, Onur A. The Relationship Between Pes Planus, Trigger Points And Muscle Strength. Eskisehir Med J. 2023; 4(supp): 227-231. doi: 10.48176/esmj.2023.137.

INTRODUCTION

Pes planus is a term which describes feet with a lowered medial longitudinal arch (1). Pes planus is flexible in a majority of patients and the rigid form has an occurrence of less than 1% in the community.

The relationship between pes planus and painful conditions in the lower extremities and lower back has been investigated in earlier studies. Changes have been shown in the kinematics of hip, knee and ankle (2). Pes planus has been reported to produce valgus stress in knee, medial rotation in the lower extremities, tension in the iliopsoas muscle (3,4), anterior pelvic tilt, internal hip rotation (5) and increased lumbar lordosis by increasing pronation in the subtalar joint. Pronated foot has also been reported to be possible cause of lower back pain and pain in the lower extremities by causing a shortness of gastrocnemius/soleus muscles and tension of the hamstring, erector spinea, and tensor fascia lata muscles (3,4). The deformities are not limited to the lower extremities, pelvis or lower back. These deformities may also affect the mechanics of the entire body mechanics throughout the lower extremity kinetic chain. Pes planus has been previously reported to increase not only lumbar lordosis (6) but also both cervical lordosis and thoracic kyphosis (7).

Myofascial pain syndrome is caused by trigger points on muscles and/or fasciae and is characterized by pain, muscle spasms and decreased range of motion (8,9). Its exact mechanism is still unclear and it is also unclear whether pes planus is one of the underlying mechanisms. Most of the studies evaluated the relationship between pes planus and lower limb, lumbar region pain (10-13). Zuil-Escobar et al. (10) reported that latent trigger points in lower limb muscles are common in patients with a lower medial longitudinal arch. And Ceyhan et al. (14) evaluated the relationship between pes planus and lumbar pain, thoracic and cervical pain. Considering the continuity of the thoracolumbar fascia and the extremities (15-18), there may be trigger points in muscles not only in lumbar and lower extremity regions, but also in upper extremity and neck regions in pes planus.

The aims were: 1-to compare the rate of having at least one trigger point in any muscle and localization of trigger points and 2- the strength of muscle structures in patients with and without pes planus.

METHODS

Patients and Study Design

This prospective case-controlled study was designed as a single-center study in March-June 2021 with 88 sedentary female patients who were admitted to the Physical Medicine and Rehabilitation (PMR) Outpatient Clinic with any complaint. The inclusion criteria were being female and aged between 18 and 45. Immobilized patients, patients with postural deviations such as genu recurvatum, kyphosis or scoliosis, discrepancy in leg length, rigid pes planus, any musculoskeletal surgery, trauma, bone mass or cancer, rheumatological disease, impaired cognitive status, any chronic diseases, any musculoskeletal diseases such as osteoarthritis, radiculopathy, temporomandibular disorder etc., except for myofascial pain syndrome, and who were postmenopausal were excluded from the study. Patients were divided into two groups according to the presence or absence of pes planus (the pes planus group and control group). Patients with pes planus in only one foot were also admitted into the pes planus group.

The Study Variables

A detailed anamnesis was carried out, including age, height, weight, employment, education, family and history of labor.

Pes planus was evaluated with the feiss line, which is the line from the medial malleolus to the first metatarsal joint through the tubercle of the navicular bone. These three points were marked in the sitting position. When the patient stood, if the tubercle of the navicularwas under the line, this was accepted as indicating pes planus. If the tubercle of navicular fell to the upper 1/3 of the distance between the line and the floor, this was interpreted as a first-degree pes planus; if it fell to the middle 2/3 of this distance, this was interpreted as a second-degree pes planus; if it completely touched the floor, this was interpreted as a third-degree pes planus (19).

Patients who had no pain in the musculoskeletal system were described as patients with no pain. Patients who described any pain in musculoskeletal system, were examined by a PMR specialist to identify the presence of trigger points and the location of the pain, whether in the masseter, an upper or lower extremity or the cervical/thoracic/lumber regions. To diagnose trigger points the diagnostic criteria of Travell and Simons were used. The major criteria are: 1. Complaining of localized pain; 2. Palpation of a trigger point leads to reported pain specific to the muscle; 3. Palpation of a taut band of muscle; 4. Tenderness along the length of the taut bands; 5. Decreased range of motion. The minor criteria are: 1. Palpation of the taut bands should reproduce the clinical pain; 2. Alleviation of pain after stretching or injection of the taut bands; 3. Local twitch response during mechanical stimulation of a trigger point. Patients must have all five major criteria and at least one minor criteria for diagnosis (20).

The Visual Analogue Scale (VAS) was assessed from 0 (no pain) to 10 (worst possible pain) (21).

Grip strength was measured with a hand-held dynamometer (Baseline, White Plains, New York, USA). Each measurement was carried out three times in a comfortable sitting positionwith a resting period of two minutes. The highest value of the three measurements was recorded in kilograms.

Leg-back strength was measured with a back, leg and chest dynamometer (Baseline, White Plains, New York,

USA). Each measurement was carried out three times with a resting period of two minutes. The length of the dynamometer chain was adjusted by the handle passing through the tibiofemoral joint of the patient while the knees were in extension. The patients held the handle with both hands and flexed both knees and hips between 60-90 degrees. When the lumbar lordosis reached the appropriate angle, the patients lifted the handle upwards as much as possible for three seconds. The highest value of the three measurements was recorded in kilograms (22).

Ethics committee approval was received from the Local Ethics Committee (date: 29.09.20/decision no: 34). Written informed consent was obtained from all patients.

Statistical Analysis

The distribution of each continuous variable was tested for normality using the Shapiro-Wilk test. Normally distributed variables were analyzed using the t test and are given as mean±standard deviation (SD). Non-normally distributed variables were analyzed using the Mann-Whitney U test and are given as median value (25-75%). The categorical variables are expressed in frequencies (n) and percentages (%). The chi-square test was used to compare categorical variables. A p-value < 0.05 was considered as significant. All analyses were performed using the SPSS version 22.0 software (SPSS Inc., Chicago, IL, USA).

RESULTS

88 young female patients (176 feet, the mean age of 32.95±7.89) were admitted to the study and divided into two groups: 36 patients in the control group, 52 patients in the pes planus group. 10 of these latter 52 patients had unilateral pes planus. 49 feet were first degree, 39 feet were at the second degree, and 6 feet were at the third degree. 54% of the 94 feet with pes planus had the same degree as the opposite foot, while 46% of the feet had a different degree from the opposite foot. The demographic characteristics were significantly similar between groups (Table 1).

Muscle strength variables were found to be significantly similar between the groups, however VAS of trigger points was significantly higher in the pes planus group. Furthermore, a highly significant relationship was found between the rate of trigger points and pes planus. 98.1% of the patients with pes planus were found to have at least one trigger point. The rate of having at least one trigger point was significantly higher in pes planus group than control group in all regions: in the masseter muscle (p=0.042), upper extremities (p=0.006), cervicotorasic region (p=0.020), lumbar region (p=0.014), and lower extremities (p=0.020). In the patients with pes planus the trigger points in the lower extremities were in flexor digitorum longus, tibialis anterior, and vastus medialis, while in control group they were in the tibialis anterior. In both groups most of the trigger points in the cervicotorasic region were in the upper trapezius, while all of the trigger points in lumbar region were in the quadratus lumborum. When the patients were evaluated in terms of symmetrical or asymmetrical pes planus, there were no significant difference between the variables. (Table 2).

Table 1. Comparison of demographic characteristics.

	Control (n=36)	Pes planus (n=52)	p value
Age*	33.5 ± 7.80	32.50 ± 7.95	0.555
Weight** (kg)	63 (55.5-67)	67 (59-75)	0.075
Height* (m)	1.62 ± 0.06	1.62 ± 0.06	0.692
Family (married)- n (%)	9 (25%)	15 (28.9%)	0.690
Working n (%)	16 (44.4%)	19 (36.6%)	0.456
Education (primary school / high school and more- n (%)	15 (41.7%) / 21 (58.3%)	20 (38.4%) / 32 (61.6%)	0.763
Giving birth n (%)	25 (69.4%)	31 (59.7%)	0.346

*(kg: kilograms, m: meter) *Mean ± Standart deviation **Median (25-75%)*

Table 2. Comparison of having trigger points according to different regions and variables between groups

	Control (n=36) n (%)	**Pes planus (n=52) n (%)**	**p value**
Having at least one trigger point n(%)	23 (63.9%)	51 (98.1%)	**<0.001**
Locations of trigger points n(%)			
Masseter muscle	6 (16.7%)	19 (36.6%)	**0.042**
Upper extremity	10 (27.8%)	30 (57.7%)	**0.006**
Cervicotorasic	16 (44.4%)	36 (62.2%)	**0.020**
Lomber	17 (47.2%)	38 (73.1)	**0.014**
Lower extremity	11 (30.6%)	29 (55.8%)	**0.020**
Grip strength*	26.90 ± 5.09	28.56 ± 6.19	0.216
Leg back strength**	70 (60-80)	74.50 (65.75-80)	0.256
VAS*	2.43 ± 2.35	3.32 ± 1.62	**0.037**

*(VAS: Visual analog scale) *Mean ± Standart deviation **Median (25-75%)*

DISCUSSION

Our results showed that almost all of the patients (98.1%) with pes planus were found to have at least one trigger point. A strong relationship was found between pes planus and the presence of trigger points in all parts of the musculoskeletal system including the neck, the upper extremities and the masseter muscle. However, this relationship was not found between muscle strength and pes planus.

Recent studies about fascia anatomy have reported the presence of a continuity between the deep fascia of limbs and the thoracolumbar fascia (15). In the distal part, the

continuity of the thoracolumbar fascia with the fascia lata and the gluteal fascia has been reported (16). The fascia lata and gluteal fascia continue with the crural fascia and then the plantar fascia (17), which has been shown to be thinner in pes planus (23). In addition, in the proximal part, the continuity of the thoracolumbar fascia with the latissimus dorsi and the trapezius have been shown. Moreover, a more distal myofascial expansion has been shown within the brachial fascia (18). Several myofascial expansions have been shown that cover whole body from feet to hands with anatomical continuity. Disfunction of myofascial tissues which has been triggered by a disorder or trauma could play a role in whole body pain, even if the pain locations are not immediately adjacent to the main disorder or trauma area. Casato et al. (24) published an article about the role of fascia in non-specific low back pain. Five patients with lower back pain were treated with manipulation only in the painful areas of their upper and lower extremities and it was reported that the severity of lower back pain significantly decreased in all patients. Two reasons were given for this result: the first was the continuity of the thoracolumbar fascia and the extremities; the second was the altered density of hyaluronan in the fascia which was triggered by a trauma or overuse of the extremities. Although their methodology was completely different from the current study, both studies showed that any disorder in the body can trigger a disorder in different parts of the body. The high rate of trigger points in patients with pes planus in our study may be explained by the continuity of the thoracolumbar fascia and the extremities. Furthermore the pain severity of trigger points was higher in patients with pes planus. This result is also consistent with previous studies (10,13).

From an anatomical point of view, structures such as the muscles, ligaments, bones and the fascia may potentially be affected by pes planus. Both grip strength and leg-back strength was measured to determine the effect of pes planus on the strength of muscular structures and there was no difference in values between the pes planus and control groups. This result may be related to the low severity of pain in both control and pes planus groups, as well as the absence of an effect of pes planus on muscle strength. Similar to the current study, Aydog et al. (25) reported no significant correlation between foot arch index and ankle strength in non-athletic healthy males. Also Nakao et al. (26) reported no significant relation between medial longitudinal arch height and hand grip strength, also reported as the medial longitudinal arch increased, the intrinsic foot strength decreased. Bone and muscle structures do not seem to be the means by which pes planus affects the muscle strength.

Most of the studies about pes planus have focused on the presence of pain in the lumbar region and lower extremities. Several studies have suggested that patients with lower back pain are more likely to have pes planus (11,12). Likewise, Kosashvili et al. (13) reported that severe and moderate pes planus approximately doubles the rate of intermittent lower back and anterior knee pain. Also similar to our study, Zuil-Escobar et al. (10) investigated the relation between the lower medial longitudinal arch and latent trigger points in the lower limb muscles, and reported that patients with a lower medial longitudinal arch have more latent trigger points in the lower limb muscles, including the flexor digitorum longus, tibialis anterior, and vastus medialis. Different from these studies, Ceyhan et al. (14) reported no relationship between pes planus and not only lumbar pain, but also thoracic and cervical pain in Faculty of Medicine students; they also reported lower pain rates than the current study. Our study was conducted with sedentary outpatients. However, the different results found by Ceyhan et al. (14) may also be explained by differences in the methodology used for data collection.

In the current study the degree of pes planus was determined using the feiss line. Although this is a valuable method, it would be more objective to use pedobarographic analysis or footprint methods (27). The other limitation of the current study was the lack of pain algometer as an objective tool. There is a need for further experimental studies about fascial connections that clearly demonstrate underlying mechanisms.

Conclusion

A significant relationship was found in young females between pes planus and trigger points in the whole body, including distant areas of the body such as the masseter muscle, the upper extremities and the cervicotorasic region. However pes planus does not seem to be affect hand-grip and leg-back strength.

Ethics Committee Approval: Osmangazi University Local Ethics Committee approved this study (date: 29.09.20/decision no: 34).

Informed Consent: Informed consent was provided from all patients who wanted participated in the study.

Authorship Contributions: Idea/Concept: FB, BO, AE, OA, Design: FB, BO, Supervision: AE, OA, Data collection or Processing: FB, BO, Analysis or Interpretation: FB, Literature Search: FB, Writing: FB, Critical Review: FB, BO, AE, OA, References and Fundings: -Materials: FB

Conflict of interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declare that they have no relevant financial.

REFERENCES

1. Shibuya N, Jupiter DC, Ciliberti LJ, VanBuren V, La Fontaine J. Characteristics of adult flatfoot in the United States. Foot Ankle Surg 2010; 49: 363-8.

2. Kerr CM, Zavatsky AB, Theologis T, Stebbins J. Kinematic differences between neutral and flat feet with and without symptoms as measured by the Oxford foot model. Gait posture 2019; 67:213-8.
3. Wiewiorski M, Valderrabano V. Painful flatfoot deformity. Acta Chir Orthop Traumatol Cech 2011; 78: 20-6.
4. Leung AKL, Mak AFT, Evans JH. Biomechanical gait evaluation of the immediate effect of orthotic treatment for flexible flat foot. Prosthet Orthot Int 1998; 22: 25-34.
5. Khamis A, Yizhar Z**.** Effect of feet hyperpronation on pelvic alignment in a standing position. Gait Posture 2007; 25:127-34.
6. Borges CS, Fernandes LFR, Bertoncello D. Relationship between lumbar changes and modifications in the plantar arch in women with low back pain. Acta Orthop Bras 2013;21:135-8.
7. Abdel-Raoof N, Kamel D, Tantawy S. Influence of second-degree flatfoot on spinal and pelvic mechanics in young females. Int J Ther Rehabil 2013; 20:428-34.
8. Yılmaz N, Erdal A, Demir O. A comparison of dry needling and kinesiotaping therapies in myofascial pain syndrome: A randomized clinical study. Turk J Phys Med Rehab 2020; 66:351-9.
9. Aksu Ö, Doğan YP, Çağlar NS, Şener BM. Comparison of the efficacy of dry needling and trigger point injections with exercise in temporomandibular myofascial pain treatment. Turk J Phys Med Rehab 2019; 65: 228-35.
10. Zuil-Escobar JC, Martínez-Cepa CB, Martín-Urrialde JA, Gómez-Conesa A. Prevalence of myofascial trigger points and diagnostic criteria of different muscles in function of the medial longitudinal arch. Arch Phys Med Rehabil 2015;96:1123-30.
11. Bird AR, Payne CB. Foot function and low back pain. Foot 1999; 9: 175-80.
12. Kang JH, Chen MD, Chen SC, Hsi WL. Correlations between subjective treatment responses and plantar pressure parameters of metatarsal pad treatment in metatarsalgia patients: a prospective study. BMC Musculoskelet Disord 2006;7:1-8.
13. Kosashvili Y, Fridman T, Backstein D, Safir O, Ziv YB. The correlation between pes planus and anterior knee or intermittent low back pain. Foot Ankle Int 2008; 29: 910-3.
14. Ceyhan Ç, Sanalan GB, Akkaya N, Şahin F. Evaluation of relationship between pes planus and axial pain in medical school students. Pam Med J 2017; 10: 158-64.
15. Stecco C. Functional Atlas of the Human Fascial System, Churchill Livingstone, Edinburgh, 2015.
16. Antonio S, Wolfgang G, Robert H, Fullerton B, Carla S. The anatomical and functional relation between gluteus maximus and fascia lata J Body Mov Ther 2013;17: 512-7.
17. Benjamin M. The fascia of the limbs and back a review. J Anat 2009;214:1-18.
18. Stecco C, Porzionato A, Macchi V et al. The Expansions of the Pectoral Girdle Muscles onto the Brachial Fascia: Morphological Aspects and Spatial Disposition, Cells Tissues Organs. 2007; 188:320-9.
19. Nilsson MK, Friis R, Michaelsen MS, Jakobsen PA, Nielsen RO. Classification of the height and flexibility of the medial longitudinal arch of the foot. J Foot Ankle Res 2012; 5:1-9.
20. Simons DG, Travell JG, Simons LS. Travell and Simons' Myofascial Pain and Dysfunction: The Trigger Point Manual. Vol 1. 2nd ed. Baltimore. MD: Williams & Wilkins 1999.
21. Gallagher EJ, Liebman M, Bijur PE. Prospective validation of clinically important changes in pain severity measured on a visual analog scale. Ann Emerg Med 2001; 38: 633-8.
22. Ten Hoor GA, Musch K, Meijer K, Plasqui G. Test-retest reproducibility and validity of the back-leg-chest strength measurements. IES 2016; 24:209-16.
23. Angin S, Crofts G, Mickle KJ, Nester CJ. Ultrasound evaluation of foot muscles and plantar fascia in pes planus. Gait posture 2014; 40: 48-52.
24. Casato G, Stecco C, Busin R. Role of fasciae in nonspecific low back pain, Eur J Transl Myol 2019;29:8330.
25. Aydog ST, Özçakar L, Tetik O, Demirel HA, Hascelik Z, Doral MN. Relation between foot arch index and ankle strength in elite gymnasts: a preliminary study. Br J Sports Med 2005;39:e13.
26. Nakao H, Imaoka M, Hida M, et al. Correlation of medial longitudinal arch morphology with body characteristics and locomotive function in community-dwelling older women: A cross-sectional study. Journal of Orthopaedic Surgery 2021;29: 23094990211015504.
27. Tuna H. Pedobarographic evaluation in foot disorders. Turk J Phys Med Rehab 2005;51(suppl B):51-4.

4.0 Uluslararası Lisansı ile lisanslanmıştır.