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RESEARCH

CAN FOOT PAIN AND MUSCULOSKELETAL DISORDERS BE COUNTED AS RISK FACTORS FOR FALLS IN THE ELDERLY?

ABSTRACT

Introduction: In this study, it was aimed to determine whether musculoskeletal disorders (FMDs) and/or foot pain (FP) were risk factors for falls and deteriorating health status in the elderly.

Materials and Method: Two hundred fifty five patients aged over 60 years were enrolled in the study. The elderly filled the questionnaire about FP and falling. The FMDs in the study included hallux valgus (HV), hammer toe (HT), mallet toe (MT), claw toe (CT), overlapping toe (OT), pes cavus (PC), pes planus (PP), metatarsalgia (MA) and plantar fasciitis (PF). Participants' risk of falling was assessed using The Performance-Oriented-Mobility-Assessment and the health status was measured using The Short-Form (SF)-36.

Results: A total of 255 patients with a mean age of 67.90±6.15 were examined; 175(69%) were female and 78 (31%) were male. Ninety-seven (38%) of the subjects reported FP and 103 (43.8%) patients were diagnosed as having FMDs. The most common FMD was HV (18.4%), followed by PF (15.9%), PP (13.3%), MA (12.9%), HT (7.8%), MT (4.3%), OT (3.5%), CT (1.6%) and PC (1.9%). FP, HV, PP, MA, PF, CT and OT were associated with risk of falling ($p<0.05$). There was a relationship between falls and the presence of FMD ($p<0.01$) and foot pain ($p<0.01$). PCSs of the patients with FP were lower than that of those without FP ($p<0.05$)

Conclusion: FMDs and FP should be considered as risk factors for falling in the elderly.

Key Words: Falls; Postural balance; Foot deformities; Aged.

ARAŞTIRMA

YAŞLILARDA AYAK AĞRISI VE AYAKTAKİ MUSKULOSKELETAL BOZUKLUKLAR DÜŞME İÇİN RİSK OLUŞTURABİLİR Mİ?

ÖZ

Giriş: Bu çalışmada yaşlılarda ayak ağrısı ve ayak muskuloskeletal hastalıklarının (AMH) düşme ve yaşam kalitesi üzerine etkisini araştırılması amaçlanmıştır.

Gereç ve Yöntem: Yaşları 60 üzerinde olan 255 yaşlı birey çalışmaya alındı. Yaşlılar ayak ağrısı ve düşme ile ilgili soruları içeren bir anket doldurdular. AMH içerisinde haluks valgus (HV), çekiç parmak (ÇP), tokmak parmak (TP), pençe parmak (PPr), üst üste binmiş parmak (ÜP), pes kavus (PK), pes planus (PP), metatarsalji (MA) ve plantar fasiitise yer verildi. Çalışmaya alınan yaşlıların düşme riski Performance-Oriented-Mobility-Assessment ile ve yaşam kaliteleri Kısa-Form (KF)-36 ile değerlendirildi.

Bulgular: Toplam 255 yaşlı birey ortalama 67.90±6.15 yaşında olup, 175(%69)'i kadın, 78(%31)'i erkekti. Doksan yedi(%38) bireyde ayak ağrısı ve 103(%43.8) bireyde AHM olduğu saptandı. En yaygın AHM %18.4 ile haluks valgus olup onu sırasıyla PF (%15.9), PP (%13.3), MA (%12.9), ÇP (% 7.8), TP (%4.3), ÜP (%3.5), PPr (%1.6) ve PK (%1.9) izledi. Ayak ağrısı, HV, PP, MA, PF, PPr ve ÜP ile düşme riski arasında anlamlı ilişki saptandı ($p<0.05$). Geçirilmiş düşme ile AHM varlığı ve ayak ağrısı ilişkili bulundu ($p<0.01$). KF-36'nın fiziksel skoru ayak ağrısı olanlarda olmayanlara kıyasla daha düşüktü ($p<0.05$).

Sonuç: Yaşlılarda düşme riski açısından ayak ağrısı ve AHM'nin göz önüne alınması gerekmektedir.

Anahtar Sözcükler: Düşme; Postüral denge; Ayak deformitesi; Yaşlı.

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INTRODUCTION

Falls in community-dwelling older adults have been reported to be associated with a number of risk factors such as visual impairment, cognitive decline, use of four or more medications, and environmental hazards (1). A fall is defined as 'an event whereby an individual comes to rest on the ground or another lower level with or without loss of consciousness' (2). However, the etiology of falls still remains unclear since it is often difficult to obtain a precise history of the situation before the fall (1). Foot problems are reported by approximately 30% of community-dwelling older people and are associated with impaired balance and functional ability. Although foot disorders are common and often the subject of medical attention, it is not clear whether they are associated with increased risk of falling (3,4). The requirement of the treatment of the foot pain is clearly indicated. However the musculoskeletal disorders in foot can cause functional limitation and balance defect even if there is no pain, and it may be necessary to treat these disorders (5,6).

Moreover, the patients who have minor biomechanical problems in their foot don't complain if their physical limitation may be tolerated. The foot examination may be considerably difficult because of complex anatomy. Poor foot and ankle mechanics and overuse can predispose the patient to injury (7). The most deformities of foot are acquired and they are easily corrected with the modification of shoe (8). However, the reasons and outcomes of functional deformities in foot with ageing were not adequately clarified in older population (9).

We aimed to evaluate the association between foot musculoskeletal disorders (FMDs), foot pain, falling risk and quality of life in the elderly.

MATERIALS AND METHOD

The foot examination included assessment of musculoskeletal conditions in a standing and weight-bearing positions. The foot musculoskeletal disorders (FMDs) in the study included hallux valgus (HV), hammer toe (HT), mallet toe (MT), claw toe (CT), overlapping toe (OT), pes cavus (PC), pes planus (PP), metatarsalgia (MA) and plantar fasciitis (PF). The diagnoses of FMDs were based on the clinical appearance of the foot and on radiographic evaluation under standardized weight-bearing conditions. The clinical and radiological evaluations were performed by separate clinicians: a physiatrist performed physical examination and a radiologist carried out radiographic evaluation. Patients were excluded from the study if they had a neurological or inflammatory disease or had a history of using drugs causing a balance disorder.

Two hundred and fifty five patients aged more than 60 years were enrolled in the study. All of the patients were controlled in the physical therapy and rehabilitation clinic as outpatient between September 2006 and May 2007. Foot pain was assessed with these questions: "During the last week, how often did you have foot pain?" ("Never", "occasionally", "fairly often", "very often", or "always"). "During the past four weeks, did you have foot pain on most days?" ("Yes" or "no"). A response of "fairly often"/"very often"/"always" to the first question or "yes" response to the second question were accepted as a positive proof of foot pain. Subjects were questioned about their walking frequency in a week and also whether they experienced any falls during the past 12 months.

Participants' risk of falling was assessed using The Performance-Oriented Mobility Assessment (TPOMA) (10). TPOMA test is scored on the patient's ability to perform specific tasks. Scoring of TPOMA tool is done on a three point ordinal scale with a range of "0" to "2". A score of "0" represents the highest degree of impairment whereas "2" would represent independence of the patient. The maximum score for the gait component is "12" points. The maximum score for the balance component is "16" points. The maximum total score is "28" points. In general, patients who score below 19 are at high risk for falls. Patients who score in the range of 19-24 indicate that the patient has a risk for falls (10). All participants were grouped according to TPOMA scores. TPOMA scores less than and equal to 24 were accepted as imbalance while over 24 were accepted normal.

Health status was measured using Short Form Health Survey (SF-36). The three scales of SF-36 (Physical Function, Role Physical and Bodily Pain) correlate most highly with the physical component and contribute most to the scoring of the Physical Component Summary (PCS) measure. The mental component correlates most highly with the Mental Health. Role Emotional and Social Function scales, also contribute most to the scoring of the Mental Component Summary (MCS) measure. Three of the scales (Vitality, General Health and Social Function) have noteworthy correlations with both components. Turkish version of SF 36 is shown to be reliable and valid and it is suggested that SF 36 will be very helpful in monitoring the treatment and follow-up of physically ill chronic patients (11, 12). Patients gave their informed consent and the local ethical committee approved the protocol.

Demographic data levels of quality of life, risk of falling, and pain were computed using descriptive statistical analysis. For comparison between groups student t test, Mann Whitney-U test and chi-square test were performed. Also binary logistic regression analysis for multivariate analysis of factors

effecting falling was done. Differences of $p<0.05$ were considered significant.

Results

Two hundred and fifty five patients with mean age 67.90+6.15 were examined; 175 (69%) were female and 78 (31%) were male. Ninety-seven (38%) of the subjects reported foot pain and one hundred and three (43.8%) patients were diagnosed as FMDs. The most common FMDs were 18.4% HV, 15.9% PF, 13.3% PP, 12.9% MA, 7.8% HT, 4.3 % MT, 3.5 % OT, 1.6% CT and 1.9% PC. Foot pain, HV, PP, MA, PF, CT and OT were associated with risk of falling ($p<0.05$) (Table 1). There was no FMD in 139 (54.5 %) subjects, and one FMD in 54(21.2%) subjects. Two FMDs in 45 (17.6%), 3 FMDs in 12 (4.7%), 4 FMDs in 3 (1.2%), 5 FMDs in 1 (0.4%) and 6 FMDs in 1(0.4%) subjects had together.

There was a significant relation between risk of falling and the presence of FMD ($p<0.01$) and foot pain ($p<0.01$). Seventy two of the subjects reported falling. The mean values of TPOMA score of the fallers was lower than the non-fallers (respectively 21.48±5.44, 23.44±6.47, $p<0.05$). There were no statistical difference between SF-36 profile summary scores of patients with and without FMDs. PCSs of the patients with foot pain were lower than those without foot pain ($p=0.001$) (Table 2). MA, PP and PF were associated with foot pain (respectively $p<0.01$, $p=0.013$, $p<0.01$) other FMDs were not associated with foot pain ($p>0.05$). None of the patients with FMDs have used foot orthoses.

Multivariate analysis with age, sex, body mass index, impaired balance, walking time during a week, foot pain and FMDs showed that only impaired balance was related with falls (Table 3).

Discussion

This study demonstrated that the presence of FMDs, including HV, PP, MA, PF and OT, was found responsible for increasing falling risk, which was determined by TPOMA in the elderly. A study of musculoskeletal pain in 1002 women older than 65 years revealed that the foot was the only pain site that was significantly associated with increased risk of fal-

Table 1— The Relationship of Pain and Foot Musculoskeletal Disorders with Balance in the Elderly

		Balance		
		Impaired n (%)	Normal n (%)	p
Foot pain	present	66 (25.9)	31 (12.2)	0.001
	absent	51 (20.0)	107 (42.0)	
Foot Musculoskeletal Disorders	present	78 (30.6)	35 (13.7)	0.001
	absent	39 (15.3)	103 (40.4)	
Hallux Valgus	present	35 (13.7)	12 (4.7)	0.001
	absent	82 (32.2)	126 (49.4)	
Plantar Fasciitis	present	31 (12.2)	10 (3.9)	0.001
	absent	86 (33.7)	128 (50.2)	
Metatarsalgia	present	27 (10.6)	6 (2.4)	0.001
	absent	90 (35.3)	132 (51.8)	
Pes Planus	present	27 (10.6)	7 (2.7)	0.001
	absent	90 (38.3)	131 (51.4)	
Hammer Toes	present	12 (4.7)	8 (3.1)	0.187
	absent	105 (41.2)	130 (51.0)	
Overlapping Toes	present	8(3.1)	1 (0.4)	0.008
	absent	109 (42.7)	137 (53.7)	
Claw Toes	present	4 (1.6)	0 (0)	0.043
	absent	113 (44.3)	138 (54.1)	
Mallet Toes	present	6 (2.4)	5 (2.0)	0.546
	absent	110 (43.3)	133 (52.4)	
Pes Cavus	present	3 (1.2)	2 (0.8)	0.522
	absent	114 (44.7)	136 (53.3)	

Table 2— The Relationship of Pain and Foot Musculoskeletal Disorders with SF 36 Score in The Elderly

		SF-36 Summary Score	
		PCS	MCS
Foot pain	present	32.8 (14.1-56.2)*	43.8 (21.5-67.8)
	absent	36.5 (15.2-57.4)	46.4 (17.9-69.5)
Foot Musculoskeletal Disorders	present	33.5 (14.1-57.4)	44.3 (21.5-67.5)
	absent	36.7 (15.2-55.9)	46.4 (17.9-69.5)

PCS: Physical Component Summary
MCS: Mental Component Summary
*p<0.05 there has significantly difference between PCS means of the older patients with positive and absent foot pain.

Tablo 3— Multivariate Analysis of Factors Effecting Falling in the Elderly

	OR	S.E.	Wald	p	95.0% CI
Sex (male)	0.632	0.665	0.901	0.342	1.881 (0.511-6.928)
Age	0.003	0.046	0.005	0.946	1.003 (0.917-1.097)
BMI	-0.019	0.016	1.411	0.235	0.982 (0.952-1.012)
Walking duration (weekly)	-0.092	0.096	0.914	0.339	0.912 (0.755-1.102)
FMD	-0.605	0.714	0.717	0.397	0.546 (0.135-2.214)
Impaired balance*	-1.831	0.660	7.682	**0.006**	0.160 (0.044-0.585)
Foot pain	0.496	0.573	0.749	0.387	1.643 (0.534 -5.054)
Constant	0.541	3.699	0.021	0.884	1.717

*Balance was evaluated using Tinetti Performance-Oriented Mobility Assessment (TPOMA).
FMD: foot musculoskeletal disorders.

ling (13). A previous study reported that the elderly showed kinematical alterations in both lower limb and body (14). The most common FMD was HV in the present study. Maximum force and peak pressure under the hallux region of the foot was found to be correlated with the degree of hallux valgus. The more pronounced the hallux valgus deformity, the less loading under the hallux (9).

HV may change the propulsive function of the first metatarsal joint leading a shifting of the load to the lateral (15). It is suggested that gait patterns are important quantifiable risk factors for fall in the elderly (1). Among gait patterns, abnormally low toe clearance is one of the factors that may contribute to tripping on small obstacles or surface roughness of the floor or ground. Mechanically, a shorter toe clearance can result from functional disturbance of the anterior tibial muscle during dorsiflexion (16). The major limitation of the present study is the lack of kinematic analysis and lack of measurement of joint range of motion of the feet. We suppose that FMDs may lead to these kinematical alterations or kinematical alterations may cause FMDs. We suggest that future studies be performed on FMDs and kinematical analysis.

Sato T et al, have developed rehabilitative training slipper which has a space on the top or insertion of weights made of lead beads in order to stimulate the anterior tibial muscles. The slipper has a back-strap to prevent its coming off during walking. They conclude that the rehabilitation slipper may be a useful tool for elderly patients, particularly those with gait disorders (16).

The feet are playing an important role because of supplying the direct contact to the ground. The foot contribute to absorb the shock, adapt to the irregular ground, and be formed the forward push momentum. The structural deformation of the foot has a potential to cause the breakdown at the loading distribution in the foot. The problems of musculoskeletal and neurological foot with ageing such as foot deformity decrease in range of motion, and decrease in the plantar tactile sensation may affect the plantar loading pattern (9). Several authors have confirmed that ageing is associated with reduced tactile sensitivity. Reduced tactile sensitivity caused by FMDs may lead to impaired balance in the elderly (9).

We have found that FMDs had higher rate with 43.8% in the elderly and 30.6% of the patients had risk of falling.

FMDs are common in individuals at their fourth, fifth and sixth decade of life. Age related deterioration of sensory and neuromuscular control mechanisms may also be responsible for both the musculoskeletal disorders of the foot and impaired balance. This may be due to in part to a compensation of age related decreases in muscle strength of the foot. Muscle strength was not quantitatively measured in this study. Only manual muscle strength test was performed and patients with weaker muscle structures were excluded. Several studies have suggested that foot problems may be a risk factor for falls. Three retrospective studies (17-19) have shown that older people who suffer from foot problems are more likely to have fallen in the previous 12 months. In our study, we asked patients about the number of falls that they have experienced in the last 12 months. We found that falling number is significantly higher in patients with FMDs than the others. In a prospective study of 100 men aged 65-85 years, it has been reported that undefined foot deformities were associated with a 4 fold increased risk of falling (3). Tinetti and colleagues found that the presence of a serious foot problem doubled the risk of falling in 336 people older than 75 years (3). Physiologic changes of the foot in the elderly include decreased flexibility, soft tissue atrophy and a widened forefoot. Footwear should be designed for safety and balance with financial considerations as necessary. Most foot problems in the elderly can be addressed conservatively with proper shoes and orthoses (20, 21). It is an interesting finding of the study that none of them was using proper shoes or orthoses.

In the present study, the most frequently observed FMDs were HV, PF, and PP. These disorders lead to biomechanical changes in the foot, and subsequently influence balance. It has previously been shown that foot posture and severity of hallux valgus influence loading patterns under the foot (9). As these structural factors may also be affected by age, a more detailed understanding of age related differences in foot function could be obtained by measuring both structure and function in young and older people (9).

We found that only foot pain is interfering with functional health. FMDs are not interfering with functional and mental health. A previous study reported that women with chronic and severe foot pain had more difficulty in walking and greater risk of disability in daily activities (22, 23). Lack of measurement of severity of foot pain can be considered as a limitation of the present study. It was also demonstrated that foot pain was associated with disability in daily activities (24). Another study demonstrated that many foot disorders were widespread in older adults, while some of the most prevalent conditions might not be considered serious or worthy of medical attention (25). We suppose that a significant number of falling could be prevented if the clinician and patients are more aware that FMDs may lead to falls. The present study showed that there was a significant relation with FMDs and fallings in the elderly. Logically, we would expect that uncomplicated operative or conservative correction of the FMDs should improve balance. In our study, impaired balance was found to be related with falls. Therefore, the impaired balance should be improved to prevent the fall. Falls in community-dwelling older adults have been reported to be associated with a number of risk factors. However, the etiology of falls still remains unclear since it is often difficult to obtain a precise history of the situation proceeding the fall (1). Although a significant relationship was found between falls and FMDs, in the multivariate analysis, ruling out the effects of the confounding factors, it was not statistically significant.

The SF-36 is an extensively validated generic health assessment instrument as opposed to one targeting a specific age disease or treatment group. Accordingly, the SF-36 has been useful in comparing general and specific populations comparing the relative burden of disease differentiating the health benefits produced by wide range of treatments and screening individual patients (26). There is no difference between SF-36 profile summary scores of older people with and without FMDs in our study. The PCS scores reflect the physical component of an individual's general health. The bodily pain and physical functioning scales as well as the physical component of the SF 36 score proved to be significantly lower in our patients with foot pain than without foot pain.

In conclusion, FMDs and foot pain might be considered as risk factors for falls in the elderly. However; ruling out the effects of the confounding factors, FMDs and foot pain were not significant for falls. Notwithstanding, we consider that these points must be paid attention to and time must be allocated for them during physical examination and further studies are necessary on relationship falls and FMDs or foot pain.

REFERENCES

1. Chiba H, Ebihara S, Tomita N, Sasaki H, Buter PJ. Differential gait kinematics between fallers and non-fallers in community-dwelling elderly people. Geriatrics and Gerontology International 2005; 2:127-34.
2. http://www.nice.org.uk/nicemedia/pdf/CG021fullguideline.pdf. Accessed on July 1, 2009.
3. Saari P, Heikkinen E, Sakari-Rantala R, Rantanen T. Fall-related injuries among initially 75- and 80 year old people during a 10-year follow-up. Arch Gerontol Geriatr 2007;45:207-15.
4. Menz HB, Morris ME, Lord SR. Foot and ankle risk factors for fall in older people: A prospective study. J Gerontol A Biol Sci Med Sci 2006; 61(8): 866- 70.

5. Badlissi F, Dunn JE, Link CL, Keysor JJ, McKinlay JB, Felson DT. Foot musculoskeletal disorders. Pain and foot-related functional limitation in older persons. JAGS 2005:1029-33.
6. Menz HB, Lord SR. The contribution of foot problems to mobility impairment and falls in older people. J Am Geriatr Soc 2001;49: 1651-6.
7. Kolodin EL, Vitale T, DeLisa JA, Gans BM, Walsh NE. (eds). Physical Medicine and Rehabilitation Principle and Practice. Lippincott Williams and Wilkins. Philadelphia. USA. 2005, pp 873-894.
8. Karpman RR. Foot problems in the geriatric patient. Clin Orthop Related Research 1995; 316:59-62.
9. Scott G, Menz HB, Newcombe L. Age-related differences in foot structure and function. Gait and Posture 2007;26:68-75.
10. Tinetti ME. Performance-oriented assessment of mobility problems in elderly patients. JAGS 1986;34:119-26.
11. McHorney CA, Ware JE, Raczek AE. The MOS 36-Item Short-Form Health Survey (SF-36), II: psychometric and clinical tests of validity in measuring physical and mental health constructs. Med Care 1993;31(3):247-63.
12. Demiral Y, Ergor G, Unal B, et al. Normative data and discriminative properties of short form 36(SF-36) in Turkish urban population. BMC Public Health 2006;9:247.
13. Leveille SG, Bean J, Bandeen-Roche K, Jones R, Hochberg M, Guralnik JM. Musculoskeletal pain and risk of falls in older disabled women living in the community. J Am Geriatr Soc 2002;50:671-8.
14. Benedetti MG, Berti L, Maselli S, Marianni G, Giannini S. How do the elderly negotiate a step? A biomechanical assessment. Clin Biomech 2007;22:567-73.
15. Hutton WC, Dhanendran M. The mechanics of normal and hallux valgus feet-a quantitative study. Clin Orthop Relat Res 1981;157:7-13.
16. Sato T, Ebihara S, Kudo H, Fujii M, Sasaki H, Butler JP. Toe clearance rehabilitative slipper for gait disorder in the elderly. Geriatr Gerontol Int 2007;7:310-1.
17. Barr EL, Browning C, Lord SR, Menz HB, Kendig H. Foot and leg problems are important determinants of functional status in community dwelling older people. Disabil Rehabil 2005; 27:917-23.
18. Wild D, Nayak U, Isaacs B. Characteristics of old people who fell at home. J Clin Exp Gerontol 1980;2:271-87.
19. Blake AJ, Morgan K, Bendall MJ, et al. Falls by elderly people at home prevalence and associated factors. Age Ageing 1988; 17:365-72.
20. Ko YJ, Kim YT, Kim DD. Problem-oriented history taking and physical examination of patients with foot pain. In: Kim DDJ. Wainapel SF (Eds). Foot and ankle rehabilitation. Hanley and Belfus. Philadelphia 2001, pp 439-57.
21. Guler H, Karazincir S, Turhanoglu AD, Sahin G, Balci A, Ozer C. The Effect of Coexisting Foot Deformity on Disability in Women Patients with Knee Osteoarthritis. J Am Podiatr Med Assoc 2009;99(1):23-7.
22. Leveille SG, Guralnik JM, Ferrucci L, Hirsch R, Simonsick E, Hochberg MC. Foot pain and disability in older women. Am J Epidemiol 1998;148:657-65.
23. Rubin R. Hylton B. Use of laterally wedged custom foot orthoses to reduce pain associated with medial knee osteoarthritis. J Am Podiatr Med Assoc 2005;95:347-52.
24. Benvenuti F, Ferrucci L, Guralnik JM, Gangemi S, Baroni A. Foot pain and disability older persons: An epidemiologic survey. J Am Geriatr Soc 1995;43:479-84.
25. Dunn JE, Link CL, Felson DT, Crincol MG, Keysor JJ, McKinlay JB. Prevalence of foot and ankle conditions in a multiethnic community sample of older adults. Am J Epidemiol 2004;159(5):491-8.
26. Lazarides SP, Hildreth A, Prassanna V, Talkhani I. Association amongst angular deformities in hallux valgus and impact of the deformity in health-related quality of life. Foot and Ankle Surgery 2005;11:193-6.