FOOT & ANKLE INTERNATIONAL

DOI: 10.3113/FAI.2008.0910

The Correlation Between Pes Planus and Anterior Knee or Intermittent Low Back Pain

Yona Kosashvili, MD[1,2]; Tali Fridman, MD, MHA[2]; David Backstein, MD, MEd, FRCSC[3]; Oleg Safir, MD, FRCSC[3]; Yaron Bar Ziv, MD[1]
Toronto, Canada

ABSTRACT

Background: **Anterior knee pain and intermittent low back pain are among the most common orthopedic complaints of adolescents. However, little is known about pes planus and its relative risk for these symptoms. The goal of the study was to track the prevalence of pes planus in adolescents, and examine its associated risk to anterior knee pain and intermittent low back pain, respectively.** ***Materials and Methods:*** **A retrospective study of 97,279 military recruits presenting to recruitment centers was conducted. Pes planus was graded by an orthopedist as mild, moderate or severe according to the flattening of the plantar arch and its rigidity to standing on one's toes. Anterior knee pain was diagnosed when symptoms were attributed to the patellofemoral joint. Intermittent low back pain was diagnosed when there was pain but neither abnormal clinical nor radiographic findings.** ***Results:*** **Pes planus was present in 15,698 (16%) individuals. 11,549 (74%), 3,341 (21%) and 808 (5%) were diagnosed as having mild, moderate and severe pes planus, respectively. The prevalence of intermittent low back pain was 5% in both the control and mild pes planus groups, while it was 10% in the moderate and severe pes planus groups ($p < 0.0001$). The prevalence of anterior knee pain was 4% in both the control and mild pes planus groups, while it was 7% in the moderate and severe pes planus groups ($p < 0.0001$).** ***Conclusion:*** **Moderate and severe pes planus was associated with nearly double the rate of anterior knee pain and intermittent low back pain, while mild pes planus was associated with no higher rate for these problems. Prophylactic measures may be helpful only in those adolescents with moderate and severe pes planus.**

INTRODUCTION

Pes planus is present in most infants, many children and about 15% of adults.[1] In the vast majority of the cases pes planus is flexible. The incidence of a rigid form is less than 1% in the general population.[7,8] Staheli[6] described two basic forms of flexible pes planus. Developmental pes planus occurs in infants and children as a normal stage of their development, whereas the hypermobile pes planus persists as a normal variant during adulthood.

Harris and Beath[5] in a classic Canadian army foot study showed that flexible pes planus is a benign condition. In addition, Giladi et al.[2] found soldiers with low arches to sustain fewer stress injuries. However, little is known about the influence of pes planus on lower extremity as well as spinal mechanical rotational axis and its clinical relevance.

This study was designed to examine the prevalence of pes planus in Israeli adolescents, and evaluate its association to anterior knee pain and intermittent low back pain. These symptoms are among the most common orthopedic complaints of military recruits.

MATERIALS AND METHODS

A retrospective study of 97,279 military recruits presenting to recruitment centers prior to their military service was performed. During the enlisting process in the Israel Defense Force (IDF), military recruits complete a medical questionnaire and are examined by general practitioner military doctors. Their physical examination includes screening for pes planus as well as other medical conditions. Recruits that are found to have pes planus or report any musculoskeletal symptoms are additionally examined by certified orthopedic surgeons. Subsequently, each individual receives a medical

[1] Division of Orthopedics, Assaf Harofeh Medical Center, Zerrifin, Israel
[2] Medical Corps, Israel Defense Force, Israel
[3] Orthopedic Surgery Division, Mount Sinai Hospital, Toronto, Canada

Level of Evidence: IV

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

Corresponding Author:
Yona Kosashvili, MD
Assaf Harofeh Medical Center
Orthopedic Surgery Division
155 Marlee Avenue
Toronto, Ontario M6B 4B5
Canada
E-mail: yonasofi@gmail.com
For information on prices and availability of reprints, call 410-494-4994 x226

Fig. 1: Mild Pes Planus at standing and toe rise

Fig. 2: Moderate pes planus at standing and toe rise

profile specifying his medical conditions and their grading. These conditions are recorded in the IDF medical database.

According to IDF medical grading regulations, pes planus is classified into mild, moderate and severe by using examiner visualization as described by Gould.[3] The patient stands with his or her back to the examiner. In pes planus there is a bulging noted medially near the nose of the talus with the roll-up of the outer border of the foot. Accompanying this may be rotation of the great toe, with obliquity of the toenail. In mild pes planus the longitudinal plantar arch is slightly flattened and flexible. It is regarded as flexible if it is correctible upon standing on one's toes (Figure 1). In the moderate form the longitudinal foot arch is severely flattened but the pes planus is still flexible (Figure 2), while in severe pes planus it is both flattened and rigid.

Essential anterior knee pain is defined as a patellofemoral knee pain lasting for 3 months despite medical and physical therapy, without radiographic pathologic findings on AP, lateral, and axial X-rays.

Intermittent low back pain is diagnosed when the recruit describes a medical history of recurrent lower back pain and presents appropriate medical documentation of this condition. In addition there are neither signs of nerve root irritation on physical examination, nor pathologic findings on radiological work up, if performed.

The purpose of this study was to analyze the prevalence of pes planus in the Israeli adolescent recruitment population and its association with essential anterior knee pain and intermittent low back pain, according to the above definitions. In addition, the influence of gender was also examined with regard to these parameters.

T-test was used for rate comparison. For all statistical tests, a p value of less than 0.05 was considered significant.

RESULTS

The study included 97,279 individuals, 78,941 (81%) were male and 18,338 (19%) were female. Pes planus was found in 15,698 (16.1%) recruits. Among the recruits with pes planus, 11,549 (74%) had mild pes planus, while 3,341 (21%) and 808 (5%) had moderate and severe pes planus, respectively.

The prevalence of intermittent low back pain was 5% in both the control and mild pes planus groups. Its prevalence was doubled and significantly higher ($p < 0.0001$) in both the moderate and severe pes planus groups (Table 1).

Similarly, the prevalence of anterior knee pain was significantly lower ($p < 0.0001$) in both the control and mild pes planus groups in comparison to the moderate and severe pes planus groups (Table 1).

Out of the 78,941 males in the study, 13,560 (17%) had pes planus, whereas out of the 18,338 females, only 2,137 (11%) had pes planus (Tables 2 and 3; $p < 0.0001$). Males were found to have significantly increased rates of mild, moderate and severe degrees of pes planus (12%, 4%, and 0.9% vs. 9%, 2%, and 0.3%, respectively; $p < 0.0001$; Tables 2 and 3).

Table 1: Prevelance of pes planus, low back pain, and anterior knee pain in general recruits' population

	No Low Back Pain	Low Back Pain	Number of Recruits	No Anterior Knee Pain	Anterior Knee Pain	Number of Recruits
No Pes Planus	77,171 (95%)	4,410 (5%)	81,581 (84%)	78,267 (96%)	3,315 (4%)	81,581 (84%)
	$p < 0.0001$	$p < 0.0001$		$p < 0.0001$	$p < 0.0001$	
Mild Pes Planus	11,025 (95%)	524 (5%)	11,549 (12%)	11,124 (96%)	425 (4%)	11,549 (12%)
	$p < 0.0001$	$p < 0.0001$		$p < 0.0001$	$p < 0.0001$	
Moderate Pes Planus	3,016 (90%)	325 (10%)	3,341 (3%)	3,095 (93%)	246 (7%)	3,341 (3%)
	$p < 0.0001$	$p < 0.0001$		$p < 0.0001$	$p < 0.0001$	
Severe Pes Planus	731 (90%)	77 (10%)	808 (1%)	752 (63%)	56 (7%)	808 (1%)
	$p < 0.0001$	$p < 0.0001$		$p < 0.0001$	$p < 0.0001$	
Total	91,943 (95%)	5,336 (5%)	97,279 (100%)	93,237 (96%)	4,042 (4%)	97,279 (100%)

* In all tables percentage in each row is out of the respective number of recruits
** In all tables percentage in each number of recruits column is out of the total number of recruits
p values are between rates of low back pain and anterior knee pain in control and mild pes planus groups compared to moderate and severe pes planus groups, respectively.

Table 2: Prevelance of pes planus, low back pain, and anterior knee pain in male recruits' population

	No Low Back Pain	Low Back Pain	Number of Recruits	No Anterior Knee Pain	Anterior Knee Pain	Number of Recruits
No Pes Planus	61,420 (94%)	3961 (6%)	65,381 (83%)	62,452 (96%)	2,929 (4%)	65,381 (83%)
	$p < 0.0001$	$p < 0.0001$		$p < 0.0001$	$p < 0.0001$	
Mild Pes Planus	9,389 (95%)	480 (5%)	9,869 (12%)	9,482 (96%)	387 (4%)	9,869 (12%)
	$p < 0.0001$	$p < 0.0001$		$p < 0.0001$	$p < 0.0001$	
Moderate Pes Planus	2,645 (90%)	301 (10%)	2,946 (4%)	2,712 (92%)	234 (8%)	2,946 (4%)
	$p < 0.0001$	$p < 0.0001$		$p < 0.0001$	$p < 0.0001$	
Severe Pes Planus	674 (90%)	71 (10%)	745 (0.9%)	692 (93%)	53 (7%)	745 (0.9%)
	$p < 0.0001$	$p < 0.0001$		$p < 0.0001$	$p < 0.0001$	
Total	74,128 (94%)	4,813 (6%)	78,941 (100%)	75,338 (95.44%)	3,603 (4.56%)	78,941 (100%)

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p values are between rates of low back pain and anterior knee pain in control and mild pes planus groups compared to moderate and severe pes planus groups, respectively.

This correlation between essential anterior knee pain and intermittent low back pain to the severity of pes planus was not altered by evaluating according to gender (Tables 2 and 3).

DISCUSSION

Several studies[2,4,5] indicate that there is no correlation between flexible pes planus and susceptibility to exercise induced injuries such as stress fractures or anterior knee pain. Yet, there is little scientific data in the literature regarding the associated prevalence of pes planus and essential anterior knee pain or intermittent low back pain in the adolescent population prior to military service.

Clinical as well as radiographic techniques such as visual estimation, tape measurements, ink mats and pedotopography have been described to grade the severity of pes planus.[3,5] Visual estimation as described in the methods section is the grading technique used routinely in the IDF. Since visual estimation is performed by experienced and specifically trained orthopedic surgeons, this technique's tendency for interobserver variability is minimized, although it is probably still less accurate than pedotopography.

Table 3: Prevelance of pes planus, low back pain, and anterior knee pain in female recruits' population

	No Low Back Pain	Low Back Pain	Number of Recruits	No Anterior Knee Pain	Anterior Knee Pain	Number of Recruits
No Pes Planus	15,752 (97%)	449 (3%)	16,201 (89%)	15,815 (98%)	386 (2%)	16,201 (89%)
	$p < 0.0001$	$p < 0.0001$		$p < 0.0001$	$p < 0.0001$	
Mild Pes Planus	1,635 (97%)	44 (3%)	1679 (9%)	1,641 (98%)	38 (2%)	1,679 (9%)
	$p < 0.0001$	$p < 0.0001$		$p < 0.0001$	$p < 0.0001$	
Moderate Pes Planus	371 (94%)	24 (6%)	395 (2%)	383 (97%)	12 (3%)	395 (2%)
	$p < 0.0001$	$p < 0.0001$		$p < 0.0001$	$p < 0.0001$	
Severe Pes Planus	57 (90%)	6 (10%)	63 (0.3%)	60 (95%)	3 (5%)	63 (0.3%)
	$p < 0.0001$	$p < 0.0001$		$p < 0.0001$	$p < 0.0001$	
Total	17,815 (97%)	523 (3%)	18,338 (100%)	17,899 (98%)	439 (2%)	18,338 (100%)

* In all tables percentage in each row is out of the respective number of recruits
** In all tables percentage in each number of recruits column is out of the total number of recruits
p values are between rates of low back pain and anterior knee pain in control and mild pes planus groups compared to moderate and severe pes planus groups, respectively.

Data in the literature regarding the prevalence rates of flexible (15%) and rigid (less than 1%) pes planus is essentially similar to the results in our study (15% and 0.8%, respectively).

The primary weaknesses of our study are its retrospective design and purely co relational data. However, it contains a large sample size which represents a cross sectional analysis of pes planus incidence in the Israeli adolescent population in consecutive years.

Our findings indicate that the severity of pes planus correlates with the prevalence of essential anterior knee pain and intermittent low back pain. Moderate or severe pes planus is associated with nearly double the rate of anterior knee pain and intermittent low back pain, while mild pes planus had no additional correlation for these symptoms. Moreover, in some instances mild pes planus had even lower rates of anterior knee pain and intermittent low back pain.

Males were found to have higher rates of the overall as well as of the various degrees of pes planus compared to females ($p < 0.0001$; Tables 2 and 3). Most importantly, they had three times greater prevalence of rigid pes planus (0.9% vs. 0.3%, $p < 0.0001$) than women. This may be attributed to increased soft tissue elasticity in females.

In both genders it was found that moderate and severe pes planus significantly correlated with essential anterior knee pain and intermittent low back pain, although by different rates. Yet, mild pes planus was found to have no correlation.

The increased prevalence of anterior knee pain and intermittent low back pain with severe and moderate pes planus, may imply that for both of these symptoms, it is the degree of the longitudinal arch flattening that is correlated rather than the rigidity of the pes planus. This correlation could be derived from the influence of the planus severity over the rotational mechanical axis in the weightbearing regions.

CONCLUSION

Screening for pes planus should be performed in adolescents suffering from essential anterior knee pain and intermittent low back pain. Nevertheless, prophylactic measures do not seem to be required in the vast majority of cases as they have only a mild form of pes planus, which can actually be a normal variant. In addition, more clinical data is required to determine whether prophylactic measures such as foot orthotics may be of benefit for the moderate pes planus cases.

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