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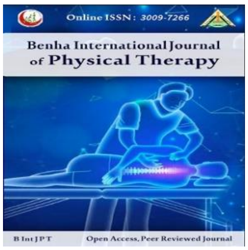

Original research

Evaluation of Balance and Ankle Proprioception in Calcaneal Spur Patients

Mai Afifi Saad Mohamed*[1], Abeer Abdelrhman Yamany[2], Mulham Mahmoud[3], Hend A Hamdy[4]

1.Demonstrator of Physical Therapy, Basic Science Department, Faculty Physical Therapy, Banha University
2. Professor of Physical Therapy, Basic Science Department, Faculty of Physical Therapy, Cairo University
3.Professor of Orthopedic Surgery , Faculty of Medicine ,Cairo University
4.Lecturer of Physical Therapy, Basic Science Department ,Faculty of Physical Therapy, Cairo University

***Correspondence to**
Dr. Mai Afifi Saad, Demonstrator of Physical Therapy, Basic Science Department.
E-mail: maiafifi85@gmail.com

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Abstract

Background: A plantar calcaneal spur (PCS) is an atypical osseous projection located at the inferior aspect of the calcaneus. Heel spurs can alter natural posture and may lead to complications such as back pain. Increased pain correlates with elevated proprioceptive inaccuracies and diminished balance and functional mobility. **Purpose:** We aim to compare the balance and proprioception of individuals with PCS and age-matched controls. **Methods:** A cross-sectional study conducted at Cairo University's Faculty of Physical Therapy involved 46 participants, including 23 patients with PCS and 23 healthy individuals. Static balance was assessed through a single-leg stance balance test, dynamic balance was assessed through the Biodex balancing system, foot function was quantified by the foot pain index, and proprioception was tested with the ankle active reposition test employing a digital inclinometer. **Results:** There was a statistically significant change in the static balance test during open-eyes results across both groups ($P = 0.005$), which indicates that the control group (group A) scored higher thanental group (group B). There was a significant change in dynamic balance regarding overall stability index score and anteroposterior (AP) and mediolateral(ML) stability index score between both groups ($P \leq 0.05$). The experimental group scored higher than the control group. There was a significant change in pain, disability, and activity limitation score among the two groups ($P \leq 0.05$), which indicates that the experimental group scored higher than the control group. **Conclusion**: According to the study, as compared to healthy subjects, patients with plantar calcaneal spur had considerably worse static and dynamic balance, foot pain, and functional performance.

Key words: Balance,Calcaneal spur,Pain, Proprioception.

Introduction

A calcaneal spur, also called enthesophyte, is an osseous protrusion located in the inferior aspect of the calcaneus, representing the most prevalent location for bony spur formation. While it is well accepted that a calcaneal spur is a prevalent source of heel discomfort, over 20% of calcaneal spurs are without symptoms, and the underlying pathophysiology is not completely explained. [1] The most of confirmed cases have been hypothesized under the theory of vertical compression, which correlates with the significant link between elevated Body Mass Index and its rising occurrence with advancing age.[2]

Numerous risk factors contribute to the development of heel spurs, including obesity, flatfoot, microtrauma, age, and certain athletic activity such as running, leaping, and ballet. Calcaneal spur is a prevalent etiology of heel discomfort.[1]

Planter calcaneal spur can alter natural posture during walking and, over time, may lead to complications such as back pain and knee pain.[3] Elevated pain correlates with heightened proprioceptive inaccuracy and diminished balance and functional mobility. Prior research has demonstrated that pain is a substantial element that might elevate fear of movement and limit motor control.[4]

Plantar fasciitis (PF) is a chronic degenerative illness that results in discomfort at the medial aspect of heel and leading to about roughly one million medical consultations annually. Individuals suffering with PF undergo discomfort that is most acute during their initial steps of the day or following extended periods of standing.[5]Plantar fasciitis, a common musculoskeletal disorder, is characterized by inflammation of the plantar fascia, a thick band of tissue that connects the heel bone to the toes. The plantar fascia plays a crucial role in supporting the arch of the foot and absorbing shock during movement.[6]

Planter calcaneal spur was observed in 89% of patients with PF, in contrast to 32% in age- and gender-matched asymptomatic controls. Several authors have indicated that plantar heel spur is a major contributor to heel pain associated with PF.[7,8] while others claim that plantar heel spur arises from continuous traction forces on the plantar fascia, leading to chronic inflammation, and the osteogenesis of the bone spur.[9]

Ankle Joint position Sense (JPS) denotes the capacity to properly sense and replicate the spatial location of the ankle joint.[10] Balance, conversely, involves the positional stability of the ankle joint during both static and dynamic activity.[11] Individuals with plantar fasciitis employ compensatory techniques to alleviate the pain experienced at the origin of the plantar fascia. These compensations alter joint position sense perception and muscle activations, resulting in body oscillations that hinder the preservation of an upright posture within the base of support (BOS). This may impact static and dynamic balance as well as proprioception[12] .Deficits in ankle proprioception may render subjects susceptible to instability, falls, and further orthopedic problems. Considering that pain and structural alterations linked to calcaneal spurs might modify sensory input and motor responses, evaluating proprioception and balance in these individuals is essential for developing successful rehabilitation programs.[13]

Although its clinical significance, few research have comprehensively investigated the degree of balance and proprioceptive impairments in subjects with calcaneal spurs.the study aims to assess these factors to enhance comprehension of the functional limits caused by PCS and to enhance treatment strategies designed to improve patient outcomes.the current study aimed to examine balance and proprioception between individuals who had plantar calcaneal spurs and age-matched controls.

Methods

Study design

A cross-sectional observational research was conducted at the outpatient clinic of the Faculty of Physical Therapy at Cairo University.Forty Six both genders subjects were participated in the study, aged between 40 and 60 years.All participants signed an informed consent document subsequent a comprehensive explanation of the objectives, advantages, and dangers associated with the research. The participants were categorized into two groups:Group A is a control group consists of 23 healthy subjects"and Group B is a study group consists of 23 participants diagnosed with PCS by an orthopedic expert.

Subjects

Participants in the research group were chosen based on the existence of unilateral calcaneal spur, pain, and inflammation at the bottom of the heel or the location where the spur is present.[14] Participants experienced acute, knife-like pain in the heel upon rising in the morning, as well as intense discomfort with initial steps after prolonged periods of rest and dispersing when weight bearing is started.[14] All diagnosed patients were assessed and validated radiologically by a specialist physician by carrying out of a standard

X-ray foot profile image. The calcaneal spur appears radiologically as a bony exostosis on the sagittal scan, protruding inferomedially from the calcaneus.[15] Participants were excluded if they had undergone ankle surgery due to a fracture within the last 6 months and sensory or motor paralysis, received ankle steroid injections within the last 3 months and lower limbs difference of ≥ 1 cm and systemic diseases in the past six months that might affect an individual to heel pain (e.g., rheumatoid arthritis and lupus).[14]

Procedure

The research ethics committee of the Faculty of Physical Therapy certified the study protocol (NO: P. T. REC/012/005501), and it was registered with the Clinical Trial Registry (NCT06740617). Prior to testing, the study's objectives and methodologies were thoroughly described to the participants, and signed informed consent was collected. Upon participants' consent to engage in the research, their general characteristics were documented, the eligability criteria were validated, and study measures were conducted.

Instrumentations and procedures for evaluation:

1) Balance biodex system (BBS)

The Balance biodex system, Version 3.1, has been utilized to assess postural balance. The Balance biodex system is multiaxial equipment that objectively evaluates and documents the participant's capacity to steady the affected joint under dynamic stress. It employs a circular platform capable of simultaneous movement along the anterior-posterior and medial-lateral axes.[16] Unilateral standing with eyes open for a duration of 20 sec was evaluated.. Stability levels were established at 8 level.[17] and participants were directed to sustain their center of pressure inside the smallest concentric zones (balancing areas) of the BBS monitor, referred to as Zone A. Initially, participants were positioned on the secured platform of the BBS. The stability platform was unlocked to provide motion in order to evaluate the foot position coordinates and determine the optimal foot location for the individuals during testing. Participants were directed to modify the foot's location until they achieved a state of platform stability. The platform was thereafter locked, testing proceeded upon its release, and participants were instructed to keep a steady standing posture. To accomplish the trial, equilibrium must be sustained for 20 seconds. All participants had one minute of training to adapt to the machine, followed by three practice trials with a 5-second intertrial rest interval to mitigate any learning effects. A mean score was determined from the three trials.[18]

2) Using the Foot Pain Index (FFI)

the impact of foot disease on function including pain, disability, and activity limitation was investigated.[19] .The range of dependability for the FFI subscale and total scores is 0.87 to 0.69.[20] Nineteen Disability (5 items), activity limitation (9 items), and pain (9 items) were the three subscales that comprise the questionnaire's 23 items. A visual analogue scale was used to answer each question, making it easier to convert any given score from 0 to 10. The FFI % was calculated by summing the subscale scores, dividing by 230, and multiplying by 100. A higher value indicates greater severity of discomfort or limitation in foot function[21].

3) The single-leg stance balance test (SLS)

was utilized to evaluate static balance and functional capability.[22] The SLS test Replace the word by reliability has been recorded as 0.89 with open eyes and 0.86 with closed eyes.[23] Participants were told to stand on the affected foot while positioning their hands on the iliac crests. They were instructed to elevate the heel of one foot and maintain a stationary posture with their eyes open, followed by a repetition with their eyes closed for 30 seconds, during which time was recorded. The interval between each repetition was 10 seconds.[24] Errors comprised hands elevated from the iliac crests and compensatory modifications, such as the displacement of the ball of the non-dominant foot. The test was conducted twice, and the superior result was documented.[25]

4) Digital inclinometer

The Digital Inclinometer Pro 360 was utilized to evaluate ankle proprioception.[26] The inclinometer has shown high to excellent reliability (ICC > .088).[27] The participant was instructed to actively perform 10 repetitions of full ranges of dorsiflexion (DF) and plantar flexion (PF) of the ankle. The examiner positioned the participant's foot into DF or PF at angles of 10 degrees and 15 degrees, commencing from the neutral position.[28]

The achieved position corresponded to the intended angle. The participants were directed to sustain that position for 15 sec and commit it to memory. The angle was determined by positioning the inclinometer on the plantar surface of the foot. Every participant was instructed to actively move the ankle ten times. Subsequently, the examiner returned the foot to its neutral position (0 degrees of DF and PF), and participant was instructed to actively replicate the intended angle from memory with maximal accuracy. The participants indicated that they had arrived at the specified location by stating "YES." The disparity between the original and final angles, referred to as the reposition error, was identified as joint reposition error.Three trials were conducted, and their means were noted as the final result.[29]

Sample size calculation:

Version 3.1.9.7 of the G*power program was employed to identify the sample size, which was conducted depending on applied pilot study along with the outcomes that were reported.[17] A previous power analysis was performed with an α error probability of 0.05 and a power (1-β beta error probability) of 0.95. The minimal sample size for the investigation was 46 subjects.

Statistical analysis

SPSS software version 22 was used to conduct all statistical analyses. The data was checked for homogeneity using Levene's test, which indicated that the data was homogenous. The significance level for all statistical analyses was determined at $P < 0.05$. Related to age, weight, height, BMI, static balance (SLS) (30 sec), dynamic balance (Biodex) (postural stability test), and joint reposition test (digital inclinometer).

The data was explored for normality using the Shapiro-Wilk test, which indicated that it was normally distributed. The Unpaired T-test was employed to compare the two groups.

Related to (FFT index): The Shapiro-Wilk test was applied to determine the data normality, revealing a non-normal distribution. The Mann-Whitney U test was utilized to compare the two groups.

Results

Participants' Characteristics:

The data reported no significant variation across both groups regarding the participants' characteristics, including age, weight, height, and BMI ($p > 0.05$) **(Table 1)**.

Table 1. Comparison of characteristics between both groups

	Group A (n:23) Control	Group B (n:23) Experimental	p-value	t-value
	$\bar{x}$ ± SD	$\bar{x}$ ± SD		
Age (years)	50.38±6.1	49.9±6.2	0.803	0.251
Weight (kg)	82.1±8.7	82.8±10.7	0.838	0.206
Height (cm)	166.7±7.2	166.8±6.4	0.946	0.068
BMI (kg/m²)	29.3±2.3	29.2±2.6	0.951	0.062

Mean, SD: Standard deviation, p-value: Probability value, *: significance $\bar{X}$

Between-Group Analysis

1-Static Balance open and closed test (Single leg stance test, 30 sec)

There was a statistically significant change in open eye test results across both groups (P= 0.005), which revealed that group A had a high score compared to group B while there was no significant difference in closed eye test result between the two groups (P= 0.123) (Table 2).

Table 2. Comparison between groups A and B regarding opened eye test

Opened eye test	Group A (n:23) Control	Group B (n:23) Study	Comparison between groups	
x̄ ± SD	27.3±1.7	25.3±2.5	F-value	P-value
SE	0.4	0.6	2.942	0.005*
MD Between group	1.95			
Closed eye test	Group A (n:23) Control	Group B (n:23) Study	Comparison between groups	
x̄ ± SD	5.7±2.2	4.6±2.5	F-value	P-value
SE	0.5	0.5	2.477	0.123
MD Between group	1.143			

Mean, SD: Standard deviation, SE: Standard Error, p-value: Probability value, *: significance, MD: Mean difference

2- Dynamic Balance (Biodex, postural stability test)

There was a significant change across both groups in the overall stability index score (P= 0.00012), (AP) stability index score (P= 0.005), and (ML) stability index score (P= 0.007), which indicated that group B (study group) had a higher level than group A (control group) **(Table 3).**

Table 3. Comparison between both groups regarding postural stability test

overall stability index score	Group A (n:23) Control	Group B (n:23) Study	Comparison between groups	
			F-value	P-value
x̄ ± SD	2.28±0.75	3.21±0.67	18.064	0.00012*
SE	0.16	0.14		
MD Between group	-0.93			
AP stability index score	Group A (n:23) Control	Group B (n:23) Study	Comparison between groups	
			F-value	P-value
x̄ ± SD	1.795±0.599	2.376±0.657	8.956	0.005*
SE	0.13	0.14		
MD Between group	-0.581			
ML stability index score	Group A (n:23) Control	Group B (n:23) Study	Comparison between groups	
			F-value	P-value
x̄ ± SD	1.624±0.577	2.21±0.739	8.198	0.007*
SE	0.13	0.16		
MD Between group	-0.586			

Mean, SD: Standard deviation, SE: Standard Error, p-value: Probability value, *: significance, MD: Mean difference

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3- Joint reposition test (Digital inclinometer)

There was no significant change across both groups in closed eye at angles of (10 degree) test result (P= 0.493) and in closed eye at angle of (15 degree) test result (P= 0.411) **(Table 4).**

Table 4. Comparison between both groups regarding Joint reposition test

Closed eye (10) test result	Group A (n:23) Control	Group B (n:23) Study	Comparison between groups	
			F-value	P-value
x̄ ± SD	-1.76±2.68	-1.19±2.67	0.478	0.493
SE	0.59	0.58		
MD Between group	0.571			
closed eye (15) test result	Group A (n:23) Control	Group B (n:23) study	Comparison between groups	
			F-value	P-value
x̄ ± SD	-0.9±2.3	-0.19±3.2	0.689	0.411
SE	0.51	0.6		
MD Between group	0.71			

Mean, SD: Standard deviation, SE: Standard Error, p-value: Probability value, *: significance,
MD: Mean difference

4- Foot function index (FFT index)

There was a significant change across both groups in pain score (P≤0.05), disability score (P≤0.05), activity limitation score (P≤0.05), and total score (P≤0.05) which indicated that group B (experimental group) had a higher score than group A(control group) **(Table 5).**

Table 5. Comparison between groups A and B regarding Foot function index scores

Pain score	Group A (n:23) Control	Group B (n:23) Study	Comparison between groups	
			Z-value	P-value
x̄ ± SD	8.6±1.7	43±4.4	-5.569	P≤0.05
SE	0.4	0.9		
MD Between group	34.4			
Disability score	Group A (n:23) Control	Group B (n:23) Study	Comparison between groups	
			Z-value	P-value
x̄ ± SD	4.5±3	21.6±1.5	-5.576	P≤0.05
SE	0.7	0.3		
MD Between group	17.1			
Activity limitation score	Group A (n:23) Control	Group B (n:23) Study	Comparison between groups	
			Z-value	P-value
x̄ ± SD	27±4.1	48.5±6.4	-5.556	P≤0.05
SE	0.9	1.4		
MD Between group	21.5			
Total score (100)	Group A (n:23) Control	Group B (n:23) Study	Comparison between groups	
			Z-value	P-value
x̄ ± SD	13.1±2.2	37.3±3.2	-5.567	P≤0.05
SE	0.5	0.6		
MD Between group	24.2			

x̄: Mean, SD: Standard deviation, SE: Standard Error, p-value: Probability value, *: significance,
MD: Mean difference

DISCUDSSION

The current study aimed to examine balance and proprioception among subjects with PCS and age-matched controls. The results indicated statistically significant difference in static balance with open eyes, dynamic balance, and foot function index (FFI) scores; however, no significant difference was seen in static balance with closed eyes or joint repositioning test results evaluated by a digital inclinometer.

The current results may be due to that Patients with heel spurs often experience heel pain during walking and other activities to alleviate discomfort, they tend to walk more slowly, take shorter steps, and spend less time on the affected foot. These pathomechanical adaptations naturally result in reduced step cadence as patients adopt these strategies to protect the painful area. Individuals with heel spurs also demonstrate a higher double support time compared to the healthy group. Heel pain during weight-bearing activities, especially walking, leads patients to spend less time on the affected foot and distribute their weight more evenly between both feet.[3] ,also Heel spurs can alter natural posture during walking and, over time, may lead to complications such as back pain and knee pain.[3] Pain impacts the somatosensory system, resulting in diminished balancing capability. Furthermore, the pathways for balance control and muscular inhibition induced by pain overlap some routes within the central nervous system. Consequently, pain-induced muscle inhibition processes might negatively impact balancing capabilities.[30]

Furthermore, PF might compromise balance owing to the discomfort experienced in the plantar fascia. Individuals with PF employ compensatory methods to mitigate the discomfort experienced at the origin of the plantar fascia. They often have an antalgic gait pattern, characterized by reduced heel contact duration with the ground and increased support on the lateral and anterior aspects of the foot. These compensations alter joint position perception and muscle activations, resulting in body oscillations that hinder the preservation of an upright posture within BOS. This may compromise both static and dynamic equilibrium.[16]

According to Richer and Fortin (2022).[30] ,who studied the influence of PF on postural control and walking in young middle-aged adults. Clinical foot measures had shown no significant change across the groups, with exception of pain palpation in the plantar fasciitis group. The fasciitis group had worse postural control, particularly during difficult balance tests, and alterations in walking patterns during three velocities.[31]

Additionally, Jalalvand (2024)[3] examined the variations in spatiotemporal gait parameters between healthy people and patients with plantar fasciitis. The results show that those with heel spurs walk more slowly than those in the healthy group. These people walk more slowly to keep their balance because they have poorer postural control.[3] A separate research assessed fifty individuals under the age of 65. The study revealed that postural balance was compromised, particularly in the anteroposterior plane, leading to an elevated risk of falls among young-adult patients with plantar fasciitis condition, with no significant differences seen between groups in static and dynamic ML balance assessments.[19] Experimental group's balance deterioration may be due to calcaneal spur, a result of long-term stress on plantar fascia[32] and foot muscles, possibly due to plantar fasciitis. This can lead to muscular weakness, reduced fascia flexiility, and tension in the Achilles tendon, causing proprioception impairment and poor postural balance.[31]

Sajja, et al.,(2023)[33] presents a case of 47-year-old male diagnosed with PF and a calcaneal spur. The findings indicate that plantar fasciitis and calcaneal spurs can cause significant chronic heel pain.[32] Menz et al. (2019)[34] studied the relationships between PCS, PF thickening, and plantar heel pain (PHP), concluding that both PCS and PF thickening are linked with plantar heel pain. PHP is a prevalent condition linked to activity restrictions, depression, and diminished quality of life.[34]

The results of the present study concurred with those of Gonçalves et al. (2020)[10], who examined functional performance with static and dynamic balance in individuals with and without PF. The researchers determined that individuals with PF had reduced reach distances in the Star Excursion Balance Test (SEBT), indicating a deficiency in dynamic balance and functional capacity relative to control individuals.[10]

Landorf et al. (2022)[35] evaluated health-related quality of life (HRQoL) in people with and without PHP, comprising adults of both sex from Australia. The researchers determined that significant changes existed between both groups for foot-specific HRQoL, namely in Visual Analogue Scale pain (first step pain, mean pain, and mean pain over the last 7 days), the FHSQ (all domains), and the FFI-R (all sub-scales)[35]. A particular study investigated gender-related differences in range of motion and balance in the lower limbs, revealing that decreased ROM of the plantar flexors may adversely affect overall balance.[36] This research contrasts with another by examining the dynamic balance of athletes with PF against those without, indicating that no significant difference exists in their dynamic balance[37].

Patients with heel spurs exhibited significantly reduced balance performance and altered plantar pressure distribution. These impairments were attributed to changes in plantar fascia thickness, heel pad elasticity, and localized pain, which collectively compromise sensory input and motor control mechanisms essential for maintaining stability.[38] The (ROM) of the ankle joint is a crucial component of the human kinetic chain, significantly influencing postural balance and gait, and it is a fundamental element in lower limb injuries and ankle injuries in sports. Other investigations indicated that insufficient dorsiflexion (DF) may result from various ankle joint problems, including dorsiflexor weakness, plantar flexor spasticity, passive stiffness of the plantar flexors, or ambulation restrictions. The reduction of ankle joint range of motion affects several facets of function and balance.[36]

Hansen et al. (2018)[39] discovered that (first step pain, current average pain, and average pain over the last 7 days) was significantly more severe in the plantar heel pain group, with effect sizes rated considerable for all three measures. The occurrence of initial pain (discomfort in heel upon initially getting out of bed) is indicative of (PHP), as everyday pain intensified with exercise and pain can persist for several years in certain individuals.[39] .The findings of the present study rejected the hypothesis that calcaneal spur with plantar fasciitis does not significantly affect static and dynamic balance, foot pain, and functional performance in comparison to healthy individuals.

Limitations

The study was limited by body mass index Range of Participants as study included participants with (BMI) less than or equal to 32, due to the limited availability of cases with an ideal BMI (<29). This may have introduced potential confounding effects, as higher BMI can independently influence balance. Also, Unspecified Onset Duration: The exact duration of symptom onset was not included as a criterion, which may have resulted in variability in symptom chronicity among participants. This could have influenced the severity of balance impairment observed.

CONCLUSION

According to the current study, as compared to healthy subjects,patients with calcaneal spur and plantar fasciitis had considerably worse static and dynamic balance, foot pain, and functional performance.

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Conflict of interest:

The authors declare no Conflicts of interest

References

1. Alatassi R, Alajlan A, Almalki T. Bizarre calcaneal spur: A case report. International Journal of Surgery Case Reports [Internet]. 2018 Jan 1;49:37–9. Available from: https://doi.org/10.1016/j.ijscr.2018.06.006

2. Velagala VR,Velagala NR, Kumar T, Singh A, Mehendale AM. Calcaneal Spurs: a potentially debilitating disorder. Cureus [Internet]. 2022 Aug 28;14(8);Available from: https://doi.org/10.7759/cureus.28497

3. Shahbazi MA, Jalalvand A. Comparison of Spatiotemporal Gait Variables Between Healthy Individuals and Patients with Heel Spur During Walking. Deleted Journal [Internet]. 2024 Nov 1;10(3):230–40. Available from: https://doi.org/10.61186/jsportbiomech.10.3.230

4. ALMohiza MA, Reddy RS, Asiri F, Alshahrani A, Tedla JS, Dixit S, et al. The Mediation Effect of Pain on the Relationship between Kinesiophobia and Lumbar Joint Position Sense in Chronic Low Back Pain Individuals: A Cross-Sectional Study. International Journal of Environmental Research and Public Health [Internet]. 2023 Mar 15;20(6):5193. Available from: https://doi.org/10.3390/ijerph20065193

5.Thompson JV, Saini SS, Reb CW, Daniel JN. Diagnosis and management of plantar fasciitis.

Journal of Osteopathic Medicine [Internet]. 2014 Dec 1;114(12):900–1. Available from: https://doi.org/10.7556/jaoa.2014.177
6.Ali Q, Long Y, Ali M. Prevalence, causes, and treatment of plantar fasciitis in young females of a medical college. Bulletin of Faculty of Physical Therapy [Internet]. 2024 Aug 21;29(1). Available from: https://doi.org/10.1186/s43161-024-00195-6
7.Johal KS, Milner SA. Plantar fasciitis and the calcaneal spur: Fact or fiction? Foot and Ankle Surgery [Internet]. 2011 Apr 18;18(1):39–41. Available from: https://doi.org/10.1016/j.fas.2011.03.003
8.DuVRIES HL. Heel Spur (Calcaneal Spur). A M a Archives of Surgery [Internet]. 1957 Apr 1;74(4):536. Available from: https://doi.org/10.1001/archsurg.1957.01280100054008
9.Vyce SD, Addis-Thomas E, Mathews EE, Perez SL. Painful prominences of the heel. Clinics in Podiatric Medicine and Surgery [Internet]. 2010 Jul 1;27(3):443–62. Available from: https://doi.org/10.1016/j.cpm.2010.04.005
10.Yang N, Waddington G, Adams R, Han J. Joint position reproduction and joint position discrimination at the ankle are not related. Somatosensory & Motor Research [Internet]. 2020 Apr 2;37(2):97–105. Available from: https://doi.org/10.1080/08990220.2020.1746638
11.Alsakhawi RS, Elshafey MA. Effect of Core Stability Exercises and Treadmill Training on Balance in Children with Down Syndrome: Randomized Controlled Trial. Advances in Therapy [Internet]. 2019 Jul 12;36(9):2364–73. Available from: https://doi.org/10.1007/s12325-019-01024-2
12.Gonçalves GA, Kamonseki DH, Martinez BR, Nascimento MA, Lombardi I Junior, Yi LC. Static, dynamic balance and functional performance in subjects with and without plantar fasciitis. Fisioterapia Em Movimento [Internet]. 2017 Mar 1;30(1):19–27. Available from: https://doi.org/10.1590/1980-5918.030.001.ao02
13.Munn J, Sullivan SJ, Schneiders AG. Evidence of sensorimotor deficits in functional ankle instability: A systematic review with meta-analysis. Journal of Science and Medicine in Sport [Internet]. 2009 May 13;13(1):2–12. Available from: https://doi.org/10.1016/j.jsams.2009.03.004
14.Dudoniene V, Balnytė M, Kuisma R. Comparison of static balance and gait between subjects with plantar fasciitis and age-matched controls. Journal of Back and Musculoskeletal Rehabilitation [Internet]. 2022 Nov 15;36(2):477–84. Available from: https://doi.org/10.3233/bmr-220092
15.Beytemür O, Öncü M. The age dependent change in the incidence of calcaneal spur. Acta Orthopaedica Et Traumatologica Turcica [Internet]. 2018 Aug 29;52(5):367–71. Available from: https://doi.org/10.1016/j.aott.2018.06.013
16.Arifin N, Osman NAA, Abas WABW. Intrarater Test-Retest reliability of static and dynamic stability indexes measurement using the Biodex Stability System during unilateral stance. Journal of Applied Biomechanics [Internet]. 2014 Apr 1;30(2):300–4. Available from: https://doi.org/10.1123/jab.2013-0130
17.Ağırman M. Evaluation of balance and fall risk in patients with plantar fasciitis syndrome. SiSli Etfal Hastanesi Tip Bulteni / the Medical Bulletin of Sisli Hospital [Internet].20181;53(4):426-429.
18.Karimi N, Ebrahimi I, Kahrizi S, Torkaman G. Evaluation of postural balance using the biodex balance system in subjects with and without low back pain. Pak J Med Sci 2008;24(3):372-7.
19.Budiman-Mak E, Conrad KJ, Mazza J, Stuck RM. A review of the foot function index and the foot function index – revised. Journal of Foot and Ankle Research [Internet]. 2013 Jan 1;6(1). Available from: https://doi.org/10.1186/1757-1146-6-5
20.Budiman-Mak E, Conrad KJ, Roach KE. The foot function index: A measure of foot pain and disability. Journal of Clinical Epidemiology [Internet]. 1991 Jan 1;44(6):561–70. Available from: https://doi.org/10.1016/0895-4356(91)90220-4
21.Martinez BR, Staboli IM, Kamonseki DH, Budiman-Mak E, Yi LC. Validity and reliability of the Foot Function Index (FFI) questionnaire Brazilian-Portuguese version. SpringerPlus [Internet]. 2016 Oct 18;5(1). Available from: https://doi.org/10.1186/s40064-016-3507-4
22.Drusini AG, Eleazer GP, Caiazzo M, Veronese E, Carrara N, Ranzato C, et al. One-leg standing balance and functional status in an elderly community-dwelling population in Northeast Italy. Aging Clinical and Experimental Research [Internet]. 2002 Feb 1;14(1):42–6. Available from: https://doi.org/10.1007/bf03324416
23.Goldberg A, Casby A, Wasielewski M. Minimum detectable change for single-leg-stance-time in older adults. Gait & Posture [Internet].

2011 Mar 28;33(4):737–9. Available from: https://doi.org/10.1016/j.gaitpost.2011.02.020
24.Perez-Cruzado D, González-Sánchez M, Cuesta-Vargas AI. Parameterization and reliability of single-leg balance test assessed with inertial sensors in stroke survivors: a cross-sectional study. BioMedical Engineering OnLine [Internet]. 2014 Aug 30;13(1): 13-127 Available from: https://doi.org/10.1186/1475-925x
25.Barrett E, McCreesh K, Lewis J. Intrarater and interrater reliability of the flexicurve index, flexicurve angle, and manual inclinometer for the measurement of thoracic kyphosis. Rehabilitation Research and Practice [Internet]. 2013 Jan 1;2013:1–7. Available from: https://doi.org/10.1155/2013/475870
26.Han J, Waddington G, Adams R, Anson J, Liu Y. Assessing proprioception: A critical review of methods. Journal of Sport and Health Science/Journal of Sport and Health Science [Internet].2015 Feb3;5(1):80–90.
27.Roach S, Juan JGS, Suprak DN, Lyda M. CONCURRENT VALIDITY OF DIGITAL INCLINOMETER AND UNIVERSAL GONIOMETER IN ASSESSING PASSIVE HIP MOBILITY IN HEALTHY SUBJECTS [Internet]. 2013;8(5):680-8.
28.Alfaya FF, Reddy RS, Alshahrani MS, Tedla JS, Dixit S, Gular K, et al. Investigating the Mediating Role of Pain in the Relationship between Ankle Joint Position Sense and Balance Assessed Using Computerized Posturography in Individuals with Unilateral Chronic Ankle Instability: A Cross-Sectional Study. Applied Sciences [Internet]. 2023 Jul 13;13(14):8169.
29.Shetty S, Eapen C, Prabhakar AJ. CHANGES IN ANKLE PROPRIOCEPTION WITH SEVERITY OF OSTEOARTHRITIS OF KNEE. Journal of Musculoskeletal Research [Internet]. 2022 Jul 16;26(03).
30.Eker Y, Kaygısız B. The effect of pain severity on balance, postural stability and fall risk in patients with shoulder pathologies. Archives of Medical Science [Internet]. 2020 May 22;17(2):390–6. Available from: https://doi.org/10.5114/aoms.2020.94491
31.Richer L, Fortin E, Gagnon G, Ngomo S, Fernandes KBP, Cortis C, et al. Impact of plantar fasciitis on postural control and walking in young middle-aged adults. The Foot [Internet]. 2022 Nov 4;53:101951.
32.Agyekum EK, Ma K. Heel pain: A systematic review. Chinese Journal of Traumatology [Internet]. 2015 Jun 1;18(3):164–9.
33.Sajja S, Elahi N, Ganti L. Plantar fasciitis with a calcaneal spur. Cureus [Internet]. 2023 Dec 28;15(12).
34.Menz HB, Thomas MJ, Marshall M, Rathod-Mistry T, Hall A, Chesterton LS, et al. Coexistence of plantar calcaneal spurs and plantar fascial thickening in individuals with plantar heel pain. Lara D Veeken [Internet]. 2018 Aug 7;58(2):237–45.
35.Landorf KB, Kaminski MR, Munteanu SE, Zammit GV, Menz HB. Health-related quality of life is substantially worse in individuals with plantar heel pain. Scientific Reports [Internet]. 2022 Sep 19;12(1). Available from: https://doi.org/10.1038/s41598-022-19588-5
36.Sung ES, Kim JH. Relationship between ankle range of motion and Biodex Balance System in females and males. Journal of Exercise Rehabilitation [Internet]. 2018 Feb 26;14(1):133–7.
37.Budihartanto NWA, Putra NHL, Wardhani NIL, Prawitri NYD, Setiawati NR. Comparison of Dynamic Balance between East Java Puslatda Athletes with Plantar Fasciitis and without Plantar Fasciitis. Indian Journal of Forensic Medicine & Toxicology [Internet]. 2021 May 17;15(3):4610–4.
38.Taş S, Bek N. Effects of morphological and mechanical properties of plantar fascia and heel pad on balance performance in asymptomatic females. The Foot [Internet]. 2018 Mar 1;36:30–4.
39.Hansen L, Krogh TP, Ellingsen T, Bolvig L, Fredberg U. Long-Term prognosis of plantar fasciitis: A 5- to 15-Year follow-up study of 174 patients with ultrasound examination. Orthopaedic Journal of Sports Medicine [Internet]. 2018 Mar 1;6(3).

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