Original Article

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Assessment of Calcaneal Morphology and Radiological Parameters in Haglund's Syndrome

Haglund Sendromunda Kalkaneus Morfolojisi ile Radyolojik Ölçümler Arasındaki İlişkinin Değerlendirilmesi

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ABSTRACT

Objective: To compare the radiological parameters of the normal population with the patients with Haglund's syndrome (HS) and to seek a correlation between pain scores and radiological parameters in patients with HS.

Methods: Thirty-one patients surgically treated for HS (Haglund group) and 36 healthy subjects free of hindfoot pathology seen in consultation for any other foot pathologies (control group) were included in the study. Demographic data of the patients were acquired, and radiological measurements such as; Fowler Philip Angle (FPA), lateral talus-first metatarsal angle (LTFMA), and Calcaneal pitch angle (CPA) were recorded. The visual analog scale (VAS) and the American Orthopaedic Foot & Ankle Society (AOFAS) scores of the patients in the Haglund group were assessed.

Results: Mean CPA, FPA, and LTFMA in the Haglund group were 23.88±4.6, 58.16±5.7, and 4.92±1.88, respectively, and the same recordings in the control group were 21.16±4.81, 59.1±4.3, and 4.25±2.57, respectively. CPA differences between Haglund and control groups were statistically significant (p=0.021). The average values of the VAS and AOFAS scores of the patients in the Haglund group were 8.45±1.06 and 47.4±7.58, respectively. There was no correlation between the scores and the radiological measurements of

ÖZ

Amaç: Bu araştırmadaki amacımız normal popülasyonun radyolojik ölçümlerini, Haglund sendromlu (HS) hastalarla karşılaştırmak ve HS hastalarda ölçümsel değişimlerin ağrı ve fonksiyonel skorlar üzerindeki etkisini incelemektir.

Yöntemler: HS nedeniyle cerrahi tedavi uygulanan 31 hasta (Haglund grubu) ve diğer ayak patolojileri için konsültasyonda görülen arka ayak patolojisi olmayan 36 sağlıklı birey (kontrol grubu) çalışmaya dahil edildi. Hastaların demografik verileri sorgulandı ve radyolojik ölçümler olarak; Fowler Philip açısı (FPA), lateral talus-birinci metatarsal açı (LTFMA) ve kalkaneal eğim açısı (CPA) ölçümleri yapıldı. Haglund grubundaki hastaların ayrıca görsel analog ölçeği (GAÖ) ve Amerikan Ortopedik Ayak ve Ayak Bileği Derneği (AOFAS) skorları değerlendirildi.

Bulgular: Haglund grubunda ortalama CPA, FPA ve LTFMA sırasıyla 23,88±4,6, 58,16±5,7 ve 4,92±1,88, kontrol grubunda ise sırasıyla 21,16±4,81, 59,1±4,3 ve 4,25±2,57 olarak bulundu. Haglund ve kontrol grupları arasındaki CPA farklılıkları istatistiksel olarak anlamlıydı (p=0,021). Haglund grubundaki hastaların GAÖ ve AOFAS skorlarının ortalama değerleri sırasıyla 8,45±1,06 ve 47,4±7,58 idi. Haglund grubundaki hastaların skorları ve radyolojik ölçümleri arasında anlamlı korelasyon bulunamadı.

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patients in the Haglund group.

Conclusion: Radiological assessments are widely debated. Many studies support our results that measurements defined for the morphology of calcaneus are not associated with the Haglund's disease severity. Increase in the CPA is found to be related to HS. This may be explained by the extension of the calcaneus to irritate the Achilles tendon and cause heel pain.

Keywords: Calcaneal pitch angle, Fowler Philip Angle, Haglund's syndrome, lateral talus-first metatarsal angle

Sonuç: Radyolojik değerlendirmelerin Haglund sendromu üzerindeki etkisi halen tartışılmaktadır. Pek çok çalışma, kalkaneus morfolojisi için tanımlanan ölçümlerin Haglund hastalığı ile ilişkisi olmadığı yönündeki sonuçlarımızı destekler niteliktedir. CPA'daki artışın HS ile ilişkili olduğu bulunmuştur. Bu, Kalkaneus'un Aşil tendonunu direkt yaralayacak şekilde ekstansiyona gelmesi ve topuk ağrısına neden olmasıyla açıklanabilir.

Anahtar Sözcüker: Kalkaneal eğim açısı, Fowler Philip açısı, Haglund sendromu, lateral talus-birinci metatarsal açı

Introduction

Heel pain is a clinical condition that is quite common in almost every decade of life. Due to various differential diagnosis, correct treatment is hard to decide. Haglund's syndrome (HS) is the most common reason of heel pain. It was first described in 1927 as retrocalcaneal bursitis caused by posterior calcaneus's superior bony prominence (1). Over time, painful heel conditions such as; retrocalcaneal bursitis, supracalcaneal bursitis, and Achilles tendinitis were also defined as HS. Although the cause is unknown; etiological factors, including wearing tight shoes and repetitive trauma, are blamed. To understand and predict HS, several different measurement techniques have been reported in the literature, unfortunately none of these methods have been consistent or reliable to be associated with Haglund's deformities (2).

This retrospective study aims to compare the radiological parameters of the normal population with the patients diagnosed as having HS to measure the reliability of the radiological parameters in the diagnosis of Haglund's disease. We hypothesized that increased abnormality of the radiological parameters would associate with more pain and decreased functionality in patients with HS.

Methods

Patients

After acquiring ethical committee approval, 31 patients treated with the diagnosis of HS over a 5-year period between January 2014 and September 2019, and 36 healthy subjects without hindfoot pathologies who were seen at the consultation for other foot pathologies, were included in the study. Informed consent was signed by all of the included patients. The Haglund group consisted of 17 female and 14 male patients, with a mean age of 47.61 years (range, 31-68 years), with 16 right and 15 left feet. Inclusion criteria comprised calcaneal insertion pain on palpation of the posterior tuberosity and distal calcaneal tendon insertion, calcaneal hump, irritation of adjacent skin by shoe wear back-strip, painful pre or retro-calcaneal bursitis, and radiologic enthesophytes. The control group consisted of 24 female and 12 male patients, with a mean age of 44.7 years (range, 18-68 years), with 17 right and 19 left feet. These patients had no posterior heel pain and hindfoot pathology or radiographic enthesophytes in the calcaneal insertion region. The exclusion criteria were as follows; history of foot surgery, foot implant, amputation of part of the foot, fractures, injury requiring cast or surgery, calcaneal tendon body tendinopathy, posterior impingement, osteochondral defect, neuromuscular pathology, diagnosed as having muscle or skeletal abnormalities, inflammatory rheumatism, osteoarthritis, congenital foot deformity, paralysis or current pregnancy. The exclusion criteria were the same in both groups. Visual analog scale (VAS) and AOFAS scores were recorded only for patients in the Haglund group.

The study was approved by the local ethics committee (date 16/07/2020 and decision number 2020-10) and was conducted in line with the principles of the Declaration of Helsinki.

Imaging

A standard lateral radiograph of the weight-bearing foot, also including ankle, was taken. All radiographs were available digitally in our database. The software available in our system was radiographically able to measure angles with a precision of two decimal points. The following angles were recorded from the lateral radiographs: Fowler Philip angle (FPA), lateral talus-first metatarsal angle (LTFMA, Meary's angle), and calcaneal pitch angle (CPA).

The FPA is subtended by a tangent to the posterior edge of the greater tuberosity of the calcaneus and a line between the lowest weight-bearing point of the posteromedial tuberosity and the end of the calcaneocuboid joint line (Figure 1). Normal values range between 44° and 69°, and the values >75° are considered pathological (3). CPA is the angle determined by the intersection of the baseline tangent to the anterior tubercle and the medial tuberosity with the horizontal surface (Figure 2). The normal

Figure 1. The fowler philip angle

range is 17-32 (4). LTFMA is the angle created between the bisection of the first metatarsal and a line perpendicular to a line connecting the anterodorsal and anterior-plantar extremes of the talar head (Figure 3). The positive value indicates the talus is plantarflexed according to the first metatarsal. The negative value indicates pes planus (5).

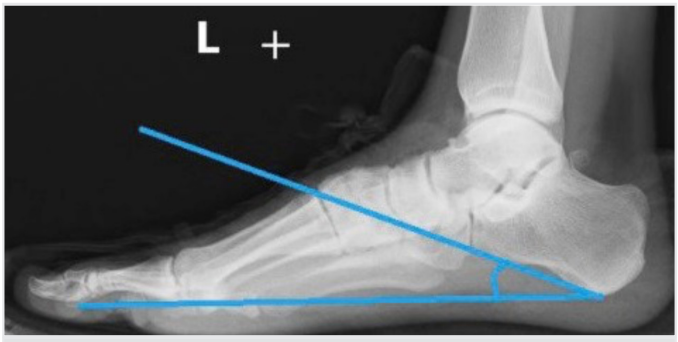

Figure 2. The calcaneal pitch angle

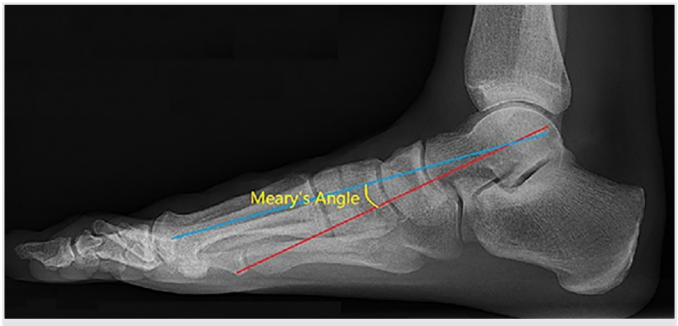

Figure 3. The lateral talus-first metatarsal angle

To determine interobserver reliability, radiologic measurements were made by 2 independent observers (orthopedic surgeons). To assess intra-observer reliability, measurements were made twice by each observer at a minimum 14-days interval. Measurements were made independently by the two observers, blind to the patient's group, known only to the principal investigator.

Statistical Analysis

The data obtained in this study were analyzed with IBM Statistical Package for Social Sciences (SPSS) Statistics 26 software (SPSS Inc., Chicago, IL, USA). The normality of the distribution for the variables was tested with the Kolmogrov-Smirnov test. The comparison of the means' values from two variables with normal distribution was performed with Independent Samples t-test. To evaluate intra-and inter-observer reliability, Pearson correlation analysis was used according to the normality test results. In the evaluation of the correlation coefficient, r:=0-0.24 was considered as poor, r=0.25-0.49 as moderate, r=0.50-0.74 as strong, and r=0.75-1.0 as very strong. Quantitative data were expressed as mean, standard deviation, minimum and maximum values. The confidence interval was 95%, a p-value less than 0.05 was considered statistically significant.

Results

Mean CPA, FPA, and LTFMA in the Haglund group were 23.88±4.6, 58.16±5.7, and 4.92±1.88, respectively, and the same recordings in the control group were 21.16±4.81, 59.1±4.3, and 4.25±2.57 respectively. There was no significant difference between the Haglund and control groups in terms of FPA and LTFMA (p=0.47, p=0.22). However, CPA was found significantly higher in the Haglund group (p=0.021). All the results are summarized in Table 1.

Table 1. Range, average, median, SD, and p value of control and Haglund groups

Measurements	Haglund group				Control group				p-value
	Min	Max	Mean	SD	Min	Max	Mean	SD	
FPA	49.7	70.3	58.16	5.7	50.7	67.1	59.1	4.3	0.47
CPA	15.3	32.1	23.88	4.6	11.7	32.4	21.16	4.81	0.021
LTFMA	1.3	9.1	4.92	1.9	-3.5	9.9	4.25	2.56	0.22

FPA: Fowler Philip angle, LTFMA: Lateral talus-first metatarsal angle, CPA: Calcaneal pitch angle, SD: Standard deviation, Min: Minimum, Max: Maximum

Table 2. FPA, CPA, and LTFMA measurements stratified by gender and group

Measurements		Haglund group		Control group	
FPA		Male	Female	Male	Female
	Means	57.7±6.27	58.6±5.34	59±4.74	59.13±4.16
	p-value	0.525		0.987	
CPA		Male	Female	Male	Female
	Means	25.41±4.2	22.62±4.7	21.62±5.4	21±4.6
	p-value	0.074		0.854	
LTFMA		Male	Female	Male	Female
	Means	5.37±1.33	4.56±2.21	3.68±3.43	4.53±2.03
	p-value	0.218		0.906	

FPA: Fowler Philip angle, LTFMA: Lateral talus-first metatarsal angle, CPA: Calcaneal Pitch angle

Table 3. Haglund group's means of VAS and AOFAS scores

VAS Score	Male	Female	Total
Means (std)	8.36±0.84	8.53±1.23	8.45±1.06
Min-max	7-10	6-10	6-10
AOFAS Score	-	-	-
Means (std)	48.21±5.32	46.71±9.15	47.4±7.58
Min-max	37-54	32-63	32-63

VAS: Visual analog scale, AOFAS: American Orthopaedic Foot & Ankle Society, std: Standard, Min: Minimum, max: Maximum

Gender and age showed no correlation with the radiological parameters (CPA, FPA, and LTFMA) in both groups (Table 2).

The average values of the VAS and AOFAS scores of the patients in the Haglund group were 8.45±1.06 and 47.4±7.58, respectively. Statistical evaluation of the patients' VAS and AOFAS scores in Haglund group showed no correlation with CPA, FPA, and LTFMA measurements. Also, there was no significant difference in terms of the AOFAS and VAS scores of the patients in the Haglund group between genders (p=0.393 and p=0.509, respectively) (Table 3).

Discussion

HS is one of the many causes of chronic posterior heel pain and is usually characterized by a posterosuperior bony prominence of the calcaneus, which is also defined as Haglund's deformity (6). There are various radiological parameters used to measure the bursal projection of calcaneus in the literature, such as; Fowler Philip angle, Angle of Steffensen and Evensen, and the parallel pitch lines (7). However, the relationship between any of these measurement techniques and symptomatic posterior heel pain is unclear. FPA angle (> 75 degrees), with a "prow-like" projection of the posterosuperior prominence of the calcaneus and painful swelling of the soft tissues surrounding the Achilles tendon insertion, were found to be related (3). However, it was also reported that the CPA or vertical inclination of the calcaneus might be more theoretically relevant than FPA in the HS (8).

Lu et al. (9) and Fiamengo et al. (10) found that the radiographic measurement techniques associated with heel pain were inconsistent and not reliable enough to assist in the decision making for surgery. Heneghan and Pavlov (11) also observed 100% false-negative results using FPA. Ruch (12) and, Fugslang, and Torup (13) observed 86 to 88% false-negative results while using FPA. Also, Fugslang and Torup (13) observed wide range of FPA variations in the non-Haglund group. Similarly, in other studies, FPA measurement below 75 degrees was detected at rates ranging from 86% to 100%, and high false-negative ratios were reported (9,11-13).

Our study analyzed and compared the radiographic measurements of LTFMA, CPA, and FPA of patients with HS with the normal population. FPA, LTFMA, and CPA are considered to be indicators of foot shape (14). We hypothesized that the presence of high arch or cavus foot will irritate Achilles tendon due to the positioning of the calcaneus and exacerbate HS. According to our hypothesis, CPA and FPA will be used to detect calcaneal positioning and LTFMA will be used for detecting cavus foot. An increase in CPA and FPA would cause the calcaneus' posterosuperior tubercle to become more prominent and thus, the Achilles tendon and retro-calcaneal bursa would be more irritated. According to our current knowledge, no previous study had reported comparison of both CPA, FPA and LTFMA in the normal population with the patients with HS .

In our study, there was no significant difference between the Haglund group (58.16±5.7) and the control group (59.1±4.3) in terms of FPA (p=0.47). In the Haglund group, there was no patient with FPA more than 75 degrees, and 100% false-negative results were observed using FPA in our study so that our study was compatible with the findings of the studies of Fiamengo et al. (10) and Pavlov et al. (8) in this respect.

Singh et al. (15) concluded that CPA was increased in 57% of the control group and 63% of patients with Haglund's deformity. Bulsara et al. (4) reported that CPA was significantly (p=0.021) higher in the Haglund group (22.14±4.74) than in the control group (20.28±5.12). Similarly, in our study, CPA was higher in the Haglund group (23.69±4.64) than in the control group (21.16±4.81). Although this value was within the normal range for CPA, it was higher than the normal control group, and this difference was statistically significant (p=0.021). Our study is compatible with the findings of Bulstra et al. (4) and Singh et al. (15) in this respect.

The LTFMA > + 4° is an indication of the cavus foot (6). In our study, the average LTFMA of the Haglund group was higher than the patients in the normal population (4.92±1.88 and 4.25±2.57, respectively). Although there is no statistically significant difference (p=0.22), this situation, together with increased CPA, shows that the arch height of the patients' feet in the Haglund group is higher than in the control group, which can be attributed as a predisposing factor for the HS. The LTFMA in the normal population was reported as 4±5.5 in the study of Thomas et al. (16) and 5.5±3.9 in the study of Lamm et al. (17). Ahn et al. (6) reported that the lateral LTFMA and CPA were higher in patients with symptomatic HS. Researchers measured LTFMA as 5.9±5.0 preoperatively, and 6.3±4.7 postoperatively in patients with HS, and they reported that postoperative LTFMA was increased, but this increase was not statistically significant. However, only patients with symptomatic HS were included in this study, and patients in the normal population were not evaluated. Unlike the other studies, radiological parameters were measured in normal and Haglund groups and were compared in our study. Our findings have shown that LTFMA is not suitable for the assessment of the HS because of the difficulty in the measurement of LTFMA as it is in a narrow range, but increased CPA may be an indicator of HS.

Study Limitations

Our study's reliability among observers was 0.902 for FPA, 0.874 for CPA, and 0.662 for LTFMA. The observers' reliability was higher between the observers for FPA and CPA, and this was similar to the previous studies. (4,9,18) Although reliability

within the observer increases with observer experience, we believe that the selected measurements should be easy to teach to acquire higher reliability (18).

Conclusion

Our results showed that LTFMA and CPA were higher in patients with symptomatic HS than in the normal population. This was statistically significant in CPA but not in LTFMA, but there was no correlation between the increment of CPA in regard of pain and functional status (VAS and AOFAS) of the Haglund group. We think that the measurement of CPA is more important in patients with heel pain. Bursal projection in a cavus foot is more prominent due to a more vertical calcaneus, even with a normal FPA. Increasing the vertical angle of the calcaneus increases the dorsal prominence of the bone and creates an important pathogenic factor. This situation can lead to an inflammatory process caused by relatively increased traction in the tendon. In other words, a dorsiflexed calcaneus may cause heel pain and HS.

The study's retrospective nature, the relatively small number of patients involved and unavailability of MRI were limitations of the study. Studies with a larger number of patients using more adequate radiographic tools such as 3D CT scans may give more insight into the increase in the vertical angle of the calcaneus, the relationship between HS and cavus foot deformity, and the pathological formation in the calcaneus. Also, MRI could be useful to exclude other pathologies that might cause heel pain to homogenize the population.

In conclusion, in everyday practice of an orthopedic foot and ankle surgeon, Haglund's deformity is an important part of heel pain complaints; although the posterolateral calcaneus's swelling is seen on physical examination, it is not possible to distinguish the orientation of the calcaneus. In our study, HS was found to be associated with a higher CPA, but the pain intensity and functionality were not correlated with the increment of CPA. Although the clinical symptoms are the main indicators of the HS, radiological measurements especially showing the cavus deformity should be taken into account as an auxiliary tool to start the medication or decide on surgery.

Ethics

Ethics Committee Approval: The study was approved by the local ethics committee (decision number: 2020-10 and date:16/07/2020) and was conducted in line with the principles of the Declaration of Helsinki.

Peer-review: Externally peer reviewed.

Authorship Contributions

Surgical and Medical Practices: K.B., B.K., G.A., M.U.M., Concept: K.B., L.A., B.K., G.A., M.U.M., Design: B.K., O.Y., G.A., M.U.M., Data Collection or Processing: K.B., L.A., B.K., O.Y., G.A., Analysis or Interpretation: L.A., O.Y., Literature Search: K.B., L.A., B.K., Writing: K.B., L.A., B.K., M.U.M.

Conflict of Interest: The authors declared no conflicts of interest.

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