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Evaluation of the Prevalence of Os Trigonum and Talus Osteochondral Lesions in Ankle Magnetic Resonance Imaging of Patients With Ankle Impingement Syndrome

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ABSTRACT

The prevalence of os trigonum and osteochondral lesions of talus (OCLT) have been presented in different prevalences among different groups in the literature for the patients with ankle impingement syndrome. Our main objective in the study was to determine the possible relationship between the impingement syndrome and the prevalence of os trigonum and OCLT in specific groups. The presence of anterior ankle impingement syndrome (AAIS), posterior ankle impingement syndrome (PAIS), os trigonum, OCLT, and the location of OCLT were evaluated in a blinded manner on magnetic resonance imaging from patients clinically considered to be diagnosed with ankle impingement syndrome from January 2014 to July 2017. The patients were separated into specific groups according to the confirmation of their clinical diagnosis of ankle impingement syndrome on magnetic resonance imaging . A total of 333 patients were included. The prevalence of os trigonum was found to be 1.3% in patients with PAIS(-) AAIS(+), 7.7% in patients with PAIS(-) AAIS(-), 63.3% in patients with PAIS(+) AAIS(-), and 81.1% in patients with PAIS(+) AAIS(+) ($p < .001$). The prevalence of OCLT was found to be 41.3% in patients with PAIS(-) AAIS(+), 23.1% in patients with PAIS(-) AAIS(-), 18.3% in patients with PAIS(+) AAIS(-), and 27% in patients with PAIS(+) AAIS(+) ($p = .005$). Our study showed that, for patients with isolated PAIS and AAIS combined with PAIS, the prevalence of os trigonum was 63.3% and 81.1%, respectively, which is more common than previously reported. For patients with isolated AAIS and PAIS, the prevalence of OCLT was 41.3% and 18.3%, respectively. Of the OCLTs combined with ankle impingement syndromes, 87.1% were medially located.

Anterior ankle impingement syndrome (AAIS) and posterior ankle impingement syndrome (PAIS) can frequently cause pain in the ankle. AAIS is characterized by pain in the anterior region of ankle with dorsiflexion. There is an impingement of the abnormal bone or soft tissue in the anterior region of the tibiotalar joint with dorsiflexion (1,2). PAIS is characterized by pain in the posterior region of the ankle with plantar flexion. There is an impingement of the abnormal bone or soft tissue in the retrocalcaneal region with plantar flexion. Especially for PAIS, the pathology causing the impingement may be related to anatomic variations (3). The most important anatomic variation that may be related to impingement is the presence of os trigonum (4). Os trigonum is observed as a separate bone in the posterior of the lateral tubercle of the posterior talar process. Os trigonum can occur as a result of the fusion defect of the secondary ossification center of the talus observed between the ages of 8 and 13 years (5,6).

Os trigonum was first defined by Rosenmuller (7) in 1804 as an accessory ossicle. Its relationship to posterior ankle pain was first reported by McDougall (8) in 1955. In the previously conducted anatomic dissection and radiography studies, the prevalence of os trigonum was reported to be 1.7% to 12.7% (4,9–11). In a study by Zwiers et al (12) in 2017 with computed tomographic images, the prevalence of os trigonum was reported to be 32.5% (12). The prevalence of os trigonum was reported to be 30.3% in patients without posterior impingement complaints and 46.4% in patients with posterior impingement complaints.

Osteochondral lesions of talus (OCLT) were first defined by Kappis in 1922 (13). The incidence of OCLT is reported as 0.09% (14). The etiology of OCLT is not fully known. Acute traumas and recurrent microtraumas are reported as the cause with prevalences of 50% and 73% (6,15–18). Laterally located lesions are associated with trauma at a rate of 98% (19). They are observed more prevalently among young men (20,21). Although OCLT is prevalently asymptomatic, it generally presents with not very specific pain increasing with activity in the ankle anterior (22).

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Pain may occur during the examination with plantar flexion and dorsiflexion, depending on the location of the lesion.

Ankle impingement syndromes are problems we come across frequently in the orthopaedic outpatient clinic. As far as we know, there is no study in the literature to determine the prevalence of os trigonum and OCLT in specific groups formed by evaluating AAIS and PAIS patients together. The objective of our study was to determine the prevalence of os trigonum and asymptomatic or minimally symptomatic OCLT in patients diagnosed with AAIS and/or PAIS through clinical examination and magnetic resonance imaging (MRI) and to evaluate the difference between the groups. Our hypothesis is that the risk posed by os trigonum to PAIS can be more accurately evaluated in comparison with AAIS.

Patients and Methods

Patients who were clinically considered to be diagnosed with ankle impingement syndrome and had ankle MRIs in 2 centers between January 2014 and July 2017 and who met the study inclusion criteria were included in the study. The predefined study inclusion criteria were:

1. Not having ankle major trauma and instability history
2. Persistence of complaints after ≥3 weeks of conservative treatment (nonsteroidal anti-inflammatory medication, rest, lifestyle/activity modification, cold application)
3. Being >13 years old (because the fusion of the secondary ossification center of talus may not be completed until the age of 13)
4. Being <65 years old (to exclude patients developing degenerative arthritis)
5. Not having positive findings in MRI other than the findings related to impingement (fractures, degenerative arthritis, avascular necrosis, Achilles tendon pathologies, Haglund's deformity, tarsal tunnel syndrome, sinus tarsi syndrome, and bone narrow edema unrelated to impingement)
6. Having a body mass index of <35 kg/m^2

Demographic information, clinical findings, and provisional diagnoses of the patients were acquired from the hospital medical records. There were 333 patients whose MRIs and medical records were acquired and who met the inclusion criteria who were included in the study. All patients included in this study were examined by the authors in 2 different hospitals. Both patients' records and MRIs were assessed by the authors separately. The positivity of AAIS and PAIS of the patients were determined by blind observation of the clinical findings and MRI images (Fig.). The presence of os trigonum and OCLT, and the location of OCLT were additionally evaluated on MRI. Positive MRI findings for AAIS were considered as capsular and synovial thickening, osseous spur, soft tissue edema, bone narrow edema in talus and tibia anterior, and fluid increase in the anterior tibiotalar joint (23–25). Patients who were clinically considered as having AAIS and who had any of these MRI findings were accepted as AAIS(+). Positive MRI findings for PAIS were considered as capsular and synovial thickening, os trigonum existence, soft tissue edema, bone narrow edema in talus/tibia posterior and calcaneus, fluid increase in posterior tibiotalar and subtalar joint, and fluid increase around the flexor hallucis longus tendon (23–25). Patients who were clinically considered as having PAIS and who had any of these MRI findings were accepted as PAIS(+). The presence of os trigonum on MRI was considered as the presence of a separate bone in the posterior of the lateral tubercle of the posterior talar process, regardless of the type or size of the os trigonum.

The average age of the 333 patients included in the study was 41.5 ± 13.1 (range 15 to 64) years. Of the patients, 51.1% were female. For 52.8% of the patients, the affected side was the right ankle. There were 260 patients considered to be AAIS(+) and 97 patients to be PAIS(+) (Fig.). The prevalence of os trigonum and OCLT was evaluated among these patients (Tables 1–2). Afterwards, 72 patients with os trigonum were evaluated in comparison with the patients without os trigonum, and 116 patients with OCLT were evaluated in comparison with the patients without OCLT. The differences between the patients in terms of age, gender, affected side, AAIS prevalence, PAIS prevalence, os trigonum, or OCLT presence were evaluated (Tables 1–2). Finally, patients were separated into groups according to ankle impingement symptoms, and the groups were evaluated according to the prevalence of os trigonum and OCLT. The first grouping was PAIS(+)/PAIS(-)/AAIS(+)/AAIS(-). The second grouping was PAIS(+)AAIS(+)/PAIS(+)AAIS(-)/PAIS(-)AAIS(-)/PAIS(-)AAIS(+) (Table 3).

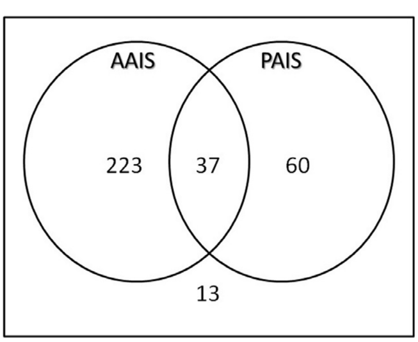

Fig. Distribution of patients according to ankle impingement syndromes. AAIS, anterior ankle impingement syndrome; PAIS, posterior ankle impingement syndrome.

Table 1
Patient and group characteristics by presence of os trigonum

Characteristic	No. (%)	Os Trigonum (+)	Os Trigonum (-)	*p* Values
Patients	333	72 (21.6)	261 (78.4)	
Age (y)	41.5 ± 13.1 (15-64)	37.3 ± 12.6 (15-64)	42.7 ± 13 (15-64)	.002*
Sex				.039*
Male	163 (48.9)	43 (59.7)	120 (46)	
Female	170 (51.1)	29 (40.3)	141 (54)	
Side				.18
Right	176 (52.8)	33 (45.8)	143 (54.8)	
Left	157 (47.2)	39 (54.2)	118 (45.2)	
AAIS	260 (78.2)	33 (45.8)	227 (87)	<.0001*
PAIS	97 (29.1)	68 (94.4)	29 (11.1)	<.0001*
OCLT	116 (34.8)	21 (29.2)	95 (36.4)	.25
Medial	101 (87.1)	18 (85.7)	83 (87.4)	
Lateral	11 (9.5)	2 (9.5)	9 (9.5)	
Central	4 (3.4)	1 (4.8)	3 (3.1)	

Abbreviations: AAIS, anterior ankle impingement syndrome; PAIS, posterior ankle impingement syndrome; OCLT, osteochondral lesion of the talus.
Data are presented as mean ± standard deviation (minimum-maximum) or no. (%).
* $p < .05$.

SPSS (Version 21.0; SPSS Inc, Chicago, IL) was used in the statistical analysis, and the χ^2 test was used for the relationship between AAIS and PAIS and the dual evaluation between the groups. In the calculation of the mean values and standard deviations for all variables, the relative risk (RR) and frequency values were also calculated using the same software. Interobserver correlation for diagnosis was tested between the 2 authors. Each observer was blinded to the other observer's diagnosis for the interobserver correlation. In the intraobserver analysis, 1 observer was blinded to his own prior diagnosis. The intraclass correlation coefficient was used to determine both interobserver and intraobserver correlations. To assess os trigonum and OCLT associated with ankle impingement syndromes, univariate and multivariate analyses where odds ratio with 95% confidence intervals (CIs) have been calculated were performed for each patient population, evaluating each variable. For all comparisons, statistical significance was reported at the value of $p \le .05$ level (2-tailed).

Results

In this study, 21.6% of patients had os trigonum, 34.8% had OCLT, 78.1% had AAIS, and 29.1% had PAIS. In the comparison of patients with

Table 2
Patient and group characteristics by OCLT existence

Characteristic	No. (%)	OCLT (+)	OCLT (-)	*p* Values
Patients	333	116 (34.8)	217 (65.2)	
Age	41.5 ± 13.1 (15-64)	40 ± 12.9 (15-60)	42.4 ± 13.2 (15-64)	.118
Sex				.683
Male	163 (48.9)	55 (47.4)	108 (49.8)	
Female	170 (51.1)	61 (52.6)	109 (50.2)	
Side				.1
Right	176 (52.8)	54 (46.6)	122 (56.2)	
Left	157 (47.2)	62 (53.4)	95 (43.8)	
AAIS	260 (78.2)	102 (87.9)	158 (72.8)	.002*
PAIS	97 (29.1)	21 (18.1)	76 (35)	.001*
Os trigonum	72 (21.6)	21 (18.1)	51 (23.5)	.255

Abbreviations: AAIS, anterior ankle impingement syndrome; PAIS, posterior ankle impingement syndrome; OCLT, osteochondral lesion of talus.
Data are presented as mean ± standard deviation (minimum-maximum) or no. (%).
* $p < .05$.

Table 3
View of os trigonum and OCLT prevalences in specific groups by ankle impingement syndromes

Characteristic	Os trigonum (+) (n = 72)	*p* Values	OCLT (+) (n = 116)	*p* Values
AAIS(+)	12.7 (33/260)	< .001*	39.2 (102/260)	.001*
AAIS(-)	53.4 (39/73)		19.2 (14/73)	
PAIS(+)	70.1 (68/97)	< .001*	21.6 (21/97)	.001*
PAIS(-)	1.7 (4/236)		40.3 (95/236)	
AAIS(+) PAIS(-)	1.3 (3/223)	< .001*	41.3 (92/223)	.005*
AAIS(+) PAIS(+)	81.1 (30/37)		27 (10/37)	
AAIS(-) PAIS(+)	63.3 (38/60)		18.3 (11/60)	
AAIS(-) PAIS(-)	7.7 (1/13)		23.1 (3/13)	

Abbreviations: AAIS, anterior ankle impingement syndrome; PAIS, posterior ankle impingement syndrome; OCLT, osteochondral lesion of talus.
Values are % (No./no.).
*$p < .05$.

Table 4
Univariate and multivariate analysis of os trigonum in ankle impingement syndromes (N = 333)

	Univariate Analysis			Multivariate Analysis		
Characteristic	OR	95% CI	*p* Value	OR	95% CI	*p* Value
AAIS(+)	0.12	0.07 to 0.22	< .001*			
PAIS(+)	136	46.19 to 400.3	< .001*	100.18	32.71 to 306.79	< .001*
AAIS(+)PAIS (+)	25.91	10.69 to 62.8	< .001*	2.48	0.93 to 6.58	.068
AAIS(+) PAIS(-)	0.07	0.02 to 0.22	< .001*			
AAIS(-) PAIS(+)	12.14	6.42 to 22.93	< .001*			
AAIS(-) PAIS(-)	0.29	0.03 to 2.28	.241*			

Abbreviations: AAIS, anterior ankle impingement syndrome; CI, confidence interval; OR, odds ratio; PAIS, posterior ankle impingement syndrome.
*$p < .05$.

and without os trigonum, the average age of patients with os trigonum was found to be 37.3 ± 12.6 years (without os trigonum, it was 42.7 ± 13 years; $p = .002$). Males accounted for 59.7% of patients with os trigonum and 46.0% of patients without it ($p = .039$). AAIS was observed in 45.8% of the patients with os trigonum and in 87.0% of the patients without os trigonum ($p < .0001$). PAIS was observed in 94.4% of patients with os trigonum and in 11.1% of patients without os trigonum ($p < .0001$). OCLT was observed in 29.2% of patients with os trigonum, and in 36.4% of patients without OCLT ($p = .25$; Table 1).

In the comparison of patients with and without OCLT, AAIS was observed in 87.9% of patients with OCLT and in 72.8% of patients without OCLT ($p = .002$). PAIS was observed in 18.1% of patients with OCLT and 35% of patients without OCLT ($p = .001$). Os trigonum was observed in 18.1% of patients with OCLT and 23.5% of patients without OCLT ($p = .25$; Table 2).

The prevalence of os trigonum was found to be 70.1% among PAIS(+) patients and 1.7% among PAIS(-) patients ($p < .001$). PAIS(+) patients had a higher risk of occurrence of an os trigonum (RR 41.36, 95% CI 15.52 to 110.24). The prevalence of os trigonum was found to be 12.7% among AAIS(+) patients and 53.4% among AAIS(-) patients ($p < .001$). AAIS(+) patients were associated with a lower risk of occurrence of an os trigonum (RR 0.24; 95% CI 0.16 to 0.35; Table 3).

The prevalence of OCLT was found to be 21.6% among PAIS(+) patients and 40.3% among PAIS(-) patients ($p = .001$). PAIS(+) patients were associated with a lower risk of occurrence of an OCLT (RR 0.54; 95% CI 0.36 to 0.81). The prevalence of OCLT was found to be 39.2% among AAIS(+) patients and 19.2% among AAIS(-) patients ($p = .001$). AAIS(+) patients were associated with a higher risk of occurrence of an OCLT (RR 2.04; 95% CI 1.25 to 3.35; Table 3).

The prevalence of os trigonum was found to be 1.3% among PAIS(-) AAIS(+) patients, 7.7% among PAIS(-) AAIS(-) patients, 63.3% among PAIS(+) AAIS(-) patients, and 81.1% among PAIS(+) AAIS(+) patients ($p < .001$). The prevalence of OCLT was found to be 41.3% among PAIS(-) AAIS(+) patients, 23.1% among PAIS(-) AAIS(-) patients, 18.3% among PAIS(+) AAIS(-) patients, and 27% among PAIS(+) AAIS(+) patients ($p = .005$; Table 3).

For interobserver and intraobserver correlations, our results were highly similar and reliable between 2 authors for the diagnosis with intraclass correlation coefficients of 0.991 and 0.993, respectively. Considering logistic regression analysis, the univariate and multivariate determinants of os trigonum and OCLT were indicated in Tables 4 and 5, respectively. PAIS was defined as multivariate predictor of os trigonum and OCLT.

Discussion

In our study, we found the prevalence of os trigonum in patients with clinical ankle impingement syndrome to be 21.6%. Because the prevalence of os trigonum was examined in a general population instead of specific patient groups in previously conducted studies (4,9–11) (excluding Zwiers et al (12) study), it would not be appropriate to make a comparison. Moreover, the evaluation being carried out with conventional radiography in the previous studies may have caused incorrect conclusions related to the type of os trigonum and radiography position. Zwiers et al (12) found the prevalence os trigonum to be 32.5% in their study conducted using computed tomographic scans. In the previous studies, the highest prevalence was reported by Tsuruta et al (11) as 12.7%. This difference was associated with the lower sensitivity in detection of os trigonum with conventional radiography. The difference between our study and the study by Zwiers et al (12) is that 60% of the patients included in their study had trauma, a deformity, or osteoarthritis. As far as we know, this is the first study in the literature to research the prevalence of os trigonum and OCLT by comparing the ankle impingement syndromes.

In a comparison of 72 patients with os trigonum to other patients, we observed that the prevalence of os trigonum was statistically significantly higher among young male patients. Zwiers et al (12) similarly found more prevalent os trigonum presence among younger patients. Although they did not find a statistically significant difference in terms of gender, they reported that it is observed more among men. In our study, the prevalence of PAIS among patients with os trigonum was found to be 94.4%, and the prevalence of AAIS was found to be 45.8%. This result in this study, which only evaluates the patients with ankle impingement syndrome, is an important indicator of the risk of PAIS posed by os trigonum, which is an anatomic variation.

We classified patients according to the presence of ankle impingement syndromes. In our study, PAIS with concomitant AAIS constituted 11.1% of all patients. Miyamoto et al (26) reported a PAIS with a concomitant AAIS ratio as 10.4% among the patients who underwent an operation for PAIS (when the patients with instability complaints are excluded). We found the prevalence of os trigonum among patients

Table 5
Univariate and multivariate analysis of OCLT in ankle impingement syndromes (N = 333)

	Univariate Analysis			Multivariate Analysis		
Characteristic	OR	95% CI	*p* Value	OR	95% CI	*p* Value
AAIS(+)	2.72	1.44 to 5.12	.002*			
PAIS(+)	0.41	0.23 to 0.71	.001*	0.41	0.23 to 0.71	.001*
AAIS(+) PAIS(+)	0.66	0.30 to 1.42	.293			
AAIS(+) PAIS(-)	2.43	1.40 to 4.22	.001*			
AAIS(-) PAIS(+)	0.35	0.17 to 0.72	.004*			
AAIS(-) PAIS(-)	0.55	0.14 to 2.03	.371			

Abbreviations: AAIS, anterior ankle impingement syndrome; CI, confidence interval; OR, odds ratio; OCLT, osteochondral lesion of talus; PAIS, posterior ankle impingement syndrome.
*$p < .05$.

with isolated PAIS to be 63.3%. Zwiers et al (12) reported the prevalence of os trigonum among patients with posterior impingement complaints as 46.4%. In our study, the lowest os trigonum prevalence was found among the PAIS(-) AAIS(+) patient group (1.3%), whereas the highest os trigonum prevalence was found among the PAIS(+) AAIS(+) patient group (81.1%). In the examination of our results, we found that the presence of AAIS had a negative correlation with the prevalence of os trigonum. However, in the presence of PAIS with concomitant AAIS, we observed that the prevalence of os trigonum was higher compared with patients with isolated PAIS. Henderson and Valette (27) found that 93.5% of PAIS is caused by bone pathology and 58% by os trigonum positivity through the posterior arthrotomy performed on 62 patients with simultaneous AAIS and PAIS. They reported that the simultaneous AAIS and PAIS may be associated with repeated inversion strains. Ribbans et al (28) reported that the pathology causing PAIS is 81% osseous (47% os trigonum) in a review evaluating sports-related PAIS treatment. Miyamoto et al (29) reported the prevalence of os trigonum as 66.6% among professional athletes who underwent surgery for combined AAIS and PAIS (12 ankles). A limited number of studies in literature show that the prevalence of os trigonum in the presence of PAIS with concomitant AAIS is higher compared with patients with isolated PAIS, although we do not know the reason for this finding. This finding may be due to the decreased ankle volume and increased risk of inversion injury associated with os trigonum. To fully understand the reason for the increase in the prevalence of os trigonum in combined PAIS and AAIS, the comparison of the groups with 3-dimensional anatomic evaluations may be beneficial in further studies.

Although the prevalence of os trigonum in patients without PAIS (1.7%) was compatible with previous studies conducted on normal populations, the prevalence of os trigonum in patients with PAIS (70.1%) was found to be greater than in the previous study. We can explain this by the difference of the patient groups formed for PAIS. Zwiers et al (12) examined the prevalence of os trigonum in patients with posterior impingement complaints who had foot and/or ankle computed tomographic scans. We, in contrast, studied the prevalence of os trigonum in patients who were diagnosed clinically by us with PAIS and confirmed for the diagnosis by ankle MRI upon the persistence of complains after ≥ 3 weeks of conservative management. In their study examining the MRI characteristics of PAIS in ballet dancers, Peace et al (24) found the prevalence of os trigonum to be 30.4% among 23 ballet dancers. They mentioned that ballet dancing at a young age, when skeletal development continues, may cause a fusion defect in the ossification center. Our hypothesis on this topic is that, in the presence of continuously repeated microtrauma on the ankle as in ballet dancing, the prevalence of soft tissue impingement may increase without the presence of os trigonum, which is an etiologic cause for PAIS, and thus the prevalence of os trigonum associated with PAIS may be lower among ballet dancers.

There are 3 possible reasons reported in the literature for the differences between os trigonum prevalences (12).

1. The lack of a standard terminology used for the definition of os trigonum, such as partial separation being interpreted as os trigonum in some studies and not in others.
2. The population studied having different ethnic origins. It has been reported that the prevalence of os trigonum is significantly lower among those of Caribbean, Surinames, and Central African ethnic origins (12).
3. The age distribution of study populations being different. Fusion of the secondary ossification center of talus may not be completed until the age of 13. Including the population under the age of 14 in the study may result in different results. For the purpose of standardization, we considered the presence of os trigonum as a completely separate bone in the posterior of lateral tubercle of the posterior talar process and excluded patients under the age of 14.

In our study, we found the prevalence of OCLT in patients with clinical ankle impingement syndrome to be 34.8%. In a comparison of 116 patients with detected OCLT with other patients, we observed that even though it was not statistically significant, the prevalence of OCLT was higher among young female patients and on the left side. In our study, the prevalence of PAIS among OCLT patients was found to be 18.1% and the prevalence of AAIS to be 87.9%. This result is an indicator in this study, in which only patients with ankle impingement syndrome are evaluated, showing that asymptomatic or minimally symptomatic OCLT may be associated with AAIS or its clinical features.

In our study, we classified patients according to the presence of ankle impingement syndromes. The lowest OCLT prevalence was found among PAIS(+) AAIS(-) patient group as 18.3% and the highest OCLT prevalence was found among PAIS(-) AAIS(+) patient group as 41.3%. When we examined our results, we observed that the presence of AAIS had a positive correlation with the prevalence of OCLT. Miyamoto et al (29) reported the prevalence of combined OCLT to be 33.3% among professional athletes (12 ankles) who underwent anterior ankle arthroscopy and hind foot endoscopy owing to combined AAIS and PAIS. We also found the prevalence of OCLT in this group to be 27%. Miyamoto et al (26) reported the prevalence of OCLT to be 10.4% among patients who underwent surgery for PAIS (excluding patients with instability complaints) and the prevalence of OCLT in the PAIS(+) AAIS(-) patient group to be 11.6%. In our study, the prevalence of OCLT in these groups was found to be 21.6% and 18.3%, respectively.

Considering the location of OCLT, we observed that 87.1% were medially and 9.5% were laterally located. Verhagen et al (30) reported OCLT locations as 58% medial and 42% lateral in a meta-analysis that included 39 studies and 879 OCLTs. Elias et al (31) reported the location of 428 OCLTs evaluated by MRI as 62.9% medial and 33.4% lateral. That the OCLT locations in our study were different than those reported elsewhere in the literature can be explained by the inclusion of asymptomatic or minimally symptomatic OCLT patients without major ankle trauma or a history of instability. It is reported that medially and centrally located lesions are idiopathic contrary to laterally located trauma-associated lesions (6). Klammer et al (18) reported that there was no progression in lesions or worsening in clinical features of patients during an average of 52-month follow-up of 48 patients with minimally symptomatic OCLT diagnosed by MRI. This result may be related to the etiologic differences between asymptomatic or minimally symptomatic OCLTs. In addition to trauma and degenerative arthritis, malalignment and instability cases, which disrupt the joint biomechanics, genetic factors, avascular necrosis, peripheral vascular disease, and endocrine/metabolic abnormalities, are reported among the reasons for OCLT (32,33). A separate evaluation of these etiologic reasons in OCLTs concomitant with ankle impingement syndromes in further studies will provide a better understanding of these lesions.

There were some limitations in our study because it was a retrospective comparative study. A prospective study that also includes the evaluation of os trigonum size and type, OCLT size, activity levels of patients, duration and severity of clinical symptoms, and the other ankle, which were not evaluated in our study, will help us to better understand the clinical importance of the differences between the groups. Owing to the limited number of patients in the group with AAIS (-) PAIS(-), we were not able to randomize the patients according to their ages. Age grouping with a greater number of patients will provide a more accurate evaluation of the patients at different activity levels. The evaluation of other anatomic variations (sloping posterior tibial plafond, enlarged tubercle [Stieda's], posteromedial accessory ossicles, os post peronei, os sub peroneal), which may be associated with PAIS, along with the size and type of os trigonum in further studies may ensure complete understanding of the occurrence mechanism of PAIS symptoms.

Our study is the first in the literature to research the prevalence of os trigonum and OCLT by comparing the clinically and radiologically confirmed ankle impingement syndromes. Our study showed that, in patients with isolated PAIS and AAIS combined with PAIS, the prevalence of os trigonum was 63.3% and 81.1%, respectively, which is more common than previously reported. The RR posed by os trigonum to PAIS was 41.36. In patients with isolated AAIS and PAIS, the prevalence of OCLT was 41.3% and 18.3%, respectively. Of OCLTs combined with ankle impingement syndromes, 87.1% were medially located, which is more common than previously reported.

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