ORIGINAL ARTICLE

AHI EVRAN MEDICAL JOURNAL
E-ISSN: 2619 - 9203

The Frequency of Biphalangeal Toes in the Turkish Population: A Radiographic Study

Türk Popülasyonunda Bifalangeal Ayak Parmakları Sıklığı: Radyografik Çalışma

***Aziz ÇATALTAPE*[1] *Melih AKAN*[1]**

ÖZ

Amaç: Bu çalışma, ayak parmaklarında bifalangeal varyantın Türk toplumundaki sıklığını araştırmayı amaçladı.
Araçlar ve Yöntem: Eylül 2020 ile Ağustos 2022 arasında 1096 vakanın (n=1286 ayak) radyografileri analiz edildi. Çalışmamızda 386 sol ayak grafisi, 439 sağ ayak grafisi ve 189 iki taraflı grafi mevcuttu. Ayak radyografileri ikinci ila beşinci parmaklarının bifalangealizmi açısından değerlendirildi. Cinsiyet, yaş, taraf, beşinci, dördüncü, üçüncü ve ikinci ayak parmaklarının falanks sayısı ve radyografi çekilme nedeni ile ilgili veriler değerlendirildi. Gruplar Fisher kesin testi ve Ki-kare testi kullanılarak karşılaştırıldı.
Bulgular: Bifalangealizmin beşinci ayak parmağında görülme sıklığı %35.70, dördüncü parmağında %1.70, üçüncü parmağında %0.50 ve ikinci parmağında ise %0.20 olarak tespit edildi. Cinsiyete ve sağ/sol ayağa göre bifalangeal ve trifalangeal parmaklarının sıklığı arasındaki fark istatistiksel olarak anlamlı değildi (sırasıyla p=0.245, p=0.815). 189 iki taraflı ayak grafisinde beşinci bifalangeal parmağın asimetrik dağılımı %6.90, dördüncü bifalangeal parmağın asimetrik dağılımı ise %0.50 olarak görüldü.
Sonuç: Bu çalışmayla, bifalangeal beşinci ayak parmağının görülme sıklığını %35.70 ve Türk toplumundaki bu anatomik varyantın diğer Türk çalışmaları ile benzer olduğunu bulduk ve gösterdik. Ayak patolojisi olan bir olgunun ayak röntgeni değerlendirilmesi sırasında iki falankslı beşinci ayak parmağı akılda tutulmalıdır. Ayrıca, aynı ayakta 5. parmak bifalangeal olmadan 4. 3. parmaklarda biphalengealizm görülmemektedir.

Anahtar Kelimeler: ayak anatomisi; ayak parmağı symphalangismi; iki falankslı ayak parmakları; pedal bifalangizmi; Türk nüfusu

ABSTRACT

Purpose: This study aimed to investigate the frequency of biphalangeal toes in the Turkish population.
Materials and Methods: Radiographs of 1096 cases (n=1286 feet) between September 2020 and August 2022 were analyzed. Our study had 386 left foot radiographs, 439 right foot radiographs, and 189 bilateral radiographs. Foot radiographs were assessed for biphalangealism of the second to the fifth toe. Data regarding sex, age, side, the number of phalanges of the fifth, fourth, third, and second toe, and the reason for performing radiographs were assessed. Groups were compared using Fisher's exact test and the Chi-square test.
Results: The prevalence of biphalangealism in the fifth toe was found to be 35.70%, in the fourth toe 1.70%, in the third toe 0.50% and in the second toe 0.20%. The difference in the frequency of biphalangeal and triphalangeal toes regarding sex and the right/left foot was statistically insignificant (p=0.245, p=0.815 respectively). The asymmetrical distribution of the fifth biphalangeal toe was seen in 6.90%, and the asymmetrical distribution of the fourth biphalangeal toe was 0.50% in the 189 bilateral feet radiographs.
Conclusions: With this study, we found and demonstrated that the incidence of biphalangeal fifth toe is 35.70% and that this anatomical variant in the Turkish population is similar to other Turkish studies. The biphalangeal fifth toe must be kept in mind during the assessment of a case with foot pathologies and foot radiographs. Additionally, biphalangealism is not observed in the 4th and 3rd fingers on the same foot without the 5th finger being biphalangeal.

Keywords: foot anatomy; two-phalanged toes toe symphalangism; pedal biphalangism; Turkish population

Received: 24.01.2024; Accepted: 24.04.2024

[1]Department of Orthopedic Surgery and Traumatology, Medipol University, Istanbul, Türkiye.
[2]Department of Radiology, Medipol University, Istanbul, Türkiye.
Corresponding Author: Aziz Çataltepe, Department of Orthopedic Surgery and Traumatology, Medipol University, Istanbul, Türkiye
e-mail: aziz.cataltepe@medipol.edu.tr

How to cite: Çataltepe A, Akan M. The frequency of biphalangeal toes in the turkish population: a radiographic study. Ahi Evran Med J. 2024;8(2):187-193.
DOI: 10.46332/aemj.1425018

INTRODUCTION

The fifth toe is characterised by having two interphalangeal joints with three bones.[1] This condition, where there are only two bones present in the fifth toe, is relatively common and varies among different populations.[2-5] It is recognized as an anatomical variation of the normal triphalangeal fifth toe. In human beings, this phenomenon of having a two-phalanged toe is also referred to as pedal biphalangism or toe symphalangism.[6]

Pedal biphalangism in the fifth toe, which was first defined by Leonardo da Vinci in 1492, is characterized by two-phalanged toes resulting from incomplete segmentation or fusion during formation or ossification.[4,7-9] This condition often manifests as a coalition due to the lack of development of the distal interphalangeal joint. While the biphalangeal toe is most commonly found in the fifth toe, it can also occur in other toes.[6,9] The prevalence of biphalangeal fifth toes has been investigated by various authors and ranges from 9.8% to 80.4% among different populations.[5] In Turkish populations specifically, several studies have examined the frequency of biphalangealsim of the fifth toe. However, misdiagnosis may occur as this common anatomical variant can be mistaken for a fracture of a distal phalanx that would otherwise represent a normal triphlangeal fifth toe.[2,5,10,11]

There have not been sufficient reports on the frequency of biphalangeal toes in the Turkish population yet. Therefore, a comprehensive assessment is necessary using a broader series of studies. We conducted a retrospective analysis to determine the incidence of triphalangeal and biphalangeal toes among patients referred for foot radiographs in our database, aiming to evaluate this anatomical variant in the Turkish population.

MATERIALS and METHODS

Radiographs of 1096 cases (n=1286 feet) with unilateral or bilateral radiographs between September 2020 and August 2022 were analyzed. We included 1014 cases in the study. We excluded 82 cases. This study was a cross-sectional study in which unilateral or bilateral foot radiographs of patients who were suspected of having pathological findings in their feet and applied for the emergency department or orthopaedic department for any reason, were evaluated. The standard radiographs for all cases were the dorsoplantar anteroposterior and oblique views. The foot radiographs were evaluated for assessment of common forefoot pathologies such as pes planus, pes cavus, and hallux valgus or trauma. Approval was received for this study from İstanbul Medipol University Faculty of Medicine Clinical Research Ethics Committee (dated 12.10.2023 and numbered 810) and was conducted in accordance with the tenets of Helsinki Declaration. Foot radiographs of 1014 adults were assessed for biphalangealism of the second to the fifth toe (Figure. 1,2,3,4).

Figure 1. Foot radiograph of an adult indicates a biphalangeal fifth toe with an intraarticular fracture in the proximal phalanx.

Figure 2. Foot radiograph of an adult indicates biphalangeal second, third, fourth, and fifth toes.

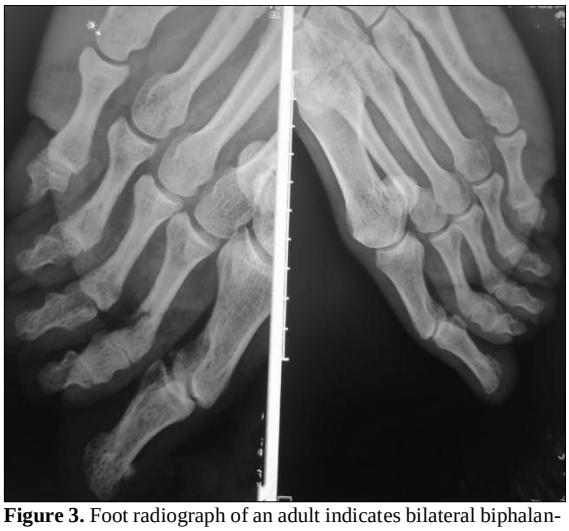

Figure 3. Foot radiograph of an adult indicates bilateral biphalangeal third, fourth, and fifth toes.

Figure 4. Asymmetrical involvement of biphalangeal fifth toes.

All radiographs indicated full fusion of the growth plates of the 5th toes in which fusion was seen complete when the distal and middle phalanx of the fifth toe was fully fused. We assessed adult patients with ≥ 18 years of age.

Exclusion criteria were: pediatric cases, fifth toe not visualized, postoperative radiographs of cases undergoing fifth toe surgery, and unable to count due to deformity. Our study had 386 left foot radiographs, 439 right foot radiographs, and 189 bilateral radiographs.

The frequency of biphalangealism of the second to the fifth toe was assessed and noted. Data regarding sex, age, side, the number of phalanges of the fifth, fourth, third, and second toe, and the reason for performing radiographs were collected from the medical records.

Statistical analyses were performed with NCSS (Number Cruncher Statistical System) 2007 Statistical Software (Utah, USA). Data description was based on the mean ± standard deviation (SD). Groups were compared using Fisher's exact test and the Chi-square test. A value of p below 0.05 was considered statistically significant.

RESULTS

The 1014 patients were composed of 528 women and 486 men. Our study had 386 left foot, 439 right foot, and 189 bilateral radiographs. The mean age was 36.8±15.5 years (Table 1).

Table 1. Demographic data of patients.

Variables	value
Age (year)	36.8±15.5 (18-88)
Female (n)	528 (52.1%)
Male (n)	486 (47.9%)
Right foot radiographs	439 (43.3%)
Left foot radiographs	386 (38.1%)
Bilateral radiographs	189 (18.6%)
2nd biphalangeal toe	2 (0.2%)
3rd biphalangeal toe	5 (0.5%)
4th biphalangeal toe	17 (1.7%)
5th biphalangeal toe	362 (35.7%)

Values are given as mean (standard deviation) or n (%).

The average frequency of biphalangealism in the fifth toe was 362 (35.70%), in the fourth toe was 17 (1.70%), in the third toe it was 5 (0.50%), and in the second toe it was 2 (0.20%). A regular decrease in the frequency of the biphalangeal toe was found from the fifth to the second toes. There was no biphalangeal fourth toe without fifth toe involvement.

Among 528 women, the fifth toe was biphalangeal in 199 cases (37.70%). On the other hand, among 486 men, it was biphalangeal in 163 cases (33.50%). The difference in the frequency of biphalangeal and triphalangeal toes regarding sex was statistically insignificant (p=0.245). Moreover, the differences in the right/left foot in the presence of the biphalangeal fifth toe were statistically insignificant (p=0.815) (Table 2).

Of the 189 bilateral foot radiographs available, 64 cases (33.90%) had fifth toe biphalangealism. Moreover, 2.60% had bilateral fourth and fifth toe biphalangealism, 1.10% had bilateral third, fourth, and fifth biphalangeal toe, and 0.50% had bilateral second, third, fourth, and fifth toe biphalangealism. The asymmetrical distribution of the fifth

biphalangeal toe was seen in 6.90%, and the asymmetrical distribution of the fourth biphalangeal toe was 0.50% in the 189 bilateral radiographs of feet (Table 3).

The frequency of the biphalangeal fifth toe was 35.70% in our study (Table 4).

Table 2. Frequency and distribution of two-boned toe of each toe regarding gender and side.

Sex	Side	No. of feet	2nd	3rd	4th	5th	p value
Female	Right n,(%)	213	1 (0.5%)	1 (0.5%)	6 (2.8%)	79 (37.1%)	
	Left n, (%)	206	-	1 (0.5%)	4 (1.9%)	78 (37.9%)	0.955‡
	Bilateral n,(%)	109	1 (0.9%)	2 (1.8%)	3 (2.7%)	42 (38.5%)	
Male	Right n, (%)	226	-	1 (0.4%)	1 (0.4%)	82 (36.3%)	0.363‡
	Left n, (%)	180	-	-	2 (1.1%)	59 (32.8%)	
	Bilateral n,(%)	80	-	-	1 (1.3%)	22 (27.5%)	
Total	Right n, (%)	439	1 (0.2%)	2 (0.5%)	7 (1.6%)	161 (36.7%)	
	Left n, (%)	386	-	1 (0.5%)	6 (1.6%)	137 (35.5%)	0.815‡
	Bilateral n,(%)	189	1 (0.5%)	2 (1.1%)	4 (2.1%)	64 (33.9%)	
P value			p=0.174†	p=0.174†	p=0.057†	p=0.245†	

Values are given as mean (standard deviation) or n (%) as appropriate. P calculated by using †Fisher's exact test and ‡Chi-square test to analyse of left to right and sex differences.
Female/Male 5th p=0.245†
Female/Male 4th p=0.057†
Female/Male 3rd p=0.209†
Female/Male 2nd p=0.174†

Table 3. Comparison of frequency of bilateral biphalangeal toe and three-boned toe.

Variable	2nd	3rd	4th	5th
Three-boned toe	188 (99.5%)	187 (98.9%)	184 (97.4%)	125 (66.1%)
Biphalangeal toe	1 (0.5%)	2 (1.1%)	5 (2.6%)	64 (33.9%)
Asymmetric	0 (0%)	0 (0%)	1 (0.5%)	13 (6.9%)

Values are given as n (%).

Table 4. Comparison of reported frequency of biphalangeal toe in Turkish population.

Study	No. of subject	2nd	3rd	4th	5th	Asymmetric
Ucpunar et al. [2], 2019	1004	-	-	-	328 (32.7%)	12 (5.8%)
Ozyurek et al [10].,2017	279	-	2(0.9%)	7 (2.5%)	127 (45.5%)	28 (10.5%)
Candan et al. [11], 2022	1528	8 (0.5%)	26(1.7%)	54(3.5%)	664 (43.5%)	-
Our study, 2022	1014	2 (0.2%)	5 (0.5%)	17(1.7%)	362 (35.7%)	14 (7.4%)
X^2	827.37		0.5	0.66	2.93	1.75
d.f	3		2	2	3	2
P value	0.00		0.77	0.71	0.40	0.41

Values are given as mean (percentage %) and p calculated by using the chi-square test.

DISCUSSION

In our study, the frequency of biphalangeal fifth toe was found 35.70% which showed that this anatomical variant is a common finding in the Turkish population. The frequency of biphalangeal toes in the Turkish population resembles the findings in other studies performed to investigate the frequency of biphalangeal toes in the Turkish population. Furthermore, the results of the overall frequency of biphalangeal third, fourth, and fifth toes in our study were similar to other reports that assessed the Turkish population.

The development of the distal or proximal interphalangeal joints in the toes is determined genetically.[12-14] In the literature, the exact etiology of pedal biphalangism is not clearly known, since it is not obvious what leads to the development of the biphalangeal fifth toe.[8,15] However, several authors have proposed some theories regarding pedal biphalangism aetiology.[9] One of the theories is that the distal and middle phalanx of the biphalangeal form is defined as fused.[5,16] One of the accepted other theories is that a congenital trait results from the lack of complete segmentation between distal and middle phalanges, resulting in the lack of development of the distal interphalangeal joint.[8,13,16]

The biphalangeal fifth toe is considered an exclusively human phenomenon because it is caused by the reduction of toes in adaptation to bipedalism.[9,16,17] The specialization of the human foot is associated with the adaptation to erect posture and bipedalism, leading to the decrease in the toes from the fifth toe to the second, particularly in the fifth toe.[16] The regular reduction in the frequency of the biphalangeal toe from the fifth to the second toe has been suggested by most authors. Our study also observed a regular decrease in the frequency of the biphalangeal toe from the

fifth to the second toe. Furthermore, the biphalangeal second, third, and fourth toes occur when the fifth toe of the same foot is biphalangeal.[16] The biphalangeal of the fourth toe is related to the biphalangeal of the fifth toe in the literature.[4,16] The same conclusion was seen in our study in which no biphalangeal fourth toe was seen without fifth toe involvement.

The biphalangeal of the fifth toe might have possible harmful effects on the treatment of disorders of the fifth toe.[8] This anatomical condition must be evaluated in a radiological assessment of the fifth toe when it is fractured or requires surgery.[5] Sufficient foot radiographs should be obtained when evaluating disorders of the fifth toe and before performing any surgical intervention.[8] In our study, one case who had a biphalangeal fifth toe experienced an intraarticular fracture in the proximal phalanx (Fig. 1).

The incidence of occurrence of biphalangeal toes varies according to ethnicity in the literature.[16] In the United Kingdom, Moultan et al. reviewed 606 patients with 655-foot radiographs and observed 291 (44.40%) radiographs having biphalangeal fifth toe.[8] The same result was reported by Le Minor et al. in France (41.02%).[16] In our study, the result of biphalangeal fifth toe was 35.70% which is a little lower than European individuals. Nakashima et al. performed a study to investigate the incidence of biphalangeal toes and found that the frequency of biphalangeal toes in 488 feet was 72.50% in the fifth, 11.90% in the fourth toe, 0.80% in the third toe, and 0.0% in the second toe.[13] The presence of biphalangeal toes in the fifth toe in the Japanese population is considerably higher than that in the Turkish population according to our study (35.70%). Moreover, a regular decreasing frequency of the biphalangeal toe has been shown from the fifth to second toes in more reports.[16] A biphalangeal fourth toe is observed with the incidence of 0.77-2.51% in the European population.[16] The biphalangeal fourth, third, and second toes are rare. In terms of the biphalangeal third toe, Le Minor et al. observed the incidence of 0.20% in their series.[16] In our study, the incidence of biphalangeal fourth toe (11.90%) was higher than that in the Japanese population previously studied (4.20%).

Differences in the biphalangeal toe regarding gender differences have been found in previous studies.[18] However, some reports showed no sex difference in incidence, whereas some indicated that toe symphalangism was more frequently observed in women.[4,6,10,18] In a previous report by Dereymaeker et al., no difference was observed regarding the frequency between women and men.[9] Nakashima et al. also reported that no sex differences were observed in the Japanese foot.[13] A report performed by Gallart et al. found that the differences between sexes were considerable; the biphalangeal fifth toe was seen in 39.88% of men, and 47.35% of women in the Spanish population.[18] Our study showed that no significant difference in frequency was found associated with gender, as in most other studies. Furthermore, no significant differences were seen between right and left feet, as in other studies. Our study also found no significant right-to-left differences in the frequency.

In bilateral radiographs, Chan et al. indicated that the asymmetrical distribution of the biphalangeal fifth toe was found in 8.20% of the 145 bilateral feet radiographs.[6] In another report, George found symmetrical involvement in all cases, while Moulton et al. showed 4.80%.[8,17] These percentages are comparable to the incidence obtained in our study. In our study, the unilateral biphalangeal fifth toe is uncommon (6.90%).

Previous radiographic reports have investigated the frequency of biphalangeal toes in the Turkish population.[2,10,11] While the highest incidence (45.50%) was obtained in a study by Ozyürek et al., the lowest frequency (35.70%) was seen in our study.[10] We compared this study and our study and found that the frequencies of biphalangeal in the fifth toe were statistically indistinguishable. A study by Ucpunar et al. found that a biphalangeal fifth toe was seen in 328 of 1004 (32.70%) cases.[2] Biphalangeal toe was seen approximately in one-third of the population, according to their results. However, they did not exclude radiographs of the bones of children with immature skeletal development. We assumed that this would impact the exact frequency of biphalangeal fifth toe in the Turkish population. It seems reasonable to think that different numbers of ossification centres can cause a different final number of phalanges, which may be biased when including children in a study. Our study excluded these radiographs to reach the exact frequency of biphalangeal in the fifth toe in the Turkish

population. Nevertheless, their result is similar to the result of our study. In another study, Candan et al. assessed 1528 feet and showed that the biphalangeal toe was found in 43.45% of 664 feet in which the biphalangeal of the second toe was found in 8 cases (0.52%), the biphalangeal of the third toe was in 26 cases (1.70%), the biphalangeal of the fourth toe was in 54 cases (3.53%), and the biphalangeal of the fifth toe was found in 576 cases (37.69%) of all cases.[11] However, it is arguable that whereas the biphalangeal toe was 43.45%, the biphalangeal fifth toe was 37.69%, according to their results. The biphalangeal of the second, third, and fourth toe is associated with the biphalangeal of the fifth toe in the literature, as in our study.[12] We assumed that their overall prevalence of pedal biphalangealism was 43.45% which is higher than the result of our study (35.70%).

Whereas Özyürek et al. showed that the frequency of biphalangeal fifth toe was found more in female cases, it was seen as statistically similar between genders in our study.[10] Candan et al. reported that there was an insignificant difference between genders.[11] In our study, there were no significant differences between genders, which is a similar result to Candan et al..

A recent study found no significant differences between the right and left feet.[11] Our study also indicated that there were no significant right-to-left differences in the frequency. Furthermore, Ozyurek et al. reported 10.50% asymmetrical distribution.[10] In another study, 5.80% of cases (204 patients) who had bilateral foot radiographs experienced unilateral biphalangeal fifth toe.[2] In our study, the frequency of asymmetry in the 5th biphalangeal toe was found to be 6.90%, similar to their report's result.

This study has strengths and limitations. The number of case sizes was large compared to recent literature using radiographs of feet in adults. A considerable amount of radiographs of bilateral feet were also assessed to analyze the symmetry of pedal biphalangism. All foot radiographs evaluated were in digital forms, which have the advantage of adjustment of contrast and opacity for clearer visualization. Nevertheless, there are some limitations regarding the projection of radiographs. The first limitation of our study was that the other side was not assessed in cases with unilateral radiographs of the feet. The last limitation was that our study was evaluated in a single hospital data.

Conclusion

In conclusion, the frequency of the biphalangeal fifth toe was 35.70% in our study, which showed that this anatomical variant in the Turkish population has been similar to the other Turkish studies. The biphalangeal fifth toe must be kept in mind during the assessment of a case with foot pathologies and evaluation of foot radiographs. Furthermore, when the fifth toe of the same foot is biphalangeal, the biphalangeal second, third, and fourth toes occur.

Conflict of Interest

The authors declare that there is not any conflict of interest regarding the publication of this manuscript.

Acknowledgements

Special thanks to Rana Konyalioglu, who is a statistician.

Ethics Committee Permission

Approval was received for this study from İstanbul Medipol University Faculty of Medicine Clinical Research Ethics Committee (dated 12.10.2023 and numbered 810).

Authors' Contributions

Concept/Design: AÇ. Data Collection and/or Processing: AÇ, MA. Data analysis and interpretation: AÇ, MA. Literature Search: AÇ, MA. Drafting manuscript: AÇ, MA. Critical revision of manuscript: AÇ, MA.

REFERENCES

1. Snell RS. Clinical anatomy, 7th edition. Lippincott Williams and Wilkins. 2004.
2. Ucpunar H, Camurcu Y, Ozcan C, Buyuk AF, Tas SK, Cobden A. The incidence of biphalangeal fifth toe: Comparison of normal population and patients with foot deformity. J Orthop Surg (Hong Kong). 2019;27(1):2309499019825521.
3. Sandström B, Hedman G. Biphalangia of the lateral toes. A study on the incidence in a Swedish population together with some observations on digital sesamoid bones in the foot. Am J Phys Anthropol. 1971;34(1):37-41.

4. Case DT, Heilman J. Pedal symphalangism in modern American and Japanese skeletons. Homo. 2005;55(3):251-262.
5. Turan A, Kose O, Guler F, Ozyurek O. Fracture of biphalangeal fifth toe: A diagnostic pitfall in the emergency department. Journal of Emergency Medicine, Trauma and Acute Care. 2016:3:2-4.
6. Chan YLC, Dao WH, Yeung T, Chow ECS. Prevalence of toe symphalangism in Hong Kong Chinese population. J Orthop Trauma. 2019;26(1):56-60.
7. Thompson FM, Chang VK. The two-boned fifth toe: clinical implications. Foot Ankle Int. 1995;16(1):34-36.
8. Moulton LS, Prasad S, Lamb RG, Sirikonda SP. How many joints does the 5th toe have? A review of 606 patients of 655 foot radiographs. Foot Ankle Surg. 2012;18(4):263-265.
9. Dereymaeker G, van der Broek C. Biphalangeal fifth toe. Foot Ankle Int. 2006;27(11):948-951.
10. Ozyurek S, Kose O, Celiktas M. Prevalence of pedalsymphalangism in Turkish population. Italian J AnatomyEmbryology. 2017;122(2):110-120.
11. Candan B, Torun E, Dikici R. The Prevalence of Accessory Ossicles, Sesamoid Bones, and Biphalangism of the Foot and Ankle: A Radiographic Study. Foot Ankle Orthop. 2022;18;7(1):24730114211068792.
12. Davis DD, Kane SM. Fifth-Toe Deformities.USA: StatPearls Publishing. 2022:32491393.
13. Nakashima T, Hojo T, Suzuki K, Ijichi M. Symphalangism (two phalanges) in the digits of the Japanese foot. Ann Anat. 1995;177(3):275-278.
14. Ceynowa M, Rocławski M, Pankowski R, Mazurek T. The prevalence and ossification pattern of the biphalangeal and triphalangeal lateral toes. Surg Radiol Anat. 2018;40(9):1039-1045.
15. Talusan PG, Milewski MD, Reach JS Jr. Fifth toe deformities: overlapping and underlapping toe. Foot Ankle Spec. 2013;6(2):145-149.
16. Le Minor JM. Biphalangeal and triphalangeal toes in the evolution of the human foot. Acta Anat (Basel). 1995;154(3):236-241.
17. George M. Biphalangeal fifth toe: an increasingly common variant? J Anat. 2001;198(2):251.
18. Gallart J, González D, Valero J, Deus J, Serrano P, Lahoz M. Biphalangeal/triphalangeal fifth toe and impact in the pathology of the fifth ray. BMC Musculoskelet Disord. 2014;5(15):295.