



The Relationship Between Ossification in Metacarpophalangeal Sesamoids of the Thumb and the Period of Puberty: A Radiographic Study

Başparmak Metakarpofalangeal Sesamoidlerin Kemikleşmesi ile Ergenlik Dönemi Arasındaki İlişki: Radyografik Bir Çalışma

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ABSTRACT

Objective: The current study aimed to determine the onset of sesamoid bones (Sbs) ossification at the thumb metacarpophalangeal (MCP) joint of the hand and its relationship with puberty.

Methods: This retrospective radiographic study included patients aged 5-17 years. The presence of Sbs was investigated separately for each age group. Patients were classified based on their age, gender, and the presence of radial and ulnar sesamoids.

Results: A total of 1,020 radiographs from 939 patients were analyzed. Sbs began to ossify in girls at the age of 8 years and in boys at the age of 9 years. The ulnar-radial sesamoids were present in all individuals in the same age group at the age of 13-14 years in girls and 15 years in boys. The age at which 50% of the individuals in the same age group had a sesamoid was 10.4 years in girls and 11.9 years in boys on the radial side, 9.5 years in girls, and 11.5 years in boys on the ulnar side.

Conclusions: In all individuals, the time between the onset of sesamoids of the MCP joint and development corresponds to the physiological period of puberty. However, the age at which puberty begins coincides with the time when Sbs begin to ossify in 50% of both sexes in the same age group.

Keywords: Sesamoid, hand, puberty, ossification

ÖZ

Amaç: Bu çalışma, elin başparmak metakarpofalangeal (MKP) eklemine sesamoid kemiklerin (Sbs) kemikleşme zamanının başlangıcını ve ergenlik dönemi ile ilişkisini belirlemeyi amaçlamıştır.

Yöntemler: Bu retrospektif radyografik çalışmaya 5-17 yaş arası hastalar dahil edildi. Her yaş grubu için ayrı ayrı Sbs varlığı araştırıldı. Hastalar yaş, cinsiyet ve radyal-ulnar sesamoid varlığına göre kaydedildi.

Bulgular: Dokuz yüz otuz dokuz hastanın 1.020 radyografisi incelendi. Sbs kızlarda 8, erkeklerde 9 yaşında kemikleşmeye başladı. Aynı yaş grubundaki tüm bireylerde ulnar-radyal sesamoidlerin bulunduğu yaş kızlarda 13-14, erkeklerde 15 idi. Sesamoidin aynı yaş grubundaki bireylerin %50'sinde görüldüğü yaş radyal taraf için kızlarda 10,4, erkeklerde 11,9 iken ulnar taraf için ise kızlarda 9,5, erkeklerde 11,5 yaş olarak belirlendi.

Sonuçlar: Örneklemimizde ergenlik başlangıç zamanı ve süresi ile karşılaştırıldığında; 1. MKP eklemdeki sesamoidlerin görülmeye başladığı yaştan tüm bireylerde görülmeye başladığı yaşa kadar geçen süre fizyolojik ergenlik süresi ile benzerdir. Ergenlik başlangıç yaşı ise aynı yaş grubundaki hem cinslerinin %50'sinde Sbs'nin görüldüğü zamana denk gelmektedir.

Anahtar kelimeler: Sesamoid, el, ergenlik, kemikleşme

INTRODUCTION

Sesamoid bones (Sbs) are oval or round-shaped bones a few millimeters in diameter that are located in the joint capsule or beneath tendons¹. Gallen, an anatomist, coined the term "sesamoid" for these bones after comparing them to sesame seeds². Sbs are found

in tendons, particularly in the distal joints on the flexor surface of the hands and feet³.

They are thought to protect tendons, reduce friction on the tendon, relieve pressure, and keep the flexor pollicis longus in place⁴. The appearance of Sbs varies greatly between ethnic groups⁵. A meta-analysis published

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Received: 28 July 2022

Accepted: 23 September 2022

Online First: 29 September 2022

Cite as: Sahin R, Kazdal C. The Relationship Between Ossification in Metacarpophalangeal Sesamoids of the Thumb and the Period of Puberty: A Radiographic Study. Medeni Med J 2022;37:300-305

in 2014 revealed that ethnicity and heredity influence the distribution of Sbs among individuals². Although the location of Sbs in the hand varies from person to person, the metacarpophalangeal (MCP) joint is the most common location, with a reported incidence of 100%^{1,3,4}. Although it is known that it can be seen on all fingers, the most common variation has five Sbs in the hand^{6,7}. There are several studies on the prevalence of Sbs based on location in the literature. However, the number of studies on the onset of ossification is small. The Sbs may help in monitoring physiological development in children by determining the onset of ossification. Sbs can be found in all the fingers, but it is most common in the MCP joint of the thumb. The current study aimed to determine the presence of Sbs ossification at the thumb MCP joint of the hand, which has been confirmed in almost all individuals (98.2%-100%) by several studies^{1-4,8-11}, separately for girls and boys, and its relationship with puberty period.

MATERIALS and METHODS

Patients between the ages of 5 and 18 who received hand radiography in the Orthopedics and Traumatology department of a tertiary university hospital between January 2018 and January 2022 were screened retrospectively. Radiographic imaging has been preferred because X-ray is the most common, fastest, and most cost-effective medical imaging method today. The picture archiving and communication system was used to examine radiographic images. The hospital information system was used to collect sociodemographic data. Patients younger than 5 years old or older than 18 years old, those with unclear bone margins on radiographs, those without an anterior-posterior and oblique radiograph displaying the 1st MCP joint, those with congenital anomalies such as polydactyly and syndactyly, those with pathologies such as a tumor or avascular necrosis in the hand, and those of foreign nationality were excluded from the study. Patients who met these criteria were eligible for the study. Approval was obtained from the Ethics Committee of Recep Tayyip Erdogan University Faculty of Medicine (decision no: 2022/92, date: 14.04.2022).

When a small oval or round bone structure was visible on the volar surface of the thumb MCP joint on a hand radiograph, the presence of Sbs was considered positive (Figure 1a). While anteroposterior and oblique radiographs confirm the presence or absence of Sbs, anteroposterior radiography was used to assess radial or ulnar localization (Figure 1b). Two experienced orthopedic specialists independently reviewed all radiography images. Any inconsistencies were resolved through mutual agreement. To better reveal the Sbs, radiographs

were examined in a digital environment using zooming and dose adjustment.

Hand radiographs from 939 patients aged 5-17 years who met the inclusion criteria and had images available for review were evaluated. 358 (38.1%) of the patients were female, while 581 (61.9%) were male. The average age was determined to be 11.9±3.1. The age, gender, and presence of the Sb on the radial and ulnar sides of the patients were all recorded (Table 1).

Statistical Analysis

The SPSS 23.0 program was used to conduct all analyses in the study. If available, descriptive data were expressed as mean and standard deviation, median (minimum-maximum), or number and frequency.

RESULTS

Our study included 939 patients, 581 of whom were boys and 358 of whom were girls. Four hundred fifteen of the radiographs evaluated were taken only on the

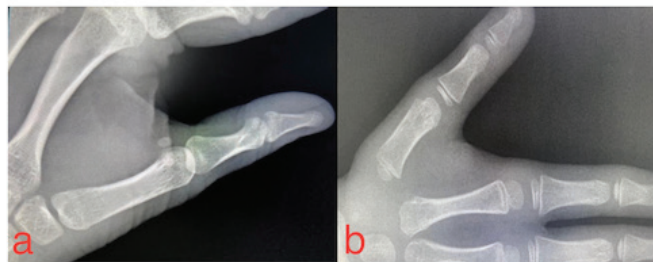


Figure 1. a. Depicts a radiograph of a 15-year-old patient's 1st MCP joint, which shows 2 oval-shaped sesamoid bone structures. **b.** Radiograph of a 7-year-old patient's 1st MCP joint showing the absence of sesamoid bone because it has yet to ossify.

MCP: Metacarpophalangeal

Table 1. Patients' data.	
	n
Patient	939
Hand	1020
Age	5-17
Sex	
Female	358 (38.1%)
male	581 (61.9%)
Side	
Right	415 (44.2%)
Left	443 (47.2%)
Bilateral	81 (8.6%)

right side, 443 on the left side, and 81 were bilateral. The radial sesamoid was first observed in both genders at the age of 9 years. However, at this age, the incidence was approximately four times higher in girls. The age at which 50% of the individuals saw the radial sesamoid was 10.4 years in girls and 11.9 years in boys. All individuals had radial sesamoid at the age of 14 years in girls and 15 years in boys. The ulnar sesamoid began to ossify in girls at the age of 8 years and in boys at the age of 9 years. The ulnar sesamoid was observed in 50% of the individuals at the

age of 9.5 years in girls and 11.5 years in boys. The age at which the ulnar sesamoid was observed in all individuals, on the other hand, was 13 years in girls and 15 years in boys. The incidence of sesamoids at the 1st MCP joint was as shown in Table 2 for radial sesamoids and as shown in Table 3 for ulnar sesamoids when patients aged 5-17 years were distributed by age group. Figures 2 and 3 show radiographic images of the Sbs in the first MCP joint for both sexes aged 9-15 years.

Table 2. Distribution of radial SB at the MCP joint of the thumb by gender.

Age	Females		Males	
	Present	Absent	Present	Absent
5 (n=29)	-	15 (100%)	-	14 (100%)
6 (n=43)	-	9 (100%)	-	34 (100%)
7 (n=31)	-	8 (100%)	-	23 (100%)
8 (n=58)	-	28 (100%)	-	30 (100%)
9 (n=62)	7 (31.8%)	15 (68.2%)	3 (7.5%)	37 (92.5%)
10 (n=73)	10 (32.3%)	21 (67.7%)	3 (7.1%)	39 (92.9%)
11 (n=90)	29 (74.4%)	10 (25.6%)	9 (17.6%)	42 (82.4%)
12 (n=102)	44 (89.8%)	5 (10.2%)	28 (52.8%)	25 (47.2%)
13 (n=106)	28 (96.6%)	1 (3.4%)	55 (71.4%)	22 (28.6%)
14 (n=123)	44 (100%)	-	76 (96.2%)	3 (3.8%)
15 (n=120)	44 (100%)	-	76 (100%)	-
16 (n=71)	24 (100%)	-	47 (100%)	-
17 (n=31)	16 (100%)	-	15 (100%)	-

MCP: Metacarpophalangeal, SB: Sesamoid bone

Table 3. Distribution of ulnar SB at the MCP joint of the thumb by gender.

Age	Females		Males	
	Present	Absent	Present	Absent
5 (n=29)	-	15 (100%)	-	14 (100%)
6 (n=43)	-	9 (100%)	-	34 (100%)
7 (n=31)	-	8 (100%)	-	23 (100%)
8 (n=58)	3 (10.7%)	25 (89.3%)	-	30 (100%)
9 (n=62)	10 (45.5%)	12 (54.5%)	2 (5.0%)	38 (95.0%)
10 (n=73)	18 (58.1%)	13 (41.9%)	7 (16.7%)	35 (83.3%)
11 (n=90)	30 (76.9%)	9 (23.1%)	17 (33.3%)	34 (66.7%)
12 (n=102)	48 (98.0%)	1 (2.0%)	34 (64.2%)	19 (35.8%)
13 (n=106)	29 (100%)	-	62 (80.6%)	15 (19.4%)
14 (n=123)	44 (100%)	-	78 (98.7%)	1 (1.3%)
15 (n=120)	44 (100%)	-	76 (100%)	-
16 (n=71)	24 (100%)	-	47 (100%)	-
17 (n=31)	16 (100%)	-	15 (100%)	-

MCP: Metacarpophalangeal, SB: Sesamoid bone



Figure 2. Depicts radiographic images of Sbs in the first MCP joint in girls aged 9-15 years.

MCP: Metacarpophalangeal, Sbs: Sesamoid bones



Figure 3. Depicts radiographic images of Sbs in the first MCP joint in boys aged 9-15 years.

MCP: Metacarpophalangeal, Sbs: Sesamoid bones

DISCUSSION

Gender, localization, and ethnicity all influence the distribution of Sbs in the hand^{5,10}. While the sesamoids of the thumb MCP joint are considered a normal skeleton part of adult humans, sesamoids of other fingers may differ^{3,10,12}. Several studies in the literature have found that all adults have Sb at the thumb MCP joint^{1-4,8-11}. Yammine² reported a 99.93% prevalence of Sbs on the radial side and a 99.81% prevalence on the ulnar side in a meta-analysis. As a result, while investigating the ossification of sesamoids in our study, we evaluated thumb sesamoids.

A detailed study of the descriptive anatomy of the thumb sesamoid revealed two structures with the appearance of a round or oval-shaped bony or fibrocartilaginous nucleus on the volar face of the MCP joint, one of which may be larger than the other⁸. Based on this definition, we looked for a small oval or round bone structure on the volar surface of the thumb MCP joint for the radial and ulnar sides, the presence of which indicated sesamoid ossification.

Although the appearance of the first sesamoid of the thumb is thought to be an indication of puberty, this finding has only been confirmed in cross-sectional studies³. Sbs normally ossify during puberty, but this

formation does not represent the onset of puberty or the stage of puberty at which the child is¹⁴. The onset of the rapid growth spurt in adolescence, which begins immediately after the development of the adductor sesamoid, is thought to coincide with the ossification of the Sbs¹⁵. As in our study, a large number of patient radiographs should be examined, and similar studies with different ethnicities should be conducted to reveal the relationship of sesamoids with puberty more clearly.

It is well known that the age at which puberty begins varies greatly between countries, ethnic groups, and sexes due to genetic, environmental, and hormonal factors and that the physiological puberty period can last for 4-5 years¹⁶. In our study, the time between the onset of ossification and appearance was 5 years for girls and 6 years for boys. However, because it does not reflect the period when the Sb begins to develop and complete in the same person, it does not fully reveal the duration of puberty, though it can provide an idea of the duration of puberty between the sexes.

The stages of skeletal development occur earlier in girls than in boys, according to a study that also evaluated the ulnar sesamoid in the thumb MCP joint. Although skeletal development occurred earlier in girls during the rapid growth phase's peak period, boys had a more

mature skeleton at the end of this phase¹⁷. The stage of puberty can thus be estimated based on the level of skeletal development. In our study, the onset of these sesamoids on radiographs, as well as the incidence and development in all individuals of the same age, revealed that ossification occurs earlier in girls.

In a similar study in the Arab population, ossification of the sesamoids at the thumb MCP joint began at the age of 10 years in girls and 11 years in boys, respectively, and was completed by the age of 13 years and 14 years³. In our study, the onset of sesamoids was found to be similar earlier in girls than in boys, with a time difference of approximately 2 years.

Thumb sesamoids were present in 50% of Czech children at the age of 13.6 years and 11.2 years of girls¹⁸. The onset of sesamoids in 50% of the children in our study was 11.5 years in boys and 9.5 years in girls for ulnar sesamoids, 11.9 years in boys, and 10.4 years in girls for radial sesamoids. A domestic puberty study with 1,020 girls found that the average age at puberty onset was 10.1 years and the duration of puberty was 4.9±1.2 years¹⁹. In our study, the onset of puberty coincided with the onset of sesamoids in 50% of girls. A similar study on 1,112 boys in Turkey discovered that the mean age at puberty onset was 11.6 +/- 1.2 years and the duration of puberty was 4.9 +/- 0.6 years³. In our study, the onset of puberty coincided with the onset of sesamoids in 50% of the boys. The length of puberty in all individuals is similar to the period between the age of onset of sesamoids and the age of development, according to the evaluation of puberty periods in these studies. Finally, the presence of sesamoids in the thumb MCP joint can be used to predict puberty in both boys and girls. Thus, the search for sesamoid findings in hand radiographs can serve as a guide in the investigation of diseases that cause early or delayed puberty. Furthermore, the morphology of sesamoids has been studied in some endocrinological diseases. Acromegaly, for example, causes enlargement of the thumb sesamoids²⁰.

The absence of one or both sesamoids in the thumb's MCP joint is unusual. Three cases of isolated absence of the radial Sb have been reported^{8,21}, which may have resulted from physiological agenesis of the Sbs. We are aware of only one case in the literature in which both Sbs were reported to be absent in the thumb². Radial and ulnar sesamoids were visible to the naked eye in all 128 girls aged 14 and older and all 138 boys aged 15 years and older in our study.

Our research had some limitations. Only radiography was used to look for the presence of Sbs. Although the

images were reviewed by two different orthopedic and traumatology specialists to avoid observational errors, prospective studies using advanced imaging methods such as computed tomography or magnetic resonance imaging, particularly for sesamoids that have just begun to ossify, should be performed.

CONCLUSION

Conclusively, the sesamoids of the first MCP joint ossify earlier in girls than in boys, and ossification is completed earlier in girls. When compared to the onset and duration of puberty in our country, the age at onset of sesamoids of the MCP joint and development in all individuals is consistent with the physiological period of puberty. The age at which puberty begins coincides with the onset of sesamoids in 50% of both sexes in the same age group, which was 11.5 years in boys and 9.5 years in girls for the ulnar sesamoid and 11.9 in boys and 10.4 years for the radial sesamoid. Although the age at which the first MCP joint sesamoid develops in half of the Turkish population is found to be correlated, the relationship between the stage of puberty and the ossification of sesamoids can be more clearly demonstrated by similar studies conducted on different ethnicities.

Ethics

Ethics Committee Approval: Ethical permission to perform this study was obtained from the Recep Tayyip Erdogan University Faculty of Medicine Non-Invasive Clinical Research Ethics Committee (decision no: 2022/92, date: 14.04.2022).

Informed Consent: Retrospective study.

Peer-review: Externally and internally peer-reviewed.

Author Contributions

Concept: R.S., C.K., Design: R.S., Data Collection and/or Processing: R.S., C.K., Analysis and/or Interpretation: R.S., Literature Search: R.S., C.K., Writing: R.S.

Conflict of Interest: The authors have no conflict of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

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