Sulcus Arteriae Vertebralis Variations on Atlas[11]

ATLAS'TA SULCUS ARTERİA VERTEBRALİS VARYASYONLARI

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Summary

We aimed to search the variations related to the sulcus arteriae vertebralis which is on the first cervical vertebrae in Turkish popidation. In our study we used direct cervical lateral graphics of one thousand cases who had no neurological disorders, and never had any operations or trauma on this region. At the posterior portion of atlas, the entrance and the conditions (complete or partial) of the foramen were clearly observed. Subtypes of the complete and partial foramens were also established. Subtypes of the complete foramen were called as thick, medium and thin. The partial foramen could be found at either anterior or posterior locations or both locations. Among sexes, the existence of the foramen was in different ratios. Three percent of the males and %2.2 of the females had complete foramen. The thin type was dominant in both sexes. The frequencies of the partial foramen were %3.9 in males and %8.2 in females. The anterior type of the partial foramen was dominant between both sexes. On the other hand, the values found in our study were lower than the values of the studies which were obtained from American and English people.

Key Words: Atlas, Sulcus arteriae vertebralis, Variations

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Özet

Servical birinci vertebra üzerinde bulunan sulcus arteria vertebralis ile ilgili varyasyonların Türk populasyonunda araştırılması amaçlandı. Çalışmamızda kranyoservikal anomalisi ve nörolojik kusuru olmayan, daha önce bu bölge ile ilgili ameliyat veya travma geçirmemiş olgulardan alınan toplam 1000 tane direk servikal lateral grafiden yararlanıldı. Atlas'ın posterior bölümünde foramen'in girişi, total veya parsiyel oluşu açıkça görülüyordu. Total ve parsiyel foramen'in subtipleri'de tespit edildi. Total foramen'in sublipleri kalın, orta ve ince olarak değerlendirildi. Parsiyel foramen'in lokalizasyonuna göre anteriorda, posteriorda ve hem anterior hemde posteriorda bulunma özelliği vardı. Her iki cinste foramen'in varlığı farklı oranlarda tespit edildi. Total foramen'in erkeklerde görülme sıklığı %3, kadınlarda %2.2 olarak belirlendi. Her iki cinstede ince tipin yaygın olduğu tespit edildi. Parsiyel foramen görülme sıklığı ise erkeklerde %3.9, kadınlarda %8.2 olarak belirlendi. Parsiyel foramen'in anterior tipi her iki cinste'de daha fazla tespit edildi. Çalışmamızda bulduğumuz değerler Amerika ve İngiliz toplumunda yapılan çalışmalardan daha düşüktü.

Anahtar kelimeler: Atlas, Sulcus arteria vertebralis, Varyasyon

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The parts of neurovascular groove, which is located in the back of the lateral part of the atlas vertebra, is called sulcus arteria vertebralis, overhangs the first cervical nerve, vertebral artery and venous plexus. The parts of neurovascular groove might be form the foramen (complete or partial) at the upper surface of the lateral wall (1,2,3). This structure was originally defined in 1930 (4). At previous studies, foramen was called as foramen atlantoideum posterior, foramen sagittale, foramen atlantoideum vertébrale, canalis arteria vertebralis, ponticulus posticus and arcuate foramen (4,5). This arch was originally thought as a simple ligamentous ossification. Dugdale (5) suggested that the foramen might be formed by the development of partial foramen. On the other hand, some other authors suggested that the ligamentous ossification made of fibrous tissue can not be considered as a real ossification seen in many other foramens found

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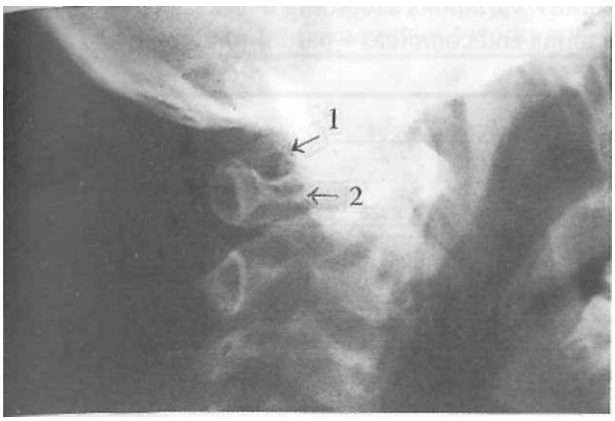

Figure 1. Thick type of complete foramen at lateral cervical x-ray (from right side) 1: complete foramen, 2: arcus posterior of atlas.

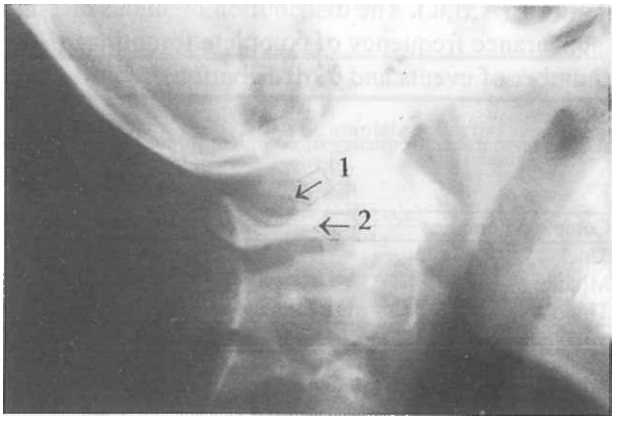

Figure 2. Anterior type of partial foramen at lateral cervical x-ray (from right side) 1: partial foramen, 2: arcus posterior of atlas.

in the body (4). The neurovascular structure might be compressed in the case of formation of the foramen. Accordingly, it is postulated that basilar insufficiency, vertebral artery obstruction, Barre Lieou's Syndrome and Chronic Upper Cervical Syndrome might develop depending on the formation of foramen (4,6,7). At previous studies, the percent of this variations was defined in the other society. The aim of our study was to determine the occurrence and varieties of the foramen in Turkish population.

Material and Method

In our study we examined a total of 1000 patients (460 males, 540 females) who applied to Radiology Department of Medical Faculty of Suleyman Demirel University. None of them have craniocervical anomaly or neurological deficiency. They had no operation or trauma related to craniocervical region. Ages of patients ranged between newborn and 80 years, (mean age for males 22 years and mean age for females 23 years). Direct cervical x-rays which were taken from the right side of cases were used. The presence or absence of the foramen (complete or partial) was detected clearly. Patients whose foramens could not be detected clearly were not included. The presence of bilateral foramen and its distribution were not included in our analysis. The types (complete, partial) and subtypes (thick, middle and thin) of the foramen were clearly seen at the posterior part of atlas. Partial foramen subtypes were determined as being at anterior, posterior and both of them. SPSS for windows 6.0 was used for statistical analysis. Chi-square test was used to determine the occurrence of the foramen between sexes.

Results

Osteogenic structure of complete foramen has enveloped its surroundings completely at cervical lateral radiographs (Figure 1). Subtypes of complete foramen seen ring shaped were categorized thick, middle, and thin as previous studies done (4,7). Osteogenic structure has not enveloped completely for partial foramen (Figure 2). As a result foramen defined as the specification of partial foramen localization; they were classified as being at anterior, posterior and both of them. The distribution of complete or partial subtypes for sexes is seen from Table 1. Statistically, differences did not found to be significant at the appearance frequency of variation (chi-square:3.60, sd:1, p:0.057). Where the appearance frequency of total foramen found excessively high in male, the appearance frequency of partial foramen found excessively high in female. Differences in comparison with sexes were found statistically significant at the appearance frequency of variation (chi-square:4.87, sd:1, p:0.027). Generally, the appearance frequency of partial foramen was found to be higher than complete foramen at all work groups (Table 1).

Table 1 (A,B,C). The distribution of sulcus arteria vertebralis variations according to sexes. The appearance frequency of complete foramina , partial foramina and complete + partial foramina (number of events and % distribution)*

A: The appearance frequency of complete foramina.

	Male		Female		Male + female	
Complete Foramina	N	%	N	%	n	%
Thick	4	0.9	-	-	4	0.4
Middle	2	0.4	4	0.7	6	0.6
Thin	8	1.7	8	1.5	16	1.6
Total	14	3.0	12	2.2	26	2.6

B: The appearance frequency of partial foramina.

	Male		Female		Male H- female	
Partial Foramina	N	%	n	%	n	%
Anterior	12	2.6	28	5.3	40	4.0
Posterior	-	-	2	0.3	2	0.2
Anterior +posterior	6	1.3	14	2.6	20	2.0
Total	18	3.9	44	8.2	62	6.2

C: The appearance frequency of complete and partial foramina.

	Male		female		Male +female	
	N	%	n	%	N	%
Complete + Partial	32	*63*	56	104	88	§4

*Percent calculations make for male or female cases (males: 460, females: 540)

Discussion and Conclusion

Atlantooccipital articulation is the part where malformations related with cervical vertebrae are frequently seen (8). At lateral cervical x-rays, anomalies related with posterior of atlas were assessed as being undeveloped arcus posterior, and at the parts of massa lateralis of atlas having crack on one or two sides by Currarino et al (9). On the other hand, White et al (10) suggested that anatomic variations at atlantooccipital articulation widespread on Down syndrome.

Buna et al (6) reported that this foramen is being together with anomalies which were commonly determined radiographically. They find out that this foramen was seen in different types approximately 35% by dissections. 15% of cases who have complete foramen were reported by Buna et al (6). Lamberty (4) pointed out from cadaver works, the most variation is partial foramen. His results were 15%) of complete foramen, and 21.66%) of partial foramen (4). He was reported that he had found 7.58% of complete foramen and 6.06 of partial foramen on his study with radiological method. Stubbs (7) stated that he found 13.5% of complete foramen (in males: 17.2%), in females: 10.3%), 5.2 %> of partial foramen (in males 4.7%, in females: 5.6%o). Stubbs (7) pointed out partial foramen was very high for white race females ($p<0.05$). According to complete foramen, there was no differences in both sexes between black and white race (7). Kendric and Bigs (11) reported that complete foramen at boys *16.67%* and girls *6.67%*. Also they found partial foramen on females 3.33% in view of black race children, complete and partial foramen were not found on black race girls, but on boys they found 16.67%) of complete foramen, 5.56% partial foramen (11). Dugdale (5) has found the appearance frequency of complete foramen as 14.87%, the appearance frequency of partial foramen as 11.7%. Additionally, he stated that partial foramen was too much in white race females

Table **2.** The verification of the appearance frequencies of complete, partial and complete + partial results which were taken from previous works and our study.

	Complete			Partial			Complete + Partial		
	Male	Female	Male + Female	Male	Female	Male + Female	Male	Female	Male + Female
Lambert)' BGH (1973. England) Cadaver			15			21.66			
X-rays			7.58			6.06			
Stubbs DM (1991, USA)	17.2	10.3	13.5	4.7	5.6	5.2			
KendrickC(1963, USA)									
White	16.67	6.67		-	3.33				
Black	16.67	-		5.56	-				
Dugdale L (1981, Australia)			14.07			11.7			
Buna M (1984, France)			15						35
LeMinor JM (1992,Germany)			14.2						
WhiteKS* (1994, USA)			5.58			17.64			
Basaloglu 11 (1989, Turkey)			4.7			19			
Tekdemiri (1993, Turkey)			10.6			33.3			
MALAS MA (1997,Turkey)	3	2.2	2.6	3.9	8.2	6.2	6.9	10.4	8.8

* White results getting from events who have Down syndrome.
USA: United States of America

(P<0.05) (5). Le Minor (12) has found the appearance frequency of complete foramen 14.2%. The appearance frequency of complete and partial foramen were determined more than our study by Tekdemir (13) and Basaloglu (14) (Table 2).

Table 2 shows that the variations of the appliance frequencies of complete, partial and complete + partial foramen results which were taken from previous works and our work. Values from our study were found a bit less than previous studies in the view of complete foramen and partial foramen (4-7). In males, complete foramen was found much more, and our results were correlated with Stubbs's (7) and Kendrick's data (Table 2). In our study partial foramen was found to be higher than complete foramen. This result is correlated with Lamberty's cadaver works. Lamberty (4) (on his radiological study), Stubbs (7), Kendrick (11) and Dugdale (5) pointed out complete foramen is higher than partial foramen. In our works, we found partial foramen in females higher than in males. This result is correlated with Stubbs's (7), but is not correlated with Kendrick's (11).

In previous studies, there was no age specification compared sex and partial foramen (5,7). For this reason, cases were not categorized as to their ages. Vertebra dimensions are important for works related with cervical vertebras (15,16). There are many differences among races (17). Familial cervical displasia related with atlas can transitive genetically (18). Variations can be seen with other cranial variations (19-24). Additionally, some syndromes can have the same symptoms (25). Sulcus arteria vertebral is variation seen at atlas vertebra is a very important criterion. According to our results, in our society sulcus arteria vertebral is variations are seen rarely. On the other hand, the values found in our study were lower than the values of the studies which were obtained from American and English people. In our opinion, this variation observed in Turkish population will highlight the way of clinical studies and assessments.

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