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Anatomical and epidemiological examination of the structure and localization of osteophytes of cervical vertebrae in geriatric patients by using computed tomography method

Geriatrik hastalarda görülen cervical vertebralara ait osteofitlerin yapı ve yerleşimlerini bilgisayarlı tomografi yöntemi kullanılarak anatomik ve epidemiyolojik olarak incelenmesi

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ABSTRACT

Background: To evaluate the osteophytes seen in the cervical vertebrae of geriatric individuals in various parameters.
Materials and Methods: 764 (M: 413, F: 351) individuals who were admitted to the State Hospital Radiology Outpatient Clinic with various complaints between the years 2018 and 2023 and who met the criteria were examined in our study. A total of 1209 osteophytes were found in the individuals. The osteophytes were evaluated in terms of gender, age, grade, vertebral level, vertebral spacing, anatomical aspect, anatomical surface and length parameters.
Results: Osteophyte formation increased with age in individuals ($p<0.05$). Osteophyte formation was observed more frequently in men when compared to women ($p>0.05$). Claw type osteophytes were observed commonly in all individuals ($p<0.05$). While fused type osteophytes were observed commonly in men, traction-type osteophytes were observed more frequently in women ($p<0.05$). Osteophyte formation of grade 2 severity was observed in all individuals ($p>0.05$). While fused osteophytes were commonly observed at grade 4 severity, claw and traction type osteophytes were observed at grade 2 severity ($p<0.05$). Osteophytes were commonly observed at the C5 vertebra level in all individuals ($p>0.05$). Fused and traction type osteophytes were commonly seen at the C6 level, while claw type osteophytes are commonly seen at the C5 level ($p<0.05$). In all individuals, osteophytes were most common in the C5-6 space, followed by the C4-5, C6-7 ($p>0.05$). Osteophytes were commonly seen anteriorly in both sexes and all osteophyte types ($p<0.05$). All osteophyte types were commonly observed in the inferior surface of the vertebra ($p<0.05$). Males had relatively longer osteophytes (mm) than females ($p<0.05$). Claw type osteophyte was observed in longer dimensions than traction type osteophyte ($p<0.05$)
Conclusions: Osteophyte type and grade severity were found to vary between individuals. In the examinations, varying features were observed in the vertebral level, anatomical aspect, surface and length parameters of the osteophytes.
Keywords: Osteophyte, Cervical vertebrae, Anatomy, Computed tomography

ÖZET

Amaç: Geriatrik bireylerin cervical vertebralarında görülen osteofitleri çeşitli parametrelerde değerlendirmektir.
Materyal ve Metot: Çalışmamızda 2018-2023 yılları arasında devlet hastanesi radyoloji polikliniğine çeşitli sebeplerle gelen 764 (e:413, k:351) birey incelenmiştir. Bireylerde toplamda 1209 adet osteofit tespit edilmiştir. Osteofitler yaş, cinsiyet, derecelendirme, vertebra seviyesi, vertebral aralık, anatomik yön, anatomik yüzey ve uzunluk olarak değerlendirildi**.**
Bulgular: Osteofit oluşumu bireylerde yaşa bağlı olarak artmaktadır ($p<0,05$). Erkeklerde kadınlara göre daha fazla sıklıkla osteofit oluşumu gözlenmiştir ($p>0,05$). Tüm bireylerde pençe tip osteofit sıklıkla görülmüştür ($p<0,05$). Erkeklerde sıklıkla kaynaşmış tip osteofit görülürken kadınlarda traksiyon tip osteofit daha fazla gözlenmiştir ($p<0,05$). Kaynaşmış osteofitler sıklıkla grade 4 şiddetinde görülürken pençe ve traksiyon tip osteofitler grade 2 şiddetinde görülmüştür ($p<0,05$). Tüm bireylerde osteofitler C5 vertebra seviyesinde sıklıkla gözlenmektedir ($p>0,05$). Kaynaşmış ve traksiyon tip osteofitler C6, pençe tip osteofitler ise C5 seviyesinde sıklıkla görülmektedir ($p<0,05$). Tüm bireylerde en fazla C5-6 aralığında osteofit görülmüştür ($p>0,05$). Her iki cinsiyet ve tüm osteofit tiplerinde osteofitler sıklıkla anteriorda görülmektedir ($p<0,05$). Tüm osteofit tipleri sıklıkla vertebranın facies inferiorunda gözlenmiştir ($p<0,05$). Erkeklerde kadınlara nispeten daha uzun ölçülerde (mm) osteofit görülmüştür ($p<0,05$). Pençe tip osteofit, traksiyon tip osteofite göre daha uzun ölçülerde tespit edilmiştir ($p<0,05$).
Sonuç: Osteofit tipi ve grade şiddetinde bireyler arası değişkenlik göstermiştir. Osteofitlerde vertebra seviyesi, anatomik yön, yüzey, uzunluk parametrelerinde değişen özellikler gözlenmiştir.
Anahtar Kelimeler: Osteofit, Servikal vertebra, Anatomi, Bilgisayarlı tomografi

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INTRODUCTION

The vertebral column is a biomechanical column in the adult human body consisting of 26 vertebrae and containing centers of gravity. The vertebral column is grouped into 5 different regions as cervical, thoracic, lumbar, sacral, coccygeal (Sargon, 2016). There are seven cervical vertebrae and they are quite mobile. While it has important functions such as the elevation and depression of the head in vision, hearing and smell functions in the sagittal plane, it also provides environmental awareness by helping to observe the environment in the horizontal plane (Bogduk, 2016). Osteophytes are bone spurs that typically develop as a result of abnormal bone growth around the joint, their formation is characterized by joint degeneration and they affect approximately 30-40% of the elderly population (Wong, Chiu, & Yan, 2016). Age and obesity are the leading etiological factors in osteophyte formation (Chen et al., 2017; Klaassen et al., 2011). Globally, the prevalence of obesity has been increasing since 1980, and according to a report published in 2008, it was found that 508 million people in the world are obese and 1.46 billion people have a body mass index greater than 25. In addition to all these, obesity creates a serious burden on the health system, both economically and in terms of the workforce, due to factors such as the diseases it causes, private living space, and a lower life expectancy (Imes & Burke, 2014). At the same time, osteophyte formation is more commonly seen with age (Chiba et al., 2022). As a result of the increasing quality of life in the world and the progress made in the fight against diseases, the population of elderly individuals is increasing frequently. It is estimated that Turkey in particular will be the country with the highest number of elderly population in Europe in 2050. Changes in the body with aging make the fight of individuals against diseases difficult, creating a serious burden on the health system (VARIŞLI, 2018). As a result of the increase in the number of geriatric individuals and obesity that may occur in the future, studies related to the complaints caused by these may be important in the literature.

Osteophytes are examined in 2 groups as spinal (vertebral) and extraspinal. Cervical vertebral osteophytes cause dysphagia, vocal cord paralysis, peristalsis disorders due to its close proximity to the larynx, pharynx, and oesophagus (Klaassen et al., 2011; Ma et al., 2022). Various anthropological, etiological and epidemiological studies have been conducted on osteophytes in the vertebral column (Chiba et al., 2022; Ezra, Hershkovitz, Salame, Alperovitch-Najenson, & Slon, 2019; Ezra, Kedar, Salame, Alperovitch-Najenson, & Hershkovitz, 2022; Kaçar et al., 2016; Praneatpolgrang, Prasitwattanaseree, & Mahakkanukrauh, 2019; Stanley et al., 2008; Suwanlikhid, Prasitwattanaseree, Palee, & Mahakkanukrauh, 2018; Watanabe & Terazawa, 2006). When these studies are examined, it can be seen that the vertebral column has generally been discussed completely and it has been found that there are not many studies for a specific age population. For this reason, we aim to contribute to the literature by examining the cervical osteophytes seen especially in geriatric patients.

MATERIALS AND METHODS

This study was carried out retrospectively on computed tomography (CT) images of patients who were admitted to the state hospital Radiology service for various reasons between 2018 and 2023. Our study was initiated with the 30.12.2022 dated and "E-18457941-050.99-75870" issued with the Artvin Çoruh University Non-Interventional Scientific Research and Ethics Committee. In our study, patients who were admitted to the State Hospital Radiology Outpatient Clinic with various complaints were examined and computerized tomography (CT) images of the cervical vertebrae of 764 (M: 413, F: 351) patients who met the criteria were examined. The study included individuals aged 65 and over. Individuals with vertebral fractures, individuals with internal fixator in the region and individuals with congenital anomalies were excluded from the study.

A total of 1209 osteophytes were detected in 764 individuals. The data of cervical vertebrae were obtained from a 128-slice CT device (Toshiba). Images were created in sagittal and coronal planes from images with a slice thickness of 1 mm. They were transferred to the hospital's PACS system and the evaluations were made on the computers in the hospital. They were analyzed according to age groups (65-74.75-84.85 and above), gender and various anatomical parameters (A. E. Van der Merwe, 2006; TÜMERDEM, 2006; Wong et al., 2016).

Osteophytes are divided into 6 groups according to the vertebral level as C2, C3, C4, C5, C6, C7. They are classified in 6 groups according to the vertebral range as C2-C3, C3-C4, C4-C5, C5-C6, C6-C7, C7-T1. They are grouped in 3 as claw, traction and fused in terms of osteophyte type. They are classified into 4 groups as Grade 1, Grade 2, Grade 3, Grade 4 according to the degree of osteophyte (Ezra et al., 2019). Grade 1: It is a formation in the form of small bone protrusions in the vertebral body. The epiphyseal line and bone surface are intact. Grade 2: Small grade osteophyte formation smaller than 2 mm in the vertebral body. Grade 3: 2 mm large osteophyte formation in the vertebral body, disrupting the epiphyseal ring. Grade 4: Severe

osteophyte formation greater than 4 mm in the vertebral body. Anatomical aspects of the osteophyte in the vertebral body is grouped into 4 as anterior, posterior, right and left. The anatomical surface of osteophyte is classified in 2 groups as superior and inferior.

Literature was used to determine the parameters related to the anatomical aspect, surface and grade of osteophytes (A. E. Van der Merwe, 2006; Gustke, Cherian, Simon, & Morrison, 2022; TÜMERDEM, 2006). Length measurements were determined according to the measurements made in the AKGÜN PACS program. As a result of the data obtained, parameters of the type, anatomical surface, aspect, length and degree of osteophytes were analysed.

Statistical analysis

In this study, SPSS 21.0 statistical program was used in data analysis. Demographic information of the participants is shown in frequency and percentage tables. Cross-tabulation and chi-square analysis were used to compare osteophyte parameters according to gender, age groups and osteophyte type. In the comparison of length, which is the continuous variable, according to gender and osteophyte type, two independent samples t-test was used; while ANOVA and LSD post hoc test were used in the comparison of length according to age groups. Level of significance was accepted as $p<0.05$ in the analyses.

RESULTS

Osteophyte was found to be present in 84.9% of female cases and 88.4% of male cases, and it was found that the presence of osteophytes did not differ significantly in terms of gender ($p>0.05$). Osteophyte was found to be present in 88.4% of the cases aged 65-74, 97.7% of the cases aged 75-84, and 100% of the cases aged 85 and over and the difference in osteophyte presence was found to be statistically significant in terms of age groups ($\chi^2=56,19$; $p<0.05$). (Table 1).

Since geriatric individuals were preferred in our study, more than one osteophyte formation was commonly observed in an individual. Consequently, 1209 cervical osteophytes were detected in total. Gender, age, grade severity, vertebral level, vertebral spacing, anatomical aspect, anatomical surface and length parameters were noted separately in all osteophytes detected. 1209 osteophytes were discussed in all analyses and tables related to osteophytes. This data has been taken into account in the tables 2-3-4.

It was found that osteophyte types differed significantly in terms of gender ($\chi^2=27.64$; $p<0.05$). According to this result, claw type osteophytes were common in both groups, while fused type was higher in male cases and traction type was higher in female cases ($p<0.05$). Grade severity was found to differ significantly in terms of gender ($\chi^2=29.50$; $p<0.05$). According to this result, although 2nd grade severity was more common in both groups, the incidence of 2nd grade severity was higher in female cases; while the incidence of grade 4 severity was higher in male cases ($p<0.05$). In female cases, vertebral level was found as C2 in 4.3%, C3 in 13.9%, C4 in 18.6%, C5 in 31.6%, C6 in 24.1%, and C7 in 7.5%. In male cases, vertebral level was found as C2 in 3%, C3 in 10.9%, C4 in 20.7%, C5 in 33.3%, C6 in 26.8%, and C7 in 5.3%. The most common vertebral level in both groups was C5, and it was found that the vertebral level did not differ significantly in terms of gender ($p>0.05$). /// In female cases, osteophyte length was 3.49±1.59 mm; it was found as 4.33±2.57 mm in male cases, and the osteophyte length in male cases was found to be significantly higher than the osteophyte length in female cases ($t=-6.51$; $p<0.05$). No significant results were found in other parameters examined in terms of gender (Table 2).

Osteophyte types were found to differ significantly in terms of age groups ($\chi^2=13.97$; $p<0.05$). According to these results, while claw type osteophytes were more common in the three age groups, fused type osteophytes were higher in the 65-74 age group compared to other age groups; claw and traction type osteophytes had a higher incidence in the 75-84 age group compared to the other groups ($p<0.05$). No significant difference was found in terms of age groups in other parameters examined (Table 3).

It was found that the grade severity differed significantly in terms of osteophyte type ($\chi^2=808,82$; $p<0.05$). According to this result, the most common grade severity in cases with fused type osteophytes was level 4; while in cases with claw and traction type osteophytes, the most common grade severity was found as level 2. It was determined that the grade severity differed significantly according to the osteophyte type ($\chi^2=808.82$; $p<0.05$). Vertebra level was found to differ significantly in terms of the osteophyte type ($\chi^2=143.77$; $p<0.05$). According to this result, the most common vertebral level in cases with fused osteophytes was C6, followed by C5; the most common vertebral level was C5 followed by C4 in cases with claw-type osteophytes; the most common vertebra level was determined as C6 and C5 in cases with traction type osteophytes ($p<0.05$). Vertebral space was found to differ significantly in terms of the osteophyte type ($\chi^2=47,09$; $p<0.05$). According to the results, osteophyte types were most common in the C5-6 space. The most common vertebral space in cases with fused osteophytes was C5-6, followed by C6-7; the most common vertebral space in cases with claw-type osteophytes was C5-6, followed by C4-5; the most common vertebral level in cases with traction type osteophytes was C5-6 and then C6-7 ($p<0.05$). Anatomical aspect was found to differ significantly in terms of the osteophyte type

(χ^2=90.53; p<0.05). According to the results, all osteophyte types were most common anteriorly. In terms of osteophyte types, osteophytes were most commonly detected in the anterior in cases with fused and claw-type osteophytes, while in cases with traction-type osteophytes, osteophytes were most commonly detected in the anterior and then posterior regions (p<0.05). Anatomical surface was found to differ significantly in terms of the osteophyte type (χ^2=297.79; p<0.05). According to the results, among the three osteophyte types, while inferior surface was the surface where osteophyte was most commonly seen, the incidence of claw -type osteophyte was higher in the inferior surface (p<0.05). Osteophyte length was found to differ significantly in terms of the osteophyte type (F=596.14; p<0.05). According to the results of the LSD post hoc test performed to determine between which groups the difference was, osteophyte length was significantly higher in cases with fused type osteophyte (7.54±2.13 mm) when compared with cases with claw type (3.56±1.57 mm), and traction type (2, 82±1.28) osteophytes. Osteophyte length of the patients with claw type (3.56±1.57 mm) osteophytes was significantly higher than the osteophyte length of the patients with traction type (2.82±1.28) osteophytes (p<0.05) (Table 4).

Table 1: Comparison of osteophyte presence by sex and age groups.

		No osteophytes		Three are Osteophytes				
Demographic variable	**Groups**	**n**	**%**	**n**	**%**	**χ^2**	**df**	**p**
Sex	Female	53	15.1	298	84.9	2.000	1	0.157
	Male	48	11.6	365	88.4			
	Total	101	13.2	663	86.8			
Age Groups	65-74 age	96	20.6	372	79.4	56.193	2	**0.001**
	75-84 age	5	2.3	217	97.7			
	85 age and old	0	0.0	75	100.0			
	Total	101	13.2	663	86.8			

χ^2: Chi square statistic df: Degree of freedom p: Significance Level

Table 2: Comparison of parameters in osteophytes by sex.

Variable		**Female**		**Male**				
	Groups	**n**	**%**	**n**	**%**	**χ^2**	**df**	**p**
Osteophyte type	Fused	48	9.4	144	20.6	27.637	2	**0.001**
	Claw	298	58.4	357	51.1			
	Traction	164	32.2	198	28.3			
	Total	510	100.0	699	100.0			
Grade type	1	46	9.0	68	9.7	29.502	3	**0.001**
	2	290	56.9	308	44.1			
	3	91	17.8	122	17.5			
	4	83	16.3	201	28.8			
	Total	510	100.0	699	100.0			
Vertebral level	C2	22	4.3	21	3.0	7.634	5	0.178
	C3	71	13.9	76	10.9			
	C4	95	18.6	145	20.7			
	C5	161	31.6	233	33.3			
	C6	123	24.1	187	26.8			
	C7	38	7.5	37	5.3			
	Total	510	100.0	699	100.0			
Vertebra space	C2-3	25	4.9	28	4.0	3.359	5	0.645
	C3-4	77	15.1	98	14.0			
	C4-5	104	20.4	154	22.0			
	C5-6	194	38.0	277	39.6			
	C6-7	107	21.0	133	19.0			
	C7-t1	3	0.6	9	1.3			
	Total	510	100.0	699	100.0			
Anatomic aspect	Anterior	310	60.8	436	62.4	12.047	3	**0.007**
	Posterior	64	12.5	122	17.5			
	Right	48	9.4	61	8.7			
	Left	88	17.3	80	11.4			
	Total	510	100.0	699	100.0			
Anatomic surface	Facies inferior	391	76.7	514	73.5	1.538	1	0.215
	Facies superior	119	23.3	185	26.5			
	Total	510	100.0	699	100.0			
Length		$\overline{X}$	**ss**	$\overline{X}$	**ss**	**t**	**df**	**p**
		3.49	1.509	4.33	2.57	-6.51	1207	**0.001**

χ^2: Chi square statistic df: Degree of freedom $\overline{X}$:Arithmetic mean ss:Standard deviation t:t test statistic p: Significance Level

Table 3: Comparison of osteophyte parameters according to age groups.

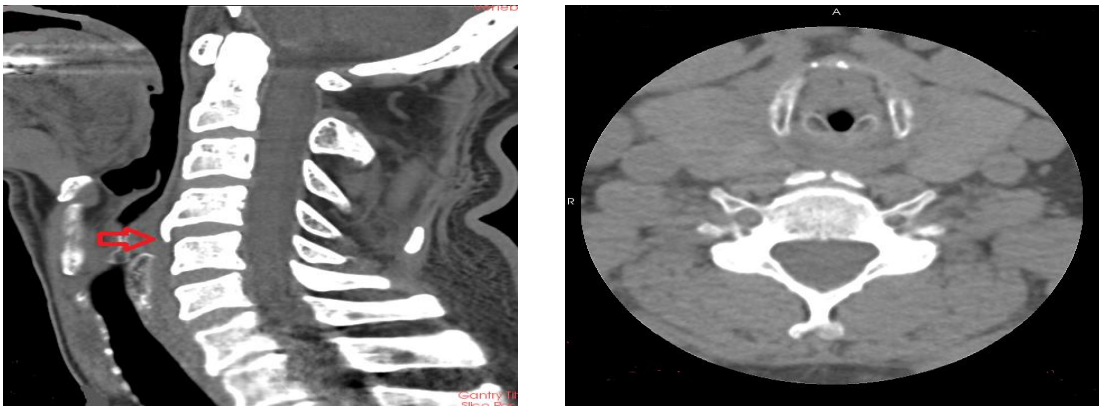
Variable		**65-74 age**		**75-84 age**		**85 age and old**				
	Groups	**n**	**%**	**n**	**%**	**n**	**%**	**χ^2**	**df**	**p**
Osteophyte type	Fused	124	18.8	46	11.2	22	15.6	13.966	4	**0.007**
	Claw	357	54.3	225	54.9	73	51.8			
	Traction	177	26.9	139	33.9	46	32.6			
	Total	658	100.0	410	100.0	141	100.0			
Grade type	1	69	10.5	38	9.3	7	5.0	11.801	6	0.067
	2	315	47.9	207	50.5	76	53.9			
	3	103	15.7	82	20.0	28	19.9			
	4	171	26.0	83	20.2	30	21.3			
	Total	658	100.0	410	100.0	141	100.0			
Vertebral level	C2	23	3.5	12	2.9	8	5.7	11.023	10	0.356
	C3	73	11.1	48	11.7	26	18.4			
	C4	129	19.6	83	20.2	28	19.9			
	C5	216	32.8	137	33.4	41	29.1			
	C6	174	26.4	108	26.3	28	19.9			
	C7	43	6.5	22	5.4	10	7.1			
	Total	658	100.0	410	100.0	141	100.0			
Vertebral space	C2-3	28	4.3	14	3.4	11	7.8	9.614	10	0.475
	C3-4	88	13.4	61	14.9	26	18.4			
	C4-5	141	21.4	88	21.5	29	20.6			
	C5-6	258	39.2	160	39.0	53	37.6			
	C6-7	135	20.5	84	20.5	21	14.9			
	C7-t1	8	1.2	3	0.7	1	0.7			
	Total	658	100.0	410	100.0	141	100.0			
Anatomic aspect	Anterior	417	63.4	247	60.2	82	58.2	6.950	6	0.325
	Posterior	105	16.0	63	15.4	18	12.8			
	Right	57	8.7	35	8.5	17	12.1			
	Left	79	12.0	65	15.9	24	17.0			
	Total	658	100.0	410	100.0	141	100.0			
Anatomic surface	Facies inferior	488	74.2	313	76.3	104	73.8	0.738	2	0.691
	Facies superior	170	25.8	97	23.7	37	26.2			
	Total	658	100.0	410	100.0	141	100.0			
Length		**$\overline{X}$**	**ss**	**$\overline{X}$**	**ss**	**$\overline{X}$**	**ss**	**F**	**df**	**p**
		4.03	2.36	3.90	2.12	3.89	2.07	0.525	2,1206	0.592

χ^2: Chi square statistic df: Degree of freedom $\overline{X}$:Arithmetic mean ss:Standard deviation F: ANOVA test statistic p: Significance Level

Table 4: Comparison of osteophyte parameters according to osteophyte type

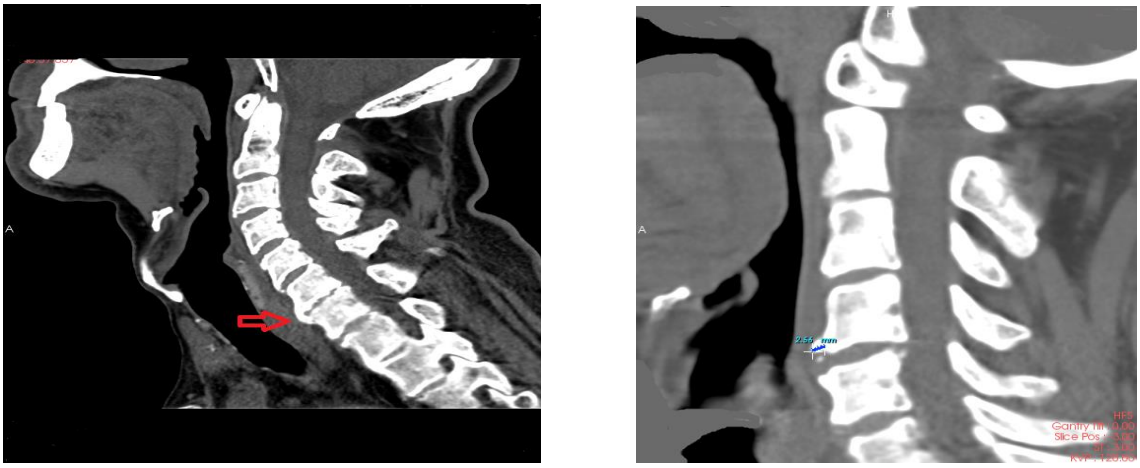
Variable		Fused		Claw		Traction				
	Groups	**n**	**%**	**n**	**%**	**n**	**%**	**χ^2**	**df**	**p**
Grade type	1	0	0.0	62	9.5	52	14.4	808.82	6	**0.001**
	2	1	0.5	332	50.7	265	73.2			
	3	0	0.0	173	26.4	40	11.0			
	4	191	99.5	88	13.4	5	1.4			
	Total	192	100.0	655	100.0	362	100.0			
Vertebral level	C2	4	2.1	36	5.5	3	0.8	143.77	10	**0.001**
	C3	16	8.3	109	16.6	22	6.1			
	C4	27	14.1	163	24.9	50	13.8			
	C5	61	31.8	223	34.0	110	30.4			
	C6	62	32.3	111	16.9	137	37.8			
	C7	22	11.5	13	2.0	40	11.0			
	Total	192	100.0	655	100.0	362	100.0			
Vertebral space	C2-3	9	4.7	38	5.8	6	1.7	47.087	10	**0.001**
	C3-4	21	10.9	113	17.3	41	11.3			
	C4-5	35	18.2	165	25.2	58	16.0			
	C5-6	82	42.7	227	34.7	162	44.8			
	C6-7	45	23.4	105	16.0	90	24.9			
	C7-t1	0	0.0	7	1.1	5	1.4			
	Total	192	100.0	655	100.0	362	100.0			
Anatomic aspect	Anterior	117	60.9	467	71.3	162	44.8	90.533	6	**0.001**
	Posterior	26	13.5	59	9.0	101	27.9			
	Right	24	12.5	49	7.5	36	9.9			
	Left	25	13.0	80	12.2	63	17.4			
	Total	192	100.0	655	100.0	362	100.0			
Anatomic surface	Facies inferior	98	51.0	620	94.7	187	51.7	297.79	2	**0.001**
	Facies superior	94	49.0	35	5.3	175	48.3			
	Total	192	100.0	655	100.0	362	100.0			
Length		**$\bar{X}$**	**ss**	**$\bar{X}$**	**ss**	**$\bar{X}$**	**ss**	**F**	**df**	**p**
		7,54	2,13	3,56	1,57	2,82	1,28	596,14	2;1206	**0,001**

χ^2: Chi square statistic df: Degree of freedom $\bar{X}$:Arithmetic mean ss:Standard deviation F: ANOVA test statistic p: Significance Level



A **B**

Figure 1: A: Claw type osteophyte formation at the level of Cervical 5th vertebra in sagittal section **B:** Claw type osteophyte seen anteriorly in the 5th cervical vertebra in axial section.



A **B**

Figure 2: A: Fused type osteophyte in the C5-6 vertebral space in a 74-year-old male patient. **B:** Measurement of grade 2 traction type osteophyte detected at c4 vertebra level.

DISCUSSION

Osteophytes are bone spurs that typically develop due to abnormal bone growth around the joint. Osteophyte formation is associated with joint degeneration and the main factors in its formation are obesity and type 1 diabetes. Osteophyte develops as a result of increased mechanical load on the body mass index and the joints. Apart from these, environmental factors, hypervitaminosis A, and the sports habits of people can be effective (Wong et al., 2016). Osteophyte can be seen in many joints in the body such as hip joint, knee joint, and distal interphalangeal joint. Clinical findings of vertebral osteophytes occur with structures that are topographically adjacent. For example, since cervical osteophytes are in close relationship with the oesophagus and pharynx structures, they may present with symptoms such as dysphagia, food aspiration, and vocal cord paralysis (Chiba et al., 2022; Malatong, Palee, Sinthubua, Na Lampang, & Mahakkanukrauh, 2022; Wong et al., 2016).

Osteophyte formation in the vertebral column often occurs in the vertebral body as a result of intervertebral disc degeneration that increases with age. Nucleus pulpous is very important in intervertebral disc degeneration; the disc space decreases and the load on the vertebral body increases as a result of the decreasing water content in its structure with age. Likewise, the anulus fibrosus, which loses its elasticity with age, cannot show strength as a result of potential maximal loads and osteophyte formation is observed due to loads on the joint surfaces (Chiba et al., 2022; Fine et al., 2023; Malatong et al., 2022; Praneatpolgrang et al., 2019; Suwanlikhid et al., 2018).

When the osteophytes in the vertebral column are examined according to the regions, the incidence of osteophytes in the cervical vertebrae in individuals over 65 years of age is 80-85% (Peng, Liu, Hong, & Meng, 2022). In a study conducted in Japan, the presence of osteophytes was examined in terms of age and it was shown that the frequency of osteophytes increased with age (Chiba et al., 2022; Watanabe & Terazawa, 2006). In a study in which osteophytes in the cervical vertebrae were examined demographically, it was determined that osteophytes increased with age (Ezra et al., 2019). In another study, it was stated that the prevalence of osteophytes in the facet joints of the cervical vertebrae increased in terms of age (Ezra et al., 2019; Ezra et al., 2022). In a study on pre-modern Joeson skeletons in Korea, the incidence of cervical osteophytes was reported to be between 89 and 91%, and an increase due to age in the incidence of osteophytes in the cervical vertebrae was observed in the examinations made in all regions (Kim, Kim, Kim, Oh, & Shin, 2012). In our study, the incidence of osteophytes increased with increasing age, and in this respect, the data found are compatible with the literature.

In a study in which osteophytes in the cervical vertebrae were examined demographically, osteophyte formation was observed more frequently in men than in women (Ezra et al., 2019). In a study examining the pre-modern Korean skeletons from Joseon tombs, osteophytes in the vertebral column were examined; osteophytes were observed more frequently in men than in women, both in all regions and also specifically in the cervical region (Kim et al., 2012). When studies examining osteophytes in the vertebral column other than the cervical region were reviewed

topographically, in a study evaluating the lumbar vertebrae in Thai population, osteophytes were found to be more common in men than in women (Suwanlikhid et al., 2018). Apart from this, in a postmortem study examining the thoracic and lumbar vertebrae with computed tomography method in the Japanese population, it was found that osteophytes were seen more frequently in men than in women (Chiba et al., 2022). In a retrospective study conducted in Turkish population in 2016, it was shown that osteophyte formation was more common in men than in women in the lower thoracic region. In this study, no significant difference was found in the comparison of osteophytes between the genders in general (Kaçar et al., 2016). In our study, when osteophyte formation in the cervical vertebrae was examined in terms of gender, more osteophytes were found in men than in women. In the light of these data, our study is in parallel with the literature in general.

In a study in which anterior cervical osteophytes were treated surgically, claw-type osteophyte formation was frequently observed when radiographic images were examined (Kolz et al., 2021). In a study examining abnormal growth areas in the cervical vertebrae, claw-type osteophyte formation was observed more commonly than traction-type osteophyte formation (Stanley et al., 2008). In a study examining the types of osteophytes seen in the lumbar vertebrae; it was stated that claw type osteophytes, which are seen together in the lower and upper vertebrae, are more common than other types (Kasai, Kawakita, Sakakibara, Akeda, & Uchida, 2009). In our study, when the osteophyte types of the cervical vertebrae were examined, claw type osteophyte formation was observed most frequently, while fused type osteophyte was frequently observed in men and traction type osteophyte was frequently observed in women. In the light of this information, our study is in parallel with the literature in general.

In a study examining osteophytes seen in the vertebral column in Japanese, an evaluation was made according to osteophyte severity and advanced age and level osteophytes were observed more frequently in men than women. In terms of grade severity, osteophytes of 1-2 grade severity were frequently observed in both genders (Watanabe & Terazawa, 2006). In a study conducted on Turkish population, thoracic and lumbar region osteophytes were examined and it was found that the severity of osteophytes was higher in men and generally increased with age (Kaçar et al., 2016). In a study examining the degeneration of facet joints in the cervical vertebrae, it was stated that degeneration and severity of osteophytes increased with age. When compared in terms of gender, it was observed that the severity of degeneration was higher in men than in women (Park et al., 2014). In our study, when the grade criteria of cervical osteophytes were examined, osteophyte formation of Grade 2 severity was observed frequently. In terms of genders, although osteophytes with grade 2 were more common in women, osteophytes with grade 4 were more common in men. Among osteophyte types, while fused type osteophytes are frequently seen at grade 4 severity, claw and traction type osteophytes are seen at grade 2 severity. In the light of these data, our study is in parallel with the literature in general.

In a demographic study on cervical vertebrae, it was observed that the height of the cervical vertebrae decreased with age, while their width increased. As thoracic kyphosis increases with age, cervical lordosis also increases to compensate for this. As a result, the pressure on the cervical vertebrae increases and disc degeneration occurs. Since the C5 and C6 are displaced towards the front of the centre of gravity, degeneration is frequently observed in both sexes and all age groups, and as a result, the enlargement of the vertebrae is generally anteriorly. This may be the reason why there is a high level of claw type at the C5 level and why claw type osteophytes are frequently seen anteriorly (Ezra et al., 2019). In the study examining the pre-modern Korean skeletons from Joseon tombs, osteophytes in the vertebral column were examined; osteophytes were frequently observed in both sexes at the C5 vertebra level (Kim et al., 2012). In a study examining the degeneration due to loads in movements in the C5 vertebra, it was found that the stress in the flexion movement is located in the corpus and anterior part of the vertebra (Wang et al., 2019). Mobility and load-bearing capacity of the C5 and C6 vertebrae often cause osteophyte formation. At the same time, excessive increase in cervical lordosis poses a great risk for C5 and C6 vertebrae (Klaassen et al., 2011). The osteophytes in our study were frequently observed at the C5 vertebra level in both genders and age groups. When vertebral level is examined according to the osteophyte type, fused and traction type osteophytes are frequently seen at the C6 level, and claw type osteophytes are frequently seen at the C5 level. In the light of these data, our study is similar to the literature in general.

In a study comparing cervical surgery techniques as a result of disc degeneration, it was found that degeneration was frequently observed at the C5-6 level in all patient groups, followed by the C6-7 level, and a significant correlation was found between the occipital-cervical angle and anterior cervical discectomy in degenerations (Yang et al., 2020). In a study examining facet joint degeneration in the cervical vertebra, it was reported that degeneration was observed frequently at grade 3 and above in the C4-5 vertebral range in individuals over 60 years of age (Park et al., 2014). In a study examining disc degeneration in cervical vertebrae in postmenopausal women, while osteophyte formation was observed frequently at C4-5 level in all grades, and at C2-3, C3-4 levels according to grades (Hong, Park, Chung, Choi, & Kang, 2021). In a study examining the

degeneration of the cervical vertebrae in individuals between the ages of 18-97, it was reported that the degree of disc degeneration increased with age, and degeneration was frequently observed at the C5-6 level (Tao et al., 2021). In a study examining the radiological features of the cervical vertebrae in dropped head syndrome, it was observed that decreased disc spaces and osteophyte formation frequently occurred at C5-6, C6-7 levels (Kudo et al., 2021). In a study examining age-related disc degeneration in the cervical vertebrae of mice, it was found that osteophyte formation and irregular bone edges were frequently seen at C4-5, C5-6 levels (Gruber, Phillips, Ingram, Norton, & Hanley, 2014). In our study, in terms of gender and age groups, osteophytes were most commonly seen in the C5-6 space, followed by the C4-5, C6-7. In the light of these data, our study is generally in parallel with the literature.

In a study examining the degeneration of the cervical vertebrae in individuals between the ages of 18-97, anterior osteophyte formation was frequently observed at all vertebral levels (Tao et al., 2021). In a demographic study conducted on cervical vertebrae, it was stated that age-related enlargement of the vertebrae usually occurred anteriorly (Ezra et al., 2019). In a study examining the degeneration due to loads in movements in the C5 vertebra, it was found that the stress in the flexion movement was located in the anterior part of the vertebra (Wang et al., 2019). In a study examining abnormal growth areas in the cervical vertebrae, osteophyte formation was observed mostly in the anterior aspect (Stanley et al., 2008). In a study which examined disc degeneration in cervical vertebrae, it was observed that the incidence of anterior osteophytes increased with increases in the degree of degeneration (Sang et al., 2021). When examined in terms of direction, it was found in our study that osteophytes were frequently seen anteriorly in both sexes and all osteophyte types. Considering the age groups, vertebral level and vertebral spacing, osteophytes were often observed anteriorly. In the light of these data, our study is in parallel with the literature in general.

In terms of vertebral level, osteophyte formation was frequently observed in inferior surface in all vertebrae except C7, while osteophyte formation was observed in superior surface at C7 level ($p<0.05$). In the study examining the degeneration of the cervical vertebrae in individuals between the ages of 18-97, it was reported that in vertebrae with osteophyte formation according to the vertebral spaces, sclerosis often developed on the inferior face towards the cranial (Tao et al., 2021). In the study examining the radiological features of the cervical vertebrae in dropped head syndrome, it was found that sclerosis was frequently seen in the C5-6, C6-7 space (Kudo et al., 2021). In a study in which subchondral bone mineral density was measured in cervical vertebrae, it was stated that superior endplate mineral density was frequently high in the inferior surfaces of all vertebrae (Zavras et al., 2021). In our study, osteophytes were frequently observed in the inferior surfaces of the vertebra in both sexes and all age groups. In terms of the osteophyte type, osteophyte formation was frequently observed in the inferior surface of all types. In the light of these data, our study is in parallel with the literature in general.

In a study which measured vertebral lengths on cadavers, claw osteophytes were reported to be longer than traction osteophytes (Marras, Palanca, & Cristofolini, 2021). In a study in which age-related osteophyte formations were measured in the Thai population, osteophytes seen in women in cervical vertebrae were found to be relatively longer than those in men (Praneatpolgrang et al., 2019). In a study in which anterior cervical osteophytes were treated surgically, the mean length of resected osteophytes was reported as 14.2 mm, and the longest osteophyte was reported to be in the C3-4 vertebral space (Kolz et al., 2021). In a study in which anterior cervical approach was applied in the treatment of cervical myelopathy, the mean length of osteophytes seen in patients was reported as 8.14 mm (Ma et al., 2022). In our study, when osteophytes were evaluated in terms of length, relatively longer (mm) osteophytes were found in males when compared with females. In terms of osteophyte type, it was stated that claw type osteophytes had relatively longer dimensions than traction type osteophytes. In terms of vertebral space, it was observed that the osteophytes in the C2-3 space had the longest measurements.

CONCLUSION

Osteophyte formation increased with age in individuals. Osteophyte formation was observed more commonly in men than in women. Claw type osteophytes were common in both sexes and all age groups. Grade 2 osteophytes were commonly observed in both sexes and all age groups. Grade 4 osteophytes were commonly observed in fused type osteophytes, while grade 2 osteophytes were commonly observed in claw and traction type osteophytes. When osteophyte types are considered as a whole, claw type osteophyte formation was observed most commonly, while fused type osteophyte was commonly observed in males and traction type osteophyte was commonly observed in females. Osteophytes were commonly observed at the C5 vertebra level in both genders and age groups. When vertebra level is considered in terms of the osteophyte type, fused and traction type osteophytes were commonly observed at the C6 level, and claw type osteophytes were commonly observed at the C5 level. In terms of gender and age groups, osteophytes were most commonly found in the C5-6 space, followed by the C4-5, C6-7. When osteophytes are examined in terms of direction; they were commonly seen anteriorly in both sexes and all

osteophyte types. In terms of anatomical surface, osteophytes were commonly observed in the inferior surface of the vertebra in both genders and all age groups, and in terms of osteophyte types, they were commonly observed in the inferior surface. When osteophytes were evaluated in terms of length, relatively longer (mm) osteophytes were found in men when compared with women. In terms of osteophyte type, it was stated that claw type osteophytes had relatively longer dimensions than traction type osteophytes. In our study, we aim to contribute to the literature by examining the cervical osteophytes seen in geriatric individuals in terms of various parameters in the light of these data.

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