

Frequency of Cervical Ribs in Healthy Asymptomatic Adolescents and Adults, Detected on Chest Radiograph for Medical Fitness Examination at CMH Lahore

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ABSTRACT

Objective: To determine the frequency of cervical ribs on chest radiographs of asymptomatic candidates undergoing medical fitness.

Study Design: Cross-sectional study.

Place and Duration of Study: Radiology Department Combined Military Hospital Lahore Pakistan from Feb 2020 to Mar 2021.

Methodology: The study was conducted on 4247 chest radiographs of candidates who reported to CMH Lahore for medical examination. The latest chest radiographs of candidates reporting for medical examinations in the CMH Lahore were included. Technically poor radiographs were excluded.

Results: The frequency of cervical ribs was 136 (3.2%) with 14 (5.6%) females and 122 (3.1%) male cases. Among cervical ribs cases, 85 (62.5%) were bilateral, and 51 (38%) were unilateral. Among unilateral cervical ribs, 28 (55%) were right-sided, and 23 (45%) were on the left side.

Conclusion: The frequency of cervical ribs is comparatively higher than in most international studies. The frequency of bilateral cervical ribs and type 4 cervical ribs are higher in females than males.

Keywords: Cervical Ribs, Chest radiograph, Elongated transverse process, Frequency, Prevalence, Thoracic outlet syndrome (TOS).

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INTRODUCTION

Cervical ribs are also called Eve's rib and are additional ribs arising from lower cervical vertebrae, usually the seventh cervical vertebra.¹ The cervical rib was first described by Galen in 150 AD.² In addition, the presence of cervical ribs in skeletal remains of a Roman era at an Italian site has been described.³ Cervical ribs are usually asymptomatic and can be detected incidentally on the chest or cervical spine radiographs.

The Head, neck and tubercle of the cervical rib are present in most cases. However, the shaft may or may not be present. The shaft length varies and is sometimes attached to the first rib by a fibrous band.⁴ The fibrous band is attached to the first rib near the insertion site of the scalene muscle or scalene tubercle of the first rib. Sometimes hypertrophied scalene tubercle participates in articulation with bony cervical rib termed pseudo-arthritis. Cervical ribs articulating with the first rib are termed complete or type four cervical ribs. In 1869 Gruber described four types of cervical ribs Table-I. Most cervical ribs arise from the CV7 vertebra; however, cervical ribs from CV6, CV5

and CV4 have been reported.⁵

Although most cervical ribs are asymptomatic; however they are associated with thoracic outlet syndrome (TOS) in up to 10% of cases.⁶ TOS is subcategorized into neurogenic, venous and arterial depending on the structure responsible for presenting symptoms. Neurogenic TOS is the commonest, accounting for 90% of cases. Cervical ribs can also mimic palpable mass at the supraclavicular fossa.⁷

Due to possible neurovascular compression by cervical ribs, candidates with cervical ribs are considered unfit for employment in the armed forces. Therefore, pre-employment chest radiographs (X-ray chest) are evaluated for the presence or absence of cervical ribs and other thoracic pathologies. The database of Chest X-ray is available in Hospital Management System (HMS). Therefore, the study aimed to determine the frequency of cervical ribs by using HMS data of Chest X-ray of candidates who reported to CMH Lahore for medical fitness.

METHODOLOGY

This cross-sectional study was conducted at the Diagnostic Radiology department of Combined Military Hospital Lahore. Approval for the study was taken from Institutional Ethical Review Board

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(Certificate Number 275/2021). The sample size was calculated using formula: $n = \frac{desired\ sample\ size}{critical\ value \times standard\ value}$ for the corresponding level of confidence, at 95% confidence level (CI) or 5% level of significance (type-I error), as 1.96, $p = 0.05$ (5%), $d = 0.01$ (1%) was chosen as the Margin of error or precision.⁸ Putting the above values into the formula, gave a sample size estimation of 3754.

Inclusion Criteria: The latest chest radiographs of candidates reporting for medical examinations in the CMH Lahore were included.

Exclusion Criteria: Technically poor radiographs were excluded. Those X-ray chests in which CV7 was not included and were technically inadequate for evaluating cervical ribs were also excluded.

Using filters, X-ray chests of candidates carried out from February 2000 to March 2021 were extracted from HMS/PACS database. Amongst these 4540 X-ray chests, few candidates had more than one chest X-ray during the subject duration. Therefore, only a single recent Chest X-ray of each candidate was included, while additional X-ray chests were excluded. After exclusion of additional X-ray chests and technically poor X-ray chests, total 4247 chest radiographs were included in the study. Convenient sampling was used for the selection. Radiographs were viewed on PACS/HMS by two experienced radiologists, and findings were recorded.

C7 vertebra was identified by its transverse process directed horizontally or downwards, unlike thoracic vertebrae having transverse processes directed upwards. If the joint between the transverse process of CV7 and the additional rib was identified, it was only labelled as the cervical rib. If the transverse process of CV7 was longer than the DV1 transverse process and no joint was identified, it was labelled as the elongated transverse process.

Cervical ribs, which were very small bone fragments articulating with the C7 transverse process and not extending beyond 10mm from the tip of the CV7 transverse process, were considered type-1. All cervical ribs which were either fused with or formed pseudo-arthrosis with the first rib were classified as type 4 irrespective of their length. Since the presence of a fibrous band could not be evaluated on X-ray chest, those ribs having a length of 10-30mm as measured from the tip of the C7 transverse process were classified as type-2, while ribs longer than 30mm were classified as type-3.^{9,10}

Age, gender, presence or absence of cervical ribs, laterality of cervical ribs, types of cervical ribs and presence of elongated CV7 transverse processes were recorded. Statistical Package for Social Sciences (SPSS) version 20.0 was used for the data analysis. The Chi-Square test was used to estimate statistical significance. The p -value of ≤ 0.05 was considered statistically significant.

Table-I: Types of Cervical Ribs

Cervical Ribs Subtypes	Description
Type 1	Rib extends just beyond the transverse process
Type 2	Rib extends beyond the transverse process with free tip almost touching the first rib
Type 3	Rib extends beyond the transverse process with fibrous band or cartilage attaching to the first rib
Type 4	Cervical rib fused to first rib by a bony pseudo-articulation

RESULTS

Chest radiographs of 4247 candidates were evaluated. The mean age was 19.88 ± 2.85 years, ranging from 10-48 years.

The frequency of 3.2% (136 out of 4247 radiographs) of cervical ribs was found among 3996 (94%) males and 251 (6%) females. However, the frequency of cervical ribs at 5.58% (14 out of 251) in females was higher than 3.05% (122 out of 3996) in males. This difference in higher cervical ribs frequency in females was statistically significant (p -value 0.028) (Table-II).

Table-II: Chi-square table for Frequency Differences between Genders (n=4247)

Baseline Characteristics	Study Groups		p -value
	Normal (n=4111)	Cervical Ribs (n=136)	
Gender n (%)			
Male	3874 (96.95%)	122 (3.05%)	0.028
Female	237 (94.42%)	14 (5.58%)	

Among 136 positive cases, cervical ribs frequency was 62% (85 out of 136) for bilateral, and 37.5% (51 out of 136) for unilateral cases Figure. This difference of higher bilateral case frequency was insignificant (p -value 0.305). Amongst 51 cases of unilateral cervical ribs, the frequency of 20.59% (28 out of 136) for left-sided cervical ribs was more than 16.91% (23 out of 136) for right-sided cervical ribs, and the difference was statistically not significant (p -value 0.695).

The frequency of bilateral cervical ribs was 1.88% (75 out of 3996) in males and 3.98% (10 out of 251) in females. The higher frequency of bilateral cervical ribs in females was statistically significant (p -value 0.021). On the other hand, the frequency of unilateral cervical ribs was 1.18% (47 out of 3996) in males and 1.59% (4 out of 251) in females, and the difference was not significant (p -value 0.556). The frequency of right-sided cervical rib was 1.59% (4 out of 251) for females and 0.47% (19 out of 3996) for males. The higher frequency difference in females was statistically significant (p -value 0.019).

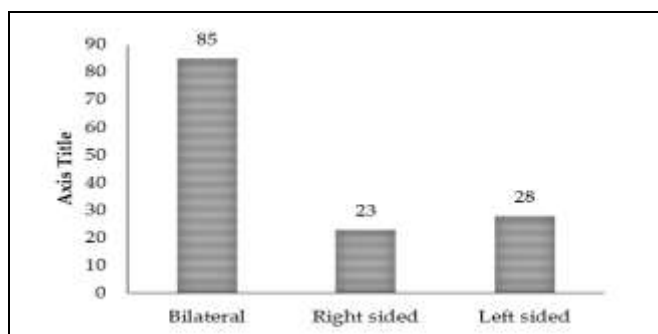


Figure: Frequency of Bilateral, Right Sided and Left Sided Cervical Ribs (n=136)

A total of 221 cervical ribs were identified in 136 radiographs, 108 on the right and 113 on the left side. The frequency of ribs was highest for type 1 and lowest for type 4 (Table-III). The frequency of type 4 ribs was higher in females (20.83%) as compared to (5.08%) in males, and the difference was statistically significant (p -value of 0.001). Gender-based differences between frequencies of Type 1, 2, and Type 3 ribs were not significant.

Table-III: Frequencies of Cervical Ribs Types (n=221)

Cervical Rib Type	Males (n=197)	Females (n=24)
1	77 (39.08%)	09 (37.50%)
2	56 (28.42%)	05 (20.83%)
3	54 (27.41%)	05 (20.83%)
4	10 (5.08%)	05 (20.83%)

The overall frequency of elongated transverse processes in our study was 2.82% (120 out of 4247). The frequency of elongated transverse processes in males was 2.88% (115 out of 3996) and in females was 2.38% (5 out of 251). The gender-based difference was insignificant (p -value 0.411) between frequencies of elongated transverse processes. Seventy-seven elongated transverse processes were bilateral, and 43 were unilateral.

Among 43 unilateral, 24 were on the right and 19 on the left (Table-IV).

DISCUSSION

The prevalence of cervical ribs varies depending upon the population.¹¹ In previous international studies cervical ribs prevalence of 0.79% (Agarwal *et al.* 2018),¹² 1.36% (Sharma *et al.* India 2014),¹³ 1.49% (Rani *et al.* 2021),¹⁴ 3.4% (Bokhari *et al.* Saudi Arabia 2012),¹⁵ and 6.2% (Erkin *et al.* Turkey 2002),¹⁶ has been reported.

Table-IV: Chi-square table for Elongated Transverse Process and Gender (n=4247)

Baseline Characteristics	Elongated Transverse Process		p -value
	Present	Absent	
Gender			
Male	115 (2.87%)	3881 (91.13%)	0.411
Female	5 (2%)	246 (98%)	
Total	120 (2.82%)	4127 (97.18%)	

The frequency of 3.1% in our study corresponds to local studies of 3.6% (Shahzad *et al.* Pakistan 2017),⁹ and 3.9% (Salam *et al.* Pakistan 2010),¹⁰ however, a much higher 6.11% (Arshad *et al.* Pakistan 2016),¹¹ and considerably lower 0.38% (Iftikhar *et al.* Pakistan 2020),⁸ frequencies have also been reported.

Similar to many previous studies (Bokhari *et al.* Saudi Arabia 2012),¹⁵ (Shahzad *et al.* Pakistan 2017),⁹ the prevalence of cervical ribs amongst females is found to be higher (5.58%) as compared to males (3.05%) in our study and difference was statistically significant. In contrast to most studies, a higher prevalence in males has also been reported in one study (Vankatesan *et al.* Chennai 2014).¹⁷ In our study, bilateral cervical ribs are more common than unilateral ones; however, the difference is statistically non-significant.

Many previous studies (Agarwal *et al.* 2018),¹² (Shahzad *et al.* Pakistan, 2017),¹⁴ (Arshad *et al.* Pakistan, 2016),¹¹ have also reported a higher frequency of bilateral cervical ribs. However, few studies (Vankatesan *et al.* Chennai 2014),¹⁷ and (Bhat *et al.* Kashmir 2017),¹⁸ have reported a higher frequency of unilateral ribs. In our study, bilateral ribs and type 4/complete cervical ribs were more common in females than males. In addition, left-sided cervical ribs were slightly more common amongst unilateral findings than the right side.

The frequency of elongated transverse processes in our study was 2.82% which is higher than 1.2% (Arshad *et al.* Pakistan, 2020),¹⁶ however, the much

higher prevalence of 10.71% (Rani *et al.* India 2021),¹⁴ and 22.5% (Shahzad *et al.* Pakistan 2017),⁹ have also been reported.

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CONCLUSION

The frequency of cervical ribs is comparatively higher than in most international studies. In addition, the frequency of bilateral cervical ribs and type four cervical ribs are higher in females than males. Considering the higher prevalence of cervical ribs, practicing clinicians should consider TOS in patients with upper limb symptoms and screen them with chest radiographs.

Conflict of Interest: None.

Auhor's Contribution

NA:, MAZH:, HR:, ZA:, KTK:, KF: Conception, design, analysis and interpretation of data.

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