

# Prevalence of cervical rib in patients visiting department of Radiodiagnosis at a tertiary care hospital: A descriptive cross-sectional study

Ruku Pandit<sup>1\*</sup>, Aarati Adhikari<sup>2</sup>, Nitasha Sharma<sup>3</sup>, Hari Prasad Upadhyay<sup>4</sup>

<sup>1</sup>Department of Anatomy, College of Medical Sciences and Teaching Hospital, Chitwan, Nepal, <sup>2</sup>Department of Radiodiagnosis, College of Medical Sciences and Teaching Hospital, Chitwan, Nepal, <sup>3</sup>Department of Anatomy, Universal College of Medical Sciences and Teaching Hospital, Bhairahawa, Nepal, <sup>4</sup>Department of Statistics, Birendra Multiple Campus, Chitwan, Nepal

## ABSTRACT

**Introduction:** The cervical ribs are the supernumerary ribs that are often associated with neuro-vascular symptoms in thoracic outlet syndromes. The objective of the study was to find the prevalence of cervical ribs among the patients visiting the Radiodiagnosis department of a tertiary care hospital. **Methods:** This is a cross-sectional study comprising 1533 chest and cervical spine radiographs of patients visiting the Radiodiagnosis department of a tertiary care hospital from March to June 2021. Ethical approval was taken from the Institutional Review Committee at the College of Medical Sciences and Teaching Hospital (Reference Number: COMSTH-IRC/2021-63). The presence or absence of a cervical rib was noted in the digital x-rays. The collected data were statistically analyzed using Statistical Package for Social Science version 20.0. **Results:** The cervical ribs were found in 23 cases, resulting in a prevalence of 1.50%, out of which 13 (0.85%) were present in males and 10 (0.65%) in females. Amongst the cases with cervical ribs, 6 (26.01%) were present bilaterally and 17 (73.91%) occurred unilaterally and more frequently on the left side. Sexual dimorphism was not found to be significantly associated with laterality and sidedness of cervical ribs. **Conclusions:** The cervical ribs were commonly encountered in our study. As the presence of the cervical rib is one of the leading causes of thoracic outlet syndromes, clinicians should not overlook the existence of cervical ribs while ruling out the etiology of thoracic outlet syndrome.

**Keywords:** Cervical rib, neurovascular manifestation, thoracic outlet syndrome.

## \*Correspondence:

Dr. Ruku Pandit  
Department of Anatomy  
College of Medical Sciences and Teaching  
Hospital, Bharatpur, Chitwan, Nepal  
Email: ruukuu\_252@yahoo.com

**Submitted:** March 21, 2022

**Accepted:** May 29, 2022

**To cite:** Pandit R, Adhikari A, Sharma N, Upadhyay HP. Prevalence of cervical rib in patients visiting department of Radiodiagnosis at a tertiary care hospital: A descriptive cross-sectional study. JGMC Nepal. 2022;15(1):14-8.  
DOI:10.3126/jgmcn.v15i1.43938

## INTRODUCTION

Cervical rib is an aberrant rib that arises due to excessive growth of anterior tubercle of the seventh cervical vertebra. It may develop from 4<sup>th</sup>, 5<sup>th</sup> or 6<sup>th</sup> cervical vertebra in rare cases.<sup>1</sup> The rib may be completely developed or presents as small outgrowth of the costal element.<sup>2</sup> The occurrence of cervical ribs varies between 0.05% to 6.2% in a radiological study<sup>3-6</sup> while it is substantially greater (17.1% to 33.0%) in osteological study of patients with embryonal malignancies.<sup>7,8</sup>

The axial skeleton develops from the paraxial mesoderm. On either side of the neural tube, the paraxial mesoderm forms a segmented series of tissue blocks called somites which differentiates into a dorsolateral component, the dermomyotome and a ventromedial component, the sclerotome. At the end of the 4<sup>th</sup> week of development, the cells of the sclerotome convert into mesenchymal cells which are ossified to form vertebrae. The ribs develop from the costal process of thoracic vertebrae. The costal process, on the other hand, is rudimentary in cervical, lumbar, and sacral vertebrae, and is represented by a costal element, which is a component of their transverse process.<sup>9</sup> Hox genes are crucial for axial skeleton

patterning, and mutations in them are likely to cause the development of cervical ribs.<sup>10</sup>

Cervical ribs are usually asymptomatic and are discovered incidentally during routine radiographic procedure. In around 10% of instances, patients with cervical rib complained of neurological symptoms such as paresthesia, pain and tingling feeling in the upper limbs, which are indicative of thoracic outlet syndrome.<sup>3,11</sup> The pain was dramatically relieved after surgical resection of aberrant rib.<sup>11</sup> Cervical ribs may also be associated with vascular symptoms like diminished radial pulsation, especially when the arm is abducted and subclavian artery aneurysm distal to the point of compression by the cervical rib.<sup>12</sup>

As the presence of the cervical rib is one of the leading causes of thoracic outlet syndrome, it is crucial to recognize and report this osseous malformation. Hence, the aim of the study was to find out the prevalence of cervical ribs among the patients visiting the Radiodiagnosis department of a tertiary care hospital.

## METHODS

This is a descriptive cross sectional study conducted in the department of Anatomy of a tertiary care hospital. After obtaining clearance from the Institutional Ethical Committee at the College of Medical Sciences and Teaching Hospital (Ref. No-COMSTH-IRC/2021-63), we collected digital chest and cervical spine radiographs of the patients visiting department of Radiodiagnosis from March to June 2021. Digital radiographs of patients in which obvious pathology obscured bony details were excluded.

Sample size was calculated by following formula:<sup>13</sup>

$$\begin{aligned} n &= Z^2 \times p \times (1-p) / e^2 \\ &= (1.96)^2 \times (0.50) \times (1-0.50) / (0.03)^2 \\ &= 1068 \end{aligned}$$

where,

n= minimum required sample size

Z= 1.96 at 95% Confidence Interval (CI)

p= past prevalence taken as 50% for maximum sample size

e= margin of error, 3%

Taking a 10% non-response rate, the sample size became 1175. However, we included digital radiographs of 1533 patients in the study using a convenient sampling technique. Demographic data like age and sex were also noted. The digital X-rays were thoroughly studied by the author and the cervical ribs were identified radiologically (Figures 1 to 3) based on the following criteria:<sup>3,7,14</sup>

1. The cervical rib must articulate with the seventh cervical vertebra with a well-defined synovial joint.
2. The cervical rib must develop from the transverse process of the seventh cervical vertebra, which is oriented

caudally and laterally, rather than the cranially oriented transverse process of the first thoracic vertebra.

3. The cervical rib must not articulate with the manubrium sterni, but it can be connected to the first rib.

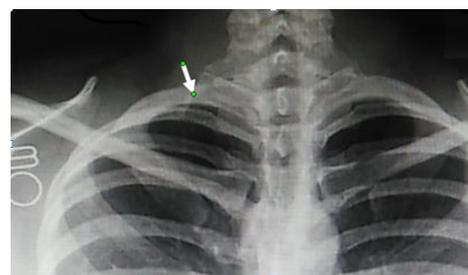
Data obtained was analyzed using Statistical Package for Social Science (SPSS) version 20.0. The cases with cervical ribs were further evaluated for any association with laterality and gender using Chi-square for one-dimensional "goodness of fit" test. Chi-square of Independence was employed to compare the various parameters (laterality and side) with genders. A p-value <0.05 (95% confidence interval) was considered significant



**Figure 1:** Radiograph of thoracic region (PA view) showing unilateral (on left side) presence of CCJ (arrow marked)



**Figure 2:** Radiograph of thoracic region (PA view) showing unilateral (on right side) presence of CCJ (arrow marked)



**Figure 3:** Radiograph of thoracic region (PA view) showing bilateral presence of CCJ (arrow marked)

## RESULTS

In the present study, we examined the chest and cervical spine radiographs of 1533 patients, out of which 818 were males and 715 were females. The mean age of patients was 45.41±17.63 years.

The cervical ribs were found in 23 cases, among which

13 (0.85%) were males and 10 (0.65 %) were females, resulting in a prevalence of 1.50 % (as illustrated in Table 1).

**Table 1:** Distribution of cervical rib on the basis of gender and laterality

Cases with cervical ribs	Male (n=818) Number (%)	Female (n=715) Number (%)	Total (N=1533) Number (%)
Unilateral or bilateral	13 (0.85)	10 (0.65)	23 (1.50)
Bilateral	4 (1.50)	2 (0.13)	6 (0.39)
Unilateral	9 (0.59)	8 (0.52)	17 (1.11)

The cases with cervical ribs were further analyzed. Chi square test for one dimensional "goodness of fit" was applied to access the association between prevalence of cervical ribs and laterality, side and gender (Table 2). In 17 cases (73.91%) cervical rib was present only on one side and on both sides in six cases (26.01%) with unilateral occurrence of cervical rib being significantly greater than bilateral occurrence ( $p < 0.05$ ). Amongst unilateral cervical ribs, 11 were observed on left side and six on right side, however, the difference was insignificant ( $p > 0.05$ ). While observing gender wise distribution, the cervical ribs was found to be predominant in male than in female, with no statistical difference between sexes.

**Table 2:** Comparison of parameters (laterality, side and gender)

Parameter	Number (%)	Chi square	p-value	
Laterality (n= 23)	Unilateral	17 (73.91)	5.26	0.022
	Bilateral	6 (26.01)		
Side (n= 17)	Right	6 (35.29)	1.47	0.225
	Left	11 (64.71)		
Gender (n= 23)	Male	13 (56.53)	0.391	0.532
	Female	10 (43.48)		

The prevalence of bilateral cervical ribs was 2(8.69%) in females and 4(17.39%) in males, while the occurrence of unilateral cervical ribs in females and males were 8(34.78%) and 9(39.13%) respectively (Table 3). Chi-square test on Independence was employed to compare various parameters (laterality and side) with gender. Sexual dimorphism was not found to be significantly associated with laterality and sidedness of cervical ribs.

**Table 3:** Association of gender with laterality and sidedness of cervical ribs

Parameters		Gender		Chi square	p-value
		Male Number (%)	Female Number (%)		
Laterality (n= 23)	Unilateral	9 (39.13)	8 (34.78)	0.346	0.55
	Bilateral	4 (17.39)	2 (8.69)		

Side (n= 17)	Right	2 (11.76)	4 (23.53)	1.449	0.229
	Left	7 (41.16)	4 (23.53)		

## DISCUSSION

The present study emphasizes on the presence of anomalous cervical ribs by analyzing digital chest and cervical spine radiographs of 1533 patients, out of which 818 were males and 715 were females.

The incidence of cervical ribs in radiological studies varies greatly among various populations. The prevalence of cervical rib was 1.5% in the current study. Rani et al.<sup>15</sup> observed various anomalies of costal element at the thoracic outlet radiologically and also found that the cervical ribs were present in 1.45% of the cases. The incidence of the cervical rib was somewhat lower ranging from 0.58% to 1.3% in several other studies.<sup>3,16-19</sup> Lalchan et al.<sup>4</sup> also conducted a similar study on the Nepalese population in the western development region and noted cervical ribs in 39 out of 3600 cases with the prevalence of 1.1%. In comparison to our study, the prevalence of cervical rib was considerably greater in Saudi 3.4%,<sup>20</sup> Caucasian 2.2%,<sup>7</sup> and Turkish 6.2%<sup>6</sup> populations. An obvious discrepancy in sample size, ethnic and regional variations and diverse methods (CT scan, MRI, conventional radiographs) adopted to identify cervical ribs might explain the disparity in results.

Ani et al.<sup>21</sup> reported a higher prevalence of unilateral cervical ribs 0.43% than bilateral in the Nigerian population, occurring more frequently on the right side 0.29%. Similarly, in the Kashmiri population, unilateral cervical ribs 1.76% with right side predominance were more common than bilateral 0.91%.<sup>22</sup> The results of the previous studies concur with the findings of our study in which the unilateral prevalence of cervical rib was significantly higher than that of bilateral; however, the cervical ribs were present more often on the left side in the present study. Likewise, in one of largest study on prevalence of cervical rib conducted on 5000 chest radiographs of people from central India, cervical ribs were more common unilaterally 0.78% than bilaterally 0.44% in which unilateral cervical ribs occurred more often on left side 0.44%.<sup>18</sup> In the Malawian population, the occurrence of cervical ribs did not show a difference in laterality (unilateral-0.29%, bilateral-0.29%), and unilateral ribs were more prevalent on the left side 0.2%.<sup>3</sup> On contrary, bilateral cervical ribs were more common than unilateral among Indians in and around Lucknow.<sup>17</sup>

In our study, the prevalence of cervical ribs was slightly higher in males 0.85% than in females 0.65%, with no significant difference between genders. Also, sexual

dimorphism was not found to be substantially associated with the laterality and sidedness of cervical ribs. Sharma et al.<sup>18</sup> found a similar result, with cervical ribs accounting for 0.68% and 0.54%, respectively, in males and females. These findings, however, contradict those of Gupta et al.<sup>17</sup> (male- 0.49%, female- 0.73%) and Bhat et al.<sup>22</sup> (male- 1.12%, female- 1.55%) studies conducted in Indian people in which cervical ribs were more prevalent in females. Females were more likely to have cervical ribs in people from Western Nepal,<sup>4</sup> Nigeria (male- 0.29%, female- 0.36%)<sup>21</sup> and Saudi Arabia (female: male= 2.01:1).<sup>20</sup> Cervical ribs are asymptomatic in 90% of the cases. If symptomatic, cervical ribs produce neurological or vascular manifestations. The morphology of the cervical ribs determines the kind of manifestation. Complete cervical ribs compress both the brachial plexus and the sub-clavian artery, resulting in neurovascular complications, whereas incomplete cervical ribs solely affect the brachial plexus, causing only neurological symptoms. The study showed that the neurological complication was much higher i.e, 85.7% than vascular insufficiency affecting women over 30 years of age.<sup>23</sup> Firm swelling was also noted in right supraclavicular area of two patients with right sided cervical ribs.<sup>4</sup>

As the present study was done on the data available in the department of Radiodiagnosis of a tertiary care hospital, presence of cervical rib could not be correlated with clinical history of the patient. Hence, in future, further research should be conducted relating cervical rib and patient's clinical history.

## CONCLUSIONS

Cervical rib is a common anatomic variant discovered during a routine radiological procedure in our study. Considering cervical ribs as one of the most important causes of thoracic outlet syndrome, radiologists must be meticulous when evaluating cervical spine and chest radiographs to identify cervical ribs.

**CONFLICT OF INTEREST:** None declared

**SOURCE OF FUNDING:** None

## REFERENCES

1. Spadlinski L, Cecot T, Majos A, Stefanczyk L, Pietruszewska W, Wysocki G, et al. The epidemiological, morphological, and clinical aspects of the cervical ribs in humans. *BioMed research International*. 2016;2016:1-7. DOI:10.1155/2016/8034613 PMID: 27975060.
2. Tubbs RS, Muhleman M, Miller J, Shoja MM, Loukas M, Wellons JC, et al. Cervical ribs with neurological

- sequelae in children: a case series. *Childs Nerv Syst*. 2012;28(4):605-8. DOI: 10.1007/s00381-011-1608-5 PMID: 22006364.
3. Brewin J, Hill M, Ellis H. The prevalence of cervical ribs in a London population. *Clinical Anatomy: The Official Journal of the American Association of Clinical Anatomists and the British Association of Clinical Anatomists*. 2009;22(3):331-6. DOI: 10.1002/ca.20774
4. Lalchan S, Jwarchan B, Gyawali M. Prevalence of Cervical Rib in Western Nepal. *Nepalese Journal of Radiology*. 2016;6(1-2):15-8. DOI: 10.3126/njr.v6i1-2.19209
5. Steiner HA. Roentgenologic manifestations and clinical symptoms of rib abnormalities. *Radiology*. 1943;40(2):175-8. DOI: 10.1148/40.2.175
6. Erken E, Ozer HT, Gulek B, Durgun B. The association between cervical rib and sacralization. *Spine*. 2002;27(15):1659-64. DOI: 10.1097/00007632-200208010-00013 PMID:12163729.
7. Merks JH, Smets AM, Van Rijn RR, Kobes J, Caron HN, Maas M, et al. Prevalence of rib anomalies in normal Caucasian children and childhood cancer patients. *Eur J Med Genet*. 2005;48(2):113-29. DOI: 10.1016/j.ejmg.2005.01.029 PMID:16053903.
8. Roos DB. Congenital anomalies associated with thoracic outlet syndrome: anatomy, symptoms, diagnosis, and treatment. *Am J Surg*. 1976;132(6):771-8. DOI: 10.1016/0002-9610(76)90456-6 PMID: 998867.
9. Bots J, Wijnaendts LC, Delen S, Van Dongen S, Heikinheimo K, Galis F. Analysis of cervical ribs in a series of human fetuses. *J Anat*. 2011;219(3):403-9. DOI: 10.1111/j.1469-7580.2011.01400.x PMID:21689099.
10. Wellik DM, Capecchi MR. Hox10 and Hox11 genes are required to globally pattern the mammalian skeleton. *Science*. 2003;301(5631):363-7. DOI: 10.1126/science.1085672 PMID:12869760.
11. Atasoy E. Thoracic outlet compression syndrome. *Orthop Clin North Am*. 1996;27(2):265-303. PMID: 8614579.
12. Halsted W. An experimental study of circumscribed dilation of an artery immediately distal to a partially occluding band, and its bearing on the dilation of the subclavian artery observed in certain cases of cervical rib. *J Exp Med*. 1916;24(3):271-86. DOI: 10.1084/jem.24.3.271 PMID: 19868040.
13. Das S, Mitra K, Mandal M. Sample size calculation: Basic principles. *Indian J Anaesth*. 2016;60(9):652-6. DOI:

- 0.4103/0019-5049.190621 PMID:27729692.
14. Etter L. Osseous abnormalities of the thoracic cage seen in forty thousand consecutive chest photoroentgenograms. *American Journal of Roentgenology*. 1944;51:359-63. DOI: 10.1080/00029890.1944.11999107
  15. Rani A, Chopra J, Singh RR, Bajpai PK. Prevalence of various anomalies of costal element at cervico-thoracic junction in and around lucknow region of uttar pradesh: A radiological study. *Biomedical Research (0970-938X)*. 2021;32(1):7-14.
  16. Ebite L, Igbigbi P, Chisi J. Prevalence of true cervical rib in adult Malawian population. *Journal of Anatomical Science*. 2007;1(1):7-9.
  17. Gupta A, Gupta D, Saxena D, Gupta R. Cervical rib: It's prevalence in Indian population around Lucknow (up). *Journal of Anatomical Society of India*. 2012;61(2):189-91. DOI: 10.1016/S0003-2778(12)80030-X
  18. Sharma D, Vishnudutt SV, Rathore M. Prevalence of 'Cervical Rib' and its association with gender, body side, handedness and other thoracic bony anomalies in a population of Central India. *Indian Journal of Basic and Applied Medical Research*. 2014;3(2):593-7.
  19. Viertel V, Intrapromkul J, Maluf F, Patel N, Zheng W, Alluwaimi F, et al. Cervical ribs: a common variant overlooked in CT imaging. *Am J Neuroradiol*. 2012;33(11):2191-4. DOI: 10.3174/ajnr.A3143 PMID:22790240.
  20. Bokhari RF, Al-Sayyad MJ, Baeesa SS. Prevalence of cervical ribs and elongated transverse processes in Saudi Arabia. *Saudi Med J*. 2012;33(1):66-9.
  21. Ani C, Adegbe E, Amedaji M, Gabkwet A. Cervical rib variant in a Nigerian Population. *Jos Journal of Medicine*. 2012;6(1):60-2.
  22. Bhat M, Mir T, Abdullah I. Prevalence of cervical ribs and elongated transverse processes in Kashmiri population. *International Journal of Research in Medical Sciences*. 2015;12:3763-5. DOI: 10.18203/2320-6012.ijrms20151437
  23. Dashti G, Ghasemi N. Evaluation of neurovascular complication of cervical ribs. *Anatomical Sciences*. 2015;12(3):111-14.