Is the existence of cervical rib an advantage for C7 posterior stabilization?

ABSTRACT

**Background and Aim:** Defining a new screwing method for C7 posterior stabilization in case of a cervical rib existence aimed in this report.

**Materials and Methods:** Ten adult patients, five of which without cervical rib (Group 1) and the other five of which (Group 2) with cervical rib that has been chosen from the radiology archive. Axial, sagittal, coronal sections of cervical computed tomography and three-dimensional images were obtained. Lateral mass sizes of all cases were measured and compared between two groups. The relationship between cervical rib and lateral mass was identified in Group 2.

**Results:** The mean length, width, and height of lateral masses were measured respectively, as 5.4, 17.6, and 12.7 mm in Group 1. The measurement of Group 2 (with cervical rib) revealed the mean length of 20.7, the width of 20.4, and the height of 15.9 mm. When both groups were compared, there were no significant differences between the width and height of the lateral masses. However, axial measurements of Group 2 revealed a remarkable and significant length for screwing.

**Conclusion:** In patients with cervical rib, directing lateral mass screw toward cervical rib conjoint can present a simple and reliable alternative method in C7 posterior stabilization process.

**Key words:** C7; cervical rib; posterior stabilization; screwing.

Introduction

Evaluation of pathological condition together with normal anatomy plays a key role in surgical planning. A favorable radiological anatomy analysis can present distinctive surgical options. Cervical vertebra injuries have a significant place in neurosurgical practice. In inferior cervical injury cases, complications are experienced during surgical treatment due to anatomical structure of C7. In addition, complication rate in posterior stabilization of C7 is relatively higher. In this study, we discussed on a new anatomical model for C7 posterior screwing. About 0.2%–8% of the population has cervical rib in C7. We have evaluated anatomical structure of cervical rib and lateral mass conjoint on radiological images of patients having cervical rib. This anatomical feature compared with the images of patients without cervical rib. Moreover, in the light of findings that we obtained, we discussed on a new alternative method aimed at screwing for C7 in cases with cervical rib.

Materials and Methods

In this study, 10 adult patients, 5 of which without cervical rib (Group 1), and the other 5 of which (Group 2) with cervical rib that has been chosen randomly from the radiology archive. Images of computed tomography were obtained by Toshiba Aquilion (Tokyo-Japan, 2007) which is a device with multiple slices and 64 detectors. Besides the axial, sagittal, and...
coronal sections, the three-dimensional (3D) reconstruction images were prepared. 2D and 3D images were performed in Vitria 2 workstation (Toshiba®), and measurements were performed on the basis of both 2D and 3D images (Kv-120, mA-150, scanning time: 5.439 sn). Lateral mass sizes of both groups were observed anatomically. The relationship between cervical rib and lateral mass was identified in the Group 2. The measurements were performed in an axial, sagittal, and coronal plane in both groups. The values obtained were noted and compared. The differences between both groups were interpreted by taking into consideration the values obtained.

Results

The mean length (anteroposterior or axial), the mean width (mediolateral or coronal), the height (vertical) of lateral masses were measured respectively, approximately, 5.4 mm (from point A to B), 17.6 mm (from point C to D), and 12.7 mm (from point E to F) in Group 1 (Table 1 and Figure 1). In the Group 2, cervical ribs were making joint with C7 and closely adjacent to the lateral mass of C7, leading toward a posterior side. In axial plane, a line was identified extending from the median point of lateral mass toward cervical rib. Mean length (A'B') was measured as 20.7 mm (Table 1 and Figure 2). Besides, the mean width and the mean height of those were measured respectively as: 20.4 mm (from point C' to D') and 15.9 mm (from point E' to F') (Table 1 and Figure 2). When both groups were compared, there were no significant differences between the mean width and the height of the lateral masses. As for the cervical rib-lateral mass conjoint, it was determined that it has an anatomical relationship which significantly increases the length.

Discussion

Lateral mass screwing method for cervical vertebra establishes a common practice of spinal surgery in cervical posterior fixation. However, C7 has the characteristics of both cervical and thoracic vertebrae. The lateral mass screwing method is problematic for C7, having thin and short lateral masses. For these reasons, various stabilization methods were reported for C7 stabilization. The transpedicular screwing method is mostly recommended. However, transpedicular screwing is technically harder. It has a high risk of causing neural or vascular injury by the screw driven out of pedicle. Hence, alternative methods as transfacet and intralaminar screwing reported.

The presence of cervical rib is a remarkable anatomical variation for C7. Two significant criteria are identified for cervical rib: First, cervical rib must make joint with C7, and it must not fuse with C7 vertebra. It is called prolonged transverse process if it fuses. Second, the rib must not originate from the transverse process of the first thoracic vertebra. Patients with cervical rib provide the optimal conditions for that diagnosis.

In the Group 2, the measurements we have taken in the axial, sagittal, and coronal plane from C7 lateral mass to cervical rib indicate that this zone provides sufficient volume for lateral mass screwing method. The mean length (A'B' line), the mean width (C'D' line), the mean height (E'F' line) of patients with cervical rib were measured respectively at 20.7 mm, 20.4 mm, and 15.9 mm (Figure 2a-c). We consider that these measurements are sufficient to replace lateral mass screw when lateral masses of the other cervical vertebrae are taken into account. The distinction in the patients with cervical rib is remarkable when compared with...
the cases without cervical rib having normal C7. When the screw is directed toward cervical rib conjoint, reliable zone also will be provided. As observed in Group 2, screw must be directed a bit more toward lateral side, unlike the methods used for lateral mass screwing [Figure 3].

Cervical ribs may have different anatomical configurations. For this reason, the lateral mass and cervical rib conjoint must be calculated, and the direction of the screw must be adjusted separately for each case. In addition, the standard values for cervical rib-lateral mass conjoint have not been defined in the cases with cervical rib. In the cases with cervical rib, that the lateral mass morphology of C7 and the relationship of it with cervical rib being reported after it is inspected in a large population, will contribute significantly to clinical practice.

As a consequence, in patients with cervical rib, directing lateral mass screw toward cervical rib conjoint can present a simple and reliable alternative method in C7 posterior stabilization process. However, this report should be supported with further biomechanical studies.

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Nil.

**Conflicts of interest**

There are no conflicts of interest.

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**Table 1: Measurements of length, width, and height of C7 in both groups**

| Cases | Group 1, without cervical rib (mm) | Group 2, with cervical rib (mm) |
|-------|-----------------------------------|--------------------------------|
|       | Length (AB) | Width (CD) | Height (EF) | Length (A'B') | Width (C'D') | Height (E'F') |
| 1     | 5.6         | 17.8       | 12.8        | 21.2         | 20.8        | 16           |
| 2     | 5.2         | 17.4       | 12.5        | 21           | 20.2        | 15.3         |
| 3     | 5.1         | 17.3       | 12.6        | 19.9         | 18.6        | 15.3         |
| 4     | 5.4         | 17.6       | 12.5        | 20.6         | 19.9        | 15.8         |
| 5     | 5.7         | 17.9       | 13.1        | 20.8         | 20.5        | 17.1         |
| Mean  | 5.4         | 17.6       | 12.7        | 20.7         | 20.4        | 15.9         |

**Figure 3:** Illustration of posterior C7 stabilization by lateral mass screw in case with cervical rib. (a) Screwing virtually on the image of three-dimensional-computed tomography, (b) charcoal image of screwing.