Morphometric Study of Uncinate Process of Cervical Vertebra and Its Surgical Importance

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Abstract

Introduction Uncinate process is a projection on the posterolateral margins of the superior surface of the body of cervical vertebra. They are involved in uncovertabral (Luschka’s) joints, with intervertebral foramen in between, which is related to the vertebral artery and spinal nerve roots. Osteophytes of uncinate process cause narrowing of intervertebral foramen, resulting in cervical spondylotic radiopathy.

Objectives To measure the morphometric parameters of the uncinate process of cervical vertebra. To classify cervical vertebra on the basis of the encroachment of uncinate process on the adjacent intervertebral foramen.

Materials and Methods 100 dry cervical vertebrae were obtained from regions in and around Mysore, Karnataka, India. Measurements were taken using digital Vernier callipers.

Results Mean average values of the parameters are: width–3.389 ± 0.83 mm (right), 3.389 ± 0.86 mm (left); length–10.42 ± 1.46 mm (right), 10.64 ± 1.88 mm (left); height–5.32 ± 1.36 mm (right), 5.21 ± 1.16 mm (left). Classification of uncinate process: Type 1 (no encroachment)–82%; Type 2 (inclined and encroaching)–12%; Type 3 (not inclined, but large enough to encroach)–6%

Conclusion Comparing the results of the present study with previous studies in different regions will help the neurosurgeons in determining the boundaries of uncinate process and allow adequate decompression of neural elements, with reduced risk of neurovascular structures during anterior decompression of spine.

Introduction

The superior discal surface of cervical vertebra is saddle-shaped, formed by flange-like lips, uncinate processes, which arise from most of the lateral circumference of the upper margin of the vertebral body. Uncinate processes are rudimentary at birth and are usually found on the third to seventh cervical vertebra in the adult. The uncinate processes on the vertebra below articulate with the corresponding bevelled surfaces on the inferior aspect of the vertebra above. Whether uncovertbral joints are synovial joints is a point that has proved to be controversial since their description by von Luschka in 1858; the demonstration of synoviocytes in the lateral joint capsule tissue of elderly uncovertbral joints suggests that they should be regarded as synovial joints.¹ The main cause of cervical spondylotic radiculopathy and myelopathy is the projection of osteophytes from the uncinate process, leading to narrowing of the intervertebral foramina.² Vertebral artery injury is a catastrophic complication that can occur during anterior decompression of the cervical foramen.² Comparison of morphometric measurements of the cervical uncinate process reduces risk to neurovascular structures during anterior cervical spine surgery and helps in improving adequate decompression of the neural elements.

Keywords

- uncinate process
- cervical vertebra
- luschka’s joint
- uncovertbral joint
- spondylosis

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Aim

To measure the morphometric parameters of the uncinate process of cervical vertebra. To classify cervical vertebra on the basis of the encroachment of uncinate process on the adjacent intervertebral foramen.

Materials and Methods

For the study, 100 dry cervical vertebrae from human cadavers of both sexes were obtained from regions in and around Mysore, Karnataka, India from May 2017 to December 2017. The bones with visible osseous pathologies like tumors, deformities, fractures, and trauma were excluded. Morphometric parameters of the uncinate process of cervical vertebra were measured using digital callipers. The length was measured as the anteroposterior distance of uncinate process (Fig. 1). The height of the uncinate process was measured as the distance between the tip of the process and the superior surface of the vertebra (Fig. 2). The width was measured as the distance between the medial and lateral margins of the uncinate process at its base (Fig. 3). Data was tabulated and reported as mean ± standard deviation.

Results

Mean average values of the parameters are: width–3.389 ± 0.83 mm (right), 3.389 ± 0.86 mm (left); length–10.42 ± 1.4 mm (right), 10.64 ± 1.88 mm (left); height–5.32 ± 1.36 mm (right), 5.21 ± 1.16 mm (left). All these values are tabulated in Table 1. Classification of the uncinate process (Table 2): Type 1 (no encroachment; Fig. 4)–82%; Type 2 (inclined and encroached; Fig. 5)–12%; Type 3 (not inclined, but large enough to encroach; Fig. 6)–6%

Discussion

The vertebral body is a composite of the annular epiphyses and the mass of bone between them. All secondary centers unite with the rest of the vertebra at approximately 25 years of age. Osteophytes (bony spurs) may form from the compact cortical bone on the anterior and lateral surfaces of the bodies. Although individual variations occur, these changes appear in most individuals from 20 years onward. Knowledge of the width of the uncinate process is also important when decompressing nerve roots posterolaterally. An increase in the width of the uncinate process due to osteophyte formation in it may result in intervertebral foraminal stenosis and neural compression. In the present study, the width ranged from 2.2 to 4.6 mm with a mean of 3.4 mm; the length ranged from 8.3 to 14.6 mm with a mean of 10.5 mm. The height and width of the uncinate process may be considered as the entrance to the spinal nerve and vertebral artery.

Table 1 Results

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Mean average value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Right</td>
</tr>
<tr>
<td>Width</td>
<td>3.389 ± 0.83 mm</td>
</tr>
<tr>
<td>Length</td>
<td>10.42 ± 1.46 mm</td>
</tr>
<tr>
<td>Height</td>
<td>5.32 ± 1.36 mm</td>
</tr>
</tbody>
</table>

Table 2 Classification of cervical vertebra according to the encroachment of uncinate process over intervertebral foramen

<table>
<thead>
<tr>
<th>Type</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>82</td>
</tr>
<tr>
<td>II</td>
<td>12</td>
</tr>
<tr>
<td>III</td>
<td>6</td>
</tr>
</tbody>
</table>
for decompression of the intervertebral foramen anterolaterally. The uncinate process is an important bone landmark that becomes larger and flatter as individuals age, losing its sharp and bony characteristics. In the present study, the height ranged from 3.2 to 6.9 mm with a mean of 5.3 mm. The results of the present study were compared with previous studies (Table 3). The results of the present study showed great variations from previous studies carried out in the Southeast Asian, European, and American regions.

Use of computed tomography images for measurements showed better results since alignment of vertebra in a single individual was not disturbed, as compared with studies conducted on dry bones (obtained from different individuals).

The main cause of cervical spondylotic radiculopathy is that osteophytes project from the uncinate process, which results in narrowing of the intervertebral foramina. Hence, in the present study, the uncinate process were classified into three types based on their relation to the intervertebral foramen, according to Bergman’s comprehensive encyclopedia of anatomic variations. In 12% of vertebrae, the uncinate process was inclined toward the intervertebral foramen, and in 6% of vertebrae, the uncinate process was not inclined but

![Fig. 4](image1.png)

Fig. 4 Type 1 no encroachment on adjacent intervertebral foramen.

![Fig. 5](image2.png)

Fig. 5 Type 2 inclined to encroach on adjacent intervertebral foramen.

![Fig. 6](image3.png)

Fig. 6 Type 3 not inclined; but large enough to encroach on adjacent intervertebral foramen.

### Table 3  Comparison of present study with previous studies

<table>
<thead>
<tr>
<th>Study</th>
<th>Region</th>
<th>Method</th>
<th>Length (mm)</th>
<th>Height (mm)</th>
<th>Width (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yu Hang Zhu et al</td>
<td>China</td>
<td>Digital calliper/CT</td>
<td>11.5</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Tae Hoon Lee et al</td>
<td>Korea</td>
<td>Digital calliper</td>
<td>13.4</td>
<td>5.5</td>
<td>5.9</td>
</tr>
<tr>
<td>N. Kocabiyik et al</td>
<td>Turkey</td>
<td>Digital calliper</td>
<td>11.46</td>
<td>7.54</td>
<td>5.29</td>
</tr>
<tr>
<td>Jike Lu et al</td>
<td>USA</td>
<td>Digital calliper</td>
<td>12.1</td>
<td>5.9</td>
<td>5.6</td>
</tr>
<tr>
<td>Mustafa Guvencer et al</td>
<td>Turkey</td>
<td>Digital calliper/CT</td>
<td>12.8</td>
<td>6.2</td>
<td>6.0</td>
</tr>
<tr>
<td>R. Shane Tubbs et al</td>
<td>England</td>
<td>Digital calliper</td>
<td>8</td>
<td>4.8</td>
<td>4.9</td>
</tr>
<tr>
<td>Present</td>
<td>India</td>
<td>Digital calliper</td>
<td>10.5</td>
<td>5.3</td>
<td>3.4</td>
</tr>
</tbody>
</table>
was large enough to encroach into the intervertebral fora-
men (► Figs. 5 and 6).

Limitations
The study was conducted on dry bones. Hence, bones of var-
ious levels did not belong to a single individual; gender and
age could not be taken into account.

Conclusion
This study shows regional variations in the morphometric
parameters of the uncinate process of cervical vertebra. Thus,
it will help the neurosurgeons in determining the boundaries
of the uncinate process and allowing adequate decompre-
sion of neural elements, with reduced risk of neurovascu-
lar structures during anterior decompression of spine.

Conflict of Interest
None.

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