

Clinical Study

The influence of cervical spine position on the three anterior endoscopic approaches to the craniovertebral junction: an imaging study

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Abstract

BACKGROUND CONTEXT: Three endoscopic anterior approaches, the transnasal, transoral, and transcervical approaches, are used for ventral lesions of the craniovertebral junction and have been compared regarding surgical working distances and approach angles. However, how the position of the cervical spine influences the depths of surgical corridors and approach angles for the three approaches has not been evaluated.

PURPOSE: To evaluate the depths of surgical corridors and the approach angles for the three endoscopic approaches, taking the influence of cervical spine position into account.

STUDY DESIGN: A radiographic study comparing three anterior endoscopic approaches to the craniovertebral junction.

PATIENT SAMPLE: Cervical extension and flexion radiographs for 34 patients and cross-sectional computed tomography scans for 30 additional patients were assessed.

OUTCOME MEASURES: The depths of the surgical corridors and the approach angles for the three endoscopic approaches in the midsagittal planes.

METHODS: We determined the mean angles of the surgical trajectories for the endoscopic transoral and transcervical approaches on cervical extension and flexion radiographs. In addition, we measured the depths of the surgical corridors and the approach angles for the three approaches in the midsagittal plane.

RESULTS: The average depths of surgical corridors were as follows: endonasal, 93.65 mm; transoral, 85.27 mm; transcervical, 62.97 mm (in extension). The average approach angles were as follows: endonasal, 31.22°; transoral, 30.87°; transcervical, 36.58° (in extension).

CONCLUSIONS: The position of the cervical spine does not influence the surgical convenience of the endoscopic transnasal approach, but it can influence the endoscopic transoral and transcervical approaches, especially the latter. The endoscopic transcervical approach offers several advantages over the endoscopic transoral and endonasal approaches. © 2014 Elsevier Inc. All rights reserved.

Keywords:

Radiography; Surgical methods; Endoscopic methods; Craniovertebral junction; Cervical spine position

Introduction

The craniovertebral junction (CVJ) extends rostrally from the foramen magnum and caudally to the atlantoaxial

vertebrae [1]. The transoral-transpharyngeal approach to the CVJ is considered the gold standard for resection of extradural lesions at this location [2,3]. Although widely used, the approach has limitations, including a contaminated field and unsuitability for intradural lesions [4]. To avoid the disadvantages of the open transoral-transpharyngeal approach, the endoscopically assisted technique was introduced. The technique can be used for the CVJ with three different endoscopic anterior approaches: endoscopic transnasal [2], transoral [5,6], and transcervical [7].

To our knowledge, only Baird et al. [8] have evaluated and compared the three endoscopic approaches to the

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anterior CVJ regarding surgical working distances and approach angles. However, they did not consider the influence of cervical spine position on working distances and approach angles. Therefore, we analyzed cervical radiographs for 34 patients and transverse computed tomography (CT) scans for 30 other patients to evaluate the influence of cervical spine position on the three anterior endoscopic approaches to the CVJ.

Materials and methods

Study participants

Cervical extension and flexion radiographs for 34 randomly selected patients and cross-sectional CT scans of the CVJ for an additional 30 randomly selected patients were analyzed. All 64 patients underwent radiographic or CT examination at our institution between January 2010 and March 2012. The contents of each radiograph and the range of each CT scan included at least the CVJ, mandible, maxillae, and inferior nasal bone. Of the 34 patients undergoing radiographic examination, 12 were men and 22 were women, and they had an average age of 43.1 years (range, 21–75). Of the 30 patients undergoing CT examination, 18 were men and 12 were women, and they had an average age of 45.1 years (range, 22–73 years).

Study exclusion criteria included (1) age younger than 18 years, (2) the availability of postoperative CT scans and/or radiographs, (3) obvious abnormality at the CVJ or cervical spine, and (4) reconstructed midsagittal plane image or radiograph showing that the patient's mouth was open during imaging.

Imaging equipment and software

The imaging devices and software included a 500-mA x-ray machine (Siemens, Erlangen, Germany), Philips Brilliance 16 CT scanner (Royal Philips Electronics, Amsterdam, The Netherlands), an AGFA computed radiography (CR) system (AGFA HealthCare, Mortsel, Belgium), Infinitt radiology information and picture archiving and communication system (Infinitt Healthcare Co., Ltd., Seoul, South Korea), and Mimics software (version 10.01; Materialise Interactive Medical Image Control System, Leuven, Belgium). The layer thickness of transverse CT scans was 1.0 mm in 12 cases and 2.0 mm in 18 cases.

Determining the midsagittal plane

First, we imported the data for the transverse CT scans of the CVJ into the Mimics program, and then the data for the primary sagittal two-dimensional (2D) reconstruction. The cervical spine is not always in the neutral position when patients undergo CT examination; therefore, the direction of the sagittal slice must sometimes be adjusted after primary 2D reconstruction. In our study, the plane through the axis of the dens and the middle line of the anterior mandible or maxilla was defined as the midsagittal plane. By using the “reslice project” function of the Mimics program, we determined the midsagittal plane (Fig. 1).

Selection of entry points

The entry point of the endoscopic transnasal approach was defined as a point in the midline at the inferior edge of the nasal bone (point N in Fig. 2), and the entry point

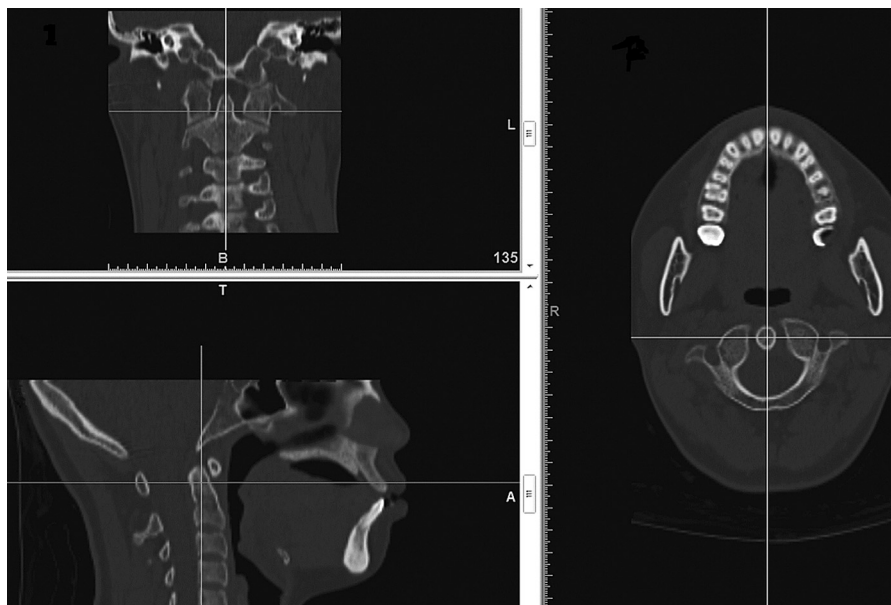


Fig. 1. Two-dimensional reconstruction of the craniocervical junction. (Top Left) The sagittal plane is visible in the frontal view through the axis of the dens. (Right) The sagittal plane is visible through the transverse view through the midline of the anterior maxilla and the axis of the dens. (Bottom Left) The sagittal plane is shown in the sagittal view.

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