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Guest speakers lectures

Surgical and functional anatomy: where are the obstacles and dangers?

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The occipitocervical junction has probably the most complex anatomy of the entire spine. One must understand the surgical anatomy in order to respect and protect the structures at risk during these approaches. The occipitocervical junction can be reached through the anterior (transoral), the lateral retropharyngeal and the posterior approach.

The vascular structures at risk are the vertebral artery, branches of the external carotid artery, internal carotid artery and the jugular vein. The endangered neural structures are the hypoglossal nerve exiting the hypoglossal canal, the nerves exiting the jugular foramen (glossopharyngeal, vagus and accessory nerves) and the marginal mandibular branch of the facial nerve. The anterior aspect of the upper cervical spine and part of the clivus can be reached through the oral cavity (transoral approach) or through the extrapharyngeal route. During the standard transoral approach there is a square area of “safe zone” extending from the clivus to the C2-3 disc. You will find the following structures limiting this “safe zone“ laterally. At the level of the clivus the hypoglossal nerve exits the skull through the hypoglossal canal cranial to the lateral third of the occipital condyle about 16.5mm from the midline (midline is identified by the basion)[1]. Just lateral to the hypoglossal canal you find the carotis interna running to the canalis caroticus, further lateral the structures exiting the jugular foramen (jugular vein and the cranial nerves IX, X, XI). At the level of the atlas the midline is identified by the anterior tubercle. About 24mm lateral to this point (about the level of the transverse foramen of the atlas) you will find the carotis interna and lateral to that, the jugular vein (dorsal to the styloid process). The vertebral artery is at risk running lateral to the atlanto-axial articulation (average extension 28mm from the midline)[1]. At the level of C2-3 you will find the superior cervical ganglion lying between the longus capitis muscle and the carotis interna (ventral to the transverse foramen of C2 and C3). The vertebral artery is found about 16mm lateral from the midline at the level of the C2-3 disc [1]. The internal carotid artery shows significant kinking or coiling at the C1-C2 level in 16-25% of the cases.

The posterior approach is used to reach the posterior aspect of the occiput between the superior and inferior nuchal lines. The suboccipital muscle group consisting of the rectus capitis posterior minor and major and the obliquus capitis superior and inferior muscles forms the deepest muscle layer together with the most cranial part of the erector spinae muscles attaching to the processus spinosus of C2 (multifidus and semispinalis cervicis muscles). Palpable landmarks are the bifid processus spinosus of C2 and 1-2cm deeper (ventral) the posterior tubercle of C1. Attachment of the suboccipital muscles is removed from the latter two and the posterior arch of C1 and the lamina of C2 is dissected subperiosteally. Care is taken to avoid injury to the horizontal part of the vertebral artery running in its groove, protruding over the C1 arch about 7mm on average (1.4-14mm) [2]. The vertebral artery intersects the outer cortex of the posterior arch about 20mm lateral to the posterior tubercle of the atlas [2]. The suboccipital nerve is the dorsal ramus of the C1 nerve root. It is passing posterior between the horizontal part of the vertebral artery and the posterior arch of the atlas and provides motor innervation to the suboccipital muscles. The C2 nerve root leaves the spinal canal running between the posterior arch of the atlas and the lamina of the axis. The medial branch of its dorsal ramus is the greater occipital nerve, which provides sensory innervation to the occipital region. The ventral ramus of C2 forms a loop passing laterally and ventrally around the vertical part of the vertebral artery, which is running lateral to the atlanto-axial articulation (on average 28mm from the midline). The vertebral artery exits the transverse foramen of the atlas about 25mm from the midline.

-- References.


-- About

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Born in Budapest, Hungary in 1981, Gergely Bodon earned his medical degree at the Semmelweisz University of Budapest in 2008. He is working at the Laboratory for Applied and Clinical Anatomy in the Department of Anatomy, Histology and Embryology at Semmelweis University.
Gregor line, Welcher basal angle, Wackenheim clivus baseline, Fischgold’s digastric line, bimastoid line and the perpendicular osteosynthesis is to restore spinal stability be it spontaneous or commonly used is the Chamberlain line, or if necessary, Mac due to a decompression procedure. Standard X-rays remain a junction include trauma, deformity and tumour. The goal of Dynamic flexion extension radiographs are recommended to establish the level and type of instability. In tumour patients, angiography may be ordered in preparation for embolisation or ligature of the feeding artery. These various approaches will be illustrated through clinical cases covering the whole range of diseases.

Detecting/assessing and checking options for osteosynthesis with imaging studies

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The main indications for osteosynthesis of the cranio-cervical junction include trauma, deformity and tumour. The goal of osteosynthesis is to restore spinal stability be it spontaneous or due to a decompression procedure. Standard X-rays remain a key tool despite the anatomical complexity of this area. The evaluation of the spatial relationship between the vertebral bodies is made easier with measurement techniques. One of the most commonly used is the Chamberlain line, or if necessary, Mac Gregor line, Welcher basal angle, Wackenheim clivus baseline, Fischgold’s digastic line, bimastoid line and the perpendicular bisector to the basilar line (Wackenheim). In trauma, the Power ratio, Lee X line method, Swischuk’s line as well as the basion-dental interval (BDI) and the basion-posterior axial line interval (BAI) described by Harris are also useful. The bone components are clearly visualised with 2D and 3D imaging using CT-scan. On the other hand, the ligaments and the relationship between the vertebral canal and its contents are better assessed with MRI. Dynamic flexion extension radiographs are recommended to establish the level and type of instability. In tumour patients, angiography may be ordered in preparation for embolisation or ligature of the feeding artery. These various approaches will be illustrated through clinical cases covering the whole range of diseases.

Indications for trans-oral approach: is the endonasal endoscopic approach better than the traditional one?

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The cranio-cervical junction may be involved in degenerative, tumoural or congenital pathologies. The transoral approach is considered as the standard approach for resection of anterior lesions of this location. Since few years, the endoscopic endonasal approach has been developed, with more and more anatomical and clinical publications [1-7]. Kassam reported the first clinical case of endoscopic endonasal resection of odontoid in 2005 [3]. We use, in our department, the endoscopic endonasal approach for cranio vertebral junction since 2008.

We have reported a series of 7 patients operated for cranio vertebral junction pathology (degenerative pannus or basilar invagination) by endoscopic endonasal approach, associated with a posterior cranio-vertebral osteosynthesis. The patients were installed in a semi-sitting position, with an intraoperative angiography scanner frameless neuronavigation allowing the precise localization of vascular and osseous structures. We used a binostri approach, with realisation of an inverse U pharyngeal flap, before bone drilling. The mean operative time was 110 min. Fluid oral intake started on 1st and solid intake on 2nd postoperative day and in-patient stay was 6 days.

All patients had neurological improvement and no complications with a good bulbo-medullary decompression on MRI. The endoscopic endonasal approach permits the same quality of neurological decompression than a trans-oral approach; and permits to avoid oro-pharyngeal complication, notably tracheostomy. We think that the endoscopic endonasal approach will be probably in the future, the new gold standard for the approach of the cranio-vertebral junction.