Rectus capitis lateralis muscle: anatomical relationships in posterior and anterior approaches to the jugular foramen

TO THE EDITOR: We read with keen interest the article by Cohen et al., in which they discussed the importance of rectus capitis lateralis (RCL) muscle as a landmark in posterior and lateral approaches to the jugular foramen (Cohen MA, Evins AI, Lapadula G, et al: The rectus capitis lateralis and the condylar triangle: important landmarks in posterior and lateral approaches to the jugular foramen. J Neurosurg [epub ahead of print January 27, 2017. DOI: 10.3171/2016.9.JNS16723]). They have described the anatomical relationships and surgical utility of the RCL for safe exposure of the jugular foramen area by cadaveric dissection and drawings. In addition, the authors defined a triangular area bounded by superior oblique and RCL muscles and a line connecting their insertions on occipital bone, and named it the condylar triangle.

We congratulate the authors for directing attention to this important muscle as a surgical landmark in skull base approaches to the jugular foramen. Although they acknowledge the contributions of Katsuta et al., Wen et al., and Rhoton et al. in describing this muscle in previous cadaveric studies, the authors state that their cadaveric study is the first comprehensive review of neural, vascular, and musculoskeletal relationships of RCL muscle. Here we would like to draw their attention to our contribution to the subject and our illustration of the RCL muscle in our recent publication titled “Craniovertebral junction 360°: A combined microscopic and endoscopic anatomical study,” which unfortunately was not cited.

While describing the craniovertebral junction anatomy from anterior, lateral, and posterior corridors, we have emphasized the importance of the RCL muscle as a useful landmark in approaches to the jugular foramen and adjoining areas. Apart from the posterior and lateral corridor, during our expanded endoscopic anterior approach we were able to demonstrate and describe important neurovascular and osseous relationships of RCL muscle.

Muscles around the neck can be divided into 3 groups of layers; namely, superficial, middle, and deep. Because superficial and middle-layer muscles are reflected with skin flap or are not dissected separately, their detailed description is surgically not important. But deep-layer muscles have a constant relationship to neurovascular and bony anatomy, and thus can be useful landmarks in surgical approaches even if the anatomy is distorted by underlying pathology. The rectus capitis muscles are a group of muscles connecting the occiput with the axis and atlas vertebrae. The rectus capitis anterior (RCA) is a short muscle immediately behind the longus capitis; it arises from the anterior surface of the lateral mass and root of the transverse process of the atlas, passing obliquely upward to be inserted between the inferior clival line and foramen magnum in the supracondylar groove. The RCL muscle can be seen as a short, flat muscle; it arises from the upper surface of the transverse process of the atlas, and it is inserted into the undersurface of the jugular process of the occipital bone. This muscle covers the internal jugular vein (IJV) and lower cranial nerves when approaching from the posterior or posterolateral aspect.

Most of the common pathologies in the jugular foramen region can extend both intra- and extracranially and displace neurovascular structures. Although the authors have demonstrated the extracranial relationship of the lower cranial nerves to RCL muscle, their origin and intracranial path is not clearly demonstrated. We made a panoramic exposure from the posterior aspect, showing the path of the lower cranial nerves from the intracranial compartment, then entering the jugular foramen area and exiting in relation to the RCL muscle. Removal of the RCL muscle gives wider access to the contents of the jugular fossa and lower cranial nerves. To get even better access one may have to mobilize or sacrifice the IJV.

Few recent cadaveric studies, including ours, have demonstrated a fully endoscopic transnasal approach to the jugular foramen to be feasible. The clinical utility of this approach is limited at present, but future technological advances and the advantages offered over traditional approaches may make it the preferred approach for a few selected cases. However, a thorough understanding and orientation of this anatomy and neurovascular relationship is of paramount importance in dealing with pathological entities in this area.

In our dissection of the jugular fossa via an anterior transnasal endoscopic approach, we identified lower cranial nerves from their origin to their extracranial course, with relation to the pharyngeal internal carotid artery.
(ICA), RCL muscle, and vertebral artery (VA). The eustachian tube (ET) is a useful landmark for the pharyngeal ICA, behind which are lower cranial nerves. The ET runs parallel and anterior to the petrous ICA, and it enters the petrous bone just medial to the ascending pharyngeal ICA before it enters into the petrous canal. The ET is removed to allow exposure of the pharyngeal ICA and petroclival synchondrosis, which lead to the jugular foramen.

Dissection lateral to the occipital condyle and between it and the pharyngeal ICA provides exposure of another muscle extending posterior to the lower cranial nerves. This is the RCL muscle, and it can be differentiated from the RCA by the direction of muscle fibers. The RCA muscle fibers are directed superiorly and medially from the transverse process of the atlas, whereas RCL muscle fibers are directed more posteriorly toward the jugular ridge from the transverse process of the atlas. The supracondylar groove is a useful landmark after removal of the RCA muscle, which gives the position of the hypoglossal canal.

We drilled the occipital condyle and lateral mass of the atlas to expose the course of the VA from the extracranial to intracranial compartment in our dissection. After that, lower cranial nerves were dissected further to expose each individual nerve. In our dissection from the anterior aspect, the hypoglossal nerve was visible coming out of the hypoglossal canal before it joins other lower cranial nerves in relation to the ICA and IJV. The VA can be seen posterior and medial to the RCL muscle, and lower cranial nerves can be seen anterior to this muscle and joining the ICA from the anterior aspect. Thus, the RCL muscle can be demonstrated from both the anterior and posterior aspects in relation to the VA and lower cranial nerves.

Although Cohen et al. described the transmastoid lateral and far-lateral posterior approach to the jugular foramen in relation to the RCL muscle in a beautiful way, we think that to better understand and orient to the neurovascular anatomy in proximity to the RCL muscle, one needs to have a view of the extracranial and intracranial course of these structures. The anterior endoscopic view adds another 3D perspective to this region.

**Sukhdeep S. Jhawar, MCh**  
Satguru Partap Singh Hospital, Ludhiana, Punjab, India

**Maximiliano Nunez, MD**  
Paolo Pacca, MD

**Daniel Seclen Voscoboinik, MD**  
Huy Q. Truong, MD

University of Pittsburgh School of Medicine, Pittsburgh, PA

**References**


**Disclosures**

The authors report no conflict of interest.

**Response**

We thank Jhawar and colleagues for their interest in our article. As our article was accepted for publication in September 2016, as is clearly printed on the footer of the paper, we thus could not have cited their article, which was first published digitally in November 2016.

Jhawar and colleagues state that our article does not clearly demonstrate the “origin and intracranial path” of the lower cranial nerves in relation to the RCL. This is, of course, correct and by design, because the RCL has absolutely no clinically relevant relationship with the intracranial aspect of the jugular foramen. The jugular tubercle serves as a well-established landmark for identification of the intracranial aspect of the jugular foramen—and the proximal lower cranial nerves in the cerebellomedullary angle—and indicates where to drill in order to expose these structures. In contrast, the RCL overlies the neurovascular structures exiting the jugular foramen extracranially and allows for their identification in postero-lateral approaches, especially in the presence of anatomically displacing tumors.

Furthermore, we dismiss the claim of Jhawar and colleagues that there exist any surgically useful relationships between the RCL and surrounding neurovascular structures in the endoscopic endonasal approach to the jugular foramen. As clearly stated in our Discussion section, “When approaching the jugular foramen anteriorly, the contents of the jugular foramen are encountered prior to the RCL; thus, the relevance of the RCL as a surgical landmark is limited to the posterolateral approaches.” Additionally, “the RCL remains a valuable and protective landmark for identifying the jugular process and the VA from lateral and anterolateral trajectories” but not from anterior or anteromedial trajectories, where the RCL is the most lateral structure, or from a posterolateral trajectory, where the VA is previously identified in the suboccipital triangle. Hence our proposal of the condylar triangle for identification of the terminal segment of the hypoglossal canal as well as the superior aspect of the VA at its exit from the C-1 foramen transversarium.

Although the endoscopic endonasal approach to the jugular foramen has gained academic interest in recent years, the surgical practicality and ethics of such an approach to lesions of the extracranial aspect of the jugular foramen—especially to an extent that would involve the
RCL, which lies less than 1 cm below the skin—must be carefully considered because it is very difficult to justify the long and difficult endonasal corridor required, as specified in detail by these authors. Jhawar et al.’s discussion of the complexity of the associated parapharyngeal and ET anatomy and traversal of the carotid sheath region to extend exposure to the extracranial aspect of the jugular foramen underscores the unnecessary difficulty of this endoscopic approach. Clinical application of such a procedure as an academic exercise with little to no benefit for the patient and a high potential for morbidity should be discouraged.

In all, we find an endonasal endoscopic approach to the extracranial aspect of the jugular foramen to be currently unjustifiable, and we encourage Jhawar and colleagues to distinguish between intra- and extracranial aspects of the jugular foramen region, because an endoscopic endonasal approach to the medial intracranial portion of the jugular foramen is certainly feasible.

Michael A. Cohen, MD1,2
Alexander I. Evins, PhD1
Gennaro Lapadula, MD1,3
Leopold Arko, MD1,4
Philip E. Stieg, PhD, MD1
Antonio Bernardo, MD1

1Weill Cornell Medical College, New York, NY
2Rutgers New Jersey Medical School, Newark, NJ
3Sapienza University of Rome, Italy
4Temple University Medical School, Philadelphia, PA

INCLUDE WHEN CITING
Published online August 4, 2017; DOI: 10.3171/2017.3.JNS17480.
©AANS, 2017