

Review article

The Far Lateral Approach to Skull Base: in the Context of Head and Neck Cancer

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Abstract:

In the context of head and neck surgery, the “Far Lateral” approach to skull base provides a means to resect metastatic lymph nodes that are fixed to the transverse process of C1 and C2, clival and upper cervical spine chordomas, tumours of the oropharynx and nasopharynx with lateral extension, malignancies with perineural spread along the hypoglossal nerve upto the hypoglossal canal, and deep lobe parotid tumours invading the craniocervical junction.

Keywords : Far lateral approach skull base, skull base tumours, extreme lateral approach skull base, head and neck cancer skull base

Introduction:

The “Far Lateral” approach to the skull base is commonly employed by neurological surgeons to gain access to upper cervical spine and brainstem, being mostly employed to control aneurysms of the vertebral artery and resect tumours such as meningiomas afflicting the dura in this region. This approach was developed by George et al,^{1,2,3,4} as a means of exposing the upper cervical spine and occipito-cervical junction to allow mobilization of the vertebral artery in order to control aneurysms afflicting this vessel. Early results of this approach were reported by them in 1979. Later in 1990, Sen and Sekhar⁵ reported their modifications of this

technique so as to apply this surgical approach to the access of tumours.

In the context of head and neck surgery, the approach provides a means to resect metastatic lymph nodes that are fixed to the transverse process of C1 and C2, clival and upper cervical spine chordomas, tumours of the oropharynx and nasopharynx with lateral extension, malignancies with perineural spread along the hypoglossal nerve upto the hypoglossal canal, and deep lobe parotid tumours invading the craniocervical junction.⁶

Anatomical considerations:

The bony anatomy:

The foramen magnum may be round or oval, thus, the surface in front of the brainstem may be deep or

shallow. The occipital condyle is mostly a hindrance in deep and oval foramen magnum, as compared to a shallow one. As an inference, this determines the trajectory of the surgical approach, i.e., whether a lateral or posterolateral approach with or without partial condylar resection is needed for the lesion. The hypoglossal canal runs in the medial third of the occipital condyles and a large condylar emissary vein exits posteriorly, which joins the jugular bulb with the extracranial venous system.

The vertebral artery :

The third portion of the vertebral artery lies within the area of this surgical approach (Fig. 1). It begins at the foramen transversarium of C2 (second cervical vertebra) and ends superiorly where it enters the dura. While within the foramen transversarium of C2, the artery turns laterally and posteriorly and exits C2 at a plane different from the one at which it enters. Thenceforth, the artery ascends to enter the transverse foramen of C1 (first cervical vertebra) followed by a sharp turn backwards, travelling along the upper surface of the posterior arch of the C1. Subsequently, the artery curves around the occiput- C1 articulation and finally enters the dura on the lateral surface of the thecal sac. Along most of the third portion, the vertebral artery is surrounded by a periosteal and venous sheath. Below C1, the artery is crossed by the ventral ramus of C2 nerve root, on lateral surface, running from posterior to anterior. Above C1, the artery is closely adherent to the C1 joint capsule.

The cranial nerves :

The cranial nerves IX to XII are often in the field of surgical approach because the jugular and hypoglossal foramina are located immediately above the occipital condyle. Inside the jugular foramen, the cranial nerves IX, X and XII are medial to the jugular bulb. The inferior petrosal

sinus joins the jugular bulb from a medial direction. It may enter by travelling in between the cranial nerves. As a result, this may be a source of troublesome bleeding in dealing with tumours in this area, requiring careful packing to protect the nerves from injury. Cranial nerve XII exits separately, inferior and medial to the jugular foramen. Within the canal, the hypoglossal nerve travels upwards and laterally while the cranial nerves IX, X and XI run inferolaterally. The hypoglossal nerve is accompanied by a branch of the ascending pharyngeal artery and an emissary vein.

Surgical technique :^{3,4,5,6,8}

The patient is placed in lateral decubitus position (Fig. 2) or slightly inclined with beanbags for support of the back. A Mayfield headrest is used for stabilization of the head and provides the opportunity for the surgeon to stand closer to the patient. If there is a record of spinal cord compression, it becomes important to have the lateral position, with the head in a neutral position. A C-shaped incision is made in the postauricular region, such that it reaches the midpoint between the inion and the mastoid. Alternatively, if an occipito-cervical fusion is planned, an inverted-J shaped incision may be used. This is made with the longer limb at the side of the neck and the shorter limb in the midline, the two being connected by a horizontal limb at the level of upper border of ear. A vertical extension into the neck is done if a radical neck dissection is part of the procedure.

The soft tissue dissection (Fig. 3) proceeds in a manner described by Sen and Sekhar.^{5,7} The sternocleidomastoid muscle is detached from the mastoid tip and retracted inferiorly, if this has not been already done as a part of a radical neck dissection. Next, the trapezius is detached from the nuchal line and retracted inferiorly. The splenius

capitis and longissimus capitis are dissected free and retracted inferiorly. Similarly, the longissimus cervicis located just lateral to the longissimus capitis, is detached as well. The deep cervical vein lies under the splenius capitis along with a plexus of veins. Subsequently, the transverse process of C1 must be identified, to which are attached the upper slip of levator scapulae and the rectus capitis posterior minor. Detachment of these muscles exposes the vertebral artery. To gain further exposure, the rectus capitis posterior major is dissected free from the transverse process of C2.

The third part of the vertebral artery, which lies in the area of this surgical field. Is covered in a thick sheath, which is a continuation of the periosteal sheath of the vertebral foramina. A plexus of vertebral veins travels along the anterior and lateral aspects of the vertebral artery. This plexus is especially prominent above C1. After the levator scapulae and inferior oblique muscles have been dissected from the transverse processes of the involved vertebrae, the vertebral artery is isolated between the vertebrae. The heavy sheath surrounding the artery acts as a barrier to tumour penetration. The transverse processes involved with disease are removed with a cutting bur or a rongeur and the artery is mobilized. If there is a preoperative suspicion of invasion of the artery by tumour and if the vessel may need to be sacrificed, then a BOT and SPECT scan must be done to ensure the safety of sacrificing this artery. In most instances, no complications develop from resection of vertebral artery of one side. If the tumour extends up the foramen magnum or into the hypoglossal canal, then partial or complete resection of one lateral mass of atlas and occipital condyle is required.

The hypoglossal canal runs through the occipital condyle obliquely, at an angle of 45 degrees, from posteromedially to anterolaterally. It exits the

occipital condyle at the junction of its anterior one third and posterior two thirds, approximately 8 mm. from the posterior edge of occipital condyle and 5 mm. above the occiput-C1 articulation.⁸ If more than two thirds of the condyle require to be resected for the purpose of exposure of the hypoglossal nerve, occipito-cervical fusion must be carried out. Decisions regarding spinal instability are generally individual and rest with the authority of the neurosurgeon.

The dissection of the tumour is carried anteriorly to the mastoid and jugular bulb, mostly necessary in the removal of large clival chordomas. After complete removal of tumour and completion of surgery, wound closure follows in anatomical layers. A suction drain is placed. If the dura has been resected and then repaired, suction drains may lead to formation of fistula. Hence, a penrose drain is placed instead. A lumbar-subarachnoid drain should be placed for three to five days.

Discussion:

The majority of tumours afflicting the craniocervical junction may be classified into intradural and extradural. The intradural tumours include meningiomas, schwannomas and glomus tumours. The extradural tumours comprise of chordomas and chondrosarcomas.

There are several difficult problems posed by tumours in this region. They may be stated as :

- Access to the ventral area of the lower clivus and cervicomedullary junction.
- Involvement of the vertebral artery on one or both sides.
- Involvement of the lower cranial nerves.
- Invasion of extradural soft tissues and bone.

The problem of access is also encountered in the case of aneurysms of the vertebral artery and vertebro-basilar junction. For the adequate surgical removal of the intradural tumours, the standard

retrosigmoid approach provides a good surgical pathway. However, it is inadequate for truly ventral tumours. Also, the involvement of the extradural tissues cannot be attended by the standard approaches because of the limitations posed by the jugular bulb, the occipital condyle and the vertebral artery within the foramen transversarium of C1. The limitations are overcome by the far lateral approach, with partial resection of the occipital condyle to improve visibility to the anterior region of the foramen magnum. The approach facilitates mobilization of vertebral artery by displacing it from transverse foramen of C1, freeing it up from the joint capsule of atlanto-occipital joint and then freeing it up circumferentially from the dural attachment, where it enters the dura.^{5,7,9}

There are, thus, many advantages to using the far lateral approach –

- Simultaneous lateral and posterolateral areas of exposure are obtained on the lesion at lower clivus, C1 and C2, allowing radical resection of tumour.
- This approach does not traverse through contaminated areas such as the pharynx and paranasal sinuses.
- The approach provides adequate control and mobilization of the vertebral artery to allow its safe dissection from the tumour, or elimination of an aneurysm.
- This surgical technique can be combined with other approaches to achieve complete tumour resection, being equally useful for intradural and extradural tumours.¹⁰

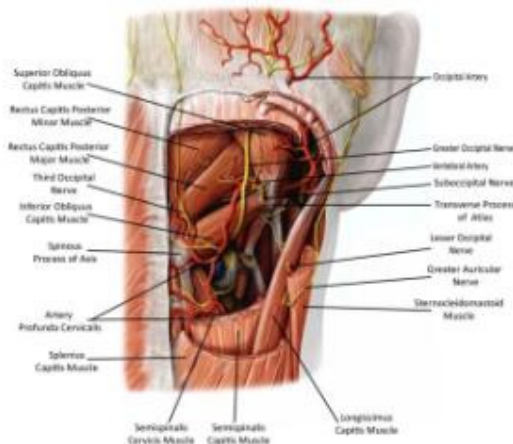


Fig. 1: A schematic diagram illustrating the related anatomy

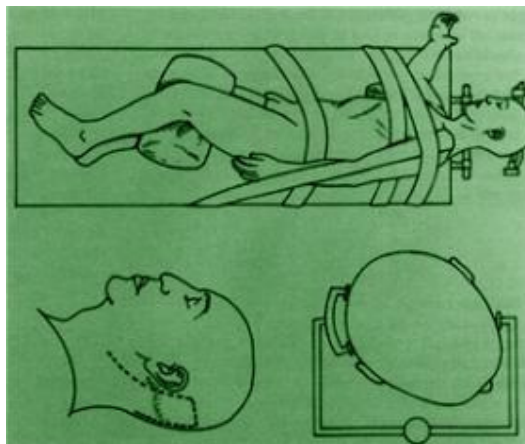


Fig. 2: A schematic diagram illustrating patient positioning and the skin incision.

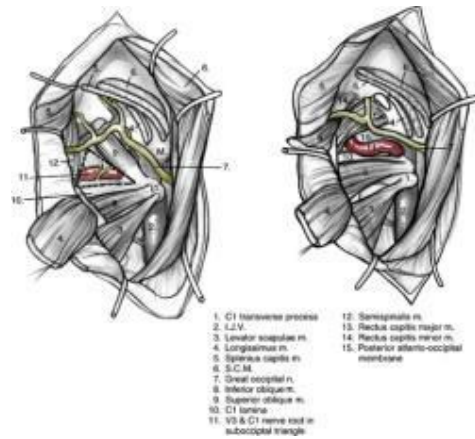


Fig. 3: A schematic diagram illustrating the surgical dissection

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