Lateral skull base approach

Routine surgical procedures at the lateral skull base depend on stepwise exposure of landmarks due to the individual anatomy of each patient within the temporal bone like the sigmoid sinus, horizontal semicircular canal, or boundary to the dura mater. In this context a large opening cavity is performed by the surgeon to reach a distinct target. The obligatory drilling is time consuming and requires an appropriate skin incision.

Different procedures at the lateral skull base (e.g., insertion of an electrode during a cochlear implantation or removing a tumor) could be performed without a conventional mastoidectomy or other extensive drilling procedures of the temporal bone. The feasibility of a single-port approach was shown by several groups in preclinical setups [1) 2) 3) 4) 5) 6)].

Lateral skull base approaches have an advantage over other approaches in the management of benign tumors of the parapharyngeal space due to the fact that they provide excellent exposure with less morbidity. The use of microscope combined with bipolar cautery reduces morbidity. Stenting of internal carotid artery gives a chance for complete tumor removal with arterial preservation [7)].

Critical neurovascular structures are confined in a small bony space at the lateral skull base. Thus, high quality of surgical training and planning of minimally invasive procedures is crucial. Simulation of lateral skull base procedures can improve motor skills, anatomical orientation, and complication management in a safe environment. Thus, simulation training can be beneficial for skull base surgeons. Minimally invasive interventions at the lateral skull base are under research, and several authors have presented approaches through single or multiple drilled ports. Precise planning and simulation of such interventions is essential because even submillimeter errors can lead to damage to critical anatomical structures. Therefore, high demands have been set for the accuracy of computer-assisted surgery [8)].

Transcanal Approach

Anschuetz et al., aimed to provide objective data regarding the area of exposure (AOE) and the surgical freedom (SF) offered by the transcanal approaches to the lateral skull base.

Minimal-invasive transcanal lateral skull base procedures have been recently developed and their clinical feasibility demonstrated. The reduced access size requires careful analysis and selection of suitable cases, qualifying for a minimal-invasive approach.

They performed the mentioned approaches in standardized dissection using human whole heads. Surgical freedom is defined as the degree of movement liberty of the surgical instrument at predefined landmarks. We assessed SF at anatomical landmarks throughout the lateral skull base. Moreover, we measured the AOE, defined as the surface on the lateral skull base reached by every approach.

They performed a total of 48 dissections under stereotactic image guidance in a total of 12 sides. The mean SF was assessed for the inferior petrous apex 602 mm, for the geniculate ganglion 1,916 mm,

and for the fundus of internal auditory canal 1,337 mm. The AOE was measured for the infracochlear approach 55 mm, supragenicular approach 67 mm, transpromontorial approach 11 mm, and for the expanded transpromontorial approach 93 mm at the fundus and 108 mm at the porus of the internal auditory canal.

This study provides a quantitative description of minimal-invasive transcanal approaches to the lateral skull base. The AOE offered by the expanded transcanal transpromontorial approach is inferior but comparable to the reported AOE of transmastoidal approaches. The reported objective measurements may provide important information for future preoperative planning and patient counseling [9].

1)
Gerber N, Bell B, Gavaghan K, Weisstanner C, Caversaccio M, Weber S. Surgical planning tool for robotically assisted hearing aid implantation. International Journal of Computer Assisted Radiology and Surgery. 2014;9(1):11–20.
2)
Hiraumi H, Yamamoto N, Sakamoto T, Ito J. A minimally invasive approach for cochlear implantation using a microendoscope. European Archives of Oto-Rhino-Laryngology. 2013;270(2):477–481.
3)
Bell B, Stieger C, Gerber N, et al. A self-developed and constructed robot for minimally invasive cochlear implantation. Acta Oto-Laryngologica. 2012;132(4):355–360.
4)
Nguyen Y, Miroir M, Vellin JL, et al. Minimally invasive computer-assisted approach for cochlear implantation: a human temporal bone study. Surgical Innovation. 2011;18(3):259–267.
5)
Labadie RF, Noble JH, Dawant BM, Balachandran R, Majdani O, Fitzpatrick JM. Clinical validation of percutaneous cochlear implant surgery: initial report. The Laryngoscope. 2008;118(6):1031–1039.
6)
Wanna GB, Balachandran R, Majdani O, Mitchell J, Labadie RF. Percutaneous access to the petrous apex in vitro using customized micro-stereotactic frames based on image-guided surgical technology. Acta Oto—Laryngologica. 2010;130(4):458–463
7)
Prasad SC, Piccirillo E, Chovanec M, La Melia C, De Donato G, Sanna M. Lateral skull base approaches in the management of benign parapharyngeal space tumors. Auris Nasus Larynx. 2014 Sep 27. pii: S0385-8146(14)00159-X. doi: 10.1016/j.anl.2014.09.002. [Epub ahead of print] PubMed PMID: 25270862.
8)
Stenin I, Kristin J, Klenzner T, Schipper J. [Surgical simulation on the lateral skull base]. HNO. 2016 Jul 8. [Epub ahead of print] German. PubMed PMID: 27393291.
9)
Anschuetz L, Presutti L, Schneider D, Yacoub A, Wimmer W, Beck J, Weber S, Caversaccio M. Quantitative Analysis of Surgical Freedom and Area of Exposure in Minimal-Invasive Transcanal Approaches to the Lateral Skull Base. Otol Neurotol. 2018 Jun 6. doi: 10.1097/MAO.0000000000001827. [Epub ahead of print] PubMed PMID: 29879089.