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Research article

Reaching the sellar region endonasally — One or both nostrils? A pilot study in body donors

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ABSTRACT

Introduction: The purpose of this study was to evaluate the effect of posterior septectomy size on surgical exposure and surgical freedom during the endoscopic transsphenoidal approach to the sellar and parasellar region.
Methods: A mononostril and binostril approach to the sellar region was performed on 4 formalin-fixed cadaveric heads. Predefined anatomical structures were identified. Additionally, a millimeter gauge was introduced into the surgical site and the extent of dorsal septectomy was analyzed for both approaches. Surgical freedom was defined as the distance between the ipsilateral and contralateral limit of opening of the sphenoid sinus.
Results: The mean extent of dorsal septectomy was 15.7 ± 5.7 mm using a binostril approach to achieve adequate visualization of all relevant anatomical structures.

Superior results were obtained via binostril technique with respect to the ability to identify the contralateral internal carotid artery or opticocarotid recessus. No such advantage was found for all other landmarks. Surgical freedom between the ipsilateral and contralateral limit of exposure of the sphenoid sinus was measured with 15 ± 0.8 mm in the mononostril and 19.2 ± 0.9 mm in the binostril group.
Conclusions: The surgical exposure increased significantly with progressively larger posterior septectomy in binostril approaches until a 20-mm posterior septectomy. Bilateral lateral opticocarotid recesses were accessible with a mean of 15 mm for posterior septectomy. In the mononostril group no dorsal septectomy was necessary. Thus, the nasal mucosa is more preserved by this technique. However, the lateral exposure is partially limited and the use of angled endoscopes is recommended when adopting a mononostril approach to the sellar region.

1. Introduction

Neurosurgical treatment of sellar lesion as well as suprasellar lesions has undergone significant changes over the last decades. Particularly because of the great progress in intracranial endoscopy since the early 1980s the use of the endoscope seems increasingly useful for skull base procedures (Cappabianca et al., 2000, 2002a,b, 2008; Cappabianca and de Divitiis, 2004; Cavallo et al., 2005, 2007, 2008; Conrad et al., 2011; Das et al., 2001; Jho, 1999, 2001; Jho and Alfieri, 2001; Nasseri et al., 2001; Oertel et al., 2015; Schroeder et al., 2004). Nowadays, the neuroendoscopy has become the gold standard in pituitary surgery in many centers. Ever since Jankowski and co-workers published their first results of a fully endoscopic transsphenoidal approach (Jankowski et al., 1992), surgical skills along with developments in endoscopic technology have made this technique a safe and minimally invasive surgical procedure, leaving patients with little deficits as well as a high quality of life (Linsler et al., 2013, 2017a,b; Little et al., 2015). Larger visualization using angled endoscopes allow surgeons to widen their field of action, stretching from the frontal cranial fossa to clival pathologies, all while keeping a minimally invasive stance (Oertel et al., 2016). While consensus was found on the benefits of endoscopic versus microscopic approach, surgeons remain uncertain whether a binostril or mononostril approach to the sellar region shows any advantage. While some might find the binostril approach to be beneficiary towards space of exposure of the region, others argue that the mononostril approach remains the lesser invasive method (Wen et al., 2016). The main surgical difference in these two

Abbreviations: ICA, internal carotid artery; OC, opticocarotid; ON, optic nerve; HD, high definition.

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approaches consists of the resection of the dorsal part of the nasal septum and the use of a speculum. While a mononostril approach needs breaking of the septum at its sphenoid cavity junction, binostril approaches need further resection of the dorsal part of the septum in order to manipulate and visualize the instruments.

It is reported that the olfactory damage is sparsely mentioned for mononostril approaches (Linsler et al., 2013) and was found to be more commonly reported in cases of binostril approaches. Little et al. found that sinonasal quality of life and overall health status are well correlated in the postoperative period, suggesting the important influence of sinonasal quality of life on the patient's experience (Little et al., 2015). Another factor that has been insufficiently investigated, taken into consideration by Alobid et al., consists of the mucociliary clearance time, responsible for defense mechanisms in the upper airways (Alobid et al., 2013). Damaging mucosal structures leads to impairment of this mechanism, crusting and thus influences the sinonasal quality of life. There is actually a debate about incidence und long term follow-up after endonasal skull base procedures in literature. The authors of different studies reported about sinonasal complaints in 2–30% of the patients (Pledger et al., 2016; Soyka et al., 2017). Against this background, the aim of this anatomical pilot study was to investigate the extent of required dorsal septectomy and therefrom resulting damage to the nasal anatomy, for exposure of the surgical field on the skull base via both, the mononostril as well as the binostril approach. This knowledge could lead to an optimized surgical approach that leaves patients with as little damage to the nasal anatomy as possible, eventually resulting in a better quality of life.

2. Methods

2.1. Cadaver preparation

Four adult cadavers without sinonasal pathologies were studied. There were 3 male (77, 78 and 82 years old) and 1 female (85 years old) body. They were formalin-fixed from whole-body donations to the Institute of Anatomy, Saarland University. The dissection and use of cadaveric specimens was in accordance with the guidelines suggested by the American Association of Anatomists, 2009.

2.2. Surgical management

The cadaveric head was maintained in a supine position with the upper part of the body slightly elevated (about 20°) and the head tilted towards the left and fixed as in a standard surgical procedure. The endonasal approaches were performed with a 0° 4 mm endoscope. The endoscopic equipment consists of a series of various rigid-rod lenses Hopkins optics, a Xenon cold light source, a digital full-HD one-chip camera, a high-resolution video monitor screen and a digital recording system (Telepack X, Karl Storz GmbH & Co. KG, Tuttlingen, Germany). For surgery, the Gaab-Set instruments for pituitary surgery were used. All equipment was provided by Karl Storz GmbH & Co. KG, Tuttlingen, Germany. All procedures were video-recorded. The endoscopic mono- and binostril approaches were performed as previously described (Conrad et al., 2016; Linsler et al., 2013).

All approaches were performed succeeding from the approach with the least tissue removal to the approach with the most extensive tissue removal. The surgical technique and the approach were carefully analysed. Special attention was paid to mucosal damage, extent of dorsal septectomy, necessity of resection of the middle turbinate and the extent of anatomical exposure. Also, surgical freedom was measured as distance between the ipsilateral and contralateral limit of exposure of the sphenoid sinus. Also the contentment of the surgeon with the approach and manoeuverability of the surgical instruments was considered.

2.3. Depth of surgical corridor and septectomy

The depth of the surgical corridor for each approach was measured in each cadaver. Thereby, the distance from the nostril to the floor of the sphenoid sinus and the distance from the nostril to the sellar floor were measured separately. Additionally, the extent of dorsal septectomy was measured in binostril approach in each cadaver.

2.4. Identification of anatomical landmarks

To evaluate both approaches, anatomical landmarks were registered after opening of the sphenoid sinus – the endoscope was placed in front of it – and after opening of the sellar floor and anterior skull base – the endoscope was placed in front of the sellar floor – with 0° or, if necessary, 30° endoscope. Predefined landmarks should be identified as shown in the schematic drawing (Fig. 1).

2.5. Data

The illustrations and descriptive data were performed using SPSS (SPSS, version 22, IBM Corporation, NY, US). Values are presented as means ± standard deviation.

3. Results

3.1. Mononostril technique

A mononostril right-sided approach was employed. After lateralization of the right middle turbinate with a speculum and a dissector and identification of sphenoid ostium and sphenoethmoidal recess, the septal mucosa was removed, the septum was fractured to the left and a nasal speculum was inserted. The sphenoid ostia were identified, and the sphenoid floor was resected. After identification of the landmarks such as the septum in sphenoid sinus, sellar floor, carotid prominence of ICAs, optico-carotid recess, clivus and optic canal and also anterior skull base, the sellar floor was opened. The pituitary gland, pituitary stalk and chiasma were identified. Main differences to the binostril approach are the manipulation only through one nostril and the use of a self-retaining nasal retractor and the use of 30° endoscopes if it was necessary for the identification of the anatomical structures.

3.2. Binostril technique

The surgery began with endoscopic identification of the nasal septum of the inferior and middle turbinate through the left nostril. After lateralization of the middle turbinate with speculum and dissector and identification of sphenoid ostium and sphenoethmoidal recess, the mucosa was removed and the left sphenoid ostium was enlarged. The same procedure was performed through the contralateral right nostril (where the ostium was already opened via the previous mononostril approach and the binostril approach was completed as described before (Conrad et al., 2016)). The dorsal part of the nasal septum was removed if necessary. After enlargement of both sphenoid ostia and after resection of the sphenoid septum, anatomical landmarks in the sphenoid sinus and intrasellar were identified as described in the mononostril technique before.

Performing the binostril approaches in these four bodies after the right mononostril approach has already been done in the same bodies was possible in the described setting because the surgical technique of enlarging the ostium and the bottom of the sphenoid sinus is identical in both techniques except for the fact that