ORIGINAL ARTICLE

Quantitative Comparison of Three Endoscopic Approaches to the Parasellar Region: Laboratory Investigation

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■ BACKGROUND: **Endoscopic endonasal transsphenoidal and contralateral sublabial transmaxillary approaches are used for approaching parasellar lesions. The aim of this anatomical study was to compare endoscopic endonasal uninostril and binostril (contralateral) and contralateral sublabial transmaxillary approaches via a quantitative analysis of exposure limits and instrument working avenues.**

■ METHODS: **Six formalin-fixed silicone-injected adult cadaveric heads (12 sides) were studied. The surgical working area, depth of the surgical corridor, angle of attack, and surgical freedom were measured and compared for the 3 approaches.**

■ RESULTS: **The endoscopic binostril endonasal approach to the parasellar area provided greater surgical freedom in the opticocarotid recess (OCR) and superior orbital fissure (SOF) compared with that of the uninostril endonasal approach (OCR, $P < 0.01$; SOF, $P = 0.01$) and the contralateral sublabial transmaxillary approach (OCR, $P = 0.01$; SOF, $P = 0.03$). The horizontal and vertical angles of attack with the binostril endonasal approach also were greater than those of the uninostril approach (OCR, $P \leq 0.05$; SOF, $P \leq 0.01$) and the contralateral transmaxillary approach (OCR, $P \leq 0.01$; SOF, $P \leq 0.01$). However, the contralateral sublabial transmaxillary approach provided more lateral exposure than the uninostril or binostril endonasal approach to the parasellar area, and it enabled a shorter surgical trajectory to the contralateral parasellar area ($P < 0.01$).**

■ CONCLUSIONS: **An anatomical comparison of the 3 endoscopic approaches to the parasellar area showed that the binostril approach provides greater exposure and freedom for instrument manipulation. The contralateral transmaxillary route provided a more lateral view, increasing exposure on average by 48%, with shorter surgical depth; however, surgical freedom was inferior to that of the binostril approach.**

INTRODUCTION

Anterior skull base approaches to parasellar lesions are challenging because of the critical neurovascular structures in this region and the surgical constraints of available sinonasal corridors.[1] Over the past 2 decades, expanded endoscopic approaches have become more widespread and have been used to address a wide range of sinonasal and skull base pathologies. The endonasal transsphenoidal and the sublabial transmaxillary approaches can provide excellent corridors to this region, and the anatomy and nuances of these approaches have been studied extensively.[2-6] We previously studied the endoscopic ipsilateral sublabial transmaxillary approach in comparison with endonasal approaches.[3] However, some neurosurgeons have

Key words
- Endonasal approach
- Endoscopy
- Parasellar region
- Transmaxillary approach

Abbreviations and Acronyms
cICA: Cavernous segment of the internal carotid artery
OCR: Opticocarotid recess
SOF: Superior orbital fissure

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advocated for a contralateral sublabial transmaxillary approach to address more laterally located lesions in the parasellar region.[7] In this study, we evaluate the surgical freedom, angles of attack, and surgical working area of the contralateral sublabial transmaxillary approach in comparison with those of both uninostril and binostril endonasal transsphenoidal approaches.

METHODS

Six adult cadaveric heads (12 sides) without sinonasal pathology were studied; heads were formalin-fixed and had silicone-injected arteries and veins. Computed tomography and magnetic resonance imaging scans were performed on each specimen before dissection. Scans were uploaded and fused in a surgical navigation guidance system (StealthStation; Medtronic Surgical Navigation Technologies, Louisville, Colorado, USA). The heads were fixed in a Mayfield head holder (Integra Life-Sciences Corp., Plainsboro, New Jersey, USA) in a supine position and registered into the guidance system with accuracy <2 mm to confirm anatomical structures and to obtain anatomical measurements. The endoscopic approaches were performed with a 0° endoscope, standard endoscopic instruments (Karl Storz, Tuttlingen, Germany), and high-speed drill and burs (Anspach; DePuy Synthes Companies, Palm Beach Gardens, Florida, USA).

The endoscopic contralateral sublabial transmaxillary and the uninostril and binostril endonasal transsphenoidal approaches (Figure 1) were performed on all 6 cadaveric heads (12 sides). For the uninostril endonasal approach, measurements were taken through the ipsilateral nostril. For the binostril endonasal approach, measurements were acquired through the contralateral nostril while the endoscope remained in the ipsilateral nostril.

SURGICAL TECHNIQUES

Endoscopic Uninostril and Binostril Transsphenoidal Approaches

Endoscopic uninostril and binostril transsphenoidal techniques were performed as previously described.[2,8] To summarize briefly, the middle and superior turbinates were lateralized to expose the sphenoid ostium without submucosal dissection. The posterior part of the septum (approximately 1.5 cm) also was removed. When the sphenoid ostia were not observed, the anterior wall of the sphenoid sinus was exposed and drilled at the midline, 1.5 cm above the upper level of the choana. The dissection was then extended toward the contralateral sphenoid ostium. The anterior wall of the sphenoid sinus was opened as widely as possible. Finally, the sellar and parasellar bones were opened, and the dura was incised to expose the underlying structures. Measurements were then obtained.

Endoscopic Contralateral Sublabial Transmaxillary Approach

The endoscopic contralateral transmaxillary approach is a multistep procedure used to reach the parasellar structures through the contralateral anterior and medial walls of the maxillary sinus.[7] When used during endonasal surgery in a clinical setting, a vascularized nasoseptal flap usually is prepared on the side contralateral to the maxillary approach to close a skull base defect and prevent cerebrospinal fluid fistula, but this step was omitted in these anatomical dissections.[9] For this study, the posterior nasal septum was resected to open the anterior wall of the sphenoid sinus. The middle turbinectomy was then performed on the side of the maxillary approach. The medial wall of the maxillary sinus was opened by starting from the ostium. Thereafter, the anterior wall of the maxillary sinus was exposed through the sublabial gingival incision 2.5 cm lateral to the midline. A 2×2-cm maxillary antrostomy was performed. The endoscopic visualization of the working corridor through the maxillary sinus was completed in a lateral to medial direction toward the opposite lateral wall of the sphenoid sinus. The contralateral opticocarotid recess (OCR), superior orbital fissure (SOF), and cavernous segment of the internal carotid artery (cICA) were then targeted in the region of interest for quantification and measurements.

Quantitative Measurements

Surgical Working Area. The surgical working area was calculated by identifying 5 points: M_U, M_D, O_L, L_U, and L_D. The first point, M_U, was defined as the uppermost reachable point at the midline. The second point, M_D, was defined as the most inferior reachable point on the clivus midline. The third point, O_L, was defined as the most lateral reachable point on the SOF. The fourth point, L_U, was defined as the uppermost and most lateral reachable point at the area of the OCR. The fifth point, L_D, was defined as the most lateral and inferior reachable point, which was on the wall of the cavernous sinus. The image guidance probe was used to acquire Cartesian coordinates of each point, which were then used to calculate the surgical working area. The surgical working area was identified as the sum of 3 triangular areas: $L_UO_LL_D$, $M_UL_UL_D$, and $M_UM_DL_D$ (Figure 2). The surgical working area represents the area extending from the midline sellar to the lateral parasellar region that could be reached and dissected by the distal end of the surgical instrument.

The endoscope was parked with an endoscope holder in the superior aspect of the ipsilateral nostril for the ipsilateral approach and in the contralateral nostril for the bilateral and transmaxillary approaches. All 3 approaches were performed in a sequence from the approach with the least tissue removal to the approach with the most extensive tissue removal.

Depth of Surgical Corridor. The depth of the surgical corridor for each approach was calculated from the Cartesian coordinates as a distance from 3 anatomical targets to the surface points: anterior nasal spine for the transsphenoidal approaches and the center of the maxillary antrostomy for the transmaxillary approach. The 3 anatomical targets were the center of the OCR, the most proximal reachable point on the cICA, and the most lateral reachable point on the SOF.

Surgical Freedom. Surgical freedom represents the maneuverability of the proximal end of the 145-mm straight endoscopic dissector while the distal end is fixed on a specific anatomical target