A novel transnasal transsphenoidal speculum: a design for both microscopic and endoscopic transsphenoidal pituitary surgery

Clinical article

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Over the last several years minimally invasive surgical approaches to the sella turcica and parasellar regions have undergone significant change. The transsphenoidal approach to this region has evolved from a sublabial transnasal, to transnasal, to pure endonasal approaches with the increasing popularity of endoscopic over microscopic techniques. Endoscopic and microscopic techniques individually or in combination have their own unique advantages, and the preference of one over the other awaits further technological refinements and surgical experience.

In parallel with this evolution in techniques for transsphenoidal surgery, the authors designed an adaptable versatile speculum for the endonasal/transnasal transsphenoidal approach to the sella turcica and parasellar regions that can be used equally effectively with a microscope or an endoscope. The development of this instrument and its unique features are described, and its initial clinical use is summarized.

This transnasal transsphenoidal speculum has interchangeable blades, unique blade angulations, and independent blade opening mechanisms and allows safe, optimal exposure in all patients regardless of the size and anatomical aberrations of individual nasal and endonasal regions. An attached endoscope carrier further allows it to be used interchangeably with microscopic or endoscopic techniques without having to remove the speculum; likewise, a single surgeon can use both hands without need of an assistant. A forehead headrest component adds further stabilization. This device has been used successfully in 90 transsphenoidal procedures. (DOI: 10.3171/2010.11.JNS101167)

KEY WORDS • pituitary • endoscopic surgery • speculum • transsphenoidal surgery

The sublabial transsphenoidal route to the sella turcica, originally pioneered by Harvey Cushing for pituitary surgery,13 remains the standard approach for tumors in the sella and parasellar region. With refinements in minimally invasive techniques, optics, and endoscopic instrumentations, many modifications of the transsphenoidal approach have been developed; they range from sublabial transnasal, to transnasal, to pure endonasal endoscopic approaches and are used with an increasing popularity in endoscopic over microscopic procedures.5,15,24,27,42

Transnasal/endonasal surgery for transsphenoidal access to the pituitary and adjacent skull base has undergone rapid evolution in recent years. Surgical approaches through the nose without sublabial incisions have become the norm in many centers throughout the world.9,11,15,19,24,27,58 Generally two approaches have been used for adequate visualization of the sella turcica and surrounding structures—endoscopic and stereomicroscopic. Each approach has advantages and disadvantages. The endoscopic approach has the advantage of allowing excellent, wider field visualization of the sphenoid sinus and surrounding structures, but it lacks the 3D stereoscopic view of the operating microscope. Although specific endoscopic instruments, as well as stereoscopic endoscopes, have been developed, the precision of endoscopically controlled manipulations of surgical instruments may still have some limitations compared with standard microsurgery.47 The operating microscope allows a high-resolution, 3D stereoscopic view of the region, but it is limited by the optical angle of view by two factors, namely the depth of the surgical target and the width of the opening of the speculum.

The more popular speculums available for transnasal pituitary surgery were designed for a sublabial approach. The Cushing,13 Hardy,17 and Cushing-Landolt43 design with straight blades, while ideal in the sublabial approach, lacks the flexibility in angulation that would be desirable in a transnasal approach. Subtle modifications to the speculum over the years had allowed for improved maneuverability in this relatively confined space.6,44,47,54

The instrument we describe here, the Chole-Dacey
transnasal transsphenoidal speculum (Anspach), makes it possible to convert from the endoscopic to the microscopic approach and vice versa at any time during an operation, and the conversion takes only a few seconds. The interchangeable blades enhance the device’s versatility so that it may be used in all patients regardless of the size and anatomical aberrations of individual nasal apertures. Once the blades of the speculum are introduced into the nasal cavity, the proximal portion of the speculum (at the naris) and the distal tips of the blades (at the sphenoid sinus) can be opened independently, allowing wider exposure at the sphenoid than at the naris. The speculum can be used with the surgical microscope and the endoscope, as surgeons become more familiar with this technique. The device fixes a 4-mm-diameter endoscope in place for endoscopic techniques, which enables the surgeon who is experienced with the microsurgical approach to easily introduce an endoscope, but also easily switch to the microscope, as needed. Because the endoscope is stabilized in position, one surgeon can perform the procedure bimanually without the need for assistance. Furthermore, the position of the endoscope holder is adjustable so that the position of the endoscope can be modified to minimize interference with the passage of other surgical instruments into and out of the field. A forehead headrest component adds further stabilization.

Methods

The transnasal transsphenoidal speculum was developed in 2005 by the two senior authors (R.A.C. and R.G.D.) for the transnasal transsphenoidal microsurgical technique and has since undergone modifications that allow for improved exposure maneuverability and permit the use of endoscopes. This speculum had been effectively used at Barnes-Jewish Hospital and St. Louis Children’s Hospital in 90 transnasal/endonasal transsphenoidal procedures, primarily for resection of pituitary adenomas in patients ranging in age from 9 to 79 years. The device depicted in this study was manufactured by Anspach.

Surgical Technique

The surgery was performed with the patient under general anesthesia with orotracheal intubation and the head fixed in a 3-pin head holder. Thus, the head is stabilized for the use of frameless navigation systems.

The facial, nasal, and abdominal regions were prepared and draped in a routine fashion, and topical and injected vasoconstrictor medications were used. A modified Killian incision29 was made, extending the incision down to the floor of the nasal cavity ipsilaterally (Fig. 1). In the subperichondrial plane, a nasal flap was elevated on one side of the quadrilateral cartilage. This was extended over the bony septum and the periosteum of the bone on the ipsilateral side of the perpendicular plate of the ethmoid, and the vomer was elevated to the face of the sphenoid sinus. The cartilaginous septum was separated off of the bony septum and the maxillary and premaxillary crests. The cartilaginous septum was then displaced into the contralateral side of the nasal cavity. Most of the perpendicular plate, as well as some of the vomer of the septum, was then removed, leaving a remnant on the rostrum of the sphenoid sinus for orientation to the midline. In theory, the speculum could be used without the elevation of a mucosal flap, but it is our opinion that the flap results in less trauma to the nasal septum and its mucosal covering.

A temporary 4-0 silk suture was placed into the nasal mucoperichondrial flap to retract it laterally, and the transnasal transsphenoidal speculum was advanced into position under direct vision, with the tips of the speculum on the face of the sphenoid sinus. The appropriate blade length was chosen depending on the individual’s anatomy. Blade lengths of 7.0, 8.0, and 9.0 cm were used in the patients in this series.

The head holder attachment was placed and the blades opened to expose the face of the sphenoid sinus. The proximal portion of the blades (at the naris) can be opened, taking care not to injure the skin of the naris (Fig. 2). The distal blades were opened independently. The tips of the blades were not advanced into the sphenoid sinus because the optic nerves course more medially beyond the face of the sphenoid sinus.18 The posterior aspect of the bony septum (the rostrum) remaining in the anterior wall of the sphenoid sinus was noted, and served as a guide to the midline. The rostrum was then removed under direct vision, entering the sphenoid sinus followed by removal of the mucosa and intersinus septae within the sphenoid sinus.

With a 0° endoscope in place, we identified the planum sphenoidale superiorly, clivus inferiorly, opticocarotid recess, and the optic and carotid prominences. Pieces of the resected bone were saved for reconstruction of the sella floor. The presence of the endoscope in the surgical field sometimes interferes with the use of some instruments. In those instances, the endoscope holder can be adjusted to minimize obstruction.

At this point, using the endoscope or microscope for visualization, the sella floor was opened and the tumor resected. A 30° endoscope was used to visualize the recesses of the sphenoid sinus as needed (Fig. 3). After removal of the tumor, grafts of bony septum, autologous abdominal adipose tissue, and Duraseal (Confluent Surgical, Inc.) were placed as needed. In April 2008, a movable intraoperative MR imaging unit became operational at our institution and has since been used in a large majority of our transsphenoidal surgeries. When intraoperative imaging was indicated, the speculum was removed for imaging and then replaced if further tumor resection was necessary. The cartilaginous septum was brought to the midline and septoplasty was performed if necessary. The Killian incision was closed with 4-0 chromic running sutures, and side-to-side mattress sutures were placed in the septum. No other packing or splints were placed.

For larger and more extensive tumors, the planum sphenoidale and portions of the clivus can be removed to obtain wider exposure of the region. If greater lateral exposure of the skull base was needed, the posterior portions of the middle turbinates and the superior turbinates can be resected and the distal ends of the speculum opened further.
Features of the Speculum

The dimensions of the speculum blades allow insertion into the nostril by elongating the vertical dimension of the nostril during insertion and then elongating the nostril in a horizontal direction when fully inserted. The anodized aluminum speculum blades are interchangeable to fit the dimensions of the individual patient’s nasal anatomy.

With a unique angulation, each blade of the speculum is curved upward 6 mm to allow for reliable visualization of the upper part of the sphenoid sinus and planum sphenoidale. The speculum is also designed with an independent blade opening mechanism. The blades can be opened in a parallel manner, allowing precise opening at the proximal part of the speculum. The distal blades can also be opened independent of the proximal part, allowing for optimal exposure of the face of the sphenoid sinus (Fig. 1). A movable endoscopic carrier coupled with a forehead brace allows placement and stabilization of a 4-mm endoscope in any position (Fig. 2). This allows the surgeon to work independently with both hands free to maneuver surgical instruments. The endoscope can be cleared of debris, in place, at any time by simply irrigating the surgical field with warmed saline. Once the temperature of the endoscope stabilizes, condensation on the lens does not occur. The endoscope carrier can be moved to the side, allowing for unobstructed access through the speculum to optimally use the operating microscope if needed. The opening of the speculum is large enough to allow access of a high-speed drill or microdebrider.

The body of the device is made of stainless steel and the blades of anodized aluminum. The device can be constructed of nonferromagnetic materials (titanium and aluminum) if the use of this device in operating suites equipped with intraoperative MR imaging and electromagnetic tracking devices is needed.

Results

Ninety patients underwent transnasal/endonasal transsphenoidal resection of pituitary adenoma in which the transnasal transsphenoidal speculum was used. There were 47 female and 43 male patients. The mean age was 49 years (median 53, range 9–79 years).

Seventy-six patients underwent resections in which the speculum was used for newly diagnosed pituitary adenomas and 14 for recurrent pituitary adenomas. There were 73 macroadenomas and 17 microadenomas. Endoscopy-assisted microsurgery was carried out in 40 patients, microsurgery in 28 patients, and a pure endoscopic procedure in 22 patients. The use of the microscope or endoscope was based on the surgeon’s preference and experience. Intraoperative MR imaging was used in 15 cases. There were no complications related to the retractor. This transnasal transsphenoidal speculum enabled excellent visualization of the sellar and parasellar regions for resection of pituitary adenomas (Fig. 3).

Discussion

Transsphenoidal surgery remains the main approach for resecting pituitary adenomas and other lesions of the sellar and parasellar regions. In recent years there has been a growing interest in extending the transsphenoidal approach and other transnasal approaches to a wide variety of tumors and other conditions of the skull base. Traditionally, sublabial, transseptal approaches have been used, but there has been an increasing trend toward transnasal approaches either via a single nostril, typically with a retractor, or via both nostrils simultaneously, commonly without a retractor. A major advance in these transsphenoidal approaches has
been the introduction of the endoscope, with improvements in optics, and high-definition cameras and monitors.\textsuperscript{1,7,12,16,22,23,25,26,29,40,45,46,49,50,52,53,60}

The advantages of the transnasal transsphenoidal speculum we have described include its excellent single-nostril exposure, which permits the resection of pituitary adenomas and other parasellar lesions, thus avoiding the potential morbidities of a sublabial approach. The speculum’s versatile curved and interchangeable blade design offers considerable advantage for the transnasal approach over traditional transsphenoidal retractors, which have straight blades that open with a fixed geometry between the proximal and distal parts of the blades. This device can be used with the operating microscope or various endoscopes during the same operative procedure. Intraoperatively the surgeon can change from using a microscope to an endoscope and back again in a few seconds. Use of this speculum requires displacement of the nasal septum. There were no septal complications in the 90 cases performed to date; preexisting septal deformities are corrected during this procedure. The endoscope holder of the speculum enables the surgeon to use a two-handed operating technique similar to that in the traditional microsurgical technique, often with the suction tube in one hand and another instrument in the other; this obviates the need for a second surgeon to operate the endoscope. The
endoscope holder is adjustable, which enables the surgeon to optimize its position for free passage of the other surgical instruments. The forehead headrest component affords further stabilization, which may be needed in some cases due to the additional forces applied to the device with the addition of the endoscope attached to its holder. One further advantage of this device is that it can be constructed from nonferromagnetic materials, facilitating its use with intraoperative MR imaging technology and electromagnetic tracking navigation devices. Procedures done with this device limit surgical access to one opening for further stabilization, which may be needed in some cases due to the additional forces applied to the device with the addition of the endoscope attached to its holder.

The forehead headrest component offers excellent exposure for transsphenoidal procedures through the sellar region, with its versatile curved and interchangeable blades, and is easily suited to approaches requiring the microscope, endoscope, or both. The one further advantage of this device is that it can be constructed from nonferromagnetic materials, facilitating its use with intraoperative MR imaging technology and electromagnetic tracking navigation devices.

Conclusions
The aforementioned transnasal transphenoidal speculum, with its versatile curved and interchangeable blades, provides excellent exposure for transsphenoidal procedures and is easily suited to approaches requiring the microscope, endoscope, or both.

Disclosure
Prototypes of the instrument were fabricated by Drs. Chole and Dacey and the final prototype fabricated by Anspach. Drs. Chole and Dacey may receive royalties. Dr. Chicoine received clinical or research funding from IMRIS, Inc.

References

Fig. 3. Intraoperative visualization of the anterior sellar wall using the transnasal transsphenoidal speculum: after removal of the mucosa (A), exposure of the dura after partial opening of the anterior bony sella (B), and intradural exposure to reach a small adenoma (C).
Pituitary speculum


46. Nakagawa T, Takashima T, Tomiyama K, Asada M: [Approaches to sella turcica in endoscopic pituitary surgery.] *Nippon Jibiinkoka Gakkai Kaiho* 104:1–8, 2001 (Jpn)


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