Endonasal Endoscopic Resection of an Os Odontoideum to Decompress the Cervicomedullary Junction

A Minimal Access Surgical Technique

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Study Design. We report the case of a 50 year-old woman with os odontoideum and posterior atlantoaxial subluxation, who underwent an occipitocervical fusion followed by endonasal endoscopic anterior decompression of the cervicomedullary junction (CMJ).

Objective. To describe the feasibility of performing endonasal endoscopic anterior decompression of CMJ pathology in conjunction with occipitocervical fusion in 1 operative setting.

Summary of Background Data. The recommended management of symptomatic atlantoaxial instability secondary to os odontoideum with irreducible ventral compression is occipitocervical fusion with anterior decompression. The traditional method for anterior decompression of CMJ abnormalities is the transoral approach. The endonasal endoscopic approach is an emerging minimal access technique that reduces the potential morbidity of the transoral approach.

Methods. The patient underwent an occipitocervical fusion and anterior decompression in 1 operative setting. Occiput to C5 fusion was first undertaken in the prone position. After a wake-up test, the patient was flipped into a supine position for the endonasal endoscopic procedure. Anterior decompression was achieved by resecting the anterior arch of C1 and the os odontoideum with the aid of frameless stereotactic navigation.

Results. The patient tolerated the procedure well and was extubated on the first postoperative day. Liquids were started that afternoon and advanced to a regular diet on the second postoperative day. The patient was discharged to rehabilitation after a short postoperative stay. Postoperative imaging demonstrated excellent decompression of the anterior CMJ pathology. At 3-month follow-up, the patient showed clear improvements in hand strength and ability to ambulate.

Conclusion. The endonasal endoscopic approach to the CMJ provides an effective and minimally invasive alternative for anterior decompression of irreducible CMJ pathology.

Key words: endoscopy, minimally invasive, os odontoideum, odontoidectomy, stereotactic navigation. Spine 2009;34:E139–E143

The transoral approach has become the standard approach for anterior decompression of pathology at the cervicomedullary junction (CMJ).1–3 However, the transoral approach has several limitations. Recently, several endoscopic approaches to the CMJ have been described including transoral,4 transcervical,5 and endonasal.6–8 The latter approach has only been described in clinical application for a handful of patients with CMJ abnormalities secondary to rheumatoid arthritis.6–8 The endoscopic endonasal approach is believed to be a less morbid minimal access procedure when compared to the transoral approach. This report describes the feasibility of the approach in a patient with os odontoideum and atlantoaxial subluxation. Furthermore, it demonstrates the feasibility of performing anterior decompression and fusion with anterior transnasal decompression at the CMJ in 1 operative setting.

Case Reports

History

The patient was a 50 year-old woman with a history of cervical spine injury at the age of 8. She had an unclear history of surgery at C1 at the time of the original trauma. The patient was previously highly functional until a few years before presentation when she developed decreased neck mobility and progressive weakness in all extremities. The patient noted increasing gait difficulty and several falls over the course of the year before presentation. She denied bowel or bladder dysfunction.

Clinical Examination

The patient had grade 4 of 5 motor strength in all extremities except grade 2 strength in the dorsiflexors of the right foot. Sensory examination was normal. She had increased tone in all extremities. The reflexes were 4+ throughout all extremities. She had bilateral positive Hoffman and Babinski signs. Four beats of clonus were noted at the ankle.

Imaging Studies

Computed tomography of the cervical spine demonstrated an os odontoideum with posterior subluxation (Figure 1A). Dynamic studies demonstrated increased posterior subluxation on extension (not shown). On magnetic resonance imaging of the cervical spine, there was moderate spinal canal stenosis at C1–C2 with severe myelomalacia of the upper cervical spinal cord (Figure 1B). The os odontoideum projected into the anterior foramen magnum resulting in basilar invagination.

Treatment

The patient was treated with a 2-stage operation. After fiberoptic intubation, the patient was placed in prone...
position with the head immobilized. Somatosensory-evoked potentials electrophysiologic monitoring was performed throughout the operation. Through a midline posterior approach the spinal cord was partially decompressed by removing a fragmented arch of C1, which was indenting into the dura. An instrumented occiput-C5 fusion was performed using an occipitocervical fusion system with a midline plate construct (Synthes, Inc., West Chester, PA). For cervical fixation, sublaminar wiring was performed at C2 and lateral mass screws were inserted into C3–C5. Local autograft bone, mixed with silicon-substituted calcium hydroxyapatite, Actifuse (Apatech, Foxborough, MA) was used for arthrodesis.

After repositioning into the supine position for the anterior procedure, a wake-up test showed that the patient moved all extremities to command and somatosensory-evoked potentials monitoring remained unchanged. The patient was again immobilized in a head holder. A preoperative computed tomography angiogram of the cervical spine was uploaded to a frameless stereotactic neuronavigation system (BrainLAB, Munich, Germany). A submucosal resection of the septal cartilage was performed. The inferior turbinates were outfractured bilaterally and the posterior 2 cm of the nasal septum was removed using a tissue shaver and high-speed drill to enlarge the choana for a wider exposure. The sphenopalatine artery and the posterior septal artery were isolated and cauterized bilaterally. We did not remove the middle turbinate and the sphenoid sinus was only opened slightly as a landmark. A 30-cm, 4-mm rigid 0° endoscope (Karl Storz, Tuttingen, Germany) was held in the left nostril with an endoscope holder and surgery was carried out using a bimanual technique either through the right nostril or both nostrils as required. A red rubber catheter was placed through the nasal cavity into the oral cavity for downward retraction of the soft palate to facilitate exposure (Figure 2). The fascia of the posterior nasopharynx was opened with an inverted U incision.
with the superior extent at the clivus, the lateral margins just medial to the Eustachian tubes, and its base at the level of the C2 vertebral body (Figure 2, 3A). The flap was pushed into the oropharynx, whereas the longus colli and capitis muscles were moved laterally with Bovie cautery. The inferior portion of the clivus along with the anterior ring of C1 was then removed with a diamond drill after identification with the neuronavigation system (Figures 2, 3B). The os odontoideum and odontoid were identified and resected with a diamond drill and curette (Figures 2, 3C–D). With the guidance of neuronavigation, the ultrasonic aspirator was used to remove the transverse ligament and inflammatory paraspinal tissue compressing the ventral brain stem until dura was visualized. No cerebrospinal fluid leak was observed. The mucosal flap was closed with Tisseel fibrin sealant (Baxter, Deerfield, IL) and Floseal hemostatic matrix (Baxter) was placed in the nasopharynx. The patient was kept intubated overnight and on postoperative examination was at her neurologic baseline. On the first postoperative day the patient was extubated and her diet was advanced. After an uneventful postoperative course, she was discharged to inpatient rehabilitation. At 3-month follow-up, she showed clear improvements in hand strength and ability to ambulate. Postoperative imaging demonstrated excellent decompression of the CMJ (Figure 4).

**Discussion**

The recommended management of atlantoaxial instability secondary to os odontoideum is posterior wiring and fusion or C1–C2 transarticular screw fixation and fusion. In symptomatic patients with significant irreducible ventral compression, an anterior decompression should be included as well. The transoral approach provides the most direct route to the ventral CMJ. The deep surgical corridor often necessitates splitting of the soft palate, resection of the hard palate, and occasionally, transmandibular or transmaxillary extensions to improve exposure, especially in patients with a small mouth. The approach requires a mouth opening of at least 25 mm. Complications secondary to the approach include tongue and tracheal edema, and velopharyngeal insufficiency. The possible addition of a tracheostomy and gastrostomy combined with long operative times lead to prolonged recovery and hospitalization for the patient. The minimally invasive nature of the endo-

Figure 3. Intraoperative endoscopic view. The fascia of the posterior nasopharynx is opened with an inverted U-shaped incision to expose the clivus (A) and the anterior ring of C1 (B). The inferior portion of the clivus and anterior ring of C1 is removed to expose the os odontoideum (C). The os odontoideum and odontoid is removed (D). SS, sphenoid sinus; ET, Eustachian tube.

Figure 4. Postoperative imaging demonstrating the occipitocervical fusion construct and decompression of the cervicomedullary junction. A, Lateral radiograph; B, sagittal computed tomography image.
nasal endoscopic approach aims to reduce these complications and comorbidities. Our patient was extubated postoperative day 1 and advanced to a regular diet quickly, allowing rehabilitation to start expeditiously. Nayak et al reported their experience with the endonasal approach to the CMJ in a series of 9 patients. Four patients required perioperative tracheostomy, 3 required postoperative gastrostomy, and 2 developed transient velopharyngeal incompetence. Though the rate of these complications is higher than expected for the approach, it should be noted that 4 patients presented with dysphagia or respiratory failure before surgery. Further experience with the endonasal endoscopic approach is needed to better gauge the relative risk of complications in comparison to the transoral approach.

One main advantage of the endoscope is its ability to improve visualization in difficult surgical corridors. Endoscopic illumination brings the lens and light source closer to the operative field, thereby reducing the need for a wide operative approach (Figure 2, 3). Compared with the transcervical approach, the field of view is not restricted by a tubular retractor system. Additionally, the endonasal approach is not limited by body habitus or halo vest. We previously demonstrated that the endonasal approach can be performed while the patient’s head is immobilized in a halo since only a nasal exposure is required. Likewise, a previous occipitocervical fusion is not a contraindication to the approach as hyperextension of the neck is not required. Unlike the endoscopic transoral and traditional transoral approach, the incision associated with the endonasal approach is above the oropharynx. This may reduce the infection risk, as the wound is not constantly bathed in saliva. One limitation of the endonasal approach is the inferior extent, which can only reach the bottom of C2, whereas the transoral approach can reach C3. Second, watertight primary closure of tissue planes may be limited, reducing the applicability to intradural lesions. However, several endoscopic techniques already exist for watertight closure of dural defects, which have been shown to be effective.

We wish to acknowledge the excellent work in cadavers, which initially described the endonasal endoscopic approach to the CMJ. The purpose of this report is to demonstrate the feasibility of the approach and highlight the increasing applicability of endonasal endoscopic techniques. Lastly, we wish to describe several operative nuances and pearls from our experience to date. (1) Combining an anterior and posterior approach to the CMJ in 1 operative setting is possible, especially with the minimally invasive endonasal endoscopic approach. (2) Stereotactic navigation expedites resection of pathology and aids in localization of key vascular structures. (3) During the odontoid resection, the operative field is relatively stable, allowing us to place the endoscope on a scope holder which obviates the need for 2 surgeons at all times. (4) Preservation of both middle turbinate does not limit space for surgery, but we believe does help restore normal laminar flow of air through the nose, minimizing postoperative crusting. (5) We did not widely open the sphenoid sinus and drill down the clivus, as previously described, which makes the operation even less invasive. (6) A submucosal resection of the septal cartilage permits the scope and instruments to be moved medially without resistance.

Conclusion

We report a case using the endonasal endoscopic approach to the CMJ, which provides an effective and minimally invasive alternative for anterior decompression of CMJ pathology. We describe and demonstrate the feasibility of an anterior decompression of os odontoideum and odontoid via an endonasal endoscopic approach. Comorbidities associated with the transoral approach may be circumvented by this minimal access procedure. However, a larger series is needed to elucidate the full capabilities and limits of the endonasal endoscopic approach to the CMJ.

Key Points

- The endonasal endoscopic approach is a feasible approach for anterior decompression of pathology at the cervicomедulляр junction.
- The endonasal endoscopic approach is an emerging minimal access technique that reduces the potential morbidity of the transoral approach.
- Frameless stereotactic navigation expedites resection of pathology and aids in localization of key vascular structures.
- It is feasible to perform a posterior decompression and fusion with anterior transnasal decompression at the cervicomедulляр junction in 1 operative setting.

References