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Original Article

Endoscopic resection of benign lesions of cervical vertebral body through intraoral approach

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Abstract: To investigate the efficacy of nasal endoscopic intraoral approach for resection of benign lesions of the cervical vertebral body. In the department of Otolaryngology and spine surgery of Shenzhen Second People's Hospital, the First Affiliated Hospital of Shenzhen University, tertiary referral hospital. From October 2013 to October 2014, five cases (3 males, 2 females) in the department of Otolaryngology and spine surgery of Shenzhen Second People's Hospital. We reviewed 5 patients who underwent endoscopic resection of benign lesions of the cervical vertebral body using an intraoral approach. Written informed consent was obtained from all subjects prior to operation. In all 5 cases, the lesions were completely removed using a nasal endoscopic intraoral approach in a single procedure with no significant complications. The patient was under general anesthesia introperatively, and we used NRS score to assess the patient after the operation every day until three days after operation. The 4-day mean NRS score was 2.5 three days after surgery. The patients were followed up for 3 to 12 months. All five patients were examined by cervical computed tomography scan three months postoperatively, which revealed complete resection of lesion without any evidence of recurrence. Endoscopic resection of benign lesions of the cervical vertebral body through intraoral approach may offer the advantage of a convenient access, fewer complications, shorter operative time and quicker postoperative recovery.

Keywords: Cervical vertebral body lesions, nasal endoscope, operation

Introduction

Cervical vertebral lesions are rare and usually not associated with readily discernible clinical signs. The early clinical symptoms are usually non-specific and liable to be mistaken for other cervical disorders; and often tend to be ignored by patients. Often medical care is sought at an advanced stage, e.g., on development of signs and symptoms of spinal cord compression. Levine, *et al.* [1] reported 9 cases of cervical tumor, among which 95% of cases had localized pain, 37% had cervical radicular pain, 29% had torticollis, 14% had a sensory disturbance and 7% had limited movement disorders.

The wide range of movements hinging on the cervical vertebrae impose considerable load on cervical vertebrae and their linkage. Erosion of the vertebrae in certain types of tumors makes them susceptible to vertebral collapse and fractures, leading on to cervical instability and dislocation of cervical intervertebral joints. Consequently, impingement of tumor masses onto the spinal canal may cause spinal cord compression and quadriplegia. Therefore, once the diagnosis of cervical vertebral tumor is confirmed, tumor resection is the preferred and most effective treatment [2].

Globally, the resection of cervical vertebral body tumor is considered to be the most effective treatment. There are three main traditional surgical approaches to cervical vertebral lesions: anterior approach, posterior approach and combined anterior-posterior approach. All three approaches involve considerable dissection and associated surgical trauma with a risk of serious complications including damage to important blood vessels and nerves in the neck

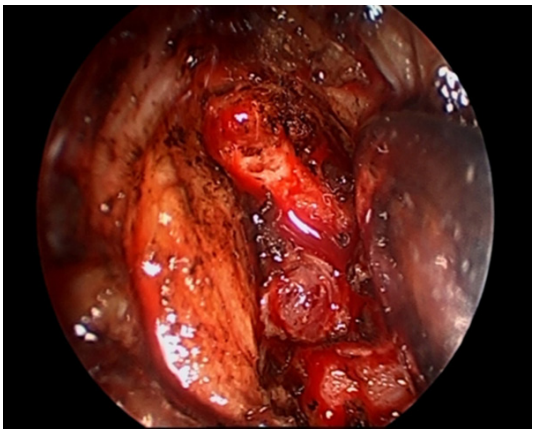

Figure 1. Longitudinal incision over the prevertebral tissues and exposure of involved cervical vertebrae and tissues.

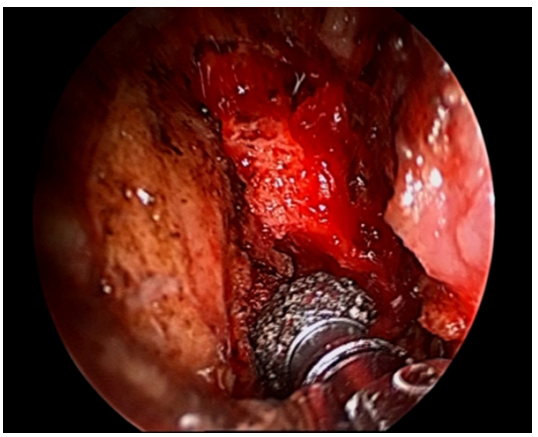

Figure 2. Grinded osteotomy.

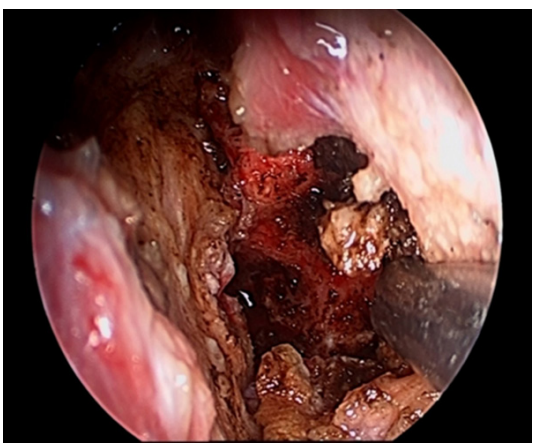

Figure 3. Cavity after resection of lesions.

[3, 4]. In malignant cervical tumors, surgical treatment is challenging and prone to relapse, with a particularly poor prognoses in children

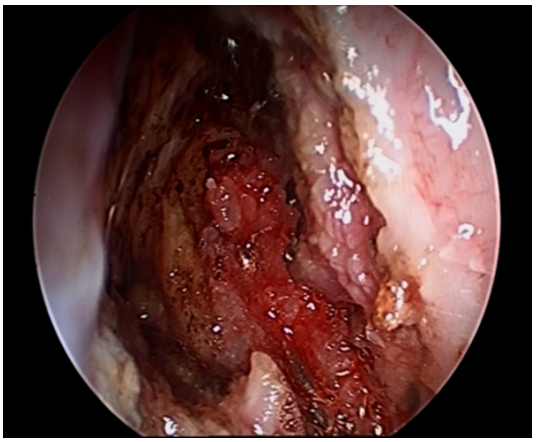

Figure 4. Implantation of artificial bone.

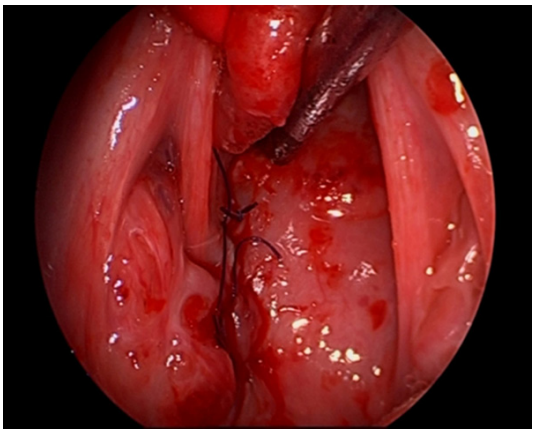

Figure 5. Suture of incision.

[5]. Due to its safety, reliability and lesser associated trauma, minimally invasive surgical technique is gradually being adopted for treatment of cervical vertebral lesions. In recent years, with the development of nasal endoscope technology, endoscopic techniques and skull base surgery, the therapeutic application of nasal endoscopic surgery has been further expanded. In this report, we present the five reported cases that underwent endoscopic resection of benign lesions of cervical vertebrae through an intraoral approach, and assess the efficacy of this surgical approach for treating benign lesions of cervical vertebrae. The report is as follows.

Subjects and methods

Clinical data

The experimental protocol was established, according to the ethical guidelines of the

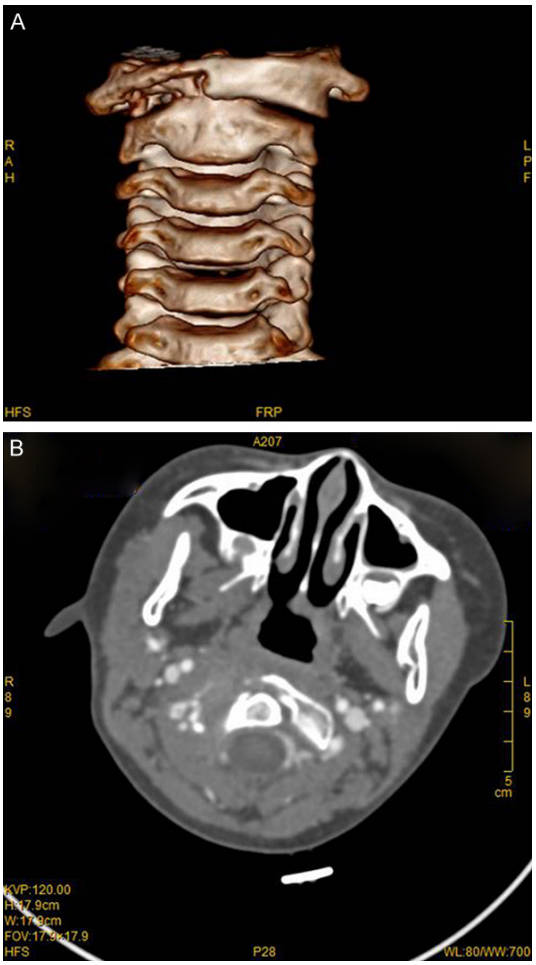

Figure 6. A. Preoperative axial cervical spine enhanced computed tomography (CT) film showing atlanto-axial vertebral bone destruction filled with soft tissue. B. Preoperative cervical spine 3D reconstruction showed atlanto-axial vertebral bone destruction.

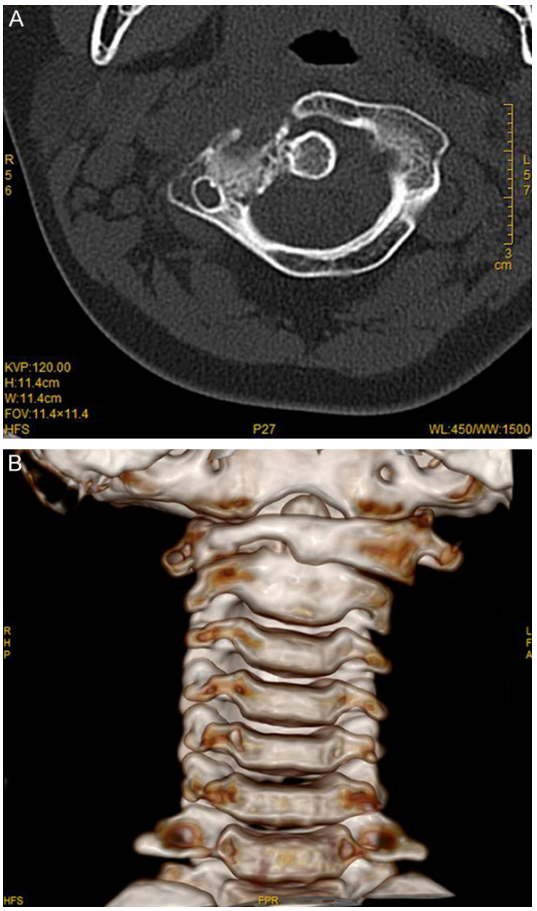

Figure 7. A. Axial cervical spine enhanced CT film 3 months postoperatively, showing atlantoaxial vertebral bone with artificial implantation and no necrosis. Artificially implanted tissue had partly fused with the bone bed with no evidence of lesion recurrence. B. Cervical spine 3D reconstruction 3 month postoperatively, showing partially repaired atlanto-axial vertebral body.

Helsinki Declaration and was approved by the Human Ethics Committee of Shenzhen Longhua new district people's hospital, China. From October 2013 to October 2014, five cases (3 males, 2 females) underwent endoscopic resection of benign lesions of cervical vertebral body performed through an intraoral approach, in the department of Otolaryngology and spine surgery of Shenzhen Second People's Hospital. Mean age of patients was 12 years (range, 5-30 years). The clinical manifestations included neck pain (in 4 cases), headache (in 3 cases) and sense of head instability (in 2 patients). All patients underwent computed tomography (CT) of the cervical spine (enhanced axial, coronal and sagittal planes) and cervical magnetic resonance imaging (MRI) pre- and post-operatively to assess the lesion location, range and relationship with the surrounding structures. There were three cases with violation of atlantoaxial vertebrae and two cases of infringement of the third cervical vertebrae, both of which had not invaded the endorhachis and spinal cord. Two patients underwent preoperative 3D reconstruction and 3D printed models, which contributed to preoperative preparation of the treatment design and communication with patients and their families. Written informed consent was obtained from all patients prior to operation.

Operative method

Preoperative preparation: Chlorhexidine mouthwash was used for oral antisepsis. Ofloxacin drops were administered intranasally for 3 days

preoperatively, to prevent infection of the nasal cavity. Antibiotics were administered for 1 day preoperatively.

Equipment: Nasal endoscopy system with a diameter of 4 mm and wide angle of 0 degrees (Stryker, Stryker Corporation, US), Davis opener (Kilner Doughty Mouth Gag, Beijing Zhongxing Industry Company, China), XPS3000 (Medtronic, Medtronic Xomed Inc, US).

Operative procedure: The patients were placed in a supine position for general anesthesia through endotracheal intubation with shoulder pads for stabilizing the head. The neck was extended and the head fixed with head ring. Povidone-iodine was used for disinfection of mouth, nose and face followed by paving with sterile towels. Children's catheter was placed in nasal cavity to hold the soft palate and uvula. Then the mouth was opened with Davis opener and the posterior pharyngeal wall revealed. After pharyngeal disinfection, nasal endoscope of 0 degrees was placed into pharynx cavity after connecting with the imaging system. A needle of 1 mL syringe was inserted into the posterior pharyngeal wall in the vertebral plane, C-arm X-ray fluoroscopy was used to locate the needle. An electric knife was used to make a longitudinal incision on pharyngeal mucosa, submucosal tissue and prevertebral muscle layers. Vertebral lesions were exposed with blunt dissection (**Figure 1**). Drill was used to grind bone wall to ensure complete removal of diseased tissue (**Figure 2**) after forceps delivery of partially frozen tissue biopsy and curettage of lesions. After electric coagulation hemostasis, iodine disinfection, saline lavage chamber (**Figure 3**) and implantation of artificial bone (**Figure 4**), the incision was closed with 4-0 absorbable interrupted suture (**Figure 5**).

Result

The duration of operation was 0.5-1.5 h, while intra-operative blood loss was 10-50 mL. Oral intake was started at 8 h postoperatively. The NRS pain scores were calculated to evaluate the pain 3 days postoperatively. The patient was under general anesthesia introperatively, and we used NRS score to assess the patient after the operation every day until three days after operation. The 4-day mean NRS score was 2.5 three days after surgery. Stitches were removed 5 d postoperatively and all wounds healed well. There were no major intraoperative or postoperative complications. The hospital stay was 6-7 d with an average of 6.5 days. Hospitalization costs were 7150-9630 yuan with an average cost of 8750 Yuan. According to histopathological report, there were four cases of eosinophilic granuloma and one case of lipoma. The follow-up assessment was done for 3-12 months. Three months postoperatively cervical CT scan revealed complete resection of the lesion without any evidence of recurrence. All cases were followed up regularly and there was complete resolution of symptoms in all patients.

A typical case

A 7-year-old boy was admitted to our hospital on 18, September, 2014 with neck pain since six months. The patient had no sore throat, no change in phonation, and no swallowing or breathing difficulties. Physical examination showed the patient in good condition, with no palpable neck mass, a normal range of neck movements, and no congestion or uplift at the posterior wall of the nasopharynx.

Cervical CT examination showed that the area of atlantoaxial pyramidal bone destruction was filled with soft tissue, and enhanced cervical CT showed significant enhancement (**Figure 6A**). The patient was admitted with a provisional diagnosis of atlantoaxial vertebral lesion suspected to be eosinophilic granuloma. Preoperative 3D reconstruction (**Figure 6B**) and 3D printed models were applied. Under general anaesthesia, endoscopic resection of atlantoaxial vertebral lesion was performed through the intraoral approach. Eosinophilic granuloma was identified by both intraoperative quick frozen section and postoperative histopathology reports. There were no symptoms at the time of the fifth postoperative day of stitch removal and discharge of the patient. Follow-up CT scan of cervical vertebrae (**Figure 7A**) and 3D reconstruction (**Figure 7B**) 3 months postoperatively showed no evidence of recurrence, and the patient continued to report complete resolution of clinical symptoms.

Discussion

The traditional surgical approach to cervical vertebral lesions has consisted of one of the following three main options: anterior approach,

posterior approach and combined anterior-posterior approach. Although all three approaches are effective, they are associated with considerable surgical trauma and risk of iatrogenic injury to adjacent blood vessels and nerves, besides cerebrospinal fluid leakage, infection, and postoperative throat discomfort [6, 7]. Removal of cervical lesions safely and effectively with optimal exposure is a key issue in these patients. Minimally invasive surgical techniques are gradually being adopted for treatment of cervical vertebral lesions owing to their better safety profile, reliability and minimal attendant trauma. Percutaneous vertebroplasty (PVP) was first proposed by Galibert, et al. [8] for the treatment of vertebral hemangioma, and PVP was first applied to the treatment of malignant tumor of vertebral body by Galibert and Déramond in 1990 [9]. Wang, *et al.* reported that endoscopic cervical vertebral body reconstruction via anterior cervical approach had the advantage of being less invasive and excellent therapeutic outcomes [10]. However, the complex anatomy of the region, the risk of infection and the limitations of endoscopic interventions *perse*, make any attempt at radical resection of tumor along the border quite challenging.

With the development of endoscopy anatomy and endoscopic techniques, indications for endoscopic skull base surgery are gradually expanding. The therapeutic application of nasal endoscopic surgery has been further expanded with good results obtained in procedures such as endoscopic skull base cerebrospinal fluid fistula repair, craniopharyngioma resection, slope chordoma resection and odontoid resection *via* nasal approach. Kassam, *et al*. reported a case of endoscopic odontoid resection through nasal approach in 2005, in which the involving dentate was removed successfully with no postoperative complications [11].

To the best of our knowledge, there are no reports in literature describing endoscopic resection of lesions of cervical vertebral body through intraoral approach. Inspired by successful resection of chordoma and odontoid lesions, we sought to investigate the efficacy of endoscopic resection through intraoral approach in five cases of cervical vertebral body benign lesions. A transoral approach for relieving spinal cord compression directly caused by atlantoaxial disease, with the advantage of a convenient access, without traction on important blood vessels and nerves, has been successfully reported [12]. However, such an approach did not allow for radical resection due to its inherent limitations, including limited exposure and little scope for manipulation of the cervical lesion. To some extent, this limitation has been responsible for its lack of widespread clinical application [13]. These and other related problems may be overcome with newer nasal endoscopic techniques that now allow convenient access to cervical vertebral lesions. Nasal endoscopy can also potentially eliminate the handicap imposed by what is referred to as the dead space of surgery, by allowing for visual access to regions that may not be accessible to the naked eyes without neck incision. This advantage is attributable to the precise and clear visual access allowed by the wide viewing angle of modern endoscopes [14]. Furthermore, good illumination of nasal endoscopic visual field, image amplification system and a variety of perspectives allow for comprehensive assessment of the extent of disease, thus guaranteeing the success of the operation and making the surgery minimally invasive. Complete removal of the lesion under direct vision also minimizes any inadvertent injury and its related complications. There were three cases of violation of atlantoaxial vertebrae and two cases of infringement of the third cervical vertebra, but in all the cases, the endorhachis and the spinal cord was not invaded by the lesion. In the present study, vertebral canal and spinal cord were not involved in any of the 5 cases and all lesions were completely removed in the first attempt.

Endoscopic resection of benign cervical vertebral body lesion can cause complications like infection in prevertebral space, bleeding, spinal cord injury, etc. However, these potential complications are not confined only to endoscopic intraoral approach. Moreover, those complications could be avoided by meticulous maintenance of a sterile surgical environment, adequate precautions for disinfection, besides ensuring complete hemostasis and technical competence of operator, e.g., by avoiding rough handling. None of the above-mentioned postoperative complications were seen in any of the

five patients, and good treatment outcomes were achieved with complete symptom resolution.

Some key aspects of our experience are summarized below: 1) Preoperative CT and MRI are needed to confirm the extent of cervical vertebral lesions and to assess involvement of spinal canal and spinal cord, if any. The lesions not involving the spinal canal and spinal cord are ideal indications for endoscopic intraoral approach. 2) Due to the characteristics of cervical vertebrae in children, C-arm x-ray machine was needed to reduce incision errors and prevent unnecessary trauma. 3) Biopsy was applied after the exposure of the cervical vertebral lesion. Nature of the lesions requires confirmation prior to curettage of diseased tissue. In order to prevent spinal canal and spinal cord injury, utmost care and gentle manipulation is required while using the electric drill for grinding bone, at the same time the drill is cooled with water. 4) Cervical vertebral bone defect filled with artificial implants appears to promote healing. 5) The difference in the visual experience of surgery with the naked eye with nasal endoscopic surgery requires the operator to not only be familiar with the regional anatomy, but also to have good nasal endoscopic surgical skills, so as to prevent unnecessary surgical trauma.

From our experience, endoscopic resection through intraoral approach appears to offer several advantages in patients whose benign cervical body lesion has not involved the spinal canal and spinal cord. Endoscopic intraoral approach is relatively simple and provides direct access to the lesion with clear anatomical delineation and minimal risk of injury to adjacent nerves, carotid sheath and esophagus, that is often seen with the traditional anterior cervical and posterior surgical approaches. Besides, the minimal surgical trauma, the incision on the posterior pharyngeal wall can be sutured directly with this approach. Compared with the previous surgical patients, curative effect was reliable, these patients experienced less pain, had no neck scar, and experienced a quick postoperative recovery. It is also more acceptable to patients because of the less invasive nature, safety and efficacy. However, the long-term efficacy of this approach needs further investigations with larger studies involving follow-up over a longer period of time.

Disclosure of conflict of interest

None.

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