# Endoscopic Endonasal Approach for Craniovertebral Junction Pathologic Conditions: Myth and Truth in Clinical Series and Personal Experience

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**Key words**
- Craniovertebral junction
- Endoscopy
- Transnasal approach
- Transoral approach

**Abbreviations and Acronyms**
**CSF**: Cerebrospinal fluid
**CVJ**: Craniovertebral junction
**EEA**: Endoscopic endonasal approach
**NAxL**: Nasoaxial line
**NPL**: Nasopalatine line
**SPIA**: Surgical palatine inferior dental arch line
**TOA**: Transoral approach

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**OBJECTIVE:** For many years, the microsurgical transoral approach has been accepted as the gold standard for anterior decompressions of the craniovertebral junction (CVJ). The introduction of the endoscopic endonasal approach (EEA) has gained wide recognition and overwhelming support in recent years, including for diseases of the CVJ. The aim of this study was to critically analyze and discuss all cases of CVJ diseases approached by means of an EEA so far reported in the literature, including our institutional experience consisting of 6 consecutive patients.

**METHODS:** Six consecutive patients affected by CVJ disease underwent an EEA. Three patients had a tumor (2 chordomas and 1 myeloma) and 3 had impressio basilaris.

**RESULTS:** Five patients had an uncomplicated postoperative course and 1 developed an intraoperative cerebrospinal fluid leak and subsequent meningitis and died 5 weeks after surgery. A total of 107 patients (including our 6) affected by CVJ disease and treated with EEA have been reported so far. Among these patients, cerebrospinal fluid leak was reported in 13 (12.4%), transient velopharyngeal incompetence in 6 (5.6%), postoperative epistaxis in 2 (1.86%), and respiratory dysfunction requiring a tracheostomy in 2 (1.86%). In our extended institutional series of more than 20 consecutive anterior decompressions for CVJ diseases (including transoral and transnasal microsurgical approaches), the only fatal complication was associated with EEA.

**CONCLUSIONS:** On the basis of the reviewed literature and our personal experience, the reported increased safety of the EEA needs to be reassessed and discussed.

## INTRODUCTION

A variety of congenital, developmental, and acquired diseases can affect the craniovertebral junction (CVJ), leading to bulbomedullary compression. The surgical treatment remains challenging because of the complex anatomic and biomechanical characteristics of the region.[1] For many years, the microsurgical transoral approach (TOA) has been accepted as the gold standard for anterior decompression.[2] However, a series of complications consisting of possible bacterial contamination, the need for postoperative nasogastric tube feeding for at least 1 week, and swelling of the tongue with possible nasopharyngeal incompetence requiring prolonged intubation have been reported associated with this approach, particularly with the extended procedures for large pathologic processes.[3-5] Since its first clinical introduction by Kassam et al. in 2005, the endoscopic endonasal approach (EEA) appeared potentially promising in overcoming previous technical challenges and surgical complications, gaining wide recognition with overwhelmingly positive opinions.[6] However, the exact role of this approach in the treatment of CVJ disease is yet to be defined. Reports available so far are limited, most of which are single cases or case series including relatively small numbers of patients.[7-19] In the present study, we report our surgical experience with EEA for different CVJ diseases. The feasibility, advantages, and limitations of this approach were critically assessed.

## METHODS

Among 21 cases operated on by anterior approaches, from 2011 to date, a consecutive series of 6 patients with varied CVJ diseases have been treated with an EEA approach by a mixed team of neurosurgeons and rhinolaryngologists expert in microneurosurgery and endoscopic video-assisted microsurgery (Table 1).

After transoral endotracheal intubation, the patients were placed in the supine position. The head was pinned in a Mayfield head-holder in a neutral position; then, the midface, forehead, and nose

**Table 1.** Institutional Casistic

| Patient | Age, years (Sex) | Primary Disease | Radiology | Preoperative C1–C2 Shift (Radiography) | Treatment | Postoperative Shift (Radiography) | Frankel Scale[20] and Di Lorenzo Grade[21] Changes | External Orthosis | Follow-Up (months) |
|---|---|---|---|---|---|---|---|---|---|
| PF 1 | 66 (F) | Impressio basilaris | CVJ anterior compression | Yes | Transnasal decompression (0°–30°), C0–C3 reduction, lateral masses screws, instrumentation, and heterologous bone fusion | No | D/E, I/I | Halo vest (1 month) | 3 (meningitis and death) |
| RS 2 | 47 (F) | Impressio basilaris + platybasia | CVJ anterior compression | Yes | Transnasal C1 decompression and odontoidectomy, C0–C3 reduction, C2 pedicles and C3 lateral masses screws, instrumentation, and autologous bone fusion | No | D/E, I/I | Halo vest (1 month) | 46 |
| LP 3 | 14 (F) | Impressio basilaris + platybasia | CVJ anterior compression | No | Transnasal C1 partial decompression and partial odontoidectomy | No | D/E, I/I | No | 48 |
| RN 4 | 22 (M) | Recurrence of clivus chordoma | CVJ destruction and compression | Not performed | Transnasal C1 decompression and odontoidectomy, C0–C3 reduction, lateral masses screws, instrumentation, and heterologous bone fusion | No | D/E, I/I | Halo vest 1 month; hard collar 2 months | 31 |
| GM 5 | 58 (M) | Myeloma | Odontoid infiltration | Not performed | Transnasal and odontoid biopsy | | E/E, I/I | No | 24 |
| OS 6 | 35 (F) | Chordoma | CVJ infiltration previously operated 1) transoral and 2) C0–C3 reduction, lateral masses | Not performed | Transnasal decompression (0°–30°) | No | D/D, I/I | Previously performed | 36 |

D and E: Frankel scale; I: Di Lorenzo grade.
F, female; CVJ, craniovertebral junction; M, male.

were shaved and washed with antiseptic solution. With sterile dressings leaving the midface, forehead, and nose free, intraoperative neuronavigation (Medtronic StealthStation) and two-dimensional endoscopy 0° and 30° (Karl Störz, Germany) were used. In all cases, the 4-handed technique via 2 nostrils was used to resect the CVJ disease. After a midline incision of the mucosa, the anterior arch of C1 and the odontoid process were removed by using a high-speed drill and ultrasonic surgical aspirator (Sonopet Ultrasonic Aspirator). The transverse ligament, tectorial membrane, any residual ligaments, and lesional tissue were removed to decompress the CVJ dura mater adequately. Contrast injection of Iopamiro 300 into the epidural space under fluoroscopy allowed verification of the extent of the resection and completion of decompression when necessary. Closure was achieved by approximating the mucosal layers with fibrin glue. Prophylactic antibiotics were administered intraoperatively and postoperatively (cefazoline 2 g/day). Patients fixed in a halo vest were transferred to the intensive care unit, where they stayed usually for 48–72 hours.

A subsequent short occipitocervical instrumentation and fusion procedure was completed according to our protocol for CVJ tumors and platybasia and to prevent cranial settling of the C2 vertebral body[22,23] 1 week later using a titanium implant (De-Puy Synthes Spine Mountaneer) in line with our patient's wishes. All the patients underwent magnetic resonance imaging, computed tomography, and standard/dynamic radiography evaluation of the CVJ before and after surgery, immediately, and every 6 months.

## RESULTS

The length of follow-up of our patients ranges from 1 to 48 months (Table 1[20,21]); all patients improved or remained unchanged (in good neurologic status) after surgery and during follow-up. Only in patient 1 an intraoperative cerebrospinal fluid (CSF) leak occurred, requiring an immediate surgical repair with a mucosa pedicle flap. The patient improved after surgery within 48 hours and was able to walk and feed herself without the need of any assistance for 10 days; nevertheless, she subsequently rapidly deteriorated and died 1 month after surgery. Because the patient was immobilized with a halo vest, CSF nose leakage was not evident spontaneously or with a jugular compression test (Queckenstedt test). During the subsequent posterior fixation procedure performed in a prone position, CSF leakage was evident in the operating room and external CSF external drainage was performed and left for 5 days followed by stable control of the leakage.

Postoperatively, the patient developed meningoencephalitis confirmed by positive CSF cultures for fungi (*Candida albicans*), which, despite appropriate antimycotic therapy (micafungin, 5-fluorocytosine) progressively worsened, leading to the patient's fatal neurologic complications (**Figures 1–3**). All other patients were discharged after posterior instrumentation and fusion procedures within 2 weeks of admission.

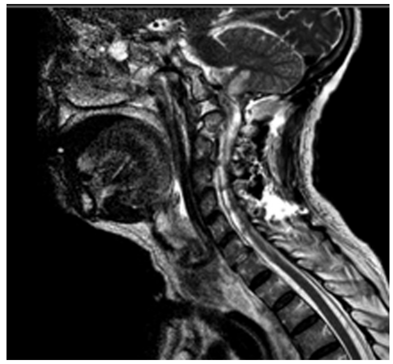

**Figure 2.** Magnetic resonance T2 weighted images sagittal reconstruction on December 29, 2 days after posterior instrumentation and fusion (December 27). A progressive tonsillar and cerebellar hemispheric T2 hyperintensity is evident.

## DISCUSSION

### EEA: The History

For many years, the microsurgical TOA has been accepted as the gold standard for anterior decompression, although it is associated with technical difficulties and surgical complications. EEA was developed as a promising technique overcoming some of the complications associated with TOA, gaining wide recognition and enthusiastic support. In recent years, some studies have reported anatomic research and surgical experience in the EEA to different areas of the midline skull base, from the olfactory groove to the CVJ.[7-19]

**Figure 1.** Patient 1 operated on on December 17, 2012. Magnetic resonance T2 weighted images sagittal reconstructions. Anhyperintensity on bulbomedullary junction is evident on December 26 (9 days later, 1 day before instrumentation and fusion procedure).

In 2002, Alfieri et al. performed a cadaveric study on exclusively transnasal endoscopic odontoidectomy through 1 or 2 nostrils, following Jho's endonasal paraseptal technique.[24] Rodlens endoscopes, 2.7 or 4 mm in diameter, 18 cm long with 0°, 30°, and 70° lenses, were used. The surgical landmarks leading to the CVJ were the inferior margin of the middle turbinate, nasopharynx, and the eustachian tubes. The nasopharynx was readily identified following the inferior margin of the middle turbinate. The line drawn between the eustachian tubes indicated the juncture between the clivus and atlas. The investigators concluded that "… contrary to a conventional transoral approach, this endoscopic endonasal approach provides unlimited access to the midline clivus and a potential of carrying out surgical decompression at the ventral craniocervical junction without adding C1-2 instability."[24] Three years later, Cavallo et al.[25] confirmed this observation in a cadaveric study.

In 2005, Kassam et al.[6] operated on a 73-year-old woman, affected by rheumatoid arthritis, resecting the odontoid with an EEA. These investigators recommended the following equipment: 1) navigation system; 2) a 0° endoscope; 3) long angled endonasal drill, 4) ultrasonic aspirator; and 5) bayoneted handheld micro instrumentation. These investigators recognized that the TOA remains the gold standard but "… the transnasal endoscopic approach being above the level of soft palate should expose to a lower degree of bacterial contamination". In the investigators' opinion, microbic flora assumed to be less aggressive in the nasal mucosa, compared with the oral mucosa, should better protect from the risk of secondary infection.[6,25]

In 2007, Messina et al.[26] concluded that the EEA, like the TOA, could provide a similar direct route to the CVJ, but probably with less morbidity.

In 2009, Kassam et al. reported the concept of the nasopalatine line (NPL), which is the line connecting the inferior margin of the nasal bone, anteriorly, and the border of the hard palate, posteriorly, in the midsagittal plane. The intersection of this line with the vertebral column indicates the inferior limit of the approach.[27]

Therefore, the maximal extent of inferior dissection with an EEA can be predicted with the NPL traced on the preoperative radiologic study. Recently, a more reliable surgical nasoaxial line (NAxL) was introduced to overcome the imprecision of the NPL (radiologic), which does not take into account the dorsal nose skin between the nostrils and the nasal bones.[28]

This approach was widely recommended as a valid alternative to the TOA for CVJ compressive diseases to prevent the splitting of the palate, often required for adequate transoral exposure. Palatal splitting has been reported to increase patient morbidity, especially velopharyngeal insufficiency, with subsequent escape of air and food into the nose during speech and swallowing, producing dysphonia and dysphagia.[26] Data supporting the transnasal endoscopic approach to the CVJ along with its complications are provided in **Table 2**.[6-14,16-19,29-41]

Neuronavigation has proved to be an important adjunct. Image guidance is a useful tool to visually reconstruct the magnified three-dimensional anatomic imaging, allowing inspection of the anatomic images in multiple

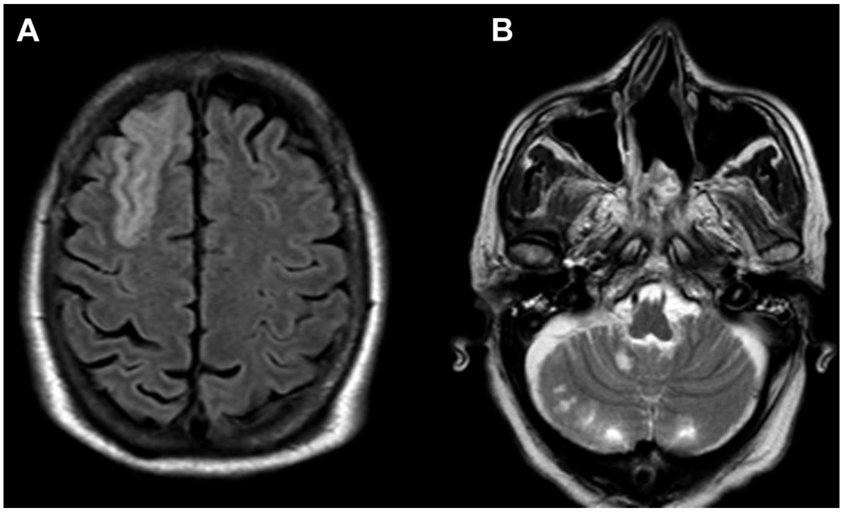


**Figure 3.** Magnetic resonance T2 axial images showing a right frontal lobe giral hyperintensity (**A**) and multiple cerebellar hemispheric hyperintensities (**B**) on December 29. The patient died on January 16, 2013, 30 days after transnasal decompression.

reconstructed views and permitting a better orientation during the surgical procedure. Although the error associated with spinal shift is not completely eliminated, the calculated accuracy is less than 1 mm.[42-44]

## The Present Experience

In this study, we present our recent institutional experience dealing with 6 patients affected by CVJ disease and operated on with EEA. Of these patients, 5 had an uncomplicated postoperative course and 1 (patient 1) developed an intraoperative CSF leak (probably as a result of the limitation of the bidimensional view with an oblique surgical view of EEA instead of the tridimensional transoral microsurgical view with a straightforward surgical view of TOA), subsequent meningitis, and died 5 weeks after surgery. Moreover, no possible other explanations (e.g., medical history, individual risk factors) should be given to better understand the unfavorable clinical course of the patient. No doubt that "the transnasal endoscopic approach being above the level of soft palate should expose to a lower degree of bacterial contamination"[6]; nevertheless, different from the other 5 patients, patient 1 presented with an intraoperative complication (CSF fistula). The double-staged approach with halo vest immobilization for 1 week, along with unrecognized persisting CSF leakage, delayed identification of this complication (probably because of the difficulty in provoking nose leakage with the Queckenstedt test), as well the instigation of medical (antibiotics) and surgical (external drainage) therapies.

A possible prophylactic antimycotic treatment does not seem reasonable for patients who are candidates for transmucosal surgical approaches to the CVJ because the literature does not provide any advice. As far as is available in the literature, antimycotic prophylaxis is suggested only in the context of radiotherapy treatment of patients with head and neck tumors and in patients with mucositis.[45,46]

Critical analysis allows development of strategies that might decrease the risk for future patients of developing complications, although albeit is not possible to completely eliminate the risk. We believe that there is no requirement for adjustment of postoperative therapy or specific patient selection; nevertheless, we strongly support the need 1) to avoid as much as possible dural tears by overcoming the learning curve and 2) to perform a 1-stage combined anterior and posterior approach to allow earlier identification of possible CSF fistula without the obstacle of the halo vest and to immediately start adequate therapies without any delay.

## The State of Art

A total of 107 patients (including our 6) affected by CVJ disease and treated with EEA have been reported in the literature so far. Among these patients, a CSF leak (intraoperative and/or postoperative) was reported in 13 (12.4%), transient velopharyngeal incompetence, variably associated with nasal speech and swallowing impairment, was reported in 6 (5.6%), postoperative epistaxis in 2 (1.86%), and respiratory dysfunction requiring a tracheostomy in 2 (1.86%). In our extended institutional series of more than 20 consecutive anterior decompressions for CVJ diseases (including the transoral and transnasal microsurgical approaches), the only fatal complication was associated with EEA.

According to the literature and to our personal experience, the presumed improved safety of EEA compared with the TOA should require a reassessment. Recently, a systematic review and meta-analysis by Shriver et al. showed a morbidity/mortality prevalence of EEA on TOA (mortality, 4%—2.9%; intraoperative CSF leaks, 30%—0.3%; postoperative CSF leak, 5.2%—0.8%; meningitis, 4%—0.4%; reoperation, 5.1%—2.5%; velopharyngeal insufficiency, 6.4%—3.3%; sepsis, 7.7%—1.9%) and a prevalence of TOA on EEA (arterial injury, 1.9%—0%; prolonged intubation or reintubation, 5.6%—6%; wound infection, 3.3%—1.9%; tracheostomy, 10.8%—3.4%). Nevertheless, none of these differences was statistically significant except for postoperative tracheostomy.[47]

## Our Experience

In our experience, the endoscopic TOA approach was found to be as safe and effective as EEA and in many cases, also preferable, according to the lesion location and the patient anatomy.[48-57] The 30° endoscope has been proposed for the TOA to avoid full soft-palate splitting, hard-palate splitting, or extended maxillo/mandibulotomy. Using the endoscope, the operator is able to look in all directions by rotating the instrument. Because the light source is at the level of the abnormality, superior illumination can be obtained. With the aid of an endoscope, abnormalities as high as the midclivus can be visualized without extensive manipulation of the soft or hard palate.[48-57] In a recent

**Table 2.** Review of the Literature

| Reference | Number | Craniovertebral Junction Disease (Number) | Complications (Number) | Number of Deaths (Cause) | Comments |
|---|---|---|---|---|---|
| Kassam et al., 2005[6] | 1 | RA | None | None | First report on EEA to CVJ, showing its feasibility based on anatomic studies and experience with the same approach for the cranial base |
| Nayak et al., 2007[11] | 9 | Ventral compression of the brainstem secondary to RA degeneration of the atlantoaxial joint with pannus formation (9) | Transient VPhI (2) | 1 (presumed pulmonary embolus) | The first case series showing the feasibility of a pure EEA for the resection of the odontoid process. Potential advantages include improved visualization, limited morbidity, decreased pain, faster recovery than traditional approaches |
| Laufer et al., 2008[29] | 1 | Juvenile RA in a nonachondroplastic dwarf | None | None | EEA to resect the dens with assistance of Iso-C three-dimensional navigation in juvenile RA |
| Magrini et al., 2008[30] | 1 | At-Ax instability and Os O caused by Down syndrome | None | None | EEA is indicated for pediatric patients presenting with narrowness of the oral cavity and the macroglossia characteristic of Down syndrome hampers the TO approach |
| Wu et al., 2008[9] | 3 | Invagination caused by RA (2) and trauma (1) | Intraoperative CSF leakage (1) | None | EEA through single nostril. Limitations from the anatomy and contraindications including intradural lesions were reported, showing technical difficulties in managing intraoperative CSF leak and reconstruction if needed |
| Leng et al., 2009[31] | 1 | Postoperative (unclear surgery at C1 42 years before) At-Ax instability secondary to Os O | None | None | Posterior decompression and fusion with anterior transnasal decompression at the CMJ in 1 operative setting is reported to be feasible |
| El-Sayed et al., 2010[32] | 2 | Not specifically mentioned in the study | NR | None | A combined transnasal-transoral approach appears to reduce procedure-related morbidity compared with open, transoral, and transpalatal surgeries |
| Hankinson et al., 2010[33] | 2 | Chiari type I malformation (2) | Reventilation, tracheostomy | None | The first experience with using an endoscopic transnasal corridor to accomplish ventral decompression in children with Chiari type I malformation complicated by ventral brainstem compression |
| Lee et al., 2010[13] | 4 | RA (1); suspected neoplasm (1); CM with platybasia; BI (1); telangiectatic osteosarcoma (1) | Intraoperative CSF leak (1) | None | C2 as the caudal limit of EEA is highlighted in this report |
| Gempt et al., 2011[17] | 3 | RA (1); retrodental tumor (1); Os O (1) | None | 1 (myocardial infarction) | EEA leaves the oropharynx intact, which could result in fewer complications especially in patients with bulbar symptoms |
| Scholtes et al., 2011[34] | 1 | BI in Chiari type I malformation | None | None | The first case of EEA to CVJ without surgical stabilization, suggesting that immediate stabilization is not mandatory in all cases of congenital causes of BI |
| Beech et al., 2012[35] | 1 | Cranial migration of odontoid peg and a resultant BI associated with Os O | Hypernasal speech and Vphl | None | Complication rate for the EEA is comparable with the TO approach |
| Gladi et al., 2012[16] | 4 | RA (2); BI (2) | None | None | Anterior C1 ring was preserved in 2 cases, contributing to avoiding cranial settling and posterior fusion with its related risk of subaxial instability |
| Patel et al., 2012[36] | 1 | BI | None | None | Pediatric case with a chronic type 3 atlantoaxial rotator fixation and significant spinal cord compression from BI and a displaced odontoid process |

Continues

**Table 2.** Continued

| Reference | Number | Craniovertebral Junction Disease (Number) | Complications (Number) | Number of Deaths (Cause) | Comments |
|---|---|---|---|---|---|
| Sinha et al., 2012[37] | 1 | Osteogenesis imperfecta and BI | None | None | The first case of a child with osteogenesis imperfecta and BI undergoing a purely EEA to resect the odontoid peg, with excellent results |
| Hickman et al., 2013[38] | 2 | Chiari type I malformation (1); BI in Down syndrome (1) | Swallowing impairment | None | Case 1: 2 EEA because of incomplete decompression. Higher reoperation rates are a concern for many endoscopic approaches, but there are insufficient data to conclude if this is the case for this procedure. EEA and other endoscopic approaches for odontoidectomy in the pediatric population are reviewed |
| Iacoangeli et al.,2013[39] | 3 | RA | None | None | The anterior C1 arch continuity was preserved, avoiding a subsequent posterior fixation |
| Nagpal, 2013[40] | 1 | BI | None | None | This article shows that a multidisciplinary team approach is needed in selected cases |
| Yu, 2013 et al.[7] | 3 | Congenital osseous malformations | CSF rhinorrhea (1) | None | EEA provides an excellent surgical route, with many advantages over standard TO odontoidectomy, potentially avoids serious intraoperative and postoperative complications |
| Choudhri et al., 2014[19] | 5 | Skull base osteomyelitis (2); RA (2); metastatic tumor (1) | Mild transient VPhI | None | Enhances the importance of intraoperative spinal navigation and imaging |
| Duntze et al., 2014[18] | 9 | RA (4); BI (2); occipitalization of atlas (1); Os O (1); nonrheum pannus (1) | None | 1 (pulmonary embolism) | EEA makes it possible to preserve the C1 anterior arch in elected cases, thus limiting the risk of cranial settling |
| Mazzatentaet al., 2014[12] | 5 | Atlanto-occipital malformation with platybasia and BI (3); At-Ax subluxation in Down syndrome (2) | None | None | Limitation of EEA consists of the narrow and deep surgical corridor. EEA could be considered as advantageous in case of peculiar anatomic conditions related to the oral cavity and to the high position of the odontoid process |
| Ponce-Gomez et al., 2014[10] | 5 | RA + BI (2); RA + BI + At-Ax subluxation (1); CM + At-Ax subluxation (1); At-Ax subluxation + hypoplasia of basiocciput (1) | None | None | Comparative study between EEA and TO approach with fewer complications in EEA |
| Yen et al., 2014[8] | 13 | RA (5); trauma (4); Os O (2); ankylosing spondylitis (1); and postinfectious deformity (1) | Intraoperative (6) and postoperative (2) CSF leaks | 1 (meningitis) | The pitfall of this approach is the difficulty in repairing dural defects and subsequent CSF leakage |
| Goldschlager et al., 2015[15] | 9 | BI + CM (3); RA + BI (2); gout (1); Os O (1); ganglion cyst (1); breast metastasis (1) | Wound infection (1); epistaxis (2) | None | Highlights the advantages of EEA in permitting early extubation and early feeding and minimizing complications compared with TO surgery. Special attention must be given to odontoid on the contralateral side of the surgeon |
| La Corte et al., 2015[14] | 8 | BI (4); cranial settling (3); chordoma (1) | NR | NR | Proposed the rhinopalatine line to predict the inferior extent of EEA |
| Shkarubo et al., 2015[41] | 2 | BI | CSF leaks (1) | None | The surgical technique of the EEA to the C1—C2 segment is more complex than that of TO surgery and requires the surgeon to be skilled and experienced |

RA, rheumatoid arthritis; EEA, endoscopic endonasal approach; CVJ, craniovertebral junction; VPhI, velopharyngeal insufficiency; CSF, cerebrospinal fluid; Os O, Os odontoideum; CMJ, cervicomedullary junction; NR; TN, transnasal; CM, Chiari malformation; BI, basilar impressio; At-Ax, atlantoaxial.

cadaveric study, because the hard palate is the limitation for both the endoscopic CVJ anterior approaches (i.e., TOA and EEA), we confirmed NAxL to be a reliable preoperative predictor of the maximal extent of inferior dissection for a transnasal approach and, on the other hand, we also found the equivalent palatine line for TOA, the so-called surgical palatine inferior dental arch line (SPIA). With SPIA, it is possible to draw preoperatively, with a standard open-mouth radiography examination, the maximal extent of superior dissection for the TOA.[56] Moreover, our study suggests that in normal conditions, the transnasal approach to the CVJ, as planned by radiologic NPL, is a more oblique approach, the reliability of which is less predictable with classic preoperative radiologic planning (NPL) compared with the TOA. Soft tissue lines (surgical) differ from hard tissue lines (radiologic), and NAxL differs more than SPIA.[56]

Because of these considerations, the indications and the advantages of EEA need to be reassessed compared with the endoscopic TOA to the CVJ. Nevertheless, more prospective trials need to be taken into consideration to better compare advantages and disadvantages of these different tools in the modern armamentarium for this challenging and complex surgery.

## CONCLUSIONS

The present study seems to suggest that EEA can produce complications similar to TOA in CVJ surgery, including velopharyngeal insufficiency and serious infections, as in our patient.

No clear-cut superiority of EEA over endoscopic TOA has been shown so far.

The best treatment should therefore be chosen according to the individual anatomy of the patient and the personal experience of the surgeon.

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