The Endoscopic Endonasal Approach for Treatment of Craniovertebral Junction Pathologies: A Minimally Invasive but not Minimal-Risk Approach

Massimiliano Visocchi, Francesco Signorelli, Chenlong Liao, Mario Rigante, Gaetano Paludetti, Giuseppe Barbagallo, and Alessandro Olivi

Introduction

Several pathologies can affect the craniovertebral junction (CVJ), leading to bulbomedullary compression. The microsurgical transoral approach (TOA) has long been considered the 'gold standard' for anterior decompression [1]. However, a series of complications, particularly with extended procedures [2–4], has recently led to the introduction of the endoscopic endonasal approach (EEA), which showed initial promise for overcoming previous technical challenges and surgical complications [5]. So far, however, only limited reports on this approach are available [6–18]; therefore, clear evidence of its superiority is yet to be demonstrated. In this paper we report our surgical experience with the EEA for treatment of different CVJ pathologies. The feasibility, advantages and limitations of this approach are critically assessed.

Material and Methods

Among 21 cases operated on using anterior approaches, from 2011 to 2018, a consecutive series of six patients with varied CVJ pathologies were treated using the EEA approach by a mixed team of neurosurgeons and rhinolaryngologists, who are experts in microneurosurgery and endoscopic video-assisted microsurgery (Table 1). In every patient, a subsequent short occipitocervical instrumentation and fusion procedure was completed 1 week later.

Results

The length of follow-up of our patients ranges from 1 to 48 months (Table 1 [19, 20]); all of the patients improved or remained unchanged (with a good neurological status) after surgery and during follow-up. However, in one patient (patient #1), intraoperative cerebrospinal fluid (CSF) leakage occurred, requiring immediate surgical repair with a mucosa pedicle flap. The patient improved after surgery within 48 h and was able to walk and feed herself without any assistance for 10 days, but she subsequently deteriorated rapidly and died 1 month after the surgery. Since the patient was immobilized with a halo vest, CSF nose leakage was not evident either spontaneously or with a jugular compression test (the Queckenstedt test). During the subsequent posterior fixation procedure performed in the prone position, CSF leakage was evident in the operating room, and an external CSF drain was set up and left in place for 5 days, achieving stable control of the leakage.

Postoperatively the patient developed meningoencephalitis, confirmed by positive CSF cultures for fungi (*Candida albicans*). Despite appropriate antimycotic therapy (micafungin and 5-fluorocytosine [flucytosine]), the meningoencephalitis progressively worsened, leading to fatal neurological complications.

All other patients were discharged after posterior instrumentation and fusion procedures within 2 weeks after admission.

M. Visocchi · F. Signorelli (✉) · A. Olivi
Institute of Neurosurgery, Catholic University of Rome, Rome, Italy

C. Liao
Department of Neurosurgery, Xinhua Hospital, Affiliated to Shanghai Jiao Tong University School of Medicine, Shanghai, China

M. Rigante · G. Paludetti
Institute of Otolaryngology, Catholic University of Rome, Rome, Italy

G. Barbagallo
Department of Neurological Surgery, Policlinico "G. Rodolico" University Hospital, Catania, Italy

Interdisciplinary Research Center on Brain Tumors Diagnosis and Treatment, University of Catania, Catania, Italy
e-mail: gbarbagallo@unict.it

M. Visocchi (ed.), *New Trends in Craniovertebral Junction Surgery*, Acta Neurochirurgica Supplement, Vol. 125,
https://doi.org/10.1007/978-3-319-62515-7_31, © Springer International Publishing AG, part of Springer Nature 2019

Table 31.1 Personal series of patients operated with EEA

Patient	Age (sex)	Primary disease	Radiology	Pre-op C1–C2 shift (X-rays)	Treatment	Post-op shift (X-rays)	Frankel scale [22] and Di Lorenzo Grade [23] changes	External orthosis	Follow-up (months)
PF #1	66 (F)	Impressio basilaris	CVJ anterior compression	Yes	(1) Transnasal decompression (0–30°) (2) C0–C3 reduction, lateral masses screws instrumentation and heterologous bone fusion	No	D/E I/I	Halovest (1 month)	6 (meningitis and death)
RS #2	47 (F)	Impressio basilaris + platybasia	CVJ anterior compression	Yes	(1) Transnasal C1 decompression and odontoidectomy (2) C0–C3 reduction, C2 pedicles and C3 lateral masses screws Instrumentation and autologous bone fusion	No	D/E I/I	Halovest (1 month)	49
LP P #3	14 (F)	Impressio basilaris + platybasia	CVJ anterior compression	No	Transnasal C1 partial decompression and partial odontoidectomy	No	D/E I/I	No	51
R N #4	22 (M)	Recurrence of clivus Chordoma	CVJ destruction and compression	Not performed	(1) Transnasal C1 decompression and odontoidectomy (2) C0–C3 reduction, lateral masses screws instrumentation and heterologous bone fusion	NO	D/E I/I	Halovest 1 month Hard collar (2 months)	34
G M #5	58 (M)	Myeloma	Odontoid infiltration	Not performed	Transnasal and odontoid biopsy		E/E I/I	No	27
O S #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	39
RC #7	36 (M)	Isolated plasmocytoma	CVJ anterior compression	Not performed	One stage transnasal C1 decompression, and odontoidectomy and C0–C3 reduction, lateral masses screws instrumentation and heterologous bone fusion	NO	D/D I/I	Soft collar (1 month)	3

Discussion

In this paper we present our recent institutional experience dealing with six patients affected by CVJ disease and operated on using the EEA. Of these, five had an uncomplicated postoperative course and one (patient #1) developed intraoperative CSF leakage and died 5 weeks after surgery.

A critical analysis of such a case warrants development of strategies that might decrease the risk of such complications developing in future patients. More specifically, we strongly support the following measures: (1) making every effort to avoid dural tears, as far as possible, by overcoming the learning curve; and (2) using a single-stage combined anterior and posterior approach to allow earlier identification of a possible CSF fistula—without the obstacle of a halo vest—and immediate commencement of adequate therapies.

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

According to the literature, and our personal experience, the presumed improved safety of the EEA, in comparison with the TOA, should be reassessed. In fact, a recent systematic review and meta-analysis by Shriver et al. showed that the EEA was associated with higher rates of 30-day mortality (4.4% versus 2.9%), intraoperative CSF leakage (30% versus 0.3%), postoperative CSF leakage (5.2% versus 0.8%), meningitis (4% versus 1%), need for prolonged intubation or re-intubation (6% versus 5.6%), need for reoperation (5.1% versus 2.5%), velopharyngeal insufficiency (6.4% versus 3.3%) and sepsis (7.7% versus 1.9%), while the TOA was associated with higher rates of arterial injury (1.9% versus 0%), wound infection (3.3% versus 1.9%) and need for tracheostomy (10.8% versus 3.4%). However, none of these differences was statistically significant, except for the difference in the need for postoperative tracheostomy [21].

Conclusion

Our experience and other reported experiences with the endoscopic endonasal approach (EEA) have highlighted occurrences of complications similar to those observed with the transoral approach (TOA) in craniovertebral junction surgery, including velopharyngeal insufficiency and serious infections, leading us to reconsider the presumed superiority of the EEA over the endoscopic TOA.

The most appropriate treatment should therefore be chosen on the basis of the individual anatomy of the patient and the personal experience of the surgeon.

Competing Interests The authors declare that they have no competing interests.

Compliance with Ethical Standards No financial support was received for this work.

References

1. Menezes AH, Van Gilder JC. Transoral–transpharyngeal approach to the anterior craniocervical junction. Ten-year experience with 72 patients. J Neurosurg. 1988;69:895–903. https://doi.org/10.3171/jns.1988.69.6.0895.
2. Crockard HA. Transoral surgery: some lessons learned. Br J Neurosurg. 1995;9:283–93.
3. Visocchi M. Advances in videoassisted anterior surgical approach to the craniovertebral junction. Adv Tech Stand Neurosurg. 2011;37:97–110. https://doi.org/10.1007/978-3-7091-0673-0_4.
4. Liu JK, Patel J, Goldstein IM, Eloy JA. Endoscopic endonasal transclival transodontoid approach for ventral decompression of the craniovertebral junction: operative technique and nuances. Neurosurg Focus. 2015;38:E17. https://doi.org/10.3171/2015.1.FOCUS14813.
5. Kassam AB, Snyderman C, Gardner P, Carrau R, Spiro R. The expanded endonasal approach: a fully endoscopic transnasal approach and resection of the odontoid process: technical case report. Neurosurgery. 2005;57:E213.
6. Yu Y, Wang X, Zhang X, Hu F, Gu Y, Xie T, Jiang X, Jiang C. Endoscopic transnasal odontoidectomy to treat basilar invagination with congenital osseous malformations. Eur Spine J. 2013;22(5):1127–36. https://doi.org/10.1007/s00586-012-2605-4.
7. Yen YS, Chang PY, Huang WC, Wu JC, Liang ML, Tu TH, Cheng H. Endoscopic transnasal odontoidectomy without resection of nasal turbinates: clinical outcomes of 13 patients. J Neurosurg Spine. 2014;21:929–37. https://doi.org/10.3171/2014.8.SPINE13504.
8. Wu JC, Huang WC, Cheng H, Liang ML, Ho CY, Wong TT, Shih YH, Yen YS. Endoscopic transnasal transclival odontoidectomy: a new approach to decompression: technical case report. Neurosurgery. 2008;63:ONSE92–4. https://doi.org/10.1227/01.neu.0000335020.06488.c8.
9. Ponce-Gomez JA, Ortega-Porcayo LA, Soriano-Baron HE, Sotomayor-Gonzalez A, Arriada-Mendicoa N, Gomez-Amador JL, Palma-Diaz M, Barges-Coll J. Evolution from microscopic transoral to endoscopic endonasal odontoidectomy. Neurosurg Focus. 2014;37:E15. https://doi.org/10.3171/2014.7.FOCUS14301.
10. Nayak JV, Gardner PA, Vescan AD, Carrau RL, Kassam AB, Snyderman CH. Experience with the expanded endonasal approach for resection of the odontoid process in rheumatoid disease. Am J Rhinol. 2007;21:601–6. https://doi.org/10.2500/ajr.2007.21.3089.
11. Mazzatenta D, Zoli M, Mascari C, Pasquini E, Frank G. Endoscopic endonasal odontoidectomy: clinical series. Spine. 2014;39:846–53. https://doi.org/10.1097/BRS.0000000000000271.

12. Lee A, Sommer D, Reddy K, Murty N, Gunnarsson T. Endoscopic transnasal approach to the craniocervical junction. Skull Base. 2010;20:199–205. https://doi.org/10.1055/s-0029-1246220.
13. La Corte E, Aldana PR, Ferroli P, Greenfield JP, Hartl R, Anand VK, Schwartz TH. The rhinopalatine line as a reliable predictor of the inferior extent of endonasal odontoidectomies. Neurosurg Focus. 2015;38:E16. https://doi.org/10.3171/2015.1.FOCUS14777.
14. Goldschlager T, Hartl R, Greenfield JP, Anand VK, Schwartz TH. The endoscopic endonasal approach to the odontoid and its impact on early extubation and feeding. J Neurosurg. 2015;122:511–8. https://doi.org/10.3171/2014.9.JNS1473.
15. Gladi M, Iacoangeli M, Specchia N, Re M, Dobran M, Alvaro L, Moriconi E, Scerrati M. Endoscopic transnasal odontoid resection to decompress the bulbo-medullary junction: a reliable anterior minimally invasive technique without posterior fusion. Eur Spine J. 2012;21((Suppl 1)):S55–60. https://doi.org/10.1007/s00586-012-2220-4.
16. Gempt J, Lehmberg J, Grams AE, Berends L, Meyer B, Stoffel M. Endoscopic transnasal resection of the odontoid: case series and clinical course. Eur Spine J. 2011;20:661–6. https://doi.org/10.1007/s00586-010-1629-x.
17. Duntze J, Eap C, Kleiber JC, Theret E, Dufour H, Fuentes S, Litre CF. Advantages and limitations of endoscopic endonasal odontoidectomy. A series of nine cases. Orthop Traumatol Surg Res. 2014;100:775–8. https://doi.org/10.1016/j.otsr.2014.07.017.
18. Choudhri O, Mindea SA, Feroze A, Soudry E, Chang SD, Nayak JV. Experience with intraoperative navigation and imaging during endoscopic transnasal spinal approaches to the foramen magnum and odontoid. Neurosurg Focus. 2014;36:E4. https://doi.org/10.3171/2014.1.FOCUS13533.
19. Frankel HL, Hancock DO, Hyslop G, Melzak J, Michaelis LS, Ungar GH, Vernon JD, Walsh JJ. The value of postural reduction in the initial management of closed injuries of the spine with paraplegia and tetraplegia. Paraplegia. 1969;7(3):179–92.
20. Di Lorenzo N. Craniocervical junction malformation treated by transoral approach. A survey of 25 cases with emphasis on postoperative instability and outcome. Acta Neurochir. 1992;118(11):112–6.
21. Shriver MF, Kshettry VR, Sindwani R, Woodard T, Benzel EC, Recinos PE. Transoral and transnasal odontoidectomy complications: a systematic review and meta-analysis. Clin Neurol Neurosurg. 2016;148:121–9.