Transoral Versus Transnasal Approach for Craniovertebral Junction Pathologies: Which Route Is Better?

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Abstract *Background:* Several pathologies that affect the craniovertebral junction (CVJ) can be treated by means of a microsurgical transoral approach (TOA) or, alternatively, with an endoscopic endonasal approach (EEA), which is potentially able to overcome some complications associated with the former approach. In this paper, after discussing updates in the recent literature, to which we add our own surgical experience, we critically analyse these procedures with the aim of demonstrating that the TOA still deserves to be considered a viable alternative and that, in selected cases, it can even be considered superior to the EEA.

Methods: Our experience involves 25 anterior procedures in 24 paediatric and adult patients (18 TOA and seven EEA). The TOA group (13 male and five female patients) encompassed three tumours, three rheumatoid arthritis cases, one condylus tertius, three basilar invaginations, four impressio basilaris cases, one developmental anomaly of C0–C1, one os odontoideum, one posttraumatic C1–C2 compression and one C2 fracture. The EEA group (three male and four female patients, median age 39 years, operated on over a 7-year period) comprised four tumours, two impressio basilaris cases and one case of impressio basilaris with platybasia.

Results: In the TOA group, all but one patient were discharged after posterior procedures within 2 weeks and improved or remained unchanged after surgery and during the follow-up period. No major complications occurred in the TOA group. In the EEA group, two patients who developed a cerebrospinal fluid (CSF) infection died, one from disease progression and the other from myocardial infarction.

Conclusion: Our data, in agreement with those from previous reports on other series, suggest that no clear superiority of the EEA over the endoscopic TOA can be postulated so far; in fact, the EEA can produce complications similar to those observed with the TOA in CVJ surgery.

Introduction

According to the current literature, the congenital, developmental and acquired pathologies that affect the anterior craniovertebral junction (CVJ) can be targeted through several surgical approaches:

1. The transoral approach (TOA), which provides the widest and shortest [1] route
2. The endoscopic endonasal approach (EEA), which was recently introduced by Kassam [2–5] with the goal of overcoming some technical challenges and surgical complications secondary to soft tissue swelling
3. The transcervical approach

In fact, the indications for the transcervical approach are not recognized worldwide, although it may still be considered in highly selected cases; as to whether the EEA is superior to the TOA in the treatment of similar CVJ pathologies, this is still a matter of debate.

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In this paper we describe our surgical experience with the TOA and EEA for different CVJ pathologies and discuss the relevant literature, seeking to demonstrate that despite the wide dissemination of the EEA, the TOA deserves and should receive greater consideration in the surgical decision-making process, and that in some cases it can even be considered superior to the EEA.

Material and Methods

Among 25 anterior procedures (in 24 patients) performed from 2011 to 2017, a consecutive series of seven patients with different CVJ pathologies were treated with the EEA and 18 with the TOA by a mixed team of neurosurgeons and rhinolaryngologists, who are expert in microneurosurgery and endoscopic video-assisted microsurgery (Table 1).

An occipitocervical instrumentation and fusion procedure was completed according to our protocol for CVJ tumours and platybasia—and to prevent cranial settling of the C2 vertebral body—1 week later, using a titanium implant (DePuy Synthes Spine Mountaineer®) in accordance with our patients' wishes. All patients underwent magnetic resonance imaging (MRI), computed tomography (CT) scanning and standard/dynamic X-ray evaluation of the CVJ before surgery, immediately after surgery and every 6 months thereafter.

Results

Our recent institutional experience is summarized in Table 1. All except one patient were discharged after the posterior instrumentation and fusion procedure within 2 weeks after admission and improved or remained unchanged (with a good neurological status) after surgery and during the follow-up period. No major complications were observed in the TOA group. On the other hand, in the EEA group, two patients who developed a cerebrospinal fluid (CSF) infection died, one from disease progression and the other from myocardial infarction.

Discussion

Among the seven patients who underwent the EEA, six had an uncomplicated postoperative course, but one developed an intraoperative CSF leak and subsequent meningitis, and eventually died 5 weeks after the surgery; none of the TOA group experienced the same complication. *Such an event was probably due to the limitation of the bidimensional view afforded by the oblique surgical view in the EEA, as opposed to the tridimensional transoral microsurgical view afforded by the straightforward surgical view in the TOA.*

According to the current literature, a total of 120 patients (including our seven) affected by CVJ disease and treated with the EEA have been reported so far. In a previous analysis [6] published in 2017—at which stage, the literature included a total of 107 patients treated with the EEA—we noted that CSF leakage (intra- and/or postoperative) had been reported in 13 patients (12.4%); transient velopharyngeal incompetence, variably associated with nasal speech and swallowing impairment, in 6 patients (5.6%); postoperative epistaxis in 2 patients (1.86%); and respiratory dysfunction requiring a tracheostomy in 2 patients (1.86%). Moreover, a recent systematic review and meta-analysis [7] showed increased prevalence rates of several complications in the EEA group in comparison with the TOA group (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%). Conversely, the same paper also showed increased prevalence rates of other complications in the TOA group in comparison with the EEA group (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 [7].

According to the available literature and our personal experience, the presumed improved safety of the EEA in comparison with the TOA requires reassessment [8, 9] even though it is regarded worldwide as being "minimally invasive" [10] .

Table 1 Personal series of patients operated by means of an anterior approach to the CVJ

Pts	Age (sex)	Primary disease	Radiology	Pre-op C1–C2 shift (X-rays)	Treatment	Post-op shift	Frankel scale and Di Lorenzo grade changes	External orthosis	Follow-up (months)
1 SO	26 (F)	CVJ chordoma	C0–C2 anterior compression CVJ instability	Virtual	1. Transoral decompression 2. C0–C3 reduction, lateral masses screws instrumentation and heterologous bone fusion	No	E/E, I/I	Philadelphia (1 month)	88
2 FF	33 (M)	CVJ chordoma	C0–C2 anterior compression CVJ instability	Virtual	1. Transoral decompression 2. C0–C3 reduction, C2 pedicles, and C3 lateral masses screws instrumentation and heterologous bone fusion	No	E/E, I/I	Philadelphia (1 month)	99
3 CO	68 (F)	Rheumatoid arthritis	Anterior C1–C2 compression C1–C2 instability	>5 mm	1. Transoral decompression 2. C0–C2 pedicles and lateral masses screws instrumentation	No	D/E, II/I	Soft collar (1 month)	82
4 CL	15 (M)	Developmental anomaly C0–C1	C0–C1 anterior compression C1–C2 instability	>5 mm	1. Transoral decompression 2. C1 laminectomy, C0 double vertical screws, C2 pedicles, and C3 lateral masses screws instrumentation	No	D/E, II/I	Soft collar (1 month)	77
5 CA	78 (M)	Chordoma (chondroid)	CVJ instability C0–C2 Ant. compression	Virtual	Transoral C1-odontoidectomy and clivectomy, C0-double vertical screws, C2, C3, C4, and C5-lateral masses screws instrumentation	No	D/E, II/I	Soft collar (1 month)	74
6 EA	11 (M)	Impressio basilaris Os odont. (Downs.)	C1–C2 anterior compression	Virtual	Transoral C1-odontoidecotmy and clivectomy in C0–C2–C3 screwing instrumentation and heterologous bone fusion (previously implanted)	No	D/E, II/I	Soft collar (1 month)	73
7 RR	14 (M)	C2 fracture and dislocation	C2 fracture and C1–C2 dislocation with cervic. contusion	>7 mm	1. Transoral C1–C2 decompression 2. C0–C3–C5 screwing instrumentation and heterologous bone fusion	No	D/E, II/I	Soft collar (1 month)	70
8 MP	8 (M)	Impressio basilaris	C0–C1–C2 compression	No	1. Transoral C1–C2 decompression 2. Staged C0–C2–C3 screwing instrumentation and fusion	No	D/E, II/I	Halo + Philadelphia (2 months)	66
9 LC	15 (M)	Third condyle	C0–C1 compression	No	1. Transoral C0–C1 decompression 2. Staged C0–C2–C3 screwing instrumentation and fusion	No	D/E, II/I	Halo + Philadelphia (3 months)	103
10 CP	67 (F)	Rheum. arthritis C2 fracture + dislocation 2 cm	C2 compression + myelopathy	Yes	1. C1–C2 decompression combined 2. C0–C2–C3 screwing instrumentation and fusion	No	C/E, III/I	Philadelphia (2 months)	8

(continued)

Table 1 (continued)

Pts	Age (sex)	Primary disease	Radiology	Pre-op C1–C2 shift (X-rays)	Treatment	Post-op shift	Frankel scale and Di Lorenzo grade changes	External orthosis	Follow-up (months)
11 PP	50 (M)	Basilar invagination	C2 anterior compression	Virtual	1. One stage transoral decompression 2. C0–C3 instrumentation and fusion	No	D/E, II/I	Soft collar (1 month)	15
12 SP	7 (M)	Basilar invagination	C0–C1–C2 compression	Virtual	1. Transoral C0–C1–C2 decompression 2. C0–C2–C3 screwing instrumentation and fusion	No	D/E, II/I	Soft collar (3 months)	68
13 SS	9 (M)	Os odontoideum	C2 compression	Virtual	1. Transoral C1–C2 decompression 2. C0–C2–C3 screwing instrumentation and fusion	No	D/E, II/I	Halo + Philadelphia (2 months)	121
14 MM	68 (F)	Rheumatoid arthritis + ED C2–C3	C2–C3 compression	Virtual	1. Transoral C0–C1–C2 decompression 2. C0–C2–C3 screwing instrumentation and fusion	No	D/E II/I	Halo + Philadelphia (3 months)	12
15 AE	12 (M)	Basilar invagination + ED C3–C4 myelopathy	C2 compression	Virtual	1. Transoral C0–C1–C2 decompression 2. Anterior C3–C4 discect. and titanium graft 3. C0–C2–C3 screwing instrumentation and fusion	No	D/E, II/I	Halo + Philadelphia (3 months)	3 (death for heart attack)
16 GC	(F)	Impressio basilaris + Chiari	C0–C1–C2 compression	Virtual	1. Transoral C0–C1–C2 decompression 2. C0–C2–C3 screwing instrumentation and fusion	No	II/I	Halo (3 months)	23
17 MS	(M)	Impressio basilaris	C0–C1–C2 compression	Virtual	1. Transoral C0–C1–C2 decompression 2. C0–C2–C3 screwing instrumentation and fusion	No	II/I	Miami (2 months)	5
18 ML	56 (M)	Posttraumatic C1–C2 compression	C1–C2 compression	Virtual	1. Transoral C0–C1–C2 decompression 2. C0–C3 screwing instrumentation and fusion	No	D/E, II/I	Soft collar (1 month)	6
19 SO	35 (F)	Chordoma	CVJ infiltration (previous TOA and C0–C3 fusion)	NP	Transnasal decompression (0°–30°)	No	D/D, I/I	Previously performed	39

20 FP	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)	3 (meningitis and death)
21SR	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)	52
22 PLP	14 (F)	Impressio basilaris + platybasia	CVJ anterior compression	No	Transnasal C1 partial decompression and partial odontoidectomy	No	D/E, I/I	No	54
23 NR	22 (M)	Recurrence of clivus chordoma	CVJ destruction and compression	NP	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)	37
24 MG	58 (M)	Myeloma	Odontoid infiltration	NP	Transnasal and odontoid biopsy	No	E/E, I/I	No	30
25 RC	36 (M)	Isolated plasmacytoma	CVJ anterior compression	NP	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

PTS patients, *CVJ* craniovertebral junction, *NP* not performed

Conclusion

No clear superiority of the endoscopic endonasal approach (EEA) over the endoscopic transoral approach (TOA) is recognized by the current literature so far; in fact, the EEA has been shown to result in complication rates similar to those observed with the TOA in craniovertebral junction surgery.

In normal anatomical conditions, superior surgical freedom is provided by the TOA in comparison with the EEA. The respective roles of the two different strategies is still a matter of debate, requiring more cohort and prospective studies, along with detailed and conclusive meta-analysis.

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

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