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Transoral and transnasal odontoidectomy complications: A systematic review and meta-analysis

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ABSTRACT

Object: The craniovertebral junction (CVJ) is a complex region of the spine with unique anatomical and functional relationships. To alleviate symptoms associated with pathological processes involving the odontoid process, decompression is often required, including odontoidectomy. Accurate knowledge of the complication rates following the transoral and transnasal techniques is essential for both patients and surgeons.
Methods: We conducted MEDLINE, Scopus and Web of Science database searches for studies reporting complications associated with the transoral and transnasal techniques for odontoidectomy. Case series presenting data for less than three patients were excluded. Rates of complication and clinical outcomes were calculated and subsequently analyzed using a fixed-effects model to assess statistical significance.
Results: Of 1288 articles retrieved from MEDLINE, Scopus, and Web of Science, twenty-six met inclusion criteria. Transoral and transnasal procedures resulted in the following respective complication rates: arterial injury 1.9% and 0.0%, intraoperative CSF leak 0.3% and 30.0%, postoperative CSF leak 0.8% and 5.2%, 30-day mortality 2.9% and 4.4%, medical complications 13.9% and 28.6%, meningitis 1.0% and 4.0%, pharyngeal wound dehiscence 1.7% (transnasal not reported), pneumonia 10.3% (transnasal not reported), prolonged or re-intubation 5.6% and 6.0%, reoperation 2.5% and 5.1%, sepsis 1.9% and 7.7%, tracheostomy 10.8% and 3.4%, velopharyngeal insufficiency 3.3% and 6.4% and wound infection 3.3% and 1.9%. None of these differences were statistically significant, except for postoperative tracheostomy, which was significantly higher after transoral odontoidectomy 8.4% (95% CI 4.9% −11.9%) compared to transnasal odontoidectomy 0.8% (95% CI −1.0% −2.9%). Neurologic outcome was improved in 90.0% and worse in 0.9% of patients after transoral compared to 94.0% and 0.0% after transnasal odontoidectomy ($p = 0.30$).
Conclusions: This work presents a systematic review of complications reported for transoral or transnasal odontoidectomy across a heterogeneous group of surgeons and patients. Due to inconsistent reporting, statistical significance was only achieved for postoperative tracheostomy, which was significantly higher in the transoral group. This investigation sets the framework for further discussions regarding odontoidectomy approach options and their associated complications during the informed consent process.

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1. Introduction

The craniovertebral junction (CVJ) is a complex region of the spine with unique anatomical and functional relationships [8]. Various pathological processes involving the odontoid process may occur such as congenital malformations, inflammatory conditions, neoplasms, trauma and infection [3,5,16,18]. Due to the proximity to vital neurological structures, lesions at the CVJ can result in neurovascular compromise [5]. Presenting symptoms may include

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neck pain, weakness, numbness or paresthesias, gait difficulty, spasticity, and in certain cases even swallowing difficulties and dysarthria [5,11,13,15].

To alleviate these symptoms, decompression is often required, including odontoidectomy [9]. The traditional method to achieve decompression is a transoral approach [2,9]. The transoral technique allows for direct access to the anterior atlantoaxial region and has demonstrated good clinical outcomes [3,8–11,17,20–22,26,28,30–32,35,38,39]. Potential complications include dysphagia and velopharyngeal insufficiency (VPI), possible need for prolonged enteral feeding or tracheostomy, cerebrospinal fluid (CSF) leak, and meningitis [3,16,28,39]. These complications are often related to scarring and infectious problems, caused by bacteria and saliva in the pharynx [9,30].

The ability to expose the odontoid process through an entirely transnasal approach was demonstrated in a cadaveric study by Alferi et al. [1]. The use of the transnasal approach differs from the transoral route because it exposes the CVJ through the nasopharynx, limiting the surgical wound's exposure to saliva and bacterial contamination [9,19]. The first published clinical report of a transnasal endoscopic approach for odontoidectomy was by Kassam et al. [19], in 2005. Palatal splitting or extensive retraction of the soft palate, either of which are often necessary during the transoral approach, can be avoided with the transnasal approach, potentially avoiding long-term complications of VPI [4,13,16]. While the transnasal approach reduces the possibility of many complications associated with the traditional transoral approach, there are limitations [16]. The hard palate may restrict caudal access to the subaxial spine and small nasal cavities may require widening through turbinate reduction, which can alter postoperative airflow during respiration [16,23].

Accurate knowledge of adverse outcomes following these two surgical approaches for odontoidectomy—transoral and transnasal—is essential for both patients and surgeons. To our knowledge, there are no previous cohort or randomized studies directly comparing the results of the transoral and transnasal techniques. A comprehensive analysis of the potential complications would prove useful in educating patients and surgeons during the informed consent process. We sought to identify all clinical studies reporting complications after odontoidectomy to better elucidate complication rates for each approach.

2. Methods

2.1. Study search

The systematic review was conducted following Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) [29]. We conducted MEDLINE, Scopus and Web of Science database searches with the search algorithm: "odontoidectomy"

Table 1
Study characteristics and surgical technique.

Author	Year	Study type	Number of Patients	Operative approach	Posterior instrumentation	Neuro-monitoring use	Mean follow-up time (Range) in months
Goldschlager et al. [13]	2015	RC	9	Transnasal endoscopic	Before and After[d]	Yes	42.9 (1.3–99.1)
Choudhri et al. [5]	2014	RC	4	Transnasal endoscopic	Before	Yes	6
Duntze et al. [9]	2014	RC	9	Transoral endoscopic	After in 6 patients	No	3[b] (3–24)
Tan et al. [36]	2014	Case series	3	Transnasal endoscopic	Before in 2 patients	Unknown	Not defined
Mazzatenta et al. [27]	2014	RC	5	Transnasal endoscopic	Before	No	34.2 (3–57)
Yen et al. [40]	2014	RC	13	Transnasal endoscopic	After in 10 patients[e]	No	51.2 (0.3–105)
Yu et al. [41]	2013	Case series	3	Transnasal endoscopic	After in 2 patients	No	26.7 (24–30)
Iacoangeli et al. [18]	2013	Case series	3	Transnasal endoscopic	None	Yes	28.3 (20–40)
Qiuhang et al. [35]	2013	Case series	5	Transoral endoscopic	None	No	29.2 (12–47)
Yadav et al. [38]	2013	Prospective	34	Transoral endoscopic	After: 29 patients	No	12[b] (12–65)
Marda [26]	2013	RC	178	Transoral microscopic	After	Unknown	Not defined
Choi et al. [3]	2013	RC	428	Transoral microscopic	After[f]	No	62.1 (1–370)
Gladi et al. [12]	2012	Case series	4	Transnasal endoscopic	Before in 1 patient; After in 1 patient	Yes	22 (12–31)
Gempt et al. [11]	2011	Case series	3	Transnasal endoscopic	Before	No	6.3
Lee et al. [24]	2010	Case series	3	Transnasal endoscopic	After	No	6
Tormenti et al. [37]	2010	RC	24	Transnasal endoscopic	After in 21 patients	Unknown	28.6 (3–57)
Mouchaty [30]	2009	RC	52	Transoral microscopic[a]	Before in 2 patients; After in 50 patients	No	31 (4–96)
Menezes [28]	2008	Prospective	280	Transoral microscopic	After[g]	No	6
Nayak et al. [33]	2007	RC	9	Transnasal endoscopic	After in 8 patients	Yes	3[b]
Landeiro et al. [22]	2007	RC	38	Transoral microscopic	After in 18 patients	No	Not defined
Mummaneni et al. [31]	2003	RC	70	Transoral microscopic	Before in 7 patients; After in 63 patients	Unknown	32 (3–82)
Kerschbaumer et al. [20]	2000	RC	15	Transoral microscopic	After in 12 patients	No	50.7 (26–77)
Yang et al. [39]	1999	RC	20	Transoral microscopic	After in 2 patients	No	8[c] (2–24)
Dickman et al. [8]	1992	RC	27	Transoral microscopic	After in 19 patients	No	14 (6–29)
Laborde et al. [21]	1992	RC	15	Transoral microscopic	After in 1 patient[h]	No	Not defined
Louis [25]	1992	RC	76	Transoral microscopic	After[i]	No	24[b]

RC = retrospective cohort; PC = prospective cohort.

[a] Transoral (Standard approach 45 patients, 5 needed osteotomy (platybasia, odontoid tip more than 20 mm above Chamberlain's line), 2 needed palate split).

[b] Minimum follow-up time.

[c] Median.

[d] Variable.

[e] Only for those with craniovertebral junction instability (those with basilar invagination or severe deformity between the condyles and the atlas).

[f] Instrumentation was performed in all rheumatoid arthritis patients due to craniocervical instability. For chordomas fixation was not always required (clival tumors especially). The decision was made on a case-by-case basis based on the degree of instability on dynamic flexion-extension cervical radiographs, MRI and CT, symptoms and signs of cord compression and whether decompressive surgery would lead to instability.

[g] Dorsal occipitocervical fusion combined with posterior fossa decompression usually mandated.

[h] With atlantoaxial dislocation.

[i] Performed eight days later only in cases of severe instability.

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