

# Transoral Resection of a Giant Cell Tumor in the Odontoid With Cementoplasty: A Technical Case Report

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**BACKGROUND AND IMPORTANCE:** Giant cell tumors (GCT) are rare neoplasms that primarily affect the long bones, with cervical spine involvement being uncommon, particularly at the C2 level. Although GCTs are considered benign, their aggressive growth patterns and high recurrence rates present significant treatment challenges, making aggressive tumor resection the treatment of choice. Using bone cement to fill the resection cavity has been associated with reduced tumor recurrence. Using a transoral approach provides an optimal surgical corridor for achieving an ideal exposure of such lesions at the anterior craniocervical junction.

**CLINICAL PRESENTATION:** A 23-year-old man presented with persistent atraumatic neck pain and no neurological deficits. Imaging revealed an osteolytic lesion in the dens, confirmed as a GCT through a transoral biopsy. To prevent spinal instability, posterior stabilization with a C1 to C4 instrumentation was performed, followed by endovascular embolization of arterial tumor feeders. Tumor resection was achieved through a transoral approach, supported by neuronavigation and intraoperative cone-beam computed tomography imaging. The resection cavity was filled with bone cement, and the construct was further stabilized using a vertical inline plate.

**CONCLUSION:** The transoral approach proved to be an effective and minimally invasive route for resecting the GCT at the odontoid in this case. Postoperatively, the patient experienced mild, transient dysphagia without neurological deficits. Cementoplasty of the odontoid proved to be a safe and effective procedure in this case, with the use of neuronavigation and intraoperative cone-beam computed tomography providing valuable feedback for the surgeon.

**KEY WORDS:** C2 giant cell tumor, Cementoplasty, Cervical spine, Dens axis, Intraoperative cone-beam CT, Neuronavigation, Transoral approach

**G**iant cell tumors (GCT) are locally aggressive bone tumors, accounting for 4% to 5% of all primary bone neoplasms.<sup>1</sup> These tumors are typically found in the long bones, with their occurrence in the spine above the sacrum being relatively rare, accounting for only 1.2% to 3.8% of all spinal tumors.<sup>2,3</sup> The cervical spine is even less common, with a reported frequency of just 0.4% to 1.0%.<sup>4,5</sup> Cases involving the odontoid process are particularly rare, with only a few cases described in the literature.<sup>6-12</sup> GCT most commonly affect young patients between the ages of 20 and 50 years.<sup>2</sup> Although classified as benign tumors, their high risk of recurrence<sup>13</sup> and development of lung metastases in 2% to 5%<sup>14,15</sup> of patients make their treatment challenging. Although they are very rare at the C2 level, this location poses a significant surgical challenge

because of its complex anatomy. It often necessitates unconventional surgical approaches and carries a risk of spinal instability after resection.<sup>16,17</sup>

The transoral approach provides an optimal pathway for accessing such lesions at the C2 level, using a natural anatomic corridor that offers exposure between the lower end of the clivus and the C2/3 interspace. First described by Kanavel<sup>18</sup> in a patient with a gunshot wound, the transoral approach offers direct access to lesions at the anterior craniocervical junction. Although early reports noted high rates of morbidity,<sup>19,20</sup> advancements in surgical techniques over the last decades have significantly improved its safety profile. Enhancement such as the development of superior retractor systems improved dura sealing techniques, and the advancement of the operative microscope made the transoral approach a much safer and more effective approach.<sup>21-24</sup>

**ABBREVIATION:** GCT, Giant cell tumors.

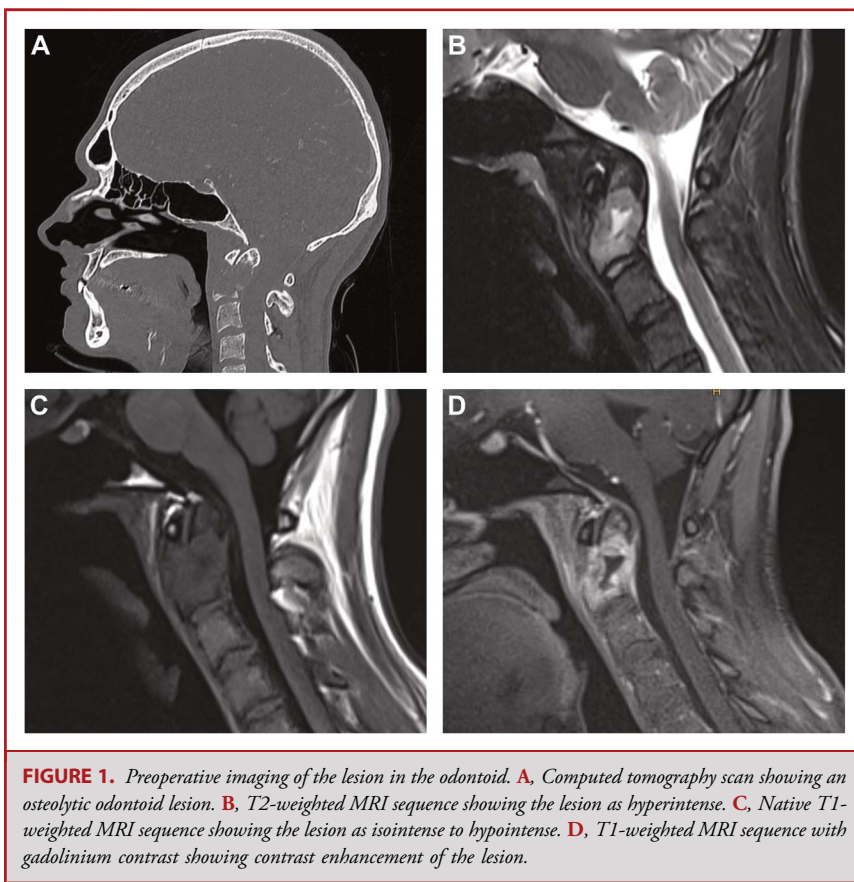
This technical case report highlights a novel variation of the transoral approach using a combination of intraoperative cone-beam computed tomography (CT) and neuronavigation for the resection of an odontoid GCT, followed by odontoid cementoplasty and stabilization with a plate.

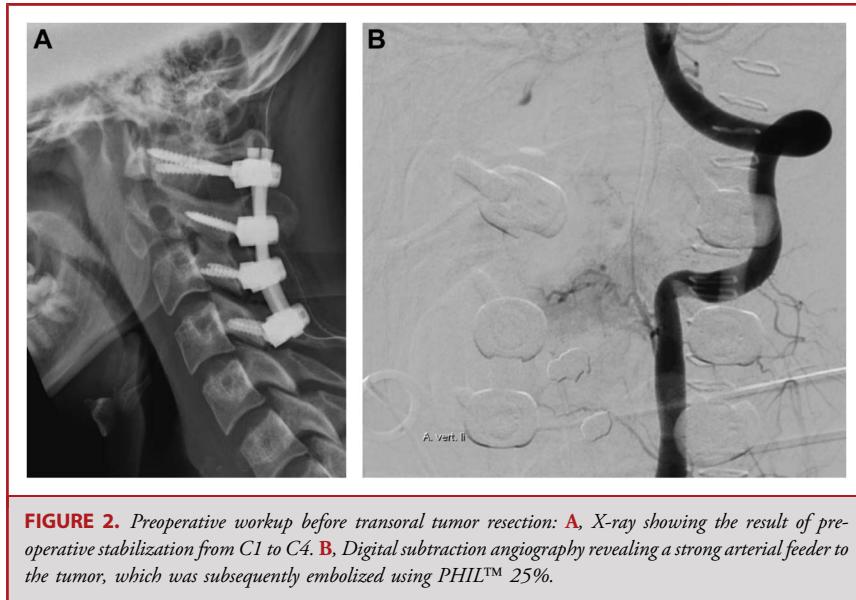
## CLINICAL PRESENTATION

A 23-year-old man presented with atraumatic neck pain persisting for several months. Neurological examination revealed no neurological deficits, and diagnostic X-ray and CT imaging identified an isolated osteolytic lesion in the odontoid. MRI showed the lesion to be hyperintense on the T2-weighted sequence and hypointense on the T1-weighted sequence, with diffuse contrast enhancement (Figure 1). Histopathological confirmation of a GCT was obtained through a transoral biopsy. To prevent potential instability of the spine through an extensive tumor resection, a posterior fusion with neuronavigation-guided instrumentation using lateral mass screws and rods from C1 to C4 was performed (Figure 2A). This was followed by endovascular embolization of a strong arterial tumor feeder coming from the left vertebral artery with PHIL™ 25%<sup>25</sup> (Figure 2B).

The following day, a transoral resection of the tumor was performed (Figure 3): The patient's head was secured in a neutral position using a carbon head clamp, and a neuronavigation system (Brainlab AG) was set up (Figure 4A). A Dingman retractor was used to optimize the surgical view by depressing the tongue. To further improve the surgical corridor, a catheter was placed endonasally and sutured to the uvula, allowing cranial retraction of the uvula to significantly improve the view of the surgical field (Figure 4B).

For precise neuronavigation, a new intraoperative cone-beam CT (Loop-X®, Brainlab AG) image was performed and registered into the neuronavigation system. The midline of the pharyngeal wall was identified by palpating the anterior tubercle of C1 and confirmed by using neuronavigation. Subsequently, the pharyngeal wall was incised with a vertical midline incision. Under navigational guidance with the operating microscope, the tumor was primarily resected through intralesional curettage. To provide thermal protection from the heat generated by the bone cement, the cavity was filled with a thin layer of Spongostan™ (Ethicon) and Fibrillar™ (Ethicon) before the application of bone cement (FORTRESS™, Globus Medical). To provide additional stability to the bone cement construct, a vertical inline plate (Globus Medical) was used and fixed with predrilled 3.5/12.5-mm screws

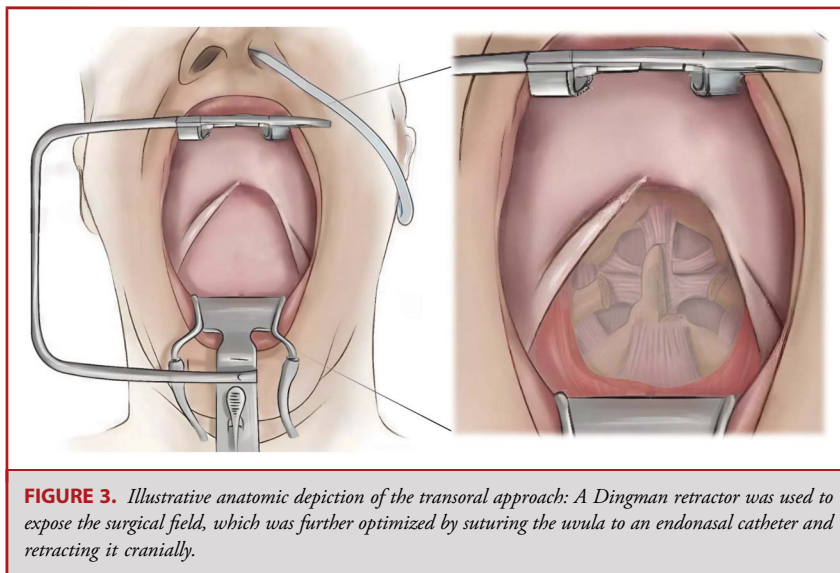


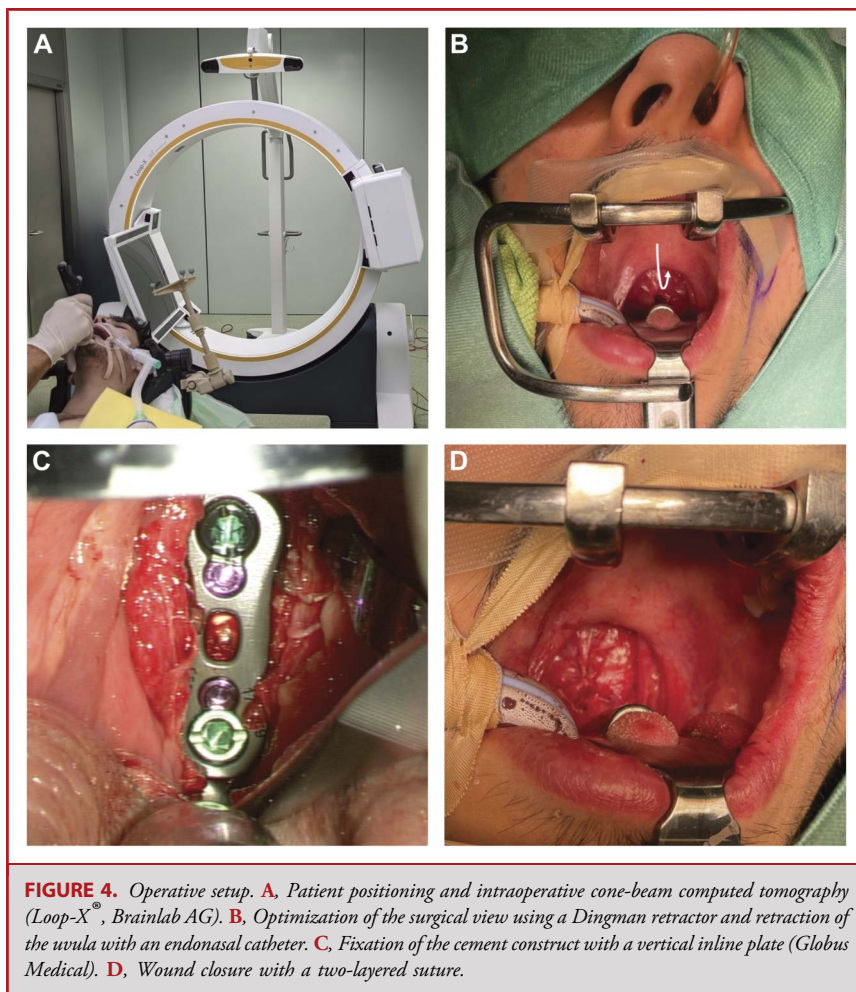


(Globus Medical) into the bone cement and the vertebral body of C3 (Figure 4C). The extent of resection and the placement of the bone cement construct were intraoperatively assessed using the cone-beam CT. The wound was closed in a two-layered fashion using a resorbable polyfilament 2-0 and 3-0 Vicryl suture (Ethicon) (Figure 4D). The main surgical steps are summarized in the supplementary video (Video 1).

Prophylactic antibiotics (ampicillin/sulbactam) were administered for 7 days postoperatively, and feeding was maintained through a gastroenteral tube during this period to protect the wound. Postoperatively, the patient experienced mild, transient

dysphagia; exhibited no neurological deficits; and was discharged from the hospital 7 days after surgery. Rotation in the upper cervical spine also decreased slightly postoperatively, from 80° to approximately 65° in both directions, while extension and flexion remained unaffected by the surgery. Follow-up imaging confirmed complete resection of the tumor and stable alignment of the cervical spine (Figure 5). Adjuvant therapy with denosumab, a RANK ligand inhibitor, was initiated at a dosage of 120 mg monthly for 6 months, followed by a reduced dosage of 60 mg monthly for an additional 6 months. The patient remains under regular follow-up, with no evidence of tumor recurrence





12 months after surgery. This study adhered to all relevant ethical regulations in Austria, and formal ethical approval was not required according to local regulations and guidelines. The patient featured in this study provided informed consent for the procedure as well as for the publication of the accompanying video and his image material.

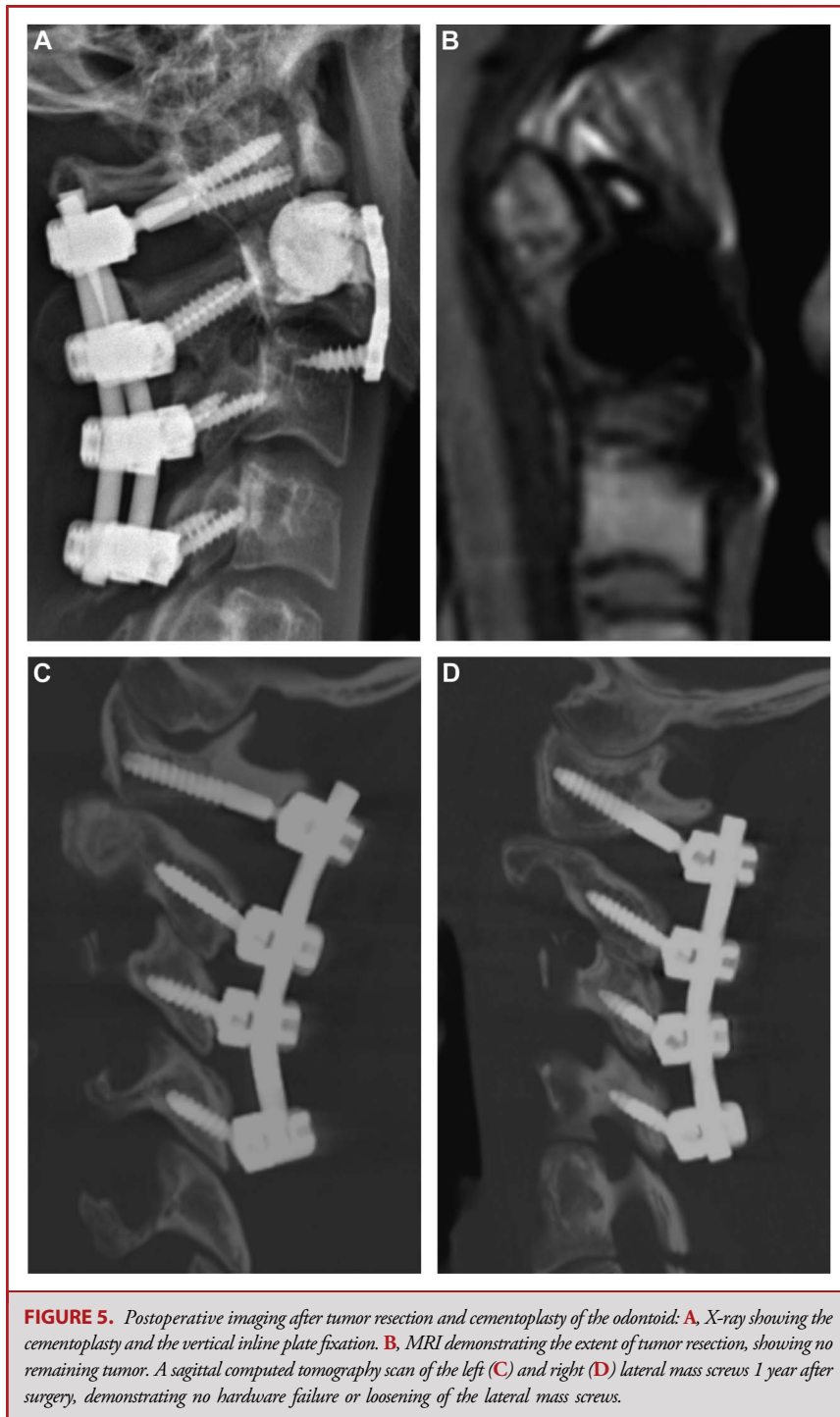
## DISCUSSION

The transoral approach for the resection of tumors in the anterior upper cervical spine is well-established but presents unique challenges because of its proximity to critical neurovascular structures and the potential for instability at the craniocervical junction. In this case, the transoral approach has been the optimal approach using a natural corridor and minimizing tissue damage. Reported complication rates associated with this approach are relatively low, with infection rates ranging from

1.4% to 3.6%,<sup>21,23</sup> and the incidence of pharyngeal dehiscence reported at approximately 0.7%.<sup>26</sup>

GCTs are considered benign tumors. However, their aggressive growth patterns and high recurrence rates make their treatment difficult and gross total tumor resection the treatment of choice.<sup>27-29</sup> The use of bone cement in the resection cavity of GCT has been associated with lower recurrence rates.<sup>13,30,31</sup> To the best of our knowledge, its application in the odontoid for GCT has not been reported, although it has been described for other neoplasms.<sup>32-34</sup> In our case, the use of bone cement proved to be both safe and effective, while the incorporation of neuronavigation and intraoperative cone-beam CT added an extra layer of safety and provided valuable feedback to the surgeon. To the best of our knowledge, this is the first reported case that combines a transoral approach with intraoperative cone-beam CT imaging to verify both the completeness of the resection and the accuracy of bone cement placement.





## CONCLUSION

This case demonstrates that a transoral approach combined with neuronavigation and intraoperative cone-beam CT is a viable option for resecting GCT of the odontoid, offering a direct,

minimally invasive trajectory to the tumor. The combination of posterior fixation and transoral tumor resection, followed by cementoplasty, resulted in a complication-free outcome with preserved stability of the craniocervical junction. By integrating advanced imaging techniques with refined surgical methods, this

treatment approach offers a potential strategy for managing similar cases.

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## Disclosures

Thomas Kretschmer acts as an advisor for Brainlab AG, Munich. The authors have no other personal, financial, or institutional interest in any of the drugs, materials, or devices described in this article.

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**Video 1.** Surgical recordings of the operating microscope from the described case.