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REVIEW ARTICLE

# SURGICAL MANAGEMENT OF A GIANT MAXILLARY AMELOBLASTOMA USING NAVIGATION-GUIDED ENDOSCOPIC ASSISTANCE AND TITANIUM MESH RECONSTRUCTION COMBINED WITH A PEDICLED BUCCAL FAT PAD: NARRATIVE LITERATURE REVIEW SUPPORTED BY AN ILLUSTRATIVE CLINICAL CASE

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**Abstract**

**Background**:Maxillary ameloblastoma is an uncommon but locally aggressive odontogenic tumor that presents substantial surgical challenges because of its proximity to the maxillary sinus, nasal cavity, orbit, and other critical midfacial structures. Extensive tumors may require radical resection followed by complex skeletal and soft-tissue reconstruction. Contemporary surgical navigation and endoscopic visualization may improve intraoperative anatomical control, whereas titanium mesh and vascularized soft-tissue techniques can facilitate restoration of complex maxillary defects.

**Objective**:To review the contemporary literature concerning the surgical management of extensive maxillary ameloblastoma, with particular emphasis on computer-assisted navigation, endoscopic assistance, titanium mesh reconstruction, and pedicled buccal fat pad reconstruction, and to illustrate the clinical application of this combined strategy through a representative case.

**Narrative Literature Review**:A narrative review of the contemporary literature was performed using PubMed, Scopus, and Web of Science, focusing on maxillary ameloblastoma, navigation-assisted surgery, endoscopic resection, titanium mesh reconstruction, and buccal fat pad flap techniques. The review focused on the anatomical and oncological challenges of maxillary ameloblastoma, the potential role of computer-assisted intraoperative navigation and endoscopic visualization, and reconstructive strategies for complex postoperative defects.

**Illustrative Clinical Case**:A 48-year-old man presented with a 1.5-year history of progressive right-sided facial asymmetry, swelling, mild pain, and ipsilateral nasal obstruction. Imaging demonstrated a 45 × 38 × 32 mm right maxillary lesion involving the alveolar process, maxillary sinus, and orbital floor. Histopathological examination confirmed follicular ameloblastoma. Three-dimensional virtual planning was performed before surgery. Tumor resection was subsequently carried out using intraoperative navigation combined with endoscopic visualization. The resulting skeletal defect was reconstructed using a pre-contoured three-dimensional titanium mesh and covered with a pedicled buccal fat pad flap.

**Clinical Outcome of the Illustrative Case**:The operative duration was 210 minutes, with an estimated blood loss of approximately 180 mL. No intraoperative complications were reported. Postoperative imaging demonstrated satisfactory positioning of the reconstructive titanium mesh. During 12 months of follow-up, no clinically evident tumor recurrence, titanium mesh exposure, or infection was observed. Complete intraoral epithelialization of the exposed buccal fat pad was achieved within four weeks, with preservation of mastication, swallowing, speech, and satisfactory facial symmetry.

**Conclusions**:The contemporary literature supports a multidisciplinary approach to extensive maxillary ameloblastoma in which precise tumor resection is combined with individualized reconstruction. The illustrative case demonstrates the practical integration of navigation-guided endoscopic surgery with titanium mesh reconstruction and pedicled buccal fat pad coverage. This combination may represent a useful reconstructive strategy for selected complex maxillary defects, although the favorable outcome of a single case cannot establish comparative efficacy or generalizability.

**Keywords:** Temporomandibular joint dysfunction; Temporomandibular joint; Orofacial pain; Diagnosis; Conservative treatment; Arthrocentesis; Multidisciplinary management.

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## 1.INTRODUCTION

Ameloblastoma is a benign odontogenic neoplasm characterized by locally aggressive and infiltrative growth and a clinically significant risk of local recurrence.[1,2,5] Although the mandible is the predominant site of occurrence, maxillary ameloblastomas represent a particularly challenging subgroup because of the complex three-dimensional anatomy of the maxilla and its close relationship with the orbit, nasal cavity, maxillary sinus, pterygopalatine and infratemporal regions, and skull base.[3,6,7] These anatomical characteristics have important implications for both oncological control and reconstructive planning and distinguish the surgical management of maxillary ameloblastoma from that of more readily accessible mandibular lesions.[4,6,7]

The clinical presentation of maxillary ameloblastoma may be deceptively inconspicuous during the early stages of disease. Because of the relatively thin cortical boundaries of the maxilla and its communication with several air-containing spaces, tumors may expand within the maxillary sinus or adjacent anatomical compartments before producing prominent external facial deformity.[6–8] Patients may therefore present with nonspecific manifestations, including swelling, facial asymmetry, dental displacement, nasal obstruction, epistaxis, pain, or tooth mobility.[6–8] Consequently, some lesions are diagnosed only after extension into multiple anatomical compartments rather than while remaining confined to a localized intraosseous site.[6–8]

Advanced maxillary ameloblastomas may involve the alveolar process, hard palate, maxillary sinus, nasal cavity, orbital floor, and posterior maxillary structures, creating a complex surgical problem in which adequate tumor removal must be balanced against preservation or restoration of critical midfacial anatomy.[4,6–8,39] The fundamental objective of treatment remains complete and appropriately planned surgical removal of the tumor while minimizing the risk of local recurrence.[5,38] Although conservative procedures may be appropriate for selected lesions, the infiltrative behavior of ameloblastoma and the anatomical characteristics of maxillary tumors may limit the applicability of conservative treatment in extensive disease.[5,6,38] Large or anatomically advanced lesions may consequently require substantial maxillary resection to achieve adequate oncological clearance.[4,6–8,38]

Extensive maxillary resection transforms tumor removal into a combined oncological and reconstructive procedure. The resulting defect may involve several anatomical and functional compartments and require restoration of the three-dimensional architecture of the midface as well as separation of the oral cavity from the sinonasal spaces.[4,9,10] Reconstruction is particularly important because the maxilla contributes to facial contour, orbital support, nasal architecture, mastication, speech, swallowing, and subsequent dental rehabilitation.[9,10,17] Loss of the maxillary walls, alveolar process, sinus boundaries, or orbital floor may therefore result in substantial functional and aesthetic impairment when appropriate reconstruction is not achieved.[9,10,17]

Communication between the oral cavity and the maxillary sinus or nasal cavity may further complicate postoperative healing and predispose to persistent oroantral or oronasal fistula, contamination, chronic sinonasal symptoms, and impaired tissue healing.[12–14] Reconstruction should consequently provide both adequate skeletal stability and reliable soft-tissue coverage capable of establishing biological separation between the involved anatomical spaces.[9,10,12–14]

Titanium mesh is an established reconstructive option for complex maxillofacial defects because of its mechanical strength, rigidity, relatively low weight, and adaptability to patient-specific three-dimensional anatomy.[15–17] Titanium mesh can facilitate restoration of maxillary and orbital contours while providing a stable structural framework for overlying soft tissues.[15–17] Computer-assisted fabrication and individualized mesh design may further improve the anatomical conformity of reconstruction in extensive maxillectomy defects.[16,17,34] However, a rigid reconstructive framework alone does not address all biological requirements of a complex surgical site. Exposure of titanium mesh to the oral or sinonasal environment may predispose to contamination, soft-tissue dehiscence, and delayed healing, emphasizing the importance of reliable soft-tissue coverage in defects involving communication with the oral cavity or paranasal spaces.[16–18]

The buccal fat pad (BFP) represents a useful autologous option for intraoral reconstruction because it is readily accessible, has a rich vascular supply, can be mobilized without creating a distant donor-site defect, and can conform to irregular maxillofacial defects.[19–22] Its use as a pedicled flap provides vascularized soft-tissue coverage and may facilitate closure of communications between the oral cavity and deeper anatomical spaces.[19–22] Clinical experience and reported reconstructive applications have demonstrated the utility of the BFP in maxillary and intraoral defects, including defects reconstructed in combination with titanium mesh.[36–38] When combined with a rigid titanium framework, these components serve complementary purposes: titanium mesh restores structural support and three-dimensional skeletal contour, whereas the vascularized BFP provides biological

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coverage of the reconstructive construct.[15–18,36–38]

The technical difficulty of extensive maxillary tumor resection is further increased by limited visualization of deep and anatomically concealed regions. Conventional open approaches provide broad surgical access but may not always allow optimal direct visualization of the posterior maxillary sinus, superior recesses, nasal cavity, or other difficult-to-access surfaces.[23–25] Endoscopic techniques can improve visualization of restricted anatomical spaces, although endoscopy alone may not provide sufficient exposure or control for extensive maxillary tumor resection.[23–25,33,35] A combined open and endoscopic approach may therefore offer complementary advantages by providing adequate access for major tumor resection while allowing direct endoscopic inspection of otherwise concealed regions and assessment of the operative field.[23–25,29,32,33,35]

Computer-assisted surgical navigation provides an additional means of intraoperative anatomical orientation. By registering the patient to preoperative three-dimensional imaging, navigation allows the surgeon to correlate the position of surgical instruments with the patient's computed tomography-based anatomy.[27–32] This capability may be particularly useful in extensive maxillary tumors in which normal anatomical landmarks are displaced, distorted, or destroyed by tumor growth.[27–32] Navigation can assist with maintenance of spatial orientation, identification of critical anatomical structures, and execution of a preoperatively defined surgical plan.[27–32,35] Nevertheless, navigation should be considered a decision-support and orientation technology rather than a substitute for surgical judgment, pathological assessment, or appropriate oncological margins.[27,29,35]

The combination of navigation and endoscopic visualization may be particularly relevant in anatomically complex maxillary surgery because the two technologies provide complementary information. Navigation provides three-dimensional spatial orientation derived from preoperative imaging, whereas endoscopy provides direct visualization of the operative surface and concealed anatomical compartments.[23,27,29,32–35] Their integration may therefore reduce uncertainty regarding anatomical orientation during resection of tumors occupying the maxillary sinus and extending toward the nasal, orbital, or posterior maxillary regions.[28,29,32–35] Importantly, the available evidence does not establish that navigation or endoscopic assistance independently improves oncological outcomes; rather, these technologies may facilitate accurate execution of an appropriately planned surgical procedure.[27,29,32–35]

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Despite advances in digital surgical planning, computer-assisted navigation, endoscopic techniques, and reconstructive materials, extensive maxillary ameloblastoma remains a technically demanding condition.[6,7,27–29,33,34] Existing literature has largely addressed individual components of management, including surgical resection, computer-assisted navigation, endoscopic maxillectomy, titanium mesh reconstruction, or buccal fat pad reconstruction.[26–37] However, comparatively limited clinical literature describes the practical integration of these technologies and reconstructive principles within a single treatment pathway for extensive maxillary ameloblastoma.[33,36–38]

The clinical relevance of such integration extends beyond the size or rarity of the tumor. An extensive maxillary lesion requires coordinated consideration of oncological resection, three-dimensional anatomical orientation, visualization of concealed surgical regions, restoration of the facial skeleton, and reliable soft-tissue coverage.[6,7,9,10,26,29,33,36–38] The potential value of the combined approach therefore lies in its technical and conceptual integration rather than in any single component. Navigation may support three-dimensional intraoperative orientation and execution of the planned resection; endoscopic assistance may enhance visualization of anatomically restricted regions; titanium mesh may restore the structural framework of the maxilla and orbital region; and a pedicled BFP may provide vascularized soft-tissue coverage of the reconstructive field.[15–21,26–37]

Accordingly, the present report describes the surgical management of an extensive maxillary ameloblastoma using navigation-guided tumor resection with endoscopic assistance, immediate three-dimensional titanium mesh reconstruction, and pedicled buccal fat pad coverage. The case is presented within a narrative review of the contemporary literature to contextualize the anatomical challenges, surgical principles, reconstructive options, potential advantages, and limitations of this integrated approach.

Rather than suggesting that this combined technique is superior to established surgical strategies, the present report aims to illustrate how contemporary image-guided surgery, endoscopic visualization, and defect-specific reconstruction can be coordinated within a single operative pathway for a complex maxillary tumor. The favorable outcome of an individual case should be interpreted as illustrative rather than comparative and cannot establish oncological superiority, comparative efficacy, or generalizability. The case therefore serves as a clinical example of the potential integration of contemporary surgical technologies and reconstructive principles in the management of extensive maxillary ameloblastoma.

## 2. MATERIALS AND METHODS

### 2.1. Narrative Literature Review

A structured narrative literature review was conducted to provide contemporary clinical and technical context for the surgical management and reconstruction of extensive maxillary ameloblastoma. The review focused on the biological and anatomical characteristics of maxillary ameloblastoma, principles of oncological resection, computer-assisted surgical navigation, endoscopic-assisted maxillectomy, three-dimensional surgical planning, titanium mesh reconstruction, and pedicled buccal fat pad (BFP) reconstruction.

The literature search was performed using PubMed/MEDLINE, Scopus, and Web of Science Core Collection. Publications indexed between January 2015 and July 2026 were considered to capture contemporary developments in image-guided surgery, endoscopic techniques, digital surgical planning, and maxillofacial reconstruction. Selected earlier publications were also considered when they represented seminal or technically important studies establishing the principles of maxillary ameloblastoma treatment, surgical navigation, titanium mesh reconstruction, or BFP flap surgery.

The search strategy combined controlled vocabulary and free-text terms related to the disease, surgical technology, and reconstructive procedures. The principal search terms included "maxillary ameloblastoma," "maxillary ameloblastoma surgery," "maxillectomy," "navigation-assisted surgery," "computer-assisted surgery," "image-guided surgery," "endoscopic-assisted maxillectomy," "endoscopic resection," "three-dimensional surgical planning," "titanium mesh reconstruction," "maxillary reconstruction," "buccal fat pad," "pedicled buccal fat pad flap," and "oral and maxillary defect reconstruction." Boolean operators (AND/OR) were used to combine the principal concepts and refine the search strategy.

Titles and abstracts were initially screened for relevance to the clinical and technical objectives of the review. Publications were considered relevant when they addressed one or more of the following domains: (1) clinical behavior, anatomical extension, or surgical management of maxillary ameloblastoma; (2) principles and technical considerations of maxillary resection; (3) computer-assisted navigation and three-dimensional surgical planning; (4) endoscopic assistance in maxillary or sinonasal tumor surgery; (5) titanium mesh or other rigid materials for maxillary and midface reconstruction; or (6) vascularized BFP -
flap reconstruction of maxillary, oral, sinonasal, or oroantral defects.

Priority was given to clinical studies, systematic reviews, narrative reviews, technical reports, case series, and representative case reports providing clinically or technically relevant information for the surgical approach described in the present case. Studies unrelated to maxillary or maxillofacial surgery, focused exclusively on mandibular ameloblastoma without transferable surgical relevance, or lacking clinically relevant information for the objectives of the review were excluded. Reference lists of relevant publications were also manually examined to identify additional seminal or highly relevant studies not retrieved through the primary database search.

Because the purpose of this work was to provide a narrative synthesis rather than a systematic evidence synthesis, no formal risk-of-bias assessment, meta-analysis, or quantitative evidence grading was undertaken. The literature was synthesized thematically according to oncological management, anatomical and surgical considerations, image-guided navigation, endoscopic visualization, skeletal reconstruction, vascularized soft-tissue coverage, and integration of these modalities. The findings of the literature review were subsequently used to contextualize the clinical decision-making, operative strategy, and reconstructive principles applied in the illustrative clinical case.

### 2.2. Illustrative Clinical Case

A 48-year-old man was referred to the Department of Maxillofacial Surgery at "Izmirlian" Medical Center with a 1.5-year history of progressive right-sided facial asymmetry, mild pain, swelling of the right maxillary region, and ipsilateral nasal obstruction. Clinical examination demonstrated visible asymmetry of the middle third of the face and expansion of the right maxillary region. Preoperative computed tomography (CT) demonstrated a large expansile osteolytic lesion involving the right maxilla, with extension into the maxillary sinus and involvement of the orbital floor. The lesion involved the maxillary alveolar process and the anterior and posterolateral walls of the maxilla. The maximum recorded tumor dimensions were 45 × 38 × 32 mm Table 1.

Histopathological examination established the diagnosis of follicular ameloblastoma. Based on the clinical, radiological, and histopathological findings, extensive surgical resection was planned. Three-dimensional virtual reconstruction of the maxillofacial skeleton was performed preoperatively to define the extent of resection, establish the intended osteotomy planes, and facilitate subsequent reconstruction.

**Table 1. Preoperative Clinical and Radiological Characteristics**

| **Parameter** | **Findings** |
|---|---|
| Age/Sex | 48-year-old male |
| Symptom duration | Approximately 1.5 years |
| Clinical symptoms | Progressive facial asymmetry, mild pain, right maxillary swelling, ipsilateral nasal obstruction |
| Anatomical location | Right maxilla with extension into the maxillary sinus and orbital floor |
| Tumor dimensions | 45 × 38 × 32 mm |
| Bone involvement | Maxillary alveolar process, anterior and posterolateral maxillary walls, and orbital floor |
| Histopathological diagnosis | Follicular ameloblastoma |
| Preoperative imaging | High-resolution maxillofacial CT with three-dimensional reconstruction |
| Virtual surgical planning | Three-dimensional computer-assisted planning with predefined resection margins of approximately 5–8 mm |
| Planned reconstruction | Three-dimensional titanium mesh with pedicled BFP coverage |

The preoperative three-dimensional plan was subsequently incorporated into the intraoperative navigation workflow. The surgical objective was complete tumor removal with appropriately planned resection margins while preserving uninvolved adjacent structures whenever anatomically and oncologically feasible.

The patient's clinical presentation, including right-sided facial asymmetry and expansion of the maxillary region, is shown in Figure 1.

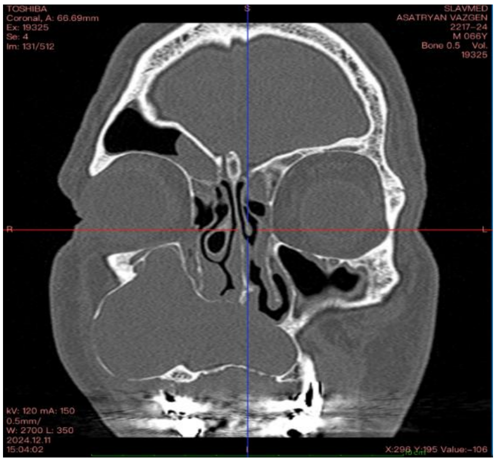

**Figure 1.** Preoperative clinical presentation of the patient with extensive right maxillary ameloblastoma, demonstrating right-sided facial asymmetry and expansion of the maxillary region.

### 2.3. Surgical Technique

#### 2.3.1. Navigation Registration

Before tumor resection, a patient-tracking frame was secured to the cranial region to establish a stable reference for intraoperative navigation. Registration was performed by correlating selected anatomical landmarks with the preoperative high-resolution CT dataset. The reported registration error was less than 0.8 mm. Registration accuracy was verified before initiation of the osteotomies.

#### 2.3.2. Surgical Access and Endoscopic Visualization

Surgical access was obtained through a transoral approach using a modified Weber–Ferguson mucosal incision.

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Following exposure of the maxillary surgical field, rigid 30° and 45° endoscopes were introduced to provide direct visualization of anatomically restricted regions, particularly the posterior maxillary area and orbital floor. Endoscopic visualization was used as an adjunct to the open surgical field rather than as an independent surgical approach.

**2.3.3. Navigation-Guided Tumor Resection**

The planned osteotomies were performed under real-time computer-assisted navigation. The navigation system was used to correlate the position of the surgical instruments with the preoperative three-dimensional reconstruction and predefined resection planes.

During tumor resection, computer-assisted navigation was used to maintain three-dimensional anatomical orientation, while endoscopic visualization was used to inspect anatomically concealed regions, particularly the posterior maxillary area and orbital floor (Figure 2A,B).

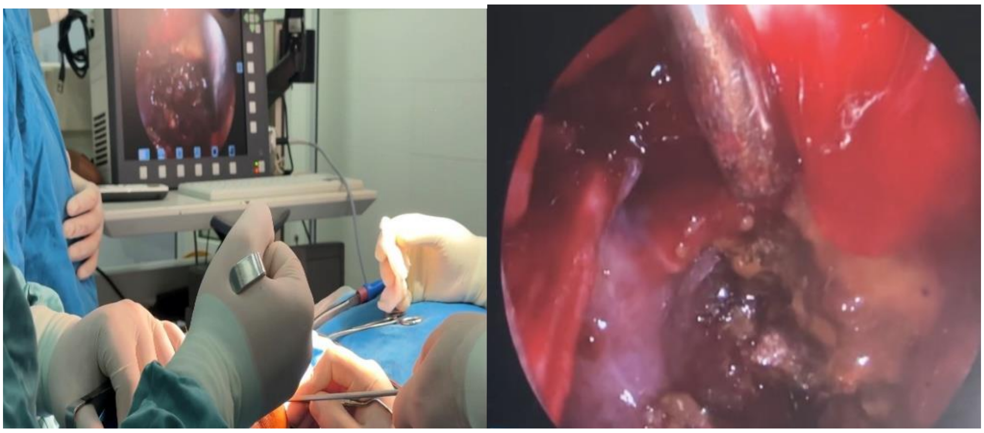

**Figure 2.** Navigation-guided tumor resection with endoscopic assistance. **(A)** Intraoperative navigation system demonstrating registration of the patient to the preoperative three-dimensional CT dataset and real-time localization of the surgical instruments. **(B)** Endoscopic inspection of the surgically treated maxillary region, demonstrating visualization of anatomically restricted areas following tumor resection.

Osteotomies were performed approximately 5–8 mm beyond the visible tumor boundaries according to the preoperative surgical plan and intraoperative anatomical assessment. Where the orbital floor was involved, selective resection of the affected segment was performed, while uninvolved adjacent structures were preserved whenever this was considered oncologically appropriate.

Following completion of the planned osteotomies, the tumor was removed en bloc and submitted for histopathological examination (Figure 3).

**Figure 3.** Resected maxillary tumor specimen following completion of the planned maxillary resection and prepared for histopathological examination.

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After removal of the tumor specimen, the operative field was inspected both directly and endoscopically to assess the resection boundaries and identify any grossly apparent residual pathological tissue. The exposed maxillary surgical field before reconstruction is shown in Figure 4.

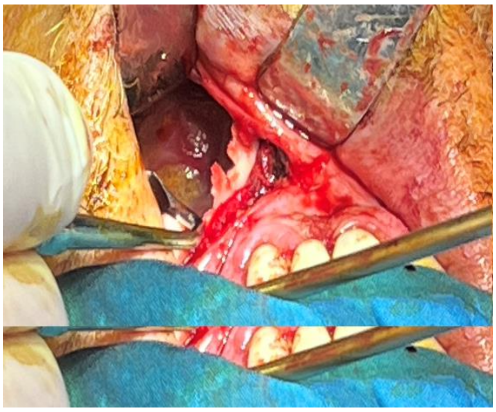

**Figure 4.** Intraoperative view of the maxillary surgical field following tumor removal, demonstrating the resulting surgical defect before completion of reconstruction.

**2.3.4. Skeletal Reconstruction**

Following completion of tumor resection, the resulting maxillary defect was reconstructed using a pre-contoured three-dimensional titanium mesh. The mesh was adapted to the planned anatomical contours of the maxilla and midface to restore the structural framework and facial contour.

The titanium mesh was rigidly secured to the remaining stable maxillary bone using microscrews. Particular attention was given to restoration of the anterior maxillary contour and the inferior orbital region.

The intraoperative positioning of the pre-contoured three-dimensional titanium mesh within the maxillary defect is shown in Figure 5.

**Figure 5.** Intraoperative reconstruction of the maxillary defect using a pre-contoured three-dimensional titanium mesh. The mesh is positioned within the defect and rigidly fixed to the remaining maxillary structures to restore the skeletal framework and facial contour.

**2.3.5. Pedicled Buccal Fat Pad Reconstruction**

A pedicled buccal fat pad (BFP) flap was subsequently harvested through the adjacent intraoral approach. The vascularized fat pad was carefully mobilized while maintaining its vascular pedicle and was transposed over the reconstructed defect and titanium mesh.

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The BFP was secured with absorbable 4-0 Vicryl sutures, providing vascularized soft-tissue coverage of the reconstructive field. The flap was positioned to facilitate biological coverage of the titanium framework and to establish separation between the oral cavity and the deeper reconstructed maxillary region.

### 2.3.6. Integrated Surgical Strategy

The operative sequence consisted of four complementary components: (1) navigation-guided oncological resection; (2) endoscopic visualization of anatomically concealed regions; (3) immediate three-dimensional titanium mesh reconstruction; and (4) vascularized pedicled BFP coverage.

This integrated strategy was designed to address the oncological and reconstructive requirements of the procedure within a single operative pathway. Navigation and endoscopy served as adjunctive technologies for anatomical orientation and visualization, whereas the titanium mesh and pedicled BFP provided complementary structural and biological reconstruction.

### 2.3.7. Postoperative Radiological Assessment

Postoperative maxillofacial CT with three-dimensional reconstruction was performed to assess the position of the titanium mesh, the reconstructed maxillary contour, and the postoperative surgical field. The postoperative three-dimensional reconstruction demonstrated satisfactory positioning of the titanium mesh and restoration of the reconstructed maxillary contour, with no radiologically apparent residual tumor (Figure 6).

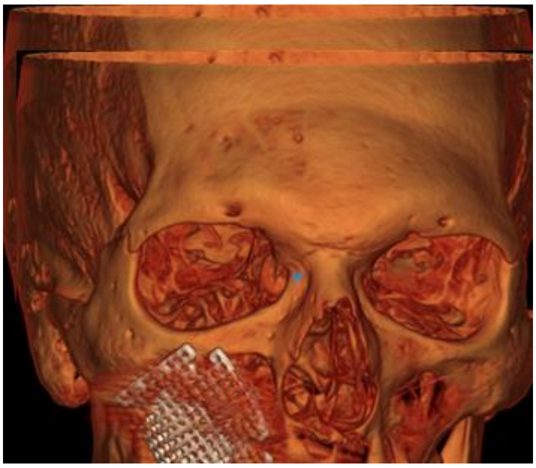

**Figure 6.** Postoperative three-dimensional computed tomography reconstruction demonstrating satisfactory positioning of the titanium mesh, restoration of the reconstructed maxillary contour, and no radiologically apparent residual tumor.

## 3. RESULTS

### 3.1. Findings of the Narrative Literature Review

The narrative synthesis identified several consistent themes relevant to the management of extensive maxillary ameloblastoma. Maxillary ameloblastomas represent a particularly demanding surgical subgroup because of their proximity to the maxillary sinus, nasal cavity, orbit, pterygopalatine region, and skull base. Compared with mandibular lesions, maxillary tumors may remain clinically inconspicuous during their early course and can extend into adjacent anatomical compartments before producing prominent external manifestations.[6–9]

Across the reviewed literature, complete surgical removal with appropriately planned resection margins remained the fundamental objective in the management of locally aggressive and extensive ameloblastoma. Although conservative procedures may be appropriate for selected lesions, the available evidence indicates that extensive maxillary disease frequently requires a more comprehensive resection because of its infiltrative growth pattern and the anatomical limitations of the maxilla.[4–7,38,39]

A further recurring theme was the increasing use of three-dimensional imaging and computer-assisted surgical
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planning. CT-based three-dimensional reconstruction can assist in defining tumor extent, identifying relevant anatomical structures, planning osteotomy lines, and anticipating the reconstructive requirements associated with extensive maxillary resection.[16,27–29,32,34] Computer-assisted navigation provides additional intraoperative anatomical orientation by correlating the position of surgical instruments with the preoperative three-dimensional imaging dataset. This may be particularly useful when normal anatomical landmarks have been distorted or removed by tumor growth.[26–32,34,35] Importantly, navigation functions as an adjunct to surgical decision-making and does not replace appropriate oncological planning or histopathological assessment of resection margins.[26,27,35] The reviewed literature also supports the complementary role of endoscopic visualization in selected maxillary and sinonasal procedures. Endoscopic assistance can improve visualization of posterior, superior, medial, and otherwise concealed regions that may be difficult to inspect adequately through an open operative field.[22–25,29,33,35] At the same time, the available literature generally supports endoscopy as an adjunct to an appropriately selected surgical approach rather than as a substitute for adequate oncological exposure.[23–25,29,33,35]

With respect to reconstruction, extensive maxillary defects commonly require restoration of both skeletal architecture and soft-tissue coverage. Titanium mesh has been used for reconstruction of complex maxillary, midface, and orbital defects because of its rigidity, adaptability, and ability to provide a stable three-dimensional framework.15–[18,34,36,37] However, rigid skeletal reconstruction alone may be insufficient when the operative defect communicates with the oral cavity or sinonasal spaces, where reliable soft-tissue coverage is important for protection of the reconstructive material and separation of anatomical compartments.[15–18] The pedicled BFP has been described as a useful vascularized local tissue for reconstruction of oral, maxillary, palatal, and oroantral defects. Its intraoral accessibility, vascular supply, mobility, and ability to conform to irregular defects make it suitable for coverage of selected maxillofacial defects.[19–22,36–38] The combination of titanium mesh and a vascularized BFP therefore provides complementary functions, with the mesh restoring skeletal support and the BFP providing biological soft-tissue coverage.[36–38]

Overall, the literature indicates that the individual components of the present surgical strategy—oncological resection, three-dimensional planning, computer-assisted navigation, endoscopic visualization, titanium mesh reconstruction, and pedicled BFP coverage—are established techniques supported by clinical and technical literature.15–38 However, the available literature contains comparatively limited documentation of their coordinated use within a single operative strategy specifically for extensive maxillary ameloblastoma. This observation provided the clinical rationale for the integrated approach applied in the present case.

**Table 2. Narrative Synthesis of the Main Surgical and Reconstructive Evidence**

| Domain | Main findings from the literature | Clinical relevance to the present case |
|---|---|---|
| Maxillary ameloblastoma | Locally aggressive behavior with potential extension into multiple anatomical compartments | Supported extensive and carefully planned resection |
| Oncological surgery | Complete tumor removal with appropriately planned margins remains the fundamental treatment objective | Guided the planned resection |
| 3D surgical planning | CT-based reconstruction facilitates assessment of tumor extent and preoperative surgical planning | Used to define osteotomy planes and reconstructive requirements |
| Computer-assisted navigation | Provides intraoperative three-dimensional anatomical orientation | Used to support the planned osteotomies |
| Endoscopic assistance | Improves visualization of posterior, superior, and otherwise concealed anatomical regions | Used to inspect difficult-to-access areas |
| Titanium mesh | Provides rigid three-dimensional skeletal reconstruction | Used to restore maxillary and orbital contours |
| Pedicled BFP | Provides vascularized local soft-tissue coverage | Used to cover the reconstructive field |
| Integrated approach | Individual components are established, whereas their coordinated application in extensive maxillary ameloblastoma is less frequently documented | Provided the rationale for the present case |

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### 3.2. Clinical Case Findings

The patient underwent the planned integrated surgical procedure consisting of navigation-guided resection of the right maxillary ameloblastoma with endoscopic assistance, followed by immediate three-dimensional titanium mesh reconstruction and pedicled BFP coverage.

The total operative time was 210 minutes, with an estimated intraoperative blood loss of approximately 180 mL. No intraoperative complications were documented. In particular, no intraoperative injury to the orbit or other adjacent critical structures was observed.

Real-time navigation was used during the planned osteotomies, while endoscopic visualization provided additional assessment of the posterior maxillary region and orbital floor. Following tumor removal, the surgical field was inspected directly and endoscopically before reconstruction.

The resulting maxillary defect was reconstructed using a pre-contoured three-dimensional titanium mesh, which was rigidly fixed to the remaining maxillary structures. A pedicled BFP flap was subsequently mobilized and positioned over the reconstructive field to provide vascularized soft-tissue coverage. The flap was secured intraorally with absorbable sutures.

A postoperative CT examination performed on postoperative day 7 demonstrated satisfactory restoration of the reconstructed maxillary contour and appropriate positioning of the titanium mesh, with no radiologically apparent residual tumor (Figure 6).

#### 3.2.1. Histopathological Assessment

Histopathological examination of the resected specimen confirmed the diagnosis of follicular ameloblastoma.

The postoperative CT finding of no radiologically apparent residual tumor was considered separately from histopathological assessment of the surgical margins. A definitive histopathological assessment of all surgical margins was not available in the documentation reviewed for the present report. Therefore, the postoperative radiological finding was not interpreted as evidence of histopathological R0 resection.

Microscopic examination demonstrated proliferating odontogenic epithelial islands and follicles within a fibrous stromal background, with peripheral palisading of columnar to cuboidal cells, reverse nuclear polarity, and central stellate-reticulum-like areas, consistent with follicular ameloblastoma (Figure 7A–C).


**Figure 7. Histopathological features of follicular ameloblastoma. (A)** Low-power view demonstrating multiple odontogenic epithelial islands and follicles within a fibrous stromal background (hematoxylin and eosin [H&E], ×40). **(B)** Intermediate-power view showing ameloblastomatous epithelial follicles with peripheral palisading of columnar to cuboidal cells (H&E, ×100). **(C)** High-power view demonstrating peripheral palisading with reverse nuclear polarity and central stellate-reticulum-like areas (H&E, ×400).

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### 3.2.2. Twelve-Month Clinical Outcome

During the 12-month follow-up period, no clinically evident local recurrence was observed. The titanium mesh remained completely covered without clinically apparent exposure or infection. Complete intraoral epithelialization of the BFP was achieved within approximately 4 weeks.

The reconstructed facial contour remained satisfactory, with improvement in the preoperative facial asymmetry. Mastication, swallowing, and speech were preserved throughout the follow-up period. No postoperative visual deterioration or diplopia was reported Table 3**.**

**Table 3. Twelve-Month Postoperative Clinical and Functional Outcomes**

| **Clinical outcome** | **12-month finding** |
|---|---|
| Local tumor control | No clinically evident local recurrence |
| Titanium mesh | No exposure or clinical evidence of infection |
| BFP healing | Complete intraoral epithelialization within approximately 4 weeks |
| Facial contour | Satisfactory restoration of facial symmetry |
| Mastication | Preserved |
| Deglutition | Preserved |
| Speech | Preserved |
| Visual function | No postoperative visual deterioration reported |
| Diplopia | Not reported |
| Postoperative CT | Satisfactory reconstructed maxillary contour and titanium mesh position; no radiologically apparent residual tumor on postoperative day 7 CT |
| Follow-up duration | 12 months |

### 3.2.3. Summary of the Clinical Outcome

Overall, the integrated surgical approach resulted in satisfactory short- and intermediate-term clinical outcomes in this patient. Navigation-guided resection and endoscopic visualization were used together to facilitate tumor removal and assessment of the complex maxillary operative field, while titanium mesh reconstruction restored the skeletal framework and the pedicled BFP provided vascularized soft-tissue coverage.

At 12 months, the patient demonstrated satisfactory facial symmetry, preserved oral functions, stable soft-tissue coverage, and no clinically evident local recurrence. The postoperative CT demonstrated satisfactory positioning of the reconstructive titanium mesh without radiologically apparent residual tumor at postoperative day 7.

These findings represent the outcome of a single illustrative clinical case and should therefore not be interpreted as evidence of comparative superiority of the integrated technique over alternative surgical or reconstructive approaches.

## 4. DISCUSSION

The management of an extensive maxillary ameloblastoma is challenging because successful treatment depends on more than tumor removal alone. The surgeon must achieve adequate oncological clearance while preserving uninvolved anatomical structures and, at the same time, restoring the three-dimensional architecture and function of the maxilla. This is particularly important in maxillary ameloblastomas because the tumor may extend into the maxillary sinus, nasal cavity, orbit, posterior maxillary spaces, and, in advanced cases, toward the skull base. Because the maxilla provides relatively little resistance to tumor spread, substantial extension may occur before the external clinical findings become pronounced. [1,5–9,39,40]

The primary objective of treatment remains complete surgical removal of the tumor with an appropriately planned margin. The extent of surgery should be determined by the biological behavior and anatomical spread of the lesion rather than by the desire to preserve structures that are already involved by tumor. Although conservative treatment may have a role in selected ameloblastomas, the available evidence generally supports more extensive surgery for large, infiltrative, or anatomically advanced lesions because conservative treatment may be associated with a greater risk of residual disease and recurrence. [4–6,12,39] In maxillary lesions, this consideration is particularly important because the thin surrounding bone and proximity of the orbit, nasal cavity, and skull base may make apparently limited disease more extensive than suggested by the clinical examination

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alone. [6–9,40] The surgical approach in the present case was therefore planned according to the radiological extent of the tumor, the structures involved, and the anticipated three-dimensional defect that would remain after resection.

Computer-assisted navigation was incorporated into the present procedure to improve three-dimensional orientation during tumor removal. This was especially useful because the lesion involved the maxillary sinus and orbital floor, where tumor expansion can alter or obscure the normal anatomical landmarks used during conventional surgery. Navigation systems allow the surgeon to correlate the operative field with the preoperative three-dimensional imaging dataset and can therefore provide useful spatial information during complex cranio-maxillofacial procedures. [27–29,31,32,34]

The value of navigation, however, should be interpreted appropriately. It is an adjunct to surgery and does not replace direct anatomical assessment, surgical experience, or histopathological examination. Even when registration accuracy is high, navigation cannot determine whether a microscopic tumor deposit remains at a resection margin. The reported registration accuracy in the present case was less than 0.8 mm, indicating close spatial correspondence between the preoperative imaging dataset and the operative field. Nevertheless, this numerical accuracy should not be equated with oncological accuracy. The adequacy of tumor resection ultimately depends on appropriate preoperative planning, intraoperative assessment, the macroscopic examination of the operative field and specimen, and definitive histopathological evaluation of the surgical margins. [27–29,34,35]

Endoscopic assistance provided an additional means of assessing regions that were difficult to visualize through the primary operative exposure. In the present case, endoscopic inspection was particularly useful in the posterior maxillary region and around the orbital floor. Endoscopic techniques have been incorporated into selected maxillary and sinonasal procedures because they may provide a different viewing angle and improve visualization of anatomically concealed surfaces. [23–26,30,33,35] These advantages are relevant when conventional direct visualization is limited by the geometry of the surgical field.

The role of endoscopy in the present case should nevertheless be viewed as complementary rather than independently oncological. The available literature supports the selective use of endoscopic assistance according to tumor location, extent, access, and the anatomy of the structures involved, but it does not establish that endoscopy by itself improves local control or survival in maxillary ameloblastoma. [23–25,30,33,35] Its principal value in this setting is the ability to inspect areas that may otherwise be difficult to assess and to provide additional visual information during and after resection.

Navigation and endoscopy therefore provide different types of information. Navigation offers a spatial relationship between the surgical instruments and the preoperative three-dimensional anatomical model, whereas endoscopy provides direct visualization of the actual operative surface.[27–35] The combination may be particularly useful when tumor growth has distorted normal landmarks and when critical structures lie immediately adjacent to the planned osteotomy or resection planes. In this context, the two technologies should not be considered interchangeable. Rather, they address different limitations of complex maxillary surgery and can be used together when clinically justified.

Another important aspect of the present case was immediate reconstruction. Extensive maxillary resection can produce a complex three-dimensional defect involving the facial skeleton, orbital support, maxillary sinus, alveolar region, and the separation between the oral and sinonasal cavities. Such defects may affect facial contour, orbital support, mastication, speech, swallowing, and subsequent dental rehabilitation. [9–11,18] Consequently, reconstruction should be considered as part of the initial surgical plan rather than as a separate procedure performed only after the tumor has been removed.

The reconstructive requirements of a maxillectomy defect vary according to its location and extent. Classification systems for midface defects emphasize the importance of restoring both structural support and the functional separation of anatomical compartments. [11,18] In extensive defects, skeletal reconstruction may be necessary to restore facial projection and orbital support, while soft-tissue reconstruction is required to provide stable coverage and separation of the oral and sinonasal spaces. [9–11]

Titanium mesh offers several practical advantages in this setting. Its rigidity allows restoration of the three-dimensional skeletal framework, while its relatively low weight and adaptability make it suitable for reconstruction of complex orbital and midfacial contours. Titanium mesh has been used extensively in orbital and midface reconstruction, including computer-assisted fabrication of individualized meshes for defects created by extensive maxillectomy. [15–17,34] In the present case, a pre-contoured three-dimensional titanium mesh was used to reconstruct the resected maxillary and orbital region and to restore the structural contour of the midface.

The use of titanium mesh, however, does not by itself

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guarantee a successful reconstruction. Stable soft-tissue coverage is essential, particularly when the reconstructed defect communicates with the oral cavity or sinonasal tract. Exposure of titanium to the oral or sinonasal environment may increase the risk of contamination, soft-tissue breakdown, infection, and subsequent reconstructive procedures. [15–17,34] For this reason, the biological environment surrounding the implant is an important consideration when titanium mesh is used in extensive maxillary reconstruction.

The pedicled buccal fat pad (BFP) was selected in the present case as a local vascularized soft-tissue flap. The BFP has several characteristics that make it suitable for intraoral reconstruction, including its close anatomical location, relatively rich vascular supply, mobility, and ability to epithelialize after intraoral placement. It has been successfully used for reconstruction of oral, maxillary, palatal, and oroantral defects. [19–22,36] In addition, the BFP can be harvested without creating a distant donor-site defect and can provide a relatively straightforward method of obtaining vascularized tissue for coverage of a complex intraoral wound.

In the present case, the pedicled BFP was mobilized and positioned over the reconstructed area to provide vascularized soft-tissue coverage of the titanium mesh. Complete intraoral epithelialization was observed within approximately four weeks, and no clinically evident titanium mesh exposure was identified during the 12-month follow-up. These findings support the technical feasibility of using a pedicled BFP for soft-tissue coverage in this particular reconstructive setting. They should not, however, be interpreted as evidence that BFP is superior to other vascularized reconstructive options.

The combination of titanium mesh and BFP is conceptually attractive because the two components address different reconstructive requirements. The titanium mesh provides the mechanical framework and maintains the desired skeletal contour, whereas the BFP provides vascularized biological coverage of the reconstructed field. Previous clinical reports have described the use of BFP together with titanium mesh or other reconstructive materials for maxillary defects, supporting the feasibility of combining rigid skeletal reconstruction with vascularized local soft-tissue coverage. [19–22,36–38]

This distinction between structural and biological reconstruction is particularly relevant in extensive maxillary defects. A rigid implant may restore the contour of the facial skeleton but remains dependent on adequate soft-tissue coverage. Conversely, a soft-tissue flap may provide reliable closure without restoring the lost skeletal architecture. Combining the two approaches allows each component to address a different part of the reconstructive problem. In the present case, the titanium mesh was used to restore the skeletal framework, while the BFP was used to establish a vascularized tissue layer over the reconstruction.

The reconstructive strategy also had functional implications. Restoration of the maxillary contour and orbital support contributes to facial symmetry and structural stability, while reliable soft-tissue closure helps maintain separation between the oral and sinonasal compartments. In the present patient, the postoperative facial contour was satisfactory, and mastication, swallowing, and speech remained preserved during the reported 12-month follow-up. These clinical findings suggest that the reconstruction achieved the principal immediate structural and functional objectives in this individual patient.

The main value of the present report does not lie in the introduction of a new individual surgical technology. Computer-assisted navigation, endoscopic assistance, titanium mesh reconstruction, and pedicled BFP reconstruction have all previously been described in the maxillofacial literature. [15–17,19–21,23–38]

Rather, the clinical interest of the present case is the coordinated use of these established techniques in the treatment of a single extensive maxillary ameloblastoma.

The treatment pathway combined preoperative three-dimensional planning with navigation-guided resection, endoscopic inspection, immediate skeletal reconstruction, and vascularized soft-tissue coverage. Each component addressed a different part of the clinical problem. Preoperative imaging established the anatomical extent of the lesion and helped define the anticipated defect. Navigation provided intraoperative spatial orientation. Endoscopy allowed direct inspection of selected concealed areas. Titanium mesh restored the skeletal framework, while the BFP provided vascularized coverage. The overall strategy therefore represents an integrated approach to a complex maxillary defect rather than reliance on any single technology. [27–35]

This integrated approach is consistent with the broader development of contemporary maxillofacial surgery toward image-guided planning and greater anatomical precision. Computer-assisted technologies have become increasingly useful in complex cranio-maxillofacial procedures, particularly when conventional anatomical landmarks are altered or when reconstruction requires accurate restoration of three-dimensional contours. [27–29,31,32,34] At the same time, the use of these technologies should remain clinically driven. Digital planning and navigation are most useful when they improve the

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surgeon's ability to understand and manage a difficult anatomical problem rather than being used simply because the technology is available.

The literature should also be interpreted with caution when considering the potential advantages of navigation and endoscopic assistance. Although navigation can improve intraoperative orientation and facilitate transfer of preoperative planning to the surgical field, current evidence does not demonstrate that navigation independently improves oncological survival or local tumor control. [27–29,34] Similarly, endoscopic assistance can improve visualization in selected regions, but its usefulness depends on the location and extent of the tumor and on the surgical access required.[23–25,30,33,35] The fundamental oncological principle remains unchanged: the tumor must be removed according to an appropriate surgical plan, and the adequacy of the margins must ultimately be determined by histopathological examination.

The present case also emphasizes the importance of planning reconstruction before resection begins. In an extensive maxillary lesion, the dimensions and location of the expected defect can be anticipated from the preoperative imaging, allowing the reconstructive strategy to be incorporated into the surgical plan from the beginning. In this case, the anticipated skeletal defect was considered during three-dimensional planning, allowing a pre-contoured titanium mesh to be prepared for immediate reconstruction. The BFP was then used to provide vascularized coverage of the reconstructed region. This coordination reduced the separation between the ablative and reconstructive stages of treatment and allowed reconstruction to be performed immediately after tumor removal.

An additional advantage of this approach is that the surgeon can evaluate the reconstruction in relation to the original three-dimensional anatomy rather than treating the defect simply as a two-dimensional surgical wound. Restoration of the orbital floor and maxillary contour requires attention to the spatial relationship between the orbit, maxillary sinus, nasal cavity, and facial skeleton. The use of preoperative three-dimensional planning and a pre-contoured mesh is therefore particularly relevant in extensive defects in which small deviations in contour may affect facial symmetry or orbital support. [11,15–17,34]

Several limitations of the present report should be acknowledged. First, this is a single clinical case, and the favorable postoperative findings cannot be generalized to all patients with giant or extensive maxillary ameloblastoma. Ameloblastoma is biologically heterogeneous, and the extent of disease, histological characteristics, surgical margins, and anatomical involvement may differ considerably between patients. [1–8,39,40]

Second, the literature component of the manuscript was designed as a narrative review rather than a systematic review. The discussion therefore provides a clinically oriented synthesis of relevant literature but should not be interpreted as an exhaustive quantitative evaluation of all available evidence. Third, the present case does not establish the comparative superiority of navigation, endoscopic assistance, titanium mesh, or BFP reconstruction over alternative techniques. The favorable result demonstrates feasibility in this patient, not superiority.

Fourth, the follow-up period of 12 months is relatively short for assessing the long-term oncological behavior of ameloblastoma. Long-term clinical and radiological surveillance remains necessary because recurrence may occur after apparently successful treatment, particularly in extensive lesions. [4–9,39,40] Fifth, standardized patient-reported outcome measures and formal comparative functional assessments were not incorporated into the present case. Although mastication, swallowing, speech, and facial appearance were clinically satisfactory, these observations cannot replace validated outcome instruments.

Finally, the reported absence of recurrence at 12 months should not be presented as evidence of long-term oncological control. The appropriate interpretation is that no clinically evident local recurrence was identified during the available follow-up period. Longer surveillance is required before any conclusion regarding durable local control can be made.

Overall, the present case supports the technical feasibility of combining navigation-guided resection, endoscopic visualization, titanium mesh reconstruction, and pedicled BFP coverage in selected patients with extensive maxillary ameloblastoma. The approach should be regarded as an illustrative integrated surgical strategy in which established technologies and reconstructive principles are coordinated according to the individual anatomical requirements of the patient. It should not be interpreted as a demonstrated superior treatment modality or as evidence of improved oncological survival.

## 5. CLINICAL RELEVANCE

The present case illustrates an integrated surgical and reconstructive strategy for an extensive maxillary ameloblastoma in which oncological resection and reconstruction were planned as parts of the same treatment pathway. The approach incorporated five complementary components:

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1. **Three-dimensional preoperative planning** to define the extent of the tumor, anticipated resection planes, relationship to the orbit and maxillary sinus, and the expected reconstructive defect.
2. **Intraoperative computer-assisted navigation** to provide three-dimensional spatial orientation during osteotomy and tumor resection, particularly in areas where normal anatomical landmarks were altered by tumor expansion.
3. **Endoscopic visualization** to facilitate direct inspection of anatomically restricted regions, including the posterior maxillary area and orbital floor, that were difficult to evaluate through the main operative exposure.
4. **Pre-contoured titanium mesh reconstruction** to restore the three-dimensional skeletal framework of the resected maxilla and adjacent orbital region.
5. **Pedicled buccal fat pad coverage** to provide vascularized soft-tissue coverage of the reconstructed area and contribute to separation of the oral cavity from the deeper reconstructed spaces.

Each component had a distinct role. Navigation provided spatial orientation based on the preoperative three-dimensional dataset, whereas endoscopy provided direct visualization of the operative anatomy. The titanium mesh addressed the structural component of reconstruction, while the BFP provided vascularized biological coverage. The combination was therefore based on the complementary functions of the individual techniques rather than on the assumption that any single technology could solve all aspects of the surgical problem.

This distinction is clinically important. Extensive maxillary defects often involve both loss of skeletal support and loss of soft-tissue separation. Reconstruction with a rigid material alone may leave the implant dependent on inadequate soft-tissue coverage, whereas soft-tissue reconstruction without restoration of the skeletal framework may not adequately restore facial contour or orbital support. [11,15–18,34] The combination of titanium mesh and a vascularized BFP offers a practical way of addressing these two components simultaneously in appropriately selected cases. [19–22,36–38]

The present case also highlights the potential usefulness of combining navigation with endoscopic inspection. These technologies provide different forms of intraoperative information and can therefore complement rather than replace one another. Navigation assists with spatial orientation, while endoscopy allows direct inspection of selected areas that may not be readily visible through the primary surgical field. 23–35

Importantly, the present case should be interpreted as an illustrative clinical application rather than evidence of treatment superiority or improved oncological survival. The principal objective remains complete and appropriately planned tumor removal, with definitive assessment of the resection margins by histopathological examination. Navigation, endoscopy, and digital planning should therefore be regarded as adjuncts that may assist the surgeon in achieving the planned procedure rather than as substitutes for sound oncological judgment.

The clinical relevance of this strategy lies primarily in the coordination of ablative and reconstructive planning. This may be particularly useful in extensive lesions involving the maxillary sinus, orbital floor, nasal cavity, or other anatomically complex regions where the surgical defect cannot be considered separately from the reconstruction that follows. The favorable structural and functional outcome observed in the present patient demonstrates that this integrated concept can be implemented successfully in an individual case.

Further evaluation in larger patient cohorts is necessary to determine whether the combination provides reproducible advantages in surgical accuracy, functional recovery, complication rates, quality of life, and long-term reconstructive stability.

## 6. CONCLUSIONS

Management of extensive maxillary ameloblastoma requires close coordination between oncological resection, three-dimensional anatomical orientation, and immediate reconstruction. In the present case, computer-assisted navigation was used to support intraoperative orientation during resection of an extensive maxillary ameloblastoma involving the maxillary sinus and orbital floor. Endoscopic visualization provided additional inspection of anatomically restricted areas that were difficult to evaluate through the primary operative field.

Immediate reconstruction with a pre-contoured titanium mesh restored the three-dimensional skeletal framework of the maxilla and involved orbital region, while a pedicled buccal fat pad flap provided vascularized soft-tissue coverage of the reconstructive field. At 12 months, the patient demonstrated satisfactory facial symmetry, preserved mastication, swallowing, and speech, complete intraoral epithelialization of the BFP, no clinically evident local recurrence, and no titanium mesh exposure or clinically apparent infection.

The principal novelty of this report is not the introduction

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of a new surgical device or technique. Rather, it lies in the integrated application of established image-guided, endoscopic, ablative, and reconstructive techniques within a single treatment pathway for an extensive maxillary ameloblastoma. The case demonstrates how these complementary methods can be coordinated to address the anatomical, oncological, functional, and reconstructive requirements of a large maxillary defect.

The favorable postoperative result supports the technical feasibility of this integrated strategy in the present patient. However, the findings should not be interpreted as evidence of superiority over conventional surgical or reconstructive approaches, nor as evidence that navigation or endoscopic assistance improves long-term oncological control.

Because this report represents a single case with 12 months of follow-up, further clinical experience is required. Larger case series, comparative studies, standardized functional and patient-reported outcome measures, and longer-term oncological surveillance will be necessary to determine the reproducibility, safety, functional value, and long-term reconstructive and oncological outcomes of this approach

## DECLARATIONS

**Ethics Approval**

Institutional ethical approval for publication of this clinical case should be reported according to the requirements of the participating institution and the target journal.

**Patient Consent**

Written informed consent for publication of the clinical information and associated clinical and radiological images should be explicitly documented.

**Conflict of Interest**

The authors declare no conflict of interest related to this manuscript.

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## REFERENCES

1. Wright JM, Vered M. Update from the 4th Edition of the World Health Organization Classification of Head and Neck Tumours: Odontogenic and Maxillofacial Bone Tumors. Head Neck Pathol. 2017;11(1):68-77. doi:10.1007/s12105-017-0794-1.
2. Shi HA, Ng CWB, Kwa CT, Sim QXC. Ameloblastoma: A succinct review of the classification, genetic understanding and novel molecular targeted therapies. Surgeon. 2021;19(4):238-243. doi:10.1016/j.surge.2020.06.009.
3. Speight PM, Takata T. New tumour entities in the 4th edition of the World Health Organization Classification of Head and Neck tumours: odontogenic and maxillofacial bone tumours. Virchows Arch. 2018;472(3):331-339. doi:10.1007/s00428-017-2182-3.
4. Chen C, Batstone M, Taheri T, Johnson N. Surgical resection and reconstruction of ameloblastoma: a 13-year retrospective review. J Oral Maxillofac Surg. 2024;82(7):862-868. doi:10.1016/j.joms.2024.03.030.
5. Hendra FN, Natsir Kalla DS, van Cann EM, de Vet HCW, Helder MN, Forouzanfar T. Radical vs conservative treatment of intraosseous ameloblastoma: systematic review and meta-analysis. Oral Dis. 2019;25(7):1683-1696. doi:10.1111/odi.13014.
6. Pitak-Arnnop P, Subbalekha K, Sirintawat N, Meningaud JP, Tangmanee C, Auychai P, Neff A. A retrospective cohort study on predictors associated with skull base invasion of maxillary ameloblastomas. J Stomatol Oral Maxillofac Surg. 2022;123(5). doi:10.1016/j.jormas.2022.03.015.
7. Evangelou Z, Zarachi A, Dumollard JM, Peoc'h M, Komnos I, Kastanioudakis I, Karpathiou G. Maxillary ameloblastoma: a review with clinical, histological and prognostic data of a rare tumor. In Vivo. 2020;34(5):2249-2258. doi:10.21873/invivo.12035.
8. Milman T, Lee V, LiVolsi V. Maxillary ameloblastoma with orbital involvement: an institutional experience and literature review. Ophthalmic Plast Reconstr Surg. 2016;32(6):441-446. doi:10.1097/IOP.0000000000000580.
9. Zwahlen RA, Grätz KW. Maxillary ameloblastomas: a review of the literature and of a 15-year database. J Craniomaxillofac Surg. 2002;30(5):273-279. doi:10.1016/S1010-5182(02)90317-3.
10. Dos Santos DM, de Caxias FP, Bitencourt SB, Turcio KH, Pesqueira AA, Goiato MC. Oral rehabilitation of patients after maxillectomy: a systematic review. Br J Oral Maxillofac Surg. 2018;56(4):256-266. doi:10.1016/j.bjoms.2018.03.001.
11. Brown JS, Shaw RJ. Reconstruction of the maxilla and midface: introducing a new classification. Lancet Oncol. 2010;11(10):1001-1008. doi:10.1016/S1470-2045(10)70113-3.
12. Effiom OA, Ogundana OM, Akinshipo AO, Akintoye SO. Ameloblastoma: current etiopathological concepts

and management. Oral Dis. 2018;24(3):307-316. doi:10.1111/odi.12646.

13. Shahrour R, Shah P, Withana T, Jung J, Syed AZ. Oroantral communication, its causes, complications, treatments and radiographic features: a pictorial review. Imaging Sci Dent. 2021;51(3):307-311. doi:10.5624/isd.20210035.
14. Oliva S, Lorusso F, Scarano A, D'Amario M, Murmura G. The treatment and management of oroantral communications and fistulas: a systematic review and network meta-analysis. Dent J (Basel). 2024;12(5):147. doi:10.3390/dj12050147.
15. Schubert W, Gear AJL, Lee C, Hilger PA, Haus E, Migliori MR, Mann DA, Benjamin CI. Incorporation of titanium mesh in orbital and midface reconstruction. Plast Reconstr Surg. 2002;110(1):102-109. doi:10.1097/01.PRS.0000021307.23118.E7.
16. Zhang WB, Mao C, Liu XJ, Guo CB, Yu GY, Peng X. Outcomes of orbital floor reconstruction after extensive maxillectomy using the computer-assisted fabricated individual titanium mesh technique. J Oral Maxillofac Surg. 2015;73(10):2065.e1-2065.e15. doi:10.1016/j.joms.2015.06.171.
17. Yu Y, Zhang WB, Sun Q, Peng X. Modified individualized titanium mesh in orbital floor reconstruction for preventing exposure. Laryngoscope Investig Otolaryngol. 2023;8(5):1196-1202. doi:10.1002/lio2.1148.
18. Cordeiro PG, Chen CM. A 15-year review of midface reconstruction after total and subtotal maxillectomy: part I. Algorithm and outcomes. Plast Reconstr Surg. 2012;129(1):124-136. doi:10.1097/PRS.0b013e318221dca4.
19. Kim MK, Han W, Kim SG. The use of the buccal fat pad flap for oral reconstruction. Maxillofac Plast Reconstr Surg. 2017;39(1):5. doi:10.1186/s40902-017-0105-5.
20. Mannelli G, Arcuri F, Comini LV, Valente D, Spinelli G. Buccal fat pad: report of 24 cases and literature review of 1,635 cases of oral defect reconstruction. ORL J Otorhinolaryngol Relat Spec. 2019;81(1):24-35. doi:10.1159/000494027.
21. Rapidis AD, Alexandridis CA, Eleftheriadis E, Angelopoulos AP. The use of the buccal fat pad for reconstruction of oral defects: review of the literature and report of 15 cases. J Oral Maxillofac Surg. 2000;58(2):158-163.doi:10.1016/S0278-2391(00)90330-6.
22. Nelke K, Morawska A, Błaszczyk B, Janeczek M, Pasicka E, Łukaszewski M, Żak K, Dobrzyński M. Anatomical and surgical implications of the usage of Bichat fat pad in oroantral communication, maxillary, palatal, and related surgeries—narrative review. J Clin Med. 2023;12(15):4909. doi:10.3390/jcm12154909.
23. Genden EM, Okay D, Stepp MT, Rezaee RP, Bales C, Buchbinder D, et al. Comparison of functional and aesthetic outcomes following endoscopic and open approaches to maxillectomy. Arch Facial Plast Surg. 2005;7(6):389-396. doi:10.1001/archfaci.7.6.389.
24. Jiang S, Fan R, Xie Z, Zhang H. Outcomes of endoscopic and open resection of sinonasal malignancies: a systematic review and meta-analysis. Braz J Otorhinolaryngol. 2022;88 Suppl 1. doi:10.1016/j.bjorl.2021.06.011.
25. López F, Shah JP, Beitler JJ, Snyderman CH, Lund V, Piazza C, et al. The selective role of open and endoscopic approaches for sinonasal malignant tumours. Adv Ther. 2022;39(6):2379-2397.doi:10.1007/s12325-022-02080-x.
26. Stammberger H, Posawetz W. Functional endoscopic sinus surgery. Concept, indications and results of the Messerklinger technique. Eur Arch Otorhinolaryngol. 1990;247(2):63-76. doi:10.1007/BF00183169.
27. Bell RB. Computer planning and intraoperative navigation in cranio-maxillofacial surgery. Oral Maxillofac Surg Clin North Am. 2010;22(1):135-156. doi:10.1016/j.coms.2009.10.010.
28. Alkhayatt NM, Alzahrani HH, Ahmed S, Alotaibi BM, Alsaggaf RM, AlAlmuaysh AM, Alomair AA. Computer-assisted navigation in oral and maxillofacial surgery: a systematic review. Saudi Dent J. 2024;36(3):387-394. doi:10.1016/j.sdentj.2023.12.002.
29. Schramm A, Suarez-Cunqueiro MM, Barth EL, Essig H, Bormann KH, Kokemueller H, Rücker M, Gellrich NC. Computer-assisted navigation in craniomaxillofacial tumors. J Craniofac Surg. 2008;19(4):1067-1074. doi:10.1097/SCS.0b013e3181760fc0.
30. Ferri A, Bellinato M, Bianchi B, Arcuri F, et al. Endoscopic-assisted maxillectomy: a combined approach for the management of maxillary malignant tumors. Indian J Otolaryngol Head Neck Surg. 2025;77(3):1521-1529.doi:10.1007/s12070-025-05370-2.
31. Baumann A, Schicho K, Klug C, Wagner A, Ewers R. Computer-assisted navigational surgery in oral and maxillofacial surgery. Atlas Oral Maxillofac Surg Clin NorthAm.2005;13(1):41-49. doi:10.1016/j.cxom.2004.10.002.
32. Pham AM, Rafii AA, Metzger MC, Jamali A, Strong EB. Computer modeling and intraoperative navigation in maxillofacial surgery. Otolaryngol Head Neck Surg. 2007;137(4):624-631. doi:10.1016/j.otohns.2007.06.719.
33. Casasayas M, Holgado A, León X, Kolanczak K, Pérez-Sempere M, Quer M, Gras-Cabrerizo JR. Endoscopic-assisted maxillectomy: our experience in tumours affecting the posterior wall of the maxillary sinus. J Laryngol Otol. 2025;139(11):1076-1080. doi:10.1017/S0022215125102958.
34. van Baar GJC, Schipper K, Forouzanfar T, Leeuwrik L, Winters HAH, Ridwan-Pramana A, Leusink FKJ. Accuracy of computer-assisted surgery in maxillary reconstruction: a systematic review. J Clin Med. 2021;10(6):1226. doi:10.3390/jcm10061226.

-

35. Deganello A, Ferrari M, Paderno A, Turri-Zanoni M, Schreiber A, Mattavelli D, et al. Endoscopic-assisted maxillectomy: operative technique and control of surgical margins. Oral Oncol. 2019;93:29-38. doi:10.1016/j.oraloncology.2019.04.002.
36. Zhang Y, Zhao X, Fu S, Wu Y. Clinical application of the pedicled buccal fat pad flap in immediate reconstruction of oral tissue defects in oral surgery. J Craniofac Surg. 2017;28(6):1531-1533. doi:10.1097/SCS.0000000000003757.
37. Yao JG, Li LJ, Li J, Chen HB, Luo XH. Reconstruction of maxillary defects combination with pedicled buccal fat pad graft, temporalis myofascial flap and titanium mesh. Hua Xi Kou Qiang Yi Xue Za Zhi. 2006;24(1):57-59. PMID:16541659.
38. Yoon JH, Park YW, Kim SG. Titanium mesh and pedicled buccal fat pad for the reconstruction of maxillary defect: case report. Maxillofac Plast Reconstr Surg. 2021;43(1):10. doi:10.1186/s40902-021-00295-6.
39. Carlson ER, Marx RE. The ameloblastoma: primary, curative surgical management. J Oral Maxillofac Surg. 2006;64(3):484-494. doi:10.1016/j.joms.2005.11.032.
40. Barrena BG, Phillips BJ, Moran KJ, Betz SJ. Sinonasal ameloblastoma. Head Neck Pathol. 2019;13(2):247-250. doi:10.1007/s12105-018-0933-3.



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