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Case Report

Management of a Maxillary Ossifying Fibroma Using a Three-Dimensional Virtual Model: A Case Report

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ABSTRACT

Introduction: Ossifying fibroma is a benign, but locally aggressive neoplasm of the maxillofacial region. It represents a fibro-osseous lesion in which normal bone tissue is replaced by cellular fibrous tissue containing mineralized material, usually detected incidentally. Treatment options range from conservative approaches such as enucleation and curettage to resection.

Case Report: We present the surgical management of an ossifying fibroma incidentally detected in the right posterior maxilla of a 48-year-old female patient with the support of three-dimensional (3D) virtual planning. Under the guidance of the virtual planning, the lesion was enucleated, and a peripheral osteotomy was performed. No recurrence was observed during the one year clinical and radiological follow-up period.

Conclusion: 3D virtual modeling can contribute to safe and precise surgery by providing spatial awareness to the surgeon and it has the potential to strengthen the informed consent process and patient–physician communication.

Keywords: Computer-assisted surgery; Image processing, computer-assisted; Imaging, three-dimensional; Patient education as topic

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INTRODUCTION

Ossifying fibroma (OF) is a benign fibro-osseous neoplasm characterized by the replacement of bone tissue with fibrous stroma and varying amounts of mineralized components and typically exhibits a slow growth pattern.[1] According to the 2022 updated classification of the World Health Organization (WHO), an ossifying fibroma is defined as a mesenchymal odontogenic tumor arising from multipotent cells of the periodontal ligament.[2] These lesions are generally observed in the 2nd to 4th decades of life, show a marked predilection for women, and most commonly affect the posterior mandibular region.[3] Although maxillary involvement is less common, lesions in this region can reach advanced stages without causing noticeable symptoms because of the presence of adjacent anatomical spaces and the cancellous structure of the maxillary bone, and are often detected incidentally during routine examinations.[4]

The treatment method for ossifying fibroma is determined by the location, size, and infiltrative potential of the lesion, and it encompasses a wide surgical spectrum, ranging from conservative procedures such as enucleation and curettage to resection.[5]

Currently, 3D modeling and virtual planning technologies are frequently used to increase operational safety and surgical precision, particularly for fibro-osseous lesions with complex anatomical relationships.[6]

This case presentation aimed to highlight the role of digital planning tools in regard to surgical management by utilizing 3D modeling technology in a case of OF incidentally detected in the posterior maxilla.

CASE REPORT

A 48-year-old female patient was referred to our clinic with a lesion detected in the right posterior maxilla during routine radiographic examinations. The medical history of the patient revealed no complaints of pain, paresthesia, or swelling. Extraoral examination revealed no obvious facial asymmetry, whereas intraoral examination revealed a firm, immobile mass in the posterior region of the right maxilla extending from the distal aspect of tooth 15 to the maxillary tuberosity, causing bone expansion in both the vestibular and palatal directions (Figure 1).

Panoramic radiography revealed a well-defined, mixed radiolucent, radiopaque lesion in the right posterior maxilla (Figure 2A). Cone-beam computed tomography (CBCT) demonstrated that the lesion measured approximately 26 × 24 × 23 mm, extended superiorly into the maxillary sinus, and was in close proximity medially to the descending palatine artery (Figure 2B).

Before the surgical intervention, an incisional biopsy was performed under local anesthesia using a trephine drill for histopathological evaluation. The performed pathological examination revealed broad, acellular osteoid islands that were partially anastomosed and surrounded by cellular spindle cell stroma with brush-like edges blending into the surrounding connective tissue (Figure 3A). At higher magnification, spindle-shaped fibroblasts without cytological atypia, spherical calcification foci between them, and “osteoblastic rimming” around the bone trabeculae (osteoblast alignment) were observed, and OF was diagnosed (Figure 3B).

For surgical planning, 3D Slicer software (version 5.8.0; www.slicer.org) was used to detail the complex relationship between the lesion and surrounding



Figure 1. Intraoral view.

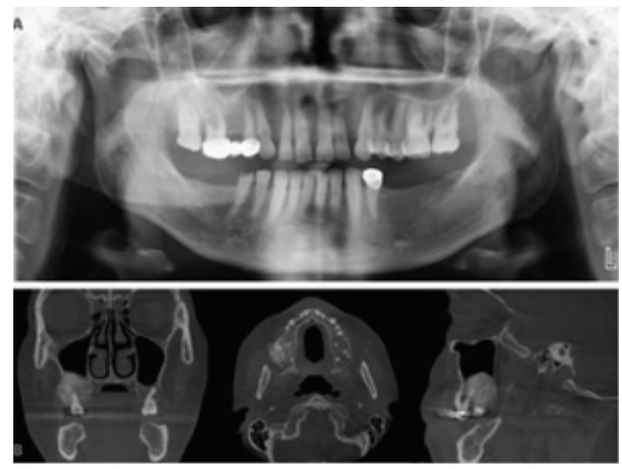


Figure 2. Radiographic images; panoramic radiograph (A) and CBCT sections (B).

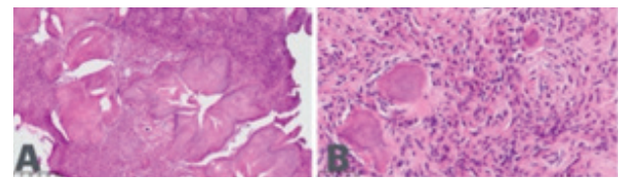


Figure 3. Histopathological images; H&E, ×100 (A) and H&E, ×400 (B).

anatomical structures, its true volume, and its margins to guide surgery. The CBCT data of the patient were imported into the software, and the craniomaxillofacial bones were automatically segmented using an artificial intelligence-based DentalSegmentator extension (3D Slicer, version 5.8.0; www.slicer.org). Because artificial intelligence could not separate the lesion from the adjacent anatomical structures, reference points were manually defined on the CBCT slices during the lesion segmentation process, and the “fill between slices” module was used. Therefore, a 3D model of the lesion was manually created (Figure 4). The surgical margins and excision strategy were designed based on a digital model obtained using a semi-automated workflow.

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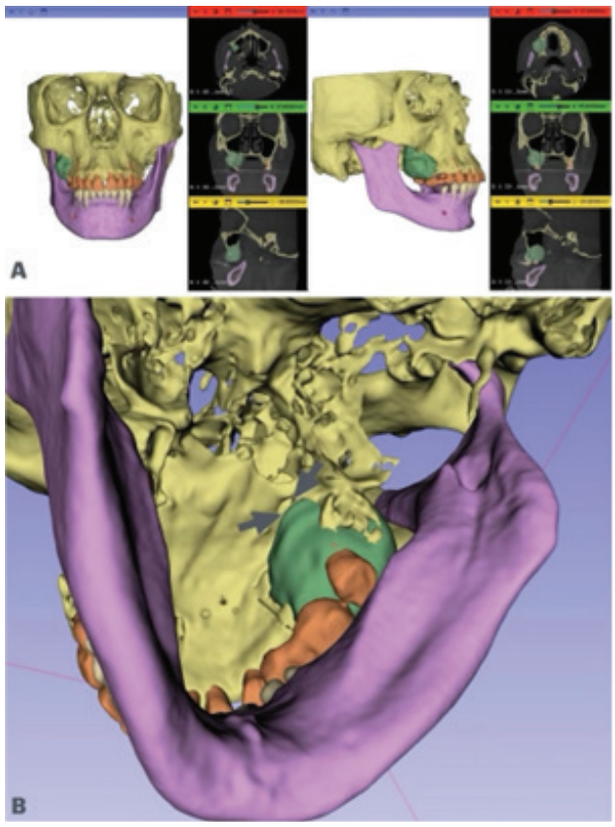


Figure 4. Three-dimensional virtual model reconstructed from CBCT data; different views of the model (A) and proximity of the lesion to the greater palatine foramen (grey arrows) (B).



Figure 5. Intraoperative views.

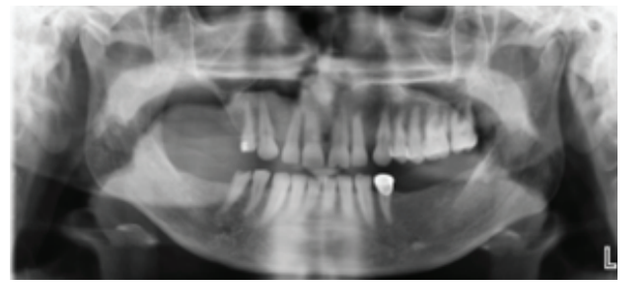


Figure 6. Panoramic radiograph at 1-year postoperative follow-up.

During the surgical procedure, teeth 16 and 17 were extracted, and the lesion was enucleated within the boundaries determined using the 3D modeling data (Figure 5). Following enucleation, peripheral osteotomy was performed on the cavity walls using appropriate burs to minimize the risk of recurrence. Perioperative observation revealed that the lesion displaced the maxillary sinus superiorly; however, the sinus membrane and bony integrity were preserved, and no perforation occurred. The descending palatine artery was also preserved. The reconstruction procedure was not considered during the initial phase. The patient was followed up for recurrence, and no signs of recurrence were detected during the year of clinical and radiological follow-up (Figure 6). Because of the potential for recurrence, the patient is still being followed up by our team. Written informed consent was obtained from the patient for the surgical procedures performed, as well as for the use of the clinical data and images included in this study for scientific publication.

DISCUSSION

Ossifying fibroma, the most common fibro-osseous lesion of the maxillofacial region, the fibrous osteoma, is a benign neoplasm that presents diagnostic challenges owing to its clinical and radiological variability.[3,7] Although the literature reports a significant predominance of mandibular over maxillary involvement (70 - 90%), lesions located in the posterior maxilla, as in the present case, can progress clinically silently and reach large sizes because of the extensive anatomical spaces and spongy bone structure of the region.[8] As in the current case, this may result in the incidental detection of the lesion during routine procedures; indeed, 31-58% of OF cases have been reported in the literature to be diagnosed incidentally.[9,10]

Because the histopathological features of benign fibro-osseous lesions are similar, a clinicoradiological correlation is essential for a definitive diagnosis.[3,7]

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At the microscopic level, the osteoblastic rimming observed in our case indicates neoplastic bone formation.[11] The presence of heterogeneous osteoid structures and brush-like edges blended into the surrounding connective tissue supported this diagnosis.[12] Histological findings alone are not diagnostic; fibrous dysplasia is the main differential diagnosis.[3,9] The sharply demarcated nature of OF, presence of cortical expansion instead of bone replacement, and heterogeneous osteoid structures are important features in distinguishing OF from fibrous dysplasia.[12,13] OF may also show histological similarities with focal and florid cemento-osseous dysplasia.[9,11] Nevertheless, it is crucial to exclude malignancies, such as low-grade osteosarcoma, particularly when rapid growth, an atypical radiological pattern, or a clinically aggressive appearance is present.[5] In this context, incisional biopsy performed with a trephine drill before surgical intervention can be considered a critical step that increases diagnostic accuracy by helping clarify the biological behavior of the lesion and rule out any aggressive variants. In suspicious cases, negativity for molecular markers such as MDM2 and CDK4 may provide additional evidence in favor of benign fibro-osseous processes.[14]

In the surgical management of the present case, 3D virtual surgical planning, an approach that has been increasingly adopted in recent years, was integrated into the clinical decision-making process.[15] Although CBCT sections provide valuable information regarding lesion boundaries and adjacent structures, visualization of these data within a 3D environment allows the assessment of lesion volume, extent, and relationship to critical anatomical structures, such as the maxillary sinus and palatal vascular structures, within a single model.[16] In the literature, virtual surgical planning (VSP) workflows frequently culminate in the fabrication of physical models and surgical guides. However, these additional production stages may limit the applicability of such methods because of the need for advanced infrastructure and associated high costs. Data on the standalone use of VSP in benign tumors, without these additional stages, remain limited.[17] Virtual models can provide an overall spatial assessment without requiring each tomographic section to be examined separately, thereby facilitating the determination of surgical access strategies and the anticipation of intraoperative risks, particularly in anatomically complex regions such as the posterior maxilla.[17,18] In the present case, the proximity of the lesion to the descending palatine artery was visualized more clearly, which allowed for a more meticulous preparation process against potential bleeding complications, thereby shortening the operative time and preventing this complication through a more predictable surgery. Given the well-circumscribed fibro-osseous nature of the lesion, enucleation was planned, and a surgical cutting guide was not considered necessary. Instead, the virtual model was referred to during the intraoperative period. Intraoperative reference to the virtual plan allowed the accuracy of each step to be verified. Through the “mental navigation” provided by the virtual model, safe surgical boundaries were more easily achieved, the conservative approach was applied more confidently, and unnecessary morbidity could be avoided. Therefore, as used in this study, virtual models can enable the surgeon to access more detailed visual information instead of relying solely on the limited information provided by CBCT sections, even in situations where physical guides and models requiring advanced infrastructure or additional costs cannot be produced. This low-cost digital workflow, based solely on virtual modeling, provides an adequate visual-spatial reference source that goes beyond conventional imaging data.

Furthermore, the availability of free and easily accessible platforms, such as the software used in this study, together with the modeling method employed, represents a significant advantage that increases the applicability of this approach across different centers.[15] Automating the segmentation and modeling process with artificial intelligence-based plugins can reduce operator dependence, provide a faster workflow, and support the broader use of digital planning in surgical practice.[15]

Three-dimensional modeling can make a meaningful contribution not only to surgical planning but also to patient education and informed consent processes.[8] Although systematic reviews have confirmed that these technologies significantly facilitate understanding of the pathology and the surgical plan, the literature remains concentrated largely in fields such as urology and orthopedics, while data regarding maxillofacial surgery are still relatively limited.[19] Compared with physical models, virtual models offer

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a lower-cost and more easily modifiable alternative. In the present case, they enabled the patient to understand the true dimensions of the lesion and the scope of the planned intervention more concretely, thereby minimizing the risk of a potential “expectation mismatch.” This clinical observation suggests that the integration of virtual models into consent processes in maxillofacial surgery represents a valuable area for future research, particularly given the current gap in the literature and the potential to improve both patient awareness and communication quality.

The combination of enucleation and peripheral osteotomy used as the treatment strategy in this case was a conservative approach that aimed to reduce residual lesion tissue while avoiding the morbidity of radical resections.[5] The recurrence rates in OF have been reported in the literature to vary widely (0–28%) depending on the surgical technique used, and long-term clinical and radiological follow-up is particularly important in cases located in the maxilla and adjacent to the sinus.[13] Although the absence of recurrence during one year of follow-up in this case was favorable in terms of short-term outcome, a longer follow-up is planned for a more accurate assessment of recurrence.

CONCLUSION

In conclusion, approaches supported by a free and easily accessible 3D modeling platform may contribute to surgical safety and increased patient awareness in maxillary OF cases, and may encourage the wider use of similar digital planning approaches in clinical practice.

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None.

CONFLICTS OF INTEREST STATEMENT

No conflicts of interest.

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Üç Boyutlu Sanal Model Kullanılarak Yönetilen Maksiller Ossifiye Fibrom: Olgu Sunumu

ÖZET

Giriş: Maksillofasiyal bölgenin benign ancak lokal agresif karakter sergileyebilen bir neoplazmı olan ossifiye fibrom, normal kemik dokusunun yerini mineralize materyal içeren selüler fibröz dokunun aldığı, sıklıkla tesadüfi olarak saptanan fibro-osseöz bir lezyondur. Tedavi seçenekleri enükleasyon ve küretaj gibi konservatif yaklaşımlardan, rezeksiyonlara kadar değişebilmektedir.

Vaka raporu: Bu olgu sunumunda, 48 yaşında kadın hastada sağ maksilla posterior bölgede rastlantısal olarak saptanan ossifiye fibromun üç boyutlu sanal planlama desteğiyle cerrahi yönetimi sunulmaktadır. Sanal planlama rehberliğinde lezyon enükle edilmiş ve periferal osteotomi uygulanmıştır. Bir yıllık klinik ve radyolojik takipte nüks izlenmemiştir.

Sonuç: Üç boyutlu sanal modelleme, cerraha uzamsal farkındalık sağlayarak güvenli ve hassas cerrahiye katkı sağlayabilecek bir araç olmakta; ayrıca aydınlatılmış onam sürecini ve hasta-hekim iletişimini de güçlendirebilecek potansiyel taşımaktadır.

Anahtar Kelimeler: Bilgisayar yardımlı cerrahi; Görüntü işleme, bilgisayar yardımlı; Görüntüleme, üç-boyutlu; Konu olarak hasta eğitimi

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