

Ramus to Ramus Mandibular Defect Reconstruction with Osteocutaneous Fibula Free Flap – Case Presentation

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ABSTRACT

Introduction: Head and neck defects after tumor resection can be difficult to reconstruct using autogenous tissue without utilizing a free flap. Osteocutaneous fibula free flap is now considered the gold standard used for mandibular reconstruction after resections due to malignancy.

Case presentation: We present the case of a 49-year old female known with an ectopic mucoepidermoid carcinoma involving the mandibula from one ramus to another. After tumor resection, we have reconstructed the mandible by using the only method available for reconstruction in this case – an osteocutaneous fibula free flap. We were able to reconstruct the mandible using 3D printed custom-made surgical guides.

Discussion: Postoperative imaging showed that the height and symmetry of the mandible were satisfactory. There were no microvascular failures and the intraoral healing time was about 10 days. The donor site skin defect from the left leg was grafted with an autograft harvested from the ipsilateral thigh. The donor site healed uneventfully.

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Article received on the 17th of September and accepted for publication on the 28th of September 2020

Conclusion: Osteocutaneous fibula free flap is a highly effective method and sometimes the only one available for reconstruction of mandibular defects after resection of intraoral malignancies. Modern technologies, such as surgical planning using computer-aided design, play a critical part in extensive reconstructions, lowering the total intervention time.

Keywords: osteocutaneous free flap, fibula free flap, head and neck reconstruction, oncologic defects.

INTRODUCTION

Oral cancers account for 4% of all cancers in the world (1). Squamous cell carcinoma is the most prevalent type of carcinoma affecting the buccal cavity, with over 90% of all oral malignancies, and mandibular involvement is seen in 49% of cases (2). Salivary gland neoplasms are a diverse group of tumors, with various morphologies, which are often challenging to diagnose and treat. According to Wahlberg et al, minor salivary gland neoplasms represent less than 25% of intraoral salivary neoplasms and are often malignant, especially compared with tumors of major salivary glands (3). Tumors of minor salivary glands are clinically impossible to differentiate – malignant from benign. The most frequent benign lesion is the pleomorphic adenoma (4).

Mucoepidermoid carcinoma represents a distinct type of tumor and is the most common malignancy of the primary salivary gland, comprising 3-15% of all salivary gland tumors (5). It consists of three cellular elements in varying proportions: mucus-secreting cells, intermediate cells and epidermoid cells (6). Ectopic mucoepidermoid carcinoma can be found in any part of the body, the incidence in the jaw being exceedingly rare, only 2-4% (7).

Even among pathologists experienced in head and neck cancer, there is significant variability in the way mucoepidermoid carcinomas are histologically graded.

Intraorally oncological resections can lead to devastating cosmetic and functional deficits which result in functional, psychological, physical, and nutritional effects. Besides the functional disorder, extensive mandibular defects cause deformation and abnormal contour of the lower one third of the face (8). These changes are often disfiguring. Due to the three-dimensional configuration of the fibula graft and the critical importance of restoring function and facial contour,

craniofacial reconstruction in such cases poses great challenges (9).

Computer aid design and manufacture play a critical part in this reconstruction, and by using CT scans we can achieve three-dimensional mandibular and fibular models (10). This helps reducing the intraoperative time as well as improving the functionality and aesthetics of the reconstructed segment (11).

The primary goals of a mandibular reconstruction are restoration of speech, swallow and mastication, by reconstructing the mandibular arch and allowing dental rehabilitation (12).

CASE PRESENTATION

We present the case of a 49-year old female known with a low to intermediate grade mucoepidermoid carcinoma involving an ectopic salivary gland in the mandible, which developed in the mandible from one ramus to another.

Eight months before presenting to our service, she started complaining of pain on the right mandibular side without history of surgery or trauma to the mandible. She went to a stomatology clinic, where she had an X-ray that showed a little demineralization in the area. Because the pain worsened, she had a neurologic evaluation for trigeminal neuralgia and had a treatment prescribed. Six months later, the right mandibular region begun to swell, so she went to an oral maxillofacial surgeon, where she had a CT that revealed a mass in the right body of the mandible. She had a biopsy that showed a low-intermediate grade mucoepidermoid carcinoma which required excision and immediate reconstruction. Unfortunately, the procedure could not be done in that clinic, so the patient was proposed radiotherapy as a primary treatment. Radiotherapy has had mixed results as a primary treatment. As adjunctive therapy, it has also met success and failure (13). The patient looked for a second opinion and two months later she arrived

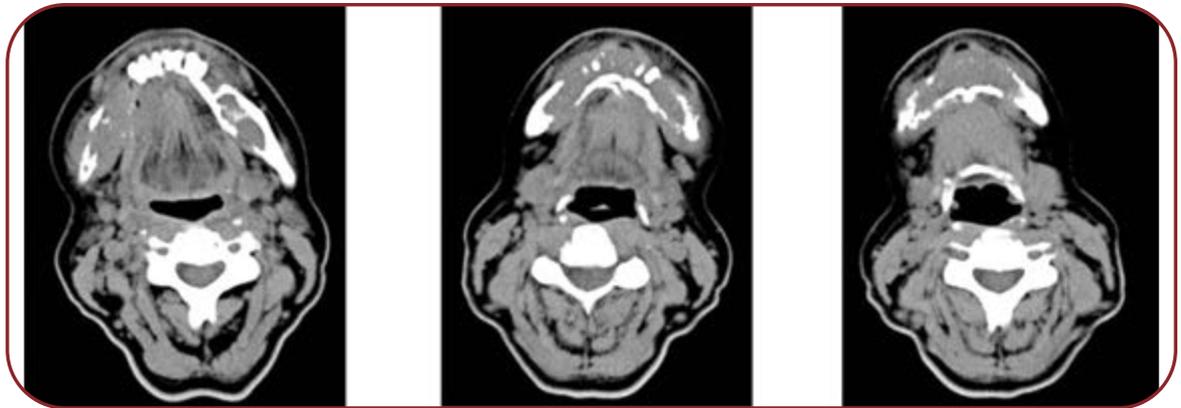


FIGURE 1. CT axial images of the tumor involving the mandible

at our hospital. The tumor had spread, from one angle of the mandible to another, as showed by computed tomography angiography (Figure 1).

The patient had no history of cigarette smoking or alcoholism. No significant medical or family history was noted.

Clinical examination revealed non-tender swelling of both mandibular regions, from the angle of the mandible to the menton, with normal skin over the swelling. Intraoral examination revealed normal intact overlying mucosa. The right mandibular group of lymph nodes were palpable, mobile and non-tender.

CT scan images showed homogeneously enhancing lytic lesion from one ascending ramus of the mandible to another with medullary bone destruction and cortical erosion, especially on the lingual side.

Evaluating the clinical and radiographic findings, together with the biopsy result, the working diagnosis considered was of ectopic (intraosseous) mucoepidermoid carcinoma of the mandible. We included the differential diagnoses of odontogenic keratocyst, odontogenic myxoma and ameloblastoma.

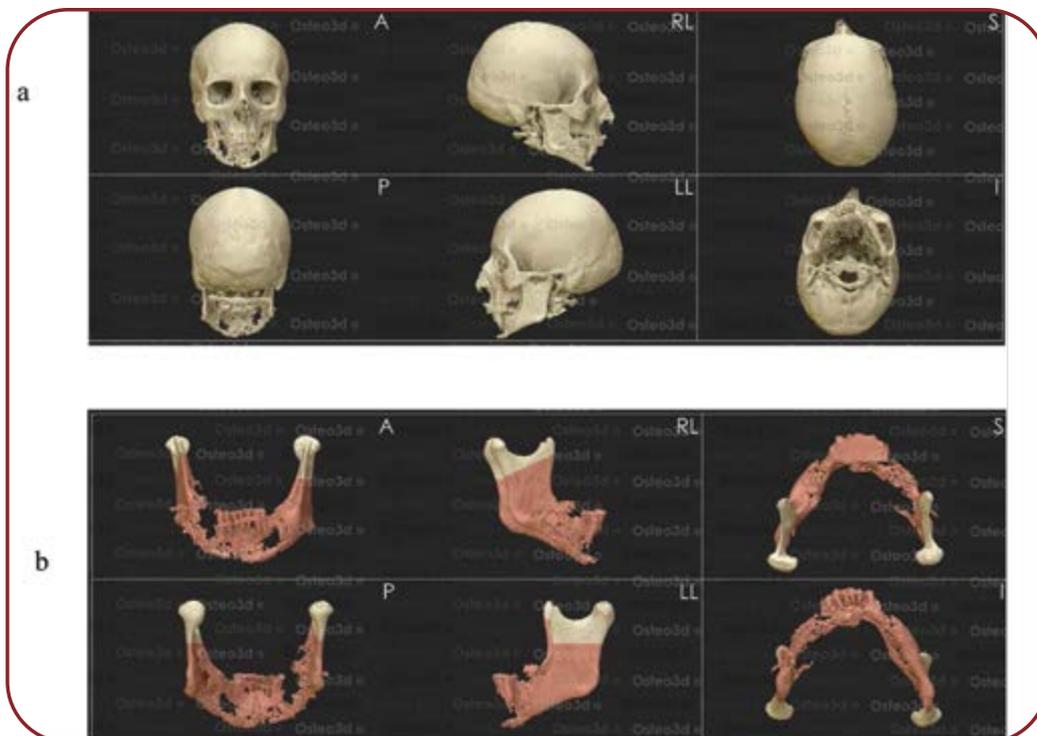


FIGURE 2. Tumor involving the mandible: a) skull reconstruction using high resolution CT images; b) mandible reconstruction using high resolution CT images



FIGURE 3.
Reconstituted
fibula: a) angles;
b) dimensions

After clinical and paraclinical data evaluation, the oncologic committee decided that the best course of action would be the removal of the tumor with bilateral cervical lymphadenectomies and immediate mandibular reconstruction.

Because of the length of the defect, osteocutaneous fibula free flap was the only available method for reconstruction of the mandible. This flap was also used to provide a possibility for later dental implantation, not only to restore the function and facial symmetry.

Because the excision left only the condyles and the coronoid processes of the mandible (Figure 2b), the reconstruction was particularly challenging and had to be done with the help of computer-aided design.

The high-resolution images obtained from the computer tomography angiography of the head and left leg were converted to digital 3D models. The images were processed by Osteo3d computer software until final images of the mandible (Figure 2b) and fibula (Figure 3a, b) were obtained. Digital models were generated based on those images and imported to a computer aided design system. Sectioning planes were defined based upon regions of the mandible and applied to the fibula model (Figure 3a, b).

The most important aspect was the design of the fibular sections as to obtain the desired initial shape of the mandible (Figure 4).

Three sets of guides were designed, a single guide for the whole fibula (Figure 5a), individual guides for every segment of the fibula that was going to be sectioned (Figure 5 b, c) and a set of guides for the mandibular cuts (Figure 5 d).

A 3D printer was used to print the three types of guides, made of thermoplastic autoclavable FDA approved material, a fibular and a mandibular model that was used to prepare the appropriate shape of the titanium plate used for the fixation of the vascularized bone graft to the mandible (Figure 6).

The patient underwent radical tumor resection (Figure 7) with type III modified bilateral radical neck dissection. The surgical margins were located intraoperatively at the cranial part of the mandibular ramus bilaterally, with no bone erosion or destruction present at this level, approximately 1 cm from the furthest macroscopic lesion. The distal osteotomy was performed at about 6 cm from the above the projection of the lateral malleolus to maintain ankle stability and proximally at about 5 cm, with careful dissection, identification and preservation of the com-

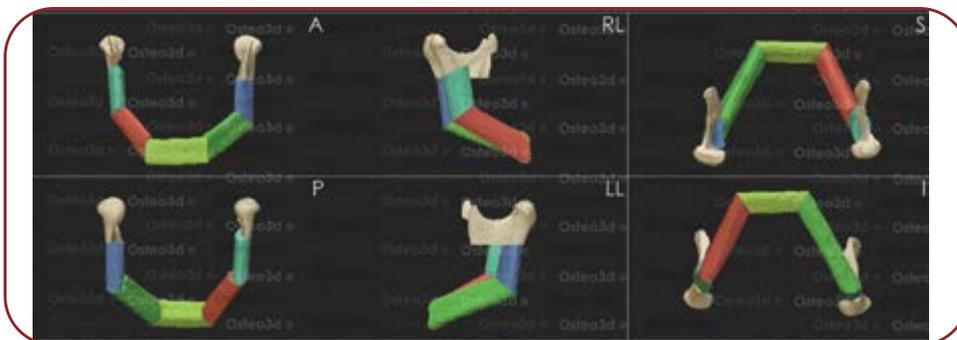


FIGURE 4. Reconstructed mandible

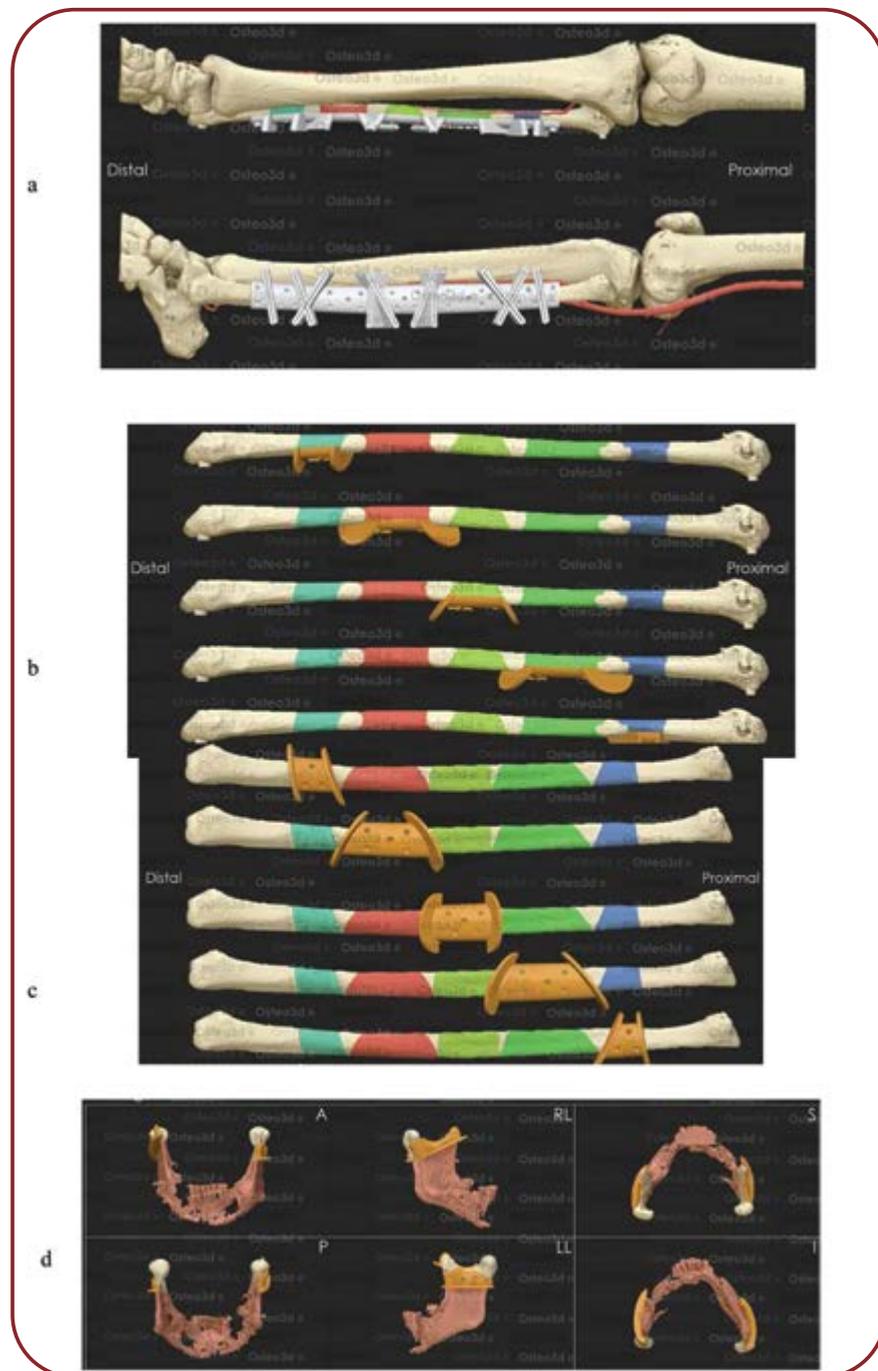


FIGURE 5. Guides: a) single piece fibular guide; b, c) individual pieces fibular guides; d) mandibular guides

FIGURE 6. Guides and models



mon peroneal nerve. In total, 23 cm of fibula were harvested. There were five fibular segments included, with 10 cuts made according to the 3D printed mandibular guide. The mandible was reconstructed prior to the peroneal vessel division. The peroneal vessels were anastomosed to the left facial artery and the left external jugular vein.

Postoperative imaging showed that the height and the symmetry of the mandible were satisfactory (Figure 8).

There were no microvascular failures and the intraoral healing time was about 10 days. The donor site skin defect from the left leg was grafted with an autograft harvested from the ipsilateral thigh. The donor site healed uneventfully.

Postoperatively, the patient was kept on a non-weight-bearing status for one week. During this time, the left leg was kept elevated on a pillow. Seven days postoperatively, the patient began to walk with assistance, non-weight bearing or minimal weight bearing on the operated-on leg for the following week. After that, she was allowed to ambulate with full weight bearing on both legs.

The diagnosis of ectopic mucoepidermoid carcinoma was confirmed based on histopatho-

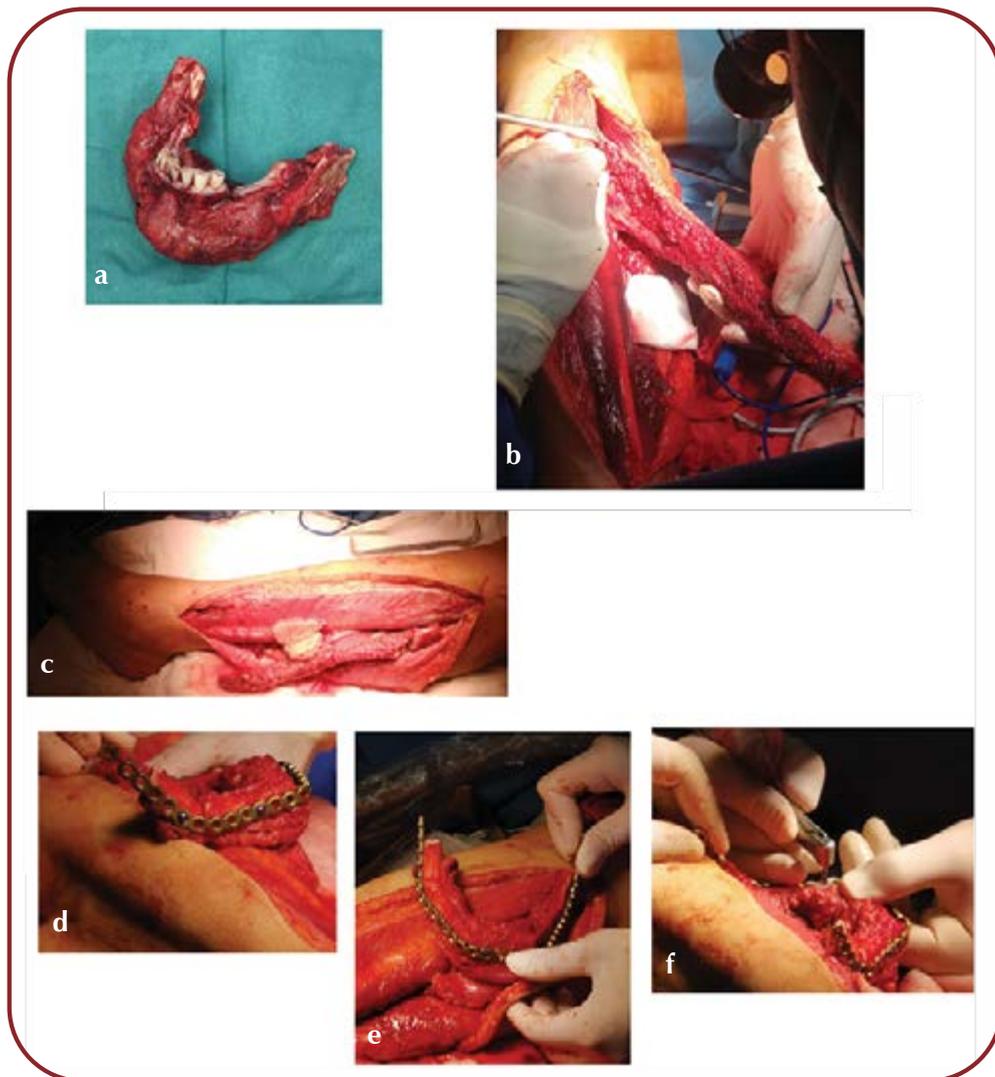


FIGURE 7. Intraoperative: a) tumor resection; b, c) fibular flap; d, e, f) mandibular reconstruction.

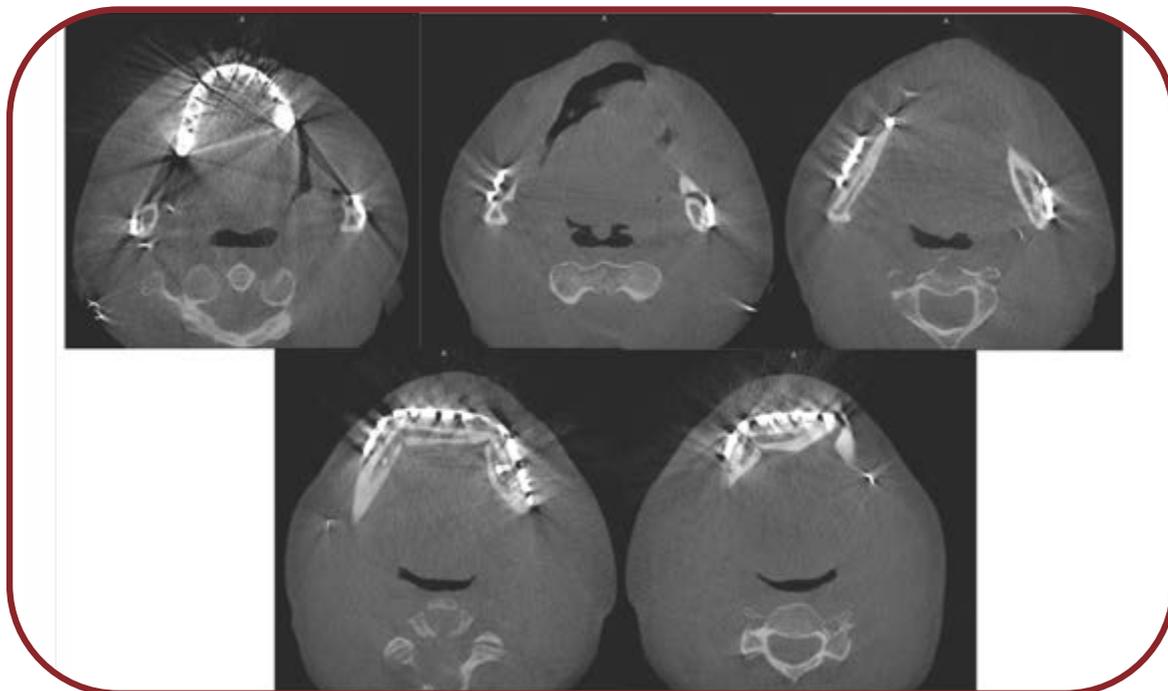


FIGURE 8. CT images at one month postoperatively

logy. Lymph node metastases were found in IV-Va right side nodal groups and in one right side facial lymph node.

The patient was referred to the Oncology Department for additional evaluation and adjuvant therapy.

DISCUSSION

Although the etiology of intraosseous of mucoepidermoid carcinoma is still unknown, there is one theory that states that ectopic salivary gland tissue may be included within the mandible during development, inferior to the mandibular canal (14, 15). Puberty can influence the ectopic salivary gland tissue allowing malignant transformation of mucous-secreting cell nests considering growth factor influence on neoplastic degeneration (16).

The osteocutaneous fibula free flap was first described by Taylor et al (17) in 1975, but it became well known for mandibular reconstruction later, after Hidalgo (18) reported its applications in 1989. It provides the longest vascularized segment of bone to date; no other flap is able to provide such length of osseous tissue. Up to 24-26 cm of bone can be harvested without compromising the leg function, with good quality of tissue and adequate pedicle length (19). In

our case the osteocutaneous fibula free flap was the only method of reconstruction available.

One of the major advantages of the osteocutaneous fibula free flap is that it can be harvested simultaneously with the excision of the tumor by a second surgical team.

The flap conformation is crucial for the functional and aesthetic outcome. In the last few years preoperative 3D modeling and virtual simulation helped in planning and executing this conformation with greater accuracy (20). Based on virtual simulation, three resection guides were designed to help the surgeon remove the mandible and fibula with greater precision and to cut the straight fibula bone into a curved shape to match the anatomy of the mandible.

Among the benefits of computer aided design and virtual planning and guided surgery are decreased local recurrence rates (21) and intraoperative time (22). The native mandible can be almost entirely reconstructed. Longstanding defects like osteoradionecrosis can be reconstructed using as a model the contralateral side, which is another great advantage.

There are also disadvantages of using computer aided design and 3D printed guides. The longer time needed to obtain the guides could disrupt the surgery, changing the osteotomy locations as the tumor develops. Also, the cost, de-

sign and manufacture of guides could involve expenditures from several hundreds to several thousand euros (23).

CONCLUSIONS

Ectopic intraosseous mucoepidermoid carcinoma is a very rare malignant neoplasm. The preoperative diagnosis is very challenging. Although sometimes it can be differentiated from ameloblastoma, odontogenic cyst, odontogenic myxoma based on imaging, the final diagnosis is usually based on histopathology.

A treatment can be chosen based on tumor grade, location and clinical and imagistic data. The aim of surgery is to achieve tumor-free margins and thus to ensure oncologic safety. The surgical approach for mucoepidermoid carcinoma requires wide resection, radical surgery can increase the chance of a favorable prognosis. Based on the grade of the lesion, additional radi-

cal neck dissection may be required, followed by adjuvant treatment. Positive margins should be re-resected, although this shows an aggressive tumor and has a reserved prognosis.

The osteocutaneous fibula free flap is a highly effective and sometimes the only method for reconstruction of large mandibular defects after resection of intraoral malignancies.

The donor site healing complications can be reduced by improving the operative time, flap ischemia time and the period between flap elevation and donor site closure.

Modern technologies, such as surgical planning using a computer-aided design, play a critical part in extensive reconstructions, lowering the total intervention time and can significantly improving the functional and aesthetic results. □

Conflicts of interest: none declared.

Financial support: none declared.

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