

# Treatment of a mandibular cyst with synthetic bone graft substitute

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**Fig. 1** Panoramic radiogram.

## Introduction

Radicular cysts appear as a result of pulp necrosis caused by inflammation, trauma or improper dental treatment. They are cavities enclosed by a wall of connective tissue with an inner epithelial layer, usually filled with fluid or pulp. Radicular cysts cause few clinical symptoms and are painless in many cases. Mobility of adjacent teeth may be noted, as well as swelling of the bone. If the cortical bone is thinned or destroyed by the growing cyst, cracking under palpation may be noticed. Although radicular cysts are benign, they grow slowly but steadily and may lead to complications, depending

on their size and location. Large cysts in the mandible may cause pathological fractures.<sup>1</sup>

The treatment of maxillary and mandibular cysts is common in oral and maxillofacial surgery. The most widespread treatment methods are curettage and radical enucleation of the cyst (cystectomy).<sup>2,3</sup> In cases of very large cysts, or if cystectomy is contra-indicated owing to the risk of damaging nearby anatomical structures, cystostomy is recommended. In cystostomy, the cystic lumen is opened in order to reduce the pressure inside the cyst. The cyst's volume is reduced subsequently by bony apposition on the cyst walls until it reaches a size that allows its safe removal by cystectomy.<sup>2,4</sup>

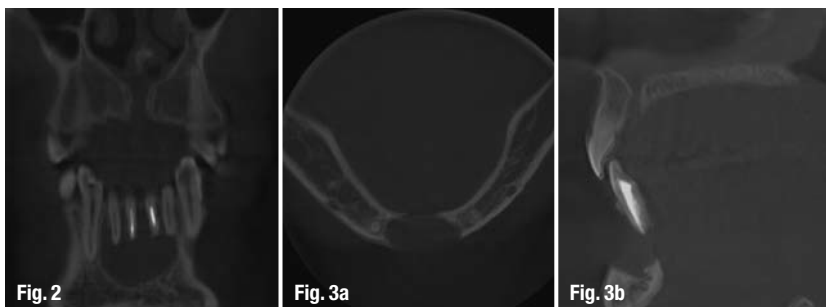
The removal of a cyst evidently results in a bone defect. Depending on its size and location, the bony lesion has to be treated with regard to functional and aesthetic aspects using autogenous grafts or bone substitutes.<sup>5</sup> The authors present the treatment of a radicular cyst in a male patient in this case report. The lesion probably occurred as a consequence of earlier trauma in the frontal section of the mandible. The cyst was asymptomatic and an incidental finding. After endodontic treatment, cystostomy and bone augmentation were performed.

## Case report

A 27-year-old male patient visited the dentist for a routine visit. In the dental panoramic tomogram and subsequent CT scan, a pathological radiolucent lesion of about 30 x 20 x 25 mm was observed in the alveolar bone of the mandible (Figs. 1–3). In the clinical examination, teeth 41 and 42 showed mobility but were painless. A pulp vitality

**Fig. 2** Frontal CT.

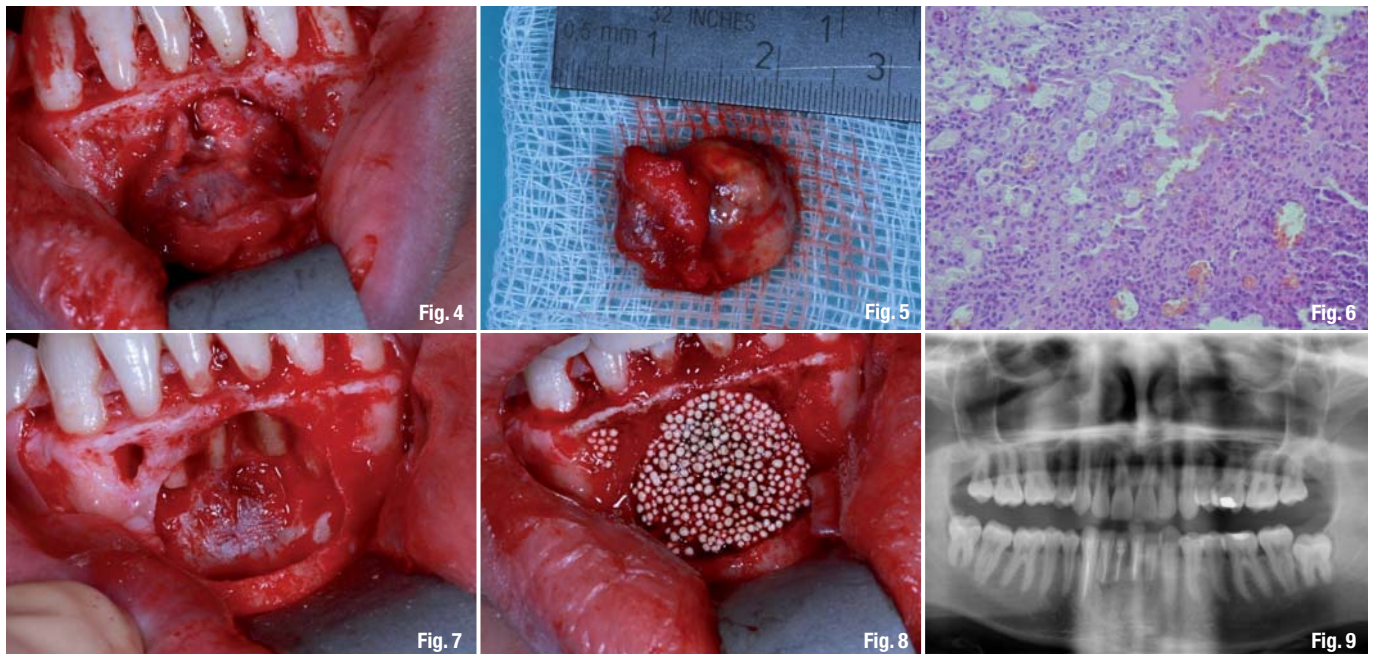
**Fig. 3** (a) Horizontal and (b) lateral CT.



**Fig. 2**

**Fig. 3a**

**Fig. 3b**



test revealed necrosis in teeth 31 and 41 to 43. The soft tissue surrounding the radiolucent lesion was intact and showed no signs of inflammation. There were neither fistulas nor swelling. In the physical examination, neither sensitivity of the gingiva nor pain was noted.

Cyst enucleation was performed under local anaesthetic with 4% articaine. Teeth 31 and 41 to 43 were treated endodontically. Upon elevation of a trapezoid mucoperiosteal flap from teeth 33 to 43, the destruction of the vestibular cortical bone was evident (Fig. 4). The cyst was enucleated and sent for histopathological examination (Figs. 5 & 6). The roots of teeth 31, 41 and 42 were resected.<sup>6</sup> Tooth 43, although non-vital, was not directly involved in the cystic lesion and thus was not subjected to root-end resection. The root canals were prepared and filled with MTA (Fig. 7). After thorough debridement, the large bone defect with partial destruction of the vestibular and lingual cortical bone walls was filled with a synthetic bone substitute (easy-graft CRYSTAL, Degradable Solutions; Fig. 8). The material consists of biphasic calcium phosphate, which is composed of 60% hydroxyapatite and 40%  $\beta$ -tricalcium phosphate. Bone substitute granules adhere to each other, forming a mouldable but porous mass. The material hardens into a stable scaffold upon contact with blood. After application, the material was covered with a porcine collagen membrane using a double-layer technique. Teeth 41 and 42 remained mobile after filling the defect, but mobility did not increase during apicectomy and cyst enucleation. The wound was closed using 6.0 nylon sutures.

The patient received analgesics and 1,200 mg clindamycin twice a day for six days. The post-operative healing was uneventful. The sutures were removed after seven days. Six months after the cystectomy, the patient returned for a clinical and radiological follow-up visit (Figs. 9–11). Clinical examination showed no sensitivity of the gingiva, nor did the patient report pain. The shape and volume of the alveolar ridge were normal, and the teeth did not show mobility. Slight scarring was observed at the sites of the vertical incisions.

Radiological examination (panoramic tomogram and CT scan) after six months confirmed that the alveolar bone had been reconstructed within the anatomical contours and the hard tissue at the former defect site showed radiopacity similar to the surrounding bone (Figs. 9–11). A small region of reduced opacity was detected around the apex of tooth 42, which may be an effect of remodelling. This region will remain under observation.

## Discussion

The diagnosis and treatment of bone cysts of the jaws, including radicular cysts, is very common in oral and maxillofacial surgery. After the removal of a cyst, the bone defect will usually be filled with blood. The blood clot contracts during early healing, which results in loss of contact between the clot and the walls of the surrounding bone. The formation and in-growth of blood vessels and, consequently, oxygen and nutrient supply—a prerequisite for bone regeneration—may be disturbed. Furthermore, the blood clot may be destroyed by the fibrinolytic activity of bacteria from the oral cavity,

**Fig. 4** Local status after flap opening.

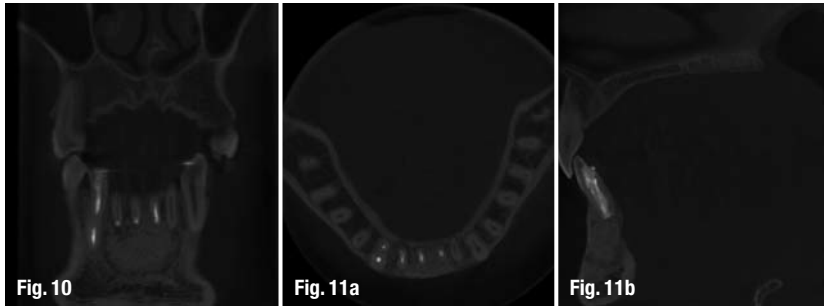
**Fig. 5** Cyst after removal.

**Fig. 6** Histopathological examination of a fragment of the cyst wall showed the characteristics of congestion, including chronic lymphocytic and plasmocytic inflammatory infiltration by foamy macrophage clusters (40x, hematoxylin & eosin staining).

**Fig. 7** The bone defect and roots of 31, 41, and 42 after the cyst removal and resection.

**Fig. 8** easy-graft® CRYSTAL in situ.

**Fig. 9** Panoramic radiogram after six months.



**Fig. 10**\_Frontal CT after six months.

**Fig. 11**\_(a) Horizontal and (b) lateral CT after six months.

which may result in wound infection. Leaving a post-resection area of a size similar to the presented case unfilled could lead to an aesthetic defect or even complications such as loss of the resected teeth or fracture.

In the literature, various treatments are described to avoid such complications and to promote bone regeneration. Schulte describes a method in which the blood clot is stabilised with collagen sponges soaked with antibiotics to reduce the contraction of the clot.<sup>7</sup> Later, this method was modified by using centrifuged blood.<sup>8</sup> Alternatively, the curetted defect may be filled with autogenous bone, which however will cause additional morbidity at the graft donor site. The use of bone substitutes enables the surgeon to stabilise the clot without graft harvesting. Bone substitutes differ in their origin (allogeneic, xenogeneic or synthetic) and their behaviour in the human body (resorbable or non-resorbable). Most bone substitutes are applied in granular form. Depending on defect size, form and location, securing the material with dental membranes is necessary. Generally, bone defects resulting from cyst enucleation are multi-walled and not mechanically challenged, thus bone regeneration is reproducible and reliable if appropriate osteoconductive scaffolds are used.

In the case presented, the authors used an in situ hardening biphasic bone substitute to fill a large bone defect. The size of the defect and the partially missing lingual and vestibular cortical bone walls constituted a challenging situation for which the in situ hardening property of the material used and its slow resorption were advantageous.

The material could be modelled to fit the defect shape and to follow the anatomical contour of the lost alveolar bone. The material hardens upon contact with blood. Thus, mobility of graft particles or deformation of the graft during early healing is prevented, which is important for large bone defects.

Bone regeneration is centripetal (i.e. bone formation starts from the defect walls and continues towards the defect centre). It is evident that bony regeneration thus will take longer in large defects than

in small defects (e.g. extraction sockets). Consequently, resorbable materials such as phase-pure  $\beta$ -tricalcium phosphate or calcium sulphate may be degraded before regeneration of large defects can be attained, which may result in incomplete bone fill. Biphasic calcium phosphates are compounds of hydroxyapatite (virtually non-resorbable) and  $\beta$ -tricalcium phosphate (resorbable). Materials with a composition of 60% hydroxyapatite and 40%  $\beta$ -tricalcium phosphate have a long and successful history of clinical use. Histologically, bone substitute particles appear to be integrated into newly formed bone. The histological findings are similar to the results obtained with bovine bone substitutes.<sup>9-11</sup> For the present case, a biphasic calcium phosphate was preferred in order to guarantee integrity of the calcium phosphate scaffold during the expected prolonged period of bone regeneration owing to the size of the defect. Histological evaluation of the regenerated hard tissue in the present case was not possible, since it would have necessitated reopening the site. However, the radiological results demonstrated that the entire cavity was filled with radiopaque tissue, which is consistent with complete bone regeneration and adequate bone substitute resorption for large cavities.

## Conclusion

The case report has demonstrated how an in situ hardening biphasic bone substitute (easy-graft CRYSTAL) can be used successfully to treat large defects originating from cystectomy in oral and maxillofacial surgery. The material's in situ hardening property and slow resorption were considered to be crucial for the treatment of the case. The authors used a resorbable membrane to cover the bone graft on the vestibular side. Further studies will be necessary to determine the indications for which the application of a membrane is useful, or whether a bone substitute used without a membrane is sufficient.

*Editorial note: A complete list of references is available from the publisher.*

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