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Case Report

Lateral sinus augmentation by using natural bovine bone substitute with hyaluronate

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Abstract: Bovine bone substitutes are among the most commonly used biomaterials for sinus grafting application. The aim of this work was to verify the clinical use and performance of a novel natural bovine bone substitute with hyaluronate in a sinus lifting procedure. Therefore, a lateral sinus lift approach was used, and a very strong hard tissue formation of residual xenograft granules embedded into newly formed bone was observed after eight months, as two implants were finally installed. In conclusion, the bovine bone substitute with hyaluronate supported efficient defect grafting and achieved successful sinus augmentation.

Keywords: sinus lift; bone augmentation; bovine; bone substitute; hyaluronate

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Introduction

The available height and width of the alveolar ridge are crucial for dental implant placement in the upper and lower jaw [1], [2]. Today there are many bone augmentation techniques to compensate for horizontal and vertical alveolar ridge deficiency [3]. Sinus lift is one of those techniques and has been used since several decades now to correct bone volume for implant placement purposes [4].

It is very challenging to treat patients with pneumatic sinus that lack sufficient volume and bone quality in the upper jaw [5]. Here it is not only important to determine the specific measures, but also to choose the correct bone and soft tissue biomaterials for regeneration [6]. Pure bovine bone derived substitutes are among the most commonly used in sinus grafting procedures [7]. However, the difference in their physicochemical properties can have an influence on the clinical result [8], [9]. For that reason, there is constant need for new and improved biomaterials.

Hyaluronic acid is a natural polymer that finds application in various fields and has been widely described in the medicine [10]. Moreover, since many years now the hyaluronic acid finds broad use in dentistry and is used in different indications [11]. Also has been used for a bovine bone substitute biofunctionalization in order to influence the osteoblast activity and improve the bone healing capacity [12], [13]. Here a positive effect of the hyaluronic acid on the bone graft integration and new bone formation was observed. However, not enough data exists on the application of this recently developed bovine bone grafting material with hyaluronate in patients.

The aim of this case report was to present a case when a novel natural bovine bone substitute with hyaluronate was used successfully in a sinus lift augmentation using lateral widow approach, after which two implants were placed uneventfully.

Materials and Methods

A 46-year-old female patient was referred to our surgical practice due to partial edentulous maxilla and complaints related to unsuccessful dental treatment. Initially the examination revealed a partially edentulous upper jaw. Also, some of the teeth were mobile and with exposed root surface due to periodontal disease and recession of the gingiva. In addition, a severe (> 5 mm CAL) generalized periodontitis was detected, and the patient's masticatory function, phonetic function, and aesthetic appearance were impaired.

After analysis of the paraclinical data and clinical examination, we used the SAC assessment tool to identify complexity and potential complications (www.iti.org). After the patient was offered several alternative treatment plans, it was decided to perform bone volume increase in the right maxillary sinus, and at a later stage the placement of two dental implants. For this reason, we used natural bovine bone substitute with hyaluronate (cerabone® plus, botiss biomaterials GmbH, Germany), which combines the well-established material cerabone® with the well-known properties of hyaluronic acid. While the high temperature treatment of cerabone® adds favorable physicochemical properties such as increased hydrophilicity, safety and long term-volume stability, the biofunctionalization with hyaluronic acid increases the cell viability [9], [12]. More specifically, a lateral sinus lift approach was selected for this case.

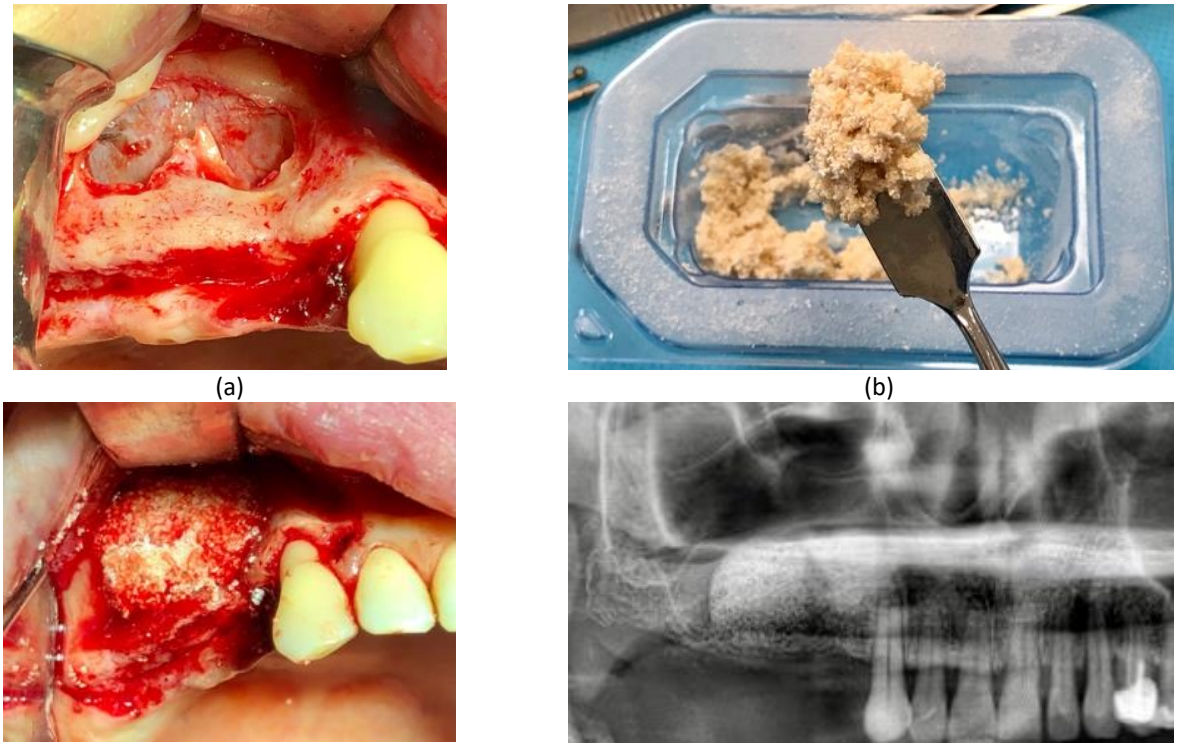
The patient started with antibiotic prophylaxis (amoxicillin/clavulanic acid, Augmentin, Glaxo-SmithKline) of 1g per 1 hour before surgery and then at every 12 hours for 7 days. Also rinsing with chlorhexidine 0.2% (Eludril, Pierre Fabre Laboratories) for two weeks after surgery was instructed.

In order to perform the surgery, a full thickness flap was elevated in the area of interest. Then an access window was drawn on the vestibular bone with surgical handpiece and diamond burs under sterile saline irrigation. After the window was created in the lateral wall of the maxillary sinus, the exposed Schneiderian membrane was carefully lifted, and no perforation was detected (Figure 1a). The cerabone® plus was first hydrated with sterile saline solution according to the manufacturer’s instructions (0,5ml per 1ml grafting material) (Figure 1b). Since the binding capacity of hyaluronate formed sticky bone almost immediately after hydration, it enabled a very convenient handling. Once the grafting material had the desirable sticky consistence, it was then inserted into the sinus cavity with additional lateral augmentation to gain horizontal bone formation (Figure 2c). The grafted area was then covered with long-term degrading collagen barrier membrane (Jason® membrane, botiss biomaterials GmbH, Germany) to support the long-lasting osseointegration regenerative mechanism enabled by the cerabone® granules. That is because the presence of the slowly resorbing xenograft - cerabone® granules maintains long-term volume stability, while the hyaluronate is fast resorbing material and therefore doesn’t have any barrier function. Finally, the mucoperiosteal flap was sutured with non-absorbable 5.0 sutures and CBCT control scan was performed to confirm the properly grafted sinus (Figure 4d).

Results

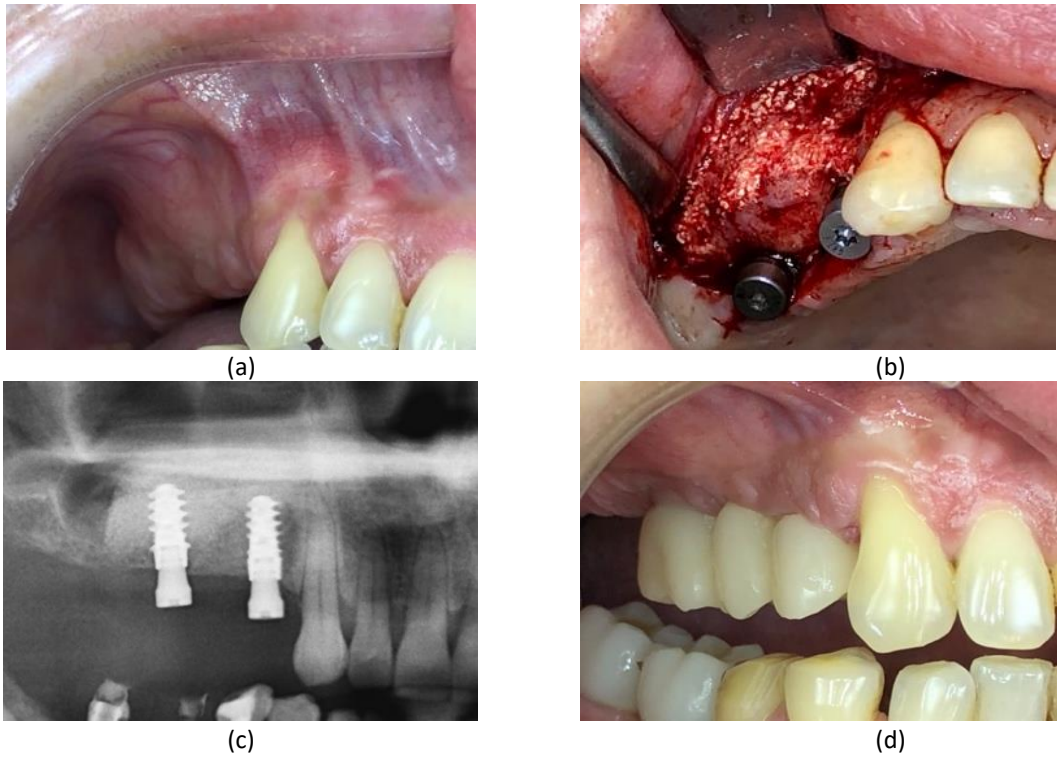
The patient had no complications during the postoperative period and underwent regular check-ups until the sutures were removed. During the removal of the sutures, a good soft tissue healing, without any dehiscence, infection or inflammatory complications was observed. Since the patient had a very satisfactory soft tissue condition at eight months after the bone augmentation (Figure 2a), a digital planning was performed and two implants (BLX Implant - Ø 4.0mm RB, SLActive® 10mm, Roxolid®; Straumann Group, Basel, Switzerland) with torque 45 Ncm were placed into the bone augmented upper jaw (Figure 2b). During the intervention well-integrated cerabone® granules embedded into newly formed bone was observed (Figure 2b), and the X-ray control immediately after surgery showed correctly placed implants

(Figure 2c). Finally, three months after placement of provisional restoration a successful soft tissue condition was confirmed (Figure 2d).



(a) (b) (c) (d)

Figure 1. Lateral sinus augmentation: (a) Bone window creation and exposed Schneiderian membrane; (b) Properly hydrated cerabone® plus; (c) Sinus grafting and lateral augmentation; (d) X-ray control immediately after surgery.



(a) (b) (c) (d)

Figure 2. Implants placement: (a) Soft tissue condition eight months after grafting; (b) Implants placed into the very hard ``granules/new bone formation`` at eight months after grafting; (c) X-ray control immediately after surgery; (d) Soft tissue condition three months after provisional restoration.

Discussion

This clinical case demonstrated successful lateral sinus augmentation by using a natural bovine bone substitute with hyaluronate.

Nowadays, the lateral sinus lift is a commonly performed procedure [14]. Over the years since its introduction, a number of modifications have been proposed that enable its performance as a less invasive and atraumatic intervention [15]. Techniques with alveolar ridge access, or internal sinus lift, are more atraumatic and have a better postoperative period for the patients [16]. However, a lateral approach is recommended in the case of a 4-6 mm residual alveolar ridge height [17].

High temperature treated xenograft obtained from bovine sources is widely used in the clinical practice because of the favorable physicochemical properties [9]. Also its high temperature treatment improves the long-term volume stability in sinus lift that is already provided by the bovine bone itself [8]. However, the constant development of new and improved bone grafting substitutes lead to the combination of a well-known material such as cerabone® and hyaluronic acid into cerabone® plus [12]. Hyaluronic acid is a natural glycosaminoglycan polymer composed of repeating disaccharides D-glucuronic acid and N-acetyl-D-glucosamine linked by a glucuronidic β (1→3) bond [10]. Due to its distinctive qualities and properties finds application in various medical fields such as ophthalmology, rheumatology, and dermatology. Also it is widely used in different dental indications such as oral ulcers, gingivitis, periodontitis, implant surgery and sinus lift [11]. It was demonstrated that such biofunctionalization increased the cell viability in vitro if compared to cerabone® alone [12]. Also, the hyaluronic acid seems to be degraded in less than two weeks in vivo and the remaining osteoconductive granules enabled the gradual bone regeneration [13]. For this reason, we selected cerabone® plus to perform lateral sinus augmentation.

After proper hydration (Figure 1b), the grafting material was very easy to apply into the prepared sinus, as well as to provide additional lateral augmentation (Figure 1c). After eight months, sufficient bone height and width were observed with residual cerabone® granules osseointegrated into the newly formed bone (Figure 2b), which enabled the patient to successfully receive two implants in this area (Figure 2c).

Conclusions

Within the limitation of this case report, we conclude that that bovine bone substitute with hyaluronate achieved successful sinus augmentation. Residual xenograft granules well integrated into vital newly formed bone was observed eight months post-augmentation, which successfully enabled installation of two implants. More clinical studies with long term follow up and histological studies are needed to confirm the findings of our case report.

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Board review and informed consent statement: The patients were provided orally and written informed consent, upon which they gave permission for images use in this publication. The local country laws allow such publication if these criteria are met.

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