Intraoral Use Of Hydrogel Expander prior to Alveolar Bone Augmentation

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INTRODUCTION

Reconstruction of hard and soft tissue defects of edentulous areas is required to place a proper implant size and length in order to restore aesthetics and function. While bone augmentation is a predictable procedure, the blood supply, space maintenance, stability and primary closure of the wound are critical parameters for successful healing and bone formation[1]. Many different modalities have been used to manage soft tissue and attain primary closure, i.e, periosteal releasing incision, and extensive flap mobilization. Yet the flap tension especially in a severely resorbed ridge runs the risk of wound dehiscence and graft exposure. To avoid this complication, some have advocated the use of tissue expanders. This technique was first described by Neumann 1957 using a balloon technique for ear defects[2]. In 1986, Lew introduced the concept of an intraoral tissue expansion prior to ridge augmentation using these conventional techniques[3]. Limitation of the conventional design, i.e, pressure peaks, repeated postoperative filling, and external filling valve[4] have led to subsequent refinement of design and eventually development of the osmed® self-inflating hydrogel expander[5,6]. The extra oral use of the hydrogel expander has been well documented[7,8]. The purpose of this presentation is to describe the advantages and limitations of using hydrogel expander prior to bone augmentation.

METHODS & MATERIAL

Literature review of both available case studies and clinical trials was conducted. Search limited to English literature using PubMed and Ovid Medline from 1957 to up to date. The following key words have been used: self-inflating osmed® soft tissue expander, tissue expansion, and bone ridge augmentation. The search provided 2066 titles. Studies reporting extra oral use were excluded. Full text analysis was performed for 20 articles

RESULTS

Hydrogel expander consists of an osmotic active hydrogel, copolymer of methylmethacrylate and N- vinyl-2-pyrrolidone, which is surrounded by perforated silicon envelop to control expansion speed[17]. After its implantation, hydrogel implants start to absorb body fluid and enlarge slowly to a predetermined size. Pressure created by the increasing size of expander will create the desired soft tissue volume[21,6]. The expanded soft tissue was of normal texture, color, and thickness with no sign of inflammation[10].The risk of post-operative graft exposition reduced from 25% to 4%, and the mean vertical bone gain increased from 4.0 to 7.5 mm in comparing to bone augmentation without previous soft tissue expansion[13]. Using intravital microscopy, higher functional microvessel density in the soft tissue was detected, which has led to more rapid healing and Osseo integration of grafted material[14]. Various bone reactions have been described. Some authors report signs of resorption and others do not[10]**.** Decrease in bone density and thickness centrally under hydrogel expander was detected by using Micro-computed tomograph[15,16]. Qualitative and quantitive bony change was attributed to constant hydrostatic pressure leading to pressure necrosis[15,16] . This can be prevented by placement of device under the hydrogel expander to distribute the pressure i.e., PDS foil[15] or titanium plate[16].

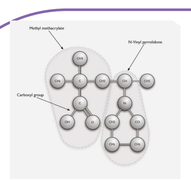

Figure 1: Cross-linked osmotic active hydrogel consisting of modified copolymer of Methylmethacrylate and N-vinyl pyrrolidone.

Figure 2: Tissue expander Cupola Dental and Cylinder Dental. Cupola Indications: small gaps (1-2 teeth) or curved edentulous areas. Cylinder Indications: Straight edentulous area (lateral mandible/maxilla).

Figure 3: Template showing initial and final expander volumes are used for selection of the appropriate tissue expander type and size. During surgery, the template facilitate correct preparation of recipient site. The templated cylindrical part corresponds to the hydrogel core.

Before Swelling* / After Swelling**

Volume	Projection	Diameter	Volume	Projection	Diameter	Swelling time**
0.05 ml	3 mm	6 mm	0.35 ml	5,6 mm	9 mm	40 Days

Before Swelling* / After Swelling**

Volume	Length	Diameter	Volume	Length	Diameter	Swelling time**
0.045 ml	7.5 mm	3 mm	0.24 ml	12 mm	6 mm	20 Days
0.15 ml	12 mm	4 mm	0.7 ml	20 mm	7 mm	40 Days
0.25 ml	13 mm	5 mm	1.3 ml	22 mm	9 mm	50 Days
0.42 ml	15 mm	6 mm	2.1 ml	24 mm	10.5 mm	90 Days

Figure 4: Dimensional and Volumetric change of Hydrogel Expander in 0.9% NaCl (in vitro studies).
Above mentioned Diagram taken from Osemed® gmbh catalogue.

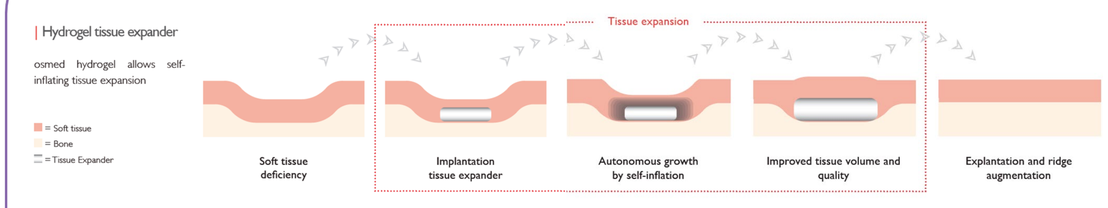

Figure 5: Schematic overview of Hydrogel Expander technique. Tissue expansion hopes to improve quality and quantity of soft tissue and its goal is to facilitate primary wound closure, with the result of reduced incidence of wound dehiscence and post-op exposure of bone grafts.

Soft Tissue Expansion with Self-Filling Osmotic Tissue Expanders Before Vertical Ridge Augmentation. A Proof of Principle Study[9]

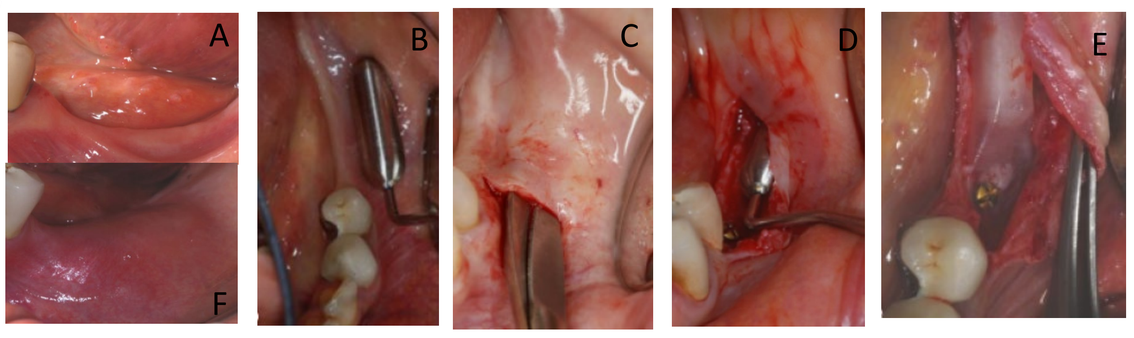

Figure 6: (A) Resorbed edentulous ridge (class C) requiring vertical bone augmentation of approx. 5 mm. (B) The appropriate expander size is selected using the surgical template (final expander volume). (C) A supraperiosteal mucosal pouch is prepared using scalpel and scissors. (D) The preparation is controlled with the surgical template (initial expander volume). (E). The tissue expander is inserted into the pouch and fixed with a bone fixation screw. (F) After 8 weeks of tissue expansion (1.3 ml expander), a considerable gain of soft tissue can be observed.

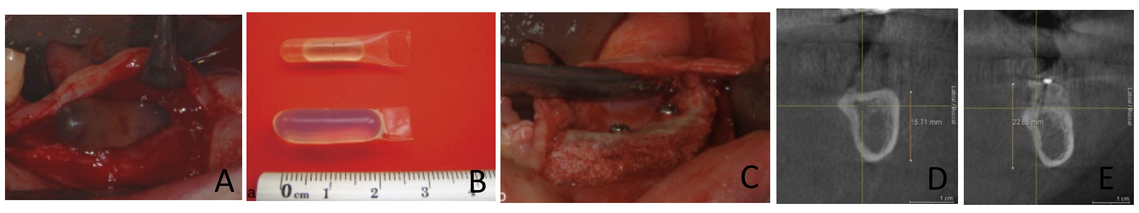

Figure 7: (A) The tissue expander is explanted in the course of bone augmentation surgery. (B). Cylindrical tissue expander before and after swelling. (C)After fixation of the bone graft, primary closure of the flap is easily achieved without further mobilization. (D) Cone-beam computed tomographic cross section of a resorbed mandible before augmentation . Mandibular height: 15.7 mm. (E) Same section of the same patient, 6 months after augmentation . Mandibular height: 22.6 mm , radiographic bone gain approx. 6.9 mm.

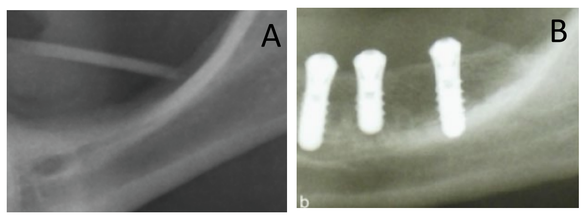

Figure 8: (A) Panoramic radiograph before bone augmentation. Minimal bone height over the mandibular canal. (B) Panoramic radiograph after implant surgery. Vertical bone gain of approx. 8 mm.

CONCLUSION

Osmed® self-inflating tissue expanders are biocompatible devices[12]. Shorter and less invasive surgical procedures, controlled slow tissue expansion, and increased success of bone graft healing with less risk of infection and dehiscence made the tissue expander a promising effective method to improve quality and quantity of soft tissue prior to bone augmentation procedure. Use of hydrogel expander is well documented for extra oral use, however more clinical human trials need to be conducted to further elucidate its role in oral surgical procedures.

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