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Evaluation of postoperative results from the application of xenogeneic grafts (Mucoderm®) and after a mandibular vestibuloplasty

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Abstract

Aim: *The aim of the present study is to clinically evaluate the role of xenogenic dermal grafts of animal origin for the purpose of covering the periosteum in frontal mandibular vestibuloplasty and thus allowing for early prosthetic loading.*

Materials and methods: *A total of 30 patients with a completely edentulous mandible underwent pre-prosthetic surgical preparation, i.e. vestibuloplasty with Mucoderm® xenogenic grafting. The collagen matrix was applied to cover the exposed periosteum. The initial results from measuring the attached mucosa in the frontal region revealed a small amount of attached keratinized mucosa (1 to 2 mm) or the lack of it. A week after surgery the patients were referred for the fabrication of removable complete dentures. For the purpose of optimal postoperative results it is advisable that prostheses fitting take place not later than 7 - 10 days post-surgery. For various reasons 12 out of all patients who underwent surgery were prothesized later (more than 30 days after vestibuloplasty).*

Results: *Immediately after surgical procedure the initial deepening of the mandibular vestibule in all patients was greater than 10 mm. Due to delay in the construction of prostheses (more than 5 weeks after vestibuloplasty) 12 of the patients exhibited a decrease in the postoperative vestibule depth by more than 50%.*

Conclusion: *Mucoderm® proves to be an effective alternative to autogenous grafts in pre-prosthetic surgery and can be successfully applied in vestibuloplasty to cover the periosteum. The use of grafts to cover the periosteum enables the reduction of patients' morbidity and facilitates dental impression and prosthesis fabrication soon after vestibuloplasty. A timeframe within 7-10 days is advisable to achieve optimal preservation of the postoperative vestibular depth.*

Keywords: vestibuloplasty, xenogenic grafts, Mucoderm®, early prosthetic loading.

Introduction

Most patients with completely edentulous jaws tend to display atrophy of the alveolar bone and an inadequate amount of attached mucosa. The bone base may be sufficient but the high muscle attachments and bucco-gingival connections may not provide the site with enough support for prostheses, which may become loose during speech or feeding. Vestibuloplasty aims to augment the bone amount and the attached mucosa, so that the available bone would ensure proper support and stability of dental prostheses [1]. There are different vestibuloplasty techniques to deepen the oral vestibule. The choice of treatment approach is subject to a number of individual and general factors. In some cases, prior bone augmentation of the base must be performed before vestibuloplasty can take place [2, 3, 4, 5, 6]. Among the principal considerations are for the surgery to be minimally invasive, to be best suited to the patient's general condition and to have the shortest possible postoperative period and greatest chances of a successful surgical outcome. These results are most likely achieved through surgical techniques affecting mainly the soft tissues. Vestibuloplasty approaches generally range from secondary epithelialization, submucosal vestibuloplasty and vestibuloplasty with transplants.

The vestibuloplasty technique with secondary epithelialization leaves an open wound surface area which is exposed to infection and suffers contractions and formation of scar tissue. Autogenous free skin or mucosal grafts cover wound surfaces but their main disadvantages are related to the presence of an additional surgical wound, donor-site morbidity, and sometimes discrepancies in the tissue colour and texture [7, 8]. Generally transplants are to prevent wound contracture and eliminate the need of a second surgical wound such as the donor site [9, 10]. After the Consensus Conference in Berlin, in 1983, the necessity of covering the periosteum was widely discussed [11]. If the periosteum is not covered, complete relapse could occur during secondary healing with scar contraction and epithelialization of the vestibular periosteum [12, 13]. The deepening of the vestibule without covering the exposed periosteum could significantly compromise the vestibulo-lingual outcome. The introduction and application of xenogeneic collagen transplants has solved quite a few problems in terms of donor sites, morbidity, and the amount of tissue required for tissue defects. Nowadays collagen matrix is used as a routine tool for both would covering as well as repair of intraoral tissue defects [14, 15].

Mucoderm® (Botiss dental, Berlin, Germany) is a 3D collagen tissue matrix derived from porcine dermis. The final product is obtained through a multi-stage process where cellular elements are removed and the risk of immune reactions is decreased. This 3D collagen matrix is composed of collagen and elastin, supporting revascularization and subsequent fast soft tissue integration [16], [17].

Aim

The aim of the present study is to clinically evaluate the role of Mucoderm® xenogeneic graft in covering the periosteum in vestibuloplasty, thus allowing for early prosthetic loading

Materials and methods

A total of 30 patients, comprising 12 men and 18 women aged 59 - 81 years (mean age 69.3 years), without any systemic diseases, were referred to the Faculty of Dental Medicine at the Medical University of Varna, Bulgaria, due to inadequate vestibular depth in the mandibular frontal area resulting in impossible prosthetic treatment. All patients underwent initial orthopantomography (OPT) and were referred for vestibuloplasty of the mandible. On the basis of clinical and radiological studies, the selection of patients was carried out after establishing the need for pre-prosthetic surgical preparation of the completely edentulous mandible. The patients were selected upon consulting with prosthodontist at the Faculty of Dental Medicine in Varna, Bulgaria. The final group comprised 30 individuals. The OPT was performed using Planmeca ProMax 3D Max available at the Faculty of Dental Medicine in Varna. The amount of attached mucosa in the mandibular frontal area was measured prior to surgery using a Periodontal probe UNC 15. The measurements were taken in millimeter (mm) at 4 to 8 points from the top of the residual alveolar ridge and the mucogingival line, ranging from 0 to 3 mm.

The patients selection criteria were as follows:

a) An edentulous mandible with clinically healthy mucosa;
b) Minimum residual bone height: 15-20 mm; c) Patient's Informed consent provided.

Among the contraindications for performing this surgical manipulation were common systemic diseases involving the haematopoetic system, patients on anticoagulant and antiplatelet therapy and mental illness patients. Some of the contraindications for vestibuloplasty were defined individually based on the extent of bone resorption: residual bone height < 15 mm; the presence of inflammation at the site; and poor oral hygiene.

The clinical indications for the diagnosis of shallow vestibule can be determined in several ways:
- Tension test/ Blanching test;
- Checking the level of the mucogingival line by measuring the distance (in millimeters) between the mucogingival line and the top of the alveolar ridge;
- Linear measurement of the distance from the top of the alveolar ridge to the mucogingival line using a Periodontal probe or by means of a compass and a vernier scale.

The need for vestibuloplasty was established after consultation with a specialist in dental prosthetics. It was based on the measurements of the attached mucosa length taken over the alveolar ridge and the residual bone height, assessed in an X-ray imaging from the top of the ridge to the inferior border of the mandible. Any patients who exhibited residual bone < 15 mm were not included, as Amphlett and Colwell noted that

in order to maintain the normal positioning of the chin and avoid chin droop at least 5 to 6 mm of mentalis muscle attachments should be left intact [18], or only a two-third segment should be cut through [19].

After administering local infiltration anesthesia (1.7ml Ubistesin 4%), an incision was made along the transitional fold of the mandibular frontal area, i.e. the discrete line between the movable and immovable mucosa in the area between the first premolar on one side to the other premolar on the opposite side. Then the mucosa was cut without reaching the periosteum, followed by dissection of the mucosal flap from the lip base to the target depth while carefully releasing the muscle insertions. While dissecting the mucosal flap, care was taken not to affect the Nn.mentales, therefore the position of the For.mentales had been established preoperatively by a panoramic image radiograph (OPT). The exposed periosteal surface of the alveolar ridge was then coated with an already prepared Mucoderm® xenogenic dermal graft, rehydrated in saline solution for 15-20 minutes. Using scissors the graft was trimmed to the shape and size of the exposed periosteal surface. It was applied over the periosteum and using a 5-0 monofilament suturing material (Polypropylene suture), it was fixed to the immovable mucosa to the top of the alveolar ridge and the base of the newly-acquired vestibule by single or suspended vertical sutures. The end of the mucosal flap was fixed to the base of the newly-extended mandibular vestibule. The patients were advised to maintain good oral hygiene, and prescribed a Chlorhexidine mouthwash for use after the second day post-surgery. Follow-up appointments were scheduled. The sutures were removed 7 days after the surgery and the patients were referred for dental impressions and fabrication of dental prosthesis.

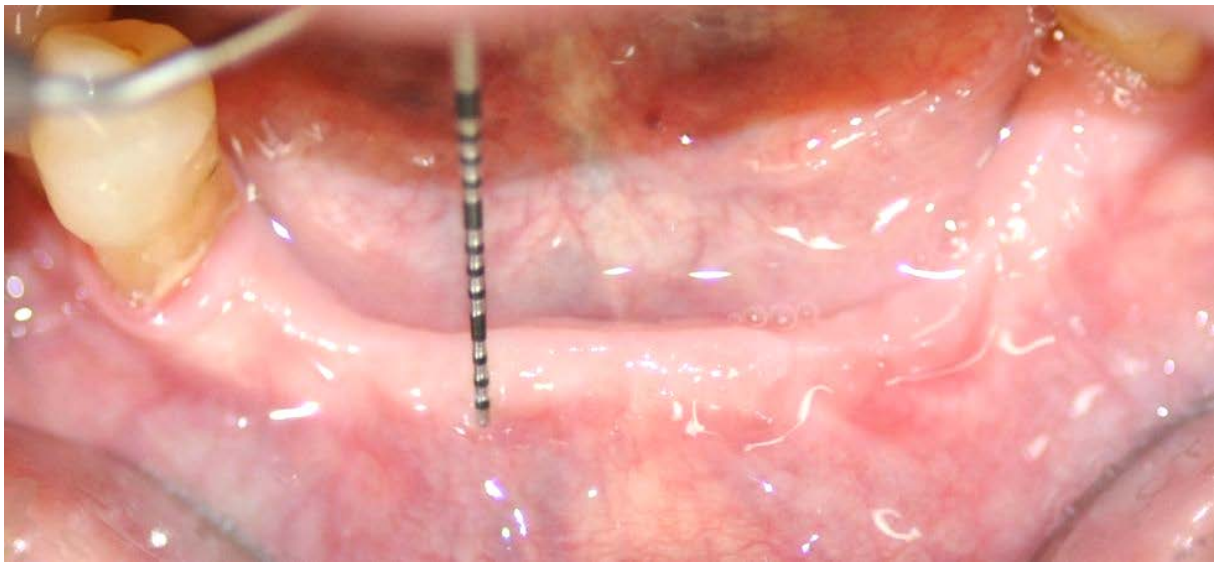

Fig.1. Prior treatment

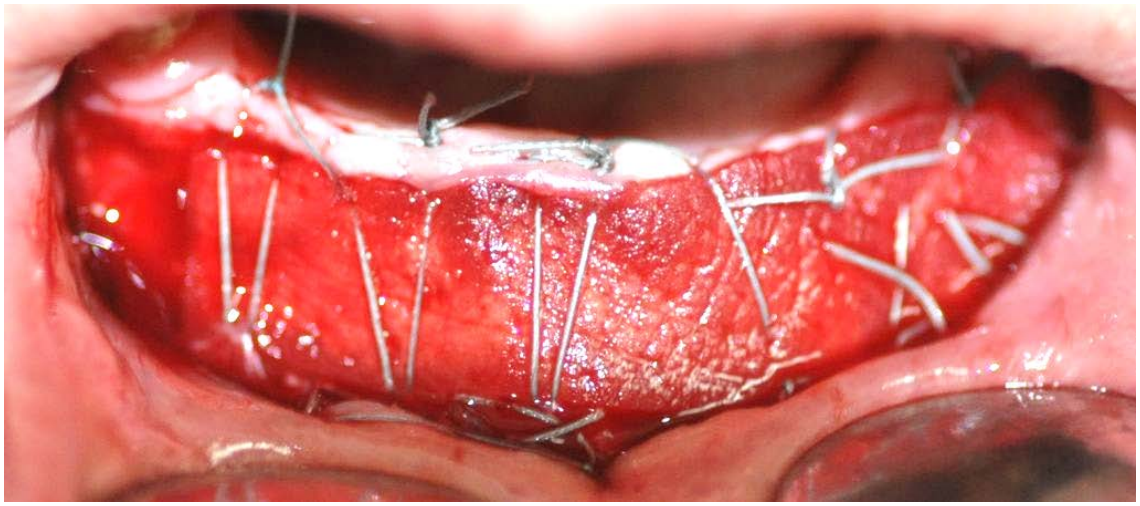

Fig.2. During treatment

Fig.3. One week post treatment (sutures removed)

Results

The depth obtained in the mandibular frontal area was measured in millimeters at 4 to 8 points. The measurements were taken using a Periodontal probe UNC 15 both preoperatively and on the day of sutures removal, with vestibular depth ranging from 7 to 10 mm. The patients were then referred for the fabrication of dental prosthesis. The patients, who had their prosthesis fitted without any delay, also exhibited best preservation of the vestibular depth gained through surgery. Conversely, the patients, who had their prosthesis fixed more than 5 weeks later, revealed reduced vestibular depth by more than 50%, with measurements ranging from 4 to 5 mm.

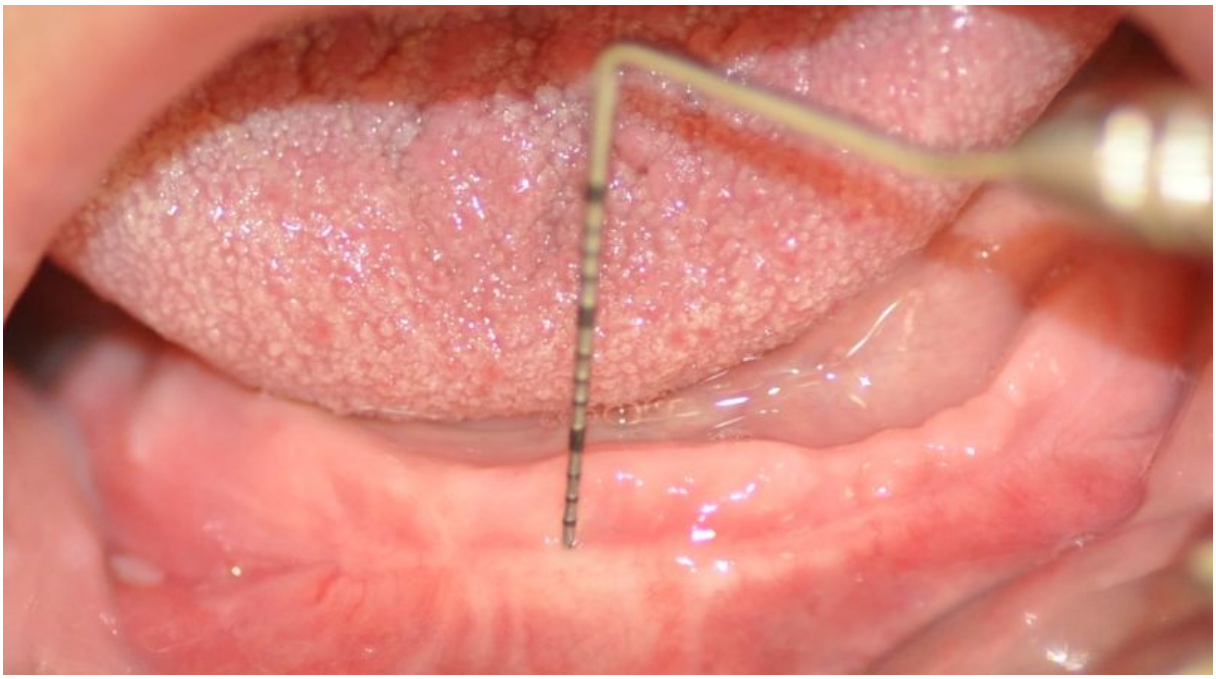

Fig.4. More than one month post treatment

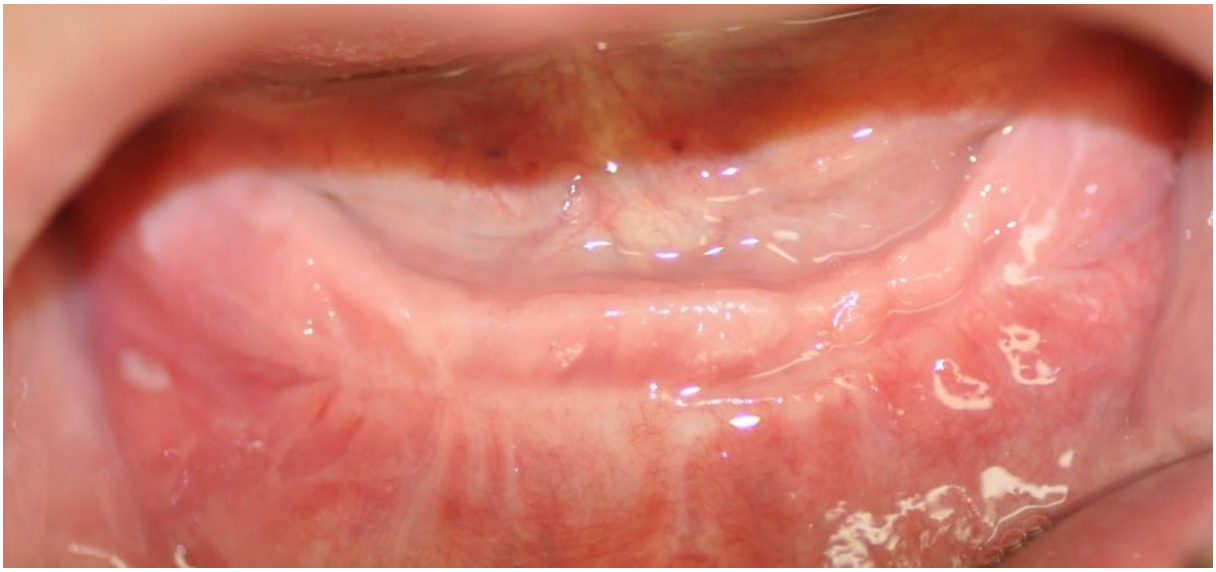

Fig.5. More than one month post treatment

The observations showed that Mucoderm® ensures a favorable postoperative period marked by less morbidity and discomfort, thus allowing for early prosthetic loading. In the cases of delayed fitting of prostheses, there is a risk of relapse.

Discussion

The main objective in all vestibuloplasty techniques is to increase the amount (and area) of the attached mucosa and the atrophied alveolar ridge by moving soft movable tissues to a new position. The soft tissue attached near the top of the alveolar ridge and sometimes on the alveolar ridge itself makes it difficult for patients with completely edentulous jaws to have plaque prostheses fitted. Furthermore, it leads to instability of removable prostheses, frequent injuries which over time are a contributing factor for fibromatous growth of the oral mucosa. The main task of vestibuloplasty is to provide sound foundation for the support and retention of plastic plaque prostheses.

Although deepening of the vestibular sulcus can be performed either with or without soft-tissue grafting, it is common practice to cover the exposed periosteum as frequent relapses and contractures may be observed during secondary epithelialization healing. According to other researchers [10] vestibuloplasty with secondary epithelialization, when the exposed periosteum is not covered with a flap of mucosa or by secondary epithelialization, there is a definite tendency to relapse. There are studies in dental literature describing the main principles of wound contraction as observed over a period of 6 months [10]. Therefore the use of xenogeneic materials such as Mucoderm® would be a good alternative for the reduction of morbidity and discomfort as well as reduction of the number of autogenous grafts, thus eliminating the need to create another wound surface as the donor site.

The ideal soft-tissue transplant must support hemostasis, relieve pain, assist faster epithelialization, prevent infection, the formation of exuberant granulation tissue and contracture without the need of further wound areas. Nowadays there are various types of collagen grafts in use for numerous applications and with different success rates [20].

Mucoderm® (Botiss dental, Berlin, Germany) is a 3D collagen tissue matrix derived from porcine dermis. The final product is obtained through a multi-stage process where cellular elements are removed and the risk of immune reactions is decreased. This 3D collagen matrix is composed of collagen and elastin, supporting revascularization and subsequent fast soft tissue integration. Mucoderm® has a well-organized structure with open porous surface that supports the ingrowth of blood vessels and soft tissues. Mucoderm® can be rehydrated in sterile saline solution or in the autogenous blood of the patient. Clinically the rehydration in a patient's own blood would create a better environment for tissue ingrowth and delivery of growth factors through the blood serum and plasma [16].

There are various approaches and techniques for retaining the vestibular depth post-surgery. One way to achieve better vestibular deepening is overcorrection, however, overcorrection in vestibuloplasty of the mandible in the chin area can result in an adverse aesthetic outcome, such as chin drooping [21], change in the appearance of the vermilion border [22] as well as excessive flattening of the mentolabial fold [23]. Frequently such changes in the soft tissue profile are considered a complication that patients suffer from [24]. Another way to retain the postoperative vestibular depth is the fabrication of surgical splints [25] which is related to an increased cost of treatment. Furthermore, splints must be secured firmly in place using titanium screws, mandibular ligatures [10], [25], transmucosal screws [25] or fibrin adhesives [26].

Splints fabricated in advance are used not only to fix the tissues in their new position immediately after surgery, but also to secure the transplant regardless of its type and to ensure maximum contact with the recipient site, preventing any risks of hematoma formation. However, the very removal of mandibular

ligatures, titanium or transmucosal screws proves to be an additional trauma for the patient, requiring administration of local anesthetic. The presence of splints impairs the quality of life and makes it difficult for patients to maintain good oral hygiene.

The main criteria used when evaluating the success of the surgical intervention are as follows: long-term preservation of medium or medium deep vestibule; no signs of tightening of the oral mucosa; absence or a very small amount of scar tissue in the long term after surgery; fast re-epithelialization of wound surface in the postoperative period. Therefore, the fabrication and fitting of dental prostheses must be carried out as early as possible after vestibuloplasty. However, there are conflicting opinions in dental literature as to how soon new prostheses are to be fabricated following preprosthetic surgery. Some authors [27, 28] advise a timeframe of 4 to 5 weeks post-surgery, while others [18] recommend 9 to 12 weeks as they argue that transplant maturation is not fully completed until the third or fourth month, and changes in its contour may continue for up to a year after surgery.

Dental impressions for the fabrication of new prostheses can be taken as early as 7 to 10 days post-surgery. This is readily accomplished with little discomfort since the patient is anesthetized and nerve endings in the grafted tissue are not fully developed. [18]. In addition, using a graft to cover the periosteum prevents irritation and thus decreases surgical wound morbidity. The donor site is the most painful due to the presence of unprotected nerve endings [18]. Thus, early fabrication of new dentures leads to optimal preservation of postoperative results and minimizes shrinkage or relapse. Additional round shaping of the borders of the new prosthesis would more naturally fit the U-shaped profile of the vestibular sulcus.

Provided new dentures are not fabricated, to maintain the effect of vestibuloplasty Amphlett and Colwell recommend readjustment of old dentures within 7-10 days post-surgery when also taking alginate impressions is not a painful experience [18]. A fair conclusion in this case would be that fixed denture impressions can be taken earlier than 4-5 weeks, i.e. 7-10 days post-surgery. In this way the results gained through vestibuloplasty can be maintained in the best possible degree.

Konstantinova et al. [29] also conducted a study of early prosthetic loading dental where prostheses were fabricated prior to vestibuloplasty with a Mucoderm® xenogeneic transplant. The prostheses were readjusted on 7th day post-surgery to ensure optimal surgical results. The study showed that the earlier the prosthetic treatment was performed after vestibuloplasty, the better results were achieved.

According to Hillerup [30] relapse should be considered any loss of vestibular depth that occurs post-surgery. Relapse is the result of the interaction between the postoperative wound contraction and the formation of granulation tissue. The force of contraction increases with the thickness of the granulation tissue in the wound [31]. In vestibuloplasty with Mucoderm® grafting material in combination with secondary epithelialization, a small groove forms at the base of the vestibule which could lead to loss of postoperative depth and muscle reinsertion. Early prosthetic treatment within a short timeframe after surgery could prevent these consequences and the formation scar tissues.
The results obtained in the present study indicated that the use of Mucoderm® xenogeneic grafting in vestibuloplasty reduced morbidity and discomfort in the postoperative period. However, if prosthetic treatment does not follow shortly after, there is a definite tendency for relapse to occur.

Conclusion

The present study of the results gained through vestibuloplasty of edentulous mandibles in combination with a xenogeneic dermal grafting of porcine origin (Mucoderm®) revealed that the grafting material was found to be a favorable alternative for increasing attached mucosa, effectively covering the exposed periosteum and assisting the healing process. It also eliminated the need for a second wound surface, thereby reducing morbidity and discomfort in patients and shortening the postoperative period. Mucoderm® is easy to apply, shape and fix and does not require any special conditions of application and storage. Practically it offers unlimited supply. However, to ensure the maintenance of surgical results, plaque prostheses treatment must commence as early as possible after vestibuloplasty, i.e. not later than 7-10 days post-surgery. The fitting of prostheses will preserve the postoperative depth and prevent rigid scarring at the base of the newly-acquired vestibule and the formation of a V-shaped groove. Early prosthetic treatment leads to an improved quality of life for patients and makes them more receptive to vestibuloplasty surgery.

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