Review

Full-thickness nasal defect: Place of prosthetic reconstruction

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A B S T R A C T

Extensive rhinectomy or full-thickness defects are not uncommon, in particular in the treatment of skin cancer. The present study lays out the principles of choice and creation of prostheses for nasal reconstruction. Prosthetic nasal reconstruction in France depends on a specialist prescription drawn up under the “Ocular and Facial Prostheses” rubric of the official List of Products and Procedures. National health insurance cover is 100% on condition that the prosthesis is produced by an approved prosthetist. The present study describes production stages, forms and means of fixation, and the timeline of implantation. Nasal prosthetic repair is simple, fast and functional, allowing social rehabilitation despite full respect of carci-nologic margins, and without ruling out subsequent multilayer reconstruction. Benefits and drawbacks, and the factors determining repair options according to pathologic context are discussed. Nasal prostheses are an integral option in the repair of full-thickness nasal defects and total rhinectomies. The head and neck surgeon needs expertise in indications and techniques of reconstruction, so as to prescribe nasal prostheses as the context demands.

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1. Introduction

Nasal full-thickness defect repair is among the most difficult challenges in head and neck repair surgery. Presenting contexts may be traumatic or infectious (leprosy), but especially concern deep invasion by cutaneous tumor. The tip, wing and columella may require full-thickness repair [1–3].

The challenge is obviously primarily esthetic, as the nasal pyramid is essential to facial visual symmetry and deformity easily entails severe esthetic blemish [2,4]. Secondly, it is desirable to restore good respiratory permeability [5–6].

Optimal esthetic results usually require reconstruction of the three anatomic layers defined in Burget’s princes description: the deep mucosal lining, intermediate cartilage and superficial skin [7,8]. Nasal reconstruction should be clearly explained to the patient [9,10].

In extensive full-thickness defects, especially in elderly subjects or patients with poor general health status, the use of a facial prosthesis should be discussed and explained. This represents a real alternative to 3D surgical reconstruction of the pyramid. The results are usually socially acceptable from the esthetic point of view, especially when the entire nasal pyramid is to be reconstructed [11,12]. The present study lays out the principles for prescription and implantation of such facial prostheses along with their role, interest and limitations.

2. Principles and procedures

2.1. Regulatory considerations

In France, national health insurance cover for facial prostheses requires a specialist prescription by an ENT surgeon, ophthalmologist, dermatologist, radiotherapist, etc. On condition that the prosthesis is produced by Health-Ministry-approved prosthethist, cover is 100% under rubric II, Section 5 (“Ocular and Facial Prostheses”) of the List of Products and Procedures (Liste des produits et prestations: LPP) covered by the national health insurance system.

On reception of the medical prescription, the prosthetist must begin by drawing up an estimate detailing the various stages of production, specifying the materials and equipment required to fulfill the prescription with respect to the individual patient. This involves filling out a preliminary approval form called CERFA S3604c [13] to be enclosed with the prescription and the estimate and sent to the patient’s local national health insurance office (Caisse d’assurance maladie: CAM).

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Like with any other prescription requiring preliminary approval, a written insurance coverage agreement must be provided by the CAM; according to the regulations, the request is deemed to have been accepted by default if no reply is received from the CAM within two weeks. Once the prosthesis has been manufactured, the prosthetist draws up an invoice based on the agreed items of the estimate sent to the CAM, and the CAM settles the invoice directly as third-party payer, without any up-front payment by the patient. The prosthesis may be renewed, again receiving full coverage, at a 2-year interval (or before, in case of biometric change to the implanted body region specified by the prescribing physician in a new prescription).

2.2. Manufacture

The first stage of manufacture consists in taking an imprint of the affected area, using high-fluidity condensation-cured silicone, so as to model the relevant body area with a high degree of precision (Fig. 1).

A cast is produced from the imprint, using a material such as dental plaster, onto which the form of the prosthesis is molded in hot modeling wax; this preliminary model is then directly tried out on the patient and refined by adapting the edges and finishing the surfaces, so as to render skin texture and any wrinkles or irregularities of the tegument. A second plaster mold (or counter-mold) is then taken, and the wax is melted off. The final prosthesis is then cast in the counter-mold using colored heat-cured medical silicone (Fig. 2).

The final step is performed with the patient: using natural pigments mixed in fluid silicone, the prosthetist paints the final coloring onto the prosthesis, by hand, in minute detail, with micro-brushes, millimeter by millimeter, so that it blends with neighboring tissue, vessels, telangiectasias, and skin markings, etc.

A final heat treatment fixes this definitive skin coloring on the prosthesis.

2.3. Types of nasal prosthesis

2.3.1. According to location

Facial prostheses may be applied in various areas of the face and be of varying size according to the loss of substance to be reconstructed. A nasal pyramid prosthesis, for example, is used to replace all or part of the nose, and, on the same principle, a pinna prosthesis may be used following total or partial ablation of the pinna,
a palpebro-orbital prosthesis following orbital evisceration, or a hemifacial prosthesis to replace a larger area of the face.

2.3.2. According to fixation technique

For each type of fixation, a study is performed of the area to be treated, the feasibility of osseointegrated implantation to facilitate fixation, skin sensitivity and also, for example, the patient’s skill in gluing the posterior side of the implant in totally or partially glued models. There are several different fixation methods:

- glue (Fig. 3): this is simple, but may not be feasible due to prosthesis weight and/or skin intolerance to the adhesive;
- implant fixed onto eyeglass frame (Fig. 4), allowing greater prosthesis weight; this may use the patient’s own corrective glasses, or a dummy;
- clip or magnetic fixation with bone-anchorages; usually 2 to 4 anchorage implants are required (Fig. 5) [14]. This type of fixation has the advantage of congruence, without risk of losing goodness of fit or adhesion. Bone implantation follows the classic principles of dental implantology [15]. When radiation therapy (RT) has been performed, an interval of several months (generally, 6–9 months) must be respected before implantation. The prosthesis can then be fitted, but only after complete healing of the bone anchorages. Ethunandan et al. [11] reported 111 Branemark implants in a series of 34 patients, with a success rate of 89% (99 definitively functional implants); smoking and previous RT were factors for impaired osseointegration. Depending on operator preference and context, implantation may be performed in the same step as resection or secondarily [14];
- prosthesis embedded in existing undercut in the operated area. The principle consists in making use of the natural depression left by resection so as to insert the prosthesis with optimal congruence. This method is mainly applied in prostheses of the superior maxillary infrastructure.

Obviously, these various methods can be associated, so as to stabilize the prosthesis as effectively and straightforwardly as possible. Teamwork with the prosthetist should begin as soon as

![Fig. 3.](image1) (A) Full-thickness dorsum nasi defect, (B) and prosthesis glued in position.

![Fig. 4.](image2) (A) Total nasal pyramid defect (B) and eyeglass-mounted prosthesis in position.

![Fig. 5.](image3) (A) Extensive full-thickness orbito-palpebro-nasal defect following recurrence of ethmoid adenocarcinoma, (B) and prosthesis fixed by magnets on osseointegrated screw-fixed implants.
possible, to plan the optimal fixation procedure. The patient should therefore be referred to the prosthodontist in the early stages, which also helps the patient understand how his/her prosthesis is produced.

3. Results and discussion

There are no randomized comparative studies of esthetic and functional results in nasal prostheses. This is doubtless due to the rarity of extensive nasal defects and the difficulty of asking the patient to accept a lottery for the management of rhinectomy. Literature reports are for isolated cases or small series; results are reported, but without comparative study. The option of a nasal prosthesis is, however, standardly proposed to patients presenting limitations in terms of age, general health status and anesthesia status. In our own experience and according to the literature, nasal prostheses offer a real alternative to 3-layer reconstruction surgery, and patients should certainly be informed of this treatment option.

3.1. Benefit

Implantation has the clear advantage of respecting carcinologic margins. This is especially important in elderly or fragile patients, in whom revision surgery is complicated. Resection can, from the outset be extensive, performed under general anesthesia in a single step, especially in case of total rhinectomy. In extensive or total rhinectomy, reconstruction surgery on the other hand, is always 2 or even 3-step; moreover, subsequent corrections are needed, which are problematic for patients who are fatigued, fragile and unwilling or unable to come easily to hospital.

The esthetic result almost always looks like a normal nasal pyramid. The prime objective is to provide the patient with a socially acceptable outcome as quickly as possible.

The tumor resection bed remains perfectly accessible, enabling high quality postoperative monitoring.

Postoperative adjuvant RT, when indicated, can be initiated after a reasonable interval, within 4 to 6 weeks of rhinectomy, whereas reconstruction surgery may involve a longer delay.

Given a complete specialized prescription, the French national health insurance system covers nasal prosthesis implantation at 100%.

The prosthesis can always be renewed after 2 years, on prescription, or earlier if medically justified by biometric changes in the affected area (skin atrophy, radiation-related effects, etc.) or to the implant itself (material degradation, color change, etc.).

Implantation, in no way, prejudices subsequent multi-layer reconstruction repair: when this is agreed upon by patient and surgeon, the prosthesis can be simply replaced by another reconstruction option.

3.2. Drawbacks

The removable nature of a nasal prosthesis is regularly reported as a physical and psychological problem for bearers, who have to get used to the idea of a non-definitive nasal structure.

In case of postoperative RT, the prosthesis cannot be prepared immediately: time must be given for the irradiated tissue to heal and stabilize. This interval is generally of about 6 months following the end of RT, but may be longer depending on skin reaction: erythema, dermatitis, effusion, crust, fragility, etc. Implantation performed too soon after RT may be complicated by tissue effects (retraction, atrophy) rapidly impairing prosthesis adaptation and also by contact intolerance and healing disorder, including possible prolonged skin and/or mucosal ulceration.

The prosthesis requires daily maintenance, especially on the endonasal-endosinus-mucosal sides, where there is continual formation of crusts that may become malodorous if not regularly removed.

Transient or late changes in skin tone around the prosthesis (sun-tan, RT-related atrophy or telangiectasias, changes in wrinkle pattern) may mar esthetic integration.

The nasal prosthesis is never definitive, because both the surrounding area and the prosthetic material itself are subject to changes. Ultraviolet exposure tends to fade implant coloring, and the silicone of which the implant is made tends to become more rigid, affecting congruence. Patients should be warned of the need to renew their prosthesis after an interval generally ranging from 18 to 24 months.

3.3. Perspectives

Producing a nasal prosthesis is, in the present situation, a kind of “handicraft”. The prosthodontist proceeds manually in molding the nasal defect to produce the silicone cast, creating relief and skin-pattern details and coloring the implant so as optimally to match the teguments. Recent publications have described new perspectives, still at the experimental stage, based on data transfer (digital files) from medical imaging to rapid prototyping by 3D “additive layer” printing [16–18]. This technology is yet to come into routine use, but promises rapid design of prostheses perfectly adapted to patient anatomy.

4. Conclusion

Nasal prostheses offer a solution for nasal defects, entirely covered by the French national health insurance system. They are simple, quick, esthetic and functional, enabling social reintegration with no compromise with respect to oncological demands. They in no way prevent subsequent resort to surgical reconstruction, if the patient so wishes. The pros and cons, and demands of the technique should be known and presented to the patient so as to guide choice of treatment options.

Nasal prostheses are an integral part of the range of options in extensive nasal pyramid defect. ENT and head and neck surgeons should master their indications and be in a position to prescribe this type of implant.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

References


