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Prosthetic Rehabilitation After Craniofacial Surgery

ABSTRACT—We report our experience during the last 6 years with 20 patients fitted with prosthesis (19 patients with osseointegration of screw, 1 patient with primarily gluing method) for camouflage of congenital or acquired (trauma, tumor resection) defects of the ear, nose, or eye. Out of a total of 53 extra-oral implants fitted, 3 were lost in the orbital area due to loosening 6 months after radiation treatment. Another three implants were removed at the request of an 80-year-old patient who preferred a prosthesis retained by spectacles because of recurring infection around one of the implants. On average, 43 months (range, 7 months to 8 years) after completion of the prosthesis, 85% of the patients assessed the result as excellent, 15% as good, 0% as fair, and 0% as poor. The ENT surgeon and the prosthesis designer were slightly more critical (ENT surgeon—95% good or excellent and 5% fair, prosthesis designer—90% good or excellent, 10% fair). (*Skull Base Surgery, 6(4):207–213, 1996*)

Extensive defects in the region of the ear, nose, or eye socket as a result of tumor resection, congenital deformities, or trauma require satisfactory cosmetic reconstruction to enable the patient to achieve full psychosocial and occupational rehabilitation and integration as early as possible. Prosthetic reconstruction has now become an established alternative to techniques using autogenous tissue.[1–11] Branemark's method of fixation using osseointegrated screws[12] offers additional benefits because it provides reliable and stable anchorage. This can be a viable option, particularly for patients who are not willing to undergo major plastic surgery which sometimes requires several operations[13–17] or in whom such procedures are contraindicated. This report describes our experience with prosthetic rehabilitation in patients with craniofacial defects.

MATERIALS AND METHODS

Fitting a patient with an external prosthetic device is performed in three stages, two of which are operative and one reconstructive. The screw-shaped implants (Branemark system, Nobelpharma) are generally inserted in two operative stages. Stage 1 involves anchoring the screw in the bone. In Stage 2, the skin-penetrating suprastructure is attached to the screw implant. The intervening period is generally about 6 to 12 weeks. As osseointegration in the mastoid process has been so successful, we have now started performing stages 1 and 2 in one operation.

In a retrospective study during the last 6 years, we evaluated all patients who had undergone prosthetic reconstruction because of craniofacial defects. We looked for complications due to surgery and loss of implants during the follow-up period. Each patient, ENT surgeon, and prosthetic designer judged the cosmetic result according to the criteria shown in Table 1.

RESULTS

Between 1988 and 1995, 20 patients underwent reconstruction and rehabilitation for craniofacial defects in our department (Tables 2, 3). No complications occurred in connection with the insertion of osseointegrated fixtures. The patients were examined after an average follow-

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Table 1. Grading of Success

	Patient	*Surgeon*	*Designer*
Excellent	Satisfied, prosthesis not noticed by others, no problems in handling prosthesis	Prosthesis difficult to recognize because of perfect reconstruction as regards size, shape, and color	Prosthesis difficult to recognize because of perfect reconstruction as regards size, shape, and color
Good	Satisfied, prosthesis noticed and favorably judged by others, few or no problems in handling prosthesis	Little difference from other side or size, shape, and color	Little difference from other side or neighborhood regarding size,shape, and color
Fair	Dissatisfied, prosthesis noticed and unfavorably judged by others, problems in handling prosthesis, wants prosthesis improved	Noticeable difference from other side or surroundings as regards size, shape, and color, fixation is not adequate	Noticeably different from other side or neighborhood regarding size, shape, and color, fixation is not adequate
Bad	Very dissatisfied, wants prosthesis replaced because of cosmetic results or problems in handling it	Disfiguring cosmetic result, bad fixation, prosthesis has to be replaced	Disfiguring cosmetic result, bad fixation, prosthesis has to be replaced

Table 2. Indication for Prosthesis in Craniofacial Surgery

	Tumor	*Trauma*	*Malformation*
Ear	3	2	10
Nose	1	0	0
Orbit	4	0	0

n = 20

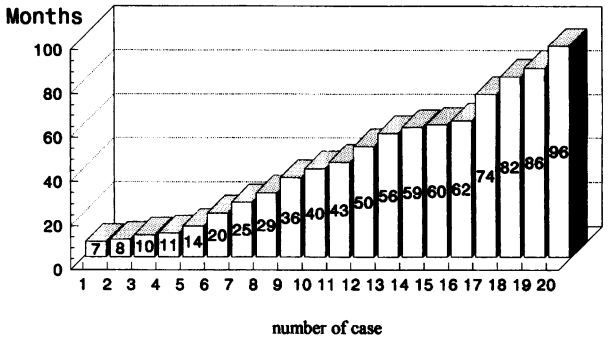

Figure 1. Follow-up period of all 20 patients.

up period of 43 months (range, 7 months to 8 years). Figure 1 shows the length of follow-up for each of the 20 patients. The ratings of the prosthesis given by the patient, the surgeon, and the prosthesis designer, respectively, are shown in Table 4. All in all, the patients judged the results to be excellent in 85% of cases and good in 15%. None of the patients assessed results as fair or poor. In view of the good cosmetic results, the patients did not see the use of artificial materials for the reconstruction as a drawback. The doctors classed the results as excellent or good in 95% of cases and fair in 5%. The prosthesis designer's assessment was 30% excellent, 60% good, and 10% fair.

We observed no intolerance reactions in the form of allergy or nonallergic skin irritation. Out of a total of 53 implants, 50 were well integrated and firm. Three implants (one patient) in the orbital region became loose after radiotherapy with 60 Gy in this region and had to be removed 15 months after implantation. Four implants in the auricular region were still firmly anchored after 15

Table 3. Prosthetic Rehabilitation in Craniofacial Surgery

	Gluing	*Spectacles*	*Osseointegrated Screws*
Ear	0	0	15
Nose	0	1*	1
Orbit	2	0	2

n = 20; *In this case fixation was initially achieved with osseointegrated screws and later by means of spectacles.

Table 4. Judgment of Esthetic Results After Prosthetic Reconstruction

	Patient	*Surgeon*	*Designer*
Ear			
Excellent	15	14	5
Good	0	1	10
Fair	0	0	0
Bad	0	0	0
Nose			
Excellent	0	0	0
Good	1	1	1
Fair	0	0	0
Bad	0	0	0
Orbit			
Excellent	2	2	1
Good	2	1	1
Fair	0	1	2
Bad	0	0	0

n = 20

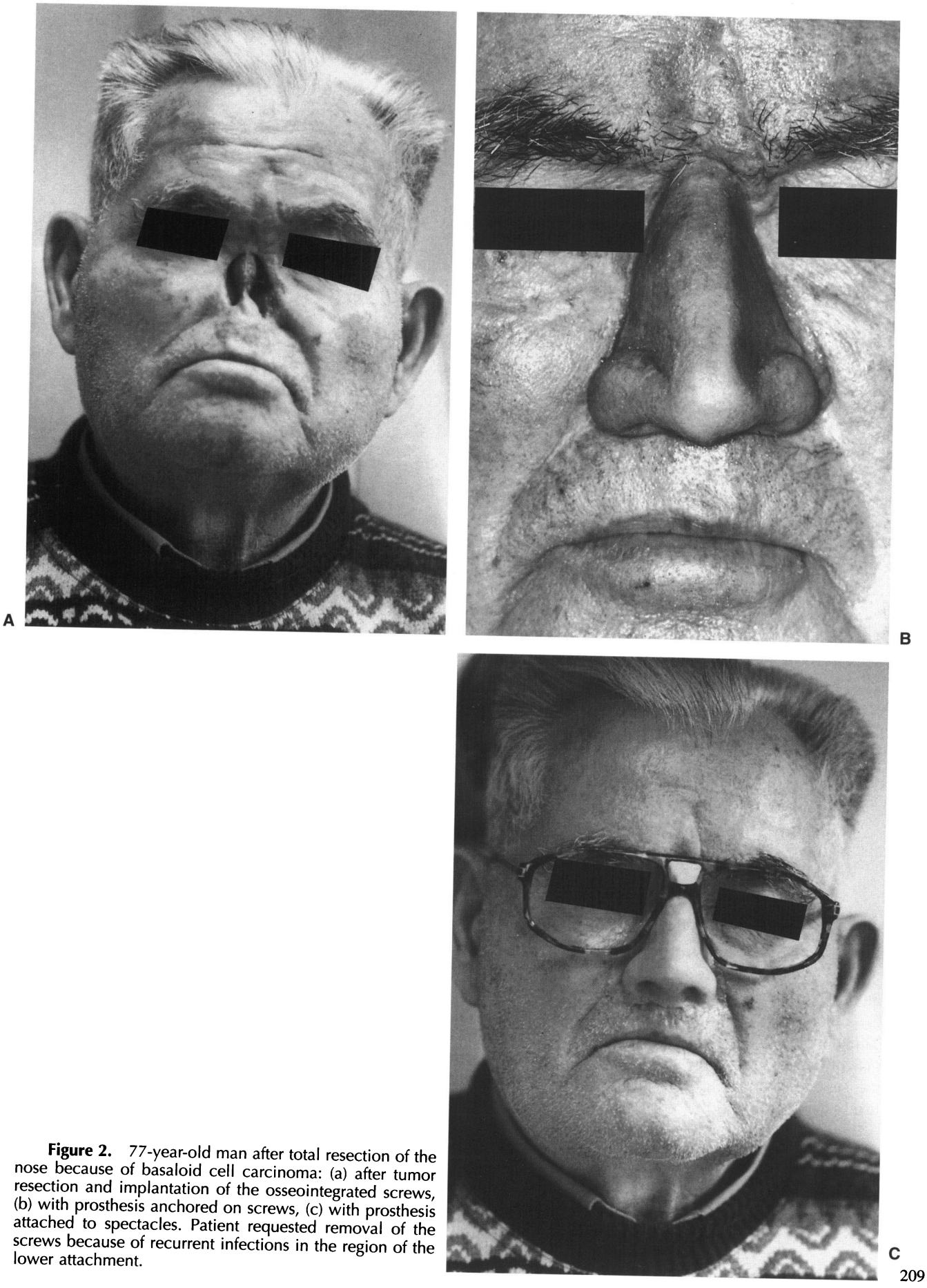

Figure 2. 77-year-old man after total resection of the nose because of basaloid cell carcinoma: (a) after tumor resection and implantation of the osseointegrated screws, (b) with prosthesis anchored on screws, (c) with prosthesis attached to spectacles. Patient requested removal of the screws because of recurrent infections in the region of the lower attachment.

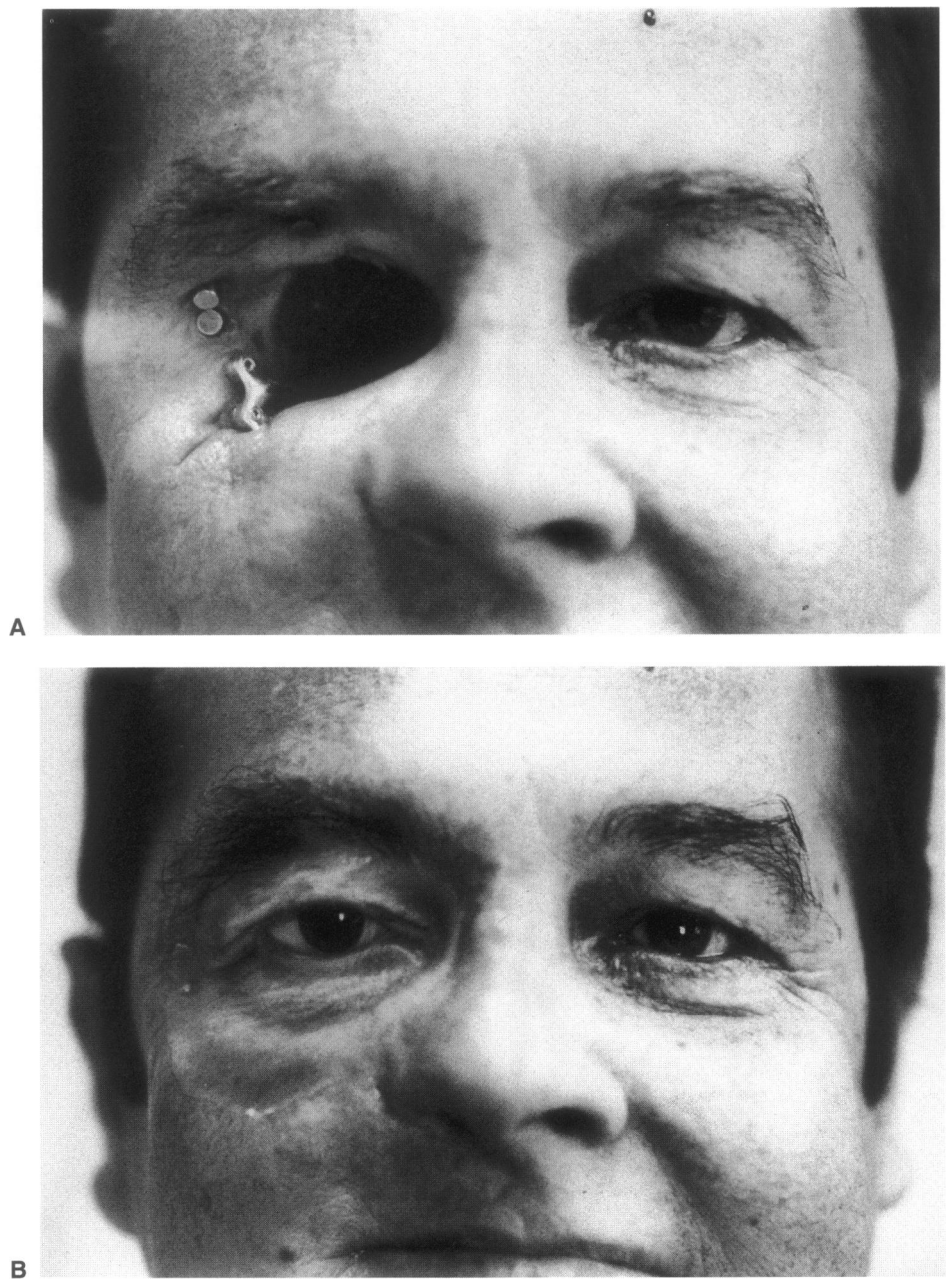

Figure 3. A 46-year-old man with cancer of the right maxillary sinus extending to the base of the skull: (a) after tumor resection and implantation of the osseointegrated screws, (b) with prosthesis.

months, despite similar radiation treatment with 60 Gy. In the other cases radiation therapy was not performed. Three implants in the nasal region were removed, as the patient had recurring skin irritation due to loosening of the suprastructure. The implants themselves were still firmly anchored.

DISCUSSION

There are three basic methods of prosthesis retention:

1. The device can be glued to the skin with adhesive.
2. It can be mounted on spectacles (Fig. 2).
3. It can be retained by osseointegrated fixtures to which the prosthesis is attached using either press studs or magnets (Figs. 3, 4).

In the region of the ear, osseointegrated fixation should be the method of choice. With glued prostheses, cleaning off the adhesive soon damages the delicate edges, which have to be modeled thinly to ensure a good fit in this region. Devices mounted on spectacles tend to slip and thus make the patient feel insecure. Bone-implanted fixtures resolve the patient's anxiety and eliminate the urge for constant checking of appearance in a mirror. In the region of the ear, two fixtures are usually sufficient.[9]

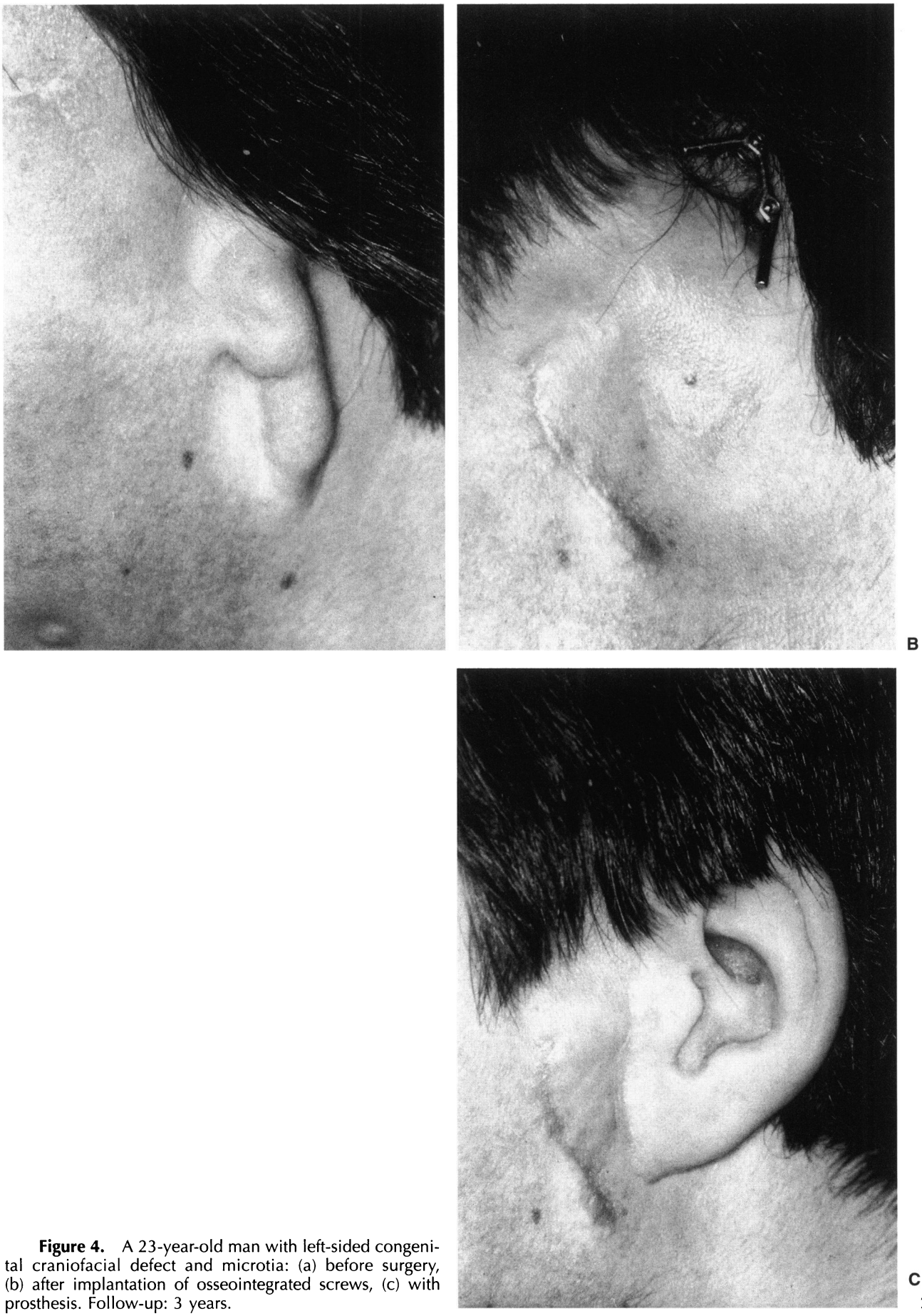

Figure 4. A 23-year-old man with left-sided congenital craniofacial defect and microtia: (a) before surgery, (b) after implantation of osseointegrated screws, (c) with prosthesis. Follow-up: 3 years.

Whenever possible, they should be positioned approximately at right angles to the skin surface, and the surrounding skin should be free of hair follicles. This can be achieved by skin grafts or by reducing the subcutaneous tissue to remove the hair roots.[1] As integration of the implants has been so problem-free, we have now started performing the two operative stages of the procedure in a single session.

Fixation by means of osseointegrated implants has more advantages than drawbacks in the nasal region. It allows for the greatest freedom of movement combined with a firm anchorage. Two fixtures are sufficient even for the nose. They are positioned in the inferior region of the piriform aperture pointing slightly forward. The constant movements of air in the nose cause mechanical stress and constant moisture. A glued prosthesis might therefore loosen or even come adrift when sneezing, as the accumulation of moisture weakens the adhesion. For this reason, Laaß et al[5] use a so-called "snort test" to check whether the attachment is sufficiently firm or whether a stronger adhesive is needed. Fixing a nasal prosthesis to spectacles is also quite reliable and has the added advantage that the glasses conceal the interface with the skin.

The problem of moisture and airflow causing stress on the device also occurs in the orbital region when tumor resection or injuries have left an open passage to the nasal cavity. Otherwise, a glued prosthesis is quite reliable. Fitting it to spectacles can also give a pleasing cosmetic result. However, a bone-anchored prosthesis attached with magnets provides not only a firm fit but has the added benefit that the patient can insert it without using a mirror. Three or four fixtures are desirable in this case, so that there is a reserve in the very unlikely case that one might be lost. Fixation is usually best performed in the cranial portion of the orbit (supra-orbital clip), especially if the caudal part of the orbital margin is lost after cancer surgery. It is important to drill vertically in this case.

Previous irradiation of the bone into which osseointegrated fixtures are to be implanted must be considered a risk factor.[18] Demineralization and fibrosis of the bone occur as a result of radiation, resulting in a higher risk of infection, which could ultimately lead to avascular necrosis.[18] The time lapse between radiation trauma and the implantation of the fixtures is therefore significant. In the literature, authors differ in their assessments of this. Whereas Jacobsson[19] proposes a wait of 1 year, Marx and Johnson[20] recommend proceeding 1 to 6 months after irradiation. The loss of implants in the orbital and maxillary regions is reported to be 58%.[18] Grantström has demonstrated that hyperbaric oxygen treatment stimulates angiogenesis in the bone and that the loss rate was reduced to 2.6% over a 2-year observation period.[18] If there is any doubt, a glued prosthesis should be given preference over osseointegrated implants after irradiation, especially in the orbital region.

Our results are in line with the literature. Parel and Tjellström describe success rates of 98.3% in the mastoid region, 91.8% in the orbital region, and 100% in the nasal region,[6] whereas the number of nose cases ($n = 9$) is too small to allow definitive statements at this stage. Present experience shows that firm integration between the skin and the underlying bone is crucial. As it is often impossible to achieve this in the nasal area, the incidence of irritation around the abutments is higher there.[3] Schwipper[8] implanted 88 osseointegrated fixtures in 32 patients (34 prostheses). The indications were auricular resection because of cancer,[16] auricular deformities,[10] loss of an ear through trauma,[1] orbital exenteration because of tumors,[5] and ablation of the nose because of tumors.[2] The success rate was 93.2% (82 of 88 implants). Tjellström[11] reports on 94 patients who received an artificial ear. Two out of 303 (0.7%) fixtures had to be removed because of failed integration, and one due to soft-tissue infection. Abutments were lost due to soft-tissue infection in 4 out of 244 cases (1.6%). Jacobsson et al implanted 59 titanium fixtures in the temporal bone of 30 children with congenital ear defects.[4] Only 2 (3.4%) failed to integrate. Federspil and Delb reported on 105 titanium implants (22 bone-anchored hearing aids, 20 bone-anchored prostheses), of which 4 failed to integrate.[1] In our opinion plastic, reconstructive surgical rehabilitation with the same esthetic result is more costly (see Table 5).

Table 5. Cost of Material and Prosthesis

	Cost for Implantation Material	*Manufacturing of Prosthesis (German prices)*
Ear	1383 US$	4943 US$
Nose	1882 US$	4081 US$
Orbit/Eye	2460 US$	6204 US$

All prices without tax

All in all, it can be said that prosthetic reconstruction of the ear, nose, or eye socket following resection of craniofacial tumors or for treatment of congenital or traumatic defects leads to successful rehabilitation adapted to individual needs.

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The revised manuscript was checked by Hilary Coleman, a physician whose primary language is English and who is a professional translator.