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Improvement in oral function following tumour surgery by a combination of tongue plasty by the Steinhäuser technique and osseointegrated implants

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SUMMARY. **Oral functions such as speaking, chewing and swallowing are often reduced after ablative tumour surgery in the mouth and oropharynx. For restoration of at least a part of these functions, stable dentures and satisfactory mobility of the tongue are necessary. Dental implants can be used to achieve stable dentures. Pre-implant surgery, however, is often needed to reduce the amount of bulky tissue when myocutaneous flaps have been used for reconstruction, and to achieve adequate mobility of the tongue.**

A combination of tongueplasty by the Steinhäuser technique and osseointegrated implants will be described and discussed. Twelve patients have been treated by this technique between 1992 and 1995, with a mean follow up of 11.6 months. All patients reported an improved tongue mobility and ability to chew.

Tongueplasty by the Steinhäuser technique with secondary epithelialization, in combination with osseointegrated implants, is a simple and effective means of improving oral function.

INTRODUCTION

In patients with malignancies of the head and neck, the primary aim of surgery is radical removal of the tumour without any compromise between radicality and possible reconstruction of the defect. Closure of the defect is the secondary aim. The final aim is function, although here the viability of the tissues is frequently such that the surgeon is forced to accept compromises with respect to function in favour of successful bridging of gaps. The possibilities for rehabilitation are often even further reduced by the need for irradiation. Consequently, it is not surprising that restoration of functions such as chewing and speech is often quite a challenging task, since this has the lowest priority in the total management of such patients.

This paper describes the problems of edentulous patients presenting with unfavourable soft tissue conditions after tumour surgery in the lower jaw and the floor of the mouth, and offers a solution. A combination of a tongue plasty by the Steinhäuser technique (1987) and the use of osseointegrated implants is described and discussed.

INDICATIONS

Oral rehabilitation demands a solution to two inseparable problems. Firstly, the dental prosthesis must have sufficient stability. Retention is significantly reduced due to loss of flexibility of the floor of the mouth and the buccal sulcus after tumour surgery in this area (Fig. 1), either because of shortage of soft

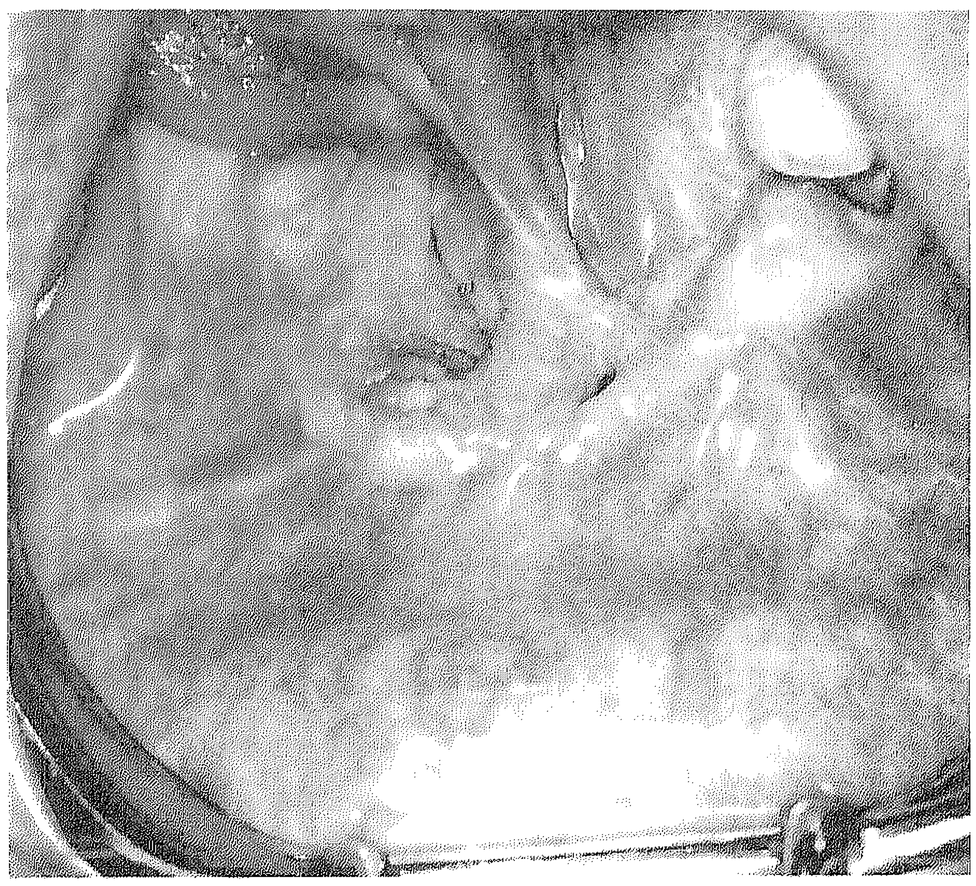

Fig. 1 – Preoperative intraoral view of patient reconstructed with a pectoralis muscle flap with impaired mobility of the tongue.

tissues overlying the defect after direct approximation or because of an excess of bulky tissue due to the application of myocutaneous flaps and microvascular grafts. Dental implants may be used to stabilize the dentures (*Misch* et al., 1990; *Weingart* et al., 1992; *Taylor* and *Worthington*, 1993; *Mericske-Stern* et al., 1994; *Scarloff* et al., 1994; *Franzen* et al., 1995). However, preprosthetic or pre-implantology surgery is often needed to effect an improvement in local conditions such that insertion of dental implants is possible and peri-implant tissues are suitable.

The second problem is the mobility of the tongue. In a study on functional reconstruction *McConell*

Table 1 – Initial treatment performed on the patients ($n=12$)

	Resection of tumour (including bone) and reconstruction with myocutaneous flap ($n=5$)	Resection of tumour (including bone) and reconstruction with local tissue ($n=3$)	Resection of tumour (without bone resection) and reconstruction with local tissue ($n=4$)
Radiotherapy ($n=7$)	3*	3*	1
No radiotherapy ($n=5$)	2	–	3

* One patient with loss of continuity of the mandible.

et al. (1987), stated that tongue mobility is the key to oral cavity function. *Logemann* and *Bytell* (1979) noted that problems with mastication were related to restricted tongue mobility. Scars in the tongue itself, loss of volume due to partial resection, loss of sensitivity and also displacement of the tongue by the bulk of the soft tissue reconstruction, on their own or in combination, impede speech, intraoral manipulation of food and swallowing. It therefore follows that, in addition to stabilizing the dentures, the mobility of the tongue should be improved as much as possible at the same time.

Solutions have to be tailored to the individual. Especially in those cases where there is restriction of tongue mobility, tongueplasty by the Steinhäuser technique (1987) has become a very valuable addition to our arsenal of surgical methods.

MATERIALS AND METHODS

Between 1982 and 1993, approximately 600 patients were treated surgically for an oral malignancy at the Department of Oral and Maxillofacial Surgery of the University Hospital Nijmegen. Oral rehabilitation by a combination of preprosthetic surgery and osseointegrated implants was performed on 41 of these patients between 1991 and 1995. Of these 41 patients, 12 (9 men and 3 women with a mean age of 61 years) were additionally treated using Steinhäuser's technique. The initial treatment performed on these patients is shown in Table 1. A total of 50 implants was inserted, of which 6 were placed in the upper jaw and the remaining 44 in the lower jaw. Table 2 shows the number of implants per patient in the lower jaw.

The main problems experienced by all these patients were inability to function with a conventional lower denture and impairment of the function of the tongue. Before deciding to operate, an attempt was made in 5 patients to tackle the problems by means of a conventional denture. In the remaining 7 patients it was felt that an attempt would not be meaningful without preprosthetic surgery.

Of the 12 patients, one was lost to follow-up due to death. The remaining eleven were followed-up for up to 4 years, with a mean of 21 months.

Table 2 – Location of the tumour in relation to number of implants placed in the lower jaw per patient

	Number of implants in lower jaw ($n=44$) per patient			
Location of tumour	2	3	4	5
Tongue	–	1	2	–
Floor of the mouth	2	–	5	–
Inf. alv. proc.	–	–	1	1

TECHNIQUE

The technique utilized was as recommended by Steinhäuser (1987). An incision is made in the depth of the vestibular sulcus, thus defining the size of the flap (Fig. 2). The width of the flap is chosen to suit the individual patient, but should not have to be more than hemimandibular. Transverse incisions from the vestibular to the lingual sulcus are made taking care not to incise the periosteum. The flap is then raised submucosally from the vestibulum towards the lingual side into the tongue. The lingual tissue adherent to the mandible is mobilized by epiperiosteal preparation towards the caudal border of the mandible. Part of this tissue, for instance the bulk of a myocutaneous flap, can be excised if necessary. This procedure was performed in 6 patients. The flap from the vestibulum is fixed in the depth of the floor of the mouth for 6 days by 2–4 transcutaneous sutures knotted over submandibularly placed buttons (Fig. 3).

Implants are placed as follows: the periosteum is incised and raised on top of the alveolar process, the bone is smoothed if necessary, implants are inserted in accordance with the Brånemark protocol and the periosteum is sutured back covering the implants (Fig. 4). Healing occurs by secondary epithelialization. This procedure can be combined with further

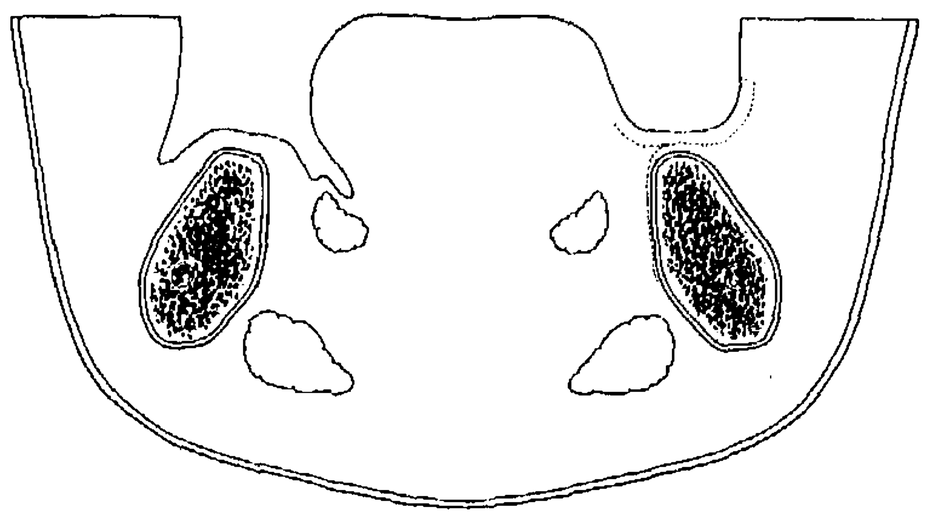

Fig. 2 – Schematic drawing illustrating incision of buccal flap (dotted line) to be raised for tongue plasty.

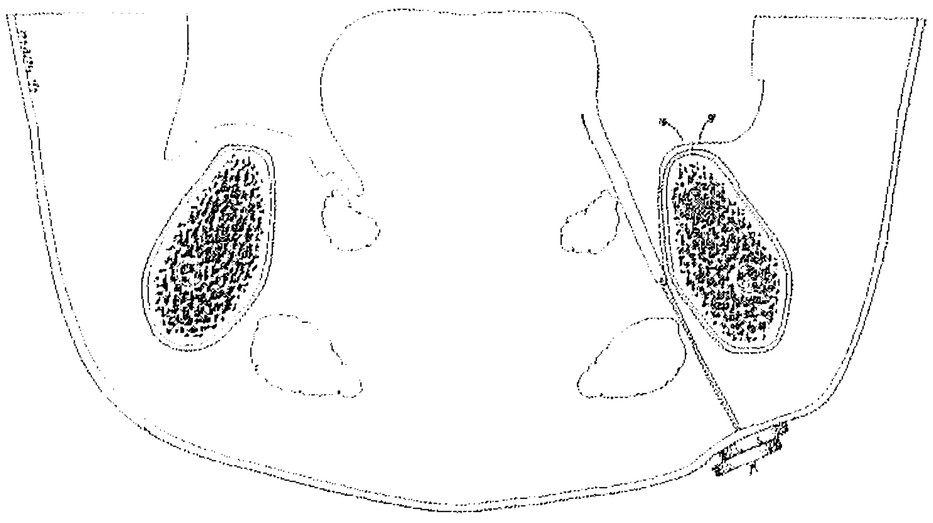

Fig. 3 – Schematic drawing of fixation of the tongue plasty over extraoral buttons and localization of incision (arrows) on top of alveolar process for insertion of implants.

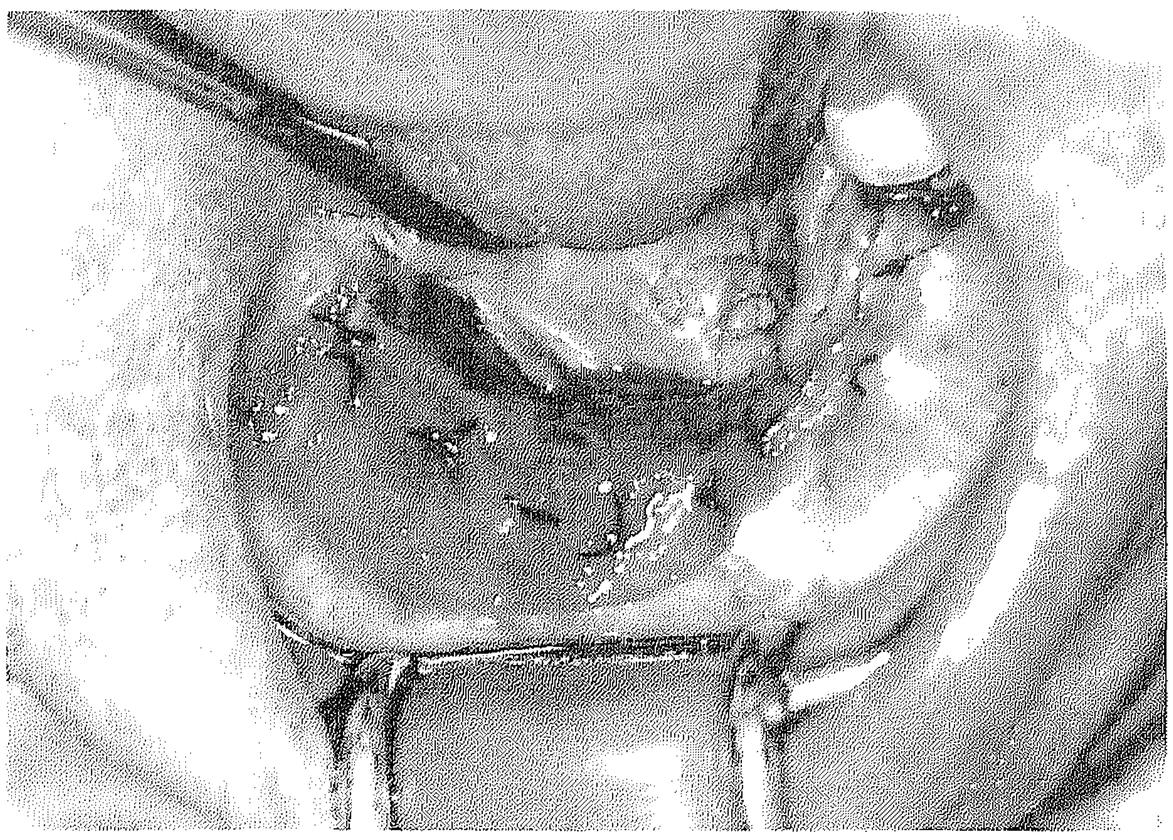

Fig. 4 – Direct postoperative view of closure of the periosteum after insertion of implants.

preprosthetic surgery on the mandible, such as conventional sulcoplasties.

After approximately one month the wound area is fully covered by epithelium. The implants are uncovered after 3 months (Fig. 5) if the mandible has not been irradiated or after 6 months if the patient has had radiotherapy prior to implant insertion.

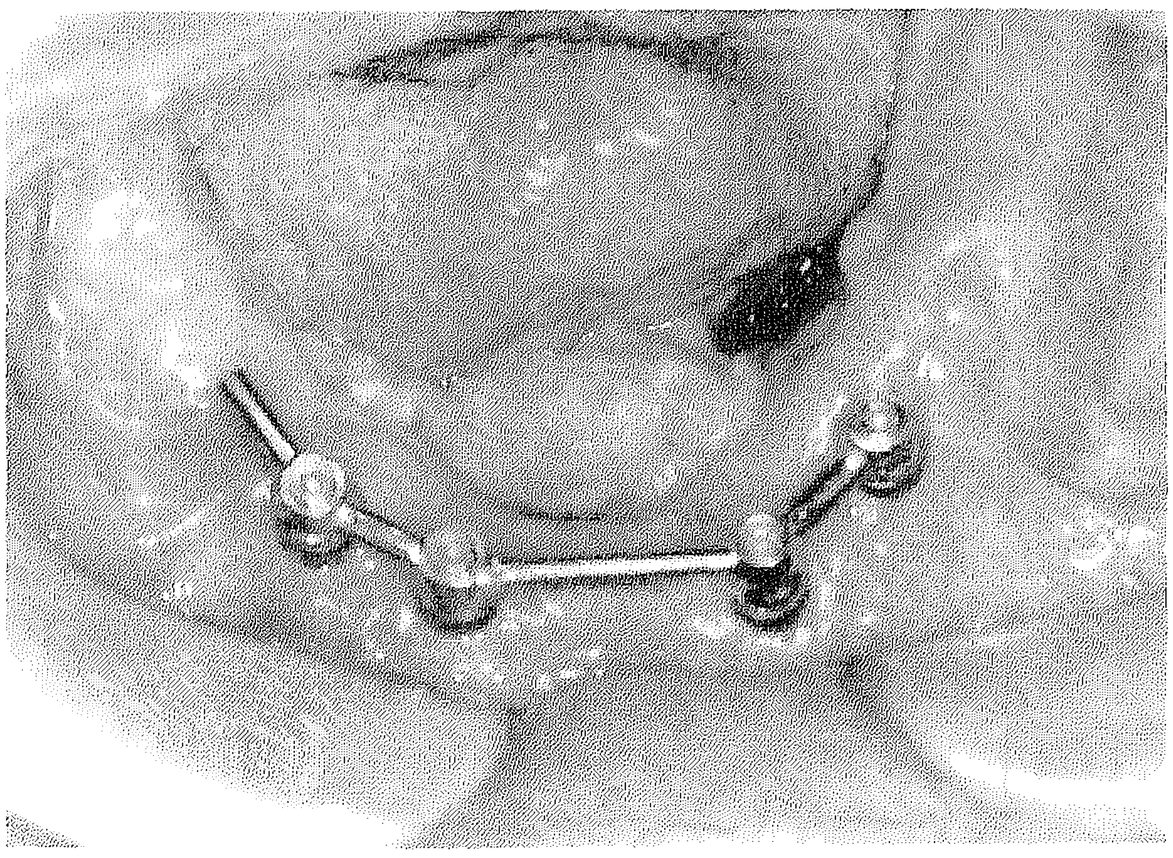

Fig. 5 – After insertion of the abutments tooth 35 has been removed and the superstructure has been inserted. Adequate mobility of the tongue has been achieved.

RESULTS

In 5 of the 7 patients who had received radiotherapy wound dehiscence developed on top of the alveolar process in the area of the incision made when inserting the implants. In three of these patients direct approximation of the wound edges had been performed at the time of initial surgery and four patients had had bone resection at that time (Table 3). In 2 patients one implant became uncovered, and in one patient all implants became uncovered. The wound dehiscences were left for secondary epithelialization. No osteoradionecrosis occurred in any of these patients and ultimately all wounds healed well. One of the implants that became uncovered was lost due to lack of osseointegration.

No wound dehiscence or partial necrosis of the vestibular and lingually raised flap, that was sutured in the depth of the floor of the mouth, occurred in any of the patients. In 2 patients additional conventional lowering of the floor of the mouth was performed during the abutment placement to achieve a better result.

It is virtually impossible to measure relapse of the lingual sulcus with accuracy. Partial relapse was recorded in all patients. However, there was a definite improvement in the depth of the lingual sulcus, including the mobility of the tongue, in all patients.

Forty-nine of the 50 implants placed were osseointegrated. To date, 41 implants have been used in 10 patients to stabilize a removable overdenture by means of a Dolder bar. In one patient the prosthetic treatment has not yet been completed and another patient died before the prosthetic treatment could be completed. All 10 patients reported an improvement in the mobility of the tongue and in their ability to chew although 2 patients stated that the level of improvement was below their expectations. It must be noted that these 2 patients had partial anaesthesia of the tongue caused by the initial tumour surgery. All ten patients claimed to be able to remove food from the buccal sulcus with their tongue when chewing. Two patients even stated that the new situation was an improvement on that which existed before surgical treatment of the tumour!

In one patient, a vestibuloplasty with palatal mucosa was performed because of frequent 'peri-implantitis' of a remaining part of the skin from the pectoralis muscle flap. In all other patients healthy mucosa surrounding the implants was observed, with pockets less than 3 mm in depth in 9 patients and less than 5 mm in depth in one patient.

DISCUSSION

The dehiscences that occurred were probably caused by the combination of loss of periosteum during the

Table 3 – Wound healing on top of the inferior alveolar process in patients treated by radiotherapy ($n=7$) in relation to the initial surgical treatment

	Resection of bone and reconstruction with myocutaneous flap	Resection of bone and reconstruction with local tissue	No bone resection; reconstruction with local tissue
Wound dehiscence ($n=5$)	2	2	1
No wound dehiscence ($n=2$)	1	1	–

original resection, the thin layer of local tissue covering the mandible and radiotherapy. However, except for the loss of one implant, no serious drawbacks were seen.

The problems of oral rehabilitation have been discussed extensively in the literature. It is widely accepted that dental reconstruction with implants is successful. Neither previous irradiation nor the presence of bulky flaps seems to be a contraindication (*Misch* et al., 1990; *Urken* et al., 1991; *Taylor* and *Worthington*, 1993; *Kraut* et al., 1994; *Mericske-Stern* et al., 1994; *Scarloff* et al., 1994; *Franzen* et al., 1995), although flaps sometimes have to be reduced in the area of implantation. However, the success of oral rehabilitation does not depend solely on stability of the denture but also, and even primarily, on tongue function. Sensitivity of the tongue is a very important part of the oral function (*Kapur* et al., 1990). The two patients who were not completely satisfied with the prosthetic rehabilitation both had anaesthesia of a part of the tongue. When sensitivity has been lost, often as a result of ablative surgery, reconstruction of the nerve is not always possible.

One aspect where there has been a definite improvement is that of the mobility of the tongue. This is clearly achieved by tongueplasty by the Steinhäuser technique, which adds a considerable amount of mucosal lining to the floor of the mouth. Mobilizing the scar fixation of the base of the tongue from the mandible gives greater flexibility to the tongue.

Partial vertical relapse of the deepened lingual sulcus must not be regarded as a serious drawback, since greater importance is attached to mobility of the tongue and this is not adversely affected by the relapse. This relapse could to some extent be reduced by the application of a skin graft. However, skin grafts should, if possible, not be used when implants are inserted.

CONCLUSIONS

The problems of oral rehabilitation following tumour resection and defect reconstruction in edentulous or partially edentulous patients are manifold. A cascade of priorities forces the treatment team to accept a series of compromises. Whilst tongue mobility is of secondary interest at the stage of initial tumour resection, it is very important for final oral function. The tongue plasty by the Steinhäuser technique with secondary epithelialization is a simple, reliable and effective means of adding mobility to the tongue. In combination with the insertion of osseointegrated implants it has proved to be very useful.

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