# Prosthodontic rehabilitation of a patient with total avulsion of the maxilla: A clinical report

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**Patients with complete avulsion of the palate may require extensive surgical and prosthodontic rehabilitation. The prosthesis should replace not only missing teeth but also lost soft tissues and bone, including the hard palate, residual alveolar ridges, and in some situations, the soft palate. This clinical report describes the prosthetic rehabilitation, after appropriate surgical options had been exhausted, of a patient with bilateral traumatic avulsion of the maxilla.** (J Prosthet Dent 2002;88:362-6.)

Fractures of the middle third of the facial skeleton extend downward from the frontal bone to the level of the maxillary teeth or, if the patient is edentulous, to the maxillary alveolus.[1] Skeletal fractures often are associated with the fracture of bones adjacent to the maxilla, as well as varying degrees of involvement of the overlying soft tissues and neighboring structures such as the eyes, nasal airways, paranasal sinuses, and tongue.[1] Fractures can vary in severity from a simple crack in the maxillary alveolus to a major disruption of the entire facial skeleton. When maxillary sinuses are involved in the fracture, comminution of the sinus walls may occur, and on radiographic examination, one or both sinuses may appear opaque.[2] Facial fractures usually are treated by reduction and immobilization/fixation of the fractured segments, followed by occlusal adjustments and restoration of missing teeth and soft tissues where necessary.[3]

Patients with acquired maxillary defects usually can be restored to close to normal function and appearance; they differ from patients with congenital maxillary defects only in the abrupt alteration in the physiological processes associated with surgical/traumatic resection of the maxilla.[4] Techniques for the prosthetic rehabilitation of both types of patients have been described.[4-7] In most of the patients treated, varying amounts of palatal and alveolar tissues remained on the nondefect side, making prosthodontic rehabilitation relatively simple and predictable.[4] However, patients with complete avulsion of the palate are rare, and their treatment requires a different approach with extensive surgical and prosthodontic rehabilitation.

The palate is composed of the maxillary and palatine bony plates. Anteriorly, the median nasal process (premaxilla) carries the incisor teeth, whereas laterally the maxillary alveolar process can be observed with the remaining maxillary teeth. The soft palate attaches to the posterior rim of the hard palate. Superior to the palate is the nasal cavity medially and the maxillary sinuses laterally. Posterolaterally, the pterygoid plates and the pterygomaxillary spaces are found.[8] These spaces contain muscles, nerves, blood vessels, and lymphatic vessels that approximate the base of the skull.[4] Tissue loss in this area poses an enormous challenge to the patient, surgeon, and prosthodontist.

Lack of a hard palate may result in speech and masticatory difficulties for the patient. The tongue is unable to make contact with a solid surface during these functions, and patients exhibit hypernasal, often unintelligible speech that may become a source of frustration for them. Similarly, the tongue cannot compress a bolus of food against the palate before the patient swallows, making eating and drinking impossible. If there is an orosinus or oronasal communication present, patients may experience nasal regurgitation of food and fluids,[9] which often is associated with episodes of acute and/or chronic sinusitis caused by continual irritation of the delicate nasal and sinus lining mucosa. The patient may use other tubes such as a peg tube for feeding, which is a poor alternative in terms of quality of life. Patients invariably also have cosmetic deformities such as facial collapse with loss of support of the middle third of the face, over closure of the mandible, and a "nose-to-chin" appearance. This may be accompanied by temporomandibular joint and dental problems.[10] Unopposed mandibular teeth tend to extrude, causing an altered occlusal plane and exposing cervical margins.[9,11] Teeth may become sensitive, develop increased mobility, and be prone to root caries. These oral disabilities can be minimized by restoration with a maxillary prosthesis, which also can reduce cosmetic deformities by supplying the missing teeth and properly supporting the maxillary lip and cheek.[4]

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Restoration of a dentition with bilateral loss of the maxilla involves numerous difficulties for the prosthodontist. The prosthesis should replace not only the missing teeth but also lost soft tissues and bone, including the hard palate, alveolar ridges, and in some situations, the soft palate. A bony base to support the prosthesis is lacking, whereas the lost residual alveolar ridges, palatal vault, posterior palatal seal area, and buccal and labial sulci compromise retention. Added complications are that the remaining palatal tissues are often scarred, tense, and sensitive, whereas scar tissue in the lips and cheeks may contract and exert strong dislodging forces.[12] A further challenge is that the jaw relationship is disrupted, and without an opposing dentition, the orientation of the occlusal plane is lost. By necessity, the prosthesis will have to be larger than a conventional denture to replace all missing oral structures. Added volume and weight further compromise retention. Finally, there are no anatomic landmarks to help determine the level of the palate and the position of the teeth.[13-15]

This clinical report describes the challenges encountered in the prosthetic rehabilitation of a patient with bilateral traumatic avulsion of the maxilla. The treatment approach is outlined. Modifications of the basic technique have been adapted and used for similar treatments. The prosthesis used to restore the bony maxilla was basically a covering plate; there was very little movement of the tissues bordering the defect. In contrast, obturators fabricated for patients with soft palate defects must function in concert with peripheral tissues, displaying considerable movement; rarely are speech and deglutition restored to normal.[4]

## CLINICAL REPORT

In 1980, a 15-year-old girl was involved in a go-cart accident that resulted in bilateral loss of the maxilla at a Le Fort I level,[2] extending posteriorly to the anterior margin of the soft palate. At initial surgery, only the thin mucoperiosteum of the nasal floor separated the oral cavity from the nasal cavity and maxillary sinuses. A full-thickness skin graft was taken from the patient's upper thigh and placed over the periosteum to close the oronasal communication. Two small openings in the remnants of the maxillary sinuses were created on either side, because the surgeon believed these could be used to help retain a future prosthesis. A nasogastric feeding tube was inserted for feeding, and the patient was referred for prosthetic rehabilitation.

Intraoral examination revealed the absence of the palatal vault, maxillary teeth, and residual alveolar ridges. The roof of the patient's mouth was lined with a skin graft and had openings into the maxillary sinus (approximately $0.5 \times 1.0$ cm in diameter) on either side (Fig. 1). This surface was mobile and tender to palpation and would not have sustained prosthesis support at this early stage. Extraorally, 2 large scars extended from the commisures of the mouth toward the ears. These scars restricted mouth opening and would have made impressions very difficult to make at that stage.


**Fig. 1.** Skin-grafted roof of mouth with bilateral openings.

Because of the missing palate, the patient was unable to speak clearly and had difficulty swallowing. In addition, the maxillary lip had lost support and was depressed into the defect area. The mandible was overclosed, resulting in a nose-to-chin deformity. The right side of the patient's face was paralyzed as a result of severing of the facial nerve at the time of the accident. This had caused her right eye to turn inward, with resulting diplopia. The right eyelids could not be closed voluntarily and the eye was red, dry, and irritated. The right side of the patient's mandibular lip also was incompetent, allowing saliva to drool from the corner of her mouth.

The patient was despondent over her inability to communicate, emotionally disturbed by her appearance, and anxious to have her dentition restored and the nasogastric feeding tube removed. To assist with nutrition, she was provided with a large syringe and instructed to attempt to inject liquid food toward the back of her mouth. This method proved satisfactory, and the feeding tube was removed. Prosthetic rehabilitation was delayed for 8 weeks after trauma to allow the tissues to heal. In the interim, the patient was referred to an ophthalmic surgeon for investigation of the rotated eye and a physiotherapist for stimulation exercises on the right side of her face.

During this time, the skin-grafted tissue in the palate healed and became firm enough for use as a denture support area. Many difficulties were encountered in attempts to restore the dentition, including lack of a firm, immobile bony basal seat for denture support; no ridges or remaining teeth to help retain a prosthesis; no indication of the level of the original palate; no remaining residual alveolar ridges to indicate lateral orientation for tooth placement; loss of the preexisting jaw relationship; scar tissue on the superior aspect of the oronasal defect and in the buccal and labial regions that could dislodge

**Fig. 2.** Baseplate lined with functional impression material. (Treatment was initiated and photo taken in 1980, before establishment of gloves as universal requirement.)

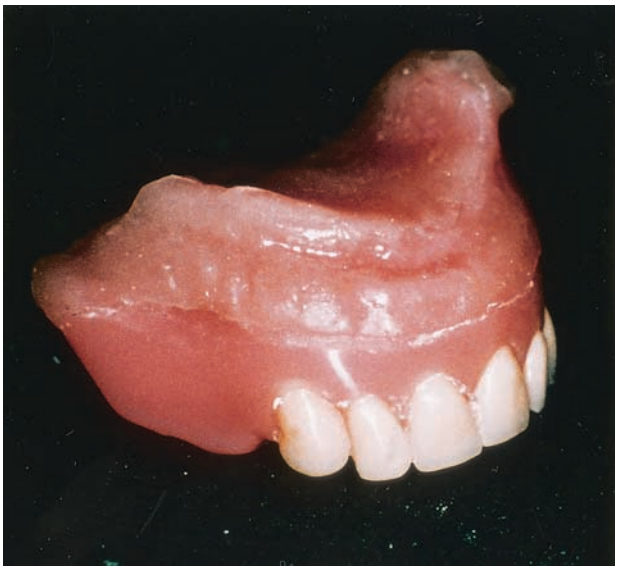

**Fig. 3.** Trial arrangement of 6 anterior teeth.

**Fig. 4.** Molded occlusal rims and registration.

**Fig. 5.** Hard acrylic resin on fitting surface of prosthesis.

a prosthesis; and facial paralysis that permitted the unopposed muscles on the unaffected side to exert an abnormal pull on the paralyzed side, which compounded the aforementioned difficulties.[12]

After the maxillary orosinus communications were packed with cotton wool to prevent impression material from entering the maxillary sinuses, an initial impression of the palate was recorded in modeling plastic impression compound (Kerr, Romulus, Mich.). This impression was used to fabricate a thin acrylic resin obturator record base. On delivery, retention and stability were poor, and so the obturator record base was lined with a functional impression material (Visco-gel; Dentsply DeTrey, Wetbridge, Surrey, United Kingdom) that was allowed to extend approximately 6 mm into the 2 small oronasal openings (Fig. 2). These extensions were an effective means of retention and were maintained in the final prosthesis. During subsequent weeks, the patient was recalled weekly. At each visit an additional layer of functional impression material was placed on the intaglio surface of the record base, which effectively lowered the level of the palate. The patient's speech and swallowing were monitored with each addition, aided by the use of palatograms, until the contours and level of the palate produced satisfactory speech and allowed the patient to swallow comfortably.[16]

Because none of the usual biometric guides (such as arch form and position, residual alveolar ridges, incisive papilla, rugae, and maxillary tuberosities) were present to help determine tooth positioning,[13-15] alternate techniques were needed. Tooth arrangement was based on phonetics and the neutral zone concept.[17] The arrangement of the 6 anterior teeth was first guided by lip position, nasolabial angle, and tooth-to-lip relations

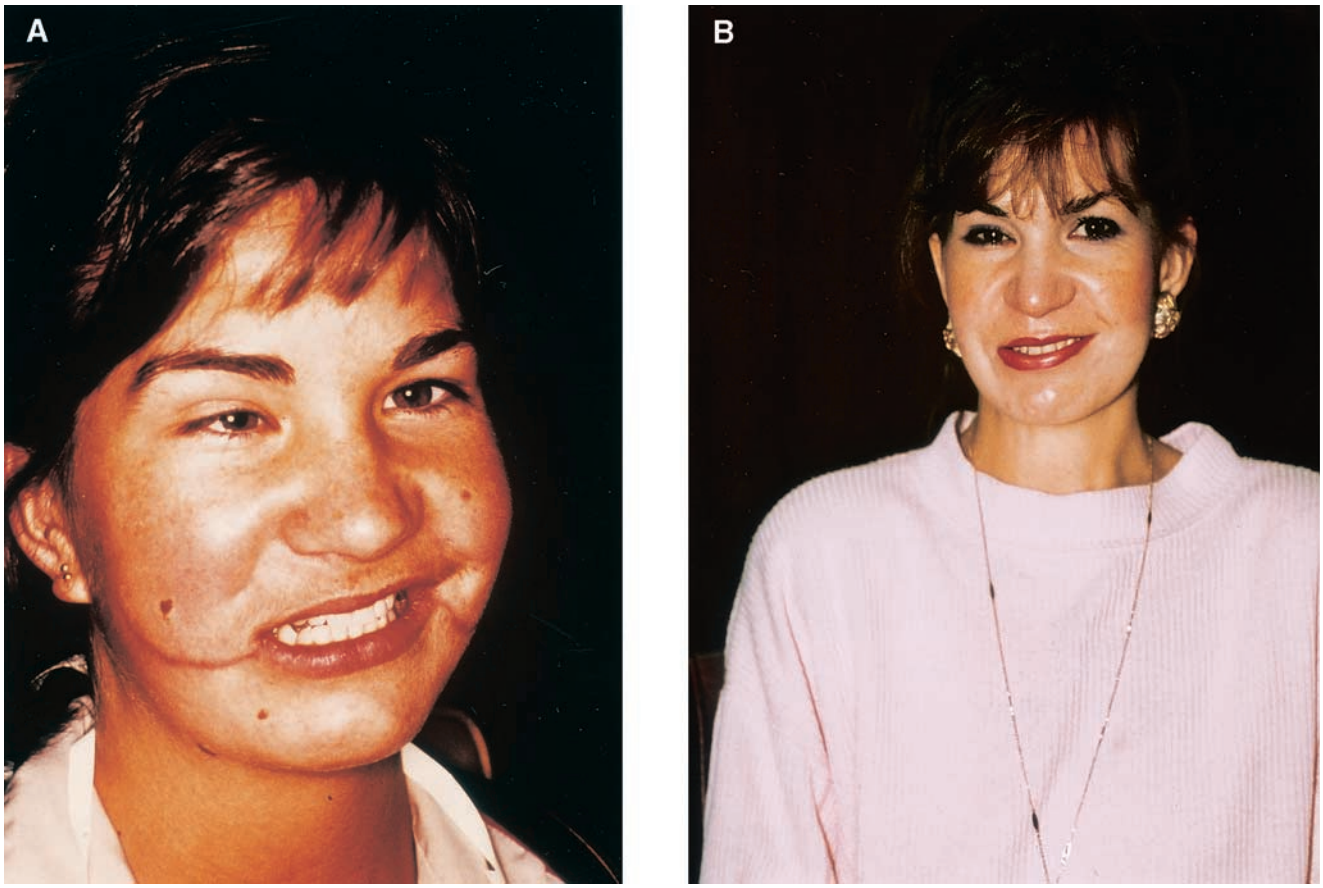


**Fig. 6.** **A,** Patient with right-sided facial paralysis. **B,** Patient 20 years after trauma.

(Fig. 3); their position was verified with phonetic tests that required the patient to pronounce /s/, /f/, /v/, and /th/ sounds.[14,18,19] To establish the best position for posterior teeth, Weinberg[20] suggested that the buccal cusp and fossa should be over the crest of the ridge. Because the patient had no remaining ridge to use as a guide, the posterior part of the arch form was determined to a great extent by the neutral zone, with muscular forces created during function of the cheeks, tongue, and lips.[14,21]

Warm modeling plastic impression compound was placed over the posterior ridge areas, and the patient was asked to performed mouth movements such as sucking and swallowing. The molded rims were used to record the occlusal plane, occlusal vertical dimension, and centric relation (Fig. 4). Teeth were placed according to the functional shape produced. On delivery of the finished prosthesis, careful occlusal adjustments were performed to ensure that dislodging interferences were minimized wherever possible.

In an attempt to improve retention and comfort, the first prosthesis was completed with a heat-polymerized silicone resilient lining material on the fitting surface (Molloplast-B; Molloplast Regneri GmbH and Co, Karlsruhel, Germany). This lining irritated the skin-grafted tissues and resulted in abrasion with candidal superinfection. The soft liner was replaced with hard acrylic resin, which the patient found more comfortable and easier to clean (Fig. 5).

The patient adapted well to her prosthesis and perceived that her speech had returned to near normal. She reported good masticatory ability, although she modified her diet to exclude foods that were difficult to chew or that adhered to the denture teeth. The patient noted that small amounts of foods invariably collected under the prosthesis and entered the oronasal communications. This led her to avoid spicy foods, because they caused severe irritation of the sinus mucosa.

Because the prosthesis was opposed by natural dentition, the acrylic resin posterior teeth became worn relatively quickly. Gold occlusal surfaces were placed on the denture teeth in an attempt to prevent this problem. The patient was not happy with the resulting esthetics, so the gold was removed, and a decision was made to replace the posterior teeth when needed. The patient's facial paralysis improved slightly over the subsequent months. Her eyelids regained movement, but the globe did not correct itself and had to be surgically realigned. The lower third of the patient's face remained permanently paralyzed (Fig. 6, *A*). New prostheses have been made

when needed, with the tooth size and position altered to improve esthetics (Fig. 6, *B*).

## DISCUSSION

In the treatment reported, where the original level of the palate had been obliterated, palatograms were an invaluable aid in establishing the new palatal level and vault shape. Similarly, when the artificial teeth were arranged, normal biometric guides were absent,[13-15] and the prosthodontist had to rely on esthetics, phonetics, and neutral zone concepts to identify the best position for the teeth. Although literature on use of the neutral zone to improve denture retention, masticatory and speech functions, and comfort is inconclusive,[22] in the patient described, the neutral zone was a useful aid in establishing the correct posterior tooth position.

Hard acrylic resin may create a problem with nasal tissues through irritation of the fragile mucosa lining the turbinates and sinuses. Lining the prosthesis with a soft silicone material has been suggested.[23,24] The soft silicone liner used for this patient resulted in mechanical irritation, which was made worse by colonization of the silicone with candidal organisms. One study showed that soft liners in contact with nasal mucosa are more prone to fungal contamination than acrylic resin[25]; it therefore is recommended that the use of soft liners be avoided in prostheses that contact nasal mucosa whenever possible.

Oroantral communications can be a source of discomfort because of food and fluids entering the sinus cavities, thereby predisposing patients to sinusitis and middle ear infections. Whenever possible, oronasal communications should be considered for surgical closure. Because they provided the only means of retention for the prosthesis described in this report, the oronasal communications were purposely kept patent by the acrylic resin extensions of the denture. This form of retention, though unconventional, can be effective and should be considered for similarly impaired patients when conventional forms of retention, including osseointegrated implants, are not a treatment option.

## SUMMARY

When surgical reconstruction of the maxilla is delayed, contraindicated, declined by the patient, or not possible, prosthetic obturation remains the treatment of choice. This clinical report described the prosthetic rehabilitation of a patient with bilateral traumatic avulsion of the maxilla. The patient adapted well to her prosthesis and reported improvements in both speech and mastication with its use.

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0022-3913/2002/$35.00 + 0 **10/1/128125**

doi:10.1067/mpr.2002.128125