Reconstruction of the Premaxilla With Autogenous Iliac Bone in Combination With Osseointegrated Implants

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The simultaneous use of autogenous bone grafts and osseointegrated implants has opened up new possibilities in the reconstruction of large tissue defects in the oral-maxillofacial region. In this paper, the successful rehabilitation of a patient who lost the premaxilla following a segmental osteotomy is described. The resulting oronasal communication and bony defect were restored by placing a bone graft from the iliac crest that was stabilized with two osseointegrated implants. A fixed prosthesis was fabricated to replace the missing anterior teeth. Esthetic and functional criteria were fulfilled.

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Key words: autologous graft, osseointegrated implants, premaxillary necrosis

Management of large congenital or acquired maxillary defects is a challenge for the surgeon and prosthodontist. The dentoalveolar defect is frequently reconstructed with a removable prosthesis following mobilization of soft tissue flaps, bone grafting, or a combination of these surgical treatment modalities. Careful pretreatment planning and meticulous surgical and prosthetic procedures combined with close multidisciplinary cooperative efforts are needed to achieve satisfactory results. A removable soft tissue-supported prosthesis may adequately reconstruct a large premaxillary defect; however, instability of the prosthesis secondary to unfavorable mandibular masticatory force vectors frequently exists and transmits unfavorable stress to the supporting soft and hard tissues. This leads to soft tissue hyperplasia and residual maxillary bone resorption.

Following closure of an oronasal maxillary defect, the edentulous or partially edentulous patient is frequently left with inadequate anatomic structure for the fabrication of a stable and retentive dental prosthesis. The surgical reconstruction may therefore have created a situation more difficult to reconstruct prosthetically than if preprosthetic surgery had not been performed. For this reason, it is desirable to surgically reconstruct the osseous defect with bone grafts, the oronasal communication with soft tissue flaps, and at the same time provide bone anchorage units to support a fixed bone-supported dental prosthesis. In recent years, techniques combining endosseous implants with various other soft tissue and osseous surgical procedures have provided a more optimal maxillary defect reconstruction because the final dental prosthesis is fixed or a fixed-removable combination rigidly supported by the bone-anchored endosseous dental implants.1-5

Brånemark and colleagues1 were the first to use composite bone grafts for jaw reconstructions. According to principles based on basic bone biology research,6 they used tubial and/or iliac crest bone in conjunction with titanium cylindrical threaded endosseous implants. The titanium endosseous implants served two functions: (1) they stabilized the donor bone graft on the
recipient site and (2) after a 6-month healing period, they supported a dental prosthesis. Others\textsuperscript{2–5} have subsequently reported their experience with one-stage maxillary onlay composite iliac bone grafts. Bone graft and endosseous implant survival has been satisfactory in recent reports.\textsuperscript{7,9} A higher implant failure rate is noted in patients with large osseous defects in which the endosseous implant cannot be placed in the residual bone or the grafted bone.\textsuperscript{7} For this reason, reconstruction is done in two stages. The first stage involves placement of the bone graft and endosseous implants adequate to secure the graft to the residual bone (as in the current report). In the second stage, additional endosseous implants are placed into the portion of the healed bone graft that was not previously supported by residual host jawbone. In this report, long implants were manufactured to secure the onlay/inlay iliac bone graft to the residual maxillary/zygomatic bone. The position and stability of these two implants eventually provided sufficient osseous support for the final fixed-removable maxillary prosthesis.

Case Report

A 23-year-old white man presented for reconstruction of an oral defect. When the patient was 18 years of age, his open bite was corrected with orthognathic surgery. The premolar segment was surgically repositioned forward and downward to achieve a normal occlusal relationship with the mandibular anterior teeth. Four weeks after surgery, both maxillary canines and the four maxillary incisors exfoliated and the maxillary bone sequestered, leaving a large anterior soft and hard tissue maxillary defect and oronasal communication (Figs 1a to 1d).

Clinical Evaluation. The initial clinical evaluation revealed a skeletal defect including the anterior one third of the palatal vault and the basal and alveolar bone mesial to the first premolars. A limited oronasal communication was present (Fig 2). The patient wore a soft-lined removable prosthesis that was unstable and did not allow effective masticatory and phonetic function. The upper lip was collapsed because no skeletal support was present.

A fixed tooth-supported prosthesis would have involved restoration coverage of the remaining teeth with a risk of mechanical fracture because of the anterior
lever of the pontic arch. The following treatment plan was developed:
1. Intensive dental hygiene to provide a healthy periodontium
2. Removal of periodontally compromised first premolars, which also provided additional space and mucoperiosteal coverage for the onlay bone graft (Fig 2)
3. Reconstructive surgery —
   a. Closure of oronasal communication
   b. Harvest of free iliac autologous bone graft and transfer to the maxillary defect
   c. Fixation of the graft using special endosseous cylindrical threaded implants into the remaining maxillary bone
4. Abutment connection surgery
5. Prosthetic treatment

**Surgical Procedure.** A single block of corticocancellous bone was harvested from the lateral-anterior ilium. A low-speed rotary and chisel bone-cutting technique was used to limit heat production, which in turn enhances graft cell (osteocyte/osteoblast) survival (Figs 3a and 3b).

The maxillary defect had almost completely epithelialized, hence a small oronasal communication was present. In addition, the oronasal soft tissue was very thin anteriorly. The soft tissue incision was placed above the anterior sulcus on the lip mucosa. The residual maxillary defect was exposed by submucous resection down to the periosteum, which was incised and reflected. The floor of the nasal mucosa was separated from the palatal mucosa and carefully preserved. The antrum was not entered on either side. Once the bone defect size was clearly demarcated by the surgeon, measurements were transferred to a second surgeon, who had simultaneously exposed the ilium; this allowed harvesting and immediate transfer of the correct-sized bone graft to the maxillary defect. Because the osseous nasal floor and inferior nasal aperture were absent, it was necessary to secure the inlay/onlay bone graft to the maxillary buttress with specially manufactured 30-mm endosseous Bränemark implants (Fig 3c). It was decided intraoperatively not to place additional implants into

Fig 2: Occlusal palatal view after the extraction of both first premolars, which was prescribed to achieve enough bone to anchor two implants for stabilizing the bone graft.

Fig 3a: Intraoral view of the harvesting of the iliac bone graft using a circular saw at low speed and profuse irrigation.

Fig 3b: Shape and size of the segment of corticocancellous bone graft.

Fig 3c: Graft, with its edges remodeled, fills the maxillary defect and is stabilized by two implants.
the anterior portion of the graft because it was not supported by the residual host bone and additional implants could be placed at a later date if required. The original oronasal soft tissue defect was closed with absorbable sutures. Meticulous buccalabial soft tissue relaxation and advancement provided coverage for the bone graft. This was accomplished by incising and advancing the periosteum superiority on the buccalabial aspect of the osseous defect. Interrupted nonabsorbable horizontal mattress sutures provided an everted watertight closure. Gauze pressure dressings were used during the first 72 hours intraorally to prevent hematoma formation between the composite bone graft and overlying soft tissue flap.

**Healing Phase.** The patient was asked to refrain from using a removable prosthesis for 2 months. Following this 2-month period, a removable prosthesis with circumferential retention clasps, occlusal stops on the remaining dentition, and light tissue contact with a soft-lined base was fabricated to replace missing teeth. Eight months later, transepithelial abutments were connected (Figs 4a and 4b). Clinical evaluation of the fixture stability showed that the right implant was totally immobile and symptom-free. The implant on the left was mildly uncomfortable when tapped with a metal instrument. While the abutment screw was retightened, slight rotation of the left implant was observed.

Olivé et al.\textsuperscript{10,11} and subsequently Teerlink et al.\textsuperscript{12} have used Periotest parameters as a measure of implant stability. The Periotest values obtained in this patient were much higher for the problematic implant, which was consistent with the discomfort experienced by the patient when he exerted pressure. Intraoral radiology revealed no radiolucency around the problematic implant. It was assumed that the anchorage tissue at the interface was immature woven bone tissue with low mechanical strength rather than fibrous capsule. Accordingly, it was decided to postpone the prosthesis fabrication until the outcome of the implant was clear. Only light contact of the transepithelial abutments with the soft prosthesis relining material was permitted for the next 17 months (Fig 5).

**Prosthetic Phase.** Repeated longitudinal Periotest measurements showed a gradual improvement in the values of the dubious implant until the symptoms disappeared (Table 1). At that time the second premolars were prepared with gold-acrylic resin veneers, and a fixed metal substructure with acrylic resin teeth was fabricated on the two implant abutments. The prosthesis was rigidly connected to the teeth (17 months after abutment connection) by precision screw attachments to better distribute force between natural and artificial abutments and assure retrievability of the components (Figs 6 and 7).

The waxed trial arrangement of teeth revealed a cos-
**Fig 6** Profile of the master cast mounted according to the patient’s articulator relation. The implant direction is indicated by the pins screwed onto the brass replicas.

**Fig 7** Acrylic resin–metal crowns were tried in premolars connected by sliding attachments, with the possibility of being screwed to an implant-supported metal framework.

**Fig 8a** Intraoral view before the orthognathic surgery, in which an anterior open bite and posterior cross bite were present.

**Fig 8b** Final prosthesis in place. It was decided to retain the open bite to achieve a labial seal. This confirmed the error of the initial orthognathic diagnosis.

**Table 1** Sequence of Periotest Values Obtained After Placement of Abutments, Extended Healing Period, and Placement of Final Prosthesis (to May 1992)

<table>
<thead>
<tr>
<th>No. of months after abutment connection</th>
<th>Periotest values</th>
<th>Right</th>
<th>Left</th>
</tr>
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<tbody>
<tr>
<td>0</td>
<td></td>
<td>13</td>
<td>16</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>10</td>
<td>14</td>
</tr>
<tr>
<td>17*</td>
<td></td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>23*</td>
<td></td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>40*</td>
<td></td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

*Final prosthesis placed.

Dentifaction problem when restoring incisor contact with the mandibular teeth. Two thirds of the height of the maxillary crowns was visible and labial incompetence was created. This was attributed to the short upper lip as well as an uncorrected vertical facial hyperplasia. To resolve the problem, lateral disocclusion guidance was shifted to the premolars. An edge-to-edge contact of the canines was allowed with an open bite of the incisors (Fig 8a and 8b).

The completed rehabilitation was judged satisfactory by the patient because mastication, speech, and esthetics (lip support and teeth esthetics) were equal to his preosteotomy condition. Figures 9a and 9b demonstrate the current status of the patient 48 months after the graft procedure.

**Conclusion**

Necrosis of osteotomy segments after orthognathic surgery is a rare event but however, the surgeon and orthodontist should consider this risk and maximize the
diagnostic and treatment planning effort. Iliac bone autografts in combination with osseointegrated fixtures can be a very useful procedure in the surgical reconstruction of large orofacial defects. An accurate assessment of bone integration and the stability of abutment-connected implants by means of manual mobility tests, intraoral radiographs, and use of the Periotest may help the prosthodontist to individualize the length of the healing period. This facilitates bone maturation assessment and reduces the risk of load-related implant failure. Meticulous prosthetic treatment planning that takes into account not only the clinical situation but also the psychological profile, motivation, and esthetic demands of the patient is essential to achieve the ultimate medical goal: restitutio ad integrum.

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References


Résumé
Reconstruction du prémaxillaire à l’aide d’un greffon d’os illiaque autogène en combinaison avec des implants ostéointégrés

L’utilisation conjointe de greffons d’os autogène et d’implants ostéointégrés a ouvert de nouvelles possibilités de reconstruction des larges défauts tissulaires à la région orale et maxillo-faciale. On a décrit dans cet article la réhabilitation réussie d’un patient ayant subi la perte du prémaxillaire à la suite d’une ostéotomie segmentaire. La communication oronasale et le défaut osseux en résultant furent restaurés par le placement d’un greffon osseux provenant de la crête illiaque qui fut stabilisé à l’aide de deux implants ostéointégrés. Une prothèse fixe fut fabriquée afin de remplacer les dents antérieures manquantes. Les critères esthétiques et fonctionnels furent remplis.

Zusammenfassung
Autogener Beckenkammknochen zur Rekonstruktion der Prämaxilla in Verbindung mit zahnärztlichen Implantaten


Resumen
La reconstrucción premaxilar con hueso ilíaco autógeno en combinación con implantes oseointegrados

El uso simultáneo de injertos óseos autógenos e implantes oseointegrados ha abierto nuevas posibilidades en la reconstrucción de defectos tisulares grandes en la región oro-maxilofacial. En este artículo se describe la rehabilitación exitosa de un paciente que perdió la premaxila luego de una osteotomía segmentaria. La comunicación oronasal y el defecto óseo resultante fueron restaurados por medio de la colocación de un injerto óseo de la cresta ilíaca, el cual fue estabilizado con dos implantes oseointegrados. Se fabricó una prótesis fija para reemplazar los dientes anteriores ausentes. Se obtuvieron las normas estéticas y funcionales del caso.
Tanto en un caso como en el otro, el diseño y fabricación de la superestructura se debe ceñir a los siguientes objetivos: (a) ajuste pasivo del bastidor sin solución de continuidad entre los cilindros de oro y las rúpicas de los pilares; (b) una masa suficiente de material que asegure la resistencia mecánica, particularmente en la unión entre los pilares distales y las extensiones libres; (c) espacio suficiente para permitir una higiene correcta en torno a los pilares; y (d) mínima superficie de metal visible (22).

B6. Prueba de dientes montados en cera sobre el armazón de metal

Una vez completada la construcción del armazón, se le transfirieron los dientes de acrílico cuya disposición tras el montaje de prueba quedó registrada mediante una llave vestibular en yeso o masilla de silicona sobre el modelo de trabajo.

En esta cita conviene verificar de nuevo los registros de relación intermaxilar, la dimensión vertical, la oclusión, la fonética, la estética y efectuar ajustes menores en la posición de las piezas dentarias si conviene. Se comprueba así mismo si el diseño elegido permite una higiene correcta de la cara gingival de la prótesis y del perímetro de los pilares. En este sentido se recomienda, siempre que no existan dificultades estéticas o fonéticas, separar la prótesis de la cresta 1-2 mm. En algunos casos, especialmente superiores y con líneas de sonrisa altas, puede ser necesario hacer contactar los pónicos contra la mucosa puntualmente por medio de superficies convexas. En ocasiones para ocultar visualmente alguno de los pilares de titanio habrá que alargar los cuellos dentarios o la resina rosa hacia el fondo de vestíbulo, pero teniendo un cuidado de conservar siempre un alivió mínimo respecto a la mucosa para permitir el paso de los instrumentos de limpieza.

B7. Colocación temporal de la POI acabada

Tras el procesado del acrílico por el laboratorio, se eliminarán eventuales errores mediante un equilibrado de la oclusión sobre el articulador. Comprobaremos que la resina no presente porosidades y que las uniones con el metal —preferiblemente en hombro puro— son perfectamente lisas a fin de minimizar la retención de placa o restos de comida.

La POI se fija a las unidades con anclaje mediante pequeños tornillos de oro, previa comprobación de que no hay residuos en los orificios centrales de los pilares y contrarrestando el torque con un instrumento tipo forcepas que sostenga el cilindro del pilar. Los canales de entrada se obturan provisionalmente mediante gutapercha, masilla de silicona o pasta de polivinilo. A continuación refinaremos de nuevo la oclusión eliminando todas las interferencias funcionales.

Con frecuencia el paciente está ansioso por probar todo tipo de comidas que hasta el momento le habían estado vedadas por la incapacidad funcional de su antigua prótesis. Habrá que advertirle que introduzca en su dieta solo de manera paulatina los alimentos de mayor consistencia a fin de no sobrecar...