Case Report

Trapezial Design Technique for Autogenous Bone Graft in Esthetic Zone Implant Treatment

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Abstract

We report bone augmentation for alveolar bone loss at the bottom of the nasal cavity in conjunction with simultaneous implant placement in the same operative field in the esthetic zone. The patient was a 33-year-old man who was referred to us requesting implant treatment after undergoing tooth extraction (#12) due to root fracture. An examination was performed using cone beam computed tomography (CT) and simulation software. The results indicated insufficient volume of labial bone for the requested procedure, especially at the planned site of the implant neck. Therefore, bone augmentation was performed at the apical site of the implant socket (alveolar bone at the bottom of the nasal cavity). Because the surgical line of the harvest site formed a trapezoidal shape, the procedure was named the “Trapezial Design Technique”. Assessment of complications (Barone & Covane classification), success (Albrektsson classification), and observation of labial bone using cone beam CT were performed postoperatively. No complications were observed at 27 months after prosthetic treatment. The implant and the tissue surrounding it were in a stable condition. This indicates that this procedure is effective in placing an implant with simultaneous bone augmentation in the esthetic zone.

Key words: Autogenous bone graft — Trapezial Design Technique (TDT) — Piezo electric bone surgery — Esthetic zone — Dental implant

Introduction

It is well known that alveolar resorption occurs following tooth loss, and marked change has been observed in the maxillary alveolar ridge following tooth removal8), with one report noting a reduction in width of approximately 50%8). Moreover, buccal alveolar bone in the anterior of the jaw is typically less than 1.0 mm thick, so augmentation is required if an implant is to be used5,10). Resorption of edentulous or partially eden-
tulous alveolar ridge or bone loss due to severe periodontitis or trauma can make the placement of a dental implant in a prosthetically ideal position difficult to achieve.

Various techniques are available for vertical or horizontal augmentation of bone. The optimum technique, however, remains to be determined. Moreover, the success of each approach may depend on operator experience or technique sensitivity\(^1\),\(^4\),\(^5\), indicating the need for simpler procedures which are less invasive and take less time to complete.

Autogenous bone grafts are still considered the gold standard in augmenting depleted bone\(^6\),\(^8\). A number of potential problems remain to be overcome with such bone regeneration procedures, however, including donor site morbidity, unpredictable resorption, limitations in amount of bone available, and the need to include additional surgical sites.

In this report, we describe the application of a less invasive method of veneer graft in the augmentation of alveolar bone loss at the bottom of the nasal cavity in conjunction with simultaneous implant placement in the same operative field in the esthetic zone.

**Case Report**

The patient was a 33-year-old man with a root fracture (#12) previously diagnosed by another doctor. This tooth was subsequently extracted. Later, however, the patient requested a dental implant, so his doctor referred him to our office. On his initial visit to our clinic, he presented with a temporary prosthetic fixed to the adjacent tooth with Superbond (Fig. 1).

An examination revealed horizontal and vertical defects in the soft tissue. His smile-line

![Fig. 1 Initial visit](image)

Tooth (#12) was extracted by previous doctor due to root fracture.
Temporary prosthetic fixed to adjacent tooth with Superbond.
a: Intraoral photograph
b: Panoramic X-ray film

![Fig. 2 Cone beam CT images revealed that volume of labial bone was insufficient for requested procedure, especially in vicinity of proposed implant neck, which was to extend 1.5 mm vertically](image)
was high, indicating that treatment would be difficult. Further observation was performed using cone beam computed tomography (CT) and simulation software. The results suggested that the volume of labial bone was insufficient for the requested procedure, especially in the vicinity of the proposed implant neck, which was to extend 1.5 mm vertically. The implant would need to be covered by at least 1 mm of labial and palatal bone. Bone volume at the donor site was deemed to be sufficient for the recipient site (Fig. 2). Bone augmentation using bone harvested from the apical site of the implant socket alveolar bone at the bottom of nasal cavity was subsequently scheduled.

Surgery was performed in accordance with a set of clinical criteria established by Dr. Shiratori (Table 1). The procedure itself is named the “Trapezial Design Technique (TDT)” due to the shape of the surgical area. Assessment of complications (Barone & Covane classification), success (Albrektsson classification), and observation of labial bone using cone beam CT were conducted for postoperative evaluation (Fig. 3).

On raising the mucoperiosteal flap following the standard procedure, a 1.5-mm deficit in volume of bone was found in the vertical direction compared to the ideal prosthetic margin, but this was only at the labial site. Volume at the palatal site was sufficient. In the horizontal direction, bone width was observed to be approximately 3.5 mm. After preparing the implant socket with an ultrasonic cutting tool (Piezo-surgery®), the implant, a NovelActive NP (width/3.5 mm in diameter, 11.5 mm in length), was inserted manually. A surgical guide was used to confirm that the implant was in the right position. Next, a trapezoidal block of autologous bone which had been harvested using the cutting tool was inverted and fixed at the implant neck at the labial site using a bone screw (Fig. 4). Pulverized autologous bone was then packed around the block and covered with a resorbable membrane. Beta-TCP was packed into the donor site. A releasing incision was performed following the general procedure, after which it was sutured. Four months later, at the second operation, the bone screw was removed by using a minimum incision. Punching was performed at the alveolar mucosal site and a healing cap (width, 3.5 mm in diameter, 5 mm in length) installed. Submucosal gum was adjusted using a provisional restoration. After the gum was confirmed to have good stability, the final restoration was performed. The final restoration, the superstructure of the zirconia crown, was set with a screw retainer (Fig. 5).

<table>
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<tr>
<th>Table 1</th>
<th>Shiratori’s clinical criteria of TDT</th>
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<td>Primary stabilization</td>
<td>Vital adjacent teeth</td>
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<tr>
<td>Good: Simultaneous implant placement</td>
<td>Poor: Staged approach</td>
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<tr>
<td>Horizontal limit of bone incision line</td>
<td>At least 2 mm horizontally from adjacent teeth</td>
</tr>
<tr>
<td>Vertical limit of bone incision line</td>
<td>Do not pursue in vertical direction</td>
</tr>
<tr>
<td>Upper limit</td>
<td>Bottom of nasal cavity</td>
</tr>
<tr>
<td>*Cortical bone of nasal cavity should be left untouched</td>
<td></td>
</tr>
<tr>
<td>Lower limit</td>
<td>Tip of implant apex can be exposed</td>
</tr>
<tr>
<td>*Do not compromise initial stability</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>Do not reach top of anterior nasal spine</td>
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</table>

Indications: For single- or multiple-tooth defects if sufficient bone for harvesting at donor site. Preoperative CT necessary.
Results

In this procedure, an autogenous block graft and implant replacement were performed simultaneously in the same operational field. No postoperative complications were observed at either the donor or graft site, apart from temporary, but marked, swelling at the surgical wound site. No complications were observed at 27 months after completion of prosthetic treatment.

Observations were made at 1 mm and 5 mm from the neck of the implant using cone beam CT. Both measurements were made in the labial direction, vertically along the long axis of the implant-fixture. The donor site was examined and measured at 27 months after the final restoration. At the graft site, the bone had a width of 2.4 mm at 1 mm from the implant neck, and a width of 2.3 mm at 5 mm. No abnormalities were found at the donor site (Fig. 6). Moreover, no problems were observed clinically from the esthetic point of view (Fig. 7).

Discussion

The most common reasons for performing an implant procedure are some kind of trauma, such as a root fracture, or major damage to the alveolar bone due to periodontitis, especially when accompanied by absorption. Here it should be noted that the average thickness of labial bone in the anterior maxilla in the Japanese population (Mongoloid) is only 0.8 mm\(^7\). Therefore, it is more likely that bone augmentation procedures will be required in this group when replacing anterior teeth in the esthetic zone with implants. Currently, clinically, a number of methods are used to augment bone, with the results mostly
Fig. 4

a: Making trapezoidal surgical incision at donor site, it is possible to harvest as much bone as necessary, while paying attention to safety and maintaining appropriate distance from dental root. Part of implant surface was exposed above residual bone.
b: It is easier to place grafted bone into defect.
c: Harvesting sufficient bone from around anterior nasal spine.
d: Piezo handpiece is much easier to handle than rotary handpiece, making it more suitable for delicate surgeries.
e: Autogenous block graft and implant replacement were performed simultaneously in same operational field.
f: Trapezoidal block of autologous bone was inverted and fixed at implant neck at labial site using bone screw.
being fine. However, it is still important to explore the possibility of even simpler procedures which are less invasive and take less time to complete.

It has been suggested that the best protocol for augmentation of a horizontal ridge involves employing a block of intraorally harvested autogenous bone either alone or in combination with deproteinized bovine bone mineral, with or without coverage with a barrier membrane. Augmentation in the vertical dimension is mainly performed using autogenous bone grafts, either as intraorally harvested blocks or as particulate supported by a space-keeping device.

In such circumstances, autogenous bone grafts are still considered the gold standard in augmenting depleted bone.

Autogenous bone offers the best candidate for replacement of depleted bone due to its capacity for bone formation, induction, and conduction. Moreover, being the patient’s own bone, there is no risk of infection from some unknown virus or an immune reaction.

However, the drawback of this approach is that it necessitates increasing the number
of surgical sites as the bone has to be harvested from the same patient. Therefore, it is necessary to find some other, less invasive, alternative.

To achieve this, harvesting and bone augmentation were performed in the same operative field in the procedure described here.

Making a trapezoidal surgical incision at the harvest site offers the following advantages: 1) it is possible to harvest as much bone as necessary, while paying attention to safety and maintaining the appropriate distance from the dental root; and 2) it is easier to place the grafted bone into the defect.

Furthermore, harvesting bone from the same operative field ensures that the quality of the bone will be similar to that at the recipient site. On the other hand, the amount of bone that can be harvested this way may be insufficient, so it is necessary to carry out preoperative CT to ensure that enough is available, something that is not a problem when harvesting bone from the mandibular ramus.

Several studies have noted nerve paralysis as a potential complication in grafting of autogenous bone. Postoperative morbidity induced by harvesting of bone from intraoral sites mainly comprises temporary neural disturbances involving branches of the inferior alveolar nerve. The incidence of neural disturbances related to harvesting of bone from the chin is between 10 and 50%, whereas with the mandibular ramus it is between 0 and 5%.

However, with our method, no major vascular nervous system is involved in the operative field, making it unlikely that any such serious complication would arise. However, a temporary, but strong, swelling was noted at the surgical site postoperatively. Such swelling might be prevented, however, if certain precautions are taken. For example, the procedure should be performed gently and with the utmost care, in no way compromising basic surgical method. Aversion should be performed manually and/or pressure immobilization using taping postoperatively. Pressure immobilization can also eliminate dead space from the surgical site, which is considered to be a valuable measure in preventing surgical site infection. In treating outpatients, care should be taken to control bleeding, in particular, and the patient should be encouraged to rest sufficiently before returning home postoperatively.

Use of an ultrasonic cutting tool is also important when using TDT. Generally, it is considered difficult to harvest sufficient bone from around the anterior nasal spine. However, we have found that using an ultrasonic cutting tool makes this easier. This type of tool offers the following advantages over the standard type of rotating or cutting device: 1) the Piezo chip is thinner than a fissure bur, which helps minimize bone loss (we specifically chose the thinnest chip, at 0.35 mm in thickness, called the OT7S-3); and 2) the Piezo handpiece is much easier to handle than a rotary handpiece, making it more suitable for delicate surgeries. Application of the Piezo tool to bone surgery is advantageous in that it keeps bone damage to a minimum. Observation and examination using CT revealed that the donor and graft sites were stable, and no esthetic issues occurred. At 27 months after the final prosthetic treatment, the peri-implant tissue was stable from a clinical point of view. Moreover, no complications were observed, indicating the effectiveness of this procedure.

A summary of this paper was presented at the 98th Annual Meeting of the American Academy of Periodontology in collaboration with the Japanese Society of Periodontology (September 30, 2012, Los Angeles, U.S.). It received an award as one of the best presentations in the General Poster Session (JSP Poster Session).

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