

Multitier Technique for Bone Augmentation Using Intraoral Autogenous Bone Blocks

Devorah Schwartz-Arad, DMD, PhD,* and Liran Levin, DMD†

Brånemark et al¹ originally described autologous bone grafts used with dental implants, and they are now a well-accepted procedure in oral and maxillofacial rehabilitation.²⁻⁵ Placement of an endosseous implant requires sufficient bone volume for complete bone coverage. Furthermore, the pattern of ridge resorption, which contributes to an unfavorable maxillomandibular relationship, requires angulation of the implant and/or angled abutment, and affects the proximity of adjacent facial concavities (maxillary sinus, nasal cavity) and vital structures (mandibular nerve).⁶

Possible origins for autogenous bone include the calvarium,⁷ tibia,⁸ and iliac crest.⁹⁻¹¹ Although the iliac crest is frequently used in major jaw reconstruction, it is not always recommended because of its morbidity, altered ambulation, and the need for hospitalization. There is also significant resorption associated with corticocancellous block grafts.¹¹⁻¹³ These disadvantages, together with the fact that dental implants do not require large amounts of bone, lead to the growing use of intraoral block bone grafts from intraoral sources, especially the mandibular symphysis^{3,6,14-17} and ramus.^{2,3}

In the repair of alveolar defects, bone grafts from the symphysis and ramus offer several benefits (e.g., conventional surgical access),¹⁵⁻¹⁷ and the prox-

Purpose: *Intraoral bone grafts are a convenient and acceptable source of autogenous bone for alveolar reconstruction due to bone origin similarity and less morbidity. In large bone defects, 1 tier might be insufficient to achieve the desired bone shape. The purpose of this article was to describe a multitier technique for reconstruction of extensive bone deficiency, using only intraoral block bone grafts for implant site augmentation.*

Materials: *After clinical and radiographic evaluation of the recipient site, measurements were taken to determine the size of the bone deficiency. The first tier of bone graft was harvest-*

ed from the mandibular ramus. After additional clinical and radiographic evaluation of the recipient site 5 months later, bone graft blocks for the second tier were harvested either from the second ramus or the mandibular symphysis.

Conclusions: *A new technique, the multitier intraoral bone block graft, for the future use of dental implants, is described. This technique can serve as an optional operation procedure for extensively atrophic alveolar bone augmentation. (Implant Dent 2007;16:5-12)*

Key Words: *bone deficiency, onlay bone graft, vertical ridge augmentation, donor site, recipient site*

imity of donor and recipient sites reduce operative and anesthesia time, making it ideal for outpatient implant surgery. There is no cutaneous scarring, minimal discomfort, and less morbidity compared with extraoral locations.

The mandibular symphysis and ramus are possible origins for intraoral block bone grafts that have been described as effective.¹⁸ However, the mandibular ramus area provides good bone quality with fewer postoperative complications compared to the symphysis area.^{3,11}

The purpose of this article is to describe a multitier technique for reconstruction of extensive bone deficiency, using only intraoral block bone grafts for implant site augmentation.

SURGICAL TECHNIQUE

Preoperatively, panoramic and conventional or computerized tomography scans were evaluated for bone shape (mesiodistal width and vertical

distance from adjacent facial concavities and vital structures) and bone angulation. In severe bone deficiency (greater than 5 mm), the option of a multitier bone graft technique was considered.¹⁹

One hour before each bone graft surgery, 1 g amoxicillin and 8 mg dexamethasone were administered. For the penicillin-allergic patients, 0.6 mg clindamycin was the drug of choice. Amoxicillin (1.5 g/day) or clindamycin (0.9 g/day) was continued for 10 days postoperatively, and 4 mg dexamethasone/day was administered for 2 additional days. Patients were instructed to rinse their mouth with chlorhexidine 0.5% for 2 minutes immediately preoperatively and to continue for 10 additional days, twice daily with chlorhexidine 0.2% postoperatively.

First Tier Operation

A midcrest incision was made along the recipient area. A mucoperiosteal flap was reflected. The recipient

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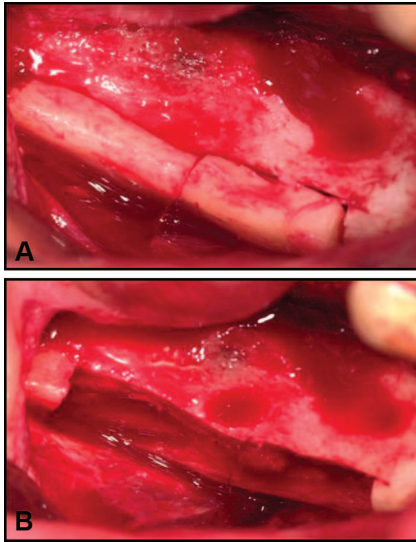


Fig. 1. Bone block harvested from the mandibular ramus before (A) and after (B) block harvest.

site was decorticated and recontoured using a round bone bur (Aesculap AG, Tuttlingen, Germany) for better adaptation of the graft and to improve graft-to-recipient bone contact. The bone defect was evaluated to determine the size and shape of the block needed.

Bone blocks for the first tier were harvested from the mandibular ramus (Fig. 1).^{19–21} Access to the ramus area for bone harvest was gained through an extension of the commonly used envelope flap for third molar extraction. The incision was made in the buccal vestibule, medial to the external oblique ridge, and extended anteriorly and laterally to the retromolar pad, continuing anteriorly into the buccal sulcus of the molars. A mucoperiosteal flap was reflected exposing the lateral aspect of the ramus and third molar area. To begin the ramus osteotomy, a reciprocating or oscillating saw was used to cut through the cortex along the anterior border of the ramus. An anterior vertical cut was made in the mandibular body (the length depended on the size of the graft needed), and a posterior vertical cut was made on the lateral aspect of the ramus. No inferior osteotomy was needed. The border cuts were made only to the depth where bleeding occurred from the underlying cancellous bone to prevent injury to the underlying neurovascular bundle. A thin

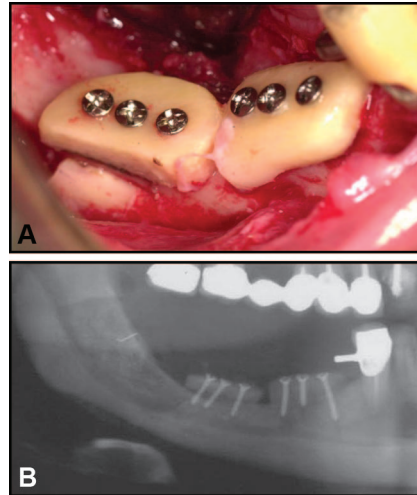


Fig. 2. Clinical (A) and radiographic (B) views of the first tier of bone blocks following fixation in the recipient site.

chisel was gently tapped along the entire length of the osteotomy, taking care to avoid injury to the inferior alveolar nerve by preventing the cancellous bone to penetrate beneath the cortical layer. Graft splitting from the ramus was then completed.

The bone blocks were restored in a sterile cold sodium chloride 0.9% solution (TEVA Medical Ltd, Ashdod, Israel) for a minimal time before placement in the recipient site. The block graft was positioned over the recipient site with the endosteal side of the graft facing the cortical bone. The block was adapted to fit close to the site. To ensure immobility, the graft was fixed to the recipient site using titanium self-tap screws, 1.6 mm in diameter (Osteomed Corp., Ltd, Addison, TX), to be removed during second tier operation or implant placement (Fig. 2). Any sharp angles in the block segment that could perforate the overlying flap were eliminated, leaving a smooth outline. Corticocancellous particles and bovine material (Bio-Oss; Geistlich Pharma AG, Wolhusen, Switzerland) filled the gap between the graft and recipient site to avoid interference of vascularization of the graft and creation of fibrous tissue ingrowth between the bed and graft. Resorbable membrane (Bio-Gide; Geistlich Pharma AG) covered the bone particles, taking care not to cover the block. Platelet-rich and platelet-poor plasma (Harvest Technology, Plymouth, MA) were used to cover the entire augmented area.

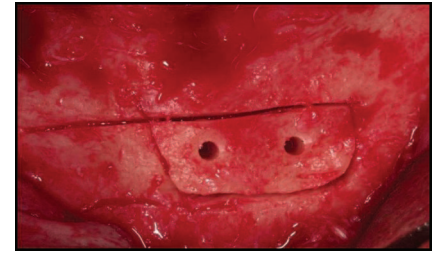


Fig. 3. Bone block harvesting from the mandibular symphysis.

The periosteum at the base of the facial flap in the recipient site was carefully incised to allow stretching of the mucosa and tension-free adaptation of the wound margins. The flap was sutured with 3-0 nonrapid polyglactin (Vicryl; Johnson & Johnson Int., Ethicon, St. Stevens Woluwe, Belgium) suture and removed 2 weeks later.

Treatment of the donor site was completed after fixation of the bone graft and closure of the recipient site, which was filled with bovine material (Bio-Oss), covered with resorbable membrane (Bio-Gide), and closed with the same sutures.

Second Tier Operation

The interval between the first and second tier operations was 5 months. Bone at the recipient area was reevaluated 3 weeks before the second tier bone graft. Panoramic and conventional or computerized tomography scans were evaluated for the new bone shape.

A mucoperiosteal flap was reflected similar to the first operation. Decortication was not performed to preserve the bone grafted at the first tier. The bone defect was reevaluated to determine the size and shape of the block needed. The titanium self-tap screws were removed.

For the second tier, bone blocks were harvested either from the second ramus or the mandibular symphysis (Fig. 3). For the symphysis, an intrasulcular incision and 2 vertical releasing incisions were made posterior to the second premolar regions, reflecting the mucoperiosteal flap at the facial side. After exposing the symphysis and locating the mental foramina, a reciprocating saw was used to outline a rectangle, the size of the exposed defect. The superior aspect of the rectangle was at least 3–5 mm below the tooth apices, and the integrity of the lower border of

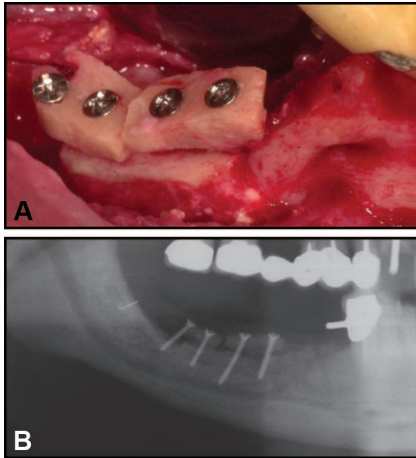


Fig. 4. Clinical (A) and radiographic (B) views of the second tier bone block placement following fixation in the recipient site.

the mandible was maintained. Osteotomes were used to free the block graft and harvest cancellous bone.

The block graft was positioned over the previous tier, with the endosteal side of the graft facing the cortical bone of the first tier. The block was adapted and fixed to the previous tier using titanium self-tap screws, 1.6 mm in diameter (Osteomed Corp., Ltd.), to be removed during implant placement. The gap was treated and covered as described in the first tier operation. The periosteum at the base of the facial flap in the recipient site was, again, carefully incised to allow stretching of the mucosa and tension-free adaptation of the wound margins.

The flap was sutured with 3-0 nonrapid polyglactin (Vicryl) suture and removed 2 weeks later. The donor site was filled and closed after fixation of the bone graft and closure of the recipient site as described in the first tier (Fig. 4). Implants were placed 5 months after the second tier surgery (Figs. 5 and 6).

DISCUSSION

Intraoral block bone graft surgery is a relatively new technique for implant site preparation. The use of bone from the mandibular symphysis, retromolar area, and mandibular ramus can serve as a good treatment alternative for alveolar ridge augmentation.^{19,21}

The present report describes a multitier intraoral onlay bone block graft that can serve as an alternative

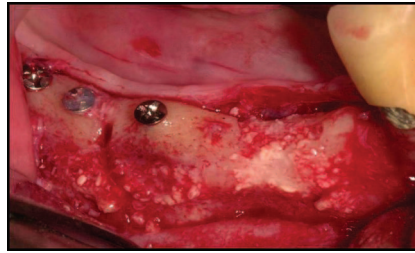


Fig. 5. Five months after second tier placement, a clinical view of the alveolar ridge just prior to dental implant placement.

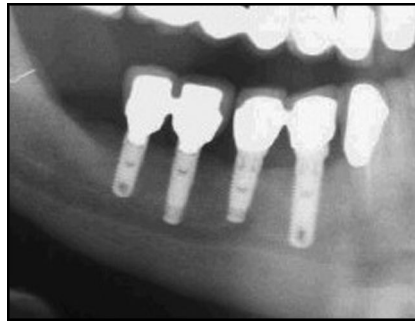


Fig. 6. Follow-up radiograph 2 years after rehabilitation.

operation for extensively absorbed ridge augmentation. Other surgical procedures, such as distraction osteogenesis or repositioning of mandibular nerve, are not always feasible in the extensively atrophic jaw due to insufficient bone, nerve injuries, risk of fractures of the basal mandibular bone, or the distracted segment and resorption of the distracted segment. Furthermore, in mandibular nerve repositioning, the impaired intermaxillary relation remains uncorrected.

It is possible to combine several augmentation techniques, such as sinus floor or subnasal elevation procedures, and onlay bone grafts.^{19,21,22} The multitier procedure offers the surgeon an improved option for reconstruction of extensive bone deficiency and better intermaxillary relation for dental implant treatment. The addition of bone improves the crown-implant ratio by increasing the implant dimension and decreasing the crown dimension. The higher amount of good quality bone after augmentation allows the clinician to place a longer implant in a better trajectory. The alveolar ridge should have adequate width to allow bone on both facial and lingual implant surfaces for circumferential osseointegration. Furthermore,

experimental evidence has shown that grafts from membranous bone have less resorption than endochondral bone due to early revascularization, better potential for incorporation in the maxillofacial region because of a biochemical similarity in the protocollagen, and greater inductive capacity because of a higher concentration of bone morphogenetic proteins and growth factors.^{2,3,14} Cortical bone grafts maintain their volumes significantly better than cancellous bone grafts.²³ Less resorption of the graft harvested from the intraoral origin makes this bone more favorable for implant placement. The main disadvantage of the proposed technique is the need for several operations, which could cause patient discomfort.

Today, fabricated bone blocks are available for alveolar reconstruction. However further research is warranted to investigate their long-term effectiveness.

CONCLUSIONS

A new technique, the multitier intraoral bone block graft, for the future use of dental implants, was described. This technique can serve as an optional operation procedure for extensively atrophic alveolar bone augmentation.

Disclosure

The authors claim to have no financial interest in any company or any of the products mentioned in this article

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Abstract Translations

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Vielschichtenmethodik zur Knochengewebsanreicherung mittels intraoralen autogenen Knochengewebsblöcken

ZUSAMMENFASSUNG: Zielsetzung: Intraorale Knochen- transplantate stellen eine passende und akzeptable Quelle autogenen

Knochengewebes für die alveolare Wiederherstellung dar, da eine große Ähnlichkeit des Knochengewebsursprungs sowie eine geringere Morbidität bestehen. Bei großen Knochengewebsdefekten reicht eine Lage eventuell nicht aus, um die gewünschte Knochenform zu erzielen. Der vorliegende Artikel zielte nun darauf ab, eine Vielschichtentechnik zur Wiederherstellung weitreichender Knochengewebsdefekte durch Anwendung ausschließlich intraoraler Blockknochen transplantate zum Aufbau der Implantationsstelle zu beschreiben. **Materialien und Methoden:** Nach einer klinischen und röntgenologischen Bewertung der Empfängerstelle wurden Messungen unternommen, um darüber das Ausmaß des Knochengewebsdefekts zu erfassen. Die erste Lage des Knochen transplantats wurde aus dem Unterkieferast entnommen. Nach zusätzlichen klinischen und röntgenologischen Beurteilungen der Empfängerstelle 5 Monate später wurden die Knochen transplantatblöcke für die zweite Schicht entweder aus dem zweiten Ast oder aus der Unterkiefersymphyse entnommen. **Schlussfolgerungen:** Es wird die intraorale Vielschicht- entransplantation von Knochengewebsblöcken als neuartige Methodik zur zukünftigen Verwendung von Zahnimplantaten beschrieben. Diese Technik kann bei weitreichender atrophischer Alveolarknochenanreicherung als Möglichkeit der operativen Vorgehensweise dienen.

SCHLÜSSELWÖRTER: Knochengewebdefizienz, Spananlagerung, Anreicherung des vertikalen Kamms, Spenderstelle, Empfängerstelle

SPANISH / ESPAÑOL

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Técnica de múltiples niveles para el aumento del hueso usando bloques intraorales de hueso autógeno

ABSTRACTO: Propósito: Los injertos intraorales de hueso son una fuente conveniente y aceptable de hueso autógeno para la reconstrucción alveolar debido a la similitud en el origen del hueso y menos morbosidad. En defectos grandes de hueso, un nivel podría ser insuficiente para lograr la forma deseada del hueso. El propósito de este artículo fue describir una técnica de múltiples niveles para la reconstrucción de una deficiencia extensa de hueso, usando solamente injertos de bloques intraorales de hueso para el aumento de la cavidad del implante. **Materiales y métodos:** Luego de la evaluación clínica y radiográfica del sitio del beneficiario, se tomaron mediciones para determinar el tamaño de la deficiencia de hueso. El primer nivel de injerto de hueso se logró del ramus mandibular. Luego de evaluaciones clínicas y radiográficas adicionales del sitio del beneficiario cinco meses después, se sacaron los bloques del injerto de hueso para el segundo nivel del segundo ramus o de la sínfisis mandibular. **Conclusiones:** Se describe una nueva técnica, un injerto de hueso intraoral de múltiples niveles para uso futuro de implantes dentales. Esta técnica puede servir como un procedimiento quirúrgico opcional para el aumento del hueso alveolar extensivamente atrófico.

PALABRAS CLAVES: deficiencia de hueso, injerto del hueso onlay, aumento de la cresta vertical, lugar de donación, tamaño del sitio del beneficiario

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Técnica Multicamadas para Aumento do Osso Usando Blocos de Osso Intra-Orais Autógenos

RESUMO: Objetivo: Enxerto de osso intra-orais são uma fonte conveniente e aceitável de osso autógeno para reconstrução alveolar devido à semelhança da origem do osso e menos morbidade. Em grandes defeitos do osso, uma fileira poderia ser insuficiente para alcançar a forma desejada do osso. O objetivo deste artigo era descrever uma técnica multicamadas para reconstrução de extensa deficiência do osso, usando apenas enxertos de osso de bloco intra-oral para aumento do local de implante. **Materiais e métodos:** Após avaliação clínica e radiográfica da área receptora, foram tomadas medidas para determinar o tamanho da deficiência do osso. A primeira fileira de enxerto ósseo foi colhida do ramo mandibular. Após avaliação clínica e radiográfica adicional da área receptora 5 meses mais tarde, os blocos de enxerto do osso para a segunda fileira foram colhidos do segundo ramo ou da sínfise mandibular. **Conclusões:** Uma nova técnica, o enxerto do bloco do osso intra-oral multicamadas, para uso futuro de implantes dentários, é descrita. Esta técnica pode servir como procedimento de operação opcional para aumento do osso alveolar extensivamente atrófico.

PALAVRAS-CHAVE: deficiência do osso, enxerto do osso “onlay”, aumento do rebordo vertical, local doador, área receptora

RUSSIAN / РУССКИЙ

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Прием многослойного наращивания костной массы с использованием внутриротовых блоков костных аутотрансплантатов

АННОТАЦИЯ: Цель: внутриротовые костные трансплантаты являются удобным и приемлемым источником костного аутотрансплантата для восстановления альвеолярной кости благодаря сходству с природной

костью и меньшей болезненности. В случае значительных дефектов кости, одного слоя может быть недостаточно для получения желаемой формы кости. Цель данной статьи – описать прием многослойного восстановления кости при значительной недостаточности костной массы с наложением внутриротовых блоков костных аутотрансплантатов для увеличения костной массы в месте установки трансплантата. **Материалы и методы:** после клинической и радиографической оценки места установки трансплантата были сделаны измерения, для того чтобы определить степень недостаточности костной массы. Первый слой костного аутотрансплантата был получен из нижнечелюстного ответвления. После дополнительной клинической и радиографической оценки места установки имплантата, сделанной 5

месяцев спустя, в качестве второго слоя были применены блоки костного аутотрансплантата, полученные либо из другого нижнечелюстного ответвления, либо из нижнечелюстного симфиза. **Выводы:** описан новый прием с применением многослойных внутриротовых блоков костного аутотрансплантата. Данный прием может использоваться в качестве вспомогательной операционной процедуры для наращивания костной массы в случае обширной атрофии альвеолярной кости.

КЛЮЧЕВЫЕ СЛОВА: недостаточность костной массы, накладываемый костный аутотрансплантат, вертикального наращивания альвеолярного гребня, донорский участок, участок-реципиент

JAPANESE / 日本語

Intra-Oral Autogenous Bone Blocksを使う骨増大のMulti-Tierテクニック

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要約:

目的: Intra-oral bone graftsは、骨起源の同一性とmorbidityの小ささゆえに、歯槽堤修復のために便利で適用可能な自家骨材料である。大きな骨損傷の場合、one tier方式では望ましい骨形を得るのに十分ではないことがありえる。そのため本論文の目的は、大型の骨損傷の修復のために、インプラントサイト増大にintra-oral bone graftだけを使用したmulti-tier方式を説明することにある。

素材と方法: 患者部位の臨床ならびにX線評価に続き、骨損傷の大きさを計測した。第1 tierの骨移植が下顎枝から採取された。患者部位の5ヵ月後のさらなる臨床ならびにX線評価の後に、第2 tier用の骨移植ブロックがもう一方の下顎枝または下顎symphysisから採取された。

結論: デンタルインプラントへの将来的適用に向けて、multi-tierのintra-oral bone graftという新技法が説明される。この技法は、高度に萎縮した歯槽骨の増大術のための治療オプションとして有用であることが考えられる。

キーワード: 骨損傷、オンレイ骨移植、垂直方向歯槽堤増大、ドナーサイト、レシピエントサイト

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使用口內自生骨塊促進骨增生的多層技術

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摘要

目的：口內骨移植是供給齒槽重建使用的自生骨一個既方便又可接受的來源，因為兩者的骨來源類似，而且較少發病現象。在大的骨缺損中，單層可能不足以獲致期望的骨形。本文的目的旨在說明僅使用口內骨塊移植的植體部位增生的大規模骨缺損重建多層技術。

資料與方法：在臨床與X光攝影評估種植部位之後，利用測量法確認骨缺損的大小。第一層的骨移植從下頷枝取得。5個月後，再次以臨床與X光攝影評估種植部位，從第二下頷枝或下頷聯合取得第二層的骨移植骨塊。

結論：說明未來牙科植體使用的全新技術 -- 多層口內骨塊移植。此技術可作為大規模齒槽萎縮的骨增生的手術選擇之一。

關鍵字：骨缺損、冠蓋體骨移植、垂直牙脊豐隆、供給部位、種植部位

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구강 내 자가 골 블록(**autogenous bone block**)을 사용한, 골 증강용 다단(**multi-tier**)법

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초록:

목적 : 골 기원이 유사하고 이환성이 적기 때문에, 구강 내 골 이식편은 치조골 재형성술에 쓰이는 자가 골의 편리하고 수용성 좋은 공급원이다. 큰 골 결손에서, 한 번의 단(**tier**)으로는 원하는 골 모양을 얻기가 충분치 않을 수 있다. 이 논문의 목적은, 임플란트 부위의 증강을 위해 단지 구강 내 골 블록 이식편을 사용하는, 넓은 골 결손 재형성을 위한 다단법(**multi-tier technique**)을 기술하는 것이었다.

자료와 방법 : 수용 부위를 임상적, 방사선학적으로 평가한 후, 골 결손의 크기를 측정하였다. 골 이식의 첫 번째 단(**tier**)은 하악골 가지에서 얻었다. 5개월 후 수용 부위를 다시 임상적, 방사선학적으로 평가한 후, 두 번째 단(**tier**)을 위한 골 이식 블록을 두 번째 가지 혹은 하악골 결합에서 얻었다.

결론 : 장차 임플란트의 사용을 위한, 새로운 방법인 다단(**multi-tier**) 구강 내 골 블록 이식술에 대해 기술하였다. 이 방법은 크게 위축된 치조골 증강의 수술 방법의 하나로 사용할 수 있다.

핵심 단어 : 골 결손, 온레이 골 이식편, 치조능 수직 증강술, 제공 부위, 수용 부위

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