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ORIGINAL ARTICLE

TENTING POLE ABUTMENT TECHNIQUE FOR THE EASY RECONSTRUCTION OF SEVERELY RESORBED ALVEOLAR RIDGES

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Abstract

Dental implant-supported oral rehabilitation is a widely used procedure in modern dentistry. However, implant placement on an atrophic alveolar ridge remains a challenging task due to the insufficient quantity and poor quality of bone. To address this issue, various surgical techniques have been employed to overcome vertical bone deficiency at implant sites, including guided bone regeneration (GBR) using non-resorbable barrier membranes or titanium mesh, onlay block grafting with intraosseous or extraosseous bone blocks, distraction osteogenesis, sandwich osteotomy with an interposition bone graft, and the ramus split bone technique.

These surgical procedures are not without their drawbacks, however. They can be technically challenging, require longer surgery times, and result in significant postoperative patient discomfort. Additionally, because the implants are not placed simultaneously, the patient's edentulous healing period is prolonged.

The utilization of tenting pole implants and abutments in conjunction with GBR procedure is a safe and effective technique for advanced ridge augmentation. This procedure has minimal complications. Future investigations are required to validate the effectiveness of this technique.

Keywords: *Tenting pole, abutment, implants, resorbed, alveolar ridges*

Introduction

Description of vertical tenting pole abutment (SANTA®)

SANTA® (Biotem implant co. Busan, Korea) is a specialized vertical tenting device designed for use in both horizontal and vertical ridge augmentation procedures. It is placed onto the implant platform within the bony defect and helps prevent the compression of bone graft materials by the periosteum and overlying mucosa. This enhances the stabilization of bone grafts, which is an essential requirement for GBR procedures. Additionally, the narrower neck design of SANTA allows for the placement of more bone graft material over the platform of the exposed implant surface. Therefore, this design can prevent exposure of the implant that may result from the dimensional changes of bone grafts that may occur over time. It has a cover head diameter of 5 and 6mm and is available in three cuff heights: 1mm (SANTA-1) for horizontal augmentation and 2mm and 3mm (SANTA-2 and SANTA 3) for 3-dimensional ridge augmentation (Figure 1).[1-3]

Figure 1a. *SANTA has 1-3mm cuff height SANTA 1 is indicated for horizontal ridge augmentation. SANTA-2 and 3 are indicated for vertical ridge augmentation*

Figure 1b*. The narrower neck design of SANTA enables over-grafting over the implant platform to compensate for bone resorption that may occur over time*

The purpose of this report is to introduce a novel surgical technique for reconstructing severely resorbed alveolar ridges using a tenting pole abutment to overcome the limitations of existing bone reconstruction procedures.

Case presentation

A 59-year-old female patient presented with pain and gingival bleeding on mandibular left and right posterior implant supported fixed restorations. Plain radiographs revealed bone resorption on the sites of the left 2nd premolar and 1st molar and the right 1st and 2nd molar implants (Figure 2).[4,5]

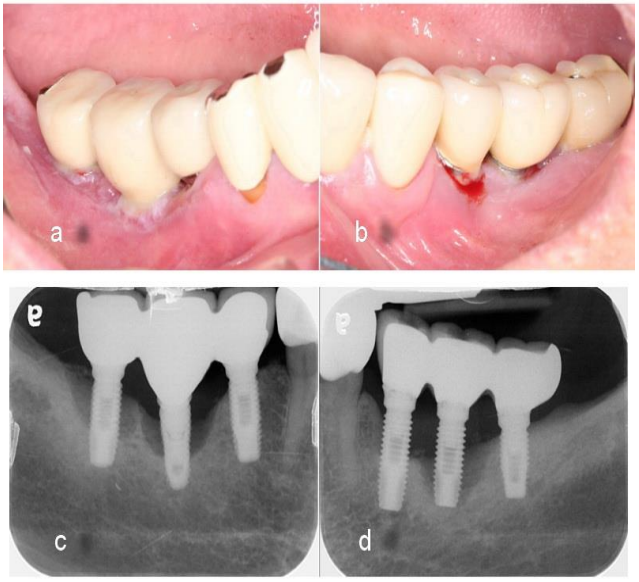

Figure 2a and b*. Intraoral photographs revealing gingival inflammation, suppuration, and bleeding around lower left and right posterior implant-supported restorations caused by peri-implantitis.* ***c and d.*** *Plain radiographs revealed severe bone resorption on lower left and right posterior implant-supported restoration due to peri-implantitis*

All implants showing bone resorption were removed using forceps and an implant removal kit on February 9th, 2022. She came back to our department after 6 weeks of soft tissue healing to receive implants on both lower posterior edentulous sites. Preoperative radiograms indicated severe horizontal and vertical alveolar defects on edentulous area (Figure 3).[6,7]

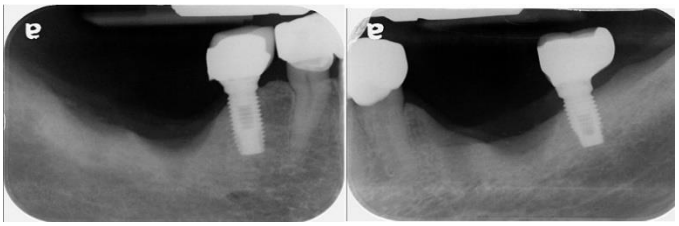

Figure 3. *Radiographic images revealing extensive three-dimensional bone loss following the extraction of failed implants*

The surgical procedure was performed under local anesthesia after IV administration of preoperative antibiotics (Flomoxef, Flumarin®, Ildong Pharm, Korea) on March 29th, 2022. The patient's venous blood was taken from the forearm to make autologous fibrin glue (AFG) and concentrated growth factors (CGF) membranes to prepare sticky bone as described first by Sohn et. Al.).[8] The blood was collected in two non-coated vacutainers and first centrifuged at 2400-2700 rpm using specific centrifuge (Medifuge, Silfradent srl, Sofia, Italy) for 2 minutes to obtain AFG, which will make sticky bone. AFG, upper layer shown on non-coated vacutainer after centrifugation was mixed with biomaterials to make sticky bone grafts. While the non-coated vacutainers were centrifuged, patient's venous blood was collected in six glass coated vacutainers were centrifuged for 12 minutes using the same centrifuge to make CGF membranes. The surgery was performed starting from the lower right posterior area. A crestal incision was made through periosteum to bone to retromolar pad and anterior and posterior vertical incisions, connecting to the crestal incision were made beyond mucogingival junction to mucosa at 45-degree angle. To release lingual flap, it was gently pushed with a periosteal elevator coronally and lingually to dissect periosteum and superficial fibers of mylohyoid muscle. The periosteum of buccal flap was released with a No 15c blade. Before bone grafting, it is essential to ensure that the flaps on both the buccal and lingual sides overlap by at least 10mm. Any soft tissue on the bony defect was removed with completely with a curette. Two large decortications were made on the buccal cortex using a bone collector (ACM, Neobiotech, Seoul, Korea) while simultaneously collecting autogenous bone.

Under-osteotomy using 1mm narrower drill than implant diameter was applied to obtain initial stability of implant. A 5mm wide and 10mm long and a 4.5mm wide and 10mm long implant (Biotem Implant, Busan, Korea) were placed on the 1st molar, and the 2nd molar, respectively with good initial stability. Implants were placed 2mm subcrestally to adjacent proximal crestal bone. Approximately 6mm of the implants were left exposed. A SANTA-2 was placed on each implant platform to maintain the volume of the sticky tooth bone graft during the healing period. Sticky autogenous bone was grafted as the first layer around exposed implant surfaces and sticky bovine bone (Medpark Inc., Busan, Korea) was grafted over the autogenous bone graft as purpose of space maintaining. A resorbable collagen membrane (Colla-D®, Medpark Inc., Busan, Korea) was used to cover the bone graft, but membrane tacks or membrane stabilization sutures were not utilized to stabilize the barrier membrane. Three CGF membranes were placed over the barrier membrane to accelerate wound healing. Tension-free wound closure was done. Before suturing, it is essential to verify that the buccal flap overlaps the lingual flap by at least 2mm (Figure 4).[9]

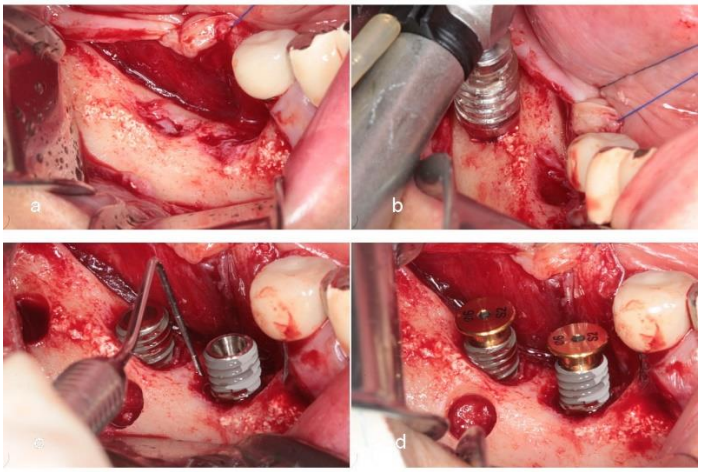

Figure 4a. *A 3-dimensional defect was observed following the elevation of buccal and lingual flaps*
b. *Autogenous bone chip was collected simultaneously while creating two large decortications on the buccal cortex*
c. *The implants were observed to be 6mm vertically exposed after being placed 2mm subcrestally to adjacent proximal bone*
d. *A SANTA 2 abutment was placed on the implant platform and tightened to 10Ncm*

The same surgical technique was applied to the left posterior region as well on the same day. After placing a 4.5mm wide and 10mm long implant on the 2nd premolar and 1st molar, respectively, a SANTA-2 was place on the implant platform. The implant surface was exposed vertically about 5mm. Layered bone grafting using sticky autogenous bone and bovine bone was performed, and a collagen barrier was covered over the bone graft. Two CGF membranes were covered over the collagen barrier, and tension free suture was achieved (Figure 5, 6).

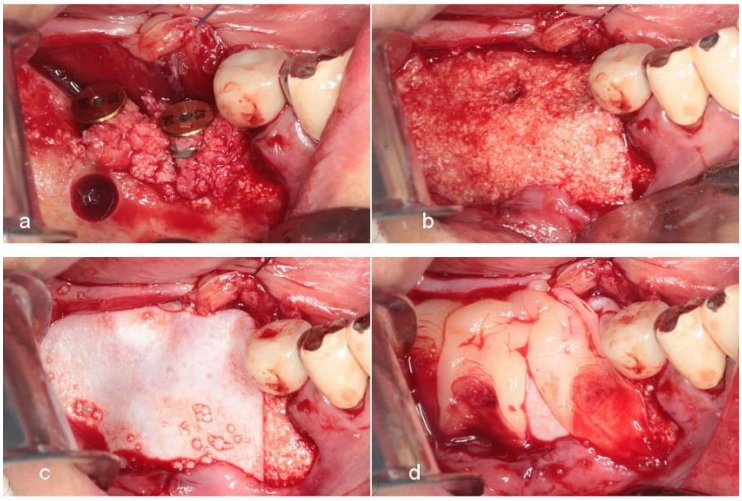

Figure 5a*. Sticky autogenous bone graft was grafted along the exposed implant surface*
b. *Sticky bovine bone was layered over the sticky autogenous bone graft to act as a space maintainer*
c*. A collagen barrier was applied over the bone graft without the use of membrane tacks or stabilization sutures*
d. *Three compressed CGF membranes were covered over the collagen barrier to accelerate wound healing, followed tension free suture*

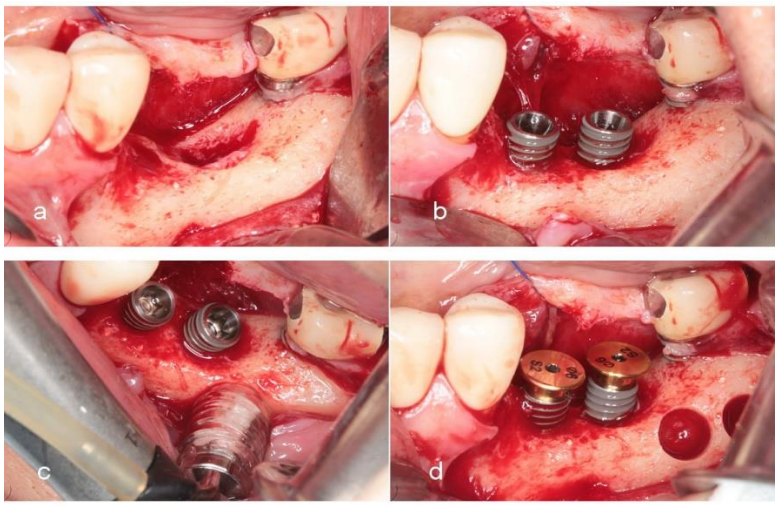

Figure 6a. *Note severe 3-diensional defect on lower left alveolar ridge*
b. *Implants were placed to function as a tenting pole screw. Implants were placed 2mm subcrestally to adjacent proximal bone. Note 5 mm vertical exposure of implants*
c. *Two large decortications were made. D. SANTA with 2mm cuff height was placed onto the implant platform*
d. *Three compressed CGF membranes were placed over the collagen barrier to expedite the healing process, and then a suture without tension was applied*

Healing on the right side was uneventful until the uncovering was done five months later. In contrast, A SANTA placed on left 2nd premolar was partially exposed after five months of healing on the left side. However, bone graft remained stable over all implant platforms. To widen attached keratinized gingiva around implants, suture-less free gingival graft was performed on the left side after connecting healing abutments. A superficial horizontal incision was made at muco-gingival junction using a 15c blade. Two superficial vertical incisions were made at the end of the horizontal incision and extended into the vestibule. The recipient bed then was prepared by split-thickness apically repositioned flap. The apically repositioned flap was stabilized at the base of vestibule with 2 periosteal sutures using a synthetic absorbable surgical suture (Coated vicryl, Ethicon LCC, USA). Free gingival tissue harvested from the palate was grafted on the recipient site and stabilized with tissue cyanoacrylate (N-butyl-2-cyanoacrylate (Histoacryl, B. Braun Surgical, S.A, Spain). Periodontal dressing (COE-PAK ™, GC, Japan) was applied to protect the wound site and to provide compression to the free gingival graft during the initial healing period **(**Figure 7).[10]

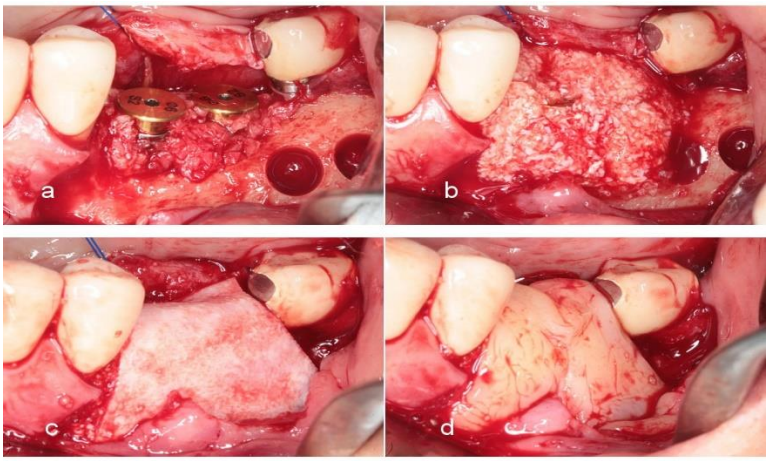

Figure 7a. *Sticky autogenous bone graft was grafted along the exposed implant surface*
b. *Sticky bovine bone was grafted over the autogenous bone graft*
c. *A collagen barrier was covered over the bone graft*
d. *Two CGF membranes were covered over the collagen membranes to accelerate the wound healing*

A final zirconia-based restoration was cemented on implants after 1 months of loading of the progressive restoration on the left side. On the right side, suture-less free gingival graft was performed after a provisional restoration on the right side. A definitive restoration was delivered after 1 month loading of a provisional restoration. After 6 months of functioning, it was observed that the bilateral prosthesis effectively maintained a stable, augmented ridge over the implant platform (Figure 8-12).

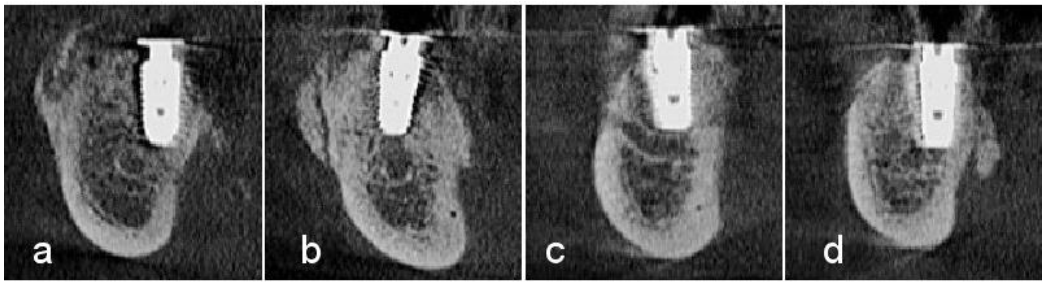

Figure 9. *Postoperative CBCT scan images. Note successful 3-dimensional ridge augmentation*

a. *the site of #17* ***b***. *the site of #16* ***c.*** *the site of # 25* ***d.*** *the site of #26*

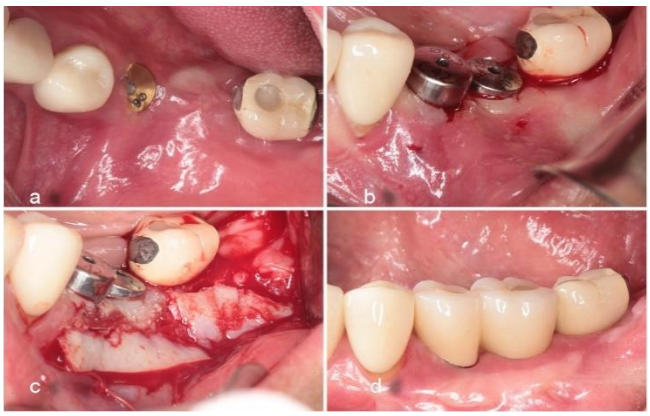

Figure 10a. *Note partial exposure of SANTA on # 25 after 5 months of healing*
b. *Intraoral image showing insufficient attached gingiva after uncovering procedure*
c. *Suture-less free gingival graft was performed*
d. *Note healthy gingiva around implant restoration after 6 months in function*

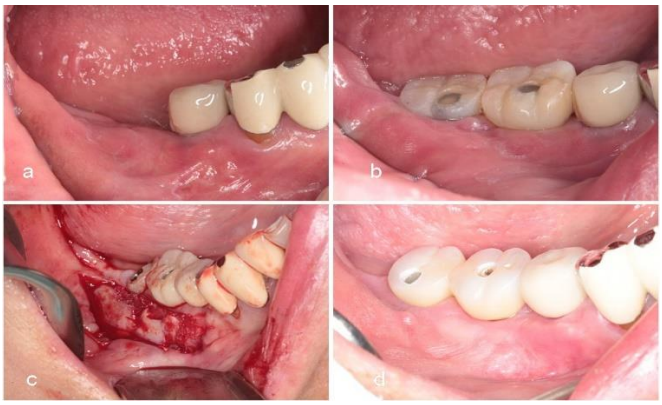

Figure 11a. *Intraoral image after 5 months of healing on the right side.*
b. *Note insufficient attached gingiva around provisional restoration*
c. *Suture-less free gingival graft was performed*
d. *Note wide zone of attached gingiva around final restoration after 6 months of loading*

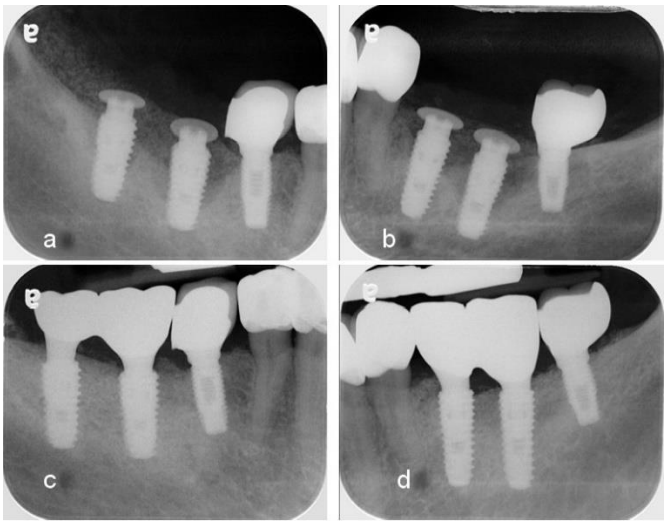

Figure 12a. *A postoperative plain radiograph on the right ridge*
b. *A postoperative plain radiograph on the left ridge*
c. *A plain radiograph on the right side after 6 months of loading revealed stable augmentation over implant platform*
d. *After 6 months of loading, a radiographic image on the right side showed that the augmentation over the implant platform was stable*

Discussion

The reconstruction of large vertical bone defects is widely recognized as a highly challenging technique. During the healing period, it is important to maintain space using a bone graft. Autogenous bone grafting has been recognized as the gold standard for vertical augmentation procedures due to its ability to maintain a solid space, but it has also been reported to have several disadvantages. Patients have a low acceptance rate for the autogenous block bone grafting due to prolonged surgical time and increased cost, greater post-operative discomfort, and the need for additional surgery at the donor site.[11,12]

The various issues, such as unpredictable resorption after healing, autograft failure, mandibular fracture during harvesting of autogenous block bone, and neurosensory disturbances at the recipient site, are also known to be some of the reasons why autogenous bone grafting may not be an easy choice.[13-16]

To overcome the limitations of autogenous bone grafts, allogenic bone blocks have been used in three-dimensional alveolar bone augmentation procedures. The advantage of using allogenic bone blocks is that they can be shaped to fit the form of the bone defect without the limitation of the amount of available bone graft material. Additionally, allogenic bone blocks have the advantage of not requiring a secondary surgical site, which is necessary in the case of autogenous bone grafts.[17,18] However, according to some studies, allogenic block bone grafts have some disadvantages, including faster resorption during the healing period, cracking of the bone graft due to occlusal force, and poor integration of grafts.[18,19,20]

To overcome the disadvantages of 3-dimensional augmentation using block bone grafts, guided bone regeneration (GBR) has been widely utilized for the reconstruction of large defects with delayed implant placement.[8,21] However, due to poor stiffness of resorbable collagen membranes, non-resorbable barriers such as dense-polytetrafluoroethylene (d-PTFE), expanded-polytetrafluoroethylene (e-PTFE) and titanium mesh are utilized to achieve more favorable vertical support in 3-dimensional ridge augmentation. However, the main disadvantage of a non-resorbable barrier membrane is early exposure, which can cause unfavorable bone generation.[22]

Another disadvantage of non-resorbable barrier-supported GBR are technical difficulties when placing it over the bone graft and when removing it after the healing period. To stabilize these barriers over the bone graft placed on the bony defect, several bone tacks should be placed on the edge of the barrier membrane to stabilize it. This procedure is recognized as time consuming and tedious procedure. In addition, "When performing guided bone regeneration (GBR) with a non-resorbable barrier or titanium mesh, over-grafting is essential because a 1-2mm thick soft tissue layer is always regenerated under a non-resorbable barrier.[23]

Bone augmentation achieved through the conventional GBR technique using a membrane is generally inferior to that achieved through block bone grafting procedures in terms of outcomes.[24] In order to overcome the limitations of conventional GBR for vertical bone augmentation procedures, the tenting pole technique techniques with GBR has been introduced in several studies as a means to enhance the effectiveness of vertical bone augmentation procedures.[25]

This tent-pole technique is relatively simpler and a less invasive augmentation procedure, compared to autogenous and allogenic block bone grafting, distraction osteogenesis or vertical sandwich techniques.[26-28]

However, the tenting pole technique requires a long edentulous period and an increased number of surgeries because implants can't be placed at the same time when performing tent-pole-assisted ridge augmentation. In contrast to the screw tenting pole technique. In several studies, guided bone regeneration (GBR) performed with simultaneous implant placement into the bone defect has been shown to be a successful alternative to the use of screws for vertical bone augmentation procedures.[29-31]

Tenting of the periosteum and soft tissue matrix using implants can lead to predictable 3-dimensional ridge augmentation. This technique is known to have many advantages. The number of surgeries is reduced, and the edentulous healing period is shortened because implants are placed simultaneously. However, remodeling of the augmented ridge results in dimensional resorption over time, which cannot be prevented. Maintaining over-grafting over implant platforms is necessary to compensate for future bone resorption.[32,33]

To prevent bone resorption in augmented ridge, a surgical technique has been developed to maintain bone grafts over implant platforms by using a tenting pole abutment. This technique creates space for bone grafting material on the platform of an implant that is placed to tent severely resorbed alveolar bone.[33-34]

The use of the tenting pole abutment technique along with GBR procedure prevented the collapse of the space created by the bone graft and minimized the resorption of the grafting material in both horizontal and vertical ridge augmentation procedures. In addition, the regenerated new bone is allowed to stay in place on the implant platform even after functional loading over time as demonstrated in this study.

Conclusion

The utilization of tenting pole implants and abutments in conjunction with GBR procedure is a safe and effective technique for advanced ridge augmentation. This procedure has minimal complications. Future investigations are required to validate the effectiveness of this technique.

Declarations

Conflicts of interest and financial disclosures

Dong-Seok Sohn is the developer of SANTA. The other authors declare that they have no conflict percent and there was no external source of funding for present research.

Source of funding

The work was not funded.

Ethical approval

Research protocol was approved by the local Ethical Committee (2018/23) and in accordance with those of the World Medical Association and the Helsinki Declaration.

Informed consent

Informed consent was obtained from all individual participants included in the study.

Availability of Data and Materials

Not applicable.

Acknowledgements

Not applicable.

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ՏԵՆՏԻՆԳ ԱԲԱԹՄԵՆԻ ՏԵԽՆԻԿԱ՝ ՉԳԱԼԻ ԱՊԱՃՈՎ ԱՏԱՄՆԱԲՆԱՅԻՆ ԵԼՈՒՆԵՐԻ ՀԵՇՏ ՎԵՐԱԿԱՆԳՆՄԱՆ ՀԱՄԱՐ

Դոնգ Սեոկ Սոն,[1] Ալբերտ Լուի,[2] Հյունսուկ Չոյ[3]

[1] Պրոֆեսոր, ստոմատոլոգիայի և բերանի խոռոչի և դիմածնոտային վիրաբուժության ամբիոն, Դաեգուի կաթոլիկ համալսարանի բժշկության դպրոց, Դեգու, Կորեայի Հանրապետություն

[2] Մասնավոր պրակտիկա, Կալգարի, Կանադա

[3] Ասիստենտ, ստոմատոլոգիայի և պրոսթոդոնտիկայի ամբիոն, Դաեգուի կաթոլիկ համալսարանի բժշկական դպրոց, Դեգու, Կորեայի Հանրապետություն

Ամփոփում

Ատամնային իմպլանտների միջոցով բերանի խոռոչի վերականգնումը լայնորեն կիրառվող պրոցեդուրա է ժամանակակից ստոմատոլոգիայում: Այնուամենայնիվ, իմպլանտների տեղադրումը զգալի ապաճով ատամնաբնային ելուներում դժվար խնդիր է՝ ոսկորերի անբավարար քանակի և վատ որակի պատճառով: Այս խնդիրը լուծելու համար կիրառվել են տարբեր վիրաբուժական մեթոդներ՝ ուղղահայաց ոսկրային անբավարարությունը հաղթահարելու համար, ներառյալ ուղղորդված ոսկրային ռեգեներացիան՝ օգտագործելով չներծծվող պատնեշային թաղանթներ կամ տիտանի ցանցեր, ներոսկրային կամ արտաոսկրային ոսկրային բլոկների պատվաստում, դիստրակցիոն օստեոգենեզ, սենդվիչ օստեոտոմիա՝ միջդիրքային ոսկրային փոխպատվաստումով և ճյուղի ոսկրային տեխնիկա: Այնուամենայնիվ, այս վիրաբուժական միջամտությունները զերծ չեն իրենց թերություններից: Դրանք կարող են լինել տեխնիկապես դժվար, պահանջել վիրահատության ավելի երկար ժամանակ և հանգեցնել հիվանդի հետվիրահատական զգալի անհանգստության: Բացի այդ, քանի որ իմպլանտները միաժամանակ չեն տեղադրվում, հիվանդի անատամ ապաքինման շրջանը երկարաձգվում է:

Տենտինգ աբաթմենների և իմպլանտների օգտագործումը ուղղորդված ոսկրային ռեգեներացիայի հետ միասին անվտանգ և արդյունավետ տեխնիկա է ապաճով ատամնաբնային ելուների մեծացման համար: Այս պրոցեդուրան ունի նվազագույն բարդություններ: Այս տեխնիկայի արդյունավետությունը հաստատելու համար ապագա հետազոտություններ են պահանջվում:

ТЕХНИКА ТЕНТИНГ АБАТМЕНТА ДЛЯ ЛЕГКОЙ РЕКОНСТРУКЦИИ СИЛЬНО РЕЗОРБИРОВАННЫХ АЛЬВЕОЛЯРНЫХ ГРЕБНЕЙ

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Абстракт

Реабилитация полости рта с опорой на зубные имплантаты – широко используемая процедура в современной стоматологии. Однако установка имплантата на атрофированном альвеолярном отростке остается сложной задачей из-за недостаточного количества и плохого качества кости. Для решения этой проблемы использовались различные хирургические методы для преодоления вертикального костного дефицита в местах установки имплантатов, в том числе направленная регенерация кости (НКР) с использованием нерезорбируемых барьерных мембран или титановой сетки, наращивание блока с костными блоками, дистракционный остеогенез, сэндвич-остеотомия с интерпозиционным костным трансплантатом и техника расщепленной ветви. Однако эти хирургические процедуры не лишены недостатков. Они могут быть технически сложными, требовать более длительного времени операции и приводить к значительному послеоперационному дискомфорту пациента. Кроме того, поскольку имплантаты не устанавливаются одновременно, у пациента продлевается период заживления адентии.

Использование тентинг имплантатов и абатментов в сочетании с процедурой НКР является безопасным и эффективным методом для расширенного увеличения альвеолярного гребня. Эта процедура имеет минимум осложнений. Будущие исследования необходимы для подтверждения эффективности этого метода.