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A case of implant-retained removable partial denture treatment in crossed occlusion with severely resorbed mandibular alveolar bone

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An crossed occlusion is an occlusion condition in which residual teeth exist both in maxilla and mandible but do not form an occlusal contact. In the crossed occlusion situation, the removable proshtesis is vulnerable to rotation, which can lead to unstable occlusion, resorption of the supporting alveolar bone, and supraeruption of the remaining teeth. One of the treatment methods for such crossed occlusion is to place an implant in the proper edentulous area to regain the occlusal support. This case report describes an implant-retained removal partial denture (IRRPD) treatment in crossed occlusion with severely resorbed mandibular alveolar bone with successful results. **(THE JOURNAL OF KOREAN ACADEMY OF OSSEOINTEGRATION 2022;14(1):1-7)**

Key words: Implant, Implant-retained removable partial denture, Removable partial denture, Crossed occlusion

INTRODUCTION

An occlusal condition in which residual teeth exist both in maxilla and mandible but do not form an occlusion due to no contact is often called as crossed occlusion situation. Removable partial dentures in crossed occlusion situation will have mandibular denture opposing maxillary dentition and maxillary denture opposing mandibular dentition[1-3]. As a result, any removable prosthesis delivered on the crossed occlusion will solely depend on mucosal support. In the crossed occlusion situation, the removable prosthesis is vulnerable to rotation, which can lead to unstable occlusion, resorption of the supporting alveolar bone, and super eruption of the remaining teeth. One of the treatment methods for such crossed occlusion is to restore the occlusal support by placing an implant in the edentulous area to prevent aforementioned consequences. This case report will describe a successful implant-retained removable partial denture treatment case in crossed occlusion with severely resorbed mandibular alveolar bone.

CASE REPORT

A 75 years old female patient presented Prosthodontics clinic in Seoul St' Mary's Hospital of Catholic University of Korea with the chief complaints of mobile tooth on her lower right side. Upon examination, patient had crossed occlusion and the mandibular right side canine had mobility with grade 2 (Figure 1, 2). Radiographic examination showed severely resorbed mandibular alveolar bone on the right side, which is opposing the maxillary teeth (Figure 3). Patient had little problem with the maxillary removable partial denture other than temporary discomfort on the abutment tooth when patient tried to wear the denture in the morning. The patient did not remember the exact date the dentures were fabricated.

Based on the examinations, the problems were listed as follows. Crossed occlusion, super eruption of the remaining teeth, irregular occlusal plane, severe alveolar resorption of mandible on the right side, generalized occlusal/incisal wear, chronic periodontal disease, and lack of retention of the mandibular removable partial denture.

To address these problems and the patient's chief complaints, a mandibular implant-retained removable partial denture treatment was decided in consultation with the patient. Korea's national health insurance system, which covers up to two implants and the removable partial denture, also influenced the patient's decision. The right mandibular canine and first premolar area was decided as implant placement position in consideration of the crossed occlusion situation and the severe resorption of mandibular alveolar bone in the right side posterior region.

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(a) Frontal view

(b) Lateral view

Figure 1. Pre-operative photographs of the case.

The treatment plan was as follows.

Surgical phase:

1. #43 tooth extraction
2. #43i, 44i implant placement

Restorative phase:

1. #43i-44i surveyed implant fixed bridge
2. Mandibular implant-retained removable partial denture
3 Maxillary removable partial denture hard reline
4. Composite restorations on mandibular incisors

The position and the angle of the implants were carefully determined upon CT radiographic examination with the aid of radiographic stent (Figure 4). The Osstem TS III SA 4.0 x 10.0 mm fixture was placed on #43 area and the Osstem TS III SA 4.0 x 8.5 mm fixture was placed on #44 area with the aid of prepared surgical stent (Figure 5, 6).

After 3 months of osseointegration period, the restorative procedures was performed. The mandibular implant-retained removable partial denture design included linguoplate major framework, #33 combination clasp, #44i RPA clasp assembly, #44i mesio-occlusal rest, guiding plane on #33 and 44i distal, and lingual rests on #32, 31, 41, 42, 43i for indirect retainer (Figure 7). Both maxillary and mandibular impressions were

(a) Frontal view

(b) Mandibular partial denture

(c) Maxillary partial denture

Figure 2. Pre-operative photographs with existing removable partial denture.

made with alginate and silicone each (Figure 8). A mandibular wax rim was used to register the centric relation at the desired vertical dimension in consideration of restorative space and occlusal plane (Figure 9). The arbitrary type facebow was used to register the maxillary occlusal plane (Figure 10). The custom abutments for #43i and 44i were milled. The wax-up for the

Figure 3. Pre-operative panoramic radiograph of the case.

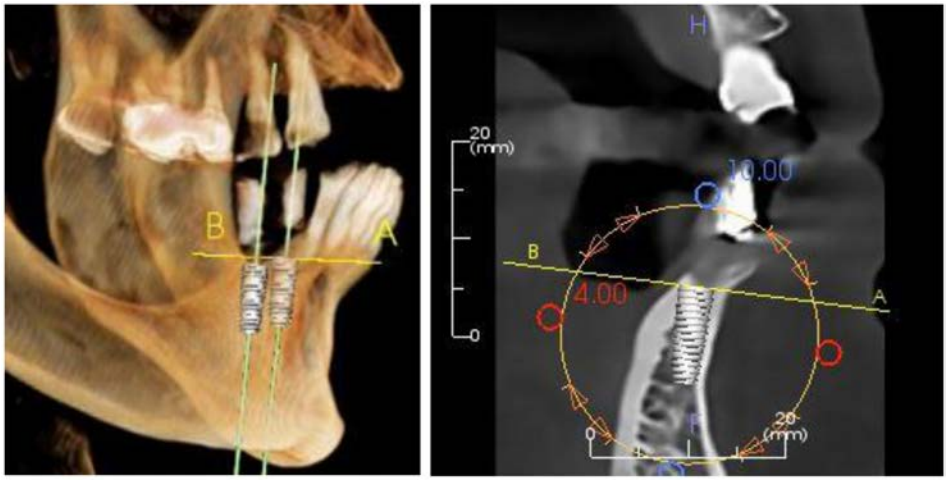

Figure 4. CT scan images for implant placement planning.

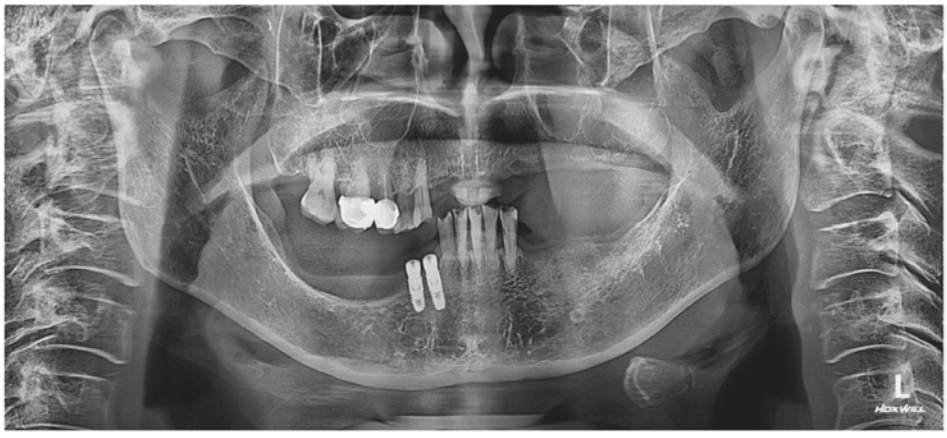

Figure 5. Post-surgical panoramic radiograph.

#43i-44i bridge was carved and surveyed (Figure 11). The wax-up was used to cast the metal fused to porcelain bridge framework. After the delivery of the implant abutments and the cement type bridge (Figure 12), border molding and final impression for the implant-retained removable partial denture was performed (Figure 13). The removable partial denture

Figure 6. Post–surgical photographs of implants.

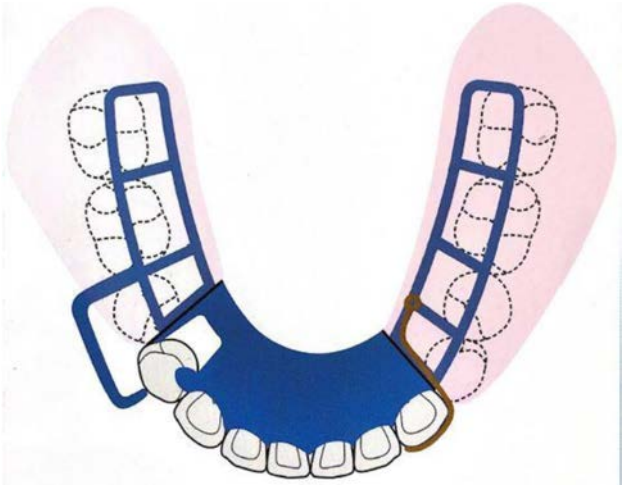

Figure 7. The RPD design.

Figure 9. The wax rim for CR registration.

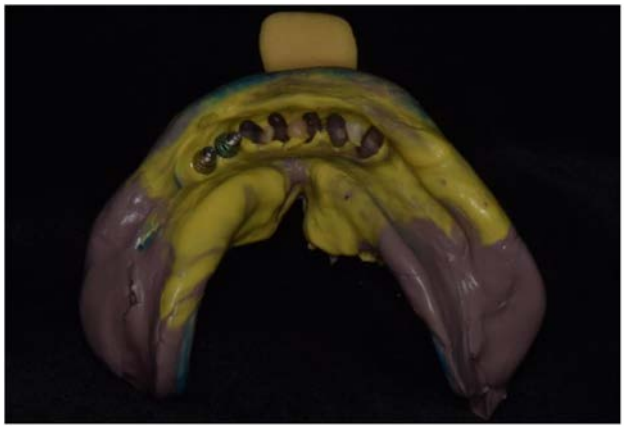

Figure 8. Final impression.

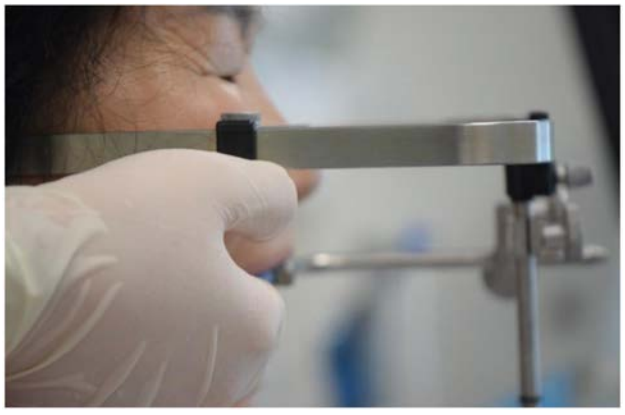

Figure 10. Facebow registration procedure.

framework was examined for adaptation, and the occlusion was registered at the same time (Figure 14). And finally, the prostheses were delivered after minor occlusal adjustment (Figure 15).

The patient showed satisfaction regarding the retention and function of the denture. The treatment was executed without bone augmentation, and within patient's financial limit. The implant restorations provided support to overcome the crossed occlusion situation, and the vertical dimension was increased to compensate the uneven occlusal plane. Long term follow up shall be required to further eval-

Figure 11. The custom milled implant abutments and wax-ups.

Figure 12. The implant abutments and prostheses delivery.

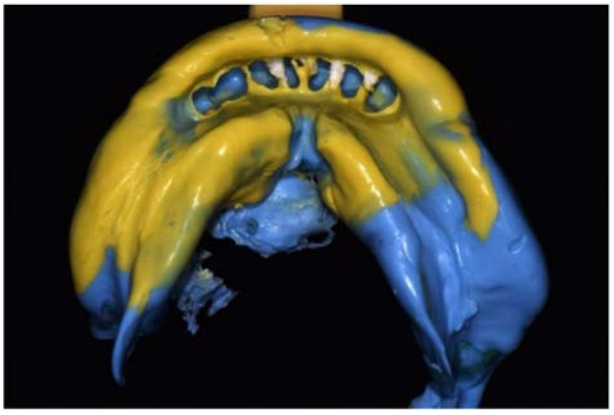

Figure 13. Border molding and final impression for the implant-retained removable partial denture.

uate the success of this treatment.

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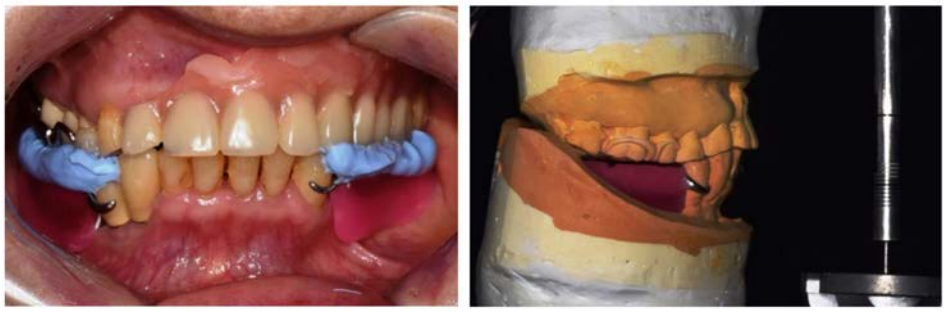

Figure 14. Centric relation registration and mounting procedure.

(a) Frontal view

(b) Lateral view

(d) Maxillary and mandibular occlusal view

Figure 15. Post-operative photographs.

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Implant placement after closing oroantral fistula with buccal fat pad

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An oroantral fistula (OAF) is an abnormal connection between the maxillary sinuses and oral cavity. As Egyedi described in 1977, BFP had been used the most commonly for the closure of OAF. The purpose of this study is to evaluate the effectiveness of pedicled BFP grafting with double-layered suture in the treatment of OAF. **(THE JOURNAL OF KOREAN ACADEMY OF OSSEOINTEGRATION 2022;14(1):8-11)**

Key words: Buccal fat pad, Oroantral fistula, Buccal flap

INTRODUCTION

An oroantral fistula (OAF) is an abnormal connection between the maxillary sinuses and oral cavity. It may be induced by tooth extraction, implant surgery, removal of pathological tissues in the palatine part. Clinical symptoms of an Oroantral fistula include such as pronunciation disturbance, liquid leak into the nasal cavity, maxillary sinusitis and excruciating pain in and around the region. OAF caused by tooth extraction or curettage are naturally closed. However, natural closure cannot occur when sinusitis is present, and if it has been more than four weeks or is greater than 4~5 mm, surgical treatment is required.

Various techniques have been introduced for the treatment of OAF, including buccal advancement flap, palatal rotation flaps, tongue and temporalis flaps. These methods, however, have disadvantages such as lowering the oral vestibule after surgery and causing discomfort to the patient until the palatal defect heals, and not always showing satisfactory results.

As Egyedi described in 1977[1], BFP grafting has been used commonly for the closure of OAF. The purpose of this study is to evaluate the effectiveness of pedicled BFP grafting in the treatment of OAF.

CASE REPORT

A 62-year-old female patient was referred from local dental clinic to department of oral and maxillofacial surgery, Cheongju Hankook General Hospital for removal of a displaced dental implant inside the left maxillary sinus. Clinical and radiographic studies revealed an implant inside the left maxillary sinus with oroantral fistula and maxillary sinusitis (Figure 1).

1. Operative procedure

Under local anesthesia, mid-crestal incision with single vertical release was made at the premolar-molar region. The full-thickness mucoperiosteal flap was elevated to expose the oroantral fistula and underlying bone defect which was about 10 mm at its largest diameter.

The dental aspirator was introduced into the antrum of maxillary sinus through the bone defect, the displacedimplant was successfully brought out through the defect. The oroantral fistula was planned to close using buccal fat pad flap (Figure 2A~C). The incision was made in the reflected periosteum posterior to the zygomatic buttress and the buccal fat pad was exposed by blunt dissection under the periosteum of the buccal flap. The exposed BFP was gently pulled out without tension toward the defect and covered the bone defect. The defect was closed with double-layered suture of BFP and oral mucosa. Two-weeks after the surgery, gingival healing was favorable and stitch out was done. 3-months after the surgery, the adequate closure of the defect in the left second molar site was achieved (Figure 2D). After the fistula closure, the adjacent implant placed in the left first molar site was also removed and bone graft was done with sinus elevation by lateral window approach. Ti-Oss® and Frabone® were used as bone graft material and Lysogide® membrane was used to cover where maxillary sinus perforation existed. 7-months after

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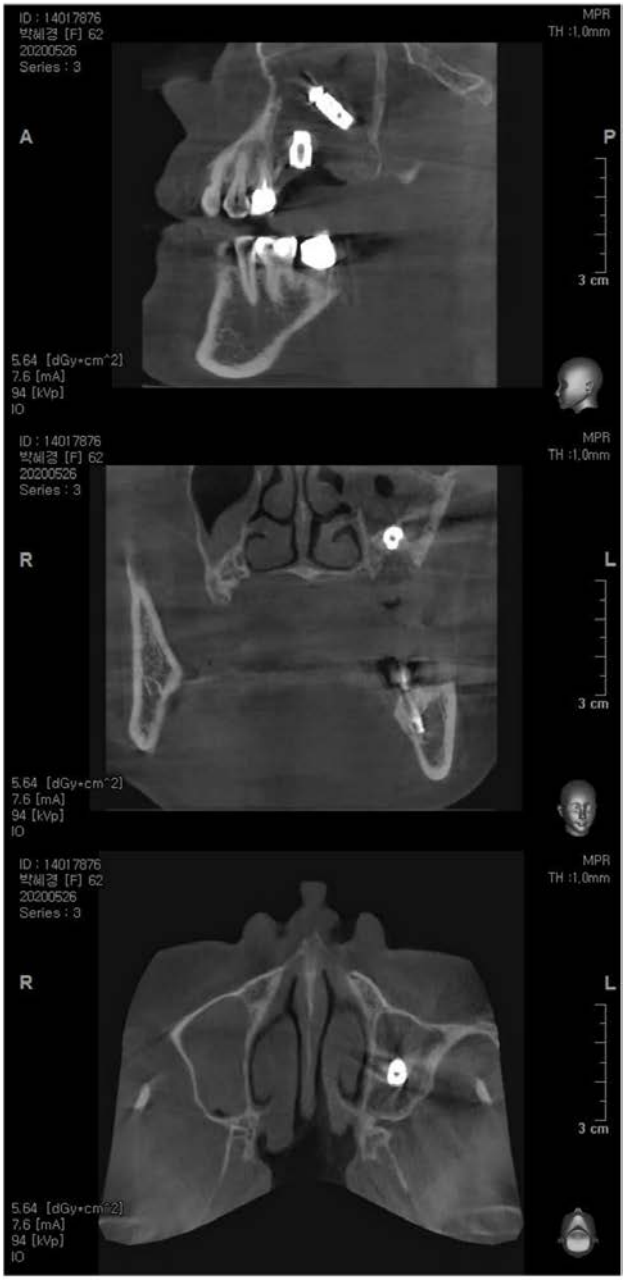

Figure 1. Cone beam CT scan showing the destruction of the left maxillary alveolar bone and sinusitis, dental implant fixture and abutment in the left maxillary sinus.

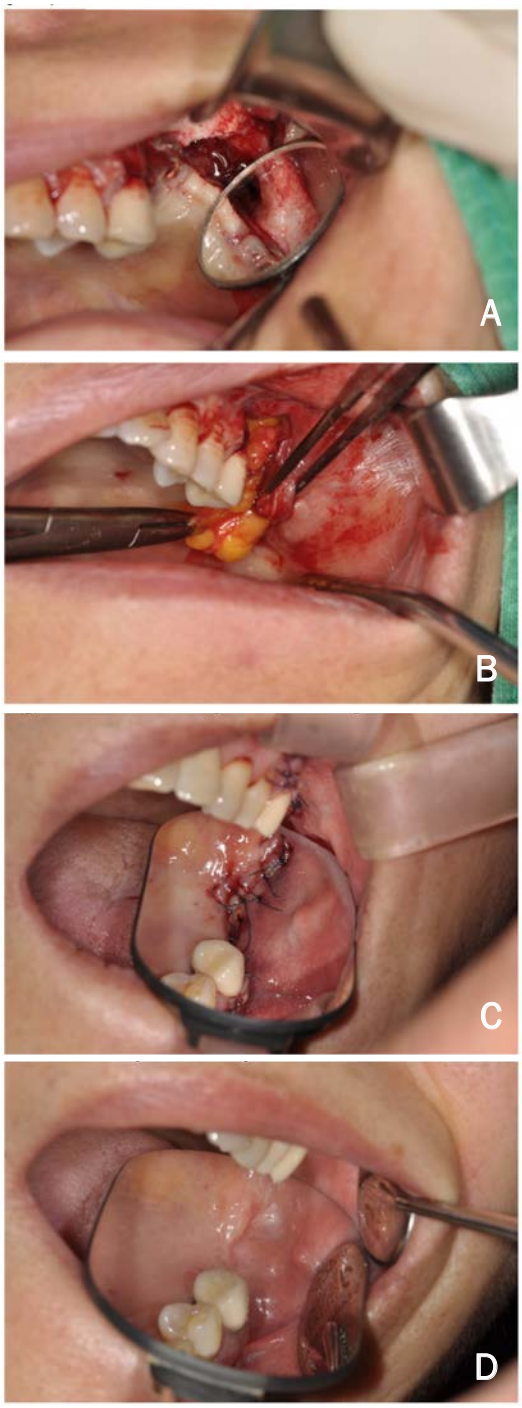

Figure 2. (A) Destruction of left maxillary alveolar bone. (B) Harvesting of buccal fat pad. (C) Closure of the defect with the BFP and oral mucosa by double-layered suture. (D) 3-months after the OAF closure.

the bone graft, two dental implants were placed on left maxillary posterior area. The implants placed were SNUCONE® AF 4.8x8 with healing abutments (Figure 3B). 6-months after the implant placement, final prosthesis was restored. The two dental implants were splinted and restored with full zirconia prosthesis (Figure 3C, 4). After 7-months follow up, there were no major complications (Figure 3D).

DISCUSSION

There are many factors that can cause an OAF, including pathological reasons such as cysts and tumors in the maxilla, iatrogenic factors such as tooth fractures during tooth extraction or

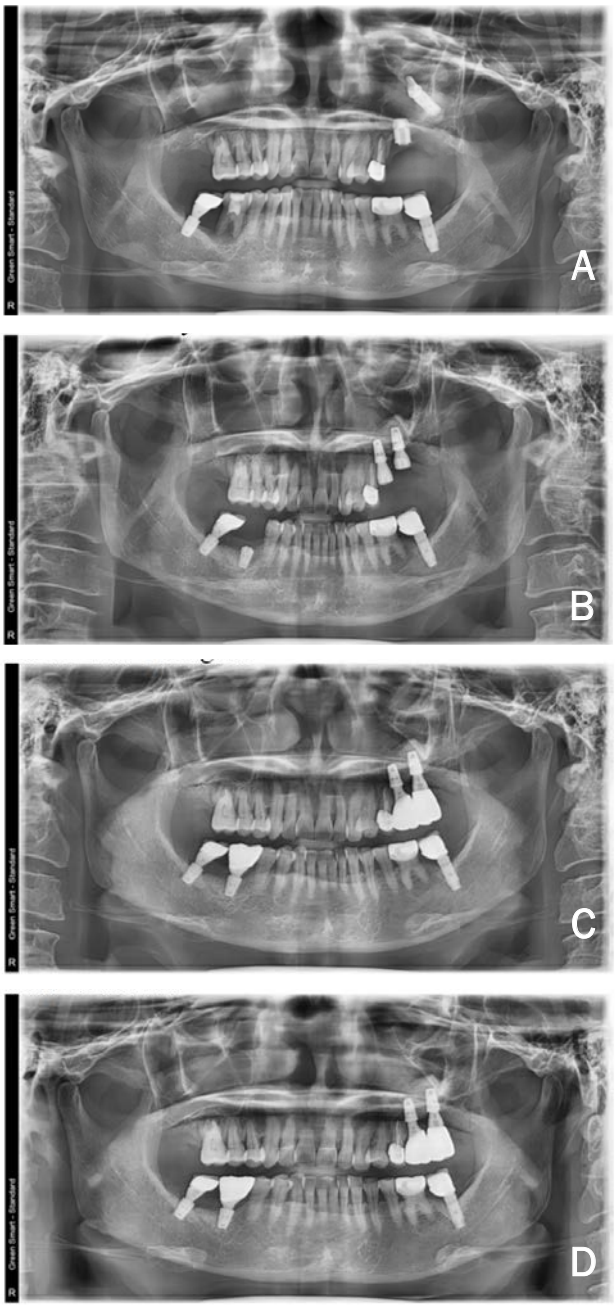

Figure 3. (A) Dental implant fixture and abutment in the left maxillary sinus. (B) Two dental implants placed after OAF closure and bone graft. (C) Restoration of implants with splinted full zirconia crowns. (D) 7−months after the final restoration.

Figure 4. Final restoration of the implants with splinted full zirconia crowns.

severe curettage, and traumatic events such as maxillary or alveolar fractures. Several factors must be considered when closing chronic OAF, including the fistula size, the time of diagnosis, and sinus infection[2]. In many cases, OAF caused by tooth extraction or curettage closes naturally. Sinusitis, however, prevents natural closure, and if the sinusitis lasts over four weeks or is greater than 4~5 mm, surgery treatment is needed.

Various techniques have been introduced for the treatment of OAF, including buccal advancement flap, palatal rotation flap, tongue and temporalis flap. However, some disadvantages of these procedures may include donor site discomfort, an extended healing period, or the lowering of the buccal vestibule. As Egyedi described in 1977[1], BFP has been used the most commonly for the closure of OAF.

The BFP has the advantages of high utilization, flourishing blood supply, low rate of complications, minimal donor-site morbidity[3]. Even if the BFP is not completely covered with the oral mucosa, it appears to undergo complete epithelialization within 4 to 6 weeks[2]. In addition, it has no significant effect on buccal sulcus depth[4]. Since this patient already had shallow buccal sulcus due to alveolar bone defect and previous surgical treatment, we chose to use BFP flap, which would be less likely to affect the sulcus depth.

Despite these advantages, the BFP graft could show the necrosis of the graft, and new fistulae formation[5]. If the blood supply is compromised, there is a chance of tissue necrosis. As the blood vessels within the adipose tissue are very weak, it is crucial to

perform blunt dissection so as not to injure the capsule overlying the fat pad while herniating it and the harvested BFP need to be sutured with minimal tension[6].

It has been suggested that combining BFP with oral mucosa can minimize complications following surgery. Generally, postoperative complications are associated with graft failure due to infection or necrosis[7]. The latter is probably caused by insufficient BFP covering the surgical defect[2]. Yet Egyedi recommended covering the flap with a skin graft, it has been documented that epithelization of the flap occurs after 3 to 4 weeks without a split skin graft on the exposed BFP[8]. Although we agree that covering BFP with other flaps provides no additional advantages, there is still the risk of overstretching and perforating BFP during collection. We used double-layered suture technique to minimize such postoperative complications, resulting in favorable soft tissue healing after the surgery.

CONCLUSIONS

There have been many applications of BFP since its introduction for OAF. Compared to other types of flaps, BFP has many advantages. Through this case, buccal fat pad flap with double-layered suture could be considered as a reliable method to close oroantral fistula and further follow up is needed to study long term prognosis of the implant placed on this site.

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Surgical and endoscopic approach on patients with maxillary sinusitis and medication-related osteonecrosis of the jaw: Case series

Won-Tack Shin[1], Geon-Young Lee[1], Won-Soek Yang[1], Heon-Young Kim[1], Jung-Hyun Park[2], Jin-Woo Kim[2], Sun-Jong Kim[1]

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Direct relationship has been established between conditions such as maxillary odontogenic infections and degenerative changes in the antral mucosa, leading to sinusitis. This retrospective study aims to describe the treatment outcomes of patients diagnosed with Mronj with concomitant maxillary sinusitis treated by oral surgical approach in conjunction with Functional Endoscopic Sinus Surgery (FESS). Mronj Patients with inflammatory condition of maxilla at Ewha Womans University Seoul Hospital from March 2019 to 2022 were included in this study. Computed tomography scans and panoramic radiographs were used as diagnostic tools. Primarily, all patients underwent sequestrectomy, when Eight patients were diagnosed with concomitant maxillary sinusitis and underwent fuctional endoscopic sinus surgery by ENT department. Post-operative follow up presented, in all patients, resolution of maxillary sinusitis and consequently, inflammatory condition of maxilla. Sequestrectomy for treatment of MRONJ in conjuction with functional endoscopic surgery when the maxillary sinus is involved is an effective way of treating MRONJ in the maxillary posterior area. **(THE JOURNAL OF KOREAN ACADEMY OF OSSEOINTEGRATION 2022;14(1):12-17)**

Key words: Mronj, Sinusitis, FESS

INTRODUCTION

Medication - related osteonecrosis of the jaw (Mronj) can be diagnosed from exposed bone or bone probed through an intraoral or extraoral fistula in the maxillofacial region that has persisted for more than 8 weeks, and no history of radiation therapy to the jaws or obvious metastatic disease to the jaws. American Association of Oral and Maxillofacial Surgery (AAOMS) defines Medication - related osteonecrosis of the jaw (Mronj) as ischemic necrosis of the jaw caused by current or previous treatment with antiresorptive or antiangiogenic agents.

Success rate of surgical treatment of Medication - related osteonecrosis of the jaw (Mronj) is relatively high (over 93%)[1]. By analyzing the outcomes of treatment of the 116 study subjects, 89 (75.0%) terminated treatment within 6 months of surgery, and 20 (17.0%) terminated treatment after 6 months or more. Treatment failure was observed in seven patients (6.0%)[2].

Direct relationship has been established between conditions such as maxillary odontogenic infections and degenerative changes in the antral mucosa, leading to sinusitis. Medication-related osteonecrosis of the jaw (Mronj), a side-effect of long-term use of bisphosphonates and anti-angiogenic drug has been reported to be one of the predisposing factors for sinusitis due to its features of bone exposure and secondary infections, causing a disruption in the schneiderian membrane as it advances. This case series aims to describe the treatment outcomes of patients diagnosed with Mronj with concomitant maxillary sinusitis treated by oral surgical approach in conjunction with Functional Endoscopic Sinus Surgery (FESS).

CASE I

First case patient is an 79-year-old woman who came for examination of a nonhealing chronic wound. The patient suffered from osteonecrosis in the right maxilla after extraction of on #17. She was diagnosed as Mronj before being admitted to Department of Oral and Maxillofacial Surgery, Ewha Womans Seoul Hospital. Patient suffered from high blood pressure and osteoposrosis for 5 years.

Pre-operative imaging of computed tomography scans show

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sinus radiopacity indicative of inflamed sinus, periapical radiolucency, osteolysis, and oro-antral communication (Figure 1). CBCT scans were reviewed in order to evaluate the involvement of the maxillary sinus and its opacifications. As a clinical sign of sinusitis, presence of a nasal obstruction, rhinorrhea, and/or foul odor and taste, headache, postnasal drip, and maxillary tenderness were examined. FESS was decided on the basis of the severity of sinusitis, the patency of the ostiomeatal unit, and the condition of the maxillary sinus floor.

Surgical treatment included extraction of tooth, sequestrectomy of effected site and functional endoscopic sinus surgery (FESS). Surgical treatment held at OMS depatment included removing the sequestrum at the maxilla and saucerization of adjacent cortical bones to achieve blood circulation. When destruction of cortical bone and infected maxillary sinus confirmed, inflammatory Soft tissue and necrotic bone were resected and sent for biopsy. Saucerization & Decortification was done with Piezoelectric surgery instument. Saline and Antibiotics (Bactacin) irrigation were done. Then curettage of granulation tissues were done in conjunction with recombinant human bone morphogenic protein (rh-BMP-2) using collagen sponges as carriers. Finally, buccal fat pad harvesting and peddicled flap graft was done to closure oroantral defect. Biopsy results confirmed Mronj diagnosis (Figure 2 and 3).

Patients diagnosed maxillary sinusitis along with Mronj went

Figure 1. Pre-operative imaging of computed tomography scan showing sinus radiopacity indicative of inflamed sinus – Case I.

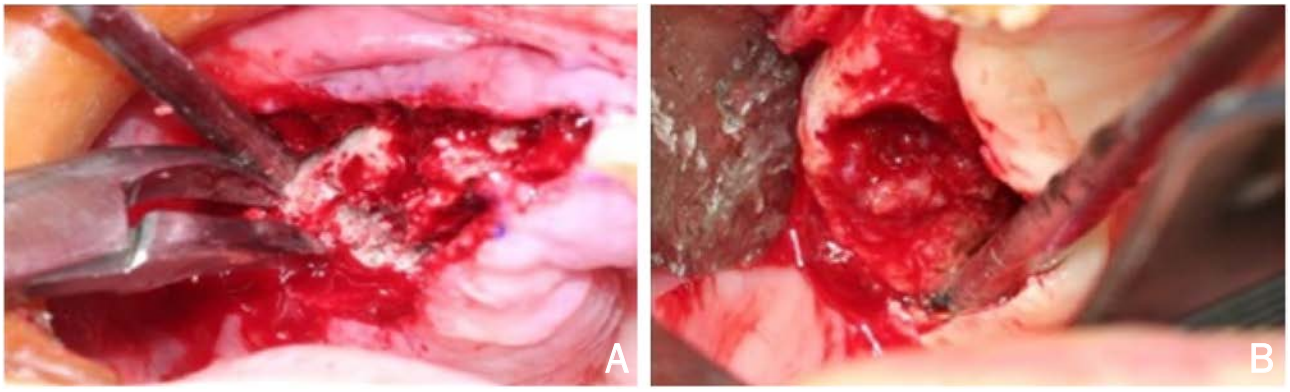

Figure 2. Sequestrectomy of necrotic bone (A) and formation of oro-antral fistula (B) – Case I.

through functional endoscopic sinus surgery (FESS) by the ENT department. Surgical procedures are as followed. Incision to the uncinate process was done using a fontanelle knife and was removed using a cutting forceps. The remnant tissue removed using a debrider. Natural ostium of maxillary sinus was checked using an ostium seeker, then the mucopus in the maxillary sinus was removed by curved suction, and saline irrigation was performed. Removed bulla with currete, debrider, and anterior ethmoidectomy was performed. Aggar nasi cell removal and frontal sinus irrigation were performed. Septal cartilage freer from the crest and bony part. Deviated cartilage & bony portion was removed using a d-knife, scissor, vallenger cutting forceps and septal forceps. The deviated and hypertrophoed crest was corrected using a gouge and mallet.

Post-operative radiographs showed Mronj resolution and obliteration of oro-antral fistula. Clinical photos showed good tissue healing (Figure 4).

CASE II

The second patient, 70-year-old man with osteoporosis, was admitted to Department of Oral and Maxillofacial Surgery, Ewha Womans Seoul Hospital for persistent pain at right maxilla. The patient was referred to our department for evaluation and treatment of the upper jaw.

From clinical evaluation, exposed necrotic bone was seen in right maxilla. There was no oroantral fistula, but panoramic radiography and computed tomography scans showed a diffuse sclerosis

Figure 3. Post-operative photo of surgical site - one week (A) and two months (B).

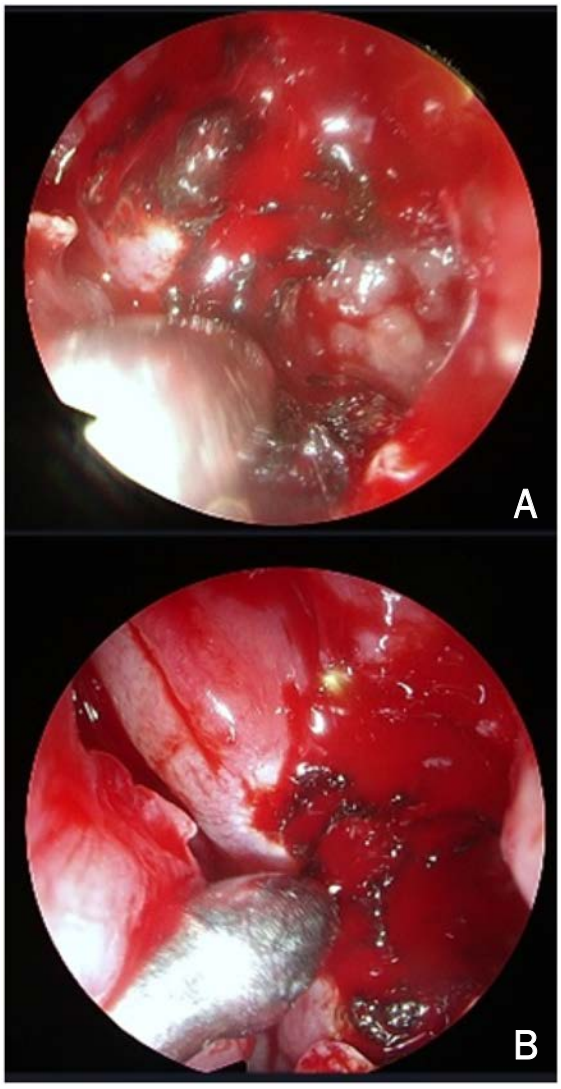

Figure 4. Sinusitis formation site during FESS – case I (A) and case II (B).

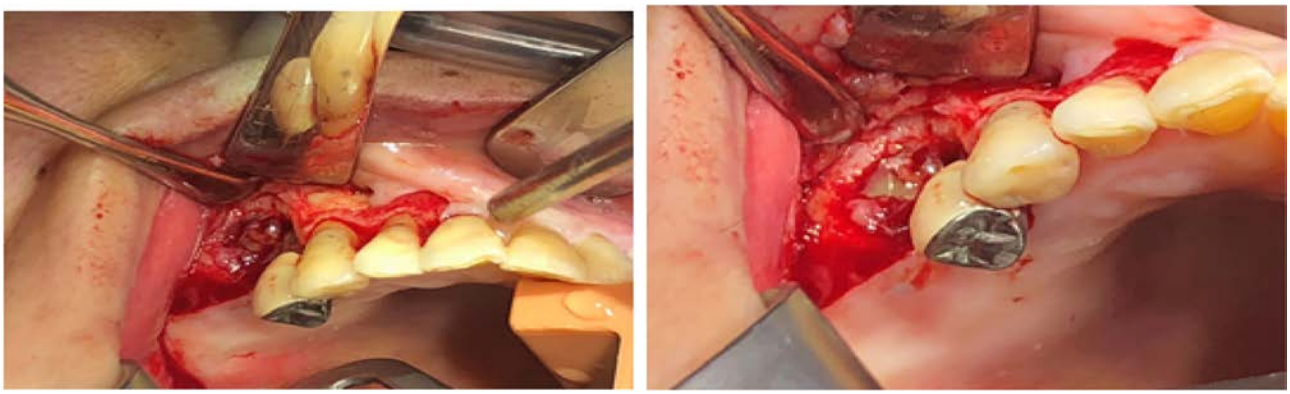

Figure 5. Exposed necrotic bone on right maxilla – Case II.

of maxillary bone and radiopacity indicative of inflamed sinus.

Patient was diagnosed with Mronj and hospitalized in August 2020. Sequestrectomy of necrotic bone was performed under general anesthesia and bone formation-inducing protein with platelet-rich fibrin were transplanted into the affected bone. Functional endoscopic sinus surgery (FESS) took place after OMS surgery (Figure 5).

Antibiotic adjuvant therapy was performed for 2 weeks. Patient suffered large pain on the surgical region for five days. Symptoms improved after 10 days, and the patient was discharged after stitch out. Continuous follow-up was conducted and normal healing state was maintained (Figure 6).

DISCUSSION

Post-operative follow up of case patients were at 7 days after release, and one, three months after then. Healing state of the bone were evaluated based on computed tomography scans and panoramic radiographs examination. Post-operative follow up presented, in both patients, resolution of maxillary sinusitis and consequently, inflammatory condition of maxilla.

MRONJ not only affects function and esthetics but also causes serious side-effects such as pain, infection, sensory disturbances, pathological fractures and odontogenic maxillary sinusitis. It is primarily an adverse side effect of denosumab or bisphosphonates, or possibly anti - angiogenic cancer treatment. In general, the incidence of Mronj increases as the duration of drug administration increases[3].

The symptoms of chronic sinusitis are identical to those seen in an acute form of the disease, but are usually milder[4]. Patients with acute sinusitis often have purulent nasal discharge, facial pain, and congestion, whereas those with chronic sinusitis have mucoid or mucopurulent nasal discharge[5]. In addition, chronic cough, bronchitis, tiredness, malaise and headache may be manifestations of chronic sinusitis. About 40% of chronic maxillary sinusitis seems to have a dental origin[6].

In Min and Kang's study[7], Use of rhBMP on bone defect sites after sequestrectomy increases the rate of new bone formation. Therefore, use of rhBMP on bone defect sites after sequestrectomy could be a successful strategy in treatment of Mronj patients. Cicciù et al.[8] investigated the clinical effects of rhBMP in Mronj patients undergoing sequestrectomy and reported successful healing of the necrotic region. In their study, the experimental group identified an increase in radiographic index 6 months after surgery (Wilcoxon signed rank test, $P<0.05$). In addition, there was a statistically significant difference in the radiographic index increase between experimental and control groups (Mann–Whitney U-test, $P<0.05$), which may be the result rhBMP facilitating bone healing. This result suggests that rhBMP contributes to new bone formation.

Marcianò et al.[9] emphasized that surgical treatment of Mronj is a reliable approach to the disease, and they confirm that appropriate soft tissue management procedures represent an additional guarantee against wound dehiscence, favoring the release of endogenous growth factors and leading to the successful healing of Mronj disease.

Following oral surgical procedure, MRONJ patients with chronic sinusitis were co-managed by the ENT Department and were subjected to further evaluation and eventually, FESS, if indicated. This approach attributes its success (83% resolution) to its less invasive nature and its re-establishment of natural drainage via the ostium. In conjunction with oral surgical treatment, it removes all the sources of possible focus of infection, hence, it pro-

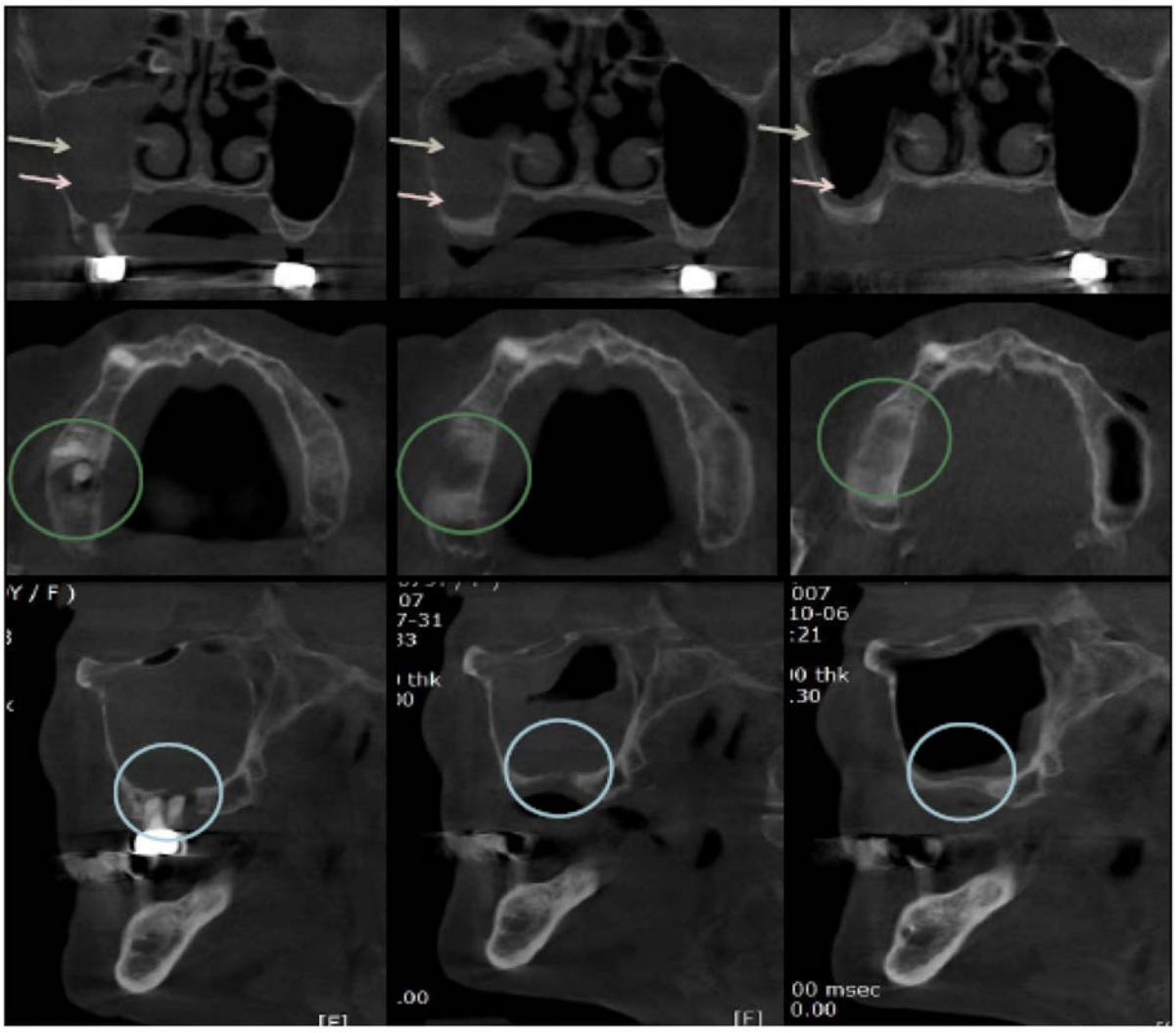

Figure 6. Pre-operative, post-operative 1 week, post-operative 2 months CBCT.

vided promising treatment outcomes.

CONCLUSION

This study was conveyed to determine the effectiveness of surgical treatment on Mronj patients with sinusitis. Maxillary sinusitis and oro-antral fistula are commonly associated with advanced maxillary MRONJ cases. Oral surgical treatment protocols in conjunction with FESS approach when chronic sinusitis is detected, presents promising treatment outcomes. It is important to detect and understand their association for treatment planning and management. Further investigation with larger pool is needed to provide treatment protocols on advanced MRONJ cases with the involvement of the maxillary sinus. However from the study, we could suggest that aggressive surgical intervention of sequestrectomy and FESS combined can properly enable reconstruction of settled oral environment on Mronj patients with maxillary sinusitis.

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A case of maxillary anterior implant prosthesis secured with proper treatment plan and prosthetic design

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With the development of digital dentistry and computer-aided-design/computer-aided-manufacturing (CAD/CAM), implant placement became possible by analyzing the final prosthetic design and the anatomical structure of the alveolar bone. Before the development of guide stents using CAD/CAM, fixed bridges or cantilever bridges were used to repair missing teeth in places where implant placement was difficult due to poor alveolar bone shape. In the cantilever bridge, stress is applied to the pontic to remove the prosthesis, or the load is concentrated on the abutment and the prognosis of the abutment is poor. The patient in this case had implants placed only in the maxillary right central incisor (#11), and the prosthesis was restored with a cantilever zirconia porcelain bridge using the left central incisor (#21) as a pontic. Afterwards, she visited our hospital due to frequent prosthetic fallout and mobility. During intraoral examination, retention of the prosthesis was insufficient due to the short abutment length in #11. As a result of CBCT imaging and analysis, it was determined that implant placement in the #21 pontic was possible if a surgical guide was used. Therefore, we report that the patient's discomfort was resolved through the restoration of the new prosthesis, and satisfactory results were obtained for both the patient and operator. **(THE JOURNAL OF KOREAN ACADEMY OF OSSEOINTEGRATION 2022;14(1):18-24)**

Key words: Surgical guide, Cantilever bridge, Dental implant diagnosis, Customized abutment

INTRODUCTION

When determining the number of implants in a partially edentulous area, it is decided by considering not only the number of missing teeth, but also the spacing between adjacent teeth and the spacing between adjacent implant fixtures[1,2]. If the distance between the two implants is too close, the resorption of the alveolar bone is caused, and the loss of the interdental papilla and non-esthetics are caused[3]. In the case of loss of both maxillary central incisors, since the acetabular canal is located between the two central incisors, even if the mesiodistal distance between the bilateral lateral incisors is sufficient for the placement of two implants, it may not be possible to secure two implant fixtures to avoid the nasopalatine canal[4]. In addition, from an aesthetic point of view, it is easier to obtain symmetry of the prosthesis by pontic processing the other side according to the shape of the implant prosthesis on one side rather than the connection of two adjacent implant fixtures. And there is no need to worry about alveolar bone resorption due to the proximity of the two implants. Nimwegen[3] reported that, through a systematic literature review, a 2-unit cantilever prosthesis fixed to a single implant was recommended as an alternative treatment in esthetic areas due to its excellent short-term success rate and excellent patient satisfaction.

However, after placing one implant fixture in the two central incisors, one side has the shape of a cantilever during prosthesis, so careful consideration of occlusion and retention of the prosthesis is necessary. If excessive forward stress is applied to the cantilever, the prosthesis on the other side is removed or a torsional stress is applied to the fixture[5]. When considering the retention force in cement-retained prostheses, the type of cement and the shape of the abutment influence the improvement of the retention force[6]. Also, the prosthetic dislodgement is the result of unbearable excessive stress. When excessive stress is applied to the implant prosthesis, loosening of the screw, fracture of the screw[7], fracture of the abutment, and detachment of the prosthesis[8] occur.

The diagnosis of implant position using CAD/CAM and the use of a surgical guide system increase the predictability of the diagnosis and treatment process of implant prosthetics. Since the

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model-based implant guide was a model-based planning system, the implant placement position could be determined according to the proper prosthesis position, but the anatomical structure of the lower alveolar bone could not be considered. Therefore, implant placement planning was limited when there were important anatomical structures nearby or when the width was narrow[9].

In this case, the number of implant fixtures was insufficient due to the esthetic purpose and inaccurate diagnostic process, and the retention form of the abutment was insufficient, so the removal of the prosthesis was continued. We report that an implant prosthesis with stability can be completed by additionally placing an implant through diagnosis using a surgical guide and connecting an abutment changed to an appropriate length.

CASE REPORT

A 35-year-old woman came to the hospital with the complaint that the implant prosthesis continued to fall off from the anterior part for some time. She had no special systemic medical history, and she had a prosthesis for her maxillary central incisor that was implanted 5 years ago (Figure 1). The implant was placed on the right central incisor of the maxilla (#11), and the abutment on the upper part had a short length and did not consider the relationship with the opposing tooth at all. The maxillary left central incisor (#21) was a ridge rap type cantilever pontic connected to the right abutment (Figure 2). The prosthesis completely lost its rentention ability without cement, but when it was placed by hand, the fit between the abutment and the prosthesis and the labial esthetics were excellent First, for evaluation, the prosthesis was cemented as before and the progress was observed. It was adjusted so that occlusal force was not applied to the pontic side. However, the prosthesis fell off again at the time of visiting 2 weeks later, and an additional implant was planned with the patient's consent.

Upon intraoral examination of site #21, it had mesiodistal broad and pale pink gingiva. When evaluated by CBCT, the thickness of the alveolar bone on the labial surface of the #11 implant fixture was insufficient, and the nasopalatine canal was expected to have a sufficient distance when the implant fixture was positioned at the #21 position (Figure 3). After obtaining a model through intraoral scan impression taking and matching this model with CBCT, the precise location of the implant was diagnosed simultaneously with the design of the implant surgical guide (Oneguide, Osstem, Korea) on Implant Studio planning software (3Shape) (Figure 4 and 5). Since the implant fixture at #11 is labial and insufficient to secure the thickness of the alveolar bone, the #21 implant fixture with 3.5 mm wide and 10 mm length (Osstem TSIII, Osstem, Pusan, South Korea) should be positioned slightly more lingually than #11. Instead, the fixture was placed deeper into the alveolar bone to control the cervical shape of the prosthesis.

After the additional implant was placed, the inner surface of the existing upper prosthesis was adjusted and temporarily cemented. The upper part of the implant healing abutment of #21 was positioned at the same height as the gingiva and a prosthesis was temporarily installed there. Cementation was maintained for a longer period of time than in previous cantilever prostheses (Figure 6).

After confirming the osseointegration, impressions were taken with an intraoral scanner (i700, Medit, Seoul, Korea). Information was delivered to the laboratory by taking impressions of the temporary crown in use, subgingival contour, scan body, and lips (Figure 7). The 2-unit implant prosthesis of #11 21 was designed by opening the stl file obtained by scan on the CAD software pro-

Figure 1. Cantilever bridge prosthesis using one implant fixture as an abutment in the right upper central incisor.

Figure 2. Symmetry of the gingival margin is esthetic, but a dark reflection of the fixture inside the gingiva (A). Upper central incisor implant prosthesis with short abutment and upper cantilever prosthesis removed (B). Zirconia bridge outside the oral cavity (C).

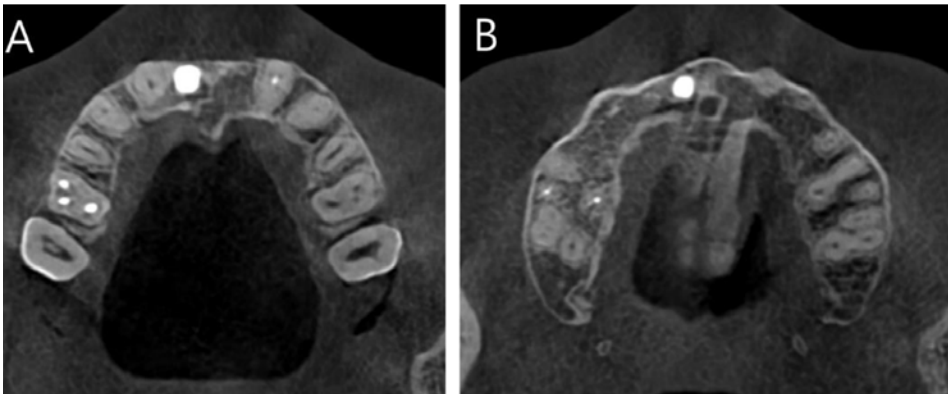

Figure 3. Insufficient labial alveolar bone mass in #11 (A). Considering the location of the nasopalatine canal, the mesiodistal space for #21 appears to be sufficient (B).

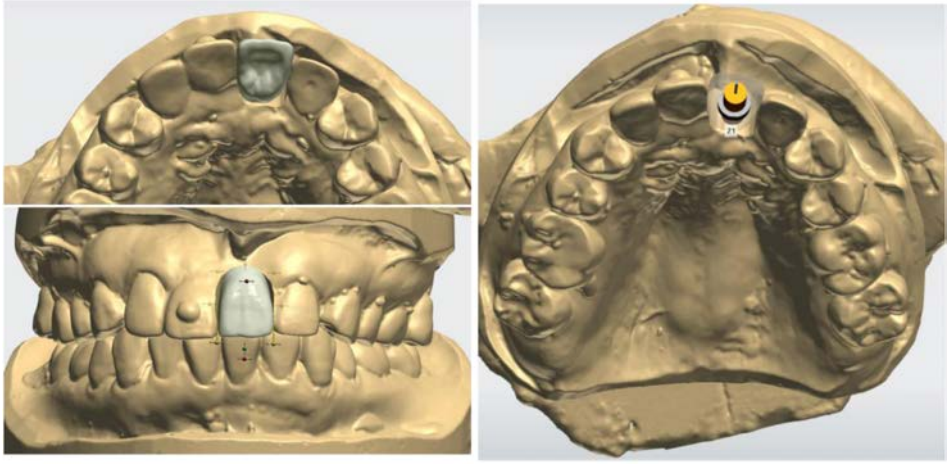

Figure 4. Virtual wax-up with reference to the position of the existing upper prosthesis.

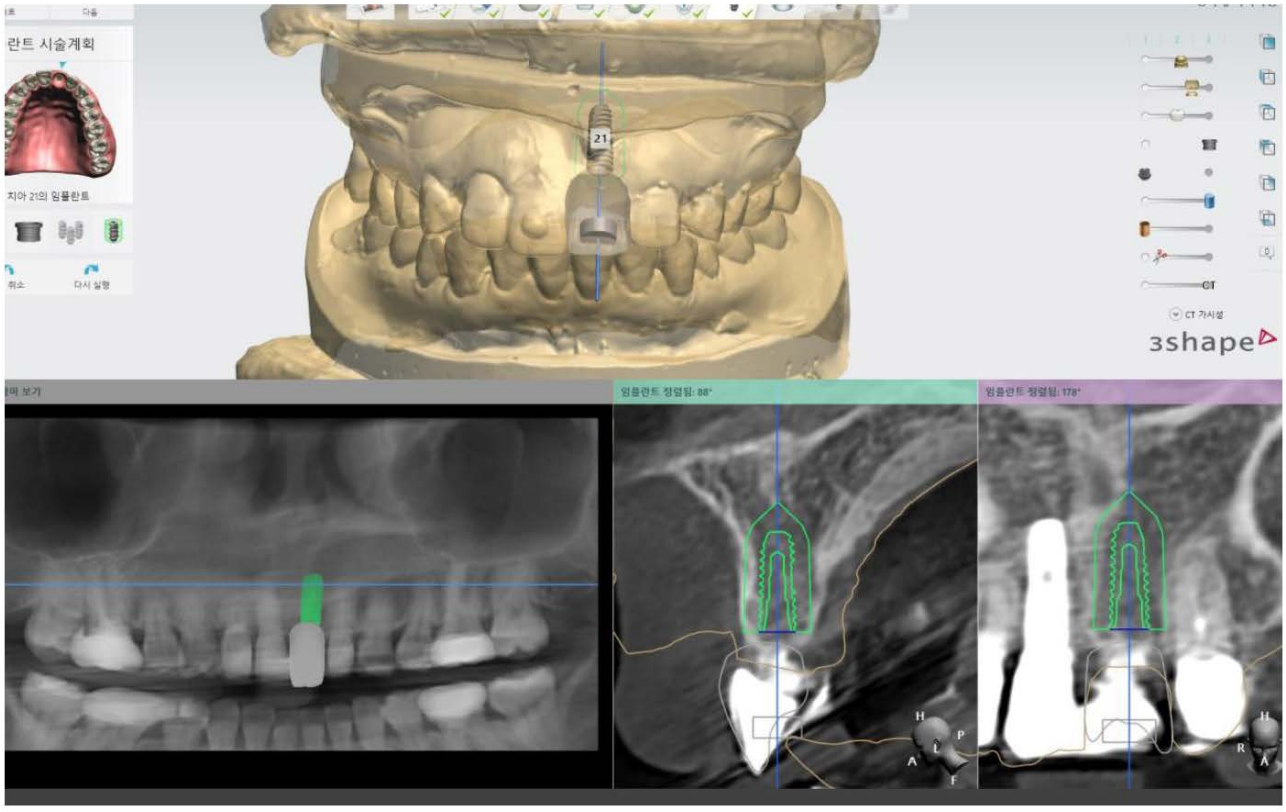

Figure 5. The position of the fixture relative to the position of the virtual wax–up. The position of the fixture relative to the position of the virtual wax–up. Buccal and mesiodistal spacing of the implant fixture is secured.

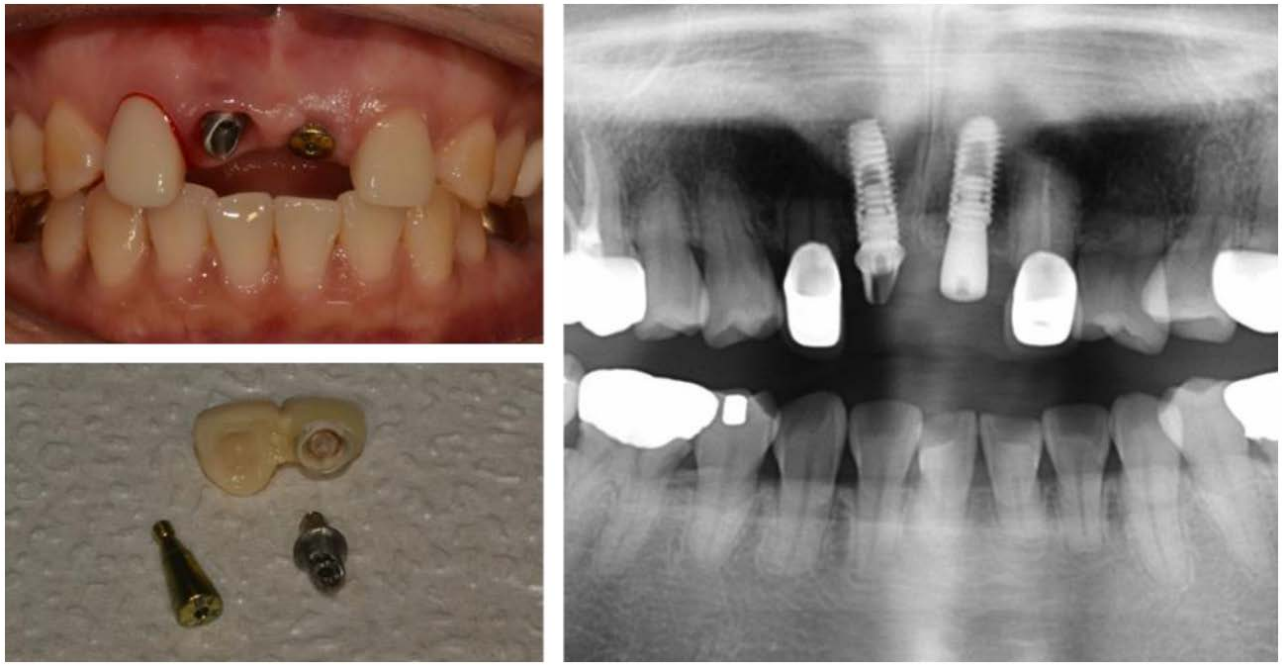

Figure 6. Period of waiting for osseointegration of fixture with healing abutment installed after additional implant placement.

gram (exocad DentalCAD; exocad GmbH). After designing the final prosthesis, the inner customized abutment was designed using the cut-back method (Figure 8).

The final prosthesis was placed in the oral cavity. The gingiva of #11 was thinner than #21, so the color of the fixture was transmitted through, but the morphological aspects such as left-right sym-

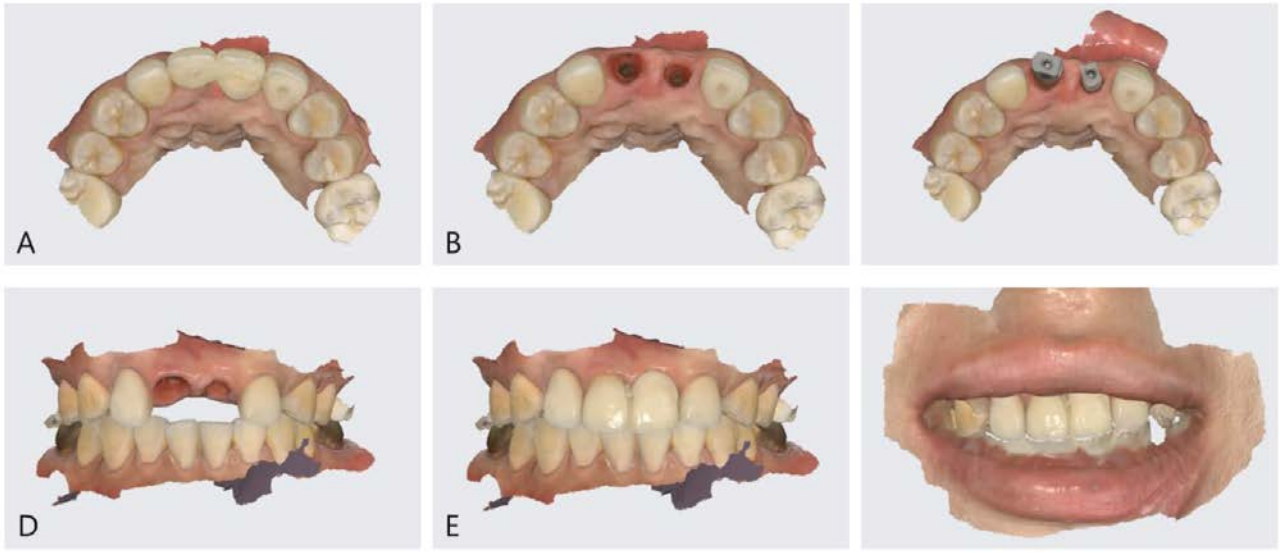

Figure 7. Impression taking. Occlusal view provisional restoration (A). Subgingival contour scan (B). Scan bodies (C). Labial view of gintival contour without prosthesis (D). Frontal view of provisional prosthesis (E). Lip scan image for estimation of teeth exposure (F).

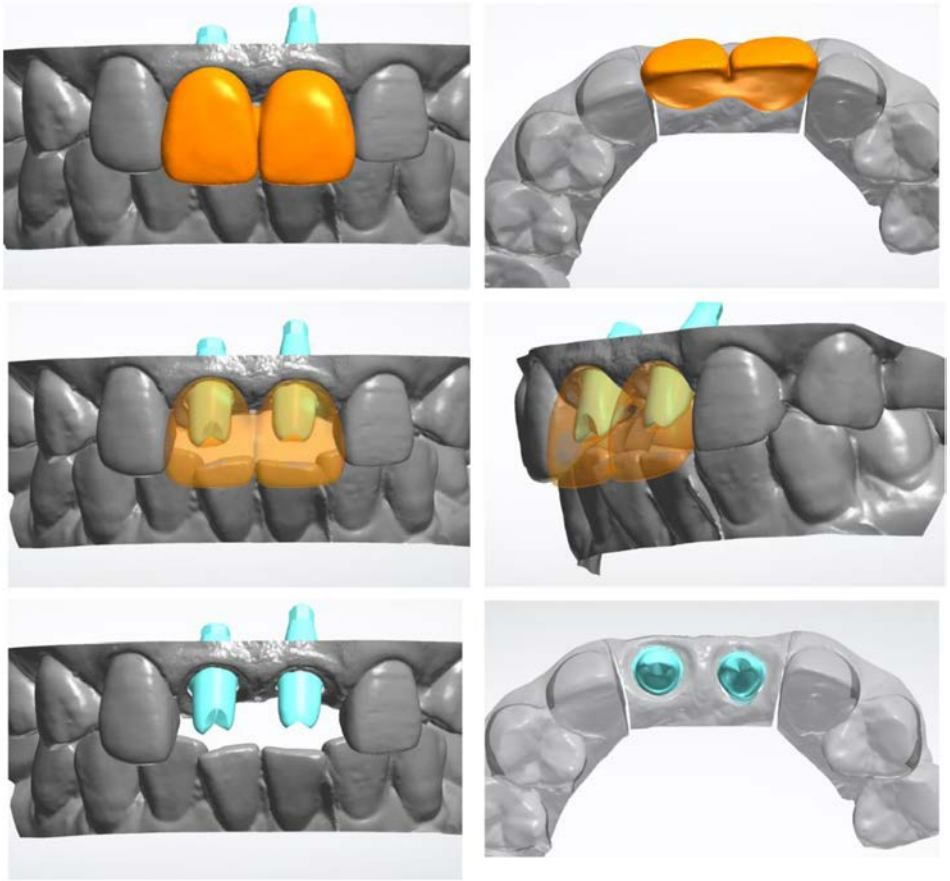

Figure 8. On the Cad software. Prosthesis design Customized abutment design tailored to the relationship with the opposing tooth and the shape of the final prosthesis.

Figure 9. Customized abutments and definite prosthesis.

metry were not bad. However, the difference in the gingival margin was more pronounced than when it was in the pontic form. At the beginning of installation, the interdental papilla between the central incisors was also in a tense state, but it was expected that the shape of the interdental papilla would change naturally during regular orthodontic visits (Figure 9). Structural retention of the prosthesis itself was exhibited, and dislodge of the prosthesis did not occur during the elapsed period after final cementation, and the patient was very satisfied esthetically and functionally.

DISCUSSION

Aesthetic implant prosthetic treatment in the maxillary anterior region is a challenging part. In the anterior maxilla, the shape and size of the alveolar bone is limited, so the placement of the implant fixture is difficult and aesthetic consideration should be given priority because it is a location that is seen outside the oral cavity.

When two implants are placed close together in a narrow area, the inter-implant nipple height is reduced and a black triangle can occur, which can reduce esthetic results. To avoid black triangle, the contact points of adjacent implant crowns are often located more apically to disguise these defects. This compensation is often used when the interdental papilla is low, but it also interferes with the creation of an esthetic and anatomically shaped implant crown[10]. In addition, the asymmetric shape of the alveolar bone and the different placement positions of the implants affect the shape of the upper gingiva, making it impossible to guarantee the symmetry of both prostheses.

Implant survival rate itself is no longer currently accepted as an outcome assessment for the clinical efficacy of implant prosthetic rehabilitation. Accurate implant positioning has obvious advantages such as good esthetic and prosthetic results, long-term stability of hard and soft tissues around the implant as a result of easier oral hygiene, and the potential to ensure optimal occlusal contact and implant loading[11].

Obtaining three-dimensional data of anatomy from CBCT and adding images generated by intraoral scanning devices to it can contribute to the digital data collected for treatment planning[12]. The accuracy of a guided implant surgical system is defined as the deviation between the planned and deployed position of the implant[13]. Errors from multiple sources can lead to inaccuracies in the accuracy of guided implant surgery. Accurate three-dimensional merging of CBCT and intraoral scan file images is a prerequisite for planning implant placement[14]. If the number of remaining teeth is insufficient or there are no teeth, the accuracy of the image superposition will be greatly reduced. Also, the choice of impression material, impression technique, casting materials and techniques, choice of computed tomography machine, and computed tomography scanning methodology are subject to error[15]. However, the digitization of implant surgery not only enables optimal planning of implant placement, but also the ability to transfer this planning to the surgical field. Accurate three-dimensional positioning of the implant allows optimal design of the final prosthesis.

In this case, only one implant was placed in the area of loss of both maxillary central incisors for aesthetic, anatomical, and technical reasons, and a cantilever prosthesis was installed and used for a long time. But, due to the loss of function of the cement and the poor shape of the lower abutment, it was unable to obtain any

more holding power. Digital technology was used to secure the basis for additional implant placement, and convenience was promoted by installing an abutment with an appropriate design considering the relationship between the shape of the upper prosthesis and the opposing tooth. The position of the two implants was not the same due to the difference in placement time and anatomical limitations, which resulted in inferior esthetics compared to the previous prosthesis. However, considering the long-term prognosis, it was possible to complete prosthetic treatment with retention and a certain degree of esthetics.

CONCLUSION

In this case, with the development of digital technology, a safe implant placement position was secured and the prosthesis was remanufactured to relieve the patient's discomfort by making a guide stent and selecting a customized abutment appropriately.

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Maxillary anterior implant restoration with orthodontic treatment for esthetics: A case report of two cases

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Esthetics is important for implant restoration in maxillary anterior teeth. The clinician must accurately identify the patient's needs before treatment because perception of esthetics is subjective, and conduct a thorough intraoral/extraoral examination. For esthetic restoration, not only the placement of the implant but also its relationship with adjacenet structures is important. Sometimes a team approach is needed to successfully meet the challenges. In this case report, we collaborated with an orthodontist for satisfying the patient's needs. An appropriate space for the implant was prepared and the implant was placed. After functional and esthetic evaluation with temporary prosthesis, definitive prosthesis was restored. Satisfactory results were obtained through maxillary anterior implant restoration with orthodontic treatment. **(THE JOURNAL OF KOREAN ACADEMY OF OSSEOINTEGRATION 2022;14(1):25-29)**

Key words: Maxillary anterior, Dental implant, Eshtetics

INTRODUCTION

Implant treatment in maxillary anterior region is challenging for clinicians because of the esthetic demands of patients and difficult pre-existing anatomy[1]. In order to maintain esthetic stability in the long term, it is important to place the implant in an ideal position and also consider the harmony between the soft tissue and the prosthesis[2-5]. For harmonious esthetic results, careful analyses including patient's facial analysis, tooth- gingival analysis, tooth ratio and symmetry, and shape and ratio analysis of teeth are needed[6]. And also for aesthetically predictive treatment, it is necessary to understand the needs of the patient and esthetic perception level in the treatment planning stage before implant placement and to consider the relationship between maxillary edentulous area and the adjacent teeth. To successfully meet the challenges of esthetic anterior implant restoration, a team approach is advantageous and highly important if needed[1,7].

This case report describes esthetic implant restorations on anterior maxilla collaborated with orthodontists. Orthodontic treatment was first performed to improve alignment and to form appropriate space for missing space then an implant was placed and restored after osseointegration.

CASE 1

A 81-year-old female presented to the Department of Prosthodontics, Seoul St. Mary's Hospital in Seoul Korea with the following chief complaint : "I want an esthetic implant restoration on upper anterior edentulous area. My original teeth were snaggleteeth." She was referred from the department of endodontics after extraction of #21 and #22 for severe caries.

Intraoral and extraoral examination reveal anterior crowding, especially biased #11 to the left based on the facial midline, labial transposition of #23, and the narrower width of edentulous area (#21, 22) than the width of opposite teeth (#11, 12) (Figure 1). In order to resolve the crowding of anterior maxillary dentition and restore esthetic implant prostheses, alignment of anterior maxilla and implant treatment were planned in collaboration with the orthodontist. Because the missing space was narrow, we decided to restore only one implant (#21) closing the space of #22. Orthodontic treatment was performed for 6 months (Figure 2). After 3months of starting the orthodontic treatment, the position and the angle of the implants were carefully determined with CBCT radiographic examination (Figure 3).

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The Osstem TSIII SA 4.0 × 10.0 mm fixture was placed on #21 area (Figure 4). After completion of orthodontic treatment, 3 months of osseointegration period, temporary restoration was fabricated and restored (Figure 5). The esthetic and function were evaluated for 3months (Figure 6). With the consent of the patient, the final prosthesis of #21 implant was fabricated with a porcelain fused to metal crown. Considering the installed angle of the fixture, it was decided to make implant crown with UCLA type (Figure 7, 8). And finally, the prosthesis was delivered after minor adjustment of contour (Figure 9). Although the left and right sides were not perfectly symmetrical, the patient's smile line was low and the width of #11 and #21 implant prosthesis was similar. After the restoration of definitive prosthesis, the patient showed satisfaction with esthetics and function of implant prosthesis.

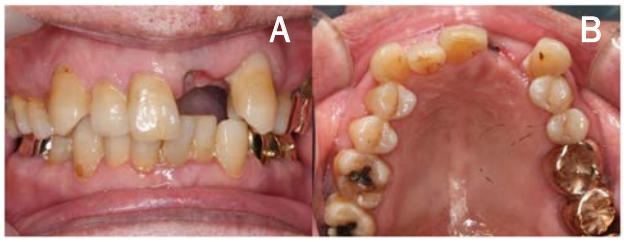

Figure 1. Pretreatment intraoral photographs. (A) Frontal view. (B) Occlusal view of maxilla.

Figure 2. Intraoral photograph taken under orthodontic treatment on anterior maxilla. (A) Frontal view. (B) Occlusal view of maxilla.

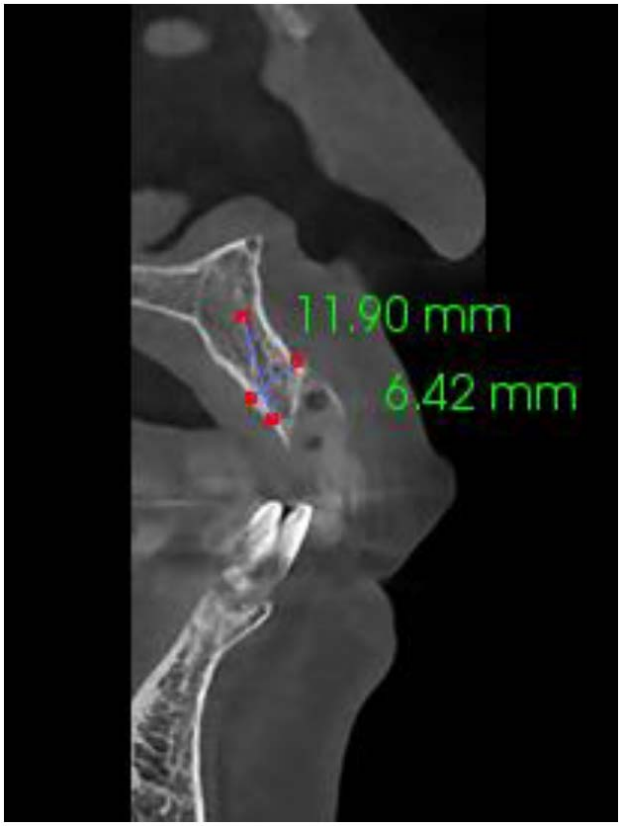

Figure 3. CBCT scan image for implant placement planning.

Figure 4. Post-surgical periapical radiograph.

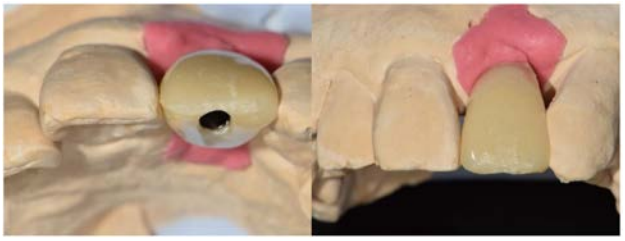

Figure 5. Fabrication of #21 implant temporary restoration.

Figure 6. The implant temporary prosthesis delivery.

Figure 7. Photographs for metal frame and shade check. (A) Metal frame check for UCLA type prosthesis. (B) Shade check.

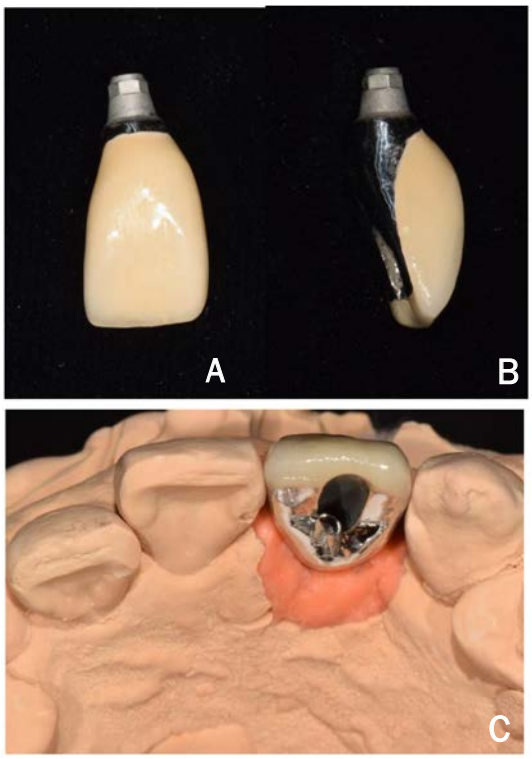

Figure 8. Fabrication of definitive prosthesis. (A) Frontal view. (B) Lateral view. (C) Occlusal view.

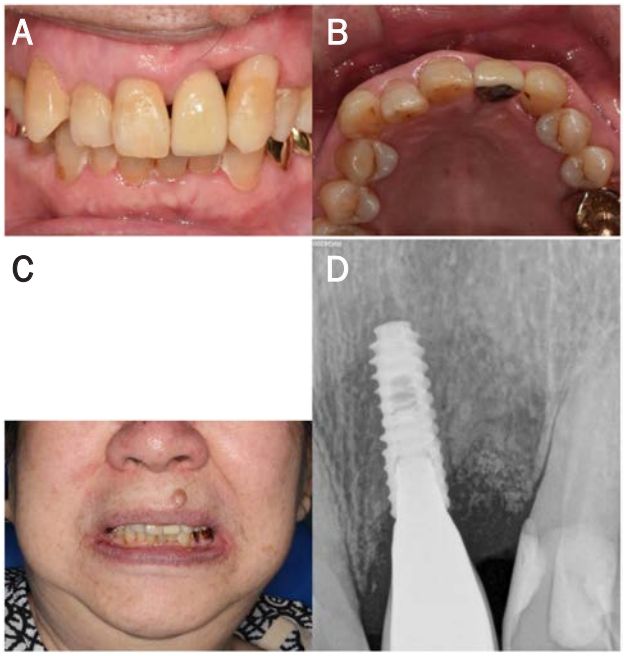

Figure 9. Post-operative photographs. (A) Frontal view. (B) Occlusal view of maxilla. (C) Smile view. (D) Periapical radiograph.

CASE 2

A 53-year-old female patient presented Prosthodontics clinic in Seoul St' Mary's Hospital of Catholic University of Korea with the wish to restore the missing space of #11 and improve the overall aesthetics of the anterior region after extraction #11 due to trauma. In oral examination, crowding and labioversion of the maxillary anterior teeth were observed (Figure 10). The mesiodistal width of missing space was narrower than that of #21. In order to resolve the crowding and esthetically restore missing teeth, implant treatment with orthodontic treatment was planned. The space was thoroughly evaluated and determined through collaboration with the department of orthodontics. During orthodontic treatment, temporary crown was attached with orthodontic appliances for esthetics (Figure 11). Before 3months of orthodontic treatment completion, CBCT was taken. After thorough examination of the radiographs, the position and the angulation of the implant were determined with the aid of radiographic stent (Figure 12). The Astra OsseoSpeed 3.5 × 11.0 mm fixture was placed on #11 area with the aid of prepared surgical stent (Figure 13). And after 4months of osseointegration period, finishing of orthodontic treatment, a temporary restoration was fabricated and delivered (Figure 14). The esthetic and function were eval-

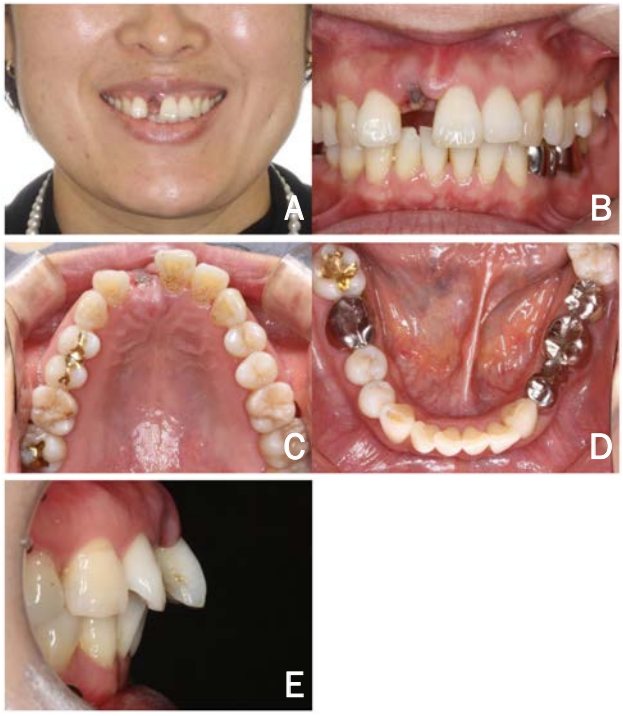

Figure 10. Pre-operative photographs. (A) Facial photographs. (B) Frontal view. (C) Occlusal view of maxilla. (D) Occlusal view of mandible. (E) Lateral view.

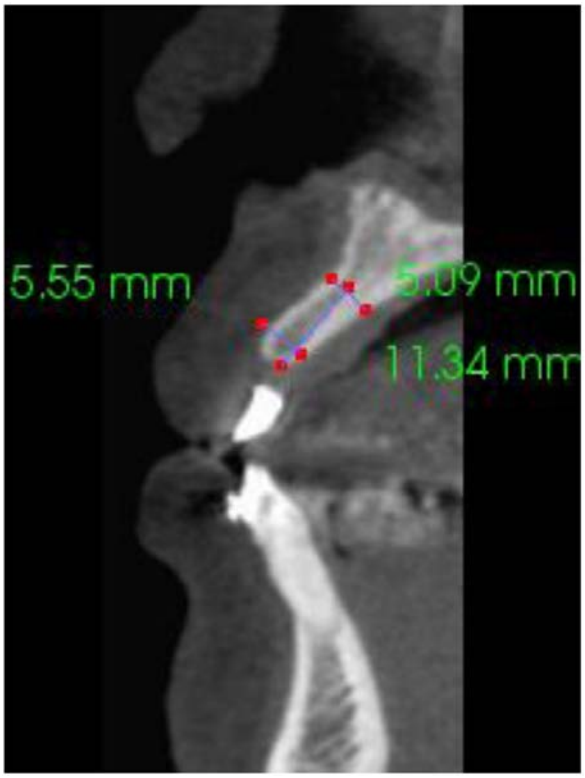

Figure 12. CBCT scan images for implant placement planning.

Figure 11. Temporary restoration of #11 with fixed orthodontic appliances.

uated for 3 months. With the consent of the patient, the definitive prosthesis of the #11 implant made of porcelain fused to precious metal was restored (Figure 15, 16). In consideration of the angle of fixture and direction of loading, it was decided to make UCLA type prosthesis. And After definitive restoration, patient was satisfied with the results.

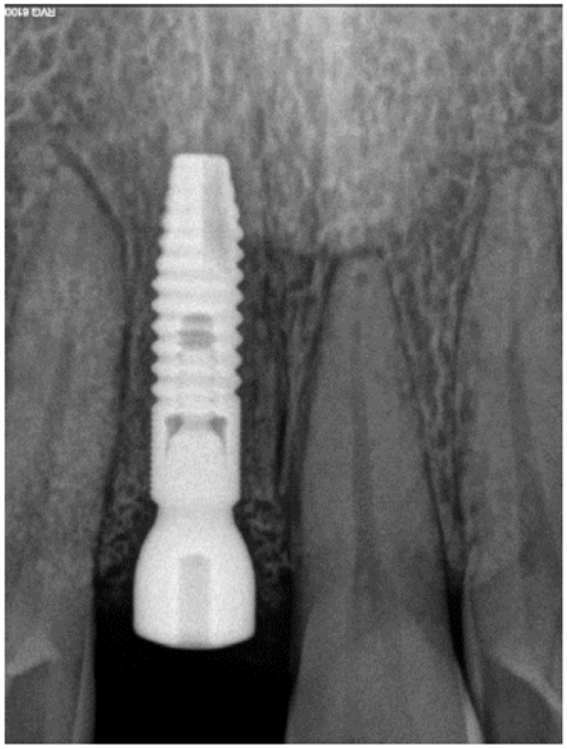

Figure 13. Post-surgical periapical radiograph.

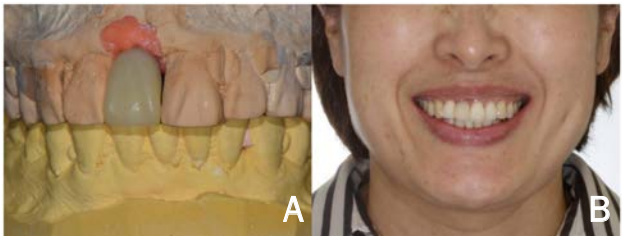

Figure 14. Fabrication and delivery of temporary prosthesis. (A) Fabrication of temporary restoration. (B) Smile view after delivery of temporary prosthesis.

Figure 15. Definitive prosthesis of implant supported fixed prosthesis.

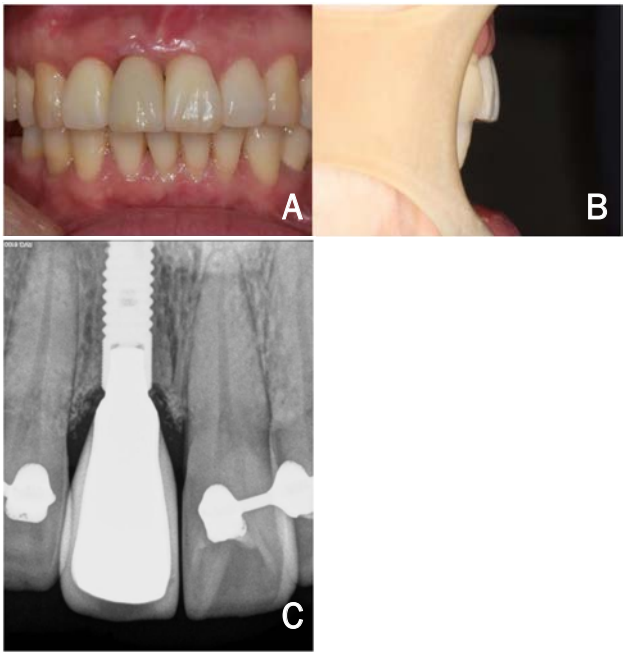

Figure 16. Post-operative photographs. (A) Frontal view. (B) Lateral view. (C) Periapical radiograph.

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A case of implant-fixed prosthetic restoration in a patient with oral scleroderma due to chronic graft versus host disease (cGVHD)

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Introduction: Chronic graft versus host disease (cGVHD) is one of the common complications after hematopoietic stem cell transplantation. Skin scleroderma and dry mouth caused by chronic graft-versus-host disease reduce the patient's orifice and increase the activation of dental caries]. In addition, when severe oral contracture is accompanied, oral hygiene management may be difficult, which may worsen dental caries. This case reports the restoration of full mouth rehabilitation with implant supported fixed prosthesis after full mouth extraction in a patient with Chronic graft versus host disease (cGVHD), with esthetically and functionally satisfactory results. **(THE JOURNAL OF KOREAN ACADEMY OF OSSEOINTEGRATION 2022;14(1):30-35)**

Key words: Chronic graft versus host disease, Dental implant, Implant supported fixed prosthesis, Full mouth rehabilitation

INTRODUCTION

Chronic graft versus host disease (cGVHD) is one of the common complications after hematopoietic stem cell transplantation. This occurs when the transfused lymphocytes cannot be destroyed by the host's immune mechanism during hematopoietic stem cell transplantation. It can appear all over the body in various forms of autoimmune disease, but the most commonly invaded area is the skin. Skin scleroderma and dry mouth caused by chronic graft-versus-host disease reduce the patient's orifice and increase the activation of dental caries[1]. In addition, when severe oral contracture is accompanied, oral hygiene management may be difficult, which may worsen dental caries.

This case reports the restoration of full mouth rehabilitation with implant supported fixed prosthesis after full mouth extraction in a patient with Chronic graft versus host disease (cGVHD), with esthetically and functionally satisfactory results.

CASE REPORT

A 50-year-old male patient was referred from the Department of Hematology for multiple caries and chewing difficulty. According to the past medical history, he was diagnosed with Acute Myeloid Leukemia (AML) 15 years ago and underwent allogeneic hematopoietic stem cell transplantation (Allo BMT). Afterwards, chronic graft-versus-host disease (cGVHD) developed and was being monitored. He complained of severe dry mouth syndrome due to the disease and medication.

According to intraoral findings, a fissured tongue and limited mouth opening due to scleroderma were observed. In radiographic view, all residual teeth were involved to dental caries which invaded the dentin (Figure 1). As Extraoral findings, skeletal class III with mandibular protrusion was observed.

As a treatment option, Mandibular and Maxillary complete denture after full mouth extraction could be considered. However, due to the dry mouth condition, various denture discomforts were expected. Therefore, a treatment plan was established with extraction of all remaining teeth and full mouth rehabilitation with implant supported fixed prosthesis.

4 months after tooth extraction, CBCT taking was performed to prepare implant diagnosis, and the bone quality and amount of the remaining alveolar bone was evaluated (Figure 2). The supporting bone seemed to be good enough for implant installation, so we decided to place 8 implants on maxilla and 6 implants on mandible. Implant first surgery (#16i, 14i, 13i, 11i, 21i, 23i, 24i, 26i, 46i, 44i, 43i, 33i, 34i, 36i) was done on planned location (Figure 3).

After 4 months of osseointegration period, the second implant surgery was performed, and after 2 weeks of soft tissue healing

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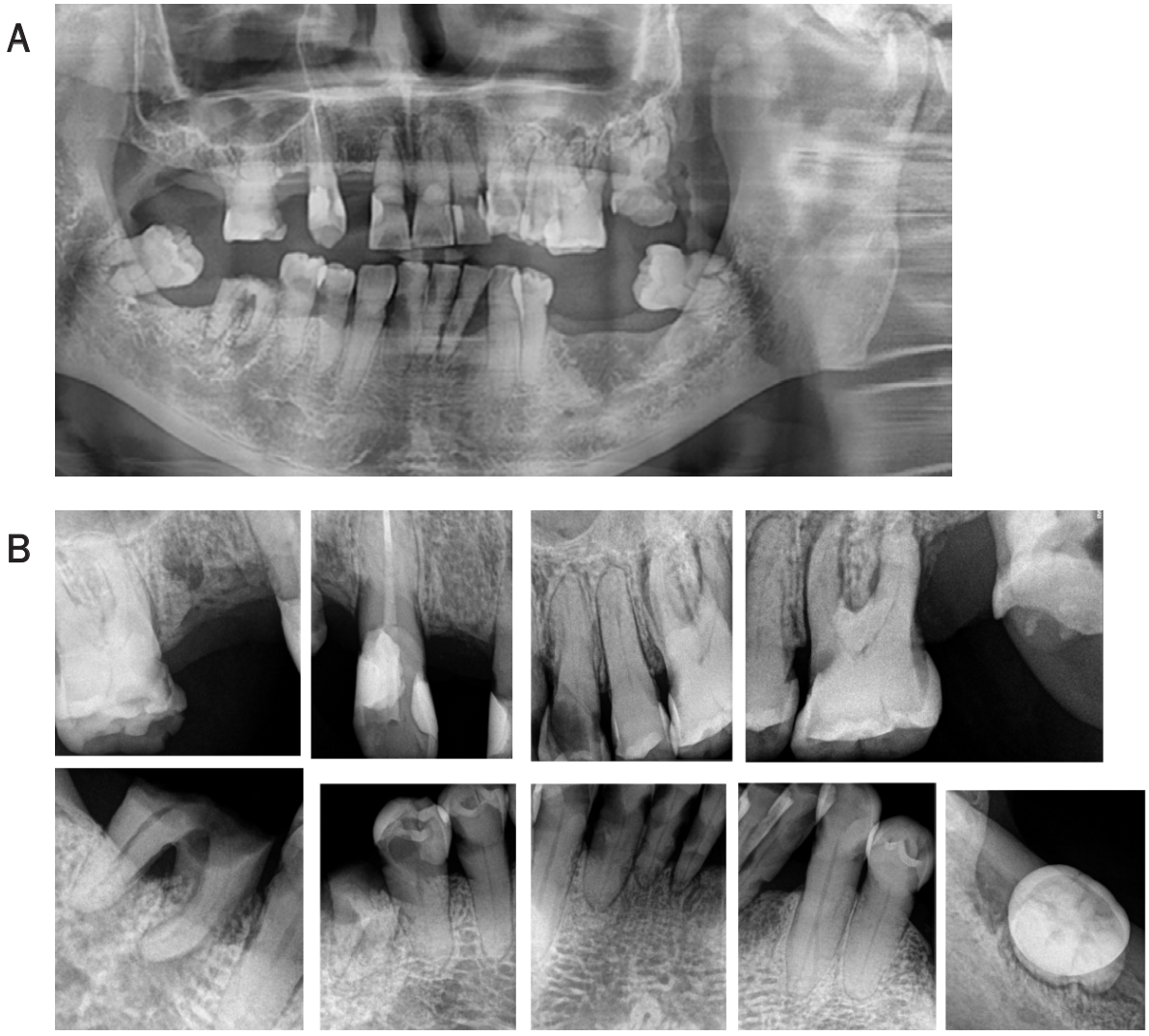

Figure 1. Pre-operative radiographic examination. (A) Panoramic view. (B) Periapical radiograph.

period, the restorative procedures were performed. Impression was taken using a transfer coping and stock tray with PVS material (Figure 4). Pick up impression coping couldn't be used due to limited mouth opening. After master cast fabrication (Figure 5), bite registration was done using temporary abutment and occlusal rim, and the centric relation at the desired vertical dimension was checked (Figure 6, 7). It was mounted on a semi-adjustable articulator using interocclusal record (Figure 8). The wax-up for the temporary prosthesis was carved (Figure 9). Temporary prosthesis on temporary abutment was made based on the wax-up model (Figure 10).

During the provisional period, centric and eccentric movement, anterior guidance was checked (Figure 11). After 2 month of provisional period, remaking of mandibular posterior temporary crown was decided due to posterior tooth wear and following VD loss. New Mandibular temporary crown and custom abutment was fabricated with 2 mm increase of VD, and custom abutments were designed supragingival margin for periodontal health (Figure 12). Maxillary custom abutments were also fabricated and bite registration was done (Figure 13). The final prosthesis was made of monolithic zirconia, except for the maxillary anterior teeth (Figure 14, 15). The maxillary anterior teeth were made of porcelain fused to gold crown in consideration of aesthetics. Careful occlusal adjustment was done to provide bilateral occlusion and mutually protected occlusion in lateral movement (Figure 16). The patient was followed up one week, one month, three months, six months after the prostheses were delivered (Figure 17).

Figure 2. CT analysis of implant surgery.

Figure 3. Post-operative Radiographic Examination.

Figure 4. Impression taking.

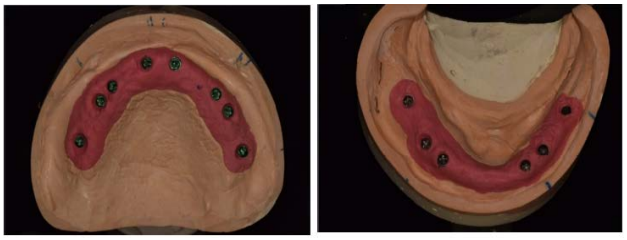

Figure 5. Master cast

Figure 6. Temporary abutment and occlusal rim.

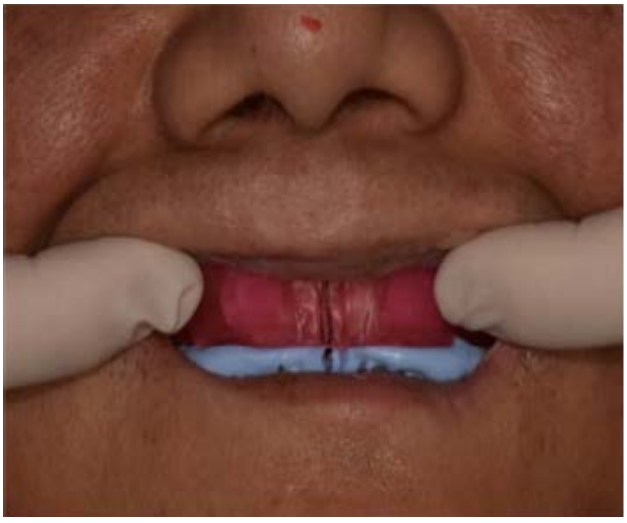

Figure 7. Bite registration.

DISCUSSION

Chronic graft versus host disease (cGVHD) in the oral cavity that occurs after hematopoietic stem cell transplantation has been reported to have an incidence of 25~70% despite the use of prophylactic agents[2]. Oral findings include erythema, ulceration, redness of the mucous membrane, and bleeding. The patient of this case also complained of severe dry mouth, and dental caries was observed in all residual teeth. Considering the high caries activity, full mouth rehabilitation after full mouth extraction was recommended rather than conservative treatment. Also removable denture was not recommended due to severe dry mouth condition.

Therefore, the treatment plan was established to implant supported fixed prosthesis, 8 implants on maxilla and 6 implants on

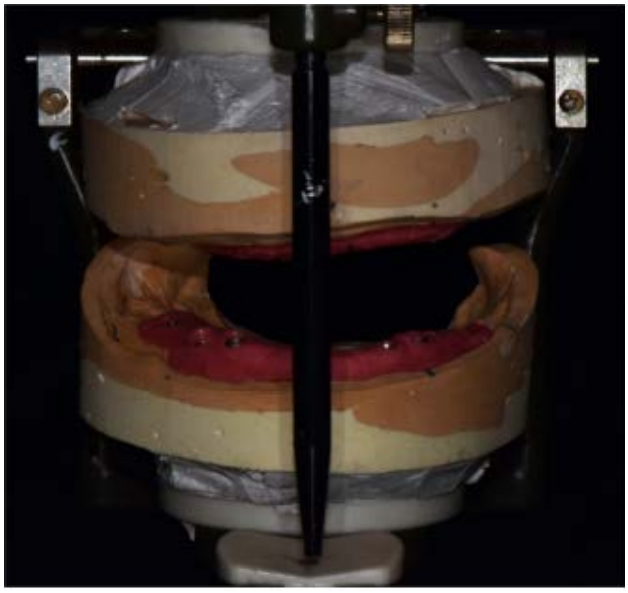

Figure 8. Mounting on a semi adjustable articulator.

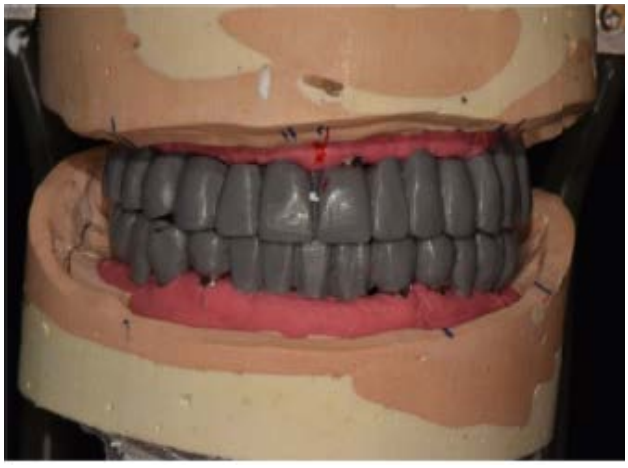

Figure 9. Wax up.

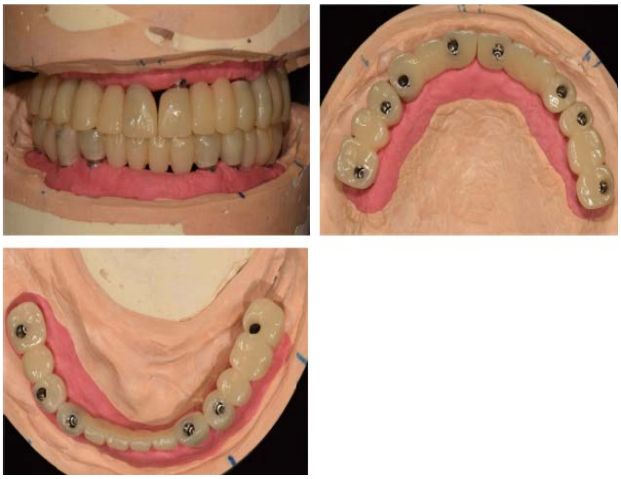

Figure 10. Temporary prosthesis.

Figure 11. Temporary prosthesis delivery.

Figure 12. Custom abutment and new mandibular provisional crown.

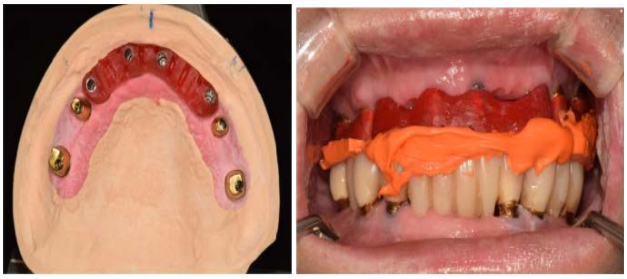

Figure 13. Maxillary custom abutment and bite registration.

mandible. According to Misch, these fixture number was minimal requirement to obtain adequate support in completely edentulous patients when restored with implant-fixed prosthesis[3]. Implant surgery was performed after consulting with the attending physician in charge of hematology, and broad-spectrum antibiotic therapy was followed before and after surgery. Since the mucous membrane was very dry and sensitive due to severe dry mouth,

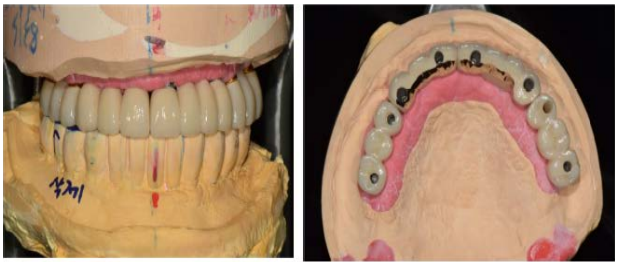

Figure 14. Maxillary final prosthesis.

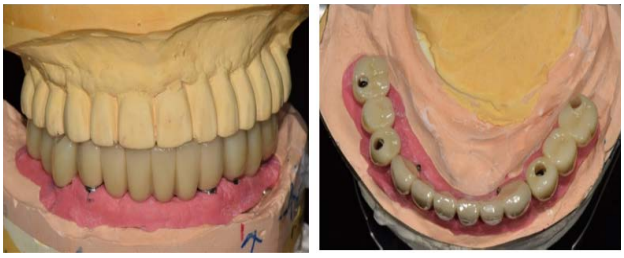

Figure 15. Mandibular final prosthesis.

appropriate lubricants such as saline and petrolatum were used in the middle of the procedure to minimize the patient's discomfort. Also, the corner of the mouth had a limited amount of opening due to repetitive ulceration and healing. Transfer impression coping rather than pick up impression coping was used to make impression considering limited mouth opening. And to minimize the number of impressions, additional abutment level impression was omitted. Furthermore, considering that patient with leukemia is vulnerable to periodontal disease, the margin of the abutments was set supragingival, and embrasure was sufficiently opened to facilitate oral hygiene management.

Implant occlusion considering biomechanical factors were given, as occlusal overload might lead to mechanical complication and implant failure. In this case, group function occlusion was given from the canine to the second premolar to obtain occlusal dispersion[4]. Nevertheless, an appropriate occlusion check

Figure 16. Final restoration.

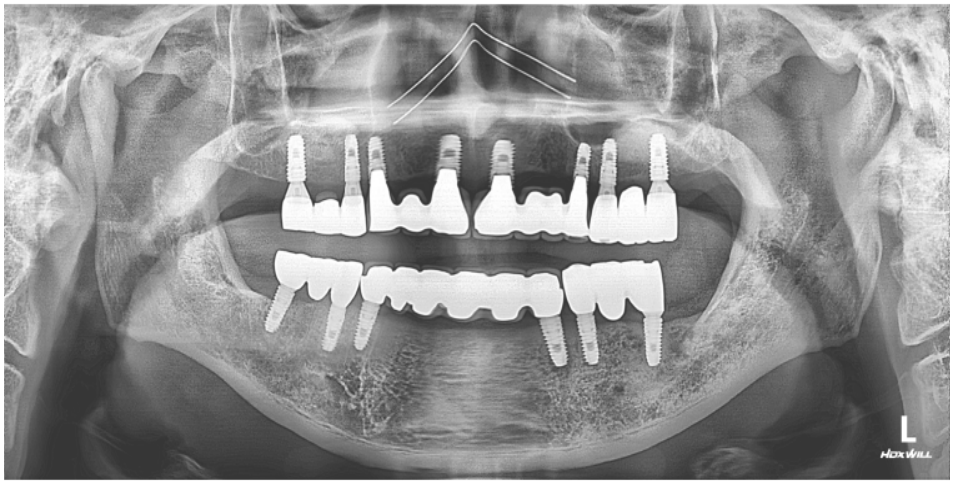

Figure 17. 6 month follow up.

should be performed through regular check.

CONCLUSION

Implant-supported prosthetics might be a practicable treatment for patients with oral scleroderma due to chronic graft versus host disease (cGVHD).

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Dental implant failure repeated at the same site or occurred in one or more implants: A case report

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Despite the fact that advances in science are improving the success rate of dental implants, a few implant failures consistently have been reported. Implant failure can come in three different forms; single, repetitive and cluster behavior. The single type refers to a single implant failure, the repetitive type refers to two or more failures at the same site, and the cluster type refers to more than one implant failure per patient that does not have to occur in the same position or quadrant. The purpose of this presentation is to investigate the rare cases of repetitive and cluster failure. **(THE JOURNAL OF KOREAN ACADEMY OF OSSEOINTEGRATION 2022;14(1):36-43)**

Key words: Dental implants, Implant failure, Peri-implantitis, Retreatment

INTRODUCTION

Dental implants replacing for missing teeth have been demonstrated to be a successful treatment with high survival rate about 90%, although some clinical situations that result in implant removal continue to be a failure[1-4]. Additionally, the high implant survival rate has made it difficult to pinpoint specific risk factors for implant failures, but patients-related factors, implant characteristics, implant location, and surgeon's experience make up the majority of identified factors for implant success[5].

Several studies have looked into the survival rates of implants placed in previously failed sites. Implant failure can come in three different forms; single, repetitive and cluster behavior. The single type refers to a single implant failure, the repetitive type refers to two or more failures at the same site[5-7], and the cluster type refers to more than one implant failure per patient that does not have to occur in the same position or quadrant[5,8-10]. The purpose of this case report is to investigate the rare cases of repetitive and cluster failure.

CASE REPORT

1. Case 1: repetitive failure

A 76-year-old male patient visited the clinic with a chief complained of uncomfortable mandibular denture. He had been taking antithrombotic drugs due to a history of stroke 3 years prior to visit. As for the past dental history, #33 implant was placed 6 years ago (USII 4.0 × 11.5 mm, Osstem Implant Co., Seoul, Korea). Clinical examination revealed that the #33 implant presented with 12 mm probing depth on the labial and bleeding on probing with suppuration. The panoramic radiographic view showed a peri-implant radiolucency on #33 implant. #33 implant removal with alveolar ridge preservation (ARP) and implant placement at #33 implant removal site were planned under the diagnosis of a peri-implantitis (Figure 1).

After #33 implant removal, ARP was performed with deproteinized bovine bone mineral with 10% collagen and collagen membrane (Bio-Oss Collagen® 250 mg, Geistlich biomaterials, Wolhusen, Switzerland, and Bio-Gide® 13 × 25 mm, Geistlich biomaterials, Wolhusen, Switzerland). During surgery, the labial bone of removal site was completely destroyed.

On the cone beam computed tomography (CBCT) image taken 5 months after ARP (Figure 2A), new bone formation was found following the previous defect configuration, and thick cortical bone was detected on the lingual side (Figure 2B).

1 month later, implant installation with additional guided bone regeneration (GBR) on buccal side and connection of healing abutment were performed (TSIII 4.0 × 10 mm; Osstem Im-

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plant Co., Seoul, Korea). The GBR was performed with deproteinized bovine bone mineral with 10% collagen and collagen membrane (Bio-Oss Collagen® 100 mg and Bio-Gide® 13 × 25 mm). Initial stability of #33 implant was 26 Ncm of insertion torque. Sutures were removed after 10 days with uneventful healing (Figure 3).

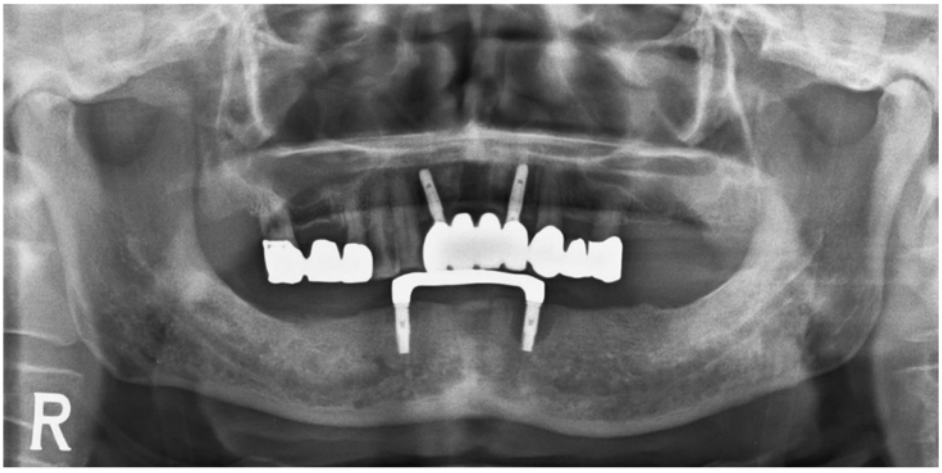

Figure 1. Pre-operative panoramic radiograph.

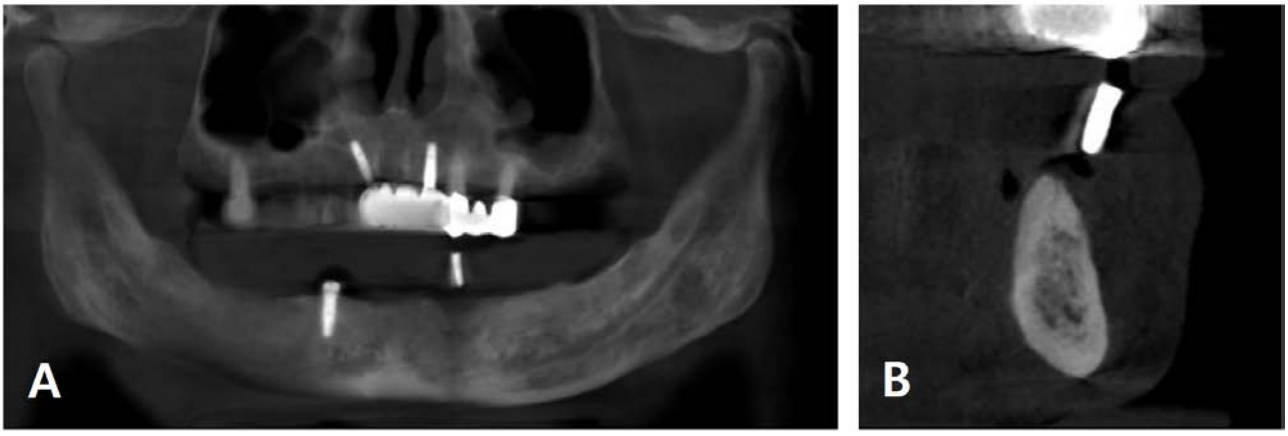

Figure 2. CBCT image taken 5 months after ARP. (A) Panoramic view. (B) Paraxial view: thick cortical bone on the lingual side was detected.

Figure 3. CBCT image after #33 implant installation. (A) Panoramic view. (B) Paraxial view.

6 weeks later of implant surgery, peri-implant radiolucency on periapical radiograph with implant mobility was detected (Figure 4). The implant removal with ARP and implant placement at the same site were planned under the diagnosis of osseointegration failure. After removal of implant, ARP was performed (Bio-Oss Collagen® 100 mg and Bio-Gide® 13 × 25 mm). 2 months later, CBCT was taken for evaluation before implant placement (Figure 5).

2 months after CBCT taking, a shorter implant was placed than before (TSIII 4.0 × 8.5 mm). This is because there was a high bone density region owing to previously existing chronic inflammation, and overheating was prevented by under-drilling this area. Initial stability of #33 implant was 13 Ncm of insertion torque. Sutures were removed after 10 days with uneventful healing (Figure 6).

6 weeks later, however, implant mobility with positive on percussion was detected. During the patient's interview, it was

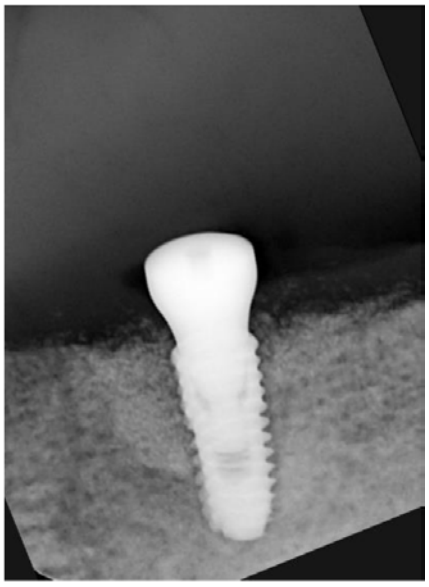

Figure 4. Periapical radiograph at 6 weeks later of implant surgery with peri-implant radiolucency.

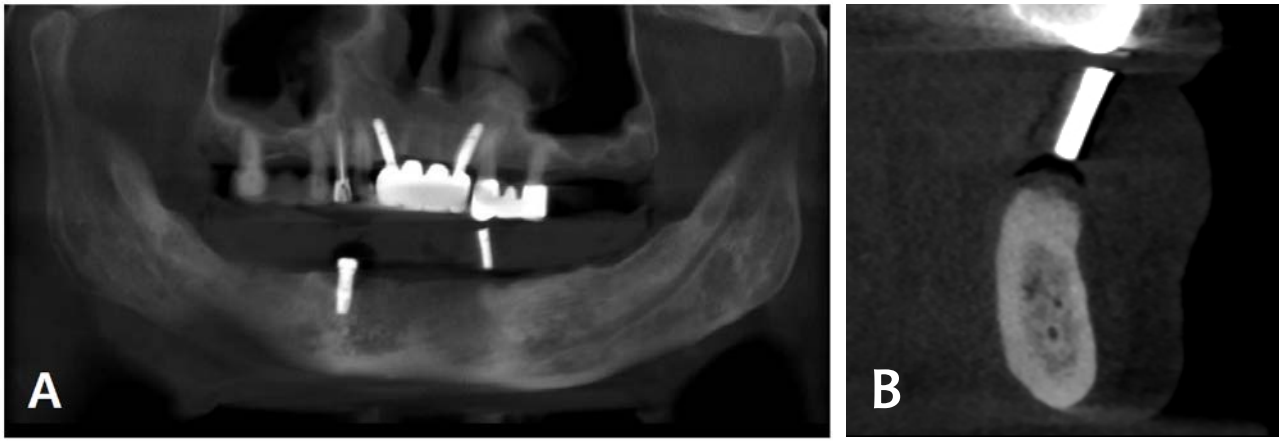

Figure 5. CBCT image at 2 months later of #33 implant removal and ARP. (A) Panoramic view. (B) Paraxial view.

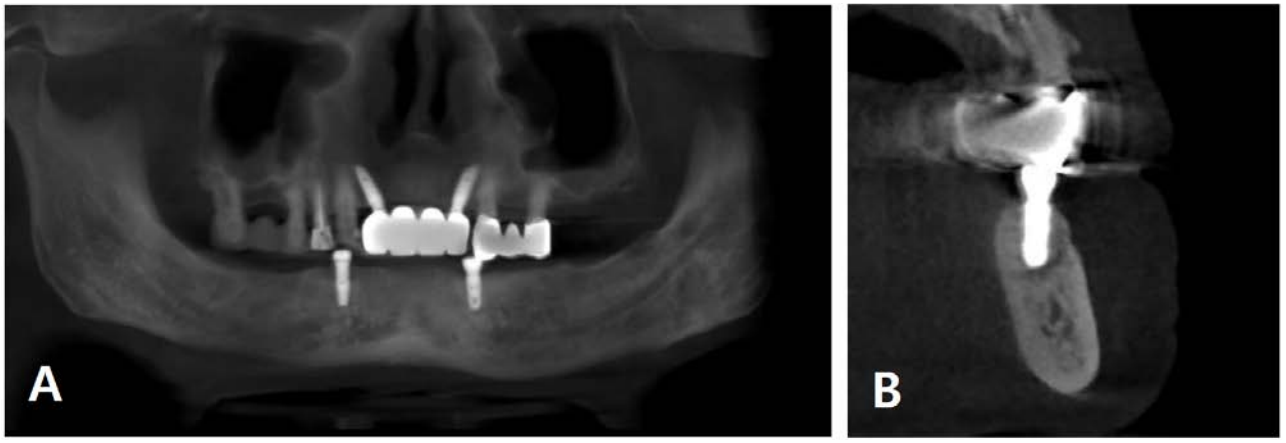

Figure 6. CBCT image after #33 implant installation with shorter length fixture. (A) Panoramic view. (B) Paraxial view.

found that the healing abutment had been chewed, and this time, the removal and implant placement in another site were planned at the same time. After one month, implant was installed on #32 site because the mental nerve was situated posteriorly in relation to the original implantation site. Initial stability of #32 implant was 35 Ncm of insertion torque, and sutures were removed after 10 days with uneventful healing. No sign of osseointegration failure was seen at the follow up period, and maintenance has so far been proceeding without any abnormal findings two years after the overdenture delivery (Figure 7).

2. Case 2: cluster failure

A 50-year-old male patient visited the clinic with a chief complained of implant installation on maxilla. He had hyperlipidemia but didn't take any medication. He also had oligodontia history except #15, 25 tooth. As for the past dental history, #33, 35, 43, 45 implant was placed 15 years ago (USII 3.75 × 15 mm on #33,43 implant, and USII 4.0 × 15 mm on #35, 45 implant), and the maxilla was edentulous since two years ago due to extractions of #15 and #25. As for the treatment plan, after placing 4 implants in the maxilla, restoration was planned with implant-supported fixed-hybrid denture (Figure 8).

Implant installation with additional GBR on #13, 23 buccal side and connection of healing abutment were performed (Straumann® Bone Level Tapered 4.1 × 10 mm on #13, 23 implant and 4.8 × 10 mm on #15, 25 implant, Waldenburg, Switzerland). The GBR was performed with deproteinized bovine bone mineral with 10% collagen and collagen membrane (Bio-Oss Collagen® 250 mg and Bio-Gide® 25 × 25 mm). Initial stability of #13,15,25 implants was 35 Ncm of insertion torque, and 24 Ncm on #23 implant (Figure 9). CBCT was taken after implant implantation (Figure 10).

5 days after implant placement, he visited the clinic for the healing abutment to fall out. At 2 weeks after suture removed, uncomfortable pain from the #15 implant was detected. 6 weeks after implant surgery, the implant stability quotient (ISQ) was measured by resonance frequency analysis (Osstell™ Mentor, Integration Diagnostics, Göteborg, Sweden) as 72/79 ISQ value on #13 implant, 68/72 ISQ value on 23 implant, and 76/80 ISQ value on 25 implant (buccal/proximal direction, respectively)[11]. On a periapical radiograph, however, it was able observe peri-implant

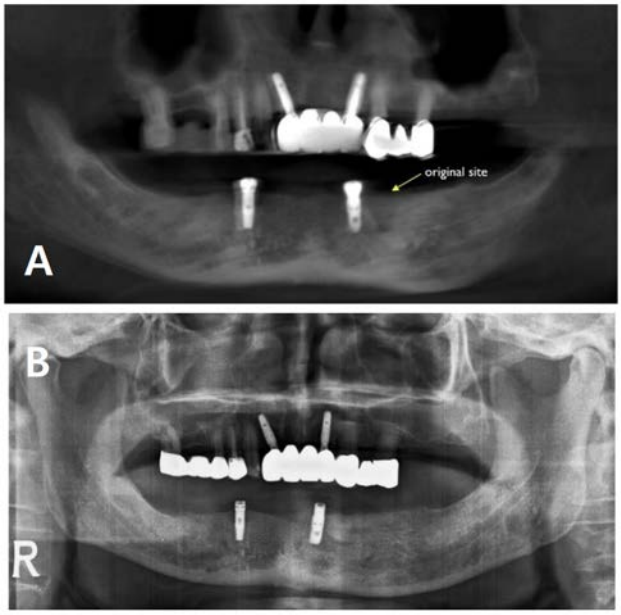

Figure 7. Panoramic radiograph. (A) Implant installation in another site (#32 site). (B) 2 years after the prosthetic treatment.

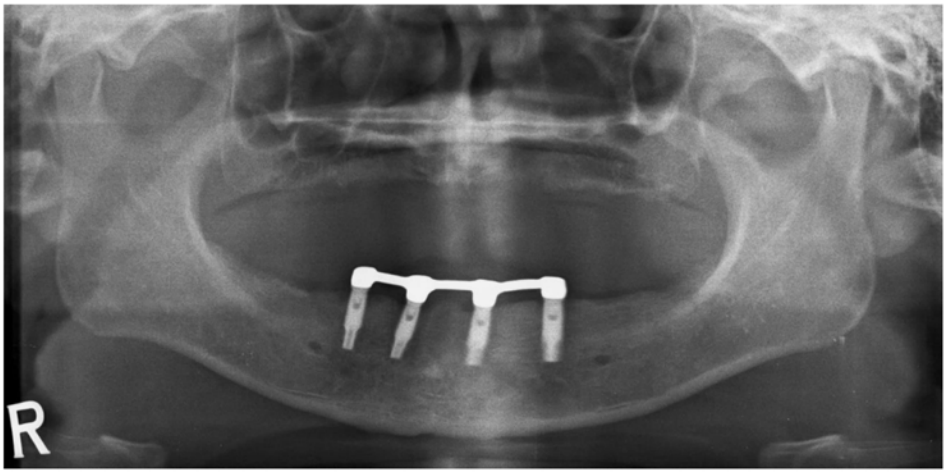

Figure 8. Pre-operative panoramic radiograph.

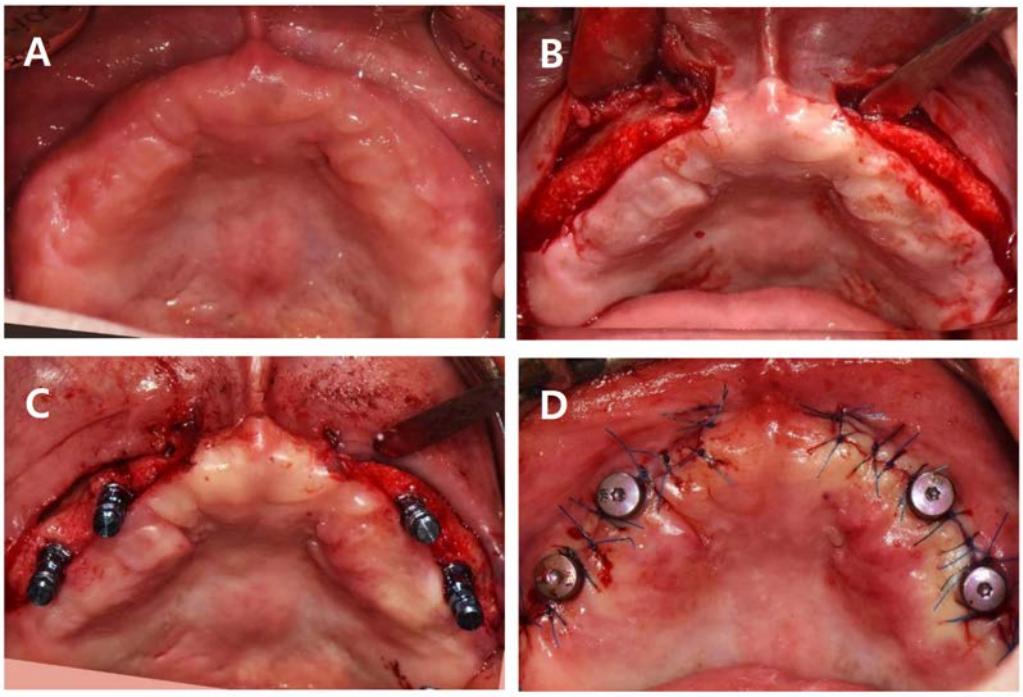

Figure 9. Clinical photographs. (A) Pre-operative photograph. (B) Flap reflection. (C) After implant installation. (D) Suture.

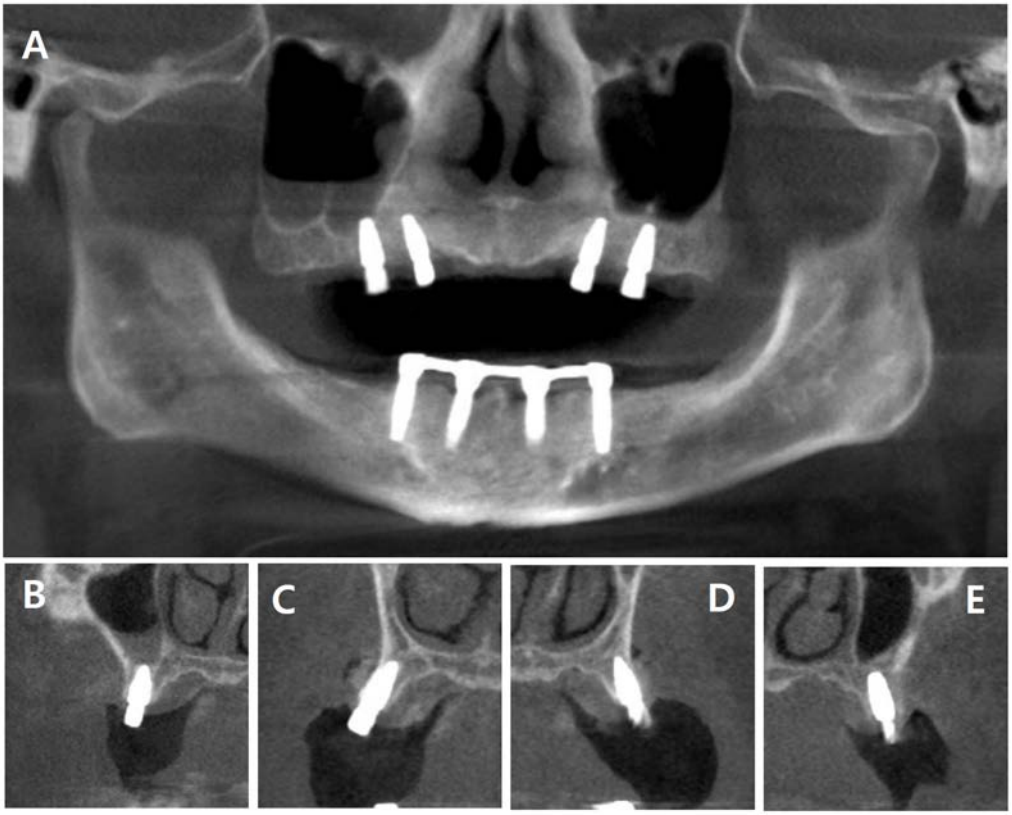

Figure 10. CBCT image after implant installation. (A) Panoramic view. (B) Paraxial view of #15 implant. (C) Paraxial view of #13 implant with lateral GBR. (D) Paraxial view of #23 implant with lateral GBR. (E) Paraxial view of #25 implant.

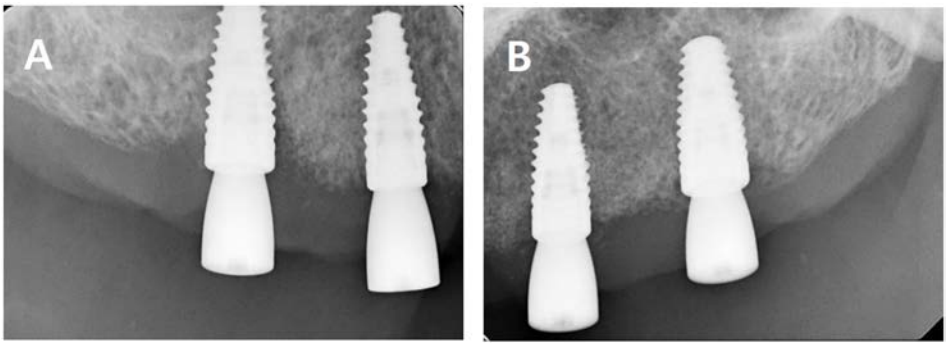

Figure 11. Periapical radiograph at 6 weeks later of implant surgery with peri-implant radiolucency on #15 implant. (A) #15, 13 implant. (B) #23, 25 implant.

radiolucency on #15 implant along with implant mobility and pain (Figure 11). The removal of #15 implant with ARP and implant placement at the same site were planned under the diagnosis of osseointegration failure. After removal of implant, remaining root fragment (Figure 12), which was invisible on CBCT, was removed together, and ARP was performed (Bio-Oss Collagen® 100 mg and Bio-Gide® 13 × 25 mm).

14 weeks after implant surgery, the ISQ was measured by resonance frequency analysis (Osstell™ Mentor) as 70/74 ISQ value on #13 implant, 69/70 ISQ value on 23 implant, and 77/79 ISQ value on 25 implant (buccal/proximal direction, respectively), and this value slightly decreased compared to the value measured 8 weeks ago (Figure 13).

5 months after #15 implant removal, implant installation on removal site was performed with 10 Ncm of insertion torque (Straumann® Bone Level Tapered 4.8 × 10 mm). However, patient complained of discomfort at the #13 implant site, and the ISQ value decreased to 65/62 with peri-implant bone loss observed on CBCT (Figure 14). The patient was informed that the #13 implant should be removed, but he refused and preferred to observe.

After 1 month of #15 implant installation, he visited the clinic complaining of pain with a clicking sound at #23 implant site while chewing with provisional denture. Clinical examination revealed that ISQ value decreased to 55/61 without pain or screw rotation, so healing abutment was changed with a reduced height. 1 month after of that day, it was decided to remove the #23 implant with decreased ISQ value of 44/53, but #13 implant had a similar ISQ value of 60/61, so further follow-up was planned. When he visited the clinic for removal of #23 implant 1 month later, ISQ value of #13 implant decreased to 52/48, so #13 implant was removed at the same time as the #23 implant with atelocollagen sponge insertion (Teruplug®, Terumo biomaterials Co., Tokyo, Japan). No sign of osseointegration failure of #15,25 implant was seen at the follow up period, and prosthetic treatment was re-planned with overdenture instead of implant-supported fixed-hybrid denture (Figure 15).

Figure 12. Clinical photograph of removed #15 implant fixture and root fragment.

DISCUSSION

This report presented rare cases the rare cases of repeated implant failure at the same site and cluster failure. Case 1 showed 3 failures at the same site. The estimated cause of 1st failure was infection due to peri-implantitis. The 2nd failure was thought to be caused by the bone overheating during drilling, and the 3rd failure was attributed to overloading on the implant due to chewing with the healing abutment. Case 2 showed a series of 3 implant failures. The failure of #15 implant was attributed to infection caused by the residual root fragment, and the failure of #13,23 implant can be related to overloading caused by parafunctional habit due to a history of recurrent fracture of the previously used denture.

Three failures in two cases are examples of osseointegration failure due to overloading, in which a healing abutment was connected by performing one-stage implant surgery. It is assumed

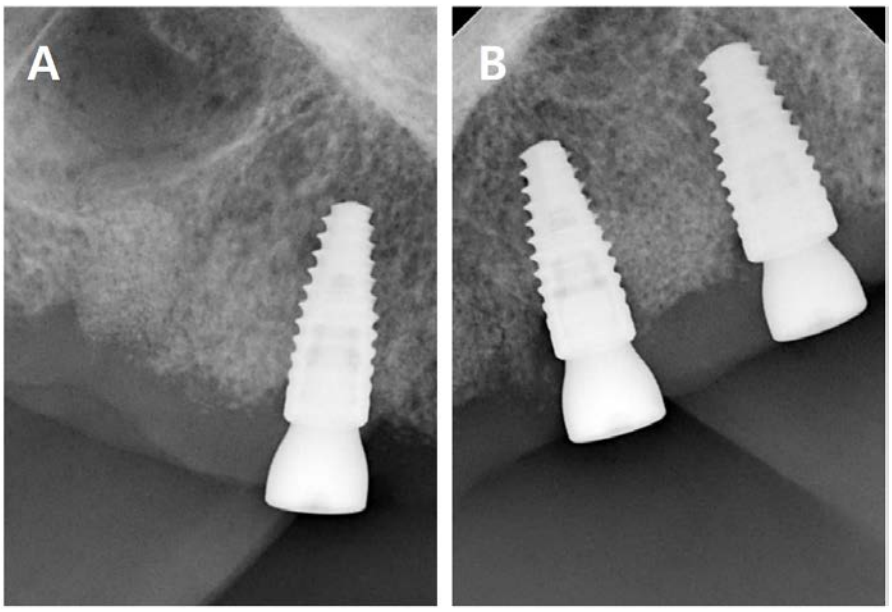

Figure 13. Periapical radiograph at 13 weeks later of implant surgery. (A) #13 implant. (B) #23, 25 implant.

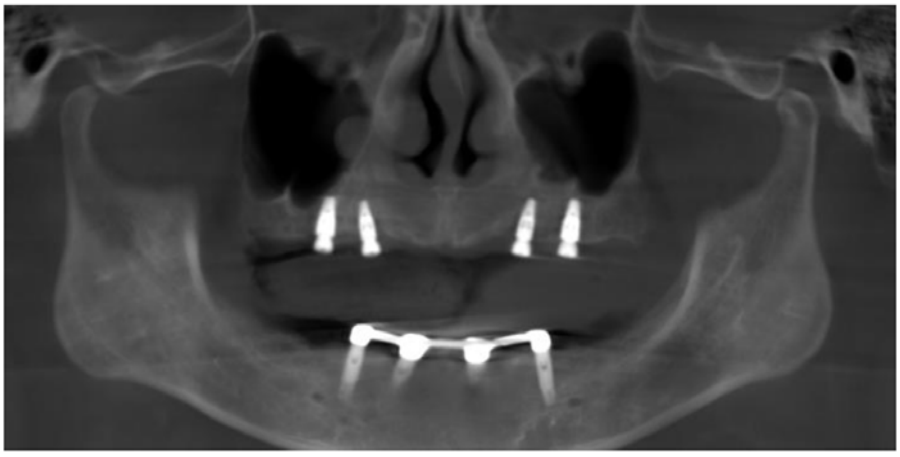

Figure 14. Panoramic view of CBCT image after #15 implant re-installation.

Figure 15. Panoramic view of CBCT image after #13, 23 implant removal.

that these patients failed osseointegration due to masticating with the healing abutment or harmful external force from the provisional denture applied to the implant. In the implant treatment of edentulous patients, the use of a provisional denture or the application of external force to the healing abutment does not result in implant osseointegration failure in all patients, but if a patient has excessive bite force, a healing abutment with reduced height or two-stage implant surgery to submerge the implant can be considered[12-14]. Additionally, installing a temporary implant could help to stabilize the temporary denture and distribute the load from the original implants[15].

A systematic review of publications up to late 2014 reported an 88% survival rate for replaced implants after failed implant removal[16]. According to the systematic review reported in 2020, the average survival rate for implants following retreatment was 86.3%, with follow-up ranging from less than a year to more than 5 years[17]. Compared to the survival rate obtained with the second attempt, the survival rate with the third attempt dropped by almost 73%[18]. As a result, the success rate of implant re-installation at the same site is significantly reduced, and studies clearly demonstrating the cause are still lacking. In a paper in 2019, overloading due to hard food consumption or parafunctional habits of clenching and bruxism was described as the main cause of failure in a study of 14 implants that failed frequently[6]. However, in many cases, it was difficult to determine the cause of failure.

CONCLUSION

This case report presented unusual cases in which implants failed repeatedly at the same place or more than one implant failure per patient that does not have to occur in the same position or quadrant. Through these cases and reviews, it has become clear that repeated implant failure is primarily due to overloading, however the precise cause has not been identified.

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