



Peri-implant tissue management after immediate implant placement using a customized restoration with emergence profile and rhBMP-2 bone graft in buccal dehiscence defect of the extraction socket

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Abstract

Objectives: Immediate implant placement using a customized restoration with emergence profile appeared as a minimally invasive approach to resolving an esthetic problem and preserve the gingival contour; however, immediate restoration in GBR case of buccal dehiscence defect is not possible. In these cases, an innovative approach through rhBMP-2 bone graft could be used to regenerate a new bone defect and preserve the soft tissue contour and eliminate the need for reopening surgery.

Clinical Considerations: The present cases describe a chairside approach to use customized restoration for immediate implants to maintain the soft tissue contours while synthetic bone graft was filled in buccal dehiscence defect around the implant which was smeared by 10~20 µg rhBMP-2 solution.

Conclusions: This technique seems to be effective to guide the soft tissue healing around implants allowing a natural emergence profile with implant-supported restorations, regenerating a new bone in buccal dehiscence defect.

Clinical Significance: An innovative approach through rhBMP-2 bone graft and customized restoration with emergence profile after immediate implant placement preserves the gingival contour and eliminates the need for the second surgery.

1 | INTRODUCTION

Attempts to shorten the overall length of the treatment period have focused on approaches like early or immediate loading following implant placement, immediate implant placement in the fresh extraction site, and immediate implant placement and early or immediate loading [1–3].

The concept of immediate implant loading has recently become popular due to less trauma, reduction in overall treatment time, decrease in hard and soft tissue resorption, increase in patient's acceptance, along with better function, aesthetics and has a psychological benefit [4, 5].

The concept of bone augmentation with the use of xenogeneic bone graft and a resorbable barrier membrane in conjunction with early implant placement was carried out in several clinical studies with successful results [6-10].

With immediate or early implants, it is possible that one or more bony walls of the postextraction socket may be either partly or completely missing due to the preexisting inflammatory processes or damaged as a complication of the tooth extraction procedure. As a result, a portion of the implants could remain exposed due to hard tissue defects. Sockets with dehiscence defects may lack the potential for complete bone regeneration, and the risk of long-term complications may be increased with immediate or early implants placed at these sites [4].

However, several reports have shown that bone regeneration may be achieved in defective sites adjacent to immediate or early implants using a variety of bone augmentation techniques, such as autogenous bone grafts, bone substitutes, and guided bone regeneration with resorbable or non-resorbable barriers [3].

In multicenter, randomized clinical trials on the efficacy and safety of *Escherichia coli*-derived rhBMP-2 with β -TCP/HA bone grafts coated with ErhBMP-2, ErhBMP-2 coated β -TCP/HA were found to be more effective in preserving alveolar bone than conventional β -TCP/HA alloplastic bone grafts. Furthermore, during the experiment, no adverse reactions to the graft material were observed [11]. The present cases describe a chairside approach to use customized restoration for immediate implants to maintain the soft tissue contours while synthetic bone graft was filled in buccal dehiscence defect around hydrophilic SLA surface implant which was smeared by the dose of less than 20 μ g rhBMP-2 lution.

The customized restoration with an emergence profile

could protect and contain the bone substitute during the healing period [12]. Through this technique, a new bone in defect will be regenerated and the soft tissue contour could be preserved and the need for reopening surgery will be eliminated.

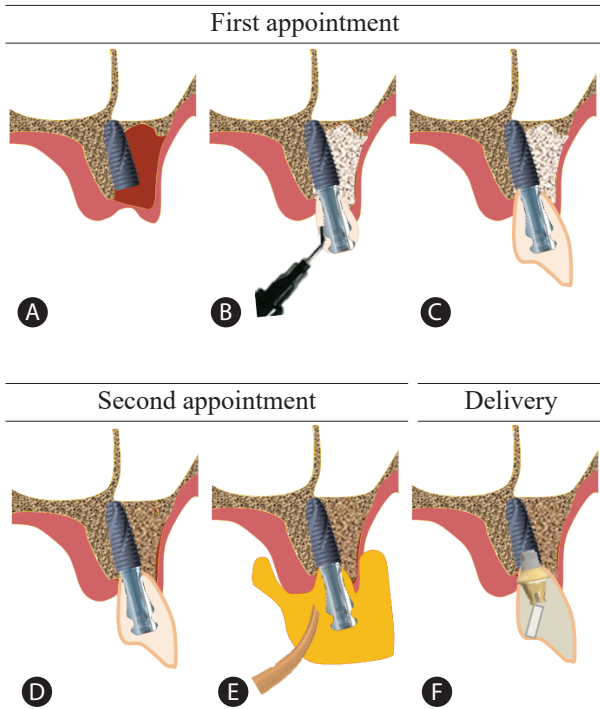
2 | MATERIALS AND METHOD

2.1 Materials

Fixture with hydrophilic SLA surface treatment (Submerged type of INNO implant, Cowellmedi Co. Ltd., Korea) was smeared by less than 20 μ g of 1.0 mg/ml rhBMP-2 solution (COWELL® BMP, Cowellmedi Co. Ltd., Korea). A synthetic bone graft was filled in the buccal bone dehiscence defect. Bite impression coping with a horizontal and longitudinal groove from fixture connection to top end was used for the post of provisional restoration and impression into fixture connection. Screw retained abutment which could be applied by straight or angulated screw channel (SFIT abutment, Cowellmedi Co. Ltd., Korea) was assayed with zirconia permanent restoration.

2.2 Methods

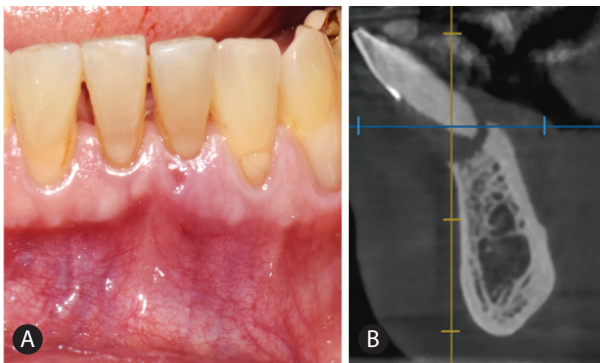
A schematic diagram of the clinical technique is represented in Figure 1. These sites were anterior teeth and premolar in the esthetic zone of which implant placement torque was over 35 N.cm in over 10 mm length and over 3.5 mm diameter fixture. For higher implant placement torque over 35 N.cm, a wider diameter fixture was selected if possible. Implant placement level was 4~5 mm from mid-crest of buccal gingiva and implant placement position was over 2 mm between buccal bone boundary and fixture. The width of the buccal bone graft in the buccal dehiscence defect was over 3 mm. The final restoration was placed in 4 to 10 weeks after the operation. Evaluation of buccal bone formation was done in CBCT findings of pre-operation, post-operation, and 1 year follow-up check visit.



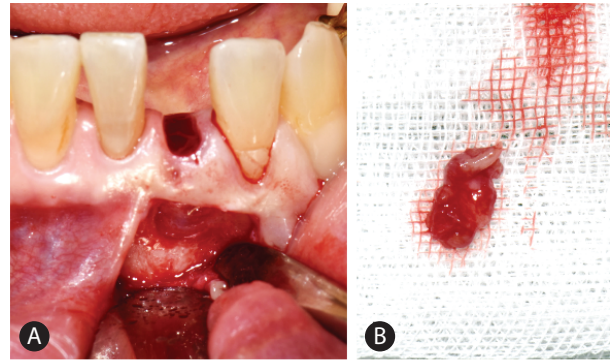
[Figure 1.] Sequence representing the clinical use of the customized restoration. A, Immediate implant placed after tooth extraction. B, Bite impression coping wrapped by resin in position and the buccal dehiscence defect filled with synthetic bone material, application, and light-curing of flowable resin until supporting the soft tissue contour. C, The coping and build-up resin restoration is removed for shaping anatomical contours, then placed in position again. D, Healed soft and hard tissues around the dental implant and the customized restoration. E, Transfer impression with bite impression coping. F, Final restoration in position following the emergence profile obtained.

3 | CASE REPORT

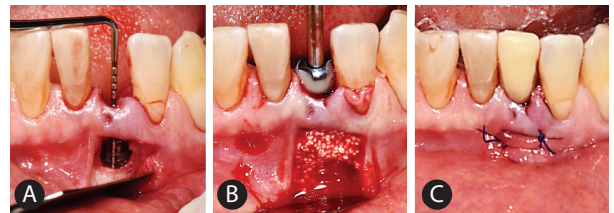
3.1 Case of mandibular incisor



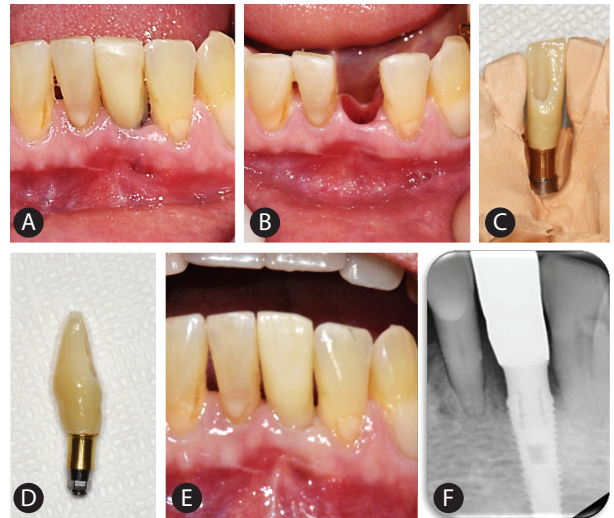
[Figure 2.] First visit. A, Gingival inflammation around the mandibular central incisor. B, Cone beam computed tomography image showing the alveolar bone loss.



[Figure 3.] Extraction socket. A, Horizontal incision at the mucogingival junction and the vertical incision at central lip frenum. B, Inflammatory granulation tissue.



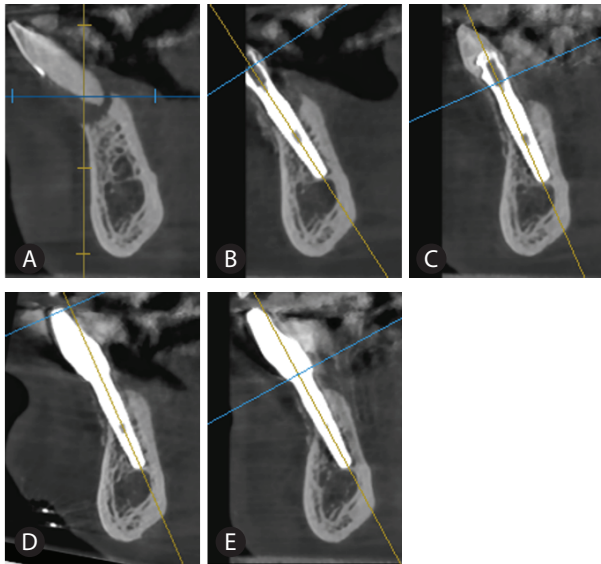
[Figure 4.] Implant placement with buccal bone graft. A, Gingival depth 5.5 mm with 2.5 mm height buccal dehiscence defect on 3.5x12 mm fixture. B, Bite impression coping wrapped by resin and buccal bone graft. C, Primary closure.



[Figure 5.] Impression in 7 weeks after surgery and zirconia screw-retained crown with abutment. A, Healing state in 7 weeks B, Gingival contour after removal of customized restoration. C, Zirconia screw-retained crown in cast model. D, Zirconia screw-retained crown and abutment. E, Try-in of the crown. F, Standard X-ray after try-in.



[Figure 6.]
1 year follow-up check. A, Gingival contour preservation. B, Emergence profile. C, Healthy gingiva.



[Figure 7.]
CBCT sagittal section. A, First visit. B, Surgery. C, Impression taking on 2 months. D, 7 months. E, 1 year after surgery.

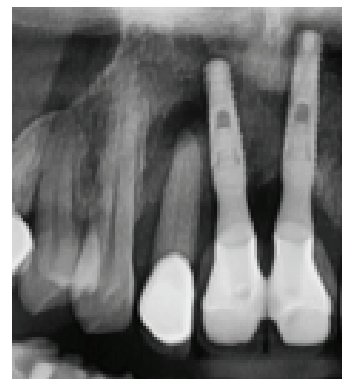
The patient, a 61-year-old woman, sought dental care due to concern about the mobility of her mandibular left central incisor. During the clinical examination, gingival inflammation and tooth mobility were observed (Figure 2A). Cone-beam computed tomography (CBCT) showed an alveolar bone loss. Furthermore, the sagittal section of CBCT showed that basal bone height was sufficient to place an implant after tooth extraction (Figure 2B).

Tooth extraction was performed with the horizontal incision at the mucogingival junction and the vertical incision at central lip frenum to minimize the scar at the attached gingiva (Figure 3A). Inflammatory granulation tissue in the socket was removed by curettage (Figure 3B). After curettage of the tooth socket and profuse irrigation, a fixture with hydrophilic SLA surface smeared by rhBMP-2 solution (3.5X12 mm: INNO implant, Cowellmedi Co. Ltd., Korea) was inserted immediately. The implant insertion torque was 40 N.cm and the buccal gingival depth of fixture from the mid-crest of buccal gingiva to top of the fixture was 5.5 mm with 2.5 mm height of

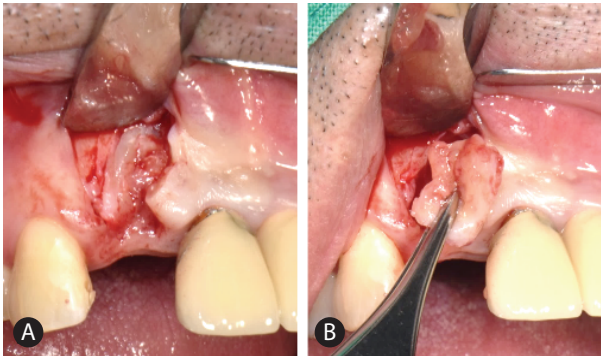
buccal dehiscence defect on the fixture (Figure 4A). As the safe primary stability for immediate provisional restoration was achieved, it was decided to perform an immediate customized restoration with an emergence profile. Firstly, the dehiscence gap between the buccal bone boundary and the implant was filled with a synthetic bone substitute (COWELL® BMP, Cowellmedi Co. Ltd., Korea), and a bite impression coping wrapped by resin was connected on the fixture (Figure 4B). Flowable resin (Filtek Z350 XTFlow, 3M ESPE; Maplewood, MN) was applied around the coping in small amounts and light-cured to prevent invasion of tooth socket until the extracted tooth contour was completed. On completion of this step, the coping was removed and the sub-gingival and crown's contours were also shaped with flowable resin. Finishing and polishing were then done and the customized restoration was cleaned in 70% alcohol. The restoration was again positioned on the implant and incision lines were closed (Figure 4C). In 7 weeks after surgery, the customized restoration was removed to take an impression for screw-retained zirconia crown (Figures 5A, 5B, 5C, 5D), and a definitive abutment for screw-retained restorations (SFIT abutment, Cowellmedi Co. Ltd., Korea) was inserted (Figure 5E). Standard X-ray showed the correct match between fixture and abutment (Figure 5F).

When the screw-retained crown was retrieved for check of gingival health in 1 year follow-up check visit, the emergence profile was maintained and any inflammation of gingiva was not shown (Figure 6A, 6B, 6C). CBCT was taken on a visit of first visit, surgery, impression taking on 2 months, 7 months, and 1 year after surgery (Figure 7A, 7B, 7C, 7D, 7E). The new buccal bone of dehiscence defect site was maintained at 1-year visit.

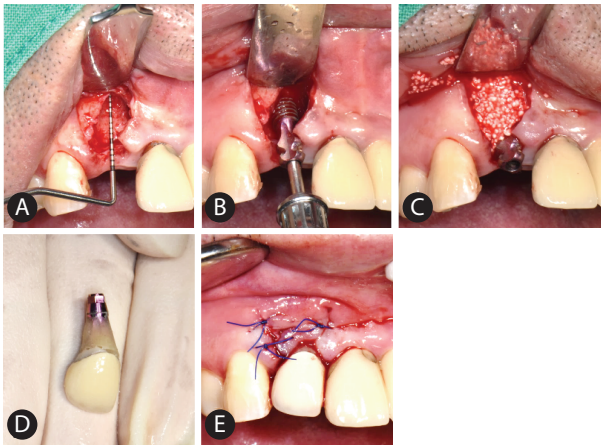
3.2 Case of maxillary incisor



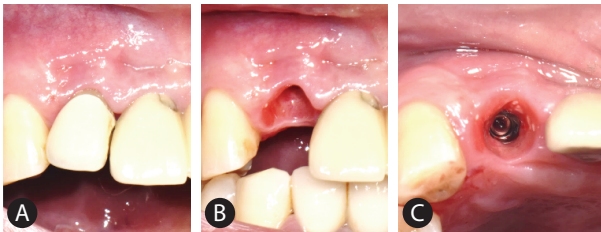
[Figure 8.]
Panoramic X-ray view of the maxillary right lateral incisor.



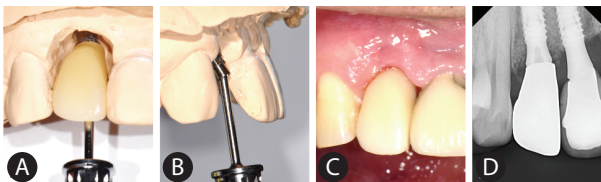
[Figure 9.]
Extraction socket. A, Buccal flap with two vertical incisions. B, Removal of inflammatory granulation tissue.



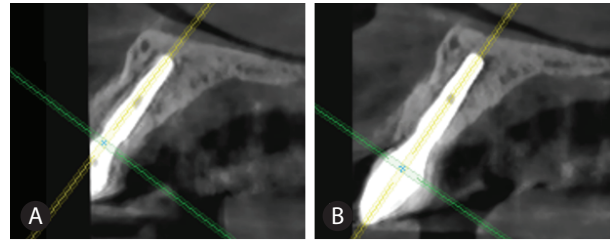
[Figure 10.]
Implant placement with buccal bone graft. A, 9 mm Gingival depth to buccal bone crest. B, 4 mm height buccal dehiscence defect on 4.0X14 mm fixture. C, Buccal bone graft on the defect. D, Bite impression coping wrapped by resin and old crown. E, Primary closure.



[Figure 11.]
Gingival contour in 7 weeks after surgery. A, Healthy gingiva. B, Emergence profile. C, Remained graft particle in the long junctional epithelial zone.



[Figure 12.]
Screw retained crown. A, Zirconia crown with SFIT abutment. B, SFIT abutment with the angulated screw channel. C, Try-in of the crown. D, Standard X-ray after try-in.



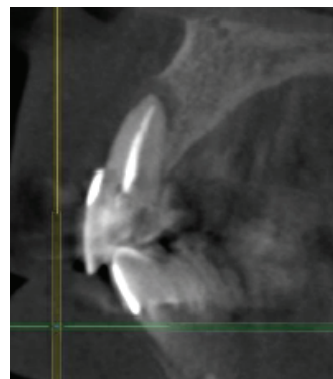
[Figure 13.]
CBCT sagittal section. A, Surgery. B, 1 year after surgery.

The patient, a 62-year-old man presented with a flexible maxillary right lateral incisor. After the clinical inspection and panoramic X-ray view, chronic periodontitis with mobility class III was diagnosed and there was sufficient bone available for immediate implant placement (Figure 8). After the lateral incisor was extracted, the buccal flap with two vertical incisions was elevated for removal of inflammatory granulation tissue (Figure 9A, 9B). Gingival depth to buccal bone crest was 9 mm and the height of buccal dehiscence defect was 4 mm on 4.0X14 mm mm fixture. Buccal bone graft was covered on the defect. The combination of bite impression coping wrapped by resin and old crown was connected on the fixture with primary closure of flap (Figure 10A, 10B, 10C, 10D, 10E).

7 weeks after surgery, the customized restoration was retrieved and the impression was taken. The gingival contour with emergence profile was healthy and natural appearance (Figure 11A, 11B, 11C). Screw retained crown and abutment (SFIT abutment, Cowellmedi Co. Ltd., Korea) with angled screw-driver channel were placed on the implant in fitted connection (Figure 12A, 12B, 12C, 12D).

CBCT was taken on a visit of surgery, and 1 year after surgery (Figure 13A, 13B). The new buccal bone of dehiscence defect site was maintained at 1-year visit.

3.3 Case of maxillary incisor



[Figure 14.]
CBCT sagittal section at the first visit.

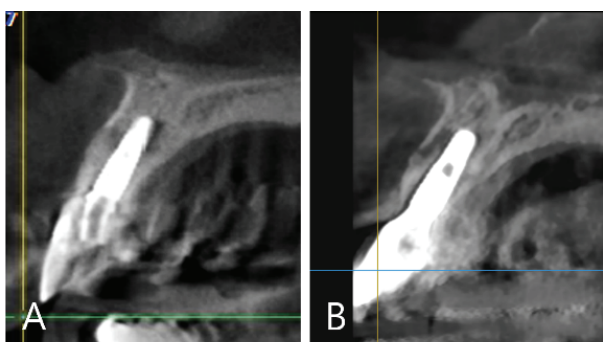
The patient, a 65-year-old man presented with an extruded maxillary right central incisor. After the clinical inspection and CBCT X-ray view, chronic periodontitis with mobility class III was diagnosed and there was sufficient bone available for immediate implant placement (Figure 14).



[Figure 15.]
Implant placement with buccal bone graft. A, Buccal bone graft beside of implant and abutment. B, The combination of bite impression coping wrapped by resin and an extracted incisor. C, Customized restoration.



[Figure 16.]
Gingival contour in 10 weeks after surgery. A, Healthy gingiva. B, Emergence profile. C, Final restoration.



[Figure 17.]
CBCT sagittal section. A, Surgery. B, 1 year after surgery.

After the central incisor was extracted, a circular incision without vertical incision was done at the socket and inflammatory granulation tissue was removed. The implant was placed at the basal bone and the buccal bone graft was filled between the implant and the buccal mucogingival tissue (Figure 15A). The height of the buccal dehiscence defect was 7 mm a 4.0X12 mm fixture. The combination of bite impression coping wrapped by resin and extracted incisor (Figure 15B) was connected on the fixture (Figure 15C).

In 10 weeks after surgery, the customized restoration was removed and the impression was taken. The gingival contour with emergence profile was healthy and natural appearance (Figure 15A, 15B, 11C). Screw-retained

crown and abutment (SFIT abutment, Cowellmedi Co. Ltd., Korea) with angulated screw channel were placed on the implant in fitted connection (Figure 15C).

CBCT was taken on a visit of surgery, and 1 year after surgery (Figure 17A, 17B). The new buccal bone of dehiscence defect site was maintained at 1-year visit.

4 | CONCLUSION

The use of customized restoration with emergence profile on rhBMP-2 smeared implants seems to be effective to guide the soft tissue healing around implants allowing a natural emergence profile with implant-supported restorations, regenerating a new bone in buccal dehiscence defect.

In these present cases, tension-free primary closure of flap around immediate restoration with emergence profile produced adequate newly formed keratinized tissue. The no need for a barrier membrane in the proposed protocol significantly reduced the surgical time and cost and may be attributed to enhanced bone regeneration and remodeling as rhBMP-2 stimulated the multipotent mesenchymal stem cells that are capable of differentiating into the bone and provides a source of blood vessels.

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