Vertical Regeneration with rhBMP-2 bone graftVersus INNO^{TM} Implants with 5.5-mm Intrabony Length in Atrophic Posterior Mandibles

Daekyung Kim DDS PhD

ABSTRACT

Purpose: To retrospectively compare the outcomes of implants placed in posterior mandibles vertically regenerated with rhBMP-2 bone grafts and short dental implants.

Methods: Consecutive patients with vertical bone atrophy in edentulous mandibular posterior regions (6 to 8 mm ofbone above the inferior alveolar nerve) were treated with either implants placed in regenerated bone using rhBMP-2 bone graft or short INNO^{TM} implants (with 4.0-mm intrabony length) in native bone between 2011 and 2013 and followed for 12 months after loading. Panoramicradiographs were obtained from each patient as follows: before surgery, immediately after implant placement, 6 months after surgery, and after 1year. Clinical and radiographic examinations were performed at every visit.

Results: Allof 3 implants at group 1 and 6 implants at group 2 were stable functionally, as well as clinically and radiographically, during the follow-up. No infection occurred in all sites, and all implants succeeded in the observation follow-up period. There was a 100% survival rate of implant in both groups, the same as in intact mandibular posterior ridge.

Conclusions: When residual bone height over the mandibular canal isbetween 6 and 8 mm, short implants (with 4.0-mm intrabony length) might be a preferable treatment optionover vertical augmentation, reducing chair time, expense, and morbidity.

Key Words: atrophied mandible, block bone graft, short dental implants

INTRODUCTION

In cases of reduced bone height in the posterior mandible, two treatment options involving implants havebeen proposed: the placement of implants subsequentto vertical augmentation with block bone graftsand the use of short implants.[1,2] The definition of shortimplants is controversial; some authors consider implantswith a length within the range of 7 to 10 mmas short,[2,3] while for others short means an intrabony length of 8 mm or less.[4,5]

Recent systematic reviews of short implants in the posterior atrophic mandible have evidenced high survival and success rates.[6–8] The main advantages of placing short implants are the avoidance of invasive bone augmentation surgeries associated with donor site morbidity and reductions in treatment duration and economic cost.[5] However, the choice of treatmentfor vertical bone defect restoration remains a subject of discussion. No clear evidence is available as to whether short implants are preferable to augmentation procedures using block bone grafts,[9,10] and few studies have compared the two treatment alternatives.[1,5,11–14] The largest series were published by Feliceet al[1,13] with 4- and 12-month follow-ups after loadingand by Esposito et al[11] with a 3-year follow-up. These reports included 60 patients, treated with either short implants (with 6.3-mm intrabony length) or 10-mm or longer implants. There are only two series with shorter implants (of 5-mm intrabony length); these studies reported4- and 12-month postloading follow-ups.[12,14]Short implants could be a simpler, cheaper, and faster alternative to bone augmentation procedures for the rehabilitation of posterior mandibles with limited bone height, providing they can be shown to produce similar implant success rates. Although previous reports have suggested that short implants may have outcomes comparable to implants placed after augmentation procedures, more controlled clinical studies and longer follow-up times are necessary to draw definitive conclusions.

The purpose of the present retrospective study was to evaluate the outcome of implant therapy in posterior mandibular regions with localized vertical bone atrophy, making a comparison between the outcomes of implants placed following alveolar ridge augmentation with rhBMP-2 grafts and short dental implant placement with a minimum follow-up of 1 year.

MATERIALSANDMETHODS

Patients

From June 2011 to March 2013, a total of 6 patients were treated with implants inserted vertical bone atrophy in the posterior edentulous mandibular regions treated with either implants placed in regenerated bone using autologous block bone grafts (group1) or short implants (with 4.0-mm intrabony length) in private dental clinic. 3 implants placed in regenerated bone using rhBMP-2 bone grafts were placed in 1 patient, and 6 INNO short implants (with 4.0-mm intrabony length) were inserted in 3 patients. Panoramic radiographs were obtained from each patient as follows: before surgery, immediately after implant placement, 6 months after surgery, and after 1year. Clinical and radiographic examinations were performed at every visit.

Patient and site inclusioncriteria were: *(1)* vertical bone atrophy in the posterior edentulous mandible (Class IV and V of Cawood and Howell 16 classification, indicating adequate width but inadequate height; 5 to 8 mm of bone available above the mandibular canal); *(2)* treatment involving vertical ridge augmentation with rhBMP-2 bone grafts and delayed implant placement or with short implants (with 4..0-mm intrabony length); *(3)* rehabilitation with fixed implant-supported prosthesis; *(4)* age>18 years; *(5)* no relevant medical conditions, *(6)* nonsmokingor smoking ≤20 cigarettes/day (all pipe orcigar smokers were excluded); *(7)* follow-up for at least12 months after prosthetic loading.

Patient and site exclusion criteria were: *(1)* patients with systemic or local conditions contraindicating implant therapy (eg, previous chemotherapy, previous irradiation of the headand neck region, or active progressive periodontitisand/or immunosuppression); *(2)* pregnant or lactating patients; *(3)* sites with acute infection; *(4)* poor oral hygiene;*(5)* horizontal alveolar ridge augmentation; *(6)* patients failing to attend follow-up visits up to and including the 12-month mark.

Augmentation Procedure

Local anesthesia was administered before surgery. An initial incision was made slightly lingual of the alveolar crest. One or two releasing incisions were made atadjacent teeth, and a mucoperiosteal flap was raised. The exposed

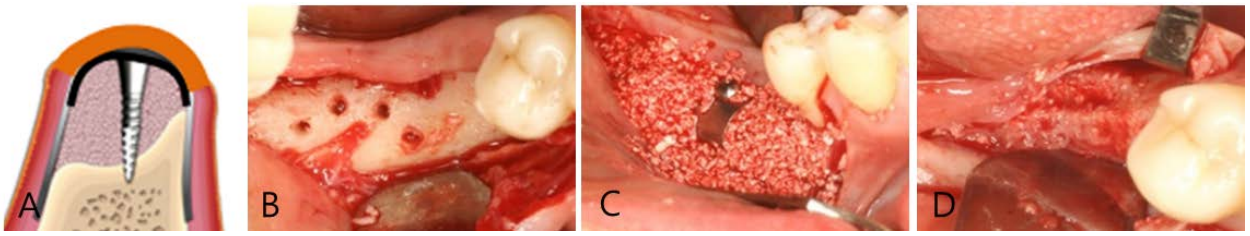

Figure 1 BOSS screw and titanium mesh with rhBMP-2 bone graft. A: Schematic drawing of BOSS screw and titanium, B: intra-marrow perforation, C: BOSS screw and titanium mesh with rhBMP-2 bone graft D: Vertical bone regeneration after 4 months.

alveolar bone was curetted to remove allsoft tissues.The cortical bone at the recipient site was perforated at multiples sites with a thin cylindric bur to increase bleeding. One tenting screw (BOSS screw, Cowellmedi, Pusan, Korea) was placed in the median of defect, and titanium mesh which supports the crestal conformation was fixed on the tenting screw. the recipient site between titanium mesh and native bone were filled with rhBMP-2 bone graft combined with ß-tricalcium phosphate(CowellBMP™, Cowellmedi, Pusan, Korea).
Periosteal incisions were made to allow flap mobilization and tension-free primary wound closure. Flaps were closed with horizontal sutures using Polisoft 4/0 sutures.(Figure 1)

Implant Placement

All implants used in the study were INNO™ implants (Cowellmedi, Pusan, Korea) with SLA surface treatment.and wereinstalled using the standard procedure according tothe manufacturer's guidelines.
In group 1, the aim of the bone grafting was to obtainenough bone to place 10-mm or longer implants with a minimum intrabony length of 8.0 mm (Fig 2). In group 2, all implants had an intrabony length of 4.0 mm (Fig 3). All implants (both groups) were placed with adequate primary stability (≥ 35 Ncm), and flap closure was performed using Polisoft4/0 sutures. Postoperatively, patients were instructed to rinse their mouth twice a day with a 0.12% chlorhexidine solution, Hexamedin (Bukwang Pharmaceutical Co., Seoul, Korea) for 2 weeks after surgery. Antibiotics were prescribed for 7days, and sutures were

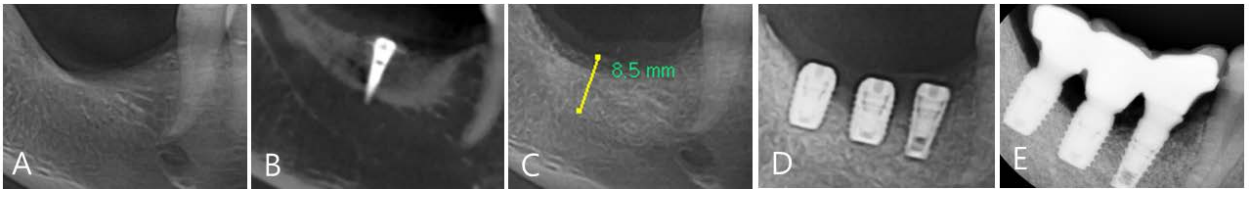

Figure 2 Panoramic X-ray at visits. A: At preoperative visit, B: Post-augmentation, C: before implant placement, D: After implant placement, E: 1 year after loading

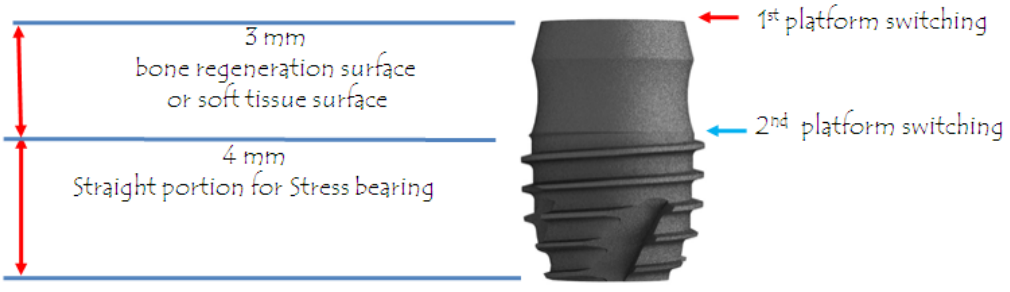

Figure 3 Total length 7 mm composed of the 3 mm height surface for bone regeneration or soft tissue and the 4 mm infrabony surface for osseointegration. The top of implant has 1st platform switching and the top of threads has 2nd platform switching for prevention of marginal bone loss.

removed after 10days. After a mean healing period of 6 months, all patients were rehabilitated with fixed crowns or bridges. After inserting the implants, the patients received follow-up care at 1 and 2 weeks, at 3, and 6 months, and every 12 months thereafter. Clinical and radiological evaluations were performed using standardized radiographs according to the following schedule: prior to surgery, immediately after surgery, 6 months after surgery, and then every year after surgery.

Radiographic analysis of the grafted bone height

Radiographic examinations were performed at every visit (Figure 2). Radiographic changes in graft height were calculated with respect to the implant's known length and the natural bone height (NBH) with Easydent viewer version 4.5 software (Vatec, Anseong, Korea) (Figure 4).

RESULTS

Allof 3 implants at group 1 and 6 implants at group 2 were stable functionally, as well as clinically and radiographically, during the follow-up. No infection occurred in all sites, and all implants succeeded in the observation follow-up period. There was a 100% survival rate of implant in both groups, the same as in intact mandibular posterior ridge. No signs of periimplantitis (probing pocket depth of >=5 mm and

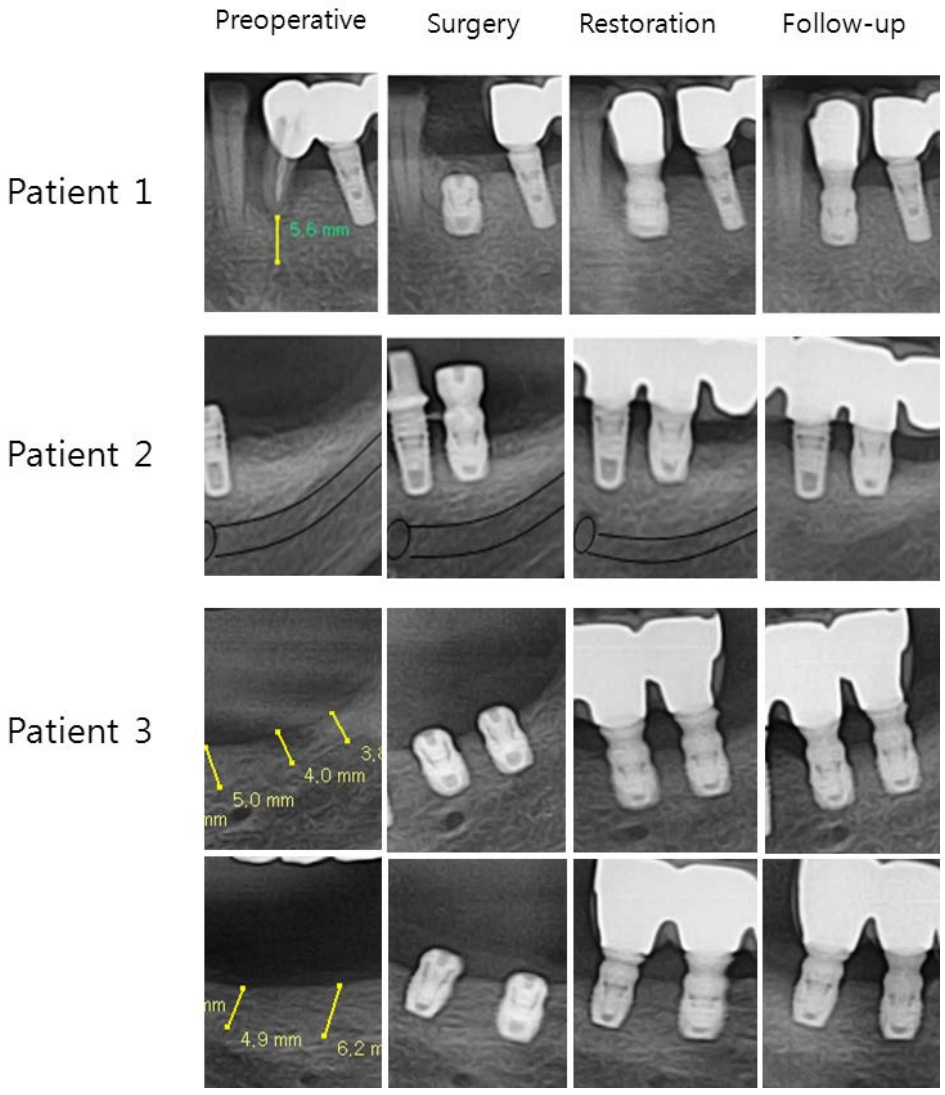

Figure 4 Panoramic X-ray of each patient at every visit during 1 year. At preoperative visit, postsurgery, restoration on 6 months after surgery, andthe last follow-up

bleeding on probing) were found during the follow-up period. These data result in a 100% survival rate of implant. In patient 1, the periimplant bone was maintained in the top of fixture, first switching platform. The others patients showed that the marginal bone level was maintained at the top of infrabony threads, second platform switching.

DISCUSSION

The present study was designed to retrospectively evaluate and compare the outcome, after a 1-year follow-up, of implants placed in regenerated bone using rhBMP-2 bone graft with that of short implants(with 4.0-mm intrabony length) placed in native bone. The study analyzed complications associated with both types of procedures, implant survival and success rates, and peri-implant marginal bone loss. With regard to complications related to the bone grafting procedure, one of the main problems is soft tissue management, given that it is necessary to perform tensionless wound closure in order to minimize the risk of dehiscence.[1] The treatment of prematurely exposed bone is complicated; resuturing the flap may lead to increased exposure of the graft. Von Arx and Buser[20]recommend the application of chlorhexidine solution or gel several times a day to reduce the bacterial load; when reepithelialization does not occur spontaneously, some research has reported the removal of theexposed bone with rotary instruments.[21] When comparing the use of short implants and augmentation procedures, most authors agree that augmentation procedures are related with higher morbidity.

Several studies report similar survival and success rates for implant treatment in sites with vertical bone defects involving either block bone grafts or short dental implants.[5,11,12]Esposito et al[11] found no statistically significant differences for implant and prosthesis failures 3 years after loading, comparing 6.3-mm-long implants and 10-mm or longer implants placed in regeneratedbone. However, in the same study, short implants lost an average of 1.24 mm of peri-implant bone compared with 1.76 mm in the long implant group, this being a statistically significant difference. Similar results were reported by Esposito et al[14] in another study comparing 5-mm-long implants and 10-mm or longer implants placed in grafted bone; at the 1-year postloading follow-up, patients with short implants had lost an average 1 mm of peri-implant bone, and patients with longer implants lost an average of 1.2mm; the difference in peri-implant bone loss between groups was statistically significant. In a recent randomized study, Feliceet al[1] compared short implants (7 mmlong) with 10-mm or longer implants placed in posterior mandibles augmented vertically using an organic bovine bone blocks. At loading, patients with short implants had lost an average of 0.58 mm of peri-implant bone versus 0.56 mm for patients with long implants,while 1 year after loading, patients in both groups hadlost an average of 1 mm.

In the present study, both procedures yielded 100 % survival rates and the minimal bone change under 0.5 mm. After a 1-year follow-up, implant survival and success rates and peri-implant bone loss were same with short implants placed in native bone and longerimplants placed in regenerated bone,

CONCLUSION

When residual bone height over the mandibular canal is between 6 and 8 mm, short implants (with 4.0-mm intrabony length) might be a preferable treatment option over vertical augmentation, reducing chair time, expense, and morbidity.

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