

The Stability of Implant Placement Simultaneous With Guided Bone Regeneration Between Two Ratios of Biphasic Calcium Phosphate in the Upper Anterior Area

Sirida ARUNJAROENSUK¹ DDS. MSc, Nikos MATTHEOS^{1,2} DDS. PhD, Atiphan PIMKHAOKHAM¹ DDS, PhD

¹ Department of Oral and Maxillofacial Surgery, Faculty Of Dentistry, Chulalongkorn University, Bangkok, Thailand

² Department of Dental Medicine, Karolinska Institute, Stockholm, Sweden



INTRODUCTION

The bone augmentation simultaneous with dental implant placement is required for obtain sufficient facial bone thickness to achieve not only pleasing esthetic but also desirable functional outcomes of dental implant. The maintenance of favorable outcomes is influenced by the stability of adequate augmented bone, especially in the anterior maxilla that have a strong effect on outcomes and patient satisfaction. BCP is a well-documented bone graft material with various ratios of HA/ β -TCP. BCP with high ratio of HA is recommended for bone augmentation. However, the clinical trials are still limiting.

OBJECTIVE

The aim of this randomized controlled clinical study was to compare the stability of the horizontal augmented bone of using Biphasic Calcium Phosphate (BCP) with hydroxyapatite (HA)/ β -tricalcium phosphate (β -TCP) between ratio of 60/40 and 70/30.

MATERIALS AND METHODS

The study protocol was approved by the Ethics Committee of the Faculty of Dentistry, Chulalongkorn University (HREC-DCU 2020-038) and Trial registration (TCTR20201109003). Patients seeking implant treatment at the Faculty of Dentistry, Chulalongkorn University from July 2020 to July 2021 were examined and invited to participate in the study. The enrolled 20 dental implants from patients requiring implant placement simultaneous with GBR in the upper anterior area were randomized to **BCP 70/30 ratio of HA/ β -TCP (n=10)** or **BCP 60/40 ratio of HA/ β -TCP (n=10)**. All dental implants used in this study were the Bone level Straumann implant. The GBR was simultaneously performed with synthetic bone graft either ratio of 60/40 or 70/30 in combination with collagen resorbable membrane. Cone-Beam Computed Tomographic was used to assess facial bone thickness post-implantation and 6 months later at implant platform and 2, 4, and 6 mm apical to it (*Figure 1a-c*). The percentage of facial bone thickness change was calculated and statistically analyzed between groups with Mann-Whitney U test (p-value <0.05)

The Stability of Implant Placement Simultaneous With Guided Bone Regeneration Between Two Ratios of Biphasic Calcium Phosphate in the Upper Anterior Area

Sirida ARUNJAROENSUK¹ DDS. MSc, Nikos MATTHEOS^{1,2} DDS. PhD, Atiphan PIMKHAOKHAM¹ DDS, PhD
¹ Department of Oral and Maxillofacial Surgery, Faculty Of Dentistry, Chulalongkorn University, Bangkok, Thailand
² Department of Dental Medicine, Karolinska Institute, Stockholm, Sweden



Figure1 a) Dental implant surgery, b) GBR simultaneously with synthetic bone graft either BCP ratio of 70/30 or 60/40, c) Measurement of facial bone thickness using CBCT images.

Levels of measurement	The change of facial bone thickness (%)		
	70/30 ratio Group	60/40 ratio Group	p-value
platform	-21.74 ± 11.51	-41.43 ± 12.01	.005*
2 mm apical	-10.06 ± 11.69	-32.66 ± 12.49	.003*
4 mm apical	-7.71 ± 7.16	-31.25 ± 11.64	.000*
6 mm apical	-6.69 ± 9.38	-29.32 ± 9.97	.000*

Table1 The percentage of facial bone thickness change immediate post-operative implant placement with GBR and 6 months later of both groups (mean ± standard deviation)
*Statistically significant difference was found between two groups at p-value<0.05

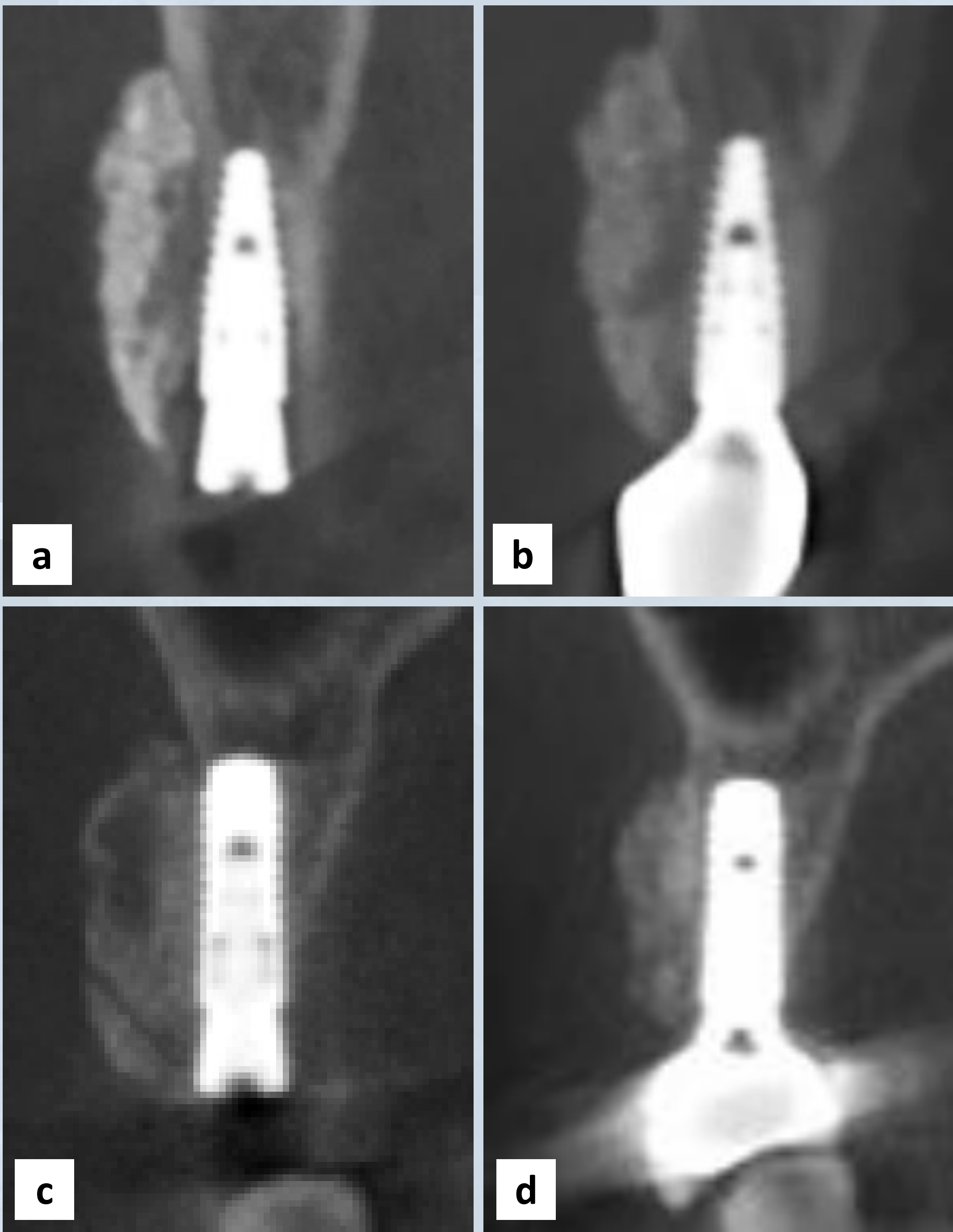


Figure2 Representative CBCT images: a) BCP 70/30 ratio at baseline, b) BCP 70/30 ratio at six months later, c) BCP 60/40 ratio at baseline, d) BCP 60/40 ratio at six months later.

RESULTS

All implants presented with detectable augmented facial bone in CBCT images at immediate post-operation and 6 months later (*Figure 2a-d*). No implant was lost throughout this study. The percentage of facial bone resorption was 21.74±11.51%, 10.06±11.69%, 7.71±7.16% and 6.69±9.38% in 70/30 BCP group, while 41.43±12.01 %, 32.66±12.49 %, 31.25±11.64 % and 29.32±9.97 % in 60/40 BCP group at the level of the implant platform and 2, 4, 6 mm apical, respectively (*Table1*). Statistically significant difference was found at 6 months at all levels of measurement (p-value<0.05).

The Stability of Implant Placement Simultaneous With Guided Bone Regeneration Between Two Ratios of Biphasic Calcium Phosphate in the Upper Anterior Area

Sirida ARUNJAROENSUK¹ DDS. MSc, Nikos MATTHEOS^{1,2} DDS. PhD, Atiphan PIMKHAOKHAM¹ DDS, PhD

¹ Department of Oral and Maxillofacial Surgery, Faculty Of Dentistry, Chulalongkorn University, Bangkok, Thailand

² Department of Dental Medicine, Karolinska Institute, Stockholm, Sweden



DISCUSSIONS

Bone augmentation in the anterior zone with GBR technique was performed to ensure volumetric stability of the regenerated mineralized tissue and thus proper long-term support of the peri-implant soft tissue. The biomaterial bone graft needs to counter the suppressing forces in the early phase of healing and maintain scaffold property of augmented bone during bone remodeling process¹⁻⁶. Thus, the augmented area can demonstrate significant early volumetric reduction in the time prior to mineralization. This study is the first clinical trial with the 70/30 ratio of BCP utilized for contour augmentation in conjunction with implant placement in the aesthetic zone. This study demonstrated that both BCP combinations maintained over 1.5 mm of facial bone thickness at all levels of measurement 6 months after the augmentation. Similar to the previous study⁷⁻⁹ that reported more favorable outcome in HA/ β -TCP ratio of 70/30.

CONCLUSIONS

The BCP bone grafts with HA/ β -TCP ratio of 60/40 and 70/30 were both effective for GBR simultaneously with implant placement and showed satisfied bone thickness. Remarkably, the 70/30 ratio was significantly superior outcome in maintaining the facial augmented bone.

ACKNOWLEDGEMENT

The 90th Anniversary of Chulalongkorn University Funding

REFERENCES

1. Caballé-Serrano J, Munar-Frau A, Ortiz-Puigpelat O, Soto-Penaloza D, Peñarrocha M, Hernández-Alfaro F. On the search of the ideal barrier membrane for guided bone regeneration. *J Clin Exp Dent*. 2018;10(5):e477-e483.
2. Mankani MH, Kuznetsov SA, Avila NA, Kingman A, Robey PG. Bone formation in transplants of human bone marrow stromal cells and hydroxyapatite-tricalcium phosphate: prediction with quantitative CT in mice. *Radiology*. 2004;230(2):369-376.
3. Herron S, Thordarson DB, Winet H, Luk A, Bao JY. Ingrowth of bone into absorbable bone cement: an in vivo microscopic evaluation. *Am J Orthop (Belle Mead NJ)*. 2003;32(12):581-584.
4. Mir-Mari J, Wui H, Jung RE, Hämmerle CHF, Benic GI. Influence of blinded wound closure on the volume stability of different GBR materials: an in vitro cone-beam computed tomographic examination. *Clinical Oral Implants Research*. 2016;27(2):258-265.
5. Sbricoli L, Guazzo R, Annunziata M, Gobbato L, Bressan E, Nastri L. Selection of Collagen Membranes for Bone Regeneration: A Literature Review. *Materials (Basel)*. 2020;13(3).
6. Kitayama S, Wong LO, Ma L, et al. Regeneration of rabbit calvarial defects using biphasic calcium phosphate and a strontium hydroxyapatite-containing collagen membrane. *Clin Oral Implants Res*. 2016;27(12):e206-e214.
7. Kim KH, Park JY, Park HS, et al. The Influences of Different Ratios of Biphasic Calcium Phosphate and Collagen Augmentation on Posterior Lumbar Spinal Fusion in Rat Model. *Yonsei Med J*. 2017;58(2):407-414.
8. La Monaca G, Iezzi G, Cristalli MP, Pranno N, Sfasciotti GL, Vozza I. Comparative Histological and Histomorphometric Results of Six Biomaterials Used in Two-Stage Maxillary Sinus Augmentation Model after 6-Month Healing. *Biomed Res Int*. 2018;2018:9430989.
9. Lim HC, Zhang ML, Lee JS, Jung UW, Choi SH. Effect of different hydroxyapatite: β -tricalcium phosphate ratios on the osteoconductivity of biphasic calcium phosphate in the rabbit sinus model. *Int Oral Maxillofac Implants*. 2015;30:65-72.