

# A 10-Year Cone Beam Computerized Tomography Observation of the Buccal Bony Wall of an Immediately Placed Implant at the Anterior Maxilla: A Case Report

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Since the introduction of immediate implant placements, the buccal bony wall has been a major consideration for success due to its correlation with soft tissue contour and color. This report presents the stability of the buccal wall thickness of an immediately placed implant at the anterior maxilla over 10 years. Although the width of the buccal wall decreased at the 2-year post-op follow-up, it remained stable afterward according to cone beam computerized tomography (CBCT) scans. Hence, this report suggests that ensuring adequate bony wall thickness with bone augmentation and fixture position may promise the longevity of the buccal bony wall and surrounding soft tissue in an immediate implant placement.

**Key Words:** *immediate implant, guided bone regeneration, cone beam computerized tomography, buccal bone plate*

## INTRODUCTION

Esthetic and prompt restoration of missing teeth has always been a demand from patients who lost a tooth in the esthetic zone. Therefore, it is no surprise that immediate implant placement for the maxillary anterior region has become a popular and requested procedure in dentistry.

Immediate implant placement has several benefits for restoring missing teeth in the anterior maxilla. The immediate placement can reduce the number of surgical interventions and overall treatment period, thus increasing patients' satisfaction. In addition, immediate provisionalization after the implant placement can help the gingival architecture maintain its optimal shape.<sup>1,2</sup> Moreover, the survival rate of this type of implant insertion does not show a large difference from implants placed into healed sites.<sup>3-5</sup> Nevertheless, there are still challenges for gaining adequate keratinized mucosa and a proper gingival tissue biotype around the dental implant. Moreover, it is difficult to predict the final gingival and bony

contours because of the profound changes caused by the remodeling process after tooth extraction.<sup>6</sup>

After the introduction of immediate implant placement as an acceptable procedure, many studies have been conducted to explore the key factors toward successful and maintainable restoration. The thickness of the buccal bony walls is considered one of the significant factors leading esthetic and sound implant restoration. Although there are still debates regarding the exact amount of the buccal wall thickness, at least 1–2 mm should be ensured to avoid vertical bone loss and subsequent inadequate gingival architecture.<sup>7,8</sup> The well-maintained buccal bony wall could lead to proper soft tissue contours around implants and, in turn, improve the esthetic result of dental implant restoration.<sup>9</sup> The long-term stability for early implant placement with a guided bone regeneration (GBR) in the anterior maxilla was reported in terms of the buccal bony wall and mucosal contour.<sup>10,11</sup> However, as for immediate implant placement with the same condition, a long-term evaluation is still required.

The purpose of this report is to present the long-term stability of the buccal bony wall thickness after immediate implant placement with GBR in the maxillary anterior region. A total of 10 years of follow-up was achieved and cone beam computerized tomography (CBCT) was taken to observe the changes in the buccal wall.

## CASE REPORT

A 20-year-old patient presenting a tooth fracture of the maxillary left central incisor was referred to the Department

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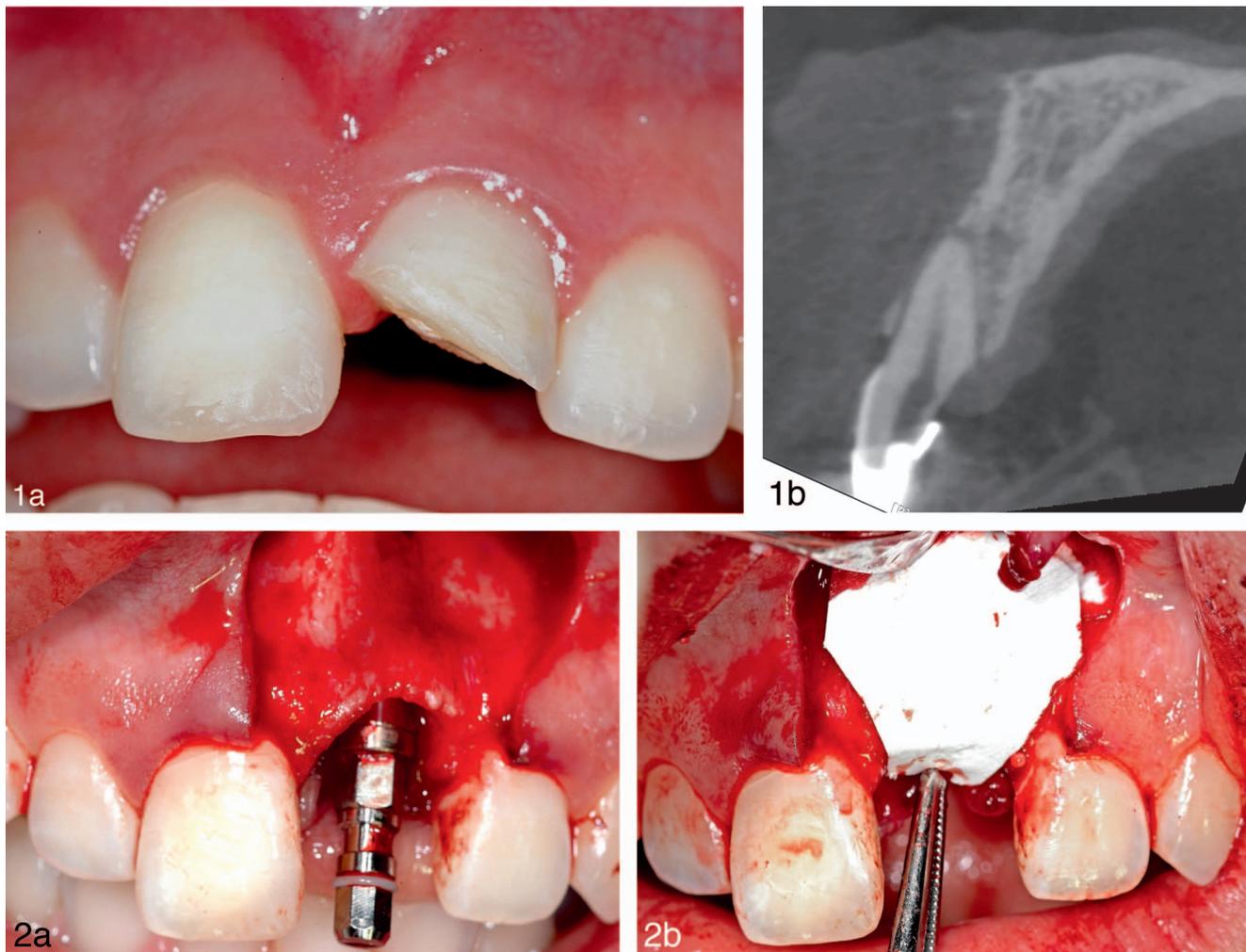
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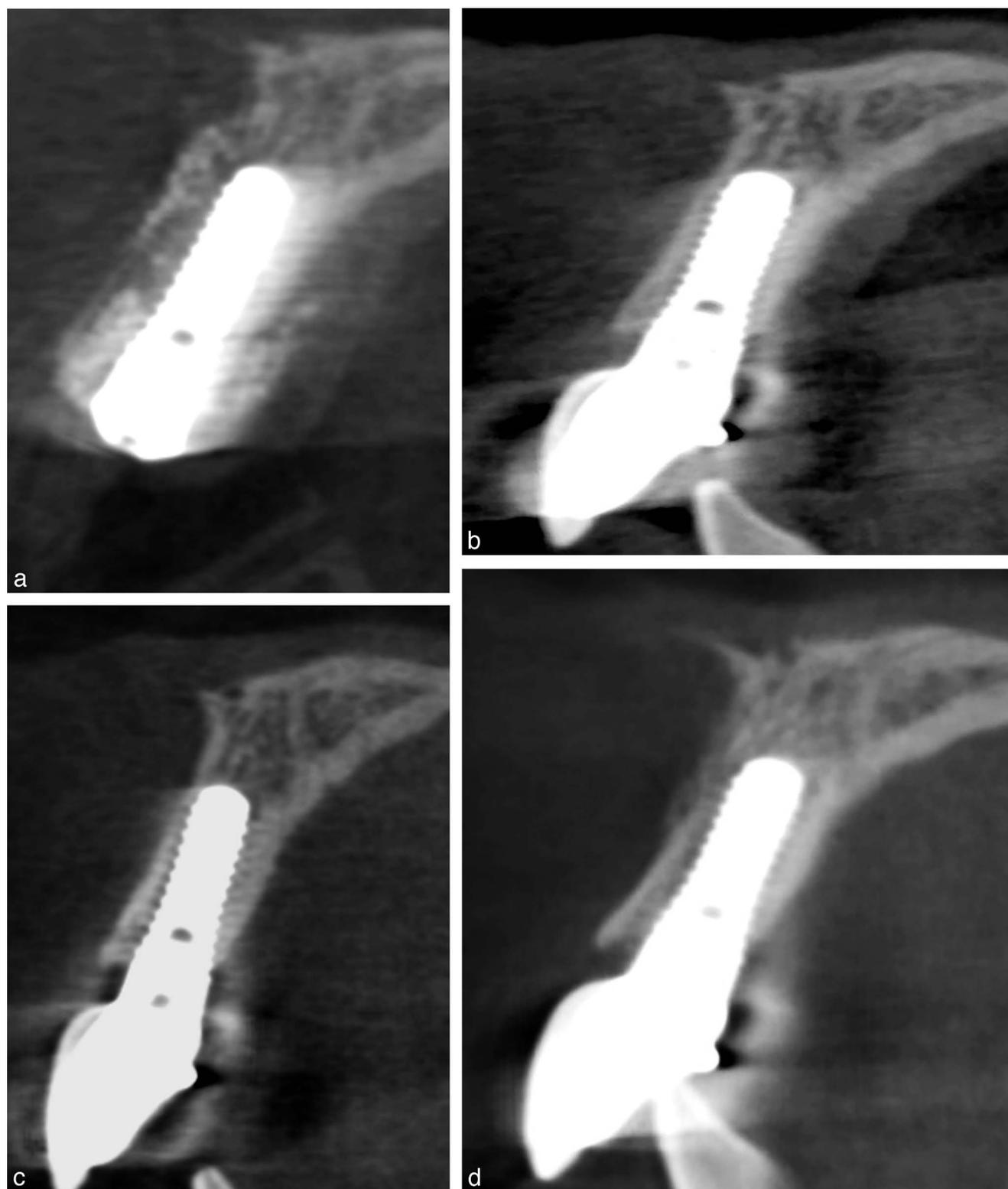
**FIGURES 1 AND 2.** **FIGURE 1.** (a) A clinical photograph showing a fracture of the left central incisor. (b) A cone beam computerized tomography image showing a thin buccal plate and the lingual margin of the fracture extended to the palatal bone crest. **FIGURE 2.** (a) Vertical positioning of the implant fixture (Straumann tapered effect). The fixture platform was placed 2 mm apical to the adjacent teeth. (b) Application of a guided bone regeneration procedure with a resorbable collagen barrier membrane and an alloplastic  $\beta$ -tricalcium phosphate.

of Oral and Maxillofacial Surgery at Kyung Hee University Dental Hospital for further evaluation. After a clinical and radiographic examination, a root fracture was diagnosed in the tooth with unfavorable prognosis of dental crown restoration and thereby tooth extraction was planned. (Figure 1a and b).

Tooth extraction was then performed without any damage to the 4 walls of the extraction socket. However, a perforation at the root apex area occurred on the buccal plate due to the thin bony wall so that the buccal flap was elevated for coverage. The buccolingual position of the implant fixture was determined as 2 mm palatal to an imaginary line connecting the buccal surfaces of the adjacent teeth from an axial view. The fixture platform was placed 2 mm apical to the gingival margin of the central incisor of contralateral side (Figure 2a). Following the fixture insertion ( $\varnothing$  3.5/4.8, 12 mm, Straumann tapered effect, Straumann AG, Basel, Switzerland), a GBR procedure was conducted with a  $\beta$ -tricalcium phosphate material (Cerasorb, Kleinostheim, Germany) and a resorbable collagen barrier membrane (Bio-Gide, Geistlich AG, Wolhusen,

Switzerland; Figure 2b). The bone substitute was placed inside the socket between the implant fixture and the inner surface of the buccal wall. The bone graft was also conducted on the outer surface of buccal wall due to its thinness. The smooth surface of the implant fixture was covered by the graft material and overcontouring was attempted with the intent of compensating for a possible future resorption.

CBCT images were taken at immediate post-operation and then 2 years, 4 years, and 10 years after the procedure (Figure 3a through d). The measurements were done at the junction of the smooth transmucosal part and sand-blasted, large grit, acid-etched (SLA) surface (coronal), middle 1/3 area and the apex. The initial postoperative width, in a sagittal-sectional view, was measured as 3.1 mm at the junction of the transmucosal part and SLA surface (Table 1). The sequential change of the buccal bony wall is described in Table 1. Up to 2 years postoperative, a major resorption was noted (38% at the coronal part, 38% at the middle 1/3, and 53% at the apex). Afterward, the dimension of the buccal bony wall remained stable.



**FIGURE 3.** Change of the buccal bony wall showing a stabilized width after 2 years post-op. (a) Immediate post-op. (b) 2 years post-op. (c) 4 years post-op. (d) 10 years post-op.

The implant was subjected to a standard loading protocol. A screw-retained interim crown was delivered 3 months after the implant placement. After 2 months use of the interim crown, a screw-retained porcelain fused to metal

crown was delivered. A clinical photograph of the final prosthesis taken at the 10-year follow-up revealed that the peri-implant gingival contour was also well maintained (Figure 4a through c).



**FIGURE 4.** A clinical photograph with final prosthesis. (a) 4 years post-op. (b) 10 years post-op. (c) A well-maintained buccal prominence of the alveolar bone at the implant area.

### DISCUSSION

Although immediate placement has been widely accepted, the long-term effects of immediately placed implants in an esthetically demanding area still require more investigation. Esthetic and functional outcomes of the immediate implant treatment, with long-term survival, can be obtained by cautious and properly planned procedures.<sup>1,4,12</sup> Moreover, accurate diagnosis and case selection are essential to achieve this goal.<sup>13</sup> However, due to the nature of the thin buccal walls of the extraction sockets in the anterior maxilla, ensuring that there is an adequate buccal bony wall in the area has always been a challenge to surgeons. Although a bone graft procedure cannot completely prevent dimensional alterations of the alveolar ridge, some authors found that the vertical and horizontal resorption could be reduced with a bone-graft substitute.<sup>14–16</sup> Furthermore, several tactics for the preservation of the buccal bony wall has been suggested.<sup>17–19</sup>

In this report, the procedure for immediate implant placement was conducted as planned and therefore a favorable result was obtained as demonstrated by the initial post-operation images. The buccal bony wall width was measured at 3.1 mm by a CBCT evaluation. Nonetheless, the buccal bony wall of the inserted implant should be evaluated to confirm long-term maintenance because, unlike the initial post-operation images, it often results in a great amount of resorption. Two years after the operation, the width of the buccal wall decreased by about 1.18 mm, which is 38% of the initial thickness. At the 2-year follow-up point, the thickness of the buccal bone was stabilized based on the CBCT images. The peri-implant gingival architecture was also adequate even 10 years after the operation.

The possible reason for the great amount of initial resorption is speculated to be the use of a  $\beta$ -tricalcium phosphate ( $\beta$ -TCP) bone substitute, which is known to resorb relatively faster than other bone substitutes.<sup>20</sup> Several studies described that the application of demineralized bovine bone material (DBBM) can be more beneficial for GBR than alloplastic materials including  $\beta$ -TCP in osteoconduction and prevention of alveolar bone resorption, due to their slow resorption and the subsequent space maintenance property.<sup>21,22</sup> Given the 38% decrease in the buccal wall thickness, the choice of biomaterial can be crucial as one of the determinants for long-term success. However, in the study conducted by Roe et al, the mean horizontal buccal bone thickness reduction was 1.23 mm, following a single immediate implant placement at the anterior

maxilla with xenograft material, which is similar to the amount of resorption found in this study.<sup>23</sup> Therefore, more studies are required to determine the factors.

The flapless approach was not chosen in this case due to a perforation at the root apex area. The flap was elevated to augment the outer surface of the buccal bone. However, since there are several studies reporting that the flapless approach causes less dimensional changes of the buccal bone plate,<sup>24,25</sup> the initial bone loss would have been less if the flapless approach had been possible.

Ever since the immediate implant placement procedure was developed, the maintenance of the buccal bony wall has always been a major concern for surgeons. Moreover, because the loss of adequate buccal wall thickness leads to an inappropriate peri-implant gingival contour and color, it is eventually connected to the patient's satisfaction. Although several studies have examined the anterior buccal bone changes within 1 year after immediate implant placement,<sup>15,23,26</sup> a long-term observation of the buccal bone has yet to be conducted. Due to the limitations of a single case report, the results we obtained are not necessarily generalizable to any clinical situation. However, the augmented buccal wall was maintained and remained stable over the long term despite the fact that an immediate implant placement was performed in an extraction socket with a thin buccal wall. Therefore, we determined that an immediate implantation with GBR in the esthetic zone can be a reliable technique with long-term results when it is positioned properly and the buccal bony wall is safeguarded. Yet, a cohort study with long-term CBCT observation would be essential to confirm this result.

### CONCLUSION

After 10 years of CBCT observation, this report demonstrates that the long-term stability of the anterior buccal bony wall in

TABLE 1

The width of the buccal bony wall measured from the cone beam computerized tomography images				
Width (mm)	Initial	2 y	4 y	10 y
Coronal	3.1	1.92	1.88	1.9
Middle 1/3	2.8	1.7	1.61	1.62
Apex	2.6	1.2	1.2	1.1

immediate implant placement can be ensured by bone augmentation procedures and proper positioning of the implant fixture at the anterior maxilla. However, due to the limitations associated with the use of only 1 case report, further investigations are required to confirm it.

#### ABBREVIATIONS

$\beta$ -TCP:  $\beta$ -tricalcium phosphate  
 CBCT: cone beam computerized tomography  
 DBBM: demineralized bovine bone material  
 GBR: guided bone regeneration  
 SLA: sand-blasted, large grit, acid etched

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#### NOTE

The authors have no conflicts of interest to declare.

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