



A tooth-supported titanium mesh bending and positioning module for alveolar bone augmentation and improving accuracy

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Introduction

Guided bone regeneration with titanium mesh is a commonly used bone augmentation technique. This article presented three cases, which describe a tooth-supported titanium mesh bending and positioning module aiming to improve the precision of bone augmentation.

Methods

After designing the ideal bone increment volume digitally, print out the difference bone module between the ideal and existing bone mass and one or two wings. The wings are supported by the adjacent teeth to show the ideal bone mass in the patients' mouth. Finally, the titanium mesh is bent and installed in the ideal position by the module.

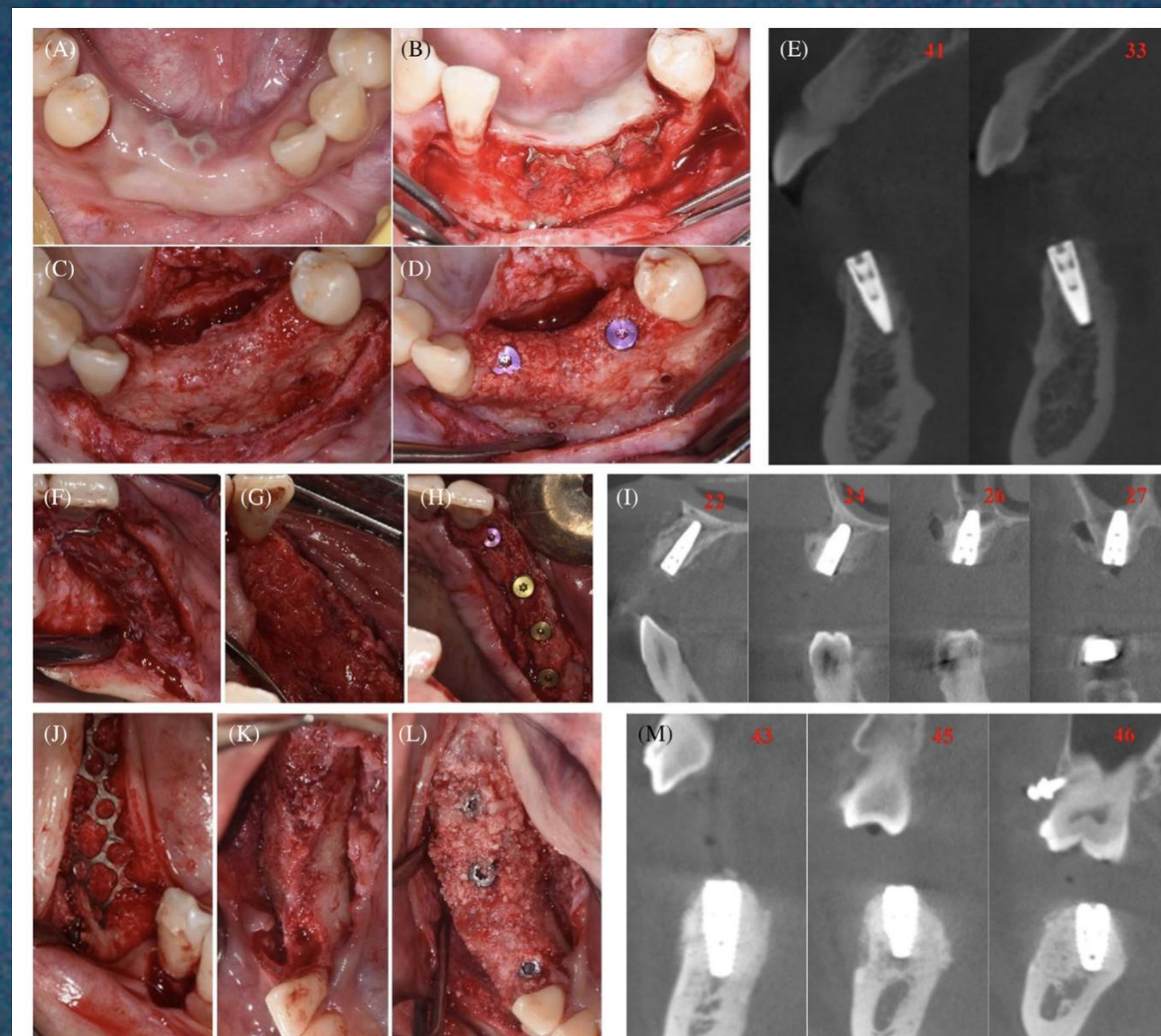


FIGURE 8 Implantation record in 6 months after operation. (A) Preoperative records of Case 1. (B) Exposed titanium mesh of Case 1. (C) Remove the titanium mesh of Case 1. (D) Implantation of Case 1. (E) CBCT image after implantation of Case 1. (F) Exposed titanium mesh of Case 2. (G) Remove the titanium mesh of Case 2. (H) Implantation of Case 2. (I) CBCT image after implantation of Case 2. (J) Exposed titanium mesh of Case 3. (K) Remove the titanium mesh of Case 3. (L) Implantation of Case 3. (M) CBCT image after implantation of Case 3.

Results

A total of 3 cases were accepted GBR operation with titanium mesh, including 1 maxillary and 2 mandibular. No complication, such as titanium mesh exposure and infection, occurred in all cases. The quality of regenerated alveolar bone was satisfactory, and supported subsequent implantation (Figure 8). Compared to ideal alveolar shape, the average vertical bone defect was 3.76 mm, and the average horizontal bone defect was 7.00 mm. Compared to preoperative alveolar models, the average vertical bone gain was 4.16 mm and the average horizontal gain was 7.48 mm after six months (Table 1). The maximum deviation between the contours of design model and postoperative model was 1.5mm. The mean contour deviation was 0.6mm. All results were described by descriptive statistical analysis using SPSS 22.0 (IBM, Armonk, New York). In our cases, the largest titanium mesh placement deviation is 1.1mm, which is much smaller than 3.4 mm in other studies. Six months after operation, the average vertical bone gain was 2.4 mm and the average horizontal bone gain was 3.2 mm, which is similar to the results reported in other studies. It proves that our method was feasible and could obtain a relatively stable bone increment effect.

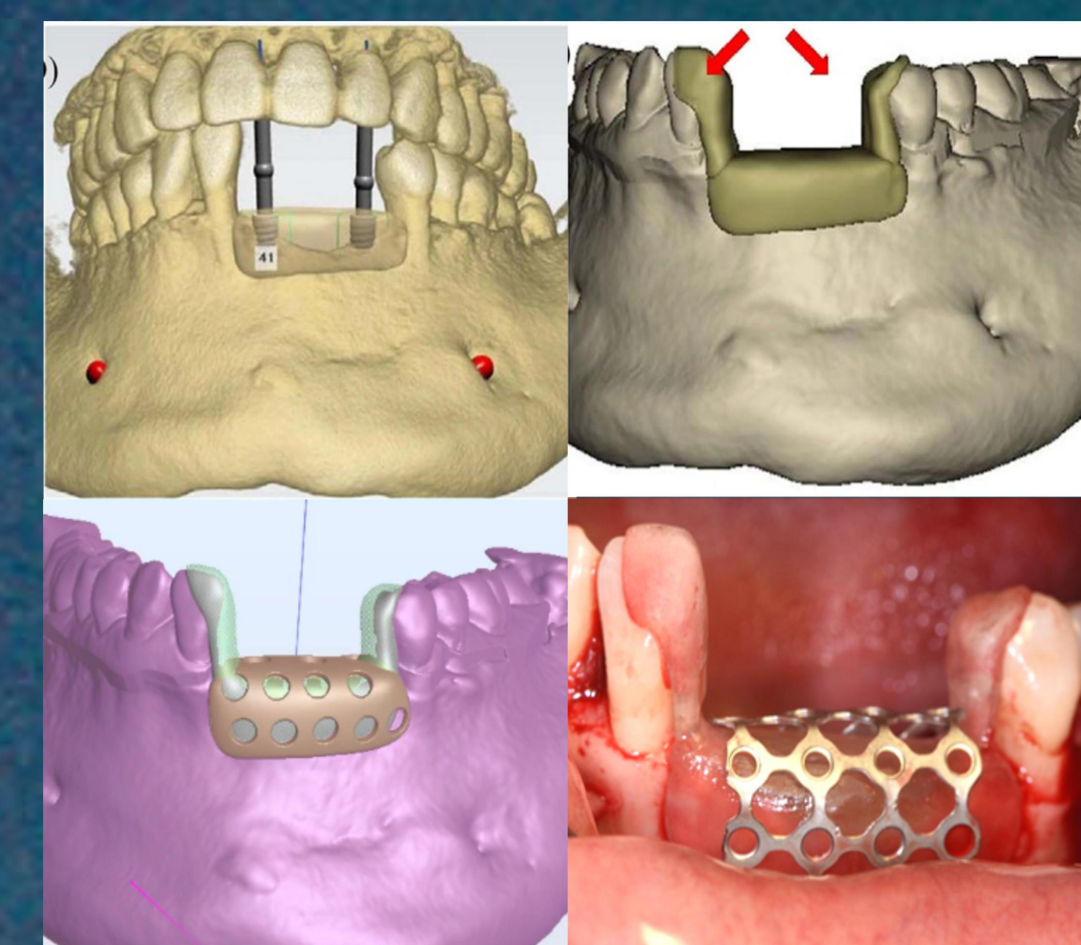


FIGURE 6 Schematic diagram of measurement of the vertical and horizontal bone gain. Measure the vertical bone gain (H1, H2) at the outermost point of the buccal and lingual side of the implant, and measure the horizontal bone gain (W1, W2, W3) at the peak and 2 and 4 mm below the implant.

TABLE 1 Bone gained of virtual design, post-guided bone regeneration (GBR) and before implant models

	Virtual design (Mean $\pm$ SD)			Post-GBR (Mean $\pm$ SD)			Before Implant (Mean $\pm$ SD)		
	Gained bone volume (mm ³)	Vertical bone gain (mm)	Horizontal bone gain (mm)	Gained bone volume (mm ³)	Vertical bone gain (mm)	Horizontal bone gain (mm)	Gained bone volume (mm ³)	Vertical bone gain (mm)	Horizontal bone gain (mm)
Case 1	437.46	3.11 $\pm$ 0.19	4.84 $\pm$ 2.66	441.61	3.07 $\pm$ 0.22	4.85 $\pm$ 2.69	422.8	2.66 $\pm$ 0.18	4.49 $\pm$ 2.20
Case 2	1557.54	5.21 $\pm$ 1.58	8.65 $\pm$ 3.29	1534.51	5.11 $\pm$ 1.86	8.94 $\pm$ 3.47	1427.26	4.38 $\pm$ 1.54	8.31 $\pm$ 2.28
Case 3	1441.72	5.02 $\pm$ 1.33	8.77 $\pm$ 3.98	1452.23	5.04 $\pm$ 1.46	9.02 $\pm$ 3.33	1396.78	4.63 $\pm$ 1.14	7.93 $\pm$ 3.15
Total	1145.57	4.76 $\pm$ 1.49	8.00 $\pm$ 3.69	1142.78	4.71 $\pm$ 1.64	8.23 $\pm$ 3.58	1082.28	4.16 $\pm$ 1.38	7.48 $\pm$ 2.92

Conclusion

We designed the ideal bone graft volume through the three-dimensional image of the patient's jaws, and made a customized bending and positioning module of the titanium mesh supported by teeth to ensure that the titanium mesh will be accurately bent and installed at the designed position before surgery. This limited study confirmed the effectiveness of the module, which can be used for large-scale vertical or horizontal bone increment.