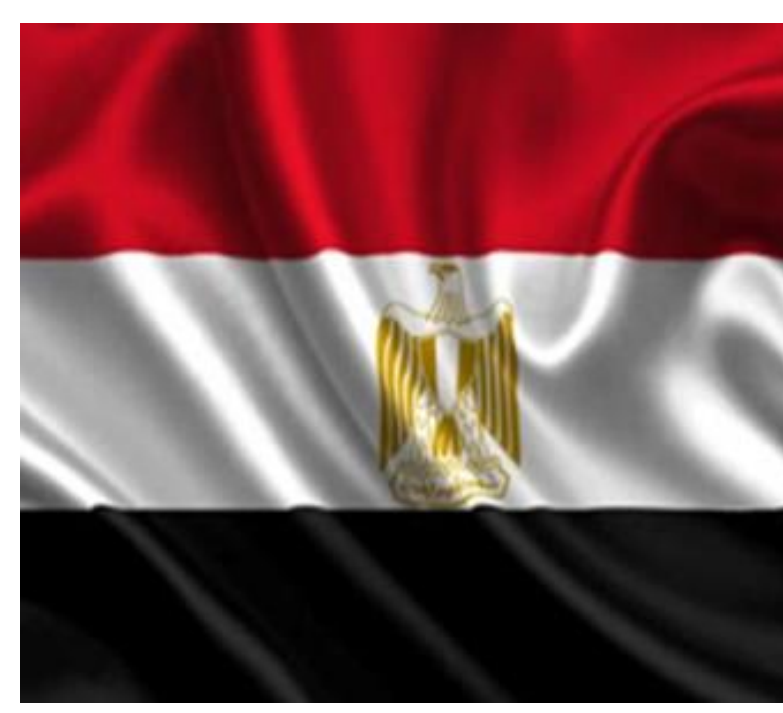
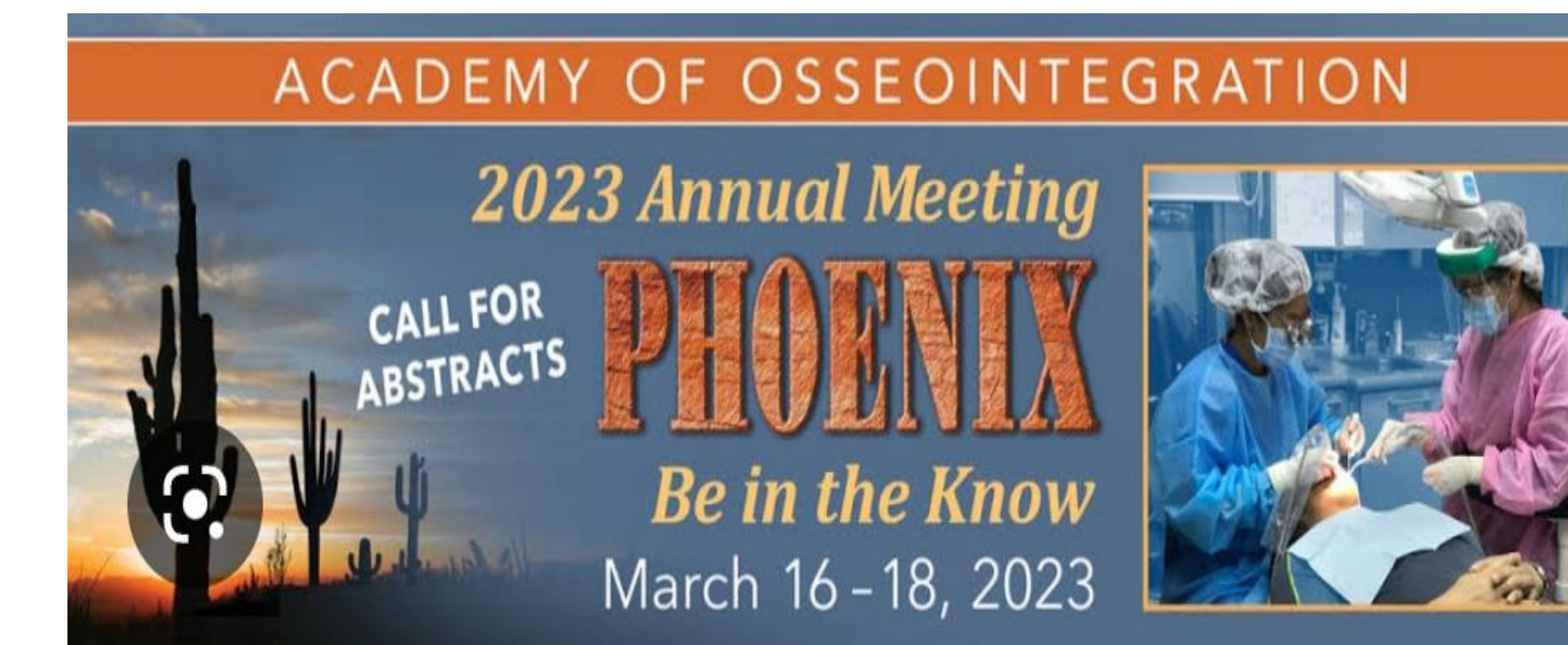




Cortical Shell Technique For Horizontal Augmentation Of The Deficient Anterior Mandible Using Two Patient Specific Interlocking Surgical Guides (PSIGs): A Novel Full Digital Protocol For Shell Harvesting And Positioning.



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Introduction: cortical shell technique usually requires specific surgical skills, prolonged intraoperative time .and associated with some technical drawbacks specially at the long span cases Such as lack of anatomical guidance during cortical shell fixation leading to an improperly positioned tilted or rotated autogenous shell, or even leaving an undesired distance between the shell and the deficient ridge .the aim of this study is to fully digitalize such technique using 2 patient specific interlocking stackable surgical guides to allow for accurate graft harvesting and positioning.



Figures 1: severely atrophied anterior mandible with deciduous non restorable teeth fig 2: after teeth extraction

- Methods:** 10 patients with deficient anterior mandible were included in this study where 5 patients received free hand harvesting and fixation of cortical shells from the symphysis (control group) while the other 5 patients received the same protocol using 2 patient specific interlocking guides (psig) the first guide used for safe and accurate shell harvesting with the proposed dimensions while the second guide used for shell fixation leaving the desired gap with the recipient site that was filled with a particulate mix of xeno and auto grafts 1:1. The harvested shell was fixed to the second guide outside the patients mouth using micro screws And this fixation guide was finally secured to its final position using two interlocking wings to lock into the first guide at the surgical site as a verification step for the accuracy of the whole procedure. Finally, the 2 guides were removed after shell fixation to the recipient site in a through and through manner at the proposed planed position.

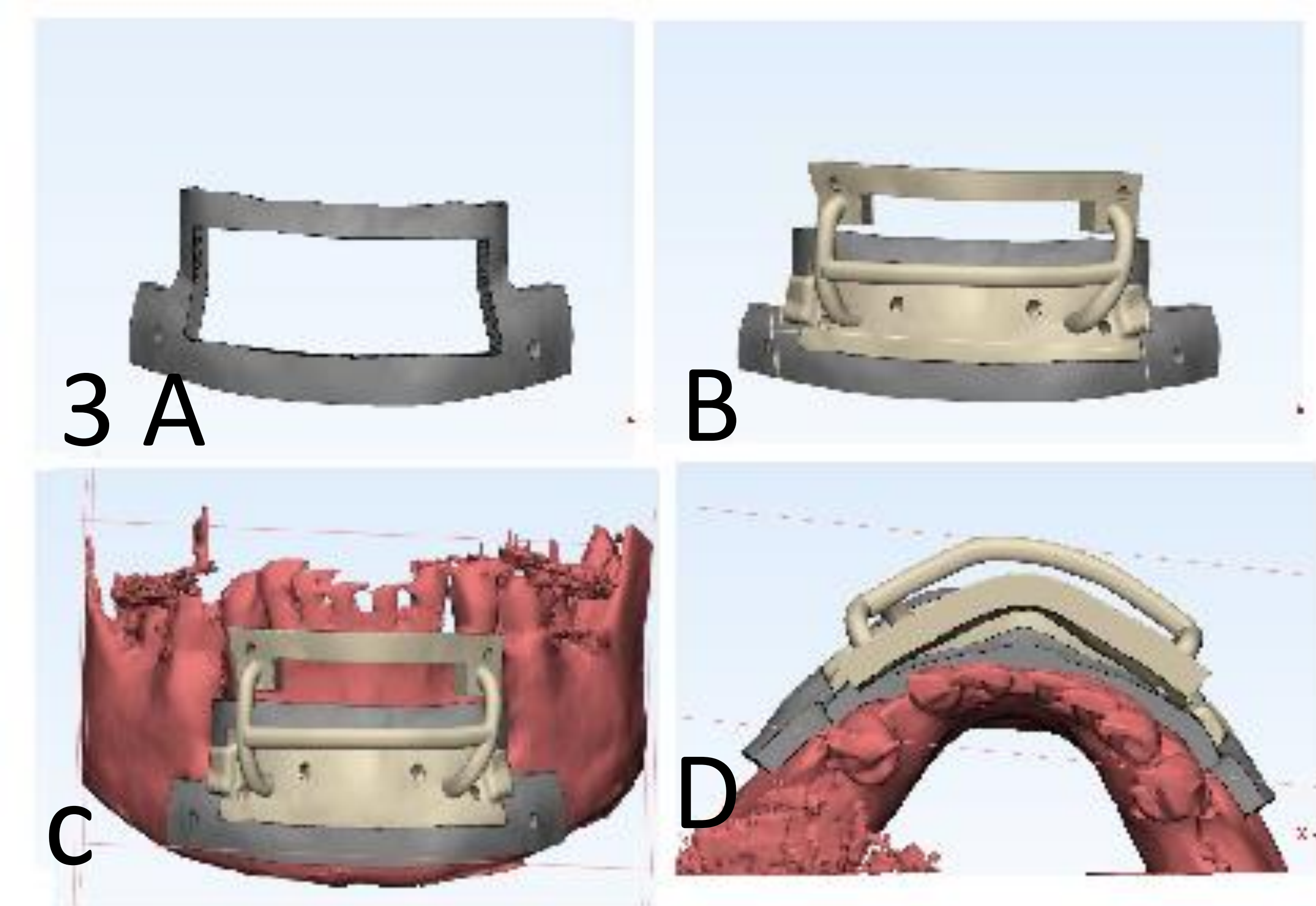


Fig 3 **CASE 1** : (A,B) virtual 3D design of the patient specific stackable harvesting and positioning Guides . (C,D) Guides in position virtually



Fig 4 **CASE 1** : preoperative cross sectional views

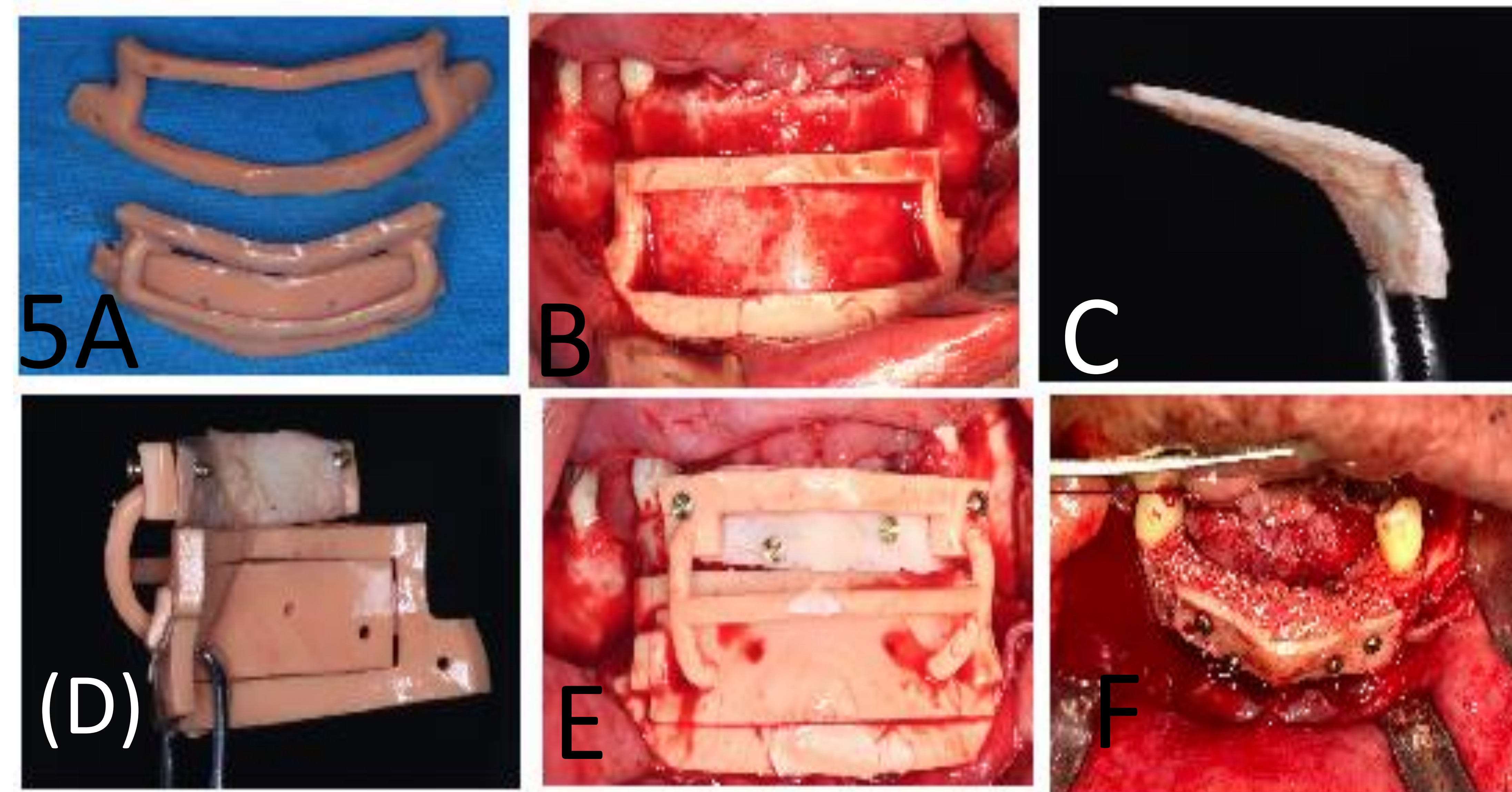


Fig 5: **CASE 1** (A,B) full thickness flap reflection and fixation of the patient specific harvesting Guide in place . (C) Harvested cortical shell. (D,E) shell fixed to the positioning guide with mini screws and interlocked with the harvesting guide then fixation of the shell into the defective site with screws . (F) removal of both guides and application of particulate bone graft at the interpositional gap.

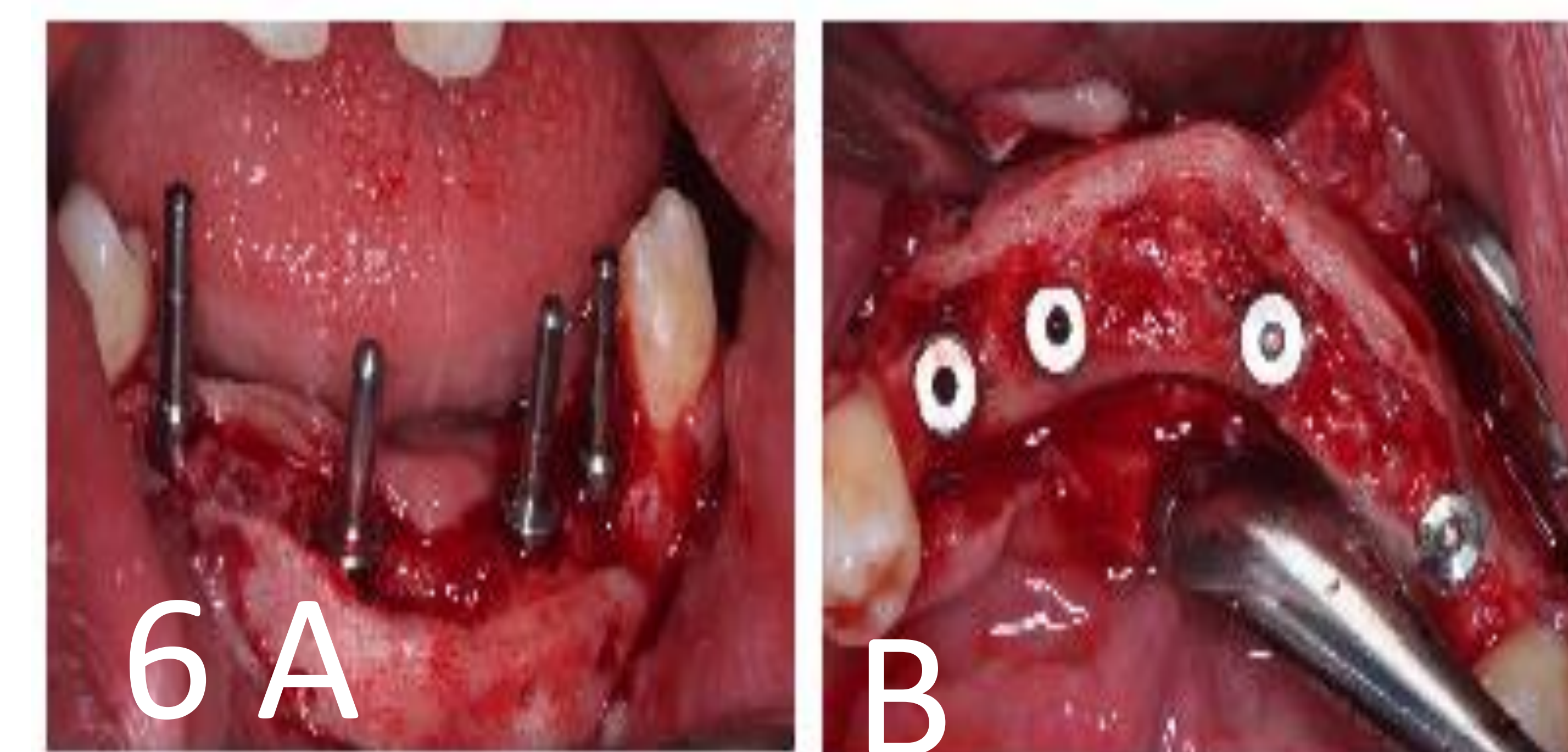


Fig 6 **CASE 1** : second stage surgery with 4 dental implant placement with excellent bone contour

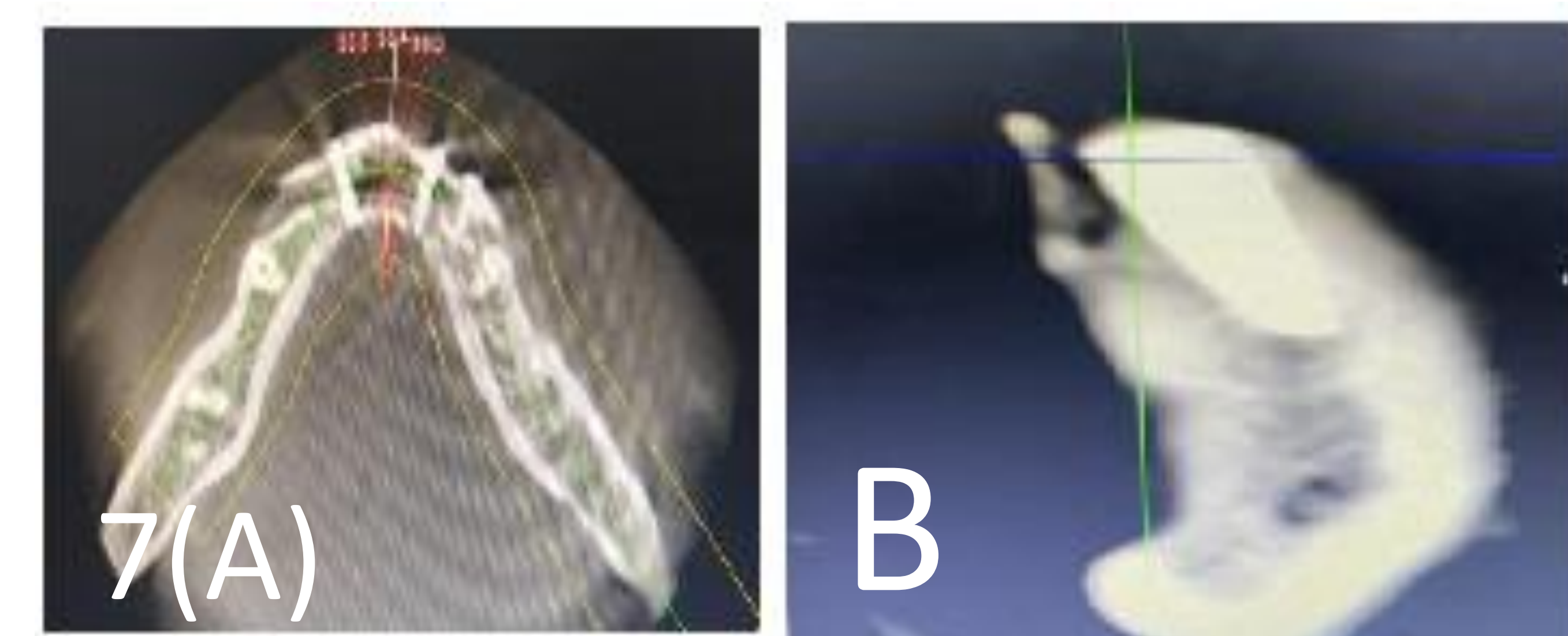


Fig 7 **CASE 1 postoperative** : axial and cross sectional postoperative cuts.

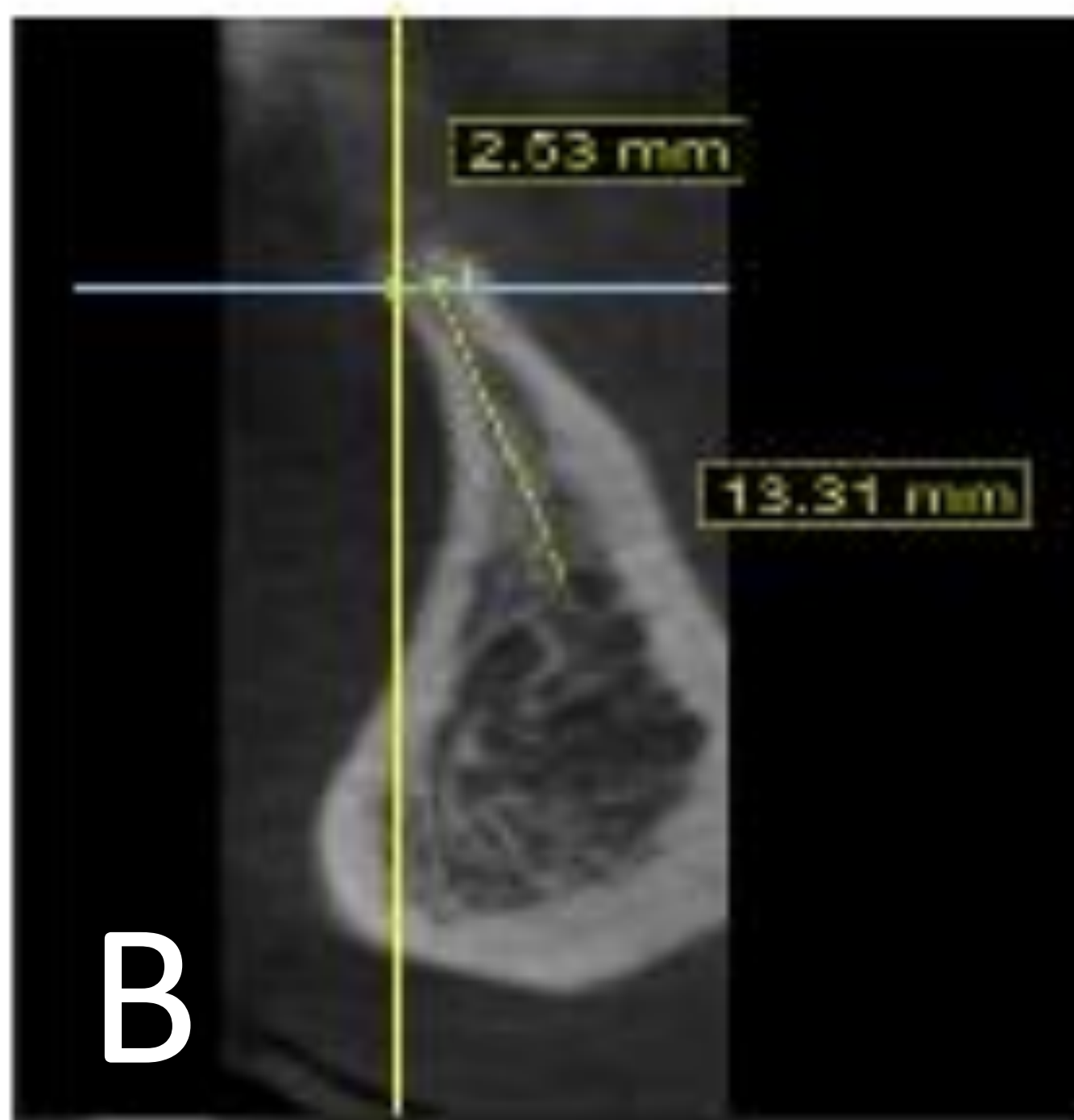
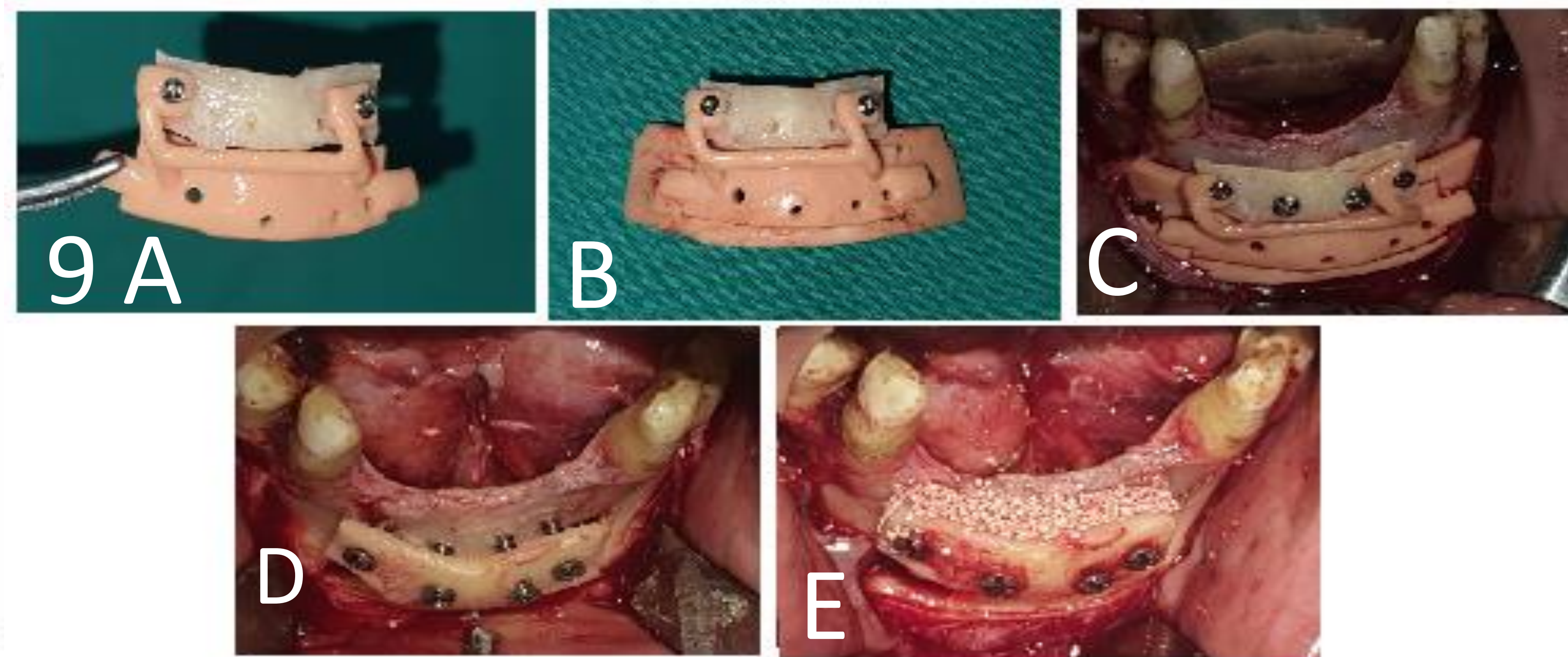
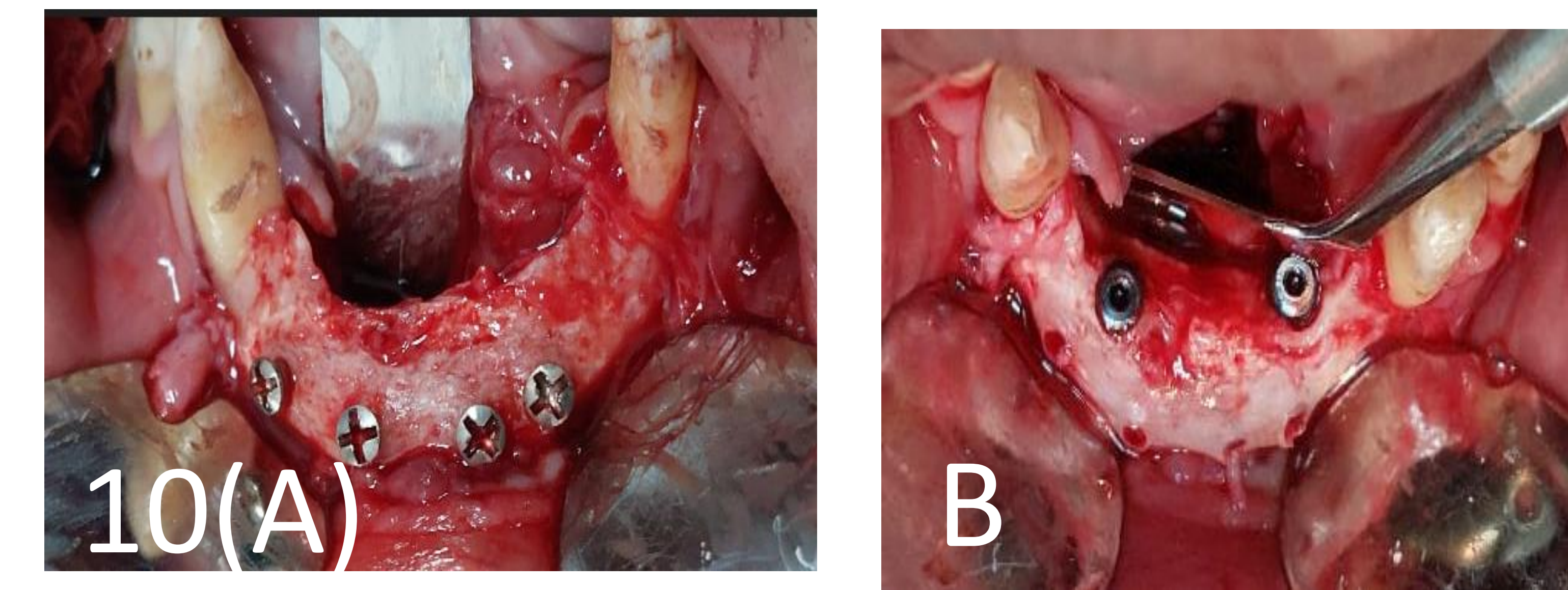


Fig 8 **CASE 2** (A,B)) virtual 3D design of the patient specific interlocking guides , preop. Cross sectional cut

Fig 9 **CASE 2** (A,b,c) harvested shell fixed to the positioning guide and both were interlocked with the harvesting guide intraoperatively, (D,E) shell in place at the proposed distance with interpositional particulate auto and xeno graft

Fig 10 (A) **CASE 2**: second stage surgery 4 months postoperatively with excellent bone contour and 2 dental implants in place

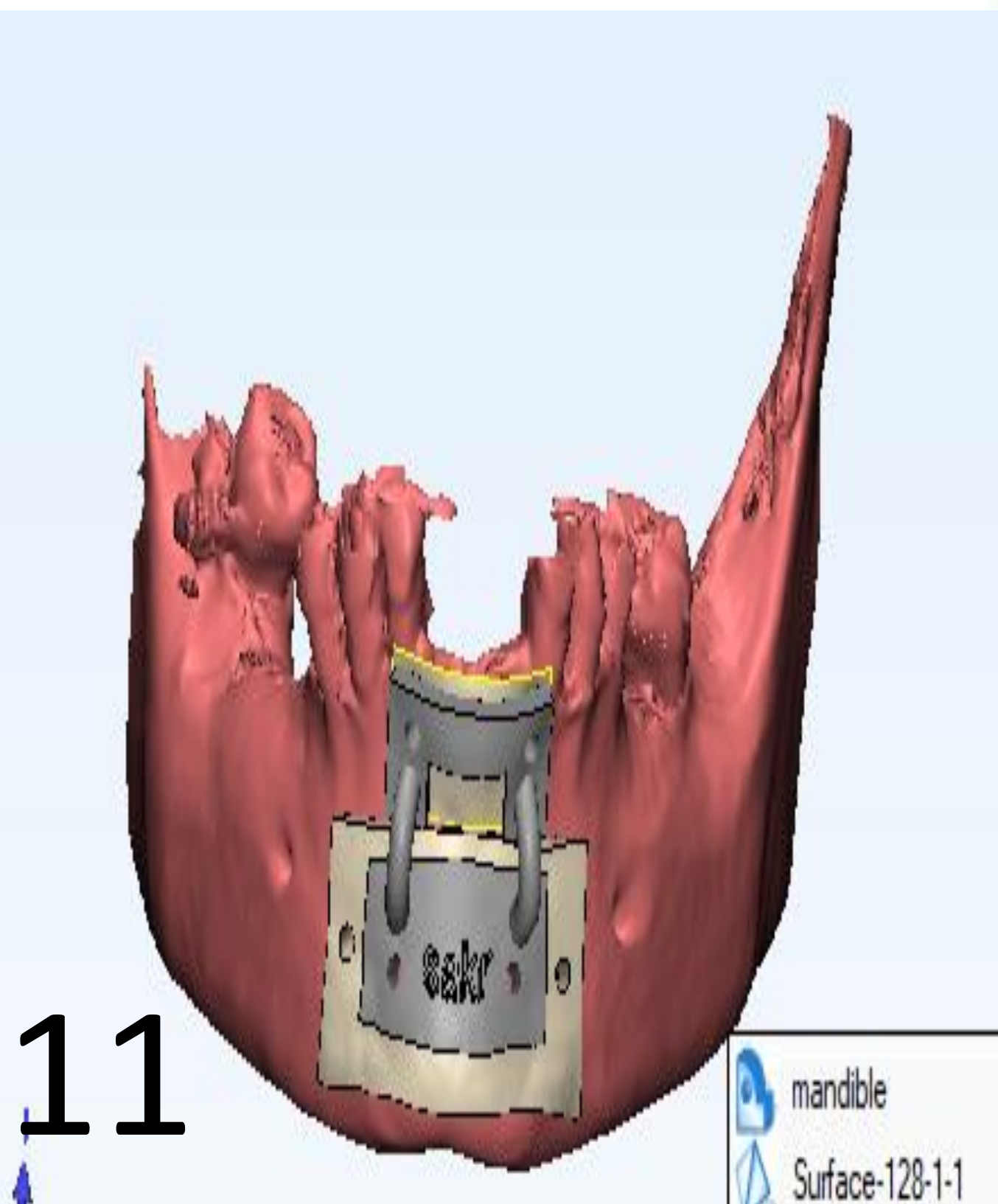
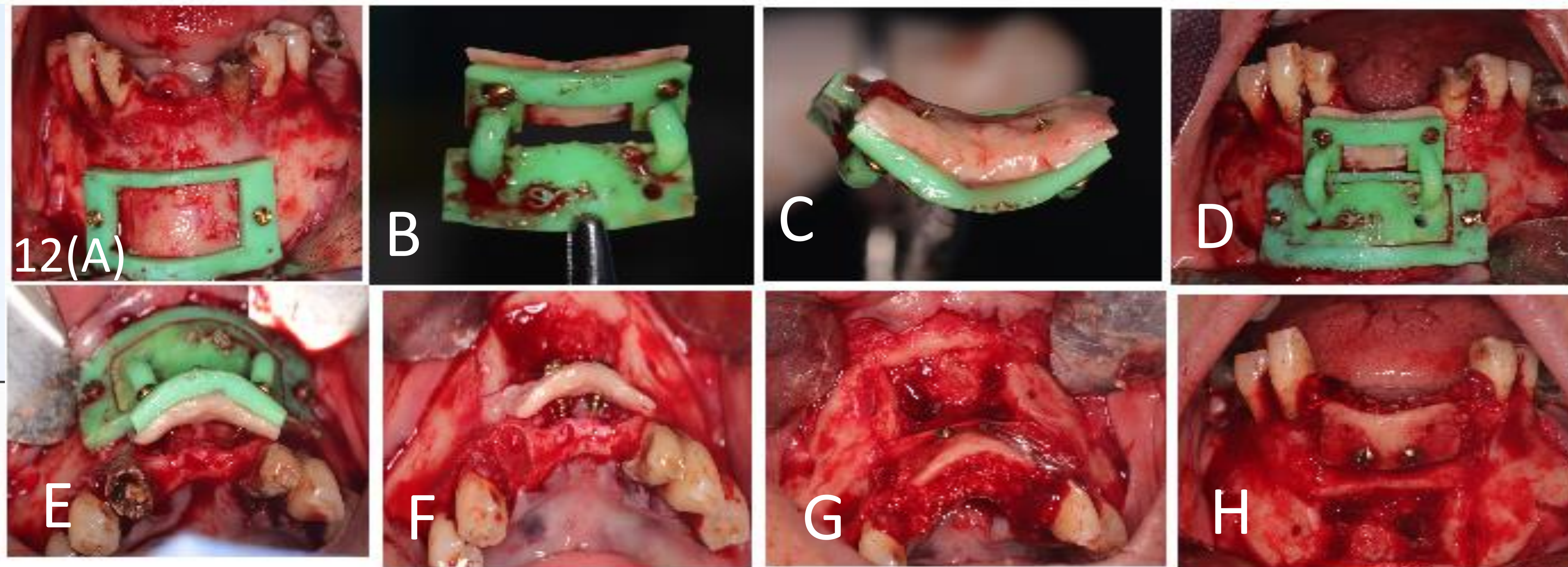
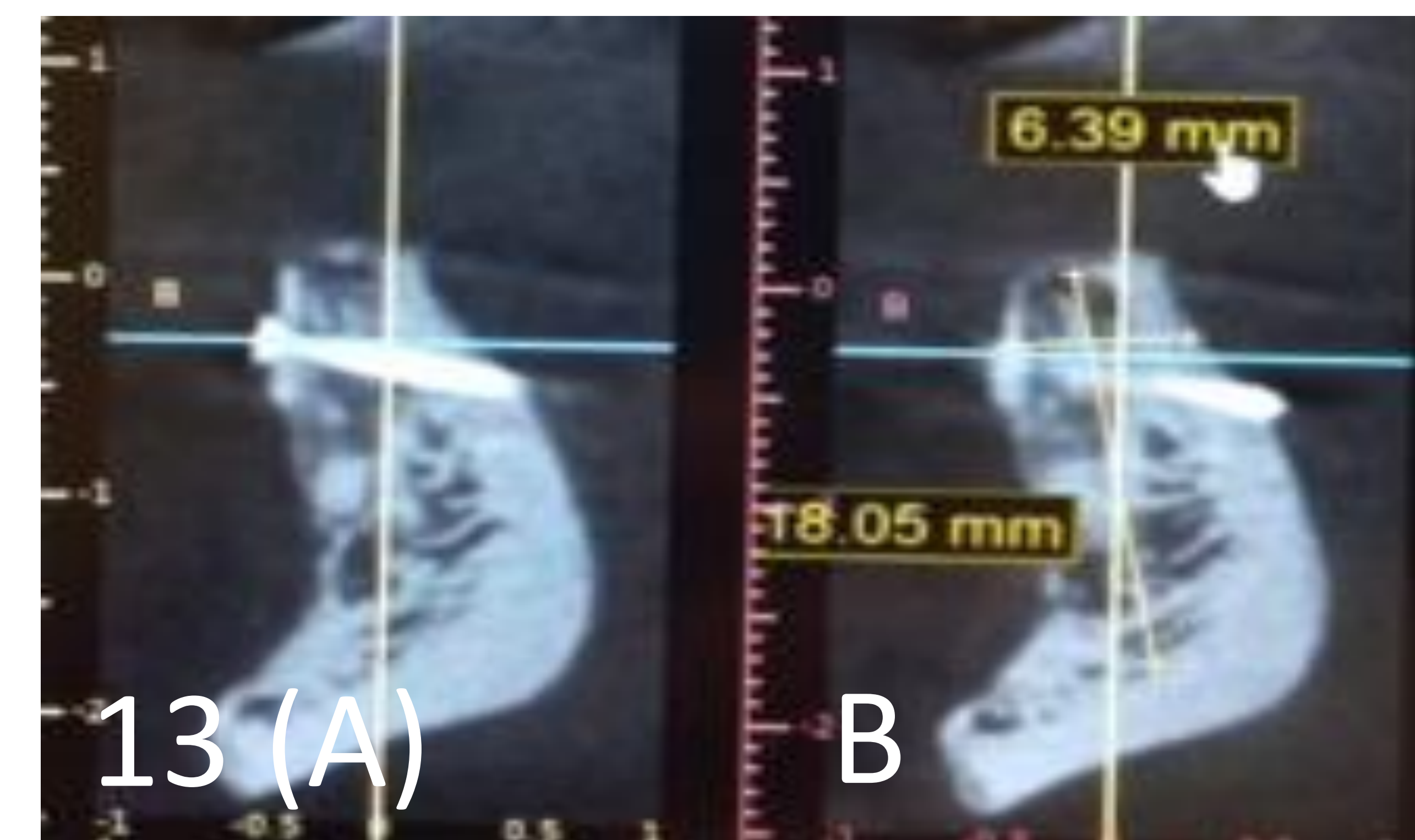
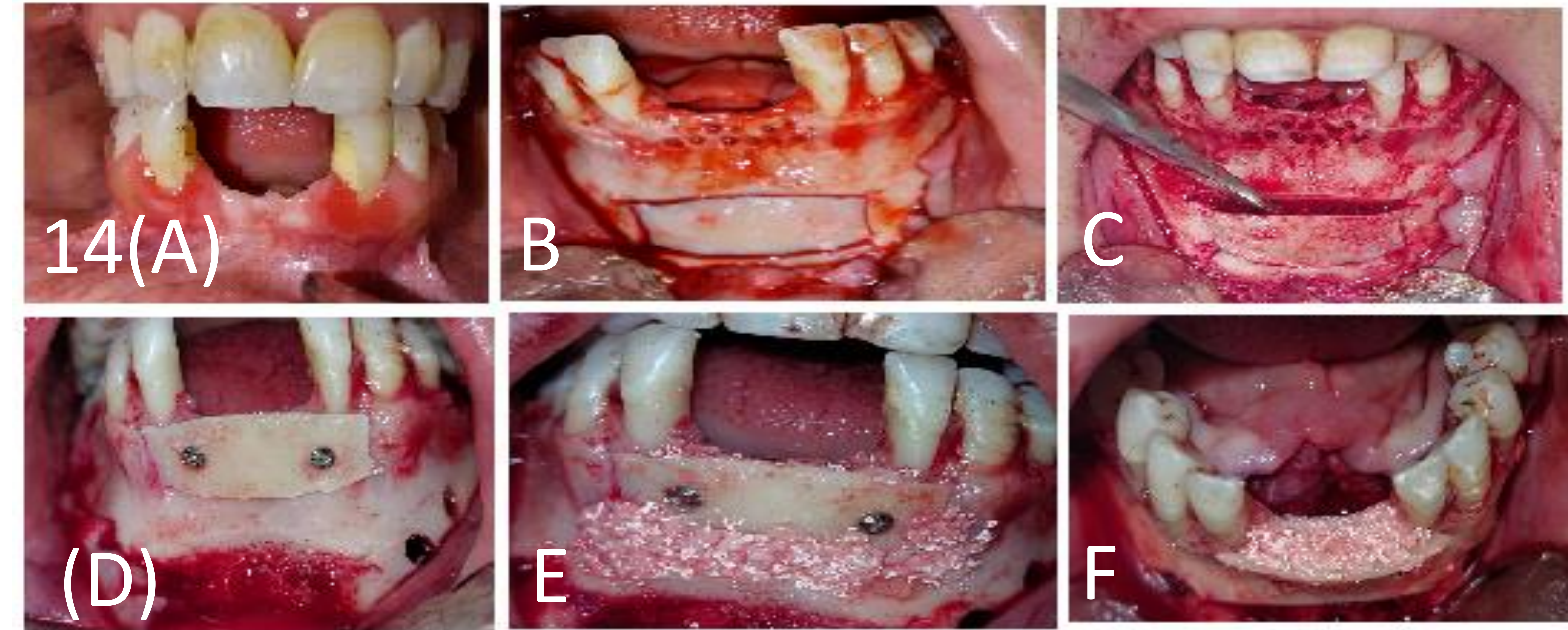
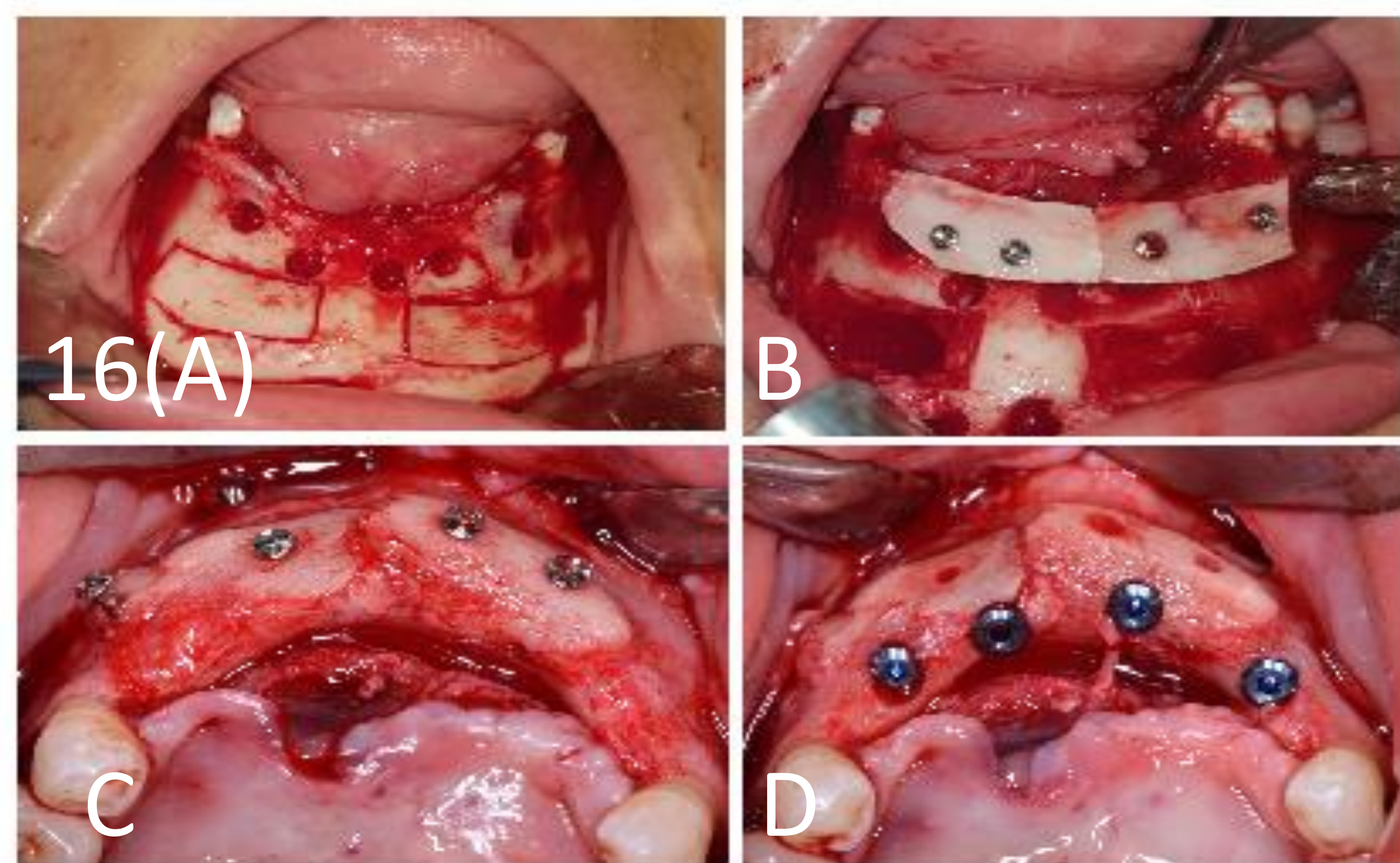
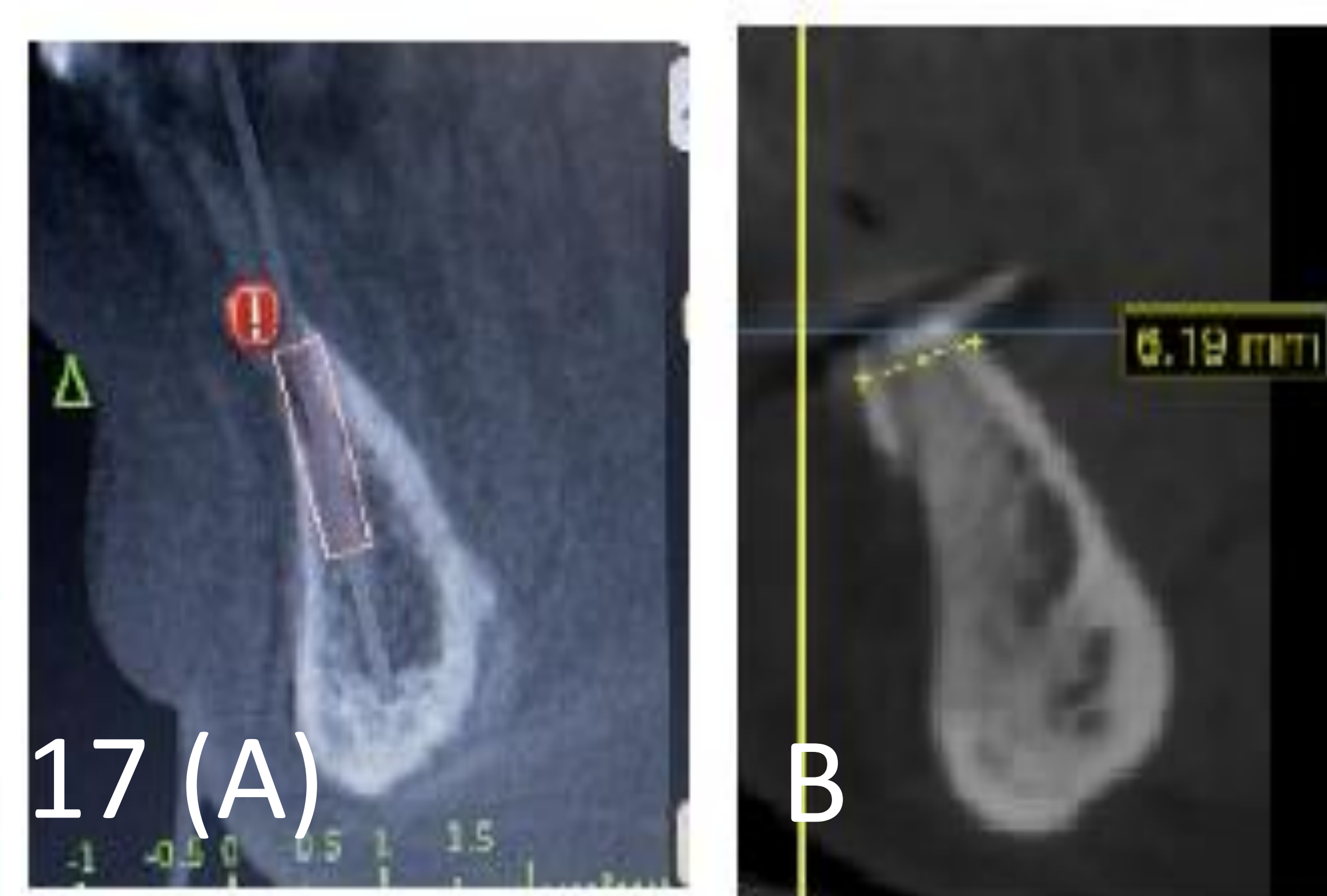
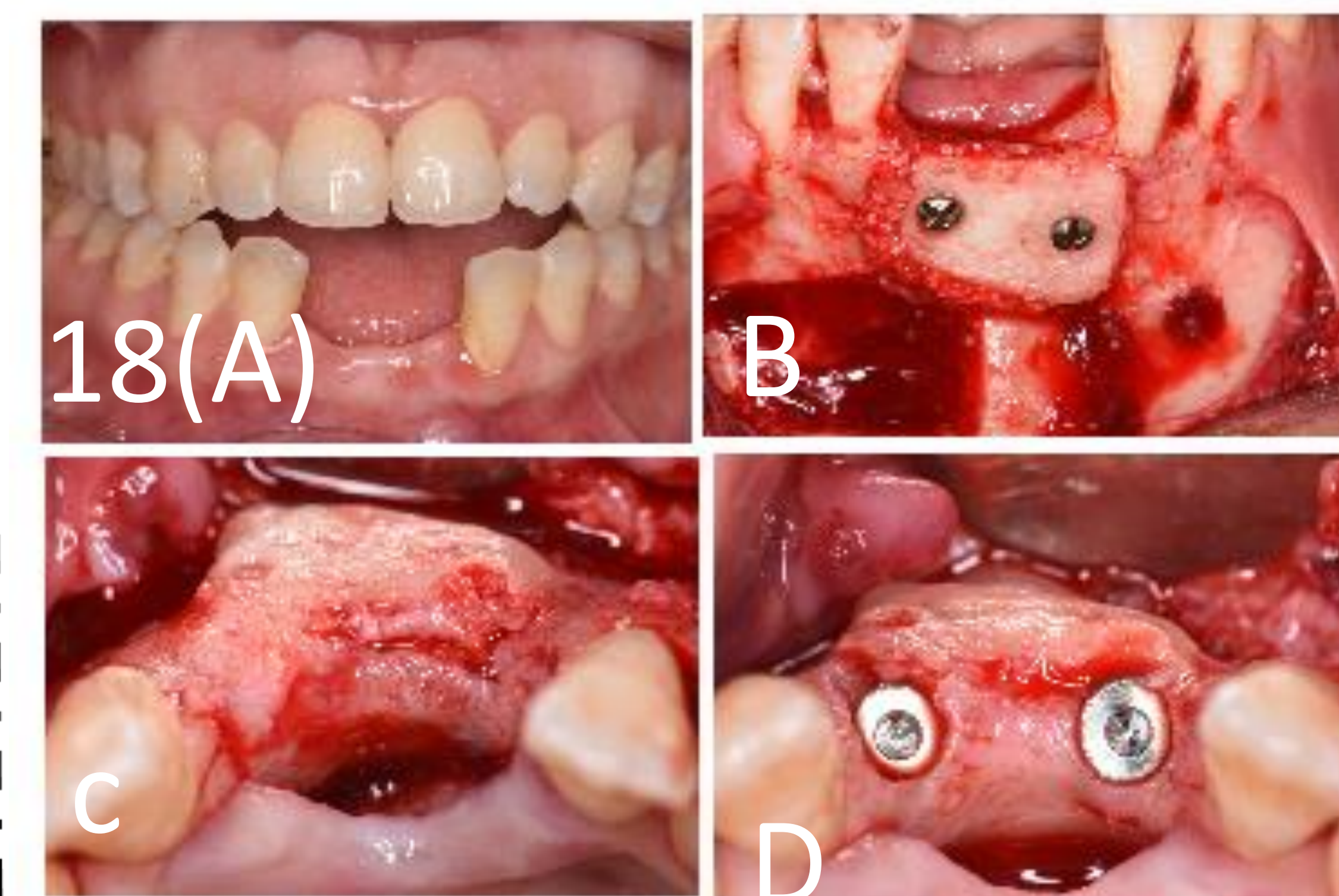
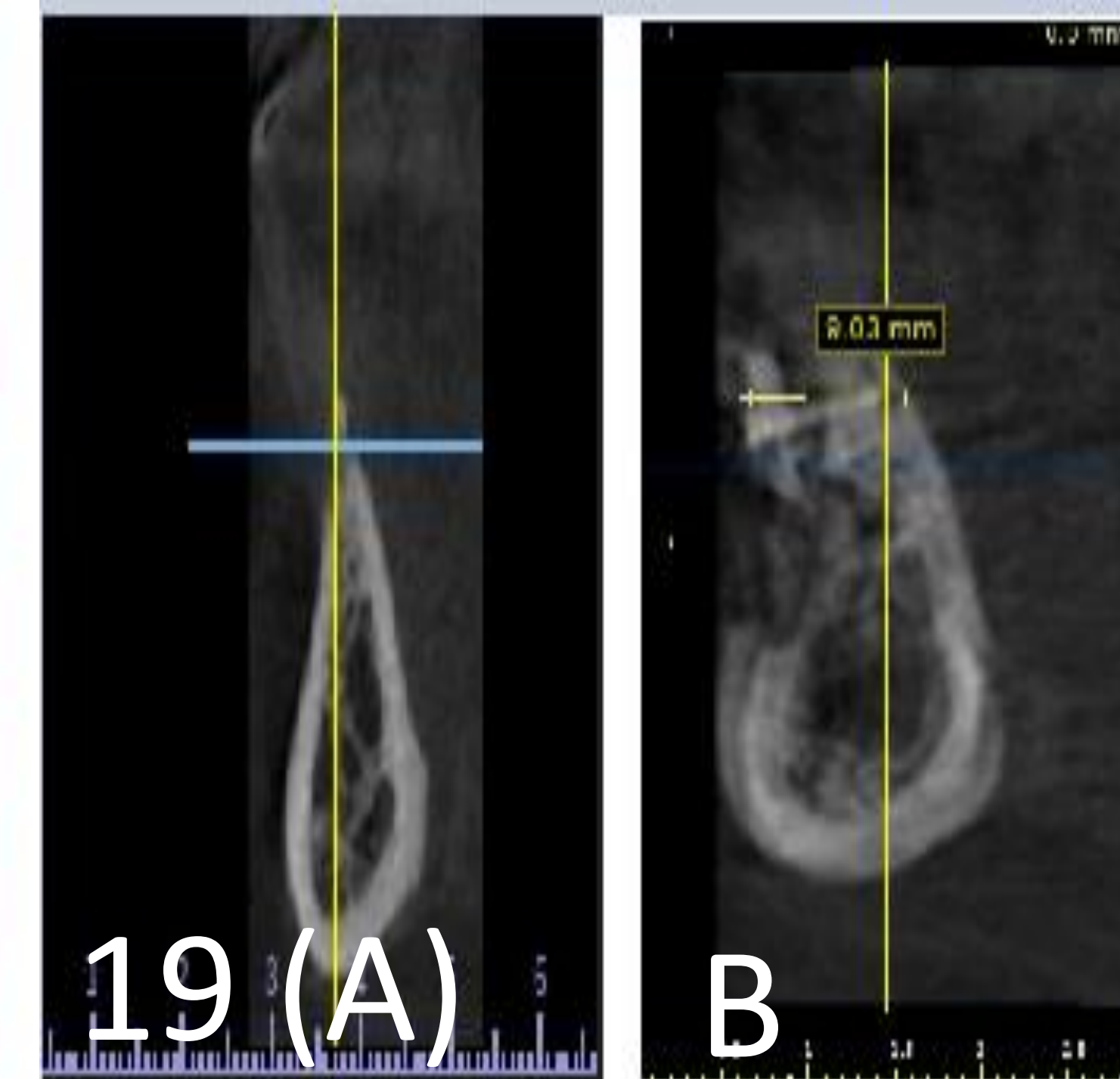


Fig 11 **CASE 3**: preop. Virtual design of the Interlocking guides

Fig 11 **CASE 3** (A) Harvesting guide in place , (B,C) harvested shell intimate fixation to the positioning guide (facial and occlusal views), (D,E) the positioning guide and the shell were interlocked with the harvesting guide intraoperatively, (F,G,H) guides were removed and shell placed at the desired pre-planned 3D position and particulate bone graft was placed to fill the interpositional gap

Fig 12 :postop. Cbct . **CASE 2**:

(A,B) postoperative cross sectional cuts showing excellent bone contour after before implant placement .

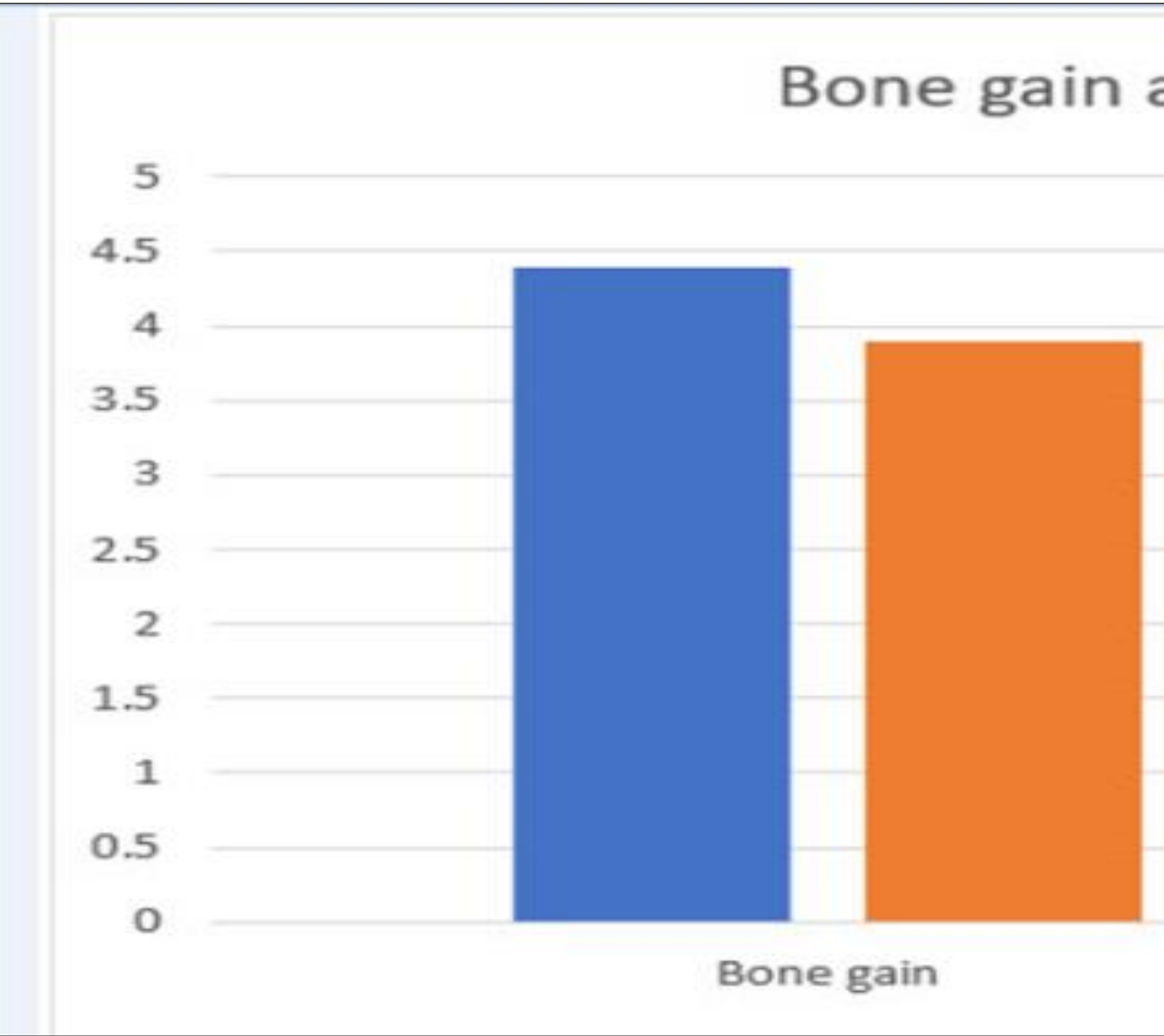


Results: all cases showed uneventful healing after 4 months of graft consolidation period, there was statistical significant difference between both groups where the final horizontal gain was 2.6 mm in the control group while 4.3 mm in the study group

Conclusion: computer guided khoury cortical shell technique allowed for more accurate and simple graft fixation specially for the inexperienced surgeons.

	Preoperative	4 months	Bone gain	Bone gain percentage (%)
Study group	10.6 ± 0.48	15 ± 1.23	4.4 ± 1.05	41.8 ± 10.1 %
Control group	10.7 ± 0.72	14.6 ± 0.55	2.9 ± 0.65	36.9 ± 8.2 %
P value	0.77	0.13	0.24	0.0038

Table : bone gain calculation between both groups



Bar Chart: bone gain calculation between both groups