



Abstract

Purpose: To introduce a modified method using CAD/CAM surgical cutting and drilling guides with additional pre-bent titanium miniplates to improve the accuracy of operation for the treatment of dentofacial deformities secondary to condylar hyperplasia.

Materials and Methods: 20 patients with condylar hyperplasia and secondary dentofacial deformities were treated by the CAD/CAM surgical cutting and drilling guides as well as pre-bent titanium miniplates. Pre- and post-operative 3D-cephalometric measurements were recorded and the difference between virtual simulation and postoperative modeling images was measured. Follow-up and radiographic examinations were performed.

Results: In our study, all patients were satisfied with the surgical outcome, without obvious relapse or evidence of temporomandibular joint disorder or other complications during follow-up; all patients avoided condylar reconstruction and sagittal split of ramus osteotomy on the ipsilateral mandible side. Comparison between simulated plans and actual postoperative outcomes showed surgical simulation plan was accurately transferred to the actual surgery.

Conclusions: The application of CAD/CAM surgical cutting and drilling guides as well as pre-bent titanium plates could achieve accurate and favorable outcomes, improving the clinical planning and surgical execution for patients with condylar hyperplasia and secondary dentofacial deformities.

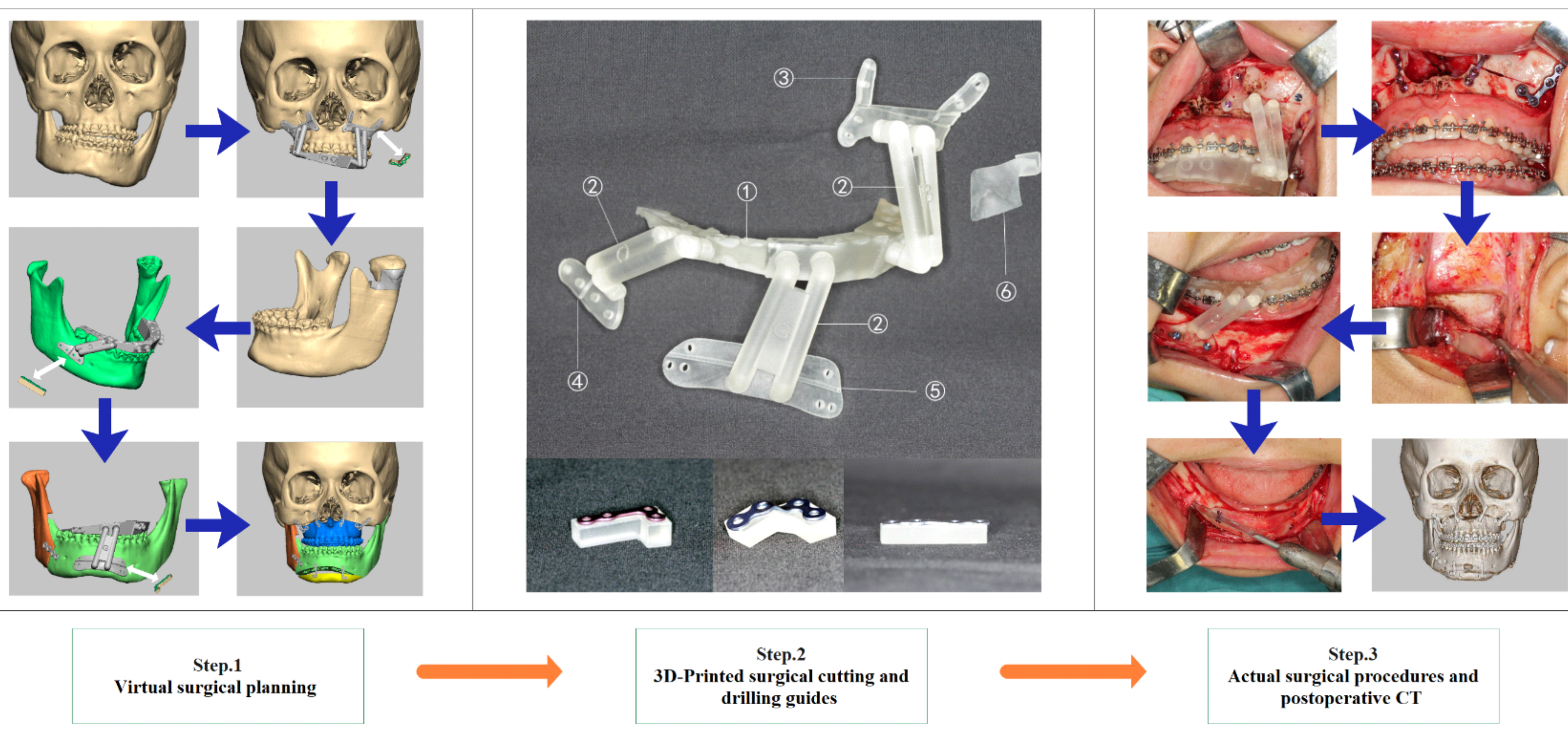


Figure.1. (Left) The process of virtual surgical simulation. (Median) 3D-Printed surgical cutting and drilling guides and the pre-bent titanium plates. (Right) The process of actual surgery and postoperative CT.

Table. Comparison of 3D-cephalometric measurement of the preoperative outcome(T0), the virtual simulation(T1) and the postoperative outcome(T2).

Measurements (mm)	T0 (Mean±SD)	T1 (Mean±SD)	T2 (Mean±SD)	P-Value (T0vsT2)	P-Value (T1vsT2)
To FH					
U6(R)	45.13±3.08	46.53±4.82	46.66±4.96	0.413	0.315
U6(L)	47.31±3.10	47.07±4.74	46.86±5.00	0.787	0.654
L6(R)	45.75±3.08	47.21±4.87	47.40±4.78	0.496	0.191
L6(L)	47.69±3.98	47.88±4.90	48.01±5.16	0.694	0.575
Go(R)	69.96±8.52	64.51±5.21	62.35±4.09	0.233	0.023 ^b
Go(L)	72.53±8.45	63.74±4.33	60.34±4.25	0.018 ^a	<0.001 ^b
To MSP					
A	0.48±0.12	0.88±0.82	0.64±0.68	0.342	0.124
B	6.13±0.54	0.81±0.66	0.73±0.57	<0.001 ^a	0.285
U1	0.73±0.12	0.66±0.61	0.58±0.56	0.635	0.916
L1	3.45±0.51	0.60±0.64	0.53±0.58	<0.001 ^a	0.427
Me	9.43±1.23	1.35±0.98	1.26±0.88	<0.001 ^a	0.598
To CoP					
U6(R)	70.83±1.39	69.85±3.03	69.79±2.95	0.482	0.769
U6(L)	69.98±1.90	70.41±3.62	70.06±3.18	0.776	0.295
L6(R)	73.81±1.19	71.49±2.31	71.11±2.07	0.036 ^a	0.084
L6(L)	73.53±4.91	71.69±3.71	71.50±3.11	0.314	0.637
Go(R)	23.33±2.28	19.23±2.94	20.28±3.08	0.008 ^a	0.703
Go(L)	24.80±5.49	18.81±5.50	21.01±4.27	0.095	0.187

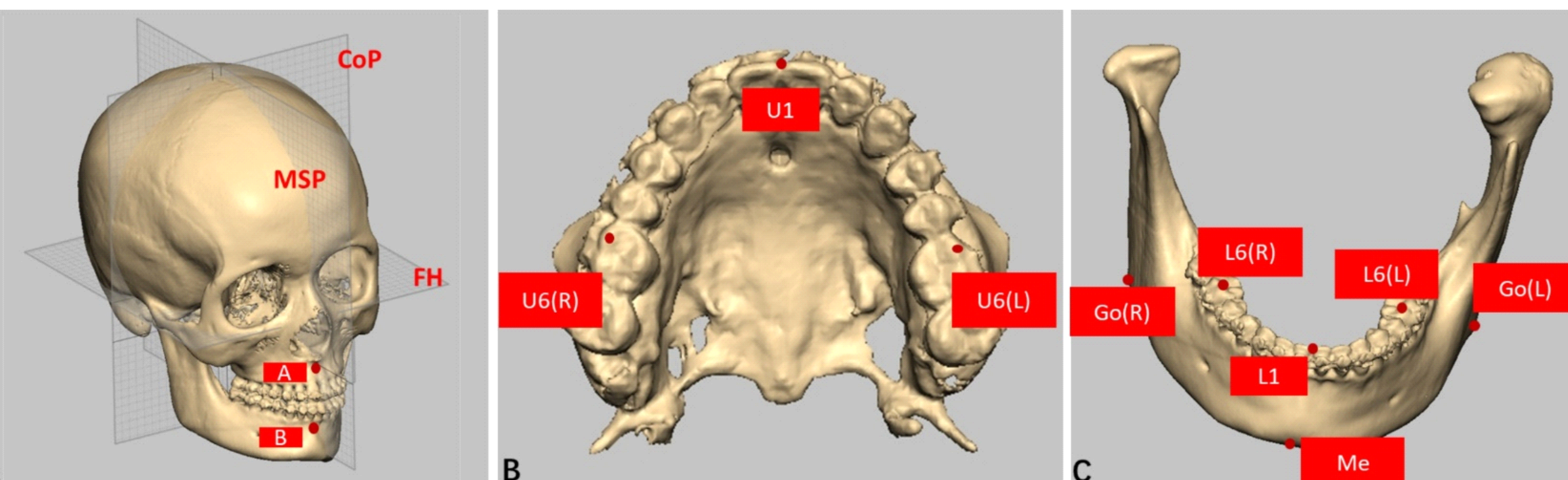


Figure.2. Reference planes for 3D measurements and landmarks on the surface of the skull.

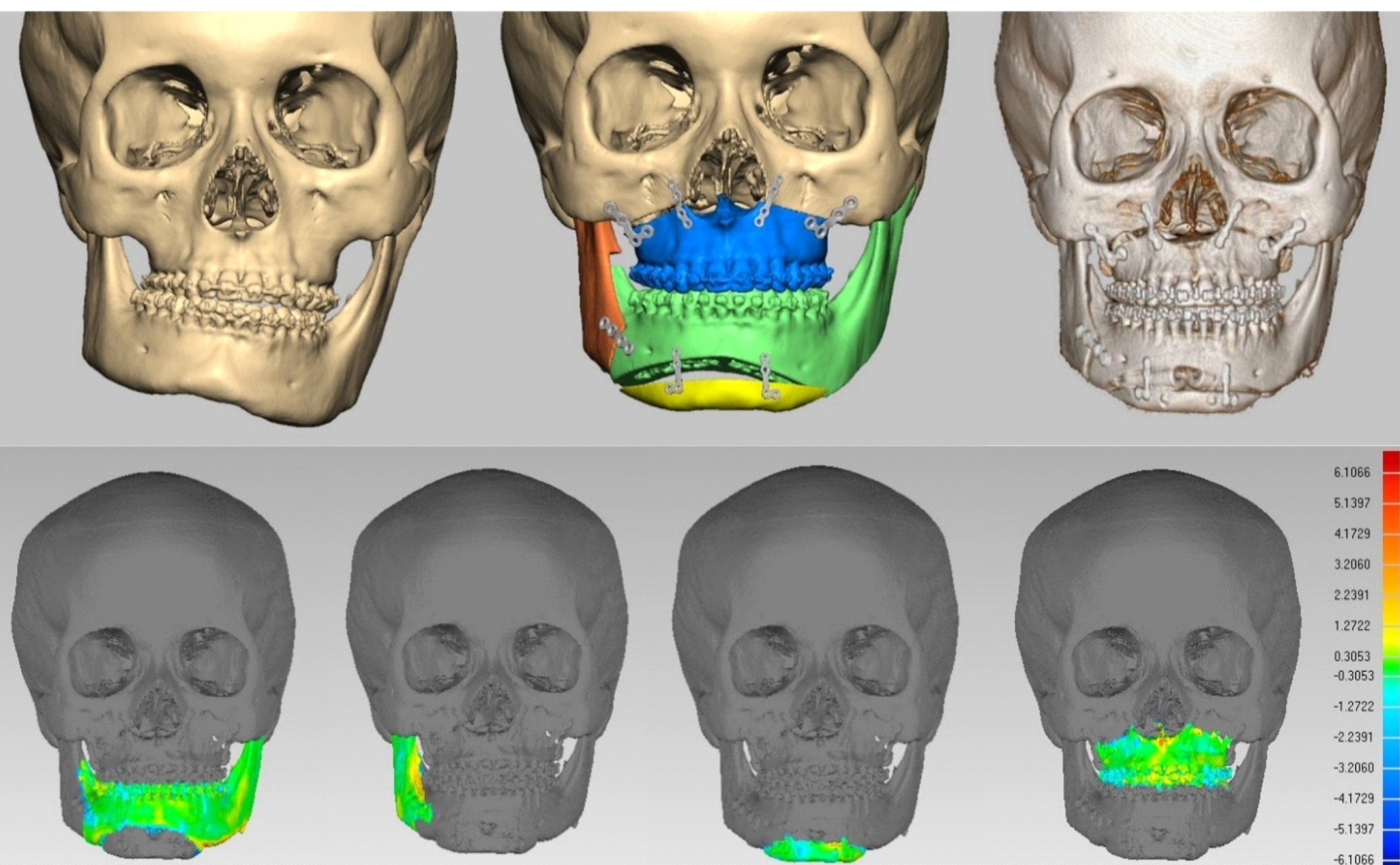


Figure.3. Evaluation of the deviation between virtual simulation and postoperative images by the color distances maps



Figure.4. Front facial profile, occlusion relationship, and CT images before surgery, 1 month after surgery, and 2 years after surgery (red arrows showed the condylar osteochondroma before surgery, 1 month after surgery, and the remodeling of condylar morphology 2 years after surgery).