



浙江大学
ZHEJIANG UNIVERSITY



Academy of
Osseointegration
Advancing the Vision of Implant Dentistry

Dual-arch immediate implant& immediate loading with an autonomous dental implant robot in terminal dentition treatment



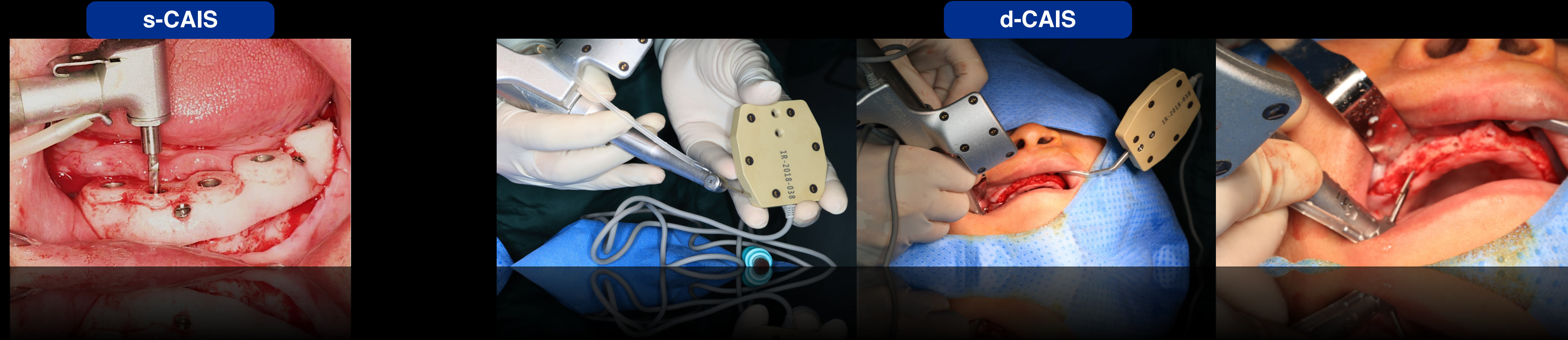
Zhejiang University
Stomatology Hospital

School of Stomatology, Zhejiang University School of Medicine
Xiaofu Yang MDS¹, Huiming Wang PhD¹

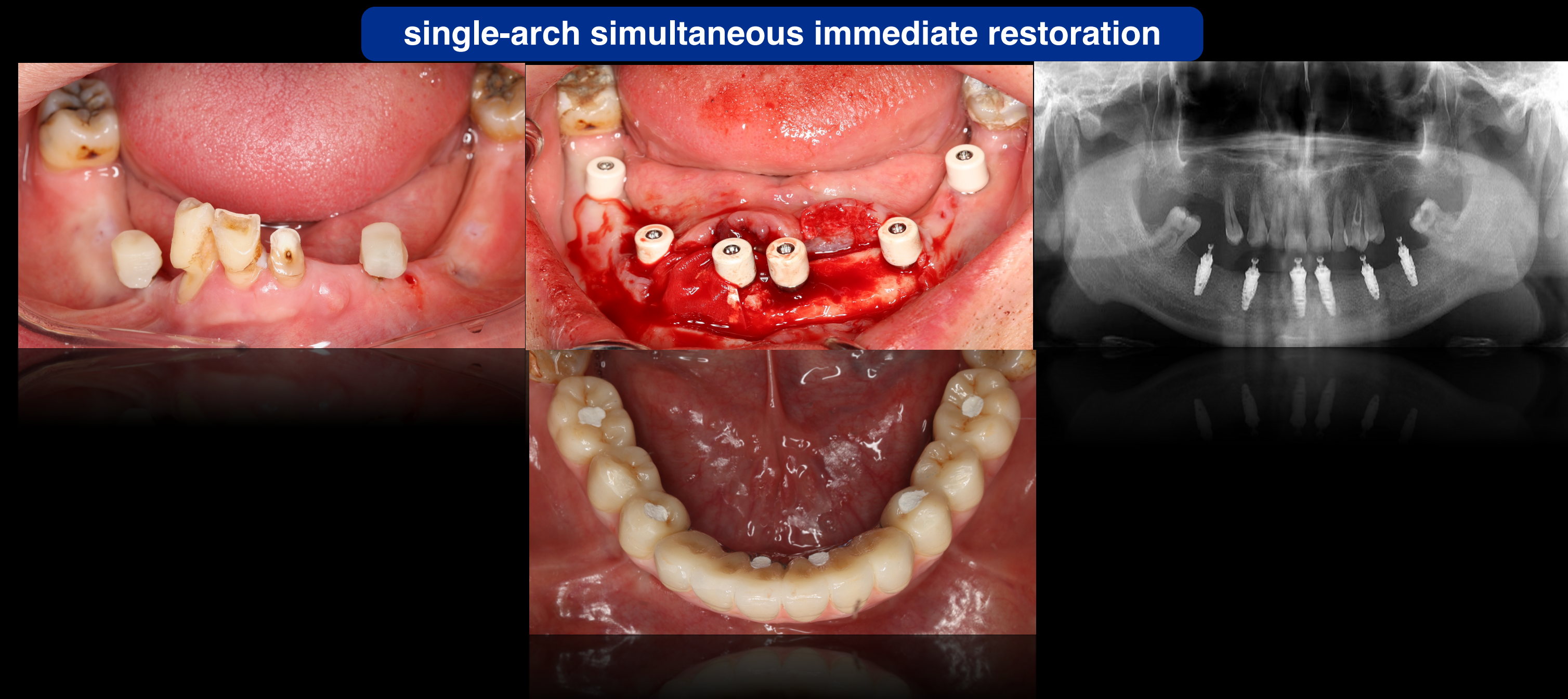
¹ Stomatology Hospital, School of Stomatology, Zhejiang University School of Medicine, Hangzhou, China.

Introduction

Computer-guided surgery, including **static computer-assisted implant surgery (s-CAIS)** and **dynamic computer-assisted implant surgery (d-CAIS)**, have been applied to complete full-arch implant-supported restorations, enabling precise, predictable and efficient implant placement.



An **autonomous robotic computer-assisted implant surgery (r-CAIS)** was previously introduced as a prospective alternative for accurate implant placement. However, the application of autonomous r-CAIS in dual-arch simultaneous immediate restoration has limited supporting evidence.

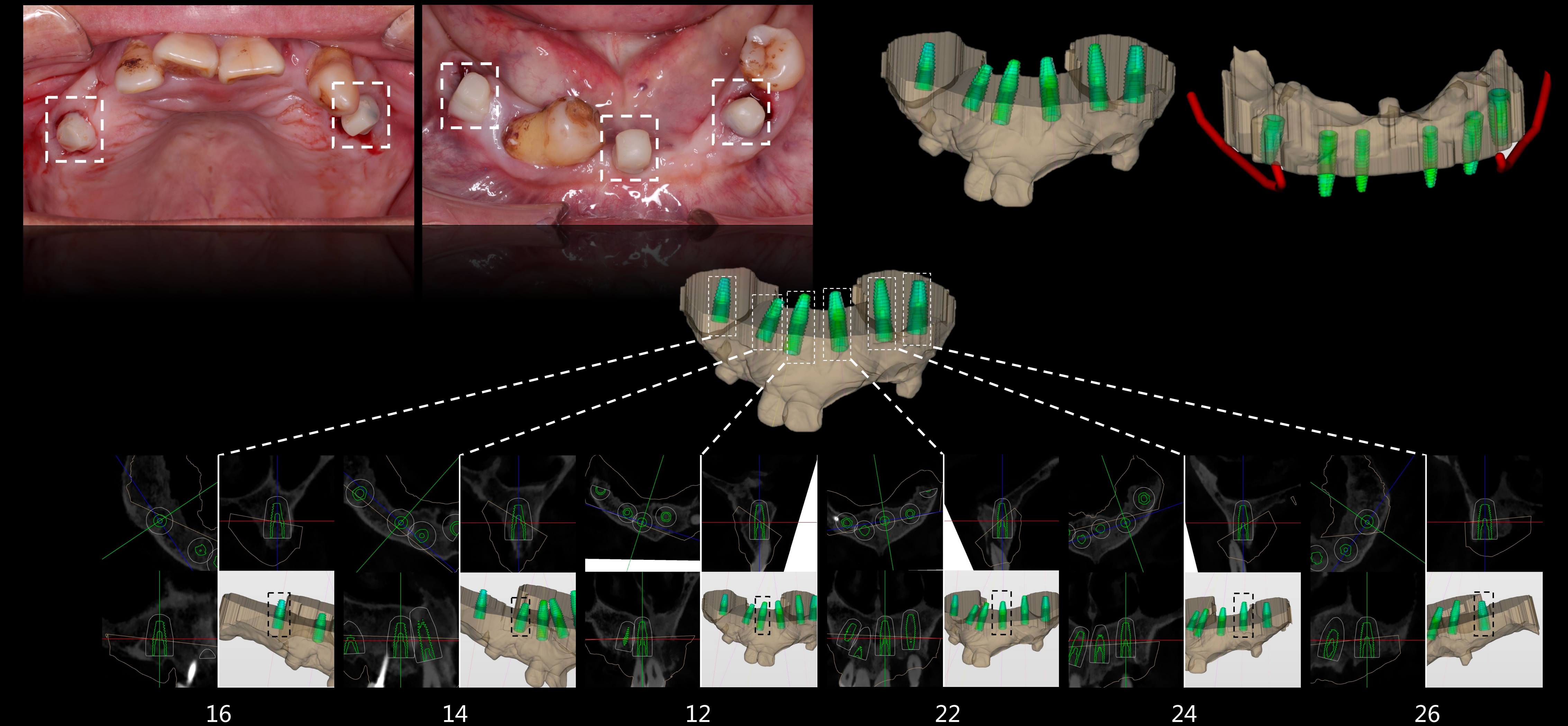


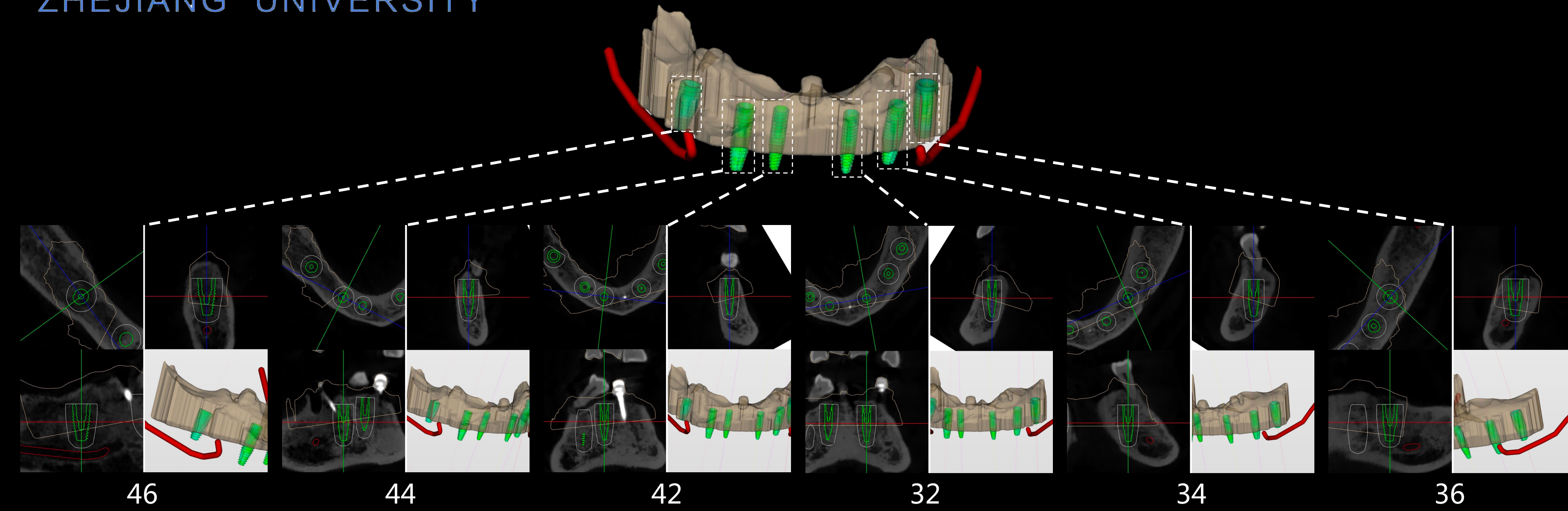
Materials&Methods

A 53-year-old male patient with terminal maxillary and mandibular dentition underwent robotic computer-assisted implant surgery using an autonomous robot.

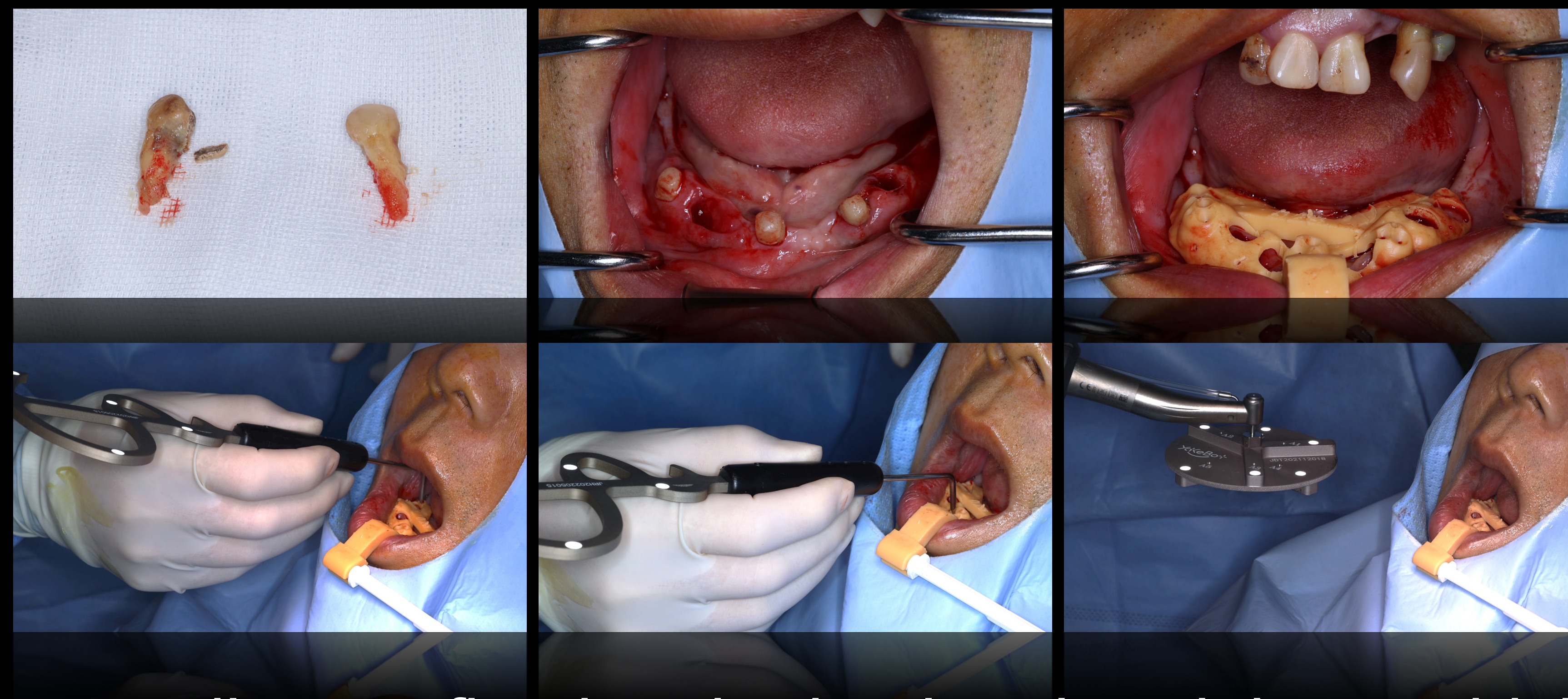


Markers were fixed into the upper and lower jaw, and then CBCT was taken and reconstructed for implants planning.



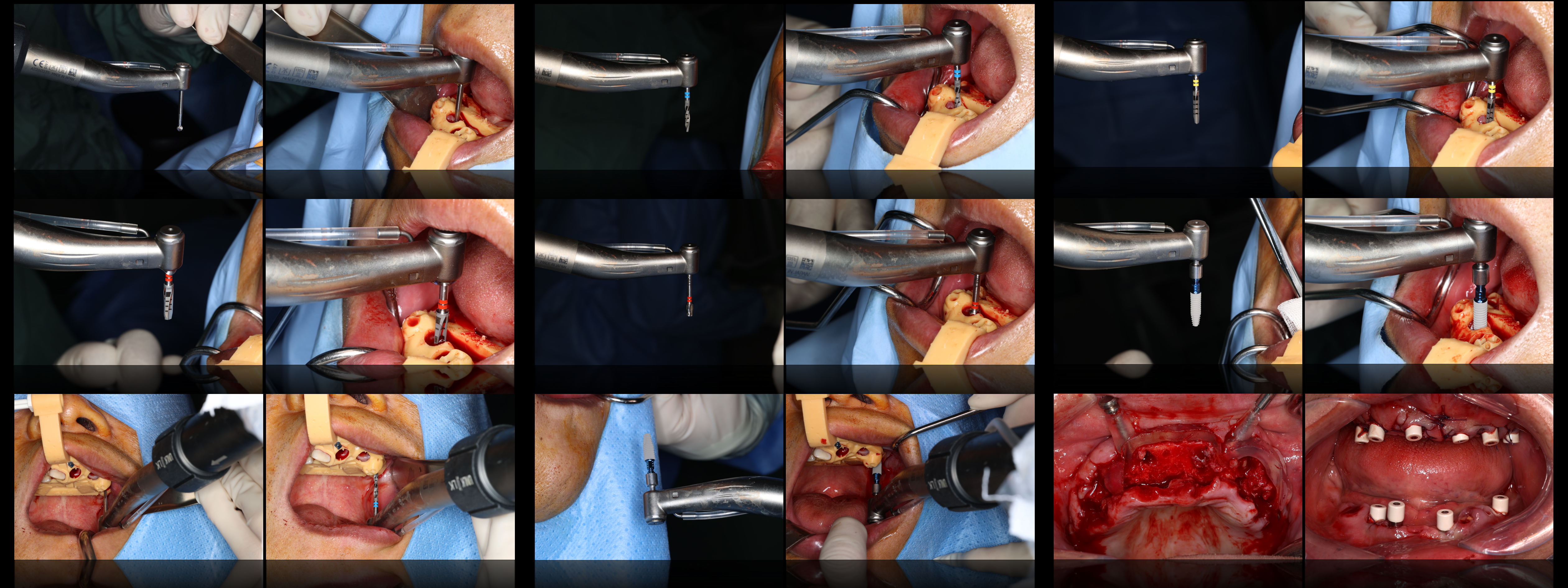


Loosened teeth were extracted. A calibration plate was installed. Through the calibration plate, marker, marker file, CBCT, and optical tracking localizer, the robotic system acquired the 3D positional relationship between the robotic arm, planned implant, and virtual patient and completed the preoperative registration.



The drilling needle was fixed to the implant handpiece, which was subsequently positioned adjacent to the implant area by depressing a manual pedal.

Upon entering the automatic recognition range, the automatic pedal was pressed, and the robotic arm automatically calibrated its direction for the implant surgery procedure.



The patient underwent postoperative CBCT examination after all implants on both arches were placed. Immediate prosthodontics is used for total prosthodontics.



Results

A total of 12 implants were placed separately in the maxilla and mandible. Alignment between the planned and placed implants proved a high degree of accuracy. Both the maxilla and the mandibular successfully received immediately loaded full-arch prostheses.

	16	14	12	22	24	26	36	34	32	42	44	46
①Global coronal deviation(mm)	0.24	0.18	0.73	0.24	0.30	0.19	0.22	0.41	0.46	0.36	0.15	0.15
②Global apical deviation(mm)	0.15	0.18	0.69	0.41	0.25	0.17	0.33	0.44	0.40	0.41	0.22	0.15
③Angular deviation(°)	0.61	0.62	0.99	0.89	0.54	0.29	0.81	0.79	0.91	0.69	0.98	0.89
④Lateral coronal deviation(mm)	0.17	0.01	0.25	0.11	0.25	0.08	0.1	0.11	0.40	0.08	0.11	0.05
⑤Lateral apical deviation(mm)	0.04	0.11	0.28	0.31	0.17	0.02	0.27	0.07	0.21	0.24	0.18	0.14
⑥Vertical coronal deviation(mm)	0.11	0.17	0.69	0.03	0.23	0.17	0.16	0.27	0.32	0.29	0.05	0.06
⑦Vertical apical deviation(mm)	0.22	0.41	0.13	0.09	0.54	0.49	0.18	0.34	0.18	0.28	0.13	0.01

The means of the global coronal deviation and global apical deviation were 0.30 ± 0.17 mm and 0.32 ± 0.16 mm, respectively. Additionally, the angular deviation was 0.75 ± 0.21 degrees.

Conclusion

This case demonstrated the feasibility of autonomous robotic implant surgery for dual-arch immediately loaded implants. Robotic computer-assisted implant surgery may open up new horizons for dental implant surgery, enabling accurate and efficient patient-specific procedures. However, further clinical trials are required to provide hard clinical evidence.

Reference

1.

Rawal S. Guided innovations: Robot-assisted dental implant surgery. J Prosthet Dent. 2022 May;127(5):673-674.

2.

Jain S, Sayed ME, Ibraheem WI, Ageeli AA, Gandhi S, Jokhadar HF, AlResayes SS, Alqarni H, Alshehri AH, Huthan HM, Alami A, Al Wadei MHD, Aljabri Y. Accuracy Comparison between Robot-Assisted Dental Implant Placement and Static/Dynamic Computer-Assisted Implant Surgery: A Systematic Review and Meta-Analysis of In Vitro Studies. Medicina (Kaunas). 2023 Dec 20;60(1):11.

3.

Bahrami R, Pourhajibagher M, Nikparto N, Bahador A. Robot-assisted dental implant surgery procedure: A literature review. J Dent Sci. 2024 Jul;19(3):1359-1368.

4.

Wang M, Liu F, Zhao X, Wu Y. Robot-assisted surgery for dental implant placement: A narrative review. J Dent. 2024 Jul;146:105034.

5.

Qiao SC, Wu XY, Shi JY, Tonetti MS, Lai HC. Accuracy and safety of a haptic operated and machine vision controlled collaborative robot for dental implant placement: A translational study. Clin Oral Implants Res. 2023 Aug;34(8):839-849.