



Augmenting Traditional Dental Implant Education with a Robotic Implant Placement System

Gregory N. Wilkins, DDS, MBA ^a; Steven E. Handel, DMD, FACP ^{bd}; Jennifer V. Sabol, DDS, FACP ^{ce}

U.S. Army Advanced Education in Prosthodontics, Fort Eisenhower, GA

^aProsthodontic Resident, ^bAssistant Professor, ^cAssociate Professor, Post Graduate Dental School; ^dAssistant Program Director, ^eProgram Director US Army Prosthodontic Residency



Purpose

Describe the use of the newly developed haptic robotics, inform clinicians of this new technology's capabilities and how it is used as a resident training modality.

Workflow

The robot-assisted surgical system (Yomi, Neocis Inc, Miami, FL) requires two team members: a surgeon and a driver. The surgeon develops a treatment plan and conducts the surgery while the driver monitors the computer to calibrate and direct the surgeon during the surgery. On the day of surgery, a sectional intraoral splint with a fiducial array is seated contralateral to the surgical site prior to the patient receiving a CBCT scan. The scan is then exported to proprietary treatment planning software where an appropriate implant is selected, and its final location is determined. Once treatment planning is completed, the fiducial marker is replaced with the robot's tracking arm, enabling motion monitoring capabilities. Surgery is then initiated. When the robot deems the handpiece is close enough to the site, the surgeon is directed to adjust the mesial-distal direction and angulation before the drill is locked into location. When 'lock-on' is achieved, the handpiece is only permitted to move in the vertical axis. Sequential osteotomies are preformed, and the implant is placed.

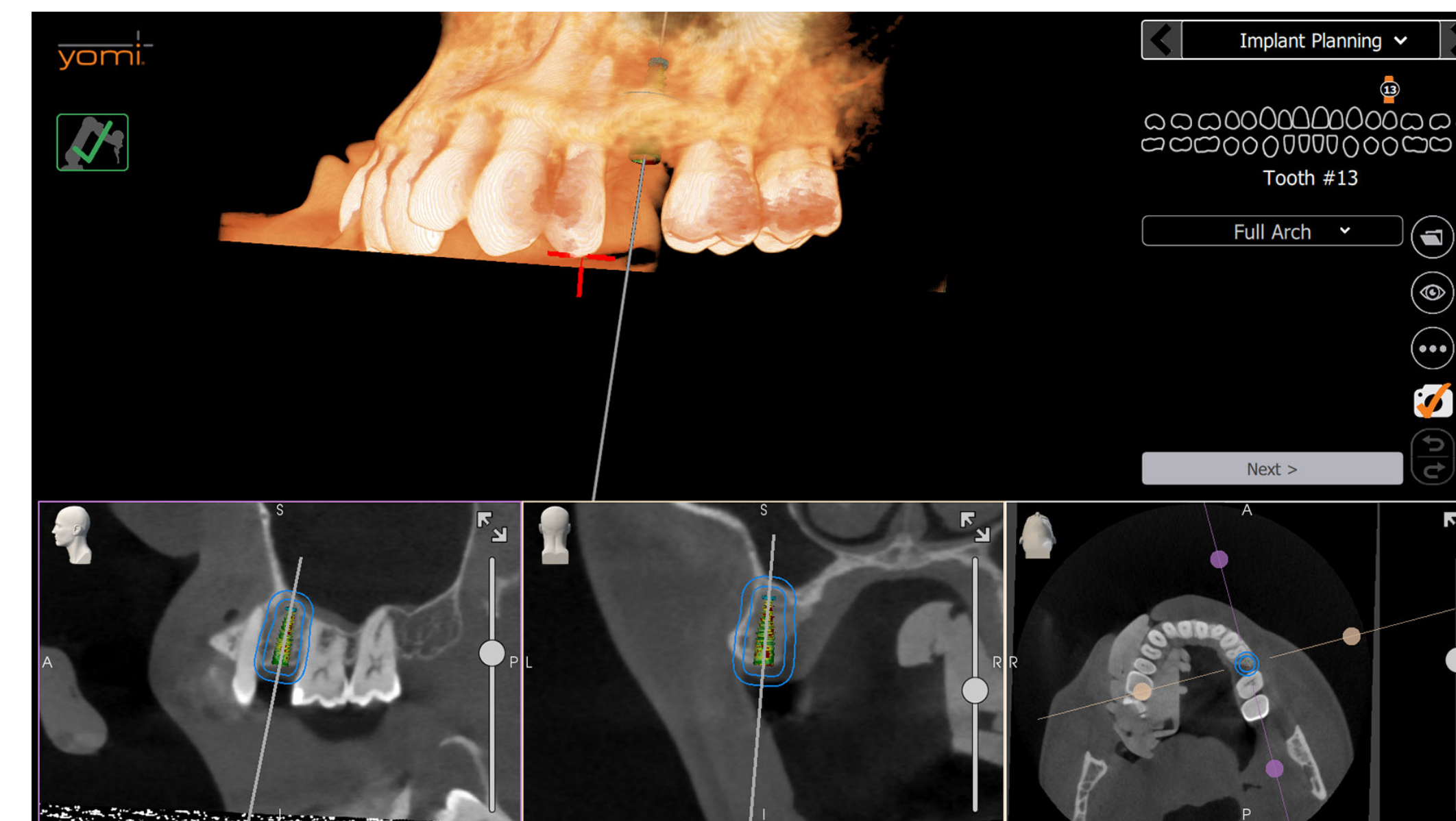
Learning Impact on Residents

Robot assisted implant placement allows providers to to perform accurate, predictable, non-evasive implant surgery for our service members. With the use of this system, residents could apply traditional implant workflows with haptic guidance the reducing positional and angular errors.

Implementation



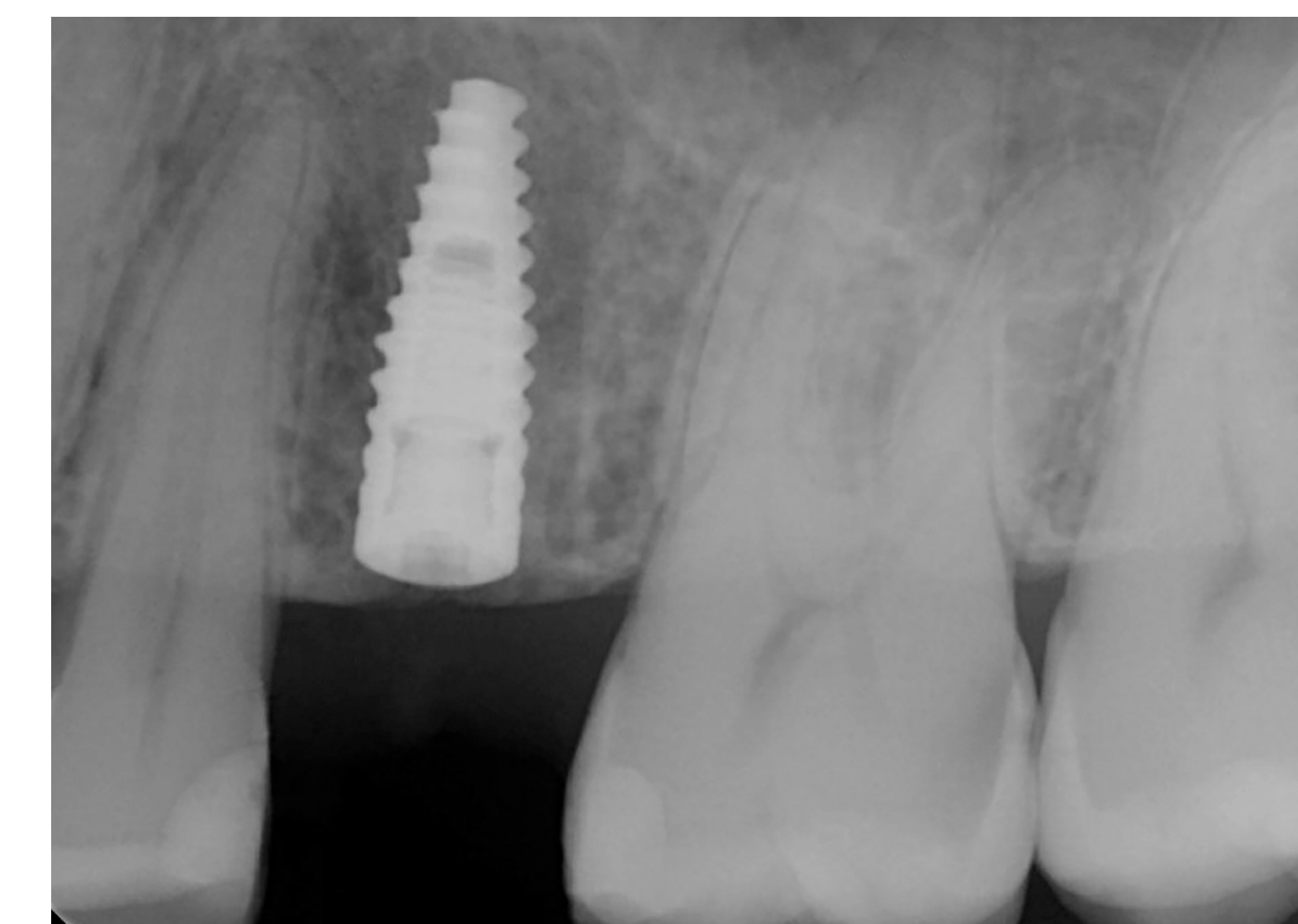
Robotic tracking arm was attached to intraoral splint



Virtual implant placement



YOMI robot



Robotically-guided implant final radiograph

Implant Teaching Evolution

Resident have the opportunity to apply their knowledge in implant surgery by solidifying the following concepts :

- Patients' acceptability recipient for implants
- Interpretation of CBCT scan results, identifying key anatomic landmarks, adequacy of the patient's alveolar ridge, screening for incidental findings
- Clinical knowledge, requirements, necessity of bone grafting procedures, and analysis of outcomes
- Treatment planning, and collaborating with restorative specialists to ensure that angulation, depth, and restorative parameters of the proposed implant are met
- Conduct flapped and flap-less implant surgery
- Multidisciplinary collaboration with Oral Surgery, Prosthodontics, Oral Maxillofacial Radiology
- Realtime feedback of proximity to critical anatomic landmarks (ie. maxillary sinuses, inferior alveolar nerve)
- The ability to make real-time adjustments during surgery

Conclusion

Traditional implant methodologies are reinforced by utilizing this technology with the added benefit of real-time haptic guidance to increase predictability and reduce positional errors allowing for dental residents to become more confident and competent when placing dental implants.

The views expressed in this presentation are those of the authors and do not necessarily reflect the official policy or position of the department of the Department of the Army, Department of Defense, or the U.S. Government