Robotic Assisted Implant Surgery: A Paradigm Shift in Dynamic Navigation - The Dental Student Perspective

Brandon Finnie, David George, DDS; Huzefa Talib, BDS, MFDRCS, FFDRCSI (OSOM), DICOI;
Thomas G. Wiedemann, MD, PhD, DDS, FEBOMFS, DICOI
New York University - College of Dentistry - Department of Oral and Maxillofacial Surgery

Introduction

Prosthetically driven implant placement is considered the global standard. Dental implant therapy has made progress toward a truly digital workflow via cone beam computed tomography (CBCT) imaging and fabricated or 3D printed physical guides. The latest development, however, toward an ultimately digital implant therapy workflow is robotic assistance. Robotic assistance has spread across many medical surgical disciplines with strong evidence for its utility in augmenting and enhancing surgical capabilities. The first FDA-cleared robotic device for dental surgery, YOMI (Neocis, Inc.), is commercially available in the United States and in clinical use at NYU Dentistry since 2021.

Background

The purpose of this study is to evaluate the efficacy and efficiency of real time robotic guidance as an emerging technology for modern clinical implant placement but also its role in academic teaching.

Material and Methods

A comprehensive PubMed electronical literature review was completed using selected key words: ”dental implant accuracy AND static guides AND robot guided dental implant OR robotic dental implant guidance OR yomi” A total of 6 primary literature articles were included but not limited to randomized clinical studies, case series, systematic reviews. Clinical experiences are based on cases performed at NYU Dentistry with a YOMI Dental Robotic System.

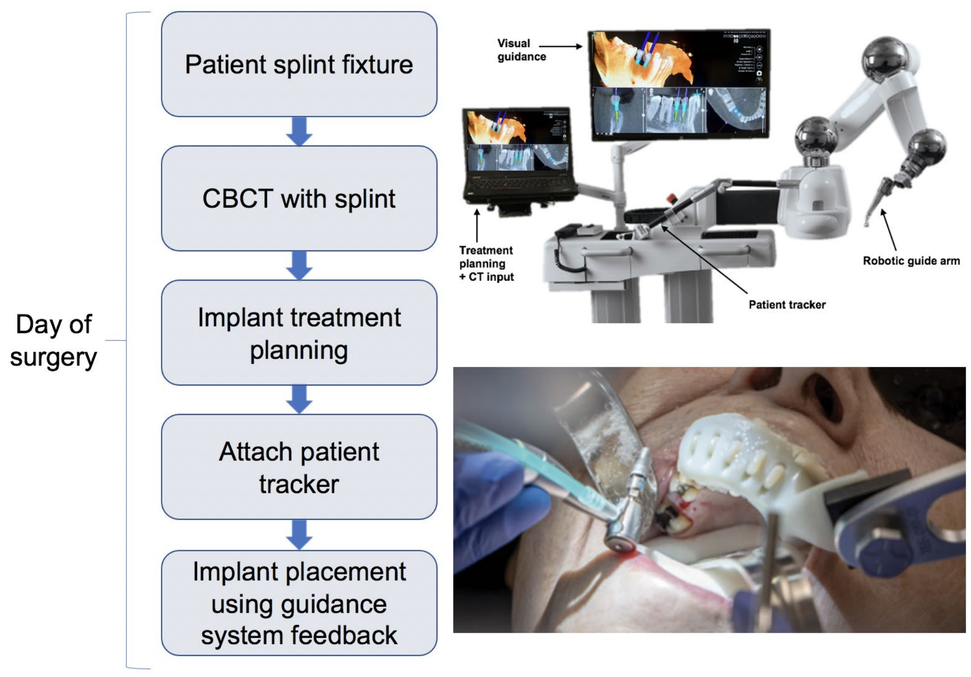


Figure 1: Workflow of Robotic Guided Surgery

Case

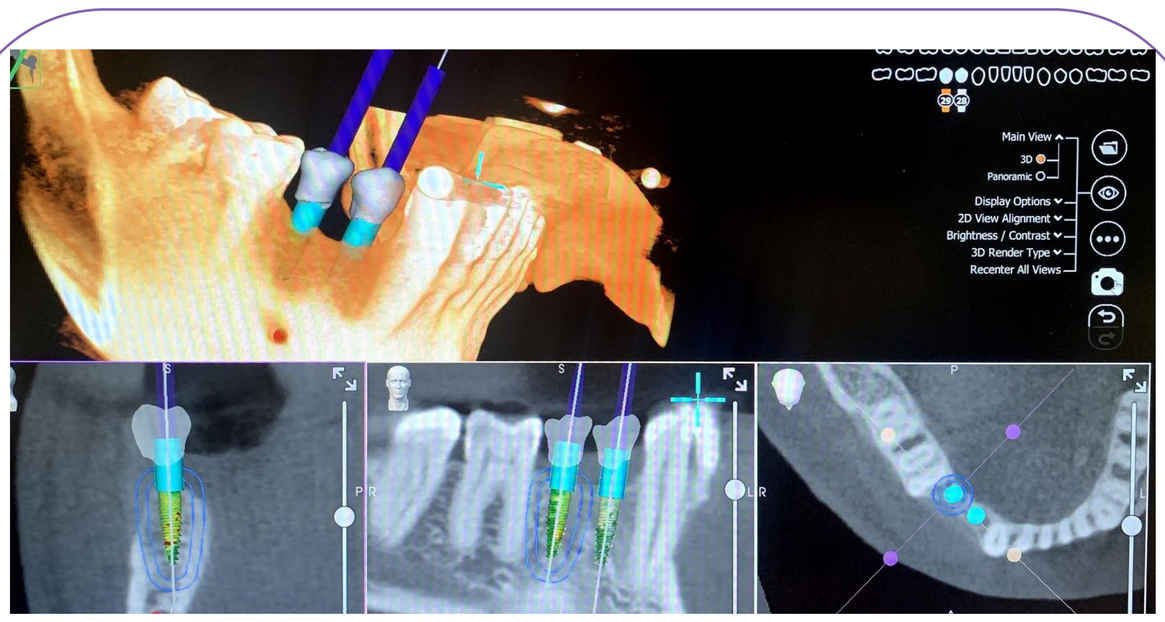
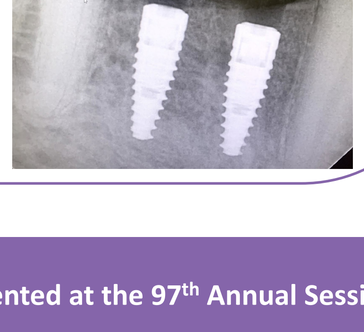


Figure 2: Procedure planning with augmented anatomical visualization and surgical outcome



Results

Mean deviation	Static guided	Robot assisted
Apical (mm)	0.67 - 2.19	0.95
Coronal (mm)	0.6 - 1.67	1.04
Angular (°)	2.6 - 4.67	2.56

Figure 3: Accuracy of static guided vs robotic assisted implant placement (1)

Positive Experiences	Areas of Concern
Visibility and intraoral clearance	Stent retention on anterior teeth
Unimpeded irrigation	Little tactile feedback or gauge of bone quality
Workflow, speed and efficiency: Same day treatment planning	Intraoral stent remains during treatment planning period - potential to dislodge
Option to modify plan at any time or go into freehand operation	

Figure 4: Personal experiences with robotic implant insertion

The Dental Student Perspective

1. The inherent safety and precision of robotic assistance provides dental students the unique opportunity to get hands-on exposure to implant procedures at their respective training level.
2. Dental students and aspiring oral surgeons can gain critical experience with all stages of implantology from treatment planning to surgery without compromising quality of care or treatment outcomes.

Conclusion

1. We believe that breakthroughs in digital procedure planning and the implementation of augmented anatomical visualization will drive haptic guided and robotic assisted implant surgery into becoming a standard of care in implant surgery in the future.
2. The integration of robotics into the academic field will help to train the novice and improve the expert’s workflow while both increasing efficiency and accuracy.

References

1.) Bolding, S. L., & Reebye, U. N. (2021). Accuracy of haptic robotic guidance of dental implant surgery for completely edentulous arches. *Journal of Prosthetic Dentistry*, 1–9.

2.) Zhou, W., Liu, Z., Song, L., Kuo, C. ling, & Shafer, D. M. (2018). Clinical Factors Affecting the Accuracy of Guided Implant Surgery—A Systematic Review and Meta-analysis. *Journal of Evidence-Based Dental Practice*, *18*(1), 28–40.

3.) Block, M. S., Emery, R. W., Cullum, D. R., & Sheikh, A. (2017). Implant Placement Is More Accurate Using Dynamic Navigation. *Journal of Oral and Maxillofacial Surgery*, *75*(7), 1377–1386.

4.) Block, M. S., & Emery, R. W. (2016). Static or Dynamic Navigation for Implant Placement - Choosing the Method of Guidance. *Journal of Oral and Maxillofacial Surgery*, *74*(2), 269–277.

5.) Mandelaris, G. A., Stefanelli, L. V, & DeGroot, B. S. (2018). Dynamic Navigation for Surgical Implant Placement: Overview of Technology, Key Concepts, and a Case Report. *Compendium of Continuing Education in Dentistry (Jamesburg, N.J. : 1995)*, *39*(9), 614–621; quiz 622.

6.) Ganz, S. D. (2015). Three-Dimensional Imaging and Guided Surgery for Dental Implants. *Dental Clinics of North America*, *59*(2), 265–290.

Presented at the 97th Annual Session of the Greater New York Dental Meeting in 2021