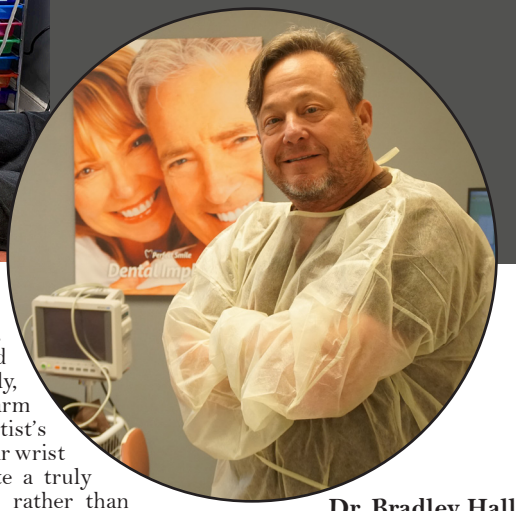


Robotically Guided Immediate Implant Placement with Osseodensification

by Millie K. Tannen DDS MAGD

Editor, *Florida Focus*

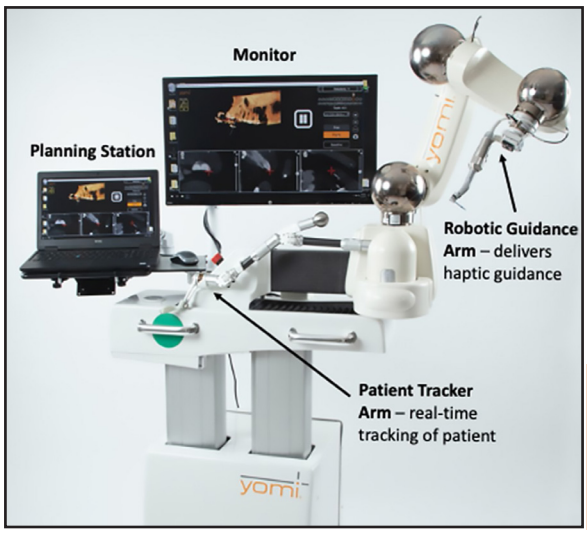


Dr. Bradley Hall

Ever since its approval by the FDA in 2016,[1] one of the most intriguing innovations in dentistry has been the introduction of robotics to implant surgery. In the Yomi system, produced by Neosis, Inc. in Miami, a robotic arm is digitally linked with the patient's cone beam computed tomography (CBCT) scan, enabling extremely precise placement of the implants and allowing the dentist to observe the surgery on the CBCT scan in real time.[1] Nearly 200 of these systems are in use today in the U.S., said Dr. Alon Mozes, Neosis cofounder and CEO.* After reading about this technology, I was delighted to be invited by Florida AGD member Dr. Bradley Hall to observe a Yomi procedure in his group practice, Amelia Perfect Smile on Amelia Island.

Robotic surgery may be fairly new to dentistry, but following its first use during a cholecystectomy in 1997, over twelve million robotic-assisted surgical operations have been performed in oropharyngeal, cardiothoracic, urological, gynecological, colorectal, and general surgery.[2] Robotic surgery offers the advantages of a minimally invasive procedure, resulting in less bleeding and discomfort, shorter hospital stays, and faster recovery for patients. Surgeons appreciate the improved ergonomics of many of the robotic procedures, and hospital readmissions are reduced, due to fewer post-surgical complications.[2] According to Intensive Surgical, the leading manufacturer of robotic surgical equipment, over 60,000 surgeons have been trained on its da Vinci system.[2]

For dental implant placement, robotics have numerous advantages. In addition to being able to view the patient's anatomy and the progression of the surgery on the CBCT scan, the software and the haptic ability of the robotic arm ensure the maintenance of the planned angulation and depth of the osteotomy during surgery; signal when the correct depth has been reached; and alert the clinician to any problems or deviation from the treatment plan.[3-9] Unlike surgical guides, the robotic system allows direct visualization and irrigation of the surgical site and permits the dentist to change the treatment plan during surgery, if necessary.[3-6] The implants can be placed more easily in sites where access is limited[4,5] and, in some cases, fully edentulous patients can be treated more accurately than with a surgical guide.[3] Flapless surgery provides the benefits of a shorter surgical procedure, reduced bone loss and pain, and a more rapid recovery.[8,9] Finally, the robotic arm eliminates the dentist's marginally irregular wrist movement to create a truly round preparation, rather than a slightly oval one, improving initial fixation.[10] Of course, one disadvantage of robotic implant placement is its cost,[4,8] although Dr. Alon Mozes said that the company works with practices to make the technology affordable.* Other disadvantages include the absence of surgical tactile sensibility, a longer set up time for the surgical procedure,[3,4] and a steep learning curve.[10]



Dr. Bradley Hall purchased the Yomi system in March, 2023, and says that in recent months, he and one of his associates, Dr. Daniel Pazos, have placed about 80 implants per month with the technology. When asked about the advantages he'd observed when performing robotic surgery, Dr. Hall said, "Postoperative pain is greatly decreased. It's more accurate. It could take an amateur surgeon and turn him into a really good surgeon. For example, when Dr. Pazos came to my office, he had placed eleven implants in postgraduate resident training, and that was the sum of his knowledge base. Now he has been doing some high level implant training courses, but as far as the implants go, I don't think you could tell the difference between an implant placed by him or by me, and I've been doing it 35 years.

"They say this system takes a good dentist and turns him into a perfect dentist. As dentists, we were taught perfection in dental school, to strive for it."

Dr. Hall chose to incorporate robotic implant surgery into his practice after

Above: Dr. Bradley Hall and assistants Dr. Timovitch Popov and Chloe Clark.

Left: The Yomi® robotic system for dental implant surgery[1,8]

seeing a Neocis demonstration. "A rep visited me. They have several of the robots in different buses, and they'll come out and do a demonstration. It was very interesting. They show you a typodont with a CT scan, how you place the implants into the software, and then how it works on an actual jaw.

"So that's how I got into it. Since I started practicing years ago, I've always liked technology. Some of the technologies I bought were fakes, and some of them turned out to be really good for dentistry, like the CEREC I use every day. When I saw the robot, I felt that there was a need for it."

The team's in-office training took place over four days, with the first two devoted to didactic and hands-on training, and the third and fourth days spent doing surgery on patients. Dr. Hall said, "The company's really good. For the first fifty surgeries, a technician was here supervising. I wanted them to go away a lot sooner, but it was fifty."

Surgical robotic systems have four major components: the preoperative planning software, the dynamic navigational technology, the patient-tracking and surgical robotic arms, and an intraoral reference splint,[4,5,7] named the "YomiLink" in this system. In addition to the doctor and the surgical assistant, the technology requires a "driver," an assistant who coordinates the link between the patient, the CBCT scan, and the robotic arms, monitoring the dynamic guidance throughout the procedure.[5,7] For this case, Dr. Hall's treatment plan was to extract fractured tooth #4 (**Fig. 1**) and place a BioHorizons 3.8 x 12 implant and a bone graft with platelet-rich fibrin (PRF). His plan included a sinus floor elevation using Densah burs.

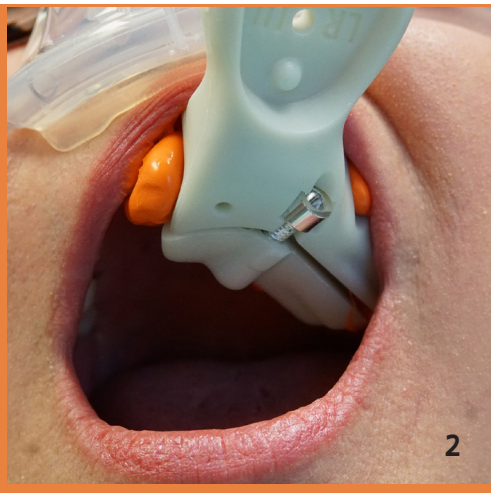
The initial clinical procedure was a venipuncture to obtain the patient's PRF. Next, since the surgery would be on the maxillary right, the YomiLink was placed on the maxillary left. It consisted of a small impression tray filled with "a very hard impression material, harder than Blu-Mousse®. It's very hard to take off," Dr. Hall said. Once set, the tray was attached to a fiducial array, a device with small round bearings which, when included in the patient's CBCT scan, establishes accurate reference points between the patient's anatomy and the navigational software[5] (**Fig. 2-6**).

Following Dr. Pazos' planning of the implant's position in the patient's new CBCT scan (**Fig. 7-9**), the fiducial array was removed from the YomiLink intraoral reference splint. Dr. Hall extracted the roots of tooth #4 atraumatically. The passive patient-tracking robotic arm was connected to the intraoral reference splint,[8,5,8] and Dr. Hall and dental assistant Chloe Clark, the procedure's driver, calibrated the robotic guidance arm and handpiece with the Yomi software, using a preselected landmark [5,7-9] (**Fig. 10**). Next, Dr. Hall moved the robotic guidance arm into position, with a 1.5 pilot drill inserted into the handpiece. (**Fig. 11-12**). Once the handpiece was near the surgical site, it entered "guided mode," locked into the predetermined site and angulation and only allowing vertical movement.[3,5,7]

"You bring the handpiece over, and once you get within a centimeter of the area, the guiding begins," Dr. Hall said prior to the appointment. "It tells you what angle to put your handpiece, to move it lingual, distal, buccal, whatever… The actual placement is going to be less than five minutes by the time we start doing the osteotomy. A beeper goes off, and you know you're done."

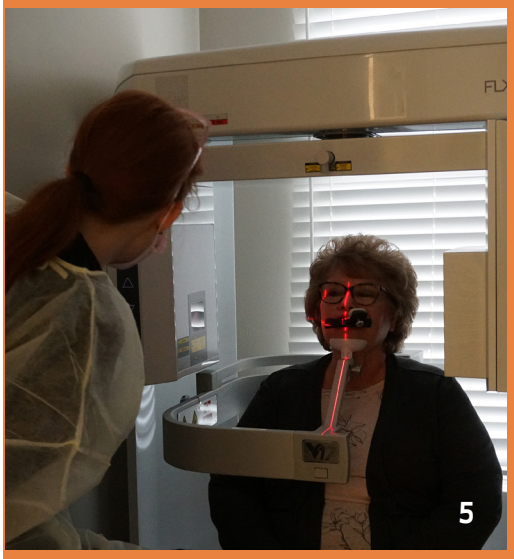
After completion of the osteotomy (**Fig. 13**), Dr. Hall performed a crestal sinus floor elevation with a Densah® bur[11] inserted into the robotic handpiece (**Fig. 14**). In the Densah sinus lift technique, the burs are first used in clockwise rotation to cut bone and then counterclockwise



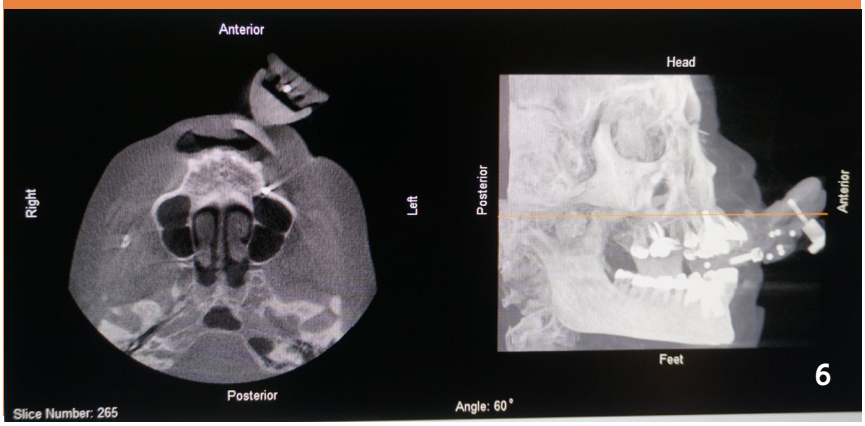








Preparation for robotic guided implant surgery. Fig. 1. Fractured tooth #4. Fig. 2. Intraoral splint, i.e. the YomiLink. Fig. 3. The fiducial array... Fig. 4. ... attached to the YomiLink. Fig. 5. CBCT scan with the splint and fiducial array. Fig. 6. The CBCT scan with the array.





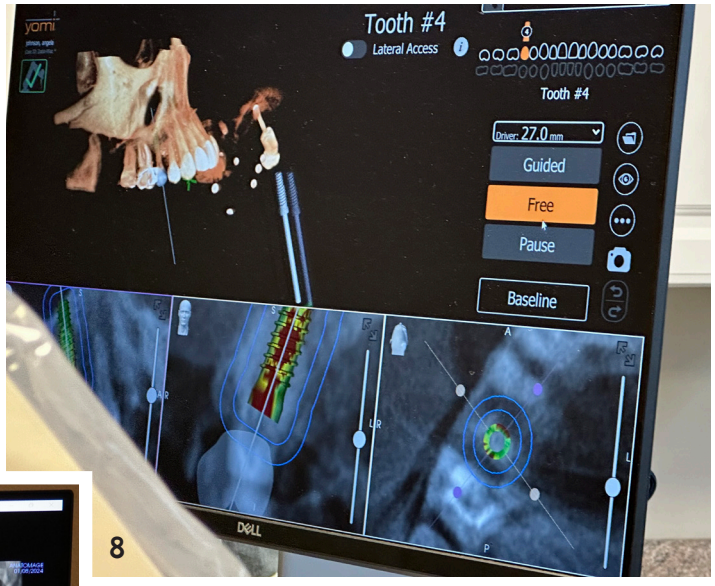




Fig. 7-9. Dr. Daniel Pazos plans the robotically assisted implant surgery.

to produce osseodensification, in which the autogenous bone fragments are compacted both at the bur's tip and in the lateral walls of the osteotomy.[11-17] When compared with the usual subtractive osteotomy preparation, osseodensification has been shown to significantly increase primary implant stability as well as require a higher torque for implant insertion.[12-14] Imaging studies have documented a layer of greater bone density apically and on the lateral walls of densified osteotomies, with three times the amount of bone present in these regions compared to standard osteotomies.[12] In addition, the Densah technique reduces the common risk of Schneiderian membrane perforation and eliminates the mild trauma the patient experiences with sinus floor elevation using osteotomes.[15,16] As the autogenous bone gradually accumulates, it separates the membrane and lifts it off the sinus floor.[12-17]

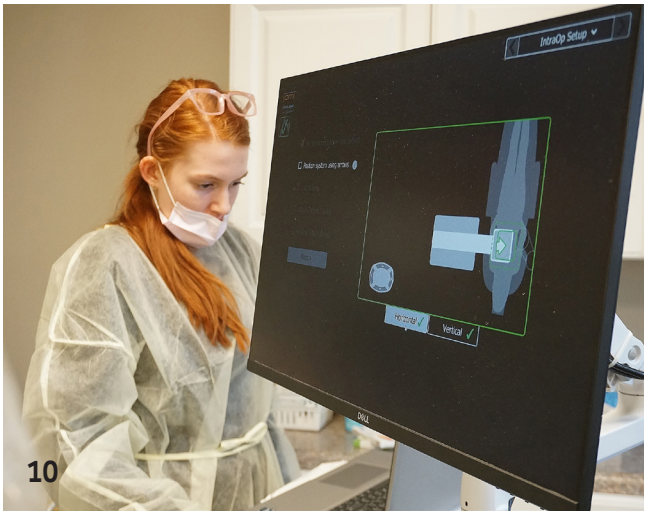
Following the osseodensification and sinus floor elevation, Dr. Hall inserted a 3.8 x 12 BioHorizons implant with the robotic handpiece (**Fig. 15**). After placement of a healing abutment, a bone graft was placed, consisting of the patient's PRF in a 30:70 mix of NovaBone® bioactive synthetic bone and AlloSculpt-3D, demineralized cortical allograft putty with cortical and cancellous chips. The site was sutured with a SurgiPoint® 4-0 polyglecaprone monofilament suture (**Fig. 16**). Both the Yomi software and post-operative radiographs revealed the successful immediate implant placement and sinus floor elevation (**Fig. 17**).

Dr. Hall said, "After placing the number of implants I have with Yomi, I don't think I would voluntarily ever go back to placing them free handed or with a surgical guide. It just is that big of a difference, as far as accuracy, less stress on the patient, and less postoperative pain. It's just really a nice way to do it."¶

*Phone conversation between Dr. Alon Mozes and the author, January 22, 2024.

References

1. Yomi at a glance. (2024). Neocis, Inc. Accessed January 30, 2024. https://www.neocis.com/products-and-services/yomi-robot/
2. McCartney J. Robotic surgery is here to stay – and so are the surgeons. ACS Bulletin 2023; 108(5):16-23. https://www.facs.org/for-medical-professionals/news-publications/news-and-articles/bulletin/2023/
3. Dibart S, Kernitsky-Barnatan J, Di Battista M, et al. Robot assisted implant surgery: Hype or hope? J Stomatol Oral Maxillofac Surg. 2023 Dec;124(6S):101612. doi:10.1016/j.jormas.2023.101612.
4. Wu Y, Wang F, Fan S, et al. Robotics in dental implantology. Oral Maxillofac Surg Clin of N Amer. 2019; 31 (3): 513-18.
5. Mozer P. Accuracy and deviation analysis of static and robotic guided implant surgery: A case study. Intl J Oral & Maxillofac Implants. 2020; 35 (5), pe86-e90. doi:10.11607/jomi.8231.
6. Shilpa S, Kiran J. Dynamic 3D navigation systems for dental implant surgery: A review. J Dent Health & Res. 2023; 4(1), 36-38.
7. Ansari R. Robotically-guided dental implant placement: Extending surgical expertise. Oral Health J. Jul/Aug 2020; 110 (7): 10-11. https://www.oralhealthgroup.com/features/robotically-guided-dental-implant-placement-extending-surgical-expertise/
8. Ali M. Flapless dental implant surgery enabled by haptic robotic guidance: A case report. Clinical Implant Dentistry and Related Research. 2023; 1-7. doi:10.1111/cid.13279
9. Compendium. Achieve implant placement according to plan with Yomi® robot-assisted surgery. Compendium of Cont Ed in Dentistry. 2021; 42 (8): 472.
10. Fatani B. Robotically assisted dental implant surgery: A narrative review of recent updates. Saudi J of Oral Sci. 2023; 10(1): 3-7. doi:10.4103/sjoralsci.sjoralsci_51_22
11. Versah® https://versah.com/clinical-versahtility/
12. Hulwais S, Meyer EG. A novel osseous densification approach in implant osteotomy preparation to increase biomechanical primary stability, bone mineral density, and bone-to-implant contact. Int J Oral Maxillofac Implants. 2017; 32 (1): 27-36. doi: 10.11607/jomi.4817
13. Althobaiti AK, Ashour AW, Firas A Halteet FA et al. A comparative assessment of primary implant stability using osseodensification vs. conventional drilling methods: A systematic review. Cureus. 2023; 15(10): e46841. doi: 10.7759/cureus.46841
14. Bergamo ETP, Zahoui A, Barrera R, Huwais S, et al. Osseodensification effect on implants primary and secondary stability: Multicenter controlled clinical trial. Clin Implant Dent Relat Res. 2021; 23(3):317-328. doi: 10.1111/cid.13007.
15. Shalash M, Mounir M, Elbanna T. Evaluation of crestal sinus floor elevation in cases exhibiting an oblique sinus floor with a residual bone height of 4.0-7.0 mm using Densah burs with simultaneous implant placement: A prospective clinical study. Int J Implant Dent. 2023; 9(1):41. doi: 10.1186/s40729-023-00510-1.
16. Puterman I, Weinstein B, Walton P, Fine M. The modified osseodensification visco-elastic (MOVE) sinus protocol: A case series to illustrate the combination of osseodensification with viscoelastic bone replacement material. Clin Adv Periodontics. 2022;12(3):180-185. doi: 10.1002/cap.10188
17. Neiva R, Tanello B, Duarte W, et al. Ossodensification crestal floor elevation with or without synthetic and resorbable calcium phosphosilicate putty. Clinical Oral Implants Research. 2018; 29 (S17): 446-446. doi:10.1111/clr.331_13358

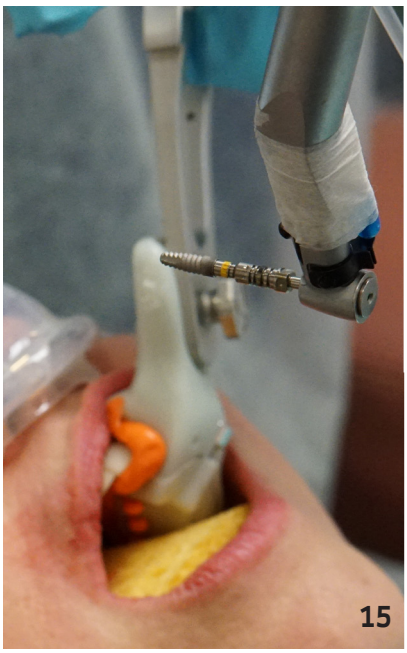














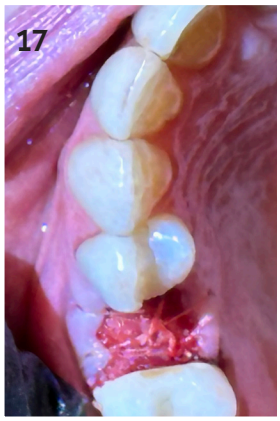




Fig. 10. Calibration of the dynamic guidance software. Fig. 11. Movement of the robotic guidance arm toward the patient. Fig. 12. A pilot drill is moved to the surgical site as the passive robotic arm tracks the patient's position. Fig. 13. The osteotomy preparation continues. Fig. 14. Osseodensification with a Densah bur. Fig. 15. The implant is inserted with the robotic guidance arm. Fig. 16. Post-surgical radiograph. Fig. 17. The site is grafted and sutured.

Fig. 18, from left: Drs. Tim Popov, Kerry Leonard, Daniel Pazos, and Bradley Hall, assistant Chloe Clark.