Robotic Assisted Implant Surgery – Clinical Benefits and Limitations

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INTRODUCTION

Since the launch of the first robotic surgical system in the early 2000s, the medical community has performed more than I million robotic assisted surgeries a year. In dentistry, however, the trend towards robotic assisted implant surgery is comparatively in its nascent stage. Despite an initial low penetration rate in the market, it is gaining popularity due to its improved accuracy and precision. The original FDA approval of robotic surgery was for placement of implants in partially and fully edentulous patients. Considering its precision and accuracy, there are a few additional applications that have evolved which include Immediate Implant Placement, Immediate Provisionalization, Customized Alveolar Ridge Splitting (CARS), Implant placement Lateral to the Inferior Alveolar Nerve (ILIAN) and sinus floor elevation. The purpose of this presentation is to demonstrate clinical cases with various indications, advantages, and drawbacks of robotic assisted implant surgery.

MATERIALS AND METHODS

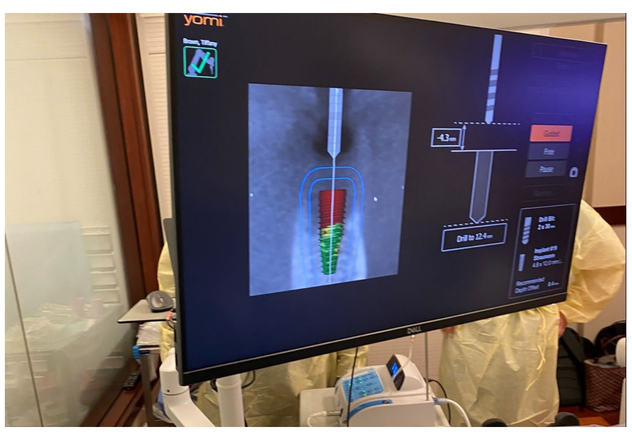
Guided implant surgery is not a new concept. It has been utilized for several years to improve accurate positioning of the dental implant, which is a key factor in successful treatment outcomes. However, newer robotic assistance technology takes guided implant surgery to another level of accuracy and precision.

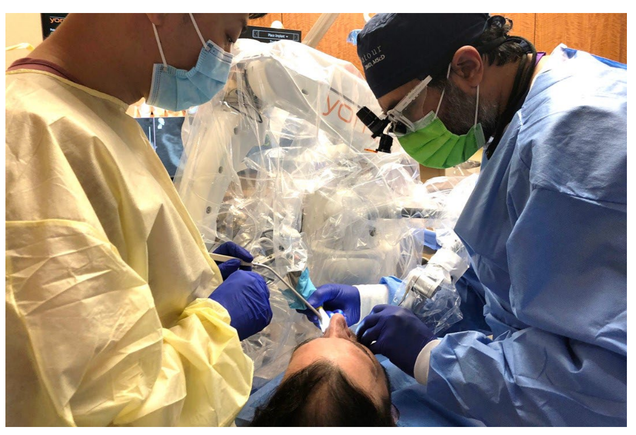
Robot-assisted surgery offers haptic robotic guidance to intensify the skilled implant dentistry teams' clinical expertise and delivers repeatable surgical precision. It is specifically designed to provide a minimally invasive approach, leading to faster surgery, faster recovery, and less pain for a patient.

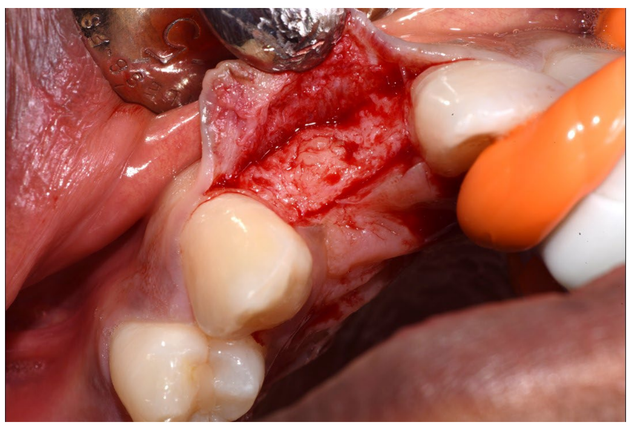
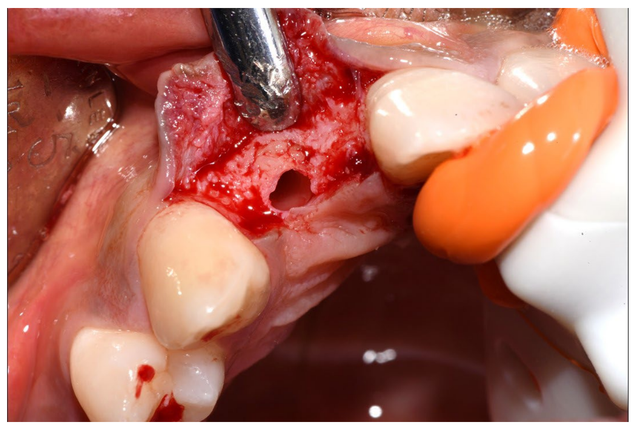
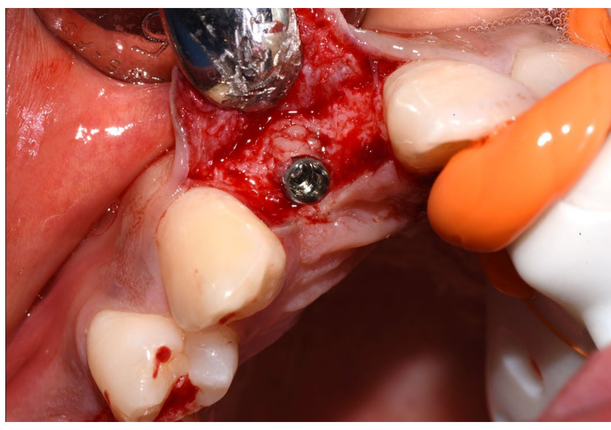
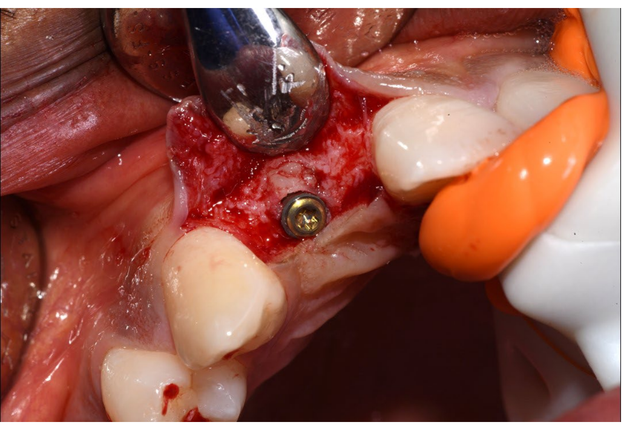
The procedure is planned virtually on the patient's CBCT scan based on restorative goals, similar to other digitally-driven procedures. In contrast to such procedures,

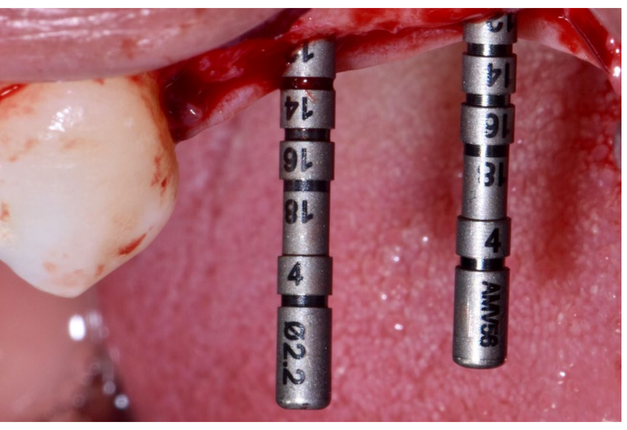
The Yomi surgical plan may be designed in advance or on the same day as the implant placement procedure. Yomi Plan, an integrated planning software, accepts DICOM files from CBCT scanners as well as STL files from intraoral scanners, to allow for prosthetically-driven treatment planning. In preparation for the surgical procedure, an intraoral splint is affixed to patient dentition contralateral to the surgical site. This splint provides a fixed location from which the patient DICOM file is first registered to the Yomi system and then tracked intraoperatively. An array of materials may be used to line the splint for mechanical retention. A fiducial array is magnetically attached to the intraoral splint and a DICOM image is obtained of metal beads embedded on the fiducial array and of the surgical area.

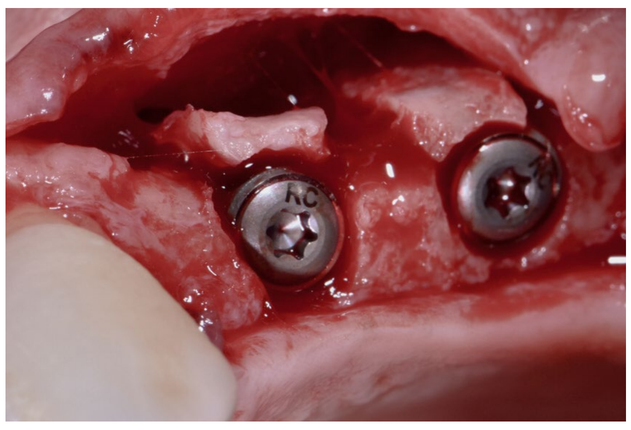
SEQUENCE OF PROCEDURE





	Limitations of conventional procedure	Advantages with Robotic Assisted Implant Surgery
IIP	• Difficult to achieve SRIR • Difficult to maintain angulation • Difficult to profile • Difficult to redrill to place deeper	• Maximize for SRIR • Can maintain precisely • Allow precise profiling • Allow redrilling with precision
CARS	• Difficult to maintain depth • Difficult to find weak area of fracture • Difficult to angulation for central fossa • Possible vibration	• Maintain depth • Can estimate weak area • Maintain precision • Minimize vibration
ILIAN	• Possible nerve damage • Difficult to maintain implant angulation for central fossa • CIL ratio can be compromised	• Nerve damage can be avoided • Easily control angulation for central fossa and avoid damage to IAN • Can maximize CIL ratio
MSA	• Difficult to place septum area • Possible deviation BL direction • Difficult to engage ant slope area • Difficult to engage sinus floor bone	• Allow precise use of septal area • Keep exact position • Keep exact position • Allow to engage sinus floor bone

IIP: Immediate Implant Placement, CARS: Custom Alveolar Ridge Splitting, SRIR: Screw Retained Implant Restoration, ILIAN: Implant Lateral to Inferior Alveolar Nerve, MSA: Maxillary Sinus Augmentation, CIL: Crown Implant Length Ratio, IAN: Inferior Alveolar Nerve

CONCLUSION

Robot-assisted surgery offers haptic robotic guidance to intensify the skilled implant dentistry teams' clinical expertise and delivers repeatable surgical precision. It is specifically designed to provide a minimally invasive approach, leading to faster surgery, faster recovery, and less pain for a patient. Robotic assisted implant surgery is a viable alternative treatment option in a variety of off label uses as well as to perfect conventional implant placement

Nevertheless, more clinical research and long-term follow-up are. needed to validate the use of robotic assisted surgery for a variety of clinical uses

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