# Virtual Reality and Augmented Reality in Oral Implantology

**Asha S Hariharan***

*Department of Prosthodontics, Saveetha Dental College and Hospitals, Chennai, India*

***Corresponding author:**

**Received date:** December 03, 2021; **Accepted date:** December 17, 2021; **Published date:** December 24, 2021

**Citation:** Hariharan AS (2021) Virtual Reality and Augmented Reality in Oral Implantology. J Oral Hyg Health 9: 295.



## Abstract

To provide insight into virtual reality/augmented reality in oral implant ology. Oral Implants are currently an established treatment modality in fixed prosthodontics. It requires a certain amount of advanced skill gained from theoretical and extensive clinical experience. With the recent introduction of three-dimensional (3D) diagnostic and treatment planning technologies in implant dentistry, a team approach to the planning and placement of dental implants, according to a restoratively driven treatment plan, has become the norm in quality patient care. Incorporation of virtual reality in the education and treatment planning in implant ology could revolutionize the practical patient management in clinical scenario. This study hence aims to spread awareness on the methods and equipment required for virtual/augmented which could change the way we learn and teach. With computer assisted procedures becoming more and more part of dentistry, the introduction of virtual reality and augmented reality based teaching, treatment planning and simulation software's has opened avenues to better understanding, diagnosis and treatment and created an interdisciplinary environment in which communication leads to better patient care and outcomes. Combining virtual and augmented reality aided software in implant dentistry provides trainees and dentists a holistic learning experience on anatomical knowledge, spatial visualization, judgment and inter-professional teamwork. Dentistry has got practically little attention from VR research, yet it is rapidly becoming an often used therapeutic aid in orthopedics and neurophysiologic procedures. This review can hence become a source of reference on virtual and augmented reality in oral implantology.

**Keywords:** Oral implants; Prosthodontics; Implantology; Neurophysiologic; Oral implantology

## Introduction

[illegible] on Introduc[illegible]ductan[illegible]oduction

## Haptics

The word ‘haptic’ means something that relates to or precedes the sense of touch. A haptic interface is a device that allows a user to interact with a three-dimensional (3D) image on a computer by receiving tactile feedback. This perception relies on the degree of opposing force applied to the user *via* the operation of a manipulator. In implant dentistry, the inclusion of haptic incorporated software enables learning operators to grasp the feeling of bone drilling similar to an actual surgery, and to better understand the tactile sensation of different bone types. Training systems in dental implantology require precise haptic feedback and hence require six degrees of freedom, which includes three translational forces and three rotational torques to render all forces applied to a drilling tool [6-8].

Haptic devices and simulation of bone drilling: Virtual bone drilling can be categorised into two techniques the voxel based approaches and the implicit surface based approaches. The voxel based approach uses volume data as the collision model, the advantage of this being that the drilling simulation is not limited to the shape of the tool, but voxelization leads to loss of surface information of the tool. On the other hand, when implicit surface based approach can render accurate collision detection, it can only represent simple geometry such as sphere, cone and cylinder. As dental implant surgery involves removal of some portion of alveolar bone it is represented as volume data, typically a 3D discrete regular grid of voxels. Each voxel has density property similar to that of the remaining bone and when the drill collides with the bone its value decreases according to the bone removal rate. The bone removal rate is logarithmically proportional to the thrust force, such that in a controlled haptic cycle greater the thrust force greater the bone removed which is then tuned to the implantologist for real time feedback. Vibrations are generated when a sinusoidal force is combined with the force feedback which is controlled for realistic haptic feedback.

## Categories of virtual reality

**[illegible] virtual reality: [illegible]**

**[illegible]**

European market and has been proven its practicability in more than 100 successfully navigated implantations [19].

**Impala System:** Developed by Premedical, Sydney in 2015. Based on optical live tracking technology, Impala provides an environment for implant surgery planning and a dual solution for improving the accuracy and safety of surgical procedures in combination with automatic drill guide generation and live tracking of surgical instruments. This system provides full volume interactive intra-surgery navigation and finds application in flapless surgeries, for angled implants, for use in atrophic sites and even for zygotic implant planning and placement.

**VirtEasy System:** Developed by DIDHAPTIC1. This system consists of two subsets; VirtEasy Scan Implant, VirtEasy Implant Pro. The objective of this system being two parts was to orient the students in planning using the VirtEasy Scan Implant without 3D interface based on a set of case reports and then allow the students to perform virtual surgeries in the VirtEasy Implant Pro that were planned in the scan implant programme. The VirtEasy Implant Pro is programmed with a force feedback mechanism allowing realistic training. VirtEasy implant pro allows force feedback with 6Degrees of freedom and the arm can work in a spherical volume of ten centimeters of diameter.The two systems together create a learning loop which allows preparation-perform-review own activity- regulation [20].

### Dynamic navigation in implant surgery

Technological advancements in virtual and augmented realities has led to its successful application in dental implantology. In dental implantology accurate positioning of the implant is essential for esthetics and functions [21]. With the incorporation of virtual or augmented reality, the preoperative CBCT is used to determine the implant size, position, direction and proximity to vital structures. For this 3D planning is done and this information is transferred using static and dynamic guides to the surgical site. Numerous static guiding systems are available based on CAD CAM which includes Easy Guide, GPIS, Impla 3D, *In vivo* Dental, Implant 3D, Nobel Bioguide and VIP (Implant Logic System). On the flip side the other method for computer assisted surgery is dynamic navigation that allows real time feedback during the placement of the implant. Such surgery has been extensively used in orthopedics, neurosurgery and maxillofacial surgery and is quickly becoming popular in the field of dental implantology. Studies done by Ruppin, and Kang show comparable accuracy between static and dynamic surgeries. Dynamic surgery overcomes certain drawbacks associated with a static guide such as the time associated with impressions and lab procedures required for a static guide and also allows a direct view of the surgical field. Dynamic surgery allows standard drills to be used for surgery which comes handy during cases with limited mouth opening [22].

## Discussion

Dynamic surgery provides room for greater flexibility by allowing alteration of the surgical plan during the time of the surgery in accordance to the surgical site and conditions which would not have been possible with a static guide. A dynamic guide is not restricted by the implant size or the drill tube size and allows planning in a single day. It allows the operator to perform minimally invasive surgery [23]. The possible disadvantage of using dynamic guided surgery in implantology comes with the need to pay attention to the patient as well as the navigation system. The integration of augmented reality through an integrated screen allows the surgeon to visualize, in real-time, patient parameters, relevant x-rays, 3D reconstruction or a navigation system screen [24,25]. This could significantly increase the use of dynamic navigation. Dynamic navigation hence proves to be the future of implant surgery, necessitating the need for further extensive studies.

## Conclusion

New technologies based on 3D evaluation of the patient and computer guided surgeries are expanding the avenues of implantology. It has enabled better understanding, enhanced teaching and learning potential, predictable diagnosis and multi-disciplinary approach to patient management. There is a steep learning curve associated before the successful incorporation of VR/AR guided surgeries hence encouraging the dentists to pursue continued education and training. Digitally augmented learning has also the potential to bring about a paradigm shift in dental education bringing about enhanced psychomotor skills, critical and innovative thinking and evidence-based decision making.

## References


1. Di Giacomo GAP, Cury PR, de Araujo NS, Sendyk WR, Sendyk, CL, et al. (2005) Clinical application of stereolithographic surgical guides for implant placement: Preliminary results. J Periodontol 76: 503-7.
2. Yilmaz RM (2018) Augmented reality trends in education between 2016 and 2017 years. State of the Art Virtual Reality and Augmented Reality 74: 943.
3. Perrenot C, Perez M, Tran N, Jehl JP, Felblinger J, et al. (2012) The virtual reality simulator dV-Trainer® is a valid assessment tool for robotic surgical skills. Surg Endoscop 26: 2587-93.
4. Siessegger M, Schneider BT, Mischkowski RA, Lazar F, Krug B, et al. (2001) Use of an image-guided navigation system in dental implant surgery in anatomically complex operation sites. J Craniomaxillofac Surg 29: 276-81.
5. Lin Y-K, Yau H-T, Wang I-C, Zheng C, Chung K-H, et al. (2015) A novel dental implant guided surgery based on integration of surgical template and augmented reality. Clin Implant Dent Relat Res 17: 543-53.
6. s-[illegible]

14. Durham M, Engel B, Ferrill T, Halford J, Singh TP, et al. (2019) Digitally augmented learning in implant dentistry. Oral Maxillofac Surg Clin North Am 31: 387-98.

15. Binon PP (2007) Treatment planning complications and surgical miscues. J Oral Maxillofac Surg 65: 73-92.

16. Li C, Wang D, Zhang Y (2011) iFeel3: A haptic device for virtual reality dental surgery simulation. In2011 International Conference on Virtual Reality and Visualization 179-184.

17. Casap N, Wexler A, Persky N, Schneider A, Lustmann J (2004) Navigation surgery for dental implants: Assessment of accuracy of the image guided implantology system. J Oral Maxillofac Surg 62: 116-9.

18. Shapira L (2002) Image guided implantology-real-time guidance of dental implant surgery in the operative field using CT-scan image. In CARS 2002 Computer Assist Radiol Surg 959-964.

19. Brief J, Edinger D, Hassfeld S, Eggers G (2005) Accuracy of image-guided implantology. Clin Oral Implants Res 16: 495-501.

20. Granger S, Pennec X, Roche A (2001) Rigid point-surface registration using an EM variant of ICP for computer guided oral implantology. InInternational Conference on Medical Image Computing and Computer-Assisted Intervention 752-761.

21. Lueth TC, Wenger T, Rautenberg A, Deppe H (2011) RoboDent and the change of needs in computer aided dental implantology during the past ten years. In2011 IEEE International Conference on Robotics and Automation 1-4.

22. Srinivasan MA, Basdogan C (1997) Haptics in virtual environments: Taxonomy, research status, and challenges. Comput Graph 21: 393-404.

23. Kwon HB, Park YS, Han JS (2018) Augmented reality in dentistry: A current perspective. Acta Odontol Scand 76: 497-503.

24. Jemt T (2017) A retro-prospective effectiveness study on 3448 implant operations at one referral clinic: A multifactorial analysis. Part II: Clinical factors associated to peri-implantitis surgery and late implant failures. Clin Implant Dentist Relat Res 19: 972-9.

25. Vardar-Sengul S (2011) Computer-assisted implant dentistry: Possibilities and limitations. Practical Osseous Surgery in Periodontics and Implant Dentistry 28: 203-26.