EUROPEAN JOURNAL OF PHARMACEUTICAL
AND MEDICAL RESEARCH
www.ejpmr.com

DIGITAL IMPRESSIONS IN IMPLANT DENTISTRY: A PARADIGM SHIFT TOWARDS PRECISION AND EFFICIENCY

Dr. T. Sai Bhavana[*], **Dr. CH. Siddesh Kumar, Dr. L. Srikanth, Dr. Majji Vasavi, Dr. KVS Dakshayani and Dr. Macherla Juhi**

IInd Year Post Graduate Student, Department of Prosthodontics & Crown and Bridge, Sree Sai Dental College & Research Institute, Srikakulam, Andhra Pradesh, India.

*Corresponding Author: Dr. T. Sai Bhavana

IInd Year Post Graduate Student, Department of Prosthodontics & Crown and Bridge, Sree Sai Dental College & Research Institute, Srikakulam, Andhra Pradesh, India.

ABSTRACT

Digital impressions have revolutionized the field of implant dentistry, offering clinicians advanced tools to enhance accuracy, efficiency, and patient comfort. This comprehensive review explores the key aspects of digital impressions in implantology, encompassing technological advancements, clinical applications, and the impact on treatment outcomes.

KEYWORDS: Digital Impressions, Intraoral scanning, Intra oral scan body, Implant Dentistry, CAD/CAM.

A. INTRODUCTION

In the evolving modern dentistry, integration of digital technology has catalyzed transformative changes in various clinical practices. One notable advancement that has revolutionized the field of implant dentistry is digital impressions. Traditional methods of obtaining physical molds have given way to a more sophisticated and precise approach, whereas intraoral scanners capture detailed, three-dimensional images of the oral environment.

This paradigm shift has not only redefined the workflow of implant treatments but has also significantly improved the accuracy, efficiency, and overall patient experience. Digital impressions offer clinicians a powerful set of tools that extend beyond mere data acquisition, influencing every stage of implant therapy from preoperative planning to the final delivery of prosthetic restorations**.**

B. DIGITAL IMPRESSION TECHNOLOGY

Digital impression technology involves the use of advanced imaging systems and digital scanners to create highly accurate and detailed three-dimensional representations of a patient's dental structures, eliminating the need for traditional physical molds.

COMPONENTS[3][8]

Intraoral scanners: These are the compact devices that use optical or laser technology to capture highly detailed digital impressions and create virtual models of the intra oral structures i.e, teeth and gingiva there by eliminating the need for traditional impressions.[3]

CAD (Computer-Aided Design): Software that processes the digital data captured by intraoral scanners to create virtual 3D models of the patient's oral anatomy.

CAM (Computer –Aided Manufacturing): Utilized for the fabrication of dental prosthetics based on the digital models generated through CAD.

ADVANTAGES[2][6]

1. Precision & Accuracy: Digital impressions provide highly precise and accurate representations of dental structures, minimizing errors associated with traditional impression materials.

2. Patient comfort: The non-invasive nature of digital impression technology improves patient comfort, eliminating the discomfort often associated with traditional molds.

3. Efficiency: Streamlining the workflow, digital impressions reduce chair time and enable faster communication between dental teams, laboratories, and manufacturers.

4. Customization: Integration with CAD allows for detailed customization of prosthetic components, leading to highly personalized and aesthetically pleasing restorations.

5. Improved communication: Digital impressions facilitate seamless communication among dental professionals, fostering collaborative treatment planning and execution.

6. Easy and selective repeatability: Repetition of scan can be done easily and can be limited to the effected area only in case of fluid contamination at the site of interest.

DISADVANTAGES[7]

1. The precision of digital impressions can be affected by factors such as scanner calibration and technique sensitivity. However, advancements in technology continue to address these issues.
2. Some patients may still find the scanning process mildly uncomfortable, particularly if they have a strong gag reflex [10].
3. Initial setup costs and a learning curve for dental professionals may be perceived as drawbacks. However, the long-term efficiency gains often offset these considerations.
4. The level of customization may depend on the proficiency of the dental professional in using CAD software.

C. APPLICATIONS IN IMPLANT DENTISTRY

1. Guided implant surgery & prosthetic planning: Understanding the role of digital impressions in guided surgery and prosthetic-driven planning for optimal implant outcomes.

2. Immediate loading with digital impressions: Exploring the possibilities of immediate loading and provisional restoration through rapid digital impression techniques.

CHALLENGES & CONSIDERATIONS

Learning curve: Adoption of digital impression technology may require training for dental professionals to become proficient in its use.

Cost: Initial investments in digital impression equipment can be significant, but long-term benefits often outweigh the upfront expenses.

D. TECHNIQUE

The digital workflow can be either direct or Indirect.[1] The indirect workflow involves making a conventional implant impression, which is then digitized in the laboratory by using an extra oral optical scanner and laboratory scan bodies. Direct workflow requires intraoral scanner and Implant scan body to obtain digital scan directly from patients mouth.

Scan bodies[1]

Scan body is a type of fiducial marker referring to a transfer coping that is connected to an implant intraorally or to an implant analog in a master cast to enable the implant dimensions and position to be acquisitioned during an optical scan.

Intra oral scan body (ISB) has 3 components- Scan region, Body and Base. They are made of different materials like Titanium, PEEK. They are autoclavable and can be reused.
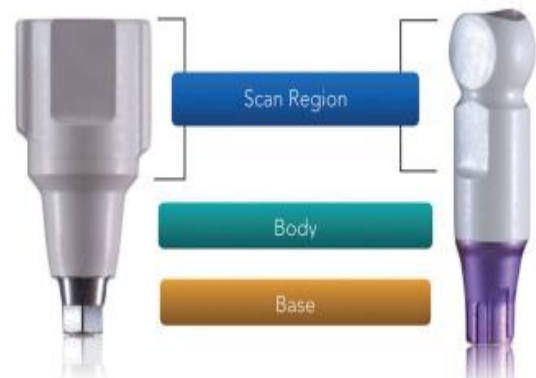

Fig. 1: Parts of ISB (Intraoral Scan Body).[1]

There are many types of scan bodies (fig 2)[1], choice of scan bodies depends on factors such as the implant manufacturer, implant platform, the type of restoration, and the digital impression system used. The type of surface of the material to be scanned will also effect the scan accuracy because dull, smooth and opaque surfaces are easier to scan than shiny and rough surfaces.

Fig 2: Commercially available Intra oral scan bodies.[1]

E.STEPS IN IMPLANT DIGITAL IMPRESSION[4][9][11]

The following are the steps to obtain digital scan of implant

- First both upper and lower arches scan was obtained, later healing abutment will be removed. The implant connection is visible after removal of the healing abutment.

- Now the scan body is placed and secured into the implant before scanning. These scan bodies should be compatible with the implant systems width and connection type and also with the type of abutment being manufactured.

- Once the scan body is placed, proper seating of the scan body is confirmed radio graphically to assure there is no gap between the implant and the scan body.
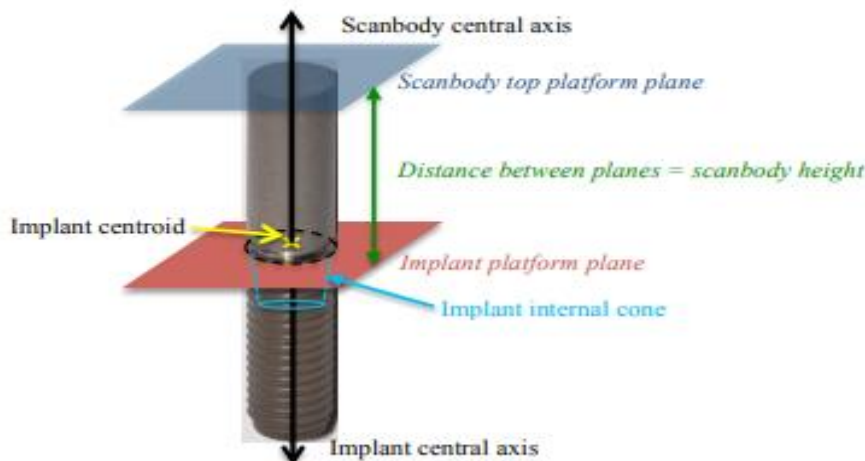

Fig. 3: Implant Centroid.

- Implant centroid was defined by constructing a pierce point between the central axis of the virtual scan body/implant internal cone and the implant platform plane.[9]

- After placing Scan body using intraoral scanner, scan process is done for both the arches and finally bite scan is done.

- For multiple implants , multiple scan bodies can be placed and are scanned one after other sequentially (or) single scan body can be placed and after scanning the implant the same scan body can be removed and is placed in the other implant and scan process is done in an order.

- The scan bodies aid in capturing raw data in the form of cloud points and surface reconstruction is done by using highly specific software algorithms into single virtual image.

- Once the ISB surface has been recreated digitally, it must be exported in the form of a standard tessellation language (STL) file. Now the exported file is imported into dental CAD software program to recognize and match the scan body surface and position the implant analog in digital model and finally the prosthesis is milled through CAD –CAM.
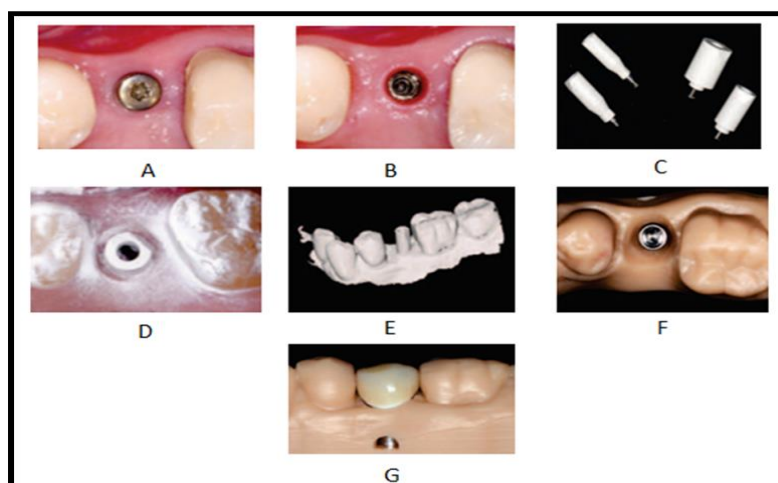

Fig. 4: Steps In Implant Digital Impression.[4]

A. Healing abutment, **B.** Visible implant connection after removal of healing abutment **C.** single piece scan bodies **D**. scan body in place dusted with contrast spray **E**. Scan with scan body in place **F**. Implant model with implant analog **G**. Final restoration.

F. FUTURE TRENDS
1. Integration with Artificial Intelligence: Advances in AI are likely to enhance the capabilities of digital impression systems, improving automation and diagnostic capabilities.

2. Enhancements in scanning speed & Accuracy: Ongoing technological developments aim to further enhance the speed and accuracy of digital scanners, making the process even more efficient.

G. CONCLUSION
Digital impressions have emerged as a game-changer in implant dentistry, revolutionizing the way practitioners approach impression-taking and prosthetic fabrication. The precision, efficiency, and improved patient experience associated with digital impressions underscore their significance in modern dental practice. As the technology continues to evolve, it holds the potential to redefine the standard of care in implant dentistry, offering clinicians and patients a more predictable and streamlined treatment journey.

REFERENCES
1. Mizumoto RM, Yilmaz B. Intraoral scan bodies in implant dentistry: A systematic review. *J Prosthet Dent*. 2018; 120(3): 343-352.
2. Christensen GJ. Impressions are changing: deciding on conventional, digital or digital plus in-office milling. *J Am Dent Assoc,* 2009; 140(10): 1301-1304.
3. Ziyad S Haidar (2023), Digital Dentistry: Past, Present, and Future. Digital Medicine and Healthcare Technology, 2023; (2): 1–16.
4. Digital impression in an implant –prosthetic workflow-3M.
5. Brandt J, Lauer HC, Peter T, Brandt S. Digital process for an implant-supported fixed dental prosthesis: A clinical report. *J Prosthet Dent,* 2015; 114(4): 469-473.
6. Zimmermann M, Mehl A, Mörmann WH, Reich S. Intraoral scanning systems - a current overview. *Int J Comput Dent,* 2015; 18(2): 101-129.
7. Priyanka G, Sujesh M, Kumar R, et al. Digital impressions in prosthodontics–past, present and future trends. IP Annals of Prosthodontics and Restorative Dentistry, 2020; 6: 66-70.
8. B Venkatesh, Swapna & Kamath, Vignesh. Digital impressions in prosthodontics -an overview. Journal of Critical Reviews. 7. 2020.
9. Tan, M.Y., Yee, S.H., Wong, K.M., Tan, Y.H., & Tan, K.B. (2019). Comparison of Three-Dimensional Accuracy of Digital and Conventional Implant Impressions: Effect of Interimplant Distance in an Edentulous Arch. *The International journal of oral & maxillofacial implants, 34 2:* 366–380.
10. Ahmed S, Hawsah A, Rustom R, et al. Digital Impressions Versus Conventional Impressions in Prosthodontics: A Systematic Review. *Cureus*. 2024; 16(1).
11. Ramsey CD, Ritter RG. Utilization of digital technologies for fabrication of definitive implant-supported restorations. *J Esthet Restor Dent,* 2012; 24(5): 299-308.
12. Lee, S.J., Lee, J.D. Digital Impressions for Implant-Supported Fixed Dental Prostheses. *Curr Oral Health Rep,* 4: 136–141.
13. Joda T, Wittneben JG, Brägger U. Digital implant impressions with the "Individualized Scanbody Technique" for emergence profile support. *Clin Oral Implants Res,* 2014; 25(3): 395-397.
14. Marques S, Ribeiro P, Falcão C, et al. Digital Impressions in Implant Dentistry: A Literature Review. *Int J Environ Res Public Health,* 2021; 18(3): 1020.