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Editorial

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The Challenges and limitations of digital Impressions in Indian dentistry

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Introduction

The fabrication of a definitive prosthesis relies fundamentally on the accuracy of the impression, which is traditionally considered the most challenging and time-consuming chairside operation in maxillofacial prosthetics. The advent of digital dentistry, specifically intraoral scanning (IOS) and photogrammetry, has the potential to revolutionize this landscape by enabling data acquisition in as little as 3-5 min while eliminating the discomfort of conventional materials [1]. In the Indian dental context, the transition from analog to digital workflows is gaining momentum, driven by the potential for superior precision and enhanced patient satisfaction. However, despite the clear clinical advantages, widespread integration remains limited. This editorial examines the current state of digital impressions in India, highlighting the dichotomy between clinical accuracy and practical barriers, such as economic, educational, and infrastructural aspects, that limit their routine adoption in dental practice.

Clinical Accuracy: The Single-Unit versus Full-Arch Dichotomy

The primary driver for adopting digital impressions is the promise of enhanced accuracy, particularly in fixed prosthodontics. Systematic reviews and meta-analyses conducted in the Indian context have consistently validated the superiority of single-unit restorations. Research indicates that digital impression techniques provide better marginal and internal fit for ceramic crowns than conventional methods [2]. Specifically, CAD/CAM crowns fabricated from direct digital scans exhibited significantly better marginal fit than those produced from indirect digitization of conventional casts, with mean marginal differences favoring the direct digital workflow by approximately 6.5 µm [2,3].

Recent comparative studies have further elucidated these benefits. When evaluating marginal fit, combined digital workflows (digital impression plus CAD/CAM) achieved marginal gaps as low as 75 ± 8 µm, significantly outperforming the 120 ± 15 µm gaps observed with intraoral digital impression systems alone, and edging out conventional impression procedures, which averaged 80 ± 10 µm [4]. These data suggest that while digital acquisition is potent, its integration into a complete digital workflow is where maximum clinical precision is realized.

However, the application of digital impressions to complex full-arch and edentulous rehabilitation presents nuanced challenges. While intraoral scanners have shown significantly lower linear and angular deviations than conventional open-tray impressions in edentulous arches, the absence of stable anatomical landmarks remains a significant challenge [5]. For full-arch implant-supported prostheses, stereophotogrammetry has emerged as the most accurate modality, outperforming both standard IOS and conventional techniques across the entire procedural workflow [6].

Technical Limitations in Complex Implant Rehabilitation

In the specific context of implant prosthodontics, the accuracy of the digital impression is not solely a function of the scanner but also of the scan bodies used in the impression. In vitro studies conducted in India have demonstrated that the quantity of scan bodies significantly influences the trueness of the master cast. For "All-on-4" configurations, reliable results can be achieved with as few as two intraoral scan bodies, although four are recommended for optimal angular accuracy. Conversely, "All-on-6" situations require a complete set of six scan bodies to ensure the passive fit of the verification jig [7]. This requirement

adds a layer of technical complexity and inventory costs that may deter practitioners from adopting fully digital workflows for complex cases.

Barriers to Adoption: Economic, Educational, and Infrastructural

Despite the documented clinical success, a significant "awareness-practice dissonance" exists among Indian dental professionals. Surveys focusing on advanced digital tools, such as photogrammetry, have revealed that while awareness levels are moderate (approximately 62%), clinical utilization remains critically low, often under 15% [6]. This gap is mirrored in related digital fields, such as AI-assisted prosthetic planning, where 68% of practitioners are aware of the technology, yet only 23% have implemented it [8].

The impediments to adoption are multifaceted and include high equipment costs, which are cited as the primary barrier, with 78% of professionals identifying them as major hurdles. Furthermore, the lack of formal training is acute; 73% of practitioners report a lack of hands-on training as a barrier, and 85% support the integration of these technologies into postgraduate curricula [6]. Beyond these immediate factors, broader infrastructural issues, such as connectivity and network stability, pose challenges to the seamless data transmission required for digital dentistry and teledentistry in India [9].

Patient-Centered Outcomes versus Professional Appraisal

From the patient's perspective, digital impressions are unequivocally preferred. Clinical trials conducted at premier Indian institutes indicate that patients report significantly higher satisfaction with digital workflows than with conventional elastomeric impressions. Patients consistently rate digital procedures more favorably regarding convenience, bad oral taste, and nausea [10].

The digital workflow also facilitates complex esthetic rehabilitation, such as gummy smile management, by allowing clinicians to visualize outcomes via Digital Smile Design and fabricate precise 3D-printed surgical guides [11]. Interestingly, while patients perceive a significant improvement in experience, objective evaluations by dentists regarding the final prosthetic fit often show no significant difference between the digital and conventional workflows [12]. This suggests that while the digital workflow enhances the patient journey, the clinical end-result in terms of fit may not always be perceptibly superior to a well-executed analog impression in the eyes of the clinician.

Conclusion

Digital impressions represent a transformative shift in Indian dentistry, offering clinically superior accuracy for single units and a viable, patient-friendly alternative for complex rehabilitation. This technology addresses the historical challenges of patient discomfort and procedural time associated with conventional impressions. However, the potential of this digital revolution is currently throttled by high entry costs, significant deficiencies in structured educational training, and infrastructural limitations. For digital impressions to become the standard of care in India, stakeholders must address these economic and academic barriers to effectively bridge the gap between high awareness and low clinical adoption.

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