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Evaluating accuracy of digital impressions and conventional impression in implant placement

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Abstract
Background: The clinical feasibility of implant restorations is heavily influenced by the accuracy of digital impressions. The purpose of this research is to compare the accuracy of conventional impressions with impressions made digitally using three-dimensional analysis. Materials and methods: Twenty implants in eight patients in the posterior region of the oral cavity formed the study sample. Two operators with good inter-examiner reliability performed the procedure. Conventional impression were taken using polyether impression material and stock trays. Digital impressions of the same patient were taken after 2-3 weeks. Outcomes assessed were total time taken, distance between scanbodies, angulation, rotation, and vertical shift were all evaluated as clinical outcomes. SPSS 23.0 version (SPSS Inc., Chicago, IL, USA) software was used for data analysis.
Results: In comparison to digital impressions, conventional impressions took longer time, which was statistically significant at p<0.001. In both impression approaches, the measurements of distance between scan bodies, angulation, and vertical shift were practically identical, which was not statistically significant.
Conclusion: Digital impressions outperformed conventional impressions during implant placement.

Keywords: Accuracy, conventional impression, implant, digital impression

Introduction

Intraoral scanners (IOS) and digital implant impressions (DII) are a relatively new, but rapidly developing method. Their usage is increasing due to a variety of patient-focused (improved comfort due to the elimination of the impression tray and materials) and dentist-focused (budget and time savings, digital information storage and analysis and so on) factors[1].IOS has added to the concept of "virtual patient" by supplementing the standard

prosthodontic method.

For a long time, conventional implant impressions (CII) have been a routine practise in fixed prosthodontics. The CII workflow has restrictions that have an impact on efficiency. The primary reasons for contemplating alternate impression techniques in fixed prosthodontics are tray and impression material selection, impression technique, time consumption, impression disinfection, transportation, and storage difficulties. A few decades ago, DII was offered as a feasible alternative to the traditional workflow[2].

The latest IOS hardware and software solutions are fast evolving and demonstrating acceptable clinical results for tooth-supported crowns [3].In mostly in vitro experiments, a recent systematic review found variances in digital implant impressions of less than 100 m [4].True reference data can be used in in vitro investigations. However, the equipment used to collect reference data cannot be used in a clinical trial, and digital impressions can only be compared to traditional impressions in general. Because there are various variables that can alter the accuracy of DII intraorally, *in vitro* studies do not adequately replicate the clinical condition[5].

Although there are many randomised clinical trials on the accuracy of digital impressions on healthy teeth, there is a scarcity of data from clinical research on the accuracy of digital impressions for implant-supported restorations in the scholarly literature [6, 7, 8].Hence this study was conducted to answer the hypothesis "There is no difference in accuracy of digital impressions against conventional impressions in implant placement?"

Methodology

The study population consisted of eight patients with twenty fixed partial restorations supported by Nobel Biocare implants. All of the implants were placed in the posterior region of the oral cavity. Two-unit (n = 6) fixed restorations, three-unit (n = 10) fixed restorations, and four-unit (n = 4) fixed restorations were made. 13.82 $\pm$ 3.96 mm was the average distance between implants.

Criteria for inclusion and exclusion: After an initial examination, 5 males and 3 males aged 31.24 $\pm$2.53 years were recruited who met the following inclusion criteria: no prior experience with either conventional or digital impressions, good general health, good oral hygiene, no periodontal disease, and no systemic diseases.

Conventional impressions: Two operators chose and applied the glue to the appropriate tray for the topic. The monophase impression technique was used to make traditional imprints with polyether impression material and stock trays. All materials were utilised according to the manufacturer's instructions, and the work was done by two people (AN and RK).

Digital impressions: Two to three weeks after the conventional impressions, the same patients were booked for a digital impression visit. The chairside dental CAD-CAM equipment was used to take digital impressions. All digital scanning operations were completed by the same operators and in accordance with the manufacturer's instructions (AN and RK).

Total time taken, distance between scanbodies, angulation, rotation, and vertical shift were all evaluated as clinical outcomes.

Data was analysed using SPSS 23.0 version ((SPSS Inc., Chicago, IL, USA)), a Wilcoxon Signed-Rank Test was used to examine the differences in effectiveness of clinical outcomes between conventional and digital impression procedures, with p = 0.05 as the level of statistical significance.

Results

The mean overall treatment time of the conventional impression technique was 539.64 ± 33.53 seconds. The mean overall treatment time of the digital impression technique was

263.33±38.53 seconds. Conventional impressions took a greater amount of time as compared to digital impressions which was statistically significant at p<0.001. The measurements of Distance between scan bodies, angulation and vertical shift was almost similar in both impression techniques, which was not statistically significant. However, there was a slight difference noted in the rotation outcome. The results are presented in Table 1. The Crohnsbach alpha coefficient for inter-examiner reliability was 0.92 suggesting good agreement between the two operators.

Table 1: Comparison of clinical outcome between conventional and digital impression technique

Clinical outcome	Conventional(Mean ± S.D)	Digital(Mean ± S.D)	P value
Time taken	539..64 ± 33.53 s	263.33 ± 38.53 s	<0.001*
Distance between scan bodies	16.74 ± 4.75 mm	16.24 ± 3.63 mm	0.065 (NS)
Angulation	9.39 ± 4.63°	9.35 ± 4.84°	0.47 (NS)
Rotation	36.64 ± 19.46°	34.63 ± 20.02°	0.025*
Vertical shift	1.65 ± 1.79 mm	1.67 ± 1.78 mm	0.057(NS)

*=Significant; NS = Not Significant.

Discussion

According to our findings, the digital impression technique was more efficient than the traditional impression technique in this study. As a result, the initial null hypothesis was ruled out.

Subjects who had no prior experience with traditional or digital impressions were included in the study population, which helped to standardise and homogenise the results. To compare the clinical outcomes of the two impression approaches, homogenising the study population is a valid clinical research method for maximising objectivity and minimising bias. This method is critical in order to avoid reporting the bias of patients who have had prior dental impression experience. The efficiency of the two impression procedures under controlled clinical conditions was the primary focus of this study.

DII have been stated to be a feasible alternative to conventional procedures in the literature, but these claims are based primarily on in vitro study results and subjective clinical experience[9].Despite the increasing possibilities of new technology, such as duplicating mucosal tissue at the created pontic area and emerging profile of the peri implant tissue or recording movements of the patient's jaw, a totally digital workflow is not yet feasible in every clinical setting. For single-unit fixed dental prosthesis, both digital and traditional imprint procedures can be advised. The digital workflow for short-span implant-supported restorations, on the other hand, is less well described.

In the literature, there are few in vivo trials evaluating the accuracy of digital implant impressions and restorations on implants. Because true reference positions of scan bodies or implants may be obtained using industrial measuring equipment, the majority of research are conducted in vitro. One way is to use an industrial-grade reference scanner in a clinical investigation, but this can only be done in the anterior region of the maxilla under certain conditions. Because all of the restorations in this study were in the posterior region, this approach could not be used elsewhere.

Additional aspects that can affect the accuracy of digital implant impressions include the repositioning accuracy of prosthetic components, the architecture and shape of the scan bodies, the scanning region, the scanning sequence and others[10, 11, 12]. When evaluating the accuracy and precision of impression procedures, different types of implant-abutment connections and machining correctness of prosthetic components could have an impact on the results.

The current study is in concordance with other study results. In their systematic review,

Sachin K Chandran*et al*.,[13]looked at 25 studies that compared digital impressions to

traditional impressions. Out of the 16 articles, 16 claimed that digital impressions are superior to traditional impressions, despite the fact that all of them showed clinically acceptable values for both. Internal fit values for conventional impressions were slightly lower; this could be attributed to the work flow of this approach. It necessitates the creation of a model, the restoration of that model, and finally the actual processing. In a digital impression, all of these processes are eliminated.

The scientific sector is rapidly filling with new knowledge confirming digital impression processes due to ongoing developments in digital technologies. Because the potential of IOS clinical applications is growing, further research is needed before digital impressions can totally replace traditional ones.

The study was organised as a randomised, double-blind, placebo-controlled trial, and the order in which the two impression procedures were evaluated was chosen for psychological reasons. The two evaluation appointments are separated by 2-3 weeks. This time span was regarded adequate for erasing an event or a process from memory. Additionally, the study looks into changes in precision between the two impression procedures.

Conclusion

The digital impression technique outperformed the traditional impression approach in terms of efficiency. The Conventional impression technique took longer than the digital imprint technique to complete the therapy. As a result, the initial null hypothesis was ruled out.

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