



**International Journal of Biology, Pharmacy
and Allied Sciences (IJBPAS)**

'A Bridge Between Laboratory and Reader'

www.jibpas.com

**VALIDITY, RELIABILITY AND ACCURACY OF 3-DIMENSIONAL AND
INTRAORAL DIGITAL SCANNERS FOR DENTAL APPLICATIONS: A REVIEW**

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ABSTRACT

The most important sight to determine quality of fixed prosthodontics is closed internal and marginal fit of the crowns. To accomplish that, accurate and precise replicas of the teeth are essential. Different CAD-systems were recently assessed in order to evaluate the influence of digitizing and surfacing on the accuracy in dental CAD/CAM technology. Achieving esthetically and functionally ideal restorations has been the goal of dental clinicians, prosthodontics and manufacturers throughout the history of dentistry. So, the aim of this study was to investigate validity, reliability and accuracy of 3-dimensional and intraoral digital scanners for dental applications. It is important to compare introduced methods for implant framework. New techniques in prosthodontic introduced in this review. We hope this literature review cast light on hidden side of prosthodontics.

Keywords: Digital scanners, Intraoral, Dentistry

INTRODUCTION

Successful treatment planning in dentistry requires precise diagnostic information and an extensive diagnosis. The procedures for taking dental impressions and forming study models have progressed since their introduction in the early 1700s. Philipp Pfaff first described an impression-taking technique by using heated sealing wax to obtain a negative representation of the dental arches that was then used to pour a cast in Plaster of Paris. In the mid-19th century, other materials such as Plaster of Paris, gutta-percha and thermoplastic modeling compound became popular for taking impressions. Reversible hydrocolloid alginate and later irreversible hydrocolloid alginate revolutionized impression taking in the early 1900s by eliminating many of the inadequacies of the previously used materials. The new materials proved to be accurate, dimensionally stable, and easy to use, while maintaining cost effectiveness. Recent technological breakthroughs have enhanced the process of cast fabrication and manipulation. This process still requires traditional alginate impressions to be taken in the orthodontic office. Instead of being poured by the orthodontist, impressions are shipped

overnight to one of the companies offering digital models [1].

Recently, various techniques for achieving the most accurate results have been described in the literature [2] with the development of computer-aided design/computer-aided manufacturing (CAD/CAM) systems and especially the use of zirconium dioxide for ceramic restorations, the digital model has become increasingly important [1]. Dental impressions are an important step in restorative dentistry. They transfer the intraoral situation to an extra oral cast, the accuracy of which influences the fit of the restorations, an important factor in the longevity of the final restoration [3]. For this purpose, 3-dimensional (3D) digital model to design and mill the restoration [4]. The latest development in CAD/CAM dentistry is a digital intraoral impression from an intraoral scan of the patient's teeth, [5] resulting in a 3D virtual model. If needed, a physical model can be fabricated by rapid prototyping stereo lithography, 3D printing or milling from the intraoral digital impression data [6]. Digital impression devices are used alternatively to conventional impression techniques and materials. So in this paper, our objective was to determine the validity, reliability and

accuracy of intraoral scanner with digital dental models. We hope the information obtained from this review help the orthodontist classify malocclusions, identify aberrations and to formulate treatment objectives.

Logical reason for an alternative instead of impression techniques

Computer-aided design and manufacturing techniques are gaining more and more importance in fabrication of dental restorations. However, most approaches are limited to the dental laboratory and start only with scans of a traditional gypsum cast based on a conventional impression technique. Despite all developments in impression techniques and materials, the results in clinical daily practice are, in many cases, still unsatisfactory and therefore in need of further improvement. The reasons for that are manifold and cannot be projected on a single work step in the manufacturing process of prosthetic restorations. Though these problems can be reduced by standardization of work sequences in the workflow, they cannot be eliminated entirely. In this context, digital imprisoning procedures may be an approach to improve the accuracy of dental restorations as by their nature these processes eliminate the error prone conventional

impression and gypsum model casting and warrant a high degree of standardization [7].

What is the CAD-CAM?

The fit of a dental restoration depends on quality throughout the entire manufacturing process. Several factors affect the quality, such as preparation design, surface roughness, impression technique, [8] production of a dental cast and, finally, when the restoration is complete, the cementation [9, 10]. In the process based on CAD/CAM technology, the chain of transferring geometrical data starts with surface digitization of the preparation [11]. However, it is difficult to assess the surface topography of an object with a complex form, such as a tooth, due to the various irregularities and geometric configurations that are unique for each tooth, and the fact that there is no exact reference form. By using a computer aided technique for evaluation of the digitizing equipment, the deviations can be calculated and presented 3-D.

Application of digital scanners in dentistry

Since its introduction to dentistry, CAD/CAM technology has been largely limited to the realm of the dental technician [12]. There are various methods available for digitizing the geometry of a body into a digital form. One of the first CAD/CAM systems launched with

dental application was based on touch-probe scanning [13]. Another method of digitizing is by using optical methods based on either laser or white light. The laser or white light is projected onto the object, and the reflected patterns are registered by a digital camera. After the reflections have been tracked in the camera image, 3-D points can be obtained using triangulation technology. In general, the advantage of optical methods is the use of a noncontact system that allows the scanning of soft and brittle materials. The optical properties of the object may, however, affect the accuracy of the scan data [14].

Laser scanner and a touch-probe scanner

The fit of a dental restoration depends on quality throughout the entire manufacturing process. There is difficulty in assessing the surface topography of an object with a complex form, such as teeth, since there is no exact reference form. Many systems have been used for the design and fabrication of fixed dental prostheses, but for the past two decades, only one system (Cerec) capable of direct intraoral impression taking has been available to the dental practitioner. The Cerec system is based on the concept of “triangulation of light”, where intersection of three linear light beams is used to locate a given point in 3D space. This concept has

been used in a variety of industrial measuring devices, but surfaces that neither disperse light irregularly or do not reflect it evenly, and surfaces that are not continuous, adversely affect the accuracy of scans based on triangulation, consequently an opaque powder coating (titanium dioxide) is used to provide uniform light dispersion and enhance the accuracy of the scan [12].

Laser scanner V.S touch-probe scanner

The null hypothesis that the 2 surface digitization devices would generate 3-D models of equal quality was accepted. Thus, the laser scanner has the potential to serve as input in a manufacturing system since the touch-probe scanner is currently used in the clinical setting and generates satisfactory clinical fit. The precision of the laser scanner may be improved by increasing the resolution in certain critical surfaces. In the touch-probe scanner, the shape of the die had an opposite effect on the distribution of the points. In the registrations of the anterior shapes, the resulting point clouds were denser than for the posterior shapes. The same number of points per turn was used and, as a consequence, a larger radius of the die resulted in a less dense point cloud. The helical motion of the probe was influenced by its angle toward the surface. As a consequence, the distribution of

the points in the rounded slope of the chamfer was less dense. As a result, this surface showed deviations in the evaluation of the repeatability. Previous studies have shown that these portions of the prepared tooth are associated with less than optimal internal fit of the manufactured crown. In the laser scanner, the repeated registrations resulted in very similar alignments. The surface creation software of the laser scanner reduces and optimizes the number of points, whereas in the touch probe scanner, no such filtration is performed. This could partly explain why the discrepancies are more scattered in alignments from the touch-probe scanner. The negative deviations obtained in the proximal surfaces, where the surface from the touch-probe scanner was located outside the surface from the laser scanner, are most likely due to the fact that the elevation of the probe was too steep and, therefore, returned an inadequate distribution of the points in the point cloud by the touch-probe scanner. Thus, the distribution of the deviations from the evaluation of the repeatability seems to have an influence on the outcome of the relative accuracy [14].

CONCLUSION

All clinical evaluation of all-ceramic crowns fabricated from intraoral digital impressions

revealed Crowns from intraoral scans are agree in significantly better marginal fit than crowns from silicone impressions. Intraoral scanner is based on the principle of active (optical) wave front sampling. Active wave front sampling refers to getting 3D information from a single lens imaging system by measuring depth based on the defocus of the primary optical system. However, there are no published clinical studies on the in vivo performance of this intraoral scanner. Marginal fit as well as fracture resistance and aesthetics are some of the most important criteria for long-term success of all-ceramic crowns. Sizable marginal discrepancies can expose the luting material to the oral environment, leading to a more aggressive rate of cement dissolution, caused by oral fluids and chemo-mechanical forces. Marginal gaps can promote plaque accumulation which may result in inflammation of the periodontal tissues as well as secondary caries at the crown margin [12]. So, we are trying to introduce new methods instead of old time consuming and costly methods which have been used in marginal adaptation restorations in dentistry. This paper is heading of our recent research which based on that we want to find standard laboratory model for assess laser scanner in

dentistry. In the next step we want to measure internal gap using to this technique to investigate efficacy of laser scanner in prosthodontics.

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