Review Article

Intraoral Surveyors: A Systematic Review

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Abstract

The purpose of this systematic review was to evaluate the currently published literature investigating the different types of intraoral surveyors that help for the parallelism of the abutments for the construction of the framework of removable and fixed partial dentures. A comprehensive search of studies published up to September 2019 was performed in PubMed/MEDLINE, Web of Science, and SCOPUS, according to the Preferred Reporting Items for Systematic Review. This review documents the historical development of knowledge associated with scientific advancement from 1966 to 2019 related to impression procedures in conventional complete denture prosthesis.

Keywords: Intraoral suveyors, Periscope, Parallelometer.

Introduction

An intraoral surveyor can be used successfully to insure that teeth are optimally prepared to serve as abutments for fixed or removable partial dentures. The intraoral surveyor serves as a guide during the teeth preparation and aids the dentist in assessing tooth preparation before making a final model. Surfaces that are parallel give guiding planes, resistance form and reciprocation must be estimated during the natural teeth preparation for fixed and removable partial dentures. Intraoral evaluation of tooth preparation is often a difficult task. The degree of difficulty is dependent on the position of the teeth involved, the length of the edentulous space, the deconstruction of the girding soft towel, and the quantum of direct vision available.[1]

During tooth preparation, main aim is always to develop a common path of placement/insertion to achieve and complete seating of the prosthesis and the fit should be passive.

Unparalleled abutments in the fixed partial denture (FPD) will provide excessive seating force that often results in veneering ceramic fracture. To avoid these side effects, clinicians tries to give more tapering to the preparation. The excessive reduction of the prepared abutments can compromise restoration retention and resistance and jeopardize the biological health of the dentin pulp complex in vital abutment teeth.

When a FPD is advised, diamond burs are used to remove the tooth structure according to the conditions of the path of insertion for the prosthesis. Accomplishment of parallel preparation is eventually indicated by complete seating of the prosthesis, but could be indicated on the master cast or dies by the use of the surveyor. Once the FPD is fabricated and fully seated, it engages the entire circumference and takes occlusal support from the abutment retainers. However, the chance for functional stability to natural teeth is good, if acceptable resistance form and fit of the prosthesis are handed. This could not be assured unless the relationship of the fixed prosthesis and the set teeth were precisely controlled. For a removable prosthesis, the necessity for proper planned and executed treatment, followed by verification of a well-fitting prosthesis that engages the teeth, is also important.

Although it does not affect the occlusal rest preparation on abutment teeth, the use of the surveyor is critical for planning the variations of all tooth that will be involved in support, stabilization, and retention of the prosthesis. In this part, the use of a surveyor to determine the demanded mouth preparation is vitally important in helping to give stable and comfortable removable prostheses.[2]

An intraoral parallelometer is a useful instrument for making the tooth preparations to be parallel. The instrument must be as simple as possible, and be made of accoutrements that will give a stable construction. The instrument must not work loose;

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at the same time, it must permit an indeed gentle movement when it is in use in the mouth. The instrument must be accurate, made with perfection, be stable and parts which are worn out must be replaced frequently.[3]

Materials And Methods

The articles that are explained about the intraoral surveyors were searched from the PubMed/Medline, Scopus, and from other relavant electronic database. In addition, further relevant studies including those of reference lists of all the included studies were also manually searched. Analysis was done based on the laboratory procedure that should be done for surveying, different types of intraoral surveyors/parallelometers that were invented by different authors, differences between the extraoral, and different types of intraoral surveying, studies were selected according to the inclusion criteria advantages of intraoral surveying and difficulties administered while doing the extraoral surveying, and different types of intraoral surveyors given by different authors.

Results

A total of 40 articles were found and 28 were selected based on their titles after reading the abstracts, titles that explained about the intraoral surveyors were selected for full-text reading. Eventually, 20 articles were selected (two *in vitro*, eight original research articles, and ten reviews). Eight articles were excluded as the author does not provide the appropriate information (Figure 1).

Literature Review

Early intraoral parallelometer

Many authors invented different types of the intraoral surveyors and there is no evidence that these instruments are used and implemented by the future dentists.

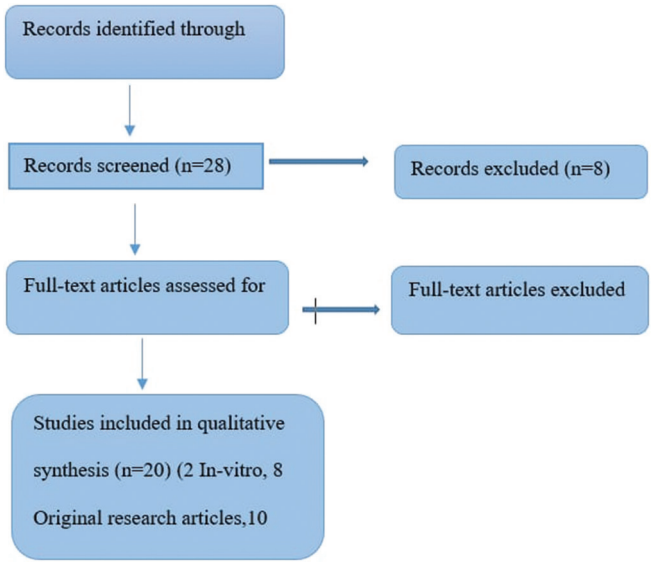

Figure 1: Data of articles selection according to PRISMA diagram

Kopsiaftis in the early 1966 developed the instrument for determining the undercut and guiding planes intraorally. It is the metallic instrument consisting of the base and the working axis. The instrument is placed in the mouth by placing the two restraining arms of the base should hold the teeth on the buccal surfaces where they can be supported (Figure 2). The instrument is fixed in this position by tightening the screw until the holding plates come into contact with the buccal surfaces of the teeth. The instrument is maintained in a comfortable position, because the anatomically shaped holding plates are covered with elastic gum. The working handpiece can be moved along the body as the joint is flexible. The handpiece is positioned vertically to obtain a good and efficient direction of the bar. The instrument is tightened to the teeth by the screw and remains in this location until the end of the cutting procedure.

It is easily fitted and removed with absolute accuracy and stability. It provides the dentist with perfect visibility and excellent freedom of movement. The preparation of the pinholes or grooves can be in either in vertical or horizontal direction in relation to the long axis of the tooth.[3]

In 1967, Parmlid designed the new intraoral parallelometer. He designed the instrument mainly to make the pinledges, grooves, and boxes for the preparation of the crowns. This instrument is required to the use of special drills and stones. Paramax-drills are used for making postholes preparation, diamond stones with the Paramax grib and slightly conical fissure-burs, and when preparing teeth for full veneer crowns and three-quarter crowns. Stability in the mouth is the topmost priority. The dentist needs the assistant definitely to hold the instrument tightly in the mouth and in the same position.[4]

In 1970, Schoeneck given the intraoral parallelometer that is simple, less weight, and effective, the main drawback for this instrument is that it does not have the mechanism to maintain the inexpensive device. This instrument is well used by the dentists for up to 2 years.[5]

McCarthy, in 1989, invented a device that is more vigorously used. It is a simple intraoral surveyor using an acrylic resin base, a guide pin, a carriage, and a paralleling tool can be easily made for determining the accuracy of tooth preparation

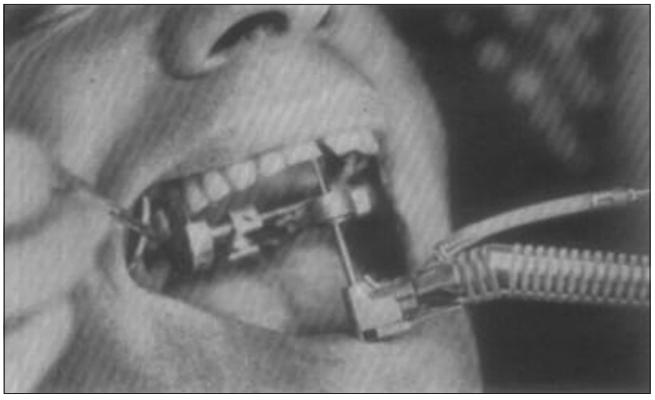

Figure 2: First intraoral parallelometer

in complex situations. The main disadvantage of this device is that, the device position differs from person to person depending on the location of the edentulous space.[6]

In 2010, Borges *et al*. introduced the new intraoral parallelometer (ParalAB) in their study. The inclinations obtained in the Paral AB device are different when compared to the Dental Surveyor. This device can prepare guide planes intra orally. This is the main advantage of the device (Figure 3).[7] This device requires sufficient light illumination.

In 1999, Moschen *et al*. compared the resin-bonded prosthesis groove parallelism with the use of four tooth preparation methods, that is, freehand, guiding pin, extraoral parallelometer, and intraoral parallelometer. This study indicated that precision of tooth preparation for guiding grooves in the posterior region of the mouth can be improved with the use of an intraoral parallelometer. This could increase resistance to dislodgment by functional horizontal or rotational stresses and result in greater survival of posterior RBPs.[8]

Dental periscope

Patil *et al*., in 2008, explained about the dental periscope that helps to examine the abutment preparations outside the mouth, which is difficult to evaluate intaorally. This device helps to evaluate relative parallelism of tooth or implant abutment preparation for FPD which become more convenient. Axial preparations for individual inlay, onlay, or crowns also can be evaluated easily with this device.

This device is designed based on the principles of any other periscope. It is constructed using three plane mirrors angulated at 45° to main metal framework. Mirrors A and B faces mirror C. Mirror C which is attached to the eyepiece faces mirror A and B. The main advantage of this device is it reduced chairside time by eliminating the multiple diagnostic impressions and casts, which are required for the purpose of examining abutments during various stages of preparations. This device requires sufficient light illumination (Figure 4).[9]

The same author, in 2012, described a modified compass measuring technique foe the intraoral parallelism. This is a chair side technique.[10]

In 2020, a study was conducted to evaluate the abutment parallelism and path of withdrawal using three intra- and one extraoral methods. Intraoral surveying devices used are the mouth mirror, photographic mirror, and dental periscope and Dental Surveyor is used as an extraoral method. The Sayed *et al*. was more favored among the respondents across all educational levels. This technique presented high potential in accurately evaluating tooth preparation undercut, abutments parallelism, and path of withdrawal in comparison to the intraoral techniques.[11]

Dumbrigue evaluated the parallelism with using intraoral photography mirrors for multiple abutment preparations.[12]

Discussion

Guiding planes are defined as parallel vertical surfaces on abutment teeth and/or dental implant abutments orientated to help in the maintenance of the direction of the path of placement and removal of a removable dental prosthesis. Functions of guiding planes include providing the path of placement/removal of a prosthesis, and thereby, removing excessive stress created on either the restoration or the abutment teeth. They should be aiding with retention against dislodging forces other than those which are acting parallel to a given path of insertion and stabilization against horizontally directed forces, eliminating troublesome food traps.

Miller stated that flat surfaces eliminate horizontal forces on the abutment tooth as the guiding plate or minor connector present in it. This will not occur when the prosthesis contacts a convex surface. Such contact would tend to deflect the tooth within its alveolar level, over a period of time; this repeated trauma may be detrimental to the abutment tooth. The RPI system described by Krol attempts to manage the inevitable tissue-ward displacement of a distal extension base under occlusal loading. The distal guide plane is more integral to its function. The guiding plane should be positioned in the occlusal one-third of the proximal surface. When occlusal pressure is exerted on the artificial teeth, the proximal plate moves toward the without torquing the abutment tooth.

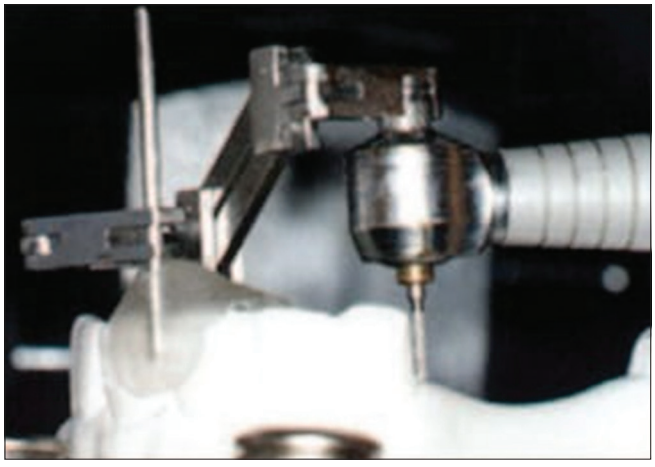

Figure 3: ParalAB device

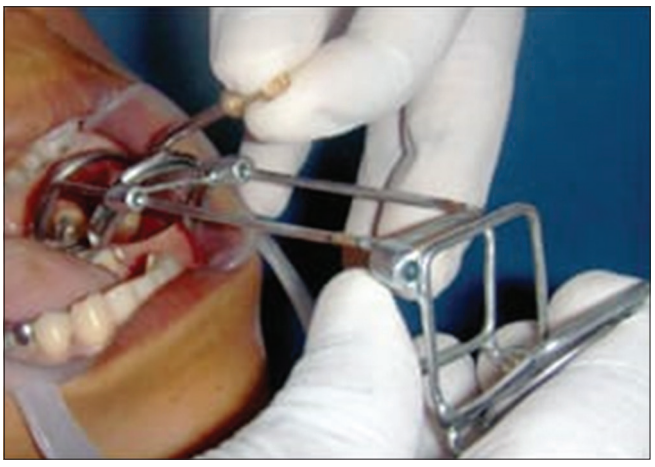

Figure 4: Dental periscope

The preparation of suitable guiding planes on abutment teeth during the fabrication of removable partial dentures is dependent on dentist ability and requires considerable chair time. In case of preparation of multiple teeth, achieving parallelism between the abutment surfaces can be challenging technically, especially in region of posterior teeth of the mouth.[13,14]

Mechanical stability of the framework can be achieved with tooth preparation of guide planes, rest seats on the abutments and retentive guiding grooves. These guiding planes should be prepared parallel to one another to create a distinct vertical path of insertion. Tooth preparation of guide planes should be prepared appropriately to establish a single path of insertion that restricts the movement of the uncemented framework, except along the path of insertion. Proximal grooves placement provides resistance to lingual displacement of the metal framework.[15] Ideally, guiding grooves should be parallel to one another and to the path of insertion/guide planes that allow an optimal fit with complete seating of the framework, without reshaping inner surfaces of the retainers, or increasing the taper of tooth preparations. Trying to improve fit by adjusting metal frames usually results in impairment of macro mechanical retention. However, intraoral readjustment of imprecisely prepared (divergent) guiding grooves usually with the aim for minimally invasive tooth preparation. The usage of paralleling instruments was recommended to increase the parallelism of proximal grooves.[16]

A dental student or a future dentist has to be trained to examine their teeth preparations to detect amount of any undercuts present to lower the further clinical and laboratory problems such as open margins and over taper.[17] The main intention to invent the parallelometers was to recommend the most preferred technique in the future curriculum which could save patients from more invasive procedures later on by reducing common mistakes which are done by the students.[18] With the usage of more complex fixed prostheses that involve multiple abutment teeth, the difficulties of achieving tapers and unparallel guiding planes are multiplied. The traditional method of the use of a freely held hand piece and "eyeballing" tooth preparations for interand intra-tooth convergence has minimum of two obvious shortcomings. First, throughout the method of preparation, the dental practitioner should rely on no matter degree of hand eye coordination and visibility he or she has at that moment. Second, it is not possible to place tooth structure if the tapers end up to be excessive.[19]

Summary

During tooth preparation, our main aim is usually to develop a standard path of placement/insertion to realize passive and complete seating of the corrective. Path of placement or withdrawal is outlined because the specific direction during which corrective is placed on the residual outgrowth, abutment teeth, implant abutment(s), or attachments. Mounted plate (FPD) with unequaled abutments can necessitate excessive seating force that usually ends up in fractures within the veneering ceramic. Hence, as to avoid these aspect effects, clinicians tend to over taper the preparation. The excessive reduction of the ready abutments will compromise restoration retention and resistance and jeopardize the biological health of the dentin pulp advanced in important abutment teeth.[20]

Conclusion

According to the data obtained from the literature review, many sorts of paralleling devices were utilized by the dentists in step with their demand and practicableness. Several of those instruments measure price effective and each instrument had their own disadvantages. Some of the studies concluded that the dental surveyor is more accurate to measure the undercuts, parallelism of the abutment than the other intraoral surveyors. A digital intraoral surveyor known as cluster (Spatial Wireless Assistant Device) was made-up by Scandinavian country scientists. This can be the wireless device that is meant to boost the facility skills of dental practitioners. However, additional correct, precise, and price effective intraoral surveyors need to be made-up for the effective use of the dentists.

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