

Techniques for preparing of guide planes: in vitro comparative study

Técnicas para preparo de planos de guia: estudo comparativo in vitro

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ABSTRACT

Objective: The correct parallelism of guiding planes when constructing a Removable Partial Denture not only defines the axis of insertion and removal of the prosthesis, but also limits the possible axes of movement during functioning. Therefore, the purpose of the study was to compare some techniques and the use of an intra-oral device for those preparations. **Material & Methods:** Dummies were performed in a direct manner, simulating the absence of teeth 15, 45, 12 and 42. The four preparation techniques chosen were: Group 1 – freehand preparation; group 2 - guide pins; Group 3 - crown guides and Group 4 - parallel intraoral device – ParalAB. **Results:** No statistical difference was shown between the mean values of angles found for the freehand (82.85°) and guide pin (83.60°) groups. Also, no statistical significant difference was observed between the mean values of angles found for the resin cap (88.83) and intraoral device (88.58 °) groups; however they were superior to the findings for the freehand and guide pin groups. **Conclusion:** The studied methods are effective for what they were proposed; however, one should select the method according to the experience and skills, to promote the best results.

KEYWORDS

Removable Partial Denture; Guide planes; Parallel intra-oral device.

RESUMO

Objetivo: A transferência de planos de guia dos modelos de estudo para a boca é procedimento de extrema importância para o bom prognóstico de uma Prótese Parcial Removível. **Objetivo:** O objetivo do trabalho foi comparar diversas técnicas de confecção dos planos de guia, avaliando também a influência da experiência do profissional executante. **Material e Métodos:** Manequins foram preparados simulando a ausência dos dentes 15, 45, 12 e 42. Foram realizadas 4 técnicas de preparo dos planos de guia, divididas em 4 Grupos: Grupo 1: técnica a mão livre; Grupo 2: técnica com pinos guias; Grupo 3: técnica com coroas guias; Grupo 4: Paralelômetro intra-oral – ParalAB. Estas técnicas foram executadas por profissionais com mais de 5 anos de formado e por alunos do último ano de graduação em odontologia. Modelos de gesso foram obtidos antes e após a confecção dos preparos e comparados em uma máquina de leitura 3D. **Resultados:** Os resultados mostraram não haver diferença estatística entre os valores da angulação para o grupo 1 (82,85°) e grupo 2 (83,60°). Entre os grupos 3 (88,83°) e 4 (88,58°) também não houve diferença estatística, porém as técnicas dos Grupos 3 e 4 foram superiores às técnicas dos grupos 1 e 2. Em relação aos profissionais executantes, a experiência mostrou ter influência apenas nos grupos 1 e 2, não sendo significativa nos grupos 3 e 4. **Conclusão:** Conclui-se que os métodos estudados foram efetivos para o propósito, e dependendo da sua experiência e habilidade, pode-se selecionar ao qual o profissional melhor se adapte, porém quando houver falta de experiência e confiança a técnica de coroas guias ou paralelômetro devem ser escolhidas.

PALAVRAS-CHAVE

Prótese Parcial Removível; Planejamento de Prótese Dentária; Condutas na Prática dos Dentistas.

INTRODUCTION

Despite of the recent modern resources used in Dentistry, there are many procedures that hinder the treatment process chosen for some works. Few procedures such as the implementation of certain prosthetic preparations can be stated, especially when they require a multiple and parallel relationship, for instance, the guiding planes. Those can be defined as two or more vertically parallel surfaces present in a direct retainer for Removable Partial Denture (RPD) [1].

The oral cavity, an area of small size and exposed to low light intensity, makes it difficult for the parallelism of guiding planes, which not only defines the axis of insertion and removal of the prosthesis, but also limits the possible axes of movement during functioning, and should be located on the enamel layer. Its delimitation and orientation must be related to an anticipated pattern of displacement as a function of the prosthesis. The factors that determine this pattern include the placement of saddles, existence of large distal extension, the morphology and orientation of abutment teeth [2].

Freehand preparation of abutment teeth far between in the oral cavity, requires good practice of the operator so as to achieve a proper path of insertion for RPD, without compromising the degree of inclination of axial walls [3].

To support parallel preparations in the oral cavity, several guidance techniques as well as intra and extra-oral devices have been developed, each of those presenting different skills, applications and versatility [4].

A few reports in the literature refer to preparation of retainers in RPD [5]. However, a scientific methodology for conducting such preparations has been hardly observed in clinical routine and may result in damage of the stomatognathic system.

Some intra or extraoral parallel devices may be adapted to prepare and verify the

guiding planes. Aiming to make this procedure easier, Borges et al. [6] in 2002, developed an intraoral device that attempts to draw, verify, and assist in making preparations of guide plans. This intraoral device would facilitate preparation of guide planes with accuracy and minimal occlusal divergence. An intraoral device with pantographic movements, called the Parallelometer AB or the ParalAB, was developed to aid in the preparation of parallel surfaces while creating a guide plane that allows the abutment teeth to have excellent biomechanical characteristics [7].

Nevertheless, due to limited use, scale and difficulty to be found in the market, researchers have developed other alternative techniques for the preparation of guide planes. In this paper, we compare some techniques, as well as, the use of an intra-oral device for those preparations, which were carried out by different professionals. The tested hypotheses were: H0 – there is no difference among the techniques of guide plane preparation, H1 - there are differences among the techniques of guide plane preparation, H0 ‘- there is no difference between the professionals who carried out the preparation, H1’ – there is difference between the professionals who carried out the preparation.

MATERIAL & METHODS

A laboratory study was carried out by using Dummies, which showed dental arches in harmonious class I relationship and good mouth opening. Hence, maintaining the same difficulties for all operators. The preparations were performed in a direct manner, simulating the absence of teeth 15, 45, 12 and 42 (figure 1).

The four preparation techniques chosen were:

Group 1 – freehand preparation

Group 2 - guide pins

Group 3 - crown guides

Group 4 - parallel intraoral device – ParalAB.



Figure 1 - Dummy used in the study.

Ten (10) dentist operators were instructed. Five of them showed more than five years of experience and five graduated one year prior to the study at School of Dentistry of the São Paulo State University – São José dos Campos – Brazil.

An operator was randomly chosen in each day. Each professional made eight preparations by using anterior upper and lower teeth and posterior upper and lower teeth, following the same technique.

Group 1: a study model was provided, containing a chosen path of insertion (Figure 2).



Figure 2 - a) Choosing the path of insertion; b) transferring the guide planes to the dummy.

Group 2: a thermal activated acrylic resin cap was prepared containing a metal pin to guide the trajectory of insertion (Figure 3).



Figure 3 - a) Thermal acrylic resin cap with the metal pin guide; b) transferring the guide plans to the dummy.

Group 3: a thermal activated acrylic resin cap was prepared and further worn by following the path of insertion, and transferred to the dummy for guide plans preparation. (Figure 4).



Figure 4 - Resin cap preparation on the surveyor.

Group 4: A parallel intraoral (ParalAB) device containing a fixing guide was used (Figure 5)



Figure 5 - Number of guide plans preparation

Three hundred and twenty (320) guide planes were prepared and compared to the path of insertion.

An irreversible hydrocolloid impression of the dental arch was carried out to check the slopes of the prepared surfaces and thus obtaining the model with type IV dental stone. This model was lead to a three-dimensional measurement machine (Mitutoyo). An initial reading was done on the dental stone model whose plane guide was prepared in delineator, this model determinated the path of insertion. The chosen path was perpendicular to the ground. With the model positioned in the machine, three points were marked determining a plane, that plane represents the path of insertion. After obtaining the prepared models, these were positioned in the machine scoring 3 points and determining the plane, which was compared to the level of the initial model. The measurement results were collected and evaluated.

Descriptive statistics were performed for data analysis by means of the ANOVA test. The Tukey's test was performed at a 5% level of significance, in order to assess whether the group results were homogeneous.

RESULTS

A total of 320 guide planes were prepared and equally divided into hemiarch and region, as shown in Table 1.

Values of central tendency distribution (median) and dispersion (standard deviation) according to the technique used for each group are shown in Table 2.

The surface slopes produced by each technique were evaluated by means of the two-way ANOVA (operator x method) – Table 3.

The Tukey test (5%) was used to reject the hypothesis of equality for each preparation technique (Table 4).

Evaluation of the results shown on Table 4 revealed no statistical difference between the mean values of angles found for the freehand (82.85°) and guide pin (83.60°) groups. Also, no statistical significant difference was observed between the mean values of angles found for the resin cap (of 88.83) and intraoral device (88.58 °) groups; however they were superior to the findings for the freehand and guide pin groups.

Table 1 - Number of guide plans preparation

Professionals				Students			
Upper		Lower		Upper		Lower	
Ant	Post	Ant	Post	Ant	Post	Ant	Post
40	40	40	40	40	40	40	40
80		80		80		80	
160				160			
320							

Table 2 - Median and standard deviation values

Technique	Median	SD
G1 Freehand	82.85 °	5.10 °
G2 Guide Pin	83.60 °	6.03 °
G3 Guide Cap	88.83 °	1.35 °
G4 ParalAB	88.58 °	1.64 °

Table 3 - ANOVA 2 factors (1-OPERATOR , 2-METHOD)

	df Effect	MS Effect	df Error	MS Error	F	p-level
1	1	9.8350	312	16.93793	0.58065	0.446633
2	3	809.6688	312	16.93793	47.80212	0.00000
12	3	0.7372	312	16.93793	0.04352	0.987908

Table 4 - Tukey Test (5%) for the preparation techniques

Technique	Median	
FREEHAND	82.85°	A
GUIDE PIN	83.60°	A
PARALAB	88.58°	B
GUIDE CAP	88.83°	B

DISCUSSION

Oral health and good support for the preparations are not the only factors that should be considered for RPD rehabilitation. No harmful forces should be present either on tooth remaining and mucosa, for that matter, teeth remodeling might be necessary to provide reciprocity during insertion and removal of prosthetic devices, as well as, during border movements [8].

Plane guides can be defined as two or more parallel vertical surfaces present in a direct retainer for RPD [1]. In some situations, the proximal plate frame is a component of the RPD, which acts as the counterpart of the plane guide. The planes are considered essential guides in terms of reciprocity, leading to direct retainer and tooth support during the movements of insertion and removal of RPD. This wear also has the potential to create frictional resistance to displacement [9].

Additionally to those functions, plan guides can decrease the space between the prosthesis and the tooth, improve retention, provide better aesthetics to the set [10] and if well assembled, they can stabilize periodontally involved teeth [11]. The presence of adequate guide plans decreases the movement of the RPD, because these components act as direct

and indirect retainers [12,13], leading to better stability and making it more comfortable for the patient [14]. However, according to McCartney [15], 1979, it is impossible to achieve perfect parallelism inside the mouth and consequently achieve reciprocity for the clip.

It must be highlighted that the stabilizing action proposed by opposed arms does not necessarily develops through its work across a dental area that extends into their proximal and lingual surfaces. In other words, the action proposed by this arm must be in the antagonistic action of the retention arm and provide an abutment to the tooth involved for static and dynamic stabilization [16]. Nevertheless, parallel surfaces inside the mouth rarely occur [17,18] and need to be prepared directly on the enamel surface, resin or metal.

In the study we compared some techniques carried out by different professionals. In relation to the hypotheses tested we refused H_0 and H_0' , and accepted H_1 and H_1' , that means that there was difference in some techniques used, but regarding the professional who did the preparation there was no relevant difference.

The in vitro experiment has a limitation when trying to convey the results to clinical practice. However, in vitro studies are important to show a trend of the results, thus we believe that the results obtained can be transported to the clinic.

For some authors, the most accurate way to accomplish what had been planned on the prosthetic treatment regarding to the modification of axial contour of clinical crowns, is represented by the use of one type of intraoral parallelometer [19-23]. In clinical trials, the

use of parallel-to-Parallel intraoral device [21] and ParalAB [23] were more efficient for the preparation of parallel grooves and surfaces, respectively, when compared to other methods. Our study is in agreement with these authors, since the use of an intraoral parallel, in this case ParalAB showed better results.

The current study compared the results with the research of Sugano et al. [23] and Carvalho et al. [22], in which mean and standard deviation values were larger, probably by using mannequins which simulate the structures of the mouth and head position and hampered the preparations.

Data were divided in two groups according to the type of operator (professional and students). This division aimed to assess whether the device was able to eliminate or minimize the influence of professional skills in preparation.

The statistical test showed no significant difference for the group operator, and there was a statistically significant difference for the group method. No statistical difference was found between the interaction operator and method for all techniques, except for the freehand technique that showed a slight advantage for the professional's experience, but no statistical significance.

This significant difference was between the groups freehand/ guide pin and the resin cap/ ParalAB groups. The difference between the two techniques showed a discrepancy of around 6°, which indicates that preparation became out of the selected path of insertion. Clinically, this would imply a loss of friction retention, loss of stability and lack of fidelity to the path of insertion.

Moschen et al. [21], 1999, found a decrease in the degree of divergence between the axial walls produced, while subsequent sessions were held, and observed that the increasing familiarity of operators with the technique was responsible for the improvement of preparation slopes. In this study, the operators performed

using only one case ParalAB. Therefore, the relationship of familiarity with the equipment and the preparations quality could not be evaluated.

Although many authors have suggested the use of guide planes to promote frictional retention, which also contribute to the retention of the RPD, there are no studies to support this proposal. According to some authors [24-26] the intimacy of contact between metal surfaces and enamel, is necessary to obtain full effects of the plane guide.

Batitucci et al. [27], 1993, evaluated the amount of misfit of cast metal frames of Co-Cr RPD in plan guides, and encountered values of 0.16 mm for molar and 0.11 mm for premolar teeth. The intermediate region of the plan guide showed lower levels of maladjustment when compared to lingual and approximal surfaces.

Cucci et al. [28], 1996, verified that preparations made by the freehand technique developed by Jochen [24] and Krikos [29], shows a tendency toward retentivity on the surface taper in the proximal and lingual surfaces. The authors observed that the middle third of the prepared surfaces revealed the lowest average deviation from insertion and removal axis.

All these findings about the effectiveness, retention planes and guide use of intraoral devices need to be carefully analysed, as we believe that such considerations may influence the decision to choose methods to perform these clinical preparations. Moreover, there are techniques with different degrees of precision, cost and ease of implementation.

Due to the high possibility of setting prosthetic spaces, as well as the condition of media elements [30], it is difficult to develop a single device that meets all possible needs [4]. Hence, studies on the advantages, disadvantages, indications, need for accuracy, time, cost and patient comfort should guide the choice for methods of transferring plan guides to the study model of the mouth.

Based on the experimental conditions and results of this study we could conclude that although there was a statistically significant difference between the preparation methods. Intraoral cap parallelometer and resin methods showed the smallest angle variation, leading us to believe that they provide more accuracy to the operator during the preparations. We also believe that there was no difference among professionals as even the most experienced ones are not familiar to the device.

We concluded that the studied methods are effective for what they were proposed. Despite of the no influence of the operator on the accuracy of the technique, each one should select the method according to the experience and skills, to promote the best results.

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Date submitted: 2013 Oct 29

Accept submission: 2014 Mar 31