FDPS FINISH LINE DESIGN AND TOOTH PREPARATION TECHNIQUE

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The purpose of this research is to perform and verify the "modified 50° preparation" suggested by the authors. This procedure was performed with a scrupulous standardization of the tooth's preparation and then of the laboratory techniques to produce a metal-ceramic crown, and the same for the crown cementation technique of on the preparation of the original sample. After the esthetic evaluations, the obtained sample was included in EPON resin and sectioned in the lingual-vestibular sense. The sections were then observed with an optical microscope in different magnifications for the final evaluations. The geometric design proposed presents the advantages of two great preparation techniques: 50° preparation and circumferential shoulder. The 50° bevel designed in first phase of preparation and the second phase of the circumferential 27° shoulder, together allowed to satisfy the following requirements: aesthetic, marginal accuracy, periodontal compliance, conservation and stability. However, this type of prosthetic preparation is not the only one, but it is one of the marginal designs in prosthetic dentistry.

To ensure the correct housing of the prosthetic restorations in fixed prosthesis, it is necessary to proceed with a procedure known as "preparation" (1-3), meaning a careful removal of the hard tooth tissues first.

This arrangement enables the morphology of the element - after reduction - to provide the following requisites (4, 5): economy of the dental substance (6), respect of the integrity of the adjacent tissues (endodontic and periodontal) (7), adequate restorative material thickness, retention and stability of the prosthetic product, precision of the preparation limits (8, 9). Moreover, further considerations are developed when there are indications for the complete covering of the dental element by a total veneer crown. In fact, in this type of restoration, due to particular requests concerning the degree of stability, retention and aesthetics, the operator must place the margins of the preparation at the sulcular level (9).

This means that the working tools will inevitably have to follow the delicate and sophisticated biological system, which enables the merging of tooth and gingiva, commonly known as the "dento-gingival junction" procedure (9-11). Especially at this point, it is very important to get enough "space" during the preparation procedure, to provide the necessary thickness for the production of an adequate prosthetic device (9, 12, 13). This involves the execution of a cervical step, which can be provided with different shapes and orientation.

To date, numerous researches have been

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carried out in relation to the different types of marginal preparation, in an attempt to satisfy basic requirements such as aesthetics, stability, retention and complete bio-mechanical incorporation of the prosthetic restoration (4, 5). The awareness of the advantages and disadvantages of each type of marginal design proposed, which includes the mandatory need to use mixed preparation techniques, motivated us to conduct our experimental research looking for a verification of a new preparation method, supported by the related drawings of marginal geometry (9).

To better understand the following work a good knowledge of the following topics is required, which we will refer to specific texts and lectures: emerging anatomy, over and under-contour, marginal fitting, marginal discrepancy, marginal distortion, knife preparation, shoulder, chamfer, 50 degrees, shoulder with bevel, chamfer with bevel (9, 14-16).

The only one topic we would like to briefly discuss is the "bevelling technique". In prosthetic restoration the advantages due to the presence of a bevelled margin are the reduction of the amount of exposed cement and the increase of stability and retention (17-19).

On the other hand, the presence of a metal edge and the clinical difficulty of a correct bevelling execution constitutes a major disadvantage. In fact, we should remember that there are technological limits in obtaining a bevelled metal corner. In fact, it has been shown that initial bevelling angle must be around 30°, and thickness of the molten edge cannot be less than 24 microns (20). Therefore, it is not possible to reproduce bevels with an angle of less than 30° otherwise, they will remain incomplete causing restoration during the trial or cementation step. The clinical problem of bevelling with an angle equal or greater than 30° has motivated our work (21). We are proposing a new design of marginal geometry, with a bevel in the first step of prosthetic preparation. The design is submitted in a modified 50° preparation.

The modified 50° preparation

The marginal geometry designs previously described, even if always usable, do not offer a total reliability, as the achievement of certain targets rules out others. The 90° shoulder preparation as an expression of the highest stability values, correspond to the greater space available for the cement and margins. The bevelling, which greatly improves the parameters of marginal closure, but inevitably represents a cause of unlightliness. The Chamfer, which although aesthetic, is noticeably predisposed to a marginal distortion and finally, the aesthetic preparation at 50°, which however leads to problems in the creation of the framework and to distortion at the margin levels (22). The theoretical modified 50° preparation experimented in this study, proposes a marginal geometry design that allows the realization of prosthetic restorations with adequate stability and at the same time good aesthetics parameters.

The assumption that leads to a modification of the 50° preparation have been inspired by the validity of this marginal configuration and from the research carried out in an attempt to improve it. The concreteness of the results obtained is reflected in the chance of using a marginal geometry design, which can simultaneously express the positive qualities of both the circumferential shoulder and the 50° inclined plane. From the operational point of view, the innovation introduced in the execution of the marginal geometry design, includes a first step in which the use of a milling cutter for 50° preparations generates the final marginal 50° bevel, angulated in respect to the longitudinal axis of the tooth (Fig. 1a). The achievement of a geometric configuration of the margins, typical of the preparation devised by Kuwata (22), is very clear at the end of this step.

In the second phase of preparation, in the middle of the inclined plane at 50°, a circumferential shoulder plane is carried out with an angle of 27°, using and taking advantage of the special dental drill conceived for this preparation. In this way, the residual portion of the inclined 50° plane (carried out in the first step) will constitute the bevelling of the preparation. The construction of the bevelling is then performed in the first phase of preparation and the 27° shoulder plane in the second phase (Fig. 1a, b). The orientation of the 27° shoulder - obtained by removal during the second phase of the cutting procedure - is achieved working with the "number two" dental drill at half

thickness, and positioning the instrument parallel to the longitudinal axis of the tooth, with the tip of cutting in contact with the inclined 50° plane (Fig. 1a, b, Fig. 3c). If there is a considerable stability request - thanks to the special dental drill (1mm diameter) studied for this preparation – it's possible to use a circumferential shoulder with 90° angle during the second preparation step (Fig. 2b). The drills used for the execution of the described preparation are multi-blade tungsten carbide burs, which can be found at reference 550 (# 1-2-3) of the "Maillefer" catalog (Fig. 3a). Using these point drills with red ring multiplier (120,000 rpm) we achieve better control, in order to obtain an accurate finishing of the two floors, during both the first and second stages of preparation.

With the introduction of this new method for prosthetic preparation, we hope to achieve an ideal marginal geometry, which can unify the advantages related to both types of preparations (50°-27° or 50°-90°) and therefore matching the following five requirements:

- Esthetic, being able to make metal-ceramic crowns without exposure of metal and in any case positioning the margin at the intrasulcular level (23, 24).
- Marginal precision, since the closure on a sloping surface also offers guarantees of cementation (25, 26).
- Periodontal respect, in preparation (27, 28).
- Control of the quality of cervical reduction (12, 29).
- Stability and retention (12, 30, 31).

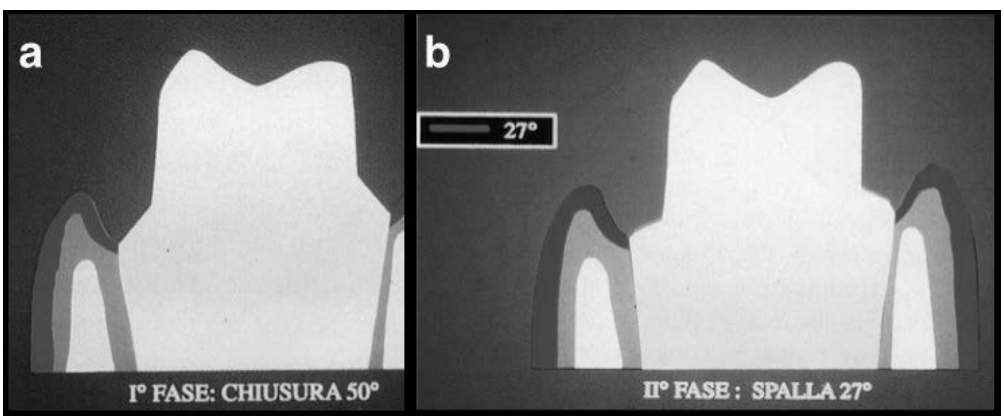
Experimental study

The purpose of this research is to perform and to verify the modified 50° preparation technique's effects, in relation to the reliable characteristics on the relative prosthetic reconstruction. The framework was performed with a scrupulous standardization of laboratory techniques, cemented on the original die. After the aesthetic evaluations, the obtained sample was included in EPON resin and sectioned in the vestibular-lingual sense. The sections were then observed under an optical microscope, at different magnifications for the final evaluations (32).

Sample preparation

For the realization of this study, a permanent human premolar has been used, extracted for orthodontic therapy and maintained in a relative 100% humidity. Tartar and organic material were removed from the coronal root by curettage. Subsequently the crown was reduced according to the modified 50° preparation technique described (two-step preparation) (Fig. 1a, b, Fig. 3b, c) using the tungsten carbide multi-tipped cutters (number 550 Maillefer) (Fig. 3a).

The impression of the tooth preparation was detected with additional silicone (Dei Rainbow Putty and Super light). After about 2 hours from setting time, the impression was developed in epoxy resin (Diemet-E ErKodent), scrupulously respecting



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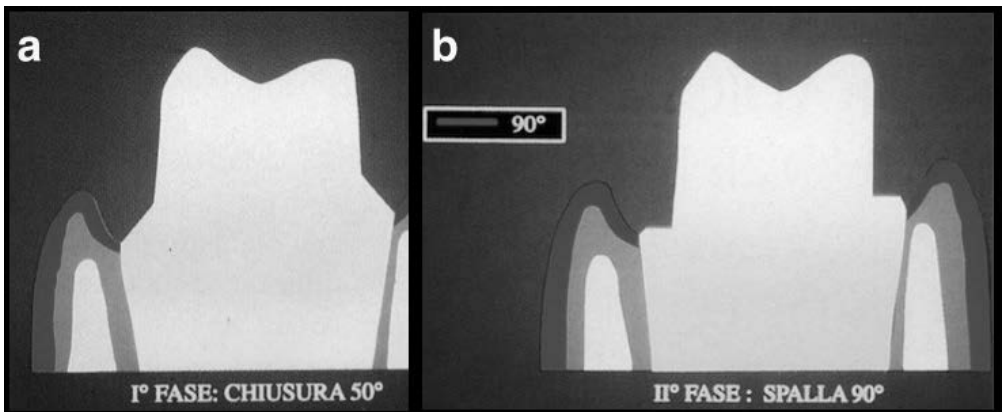
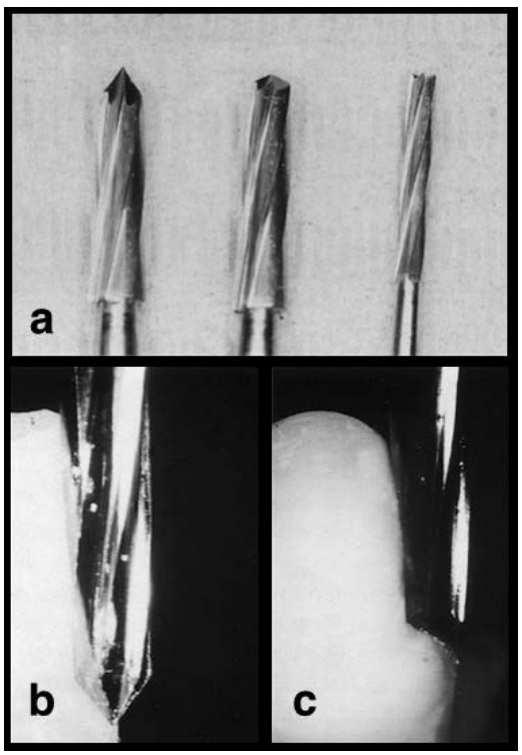


the indications of the manufacturer. After 8 h, the model was analysed under an optical microscope and the marginal finishing line was highlighted with a red wax pencil, always under microscopic control. Prior to waxing procedure, a total thickness of 25 microns was applied with spacers, 0.5 mm from the finishing line. Then, under microscopic vision, the wax modelling was performed, with particular attention to the waxing of the margin. After the wax framework coating (GC vest G), for the gold alloy casting, Shillmen Gold metal-ceramic was used which has excellent hardness and non-deformability characteristics. After pickling, the casting pin was removed, the framework repositioned and checked on the master model and on the tooth preparation.

Details of the finishing line of metal casting (Fig. 4a). After refinement, performed the ceramization (Vita Omega-Vita), the framework has been repositioned and controlled on the master model. Then cementation was carried out on the tooth die with zinc phosphate cement (Harvard cement). The sample was subjected to pressure for about 60 min. Magnification detail of the cementation sample for the evaluation of aesthetic and marginal precision (Fig. 4b). Then the specimen was included in EPON resin. The sections obtained were observed in reflected light, using the Zeiss OPM1 optical microscope at different magnifications (28).

RESULTS

The image of the cemented crown (Fig. 4b)

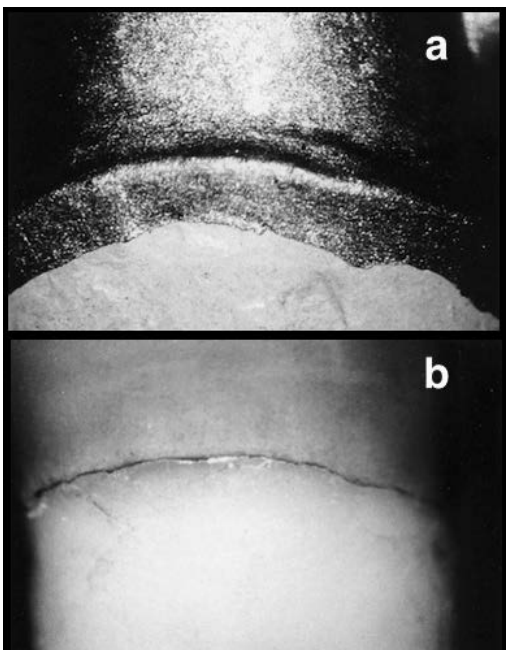


distinctly shows a positive result on the possibilities of aesthetic expression of the modified 50° preparation. Fig. 4b illustrates the marginal closure, which indeed obtained a reduction to the minimum of the metal collar, thanks to the 50° bevel. Furthermore, Fig. 5a, b clearly reveal the principles of stability in relation to the marginal configuration proposed by authors. Fig. 5b shows a particular of the margin at the vestibular level, with a very good ratio marginal precision between prepared tooth-crown.

DISCUSSION

The analysis of dental and dental technician problems, led us to propose a new type of marginal geometry. The updated geometrical design we made, seems to merge together the advantages of two great techniques of preparation: 50° and circumferential shoulder. The experimental study supported by a bibliographic compilation, gives enough credit to this new intuition which is proved to be achievable. In fact, the preparation we proposed: modified 50°, was used to make a gold-ceramic crown, cemented and analysed in terms of aesthetics and stability. The 50° bevel, in the first step of preparation, and the 27° shoulder in the second step, allowed to meet the following requirements:

- Aesthetic: in relation to the possibility of making gold-ceramic crowns without metal exposure (Fig. 4b).
- Marginal precision: because the closure on a sloping surface is more precise, and it offers more guarantees after cementation (Fig. 4b, 5a, b).
- Periodontal compliance: in the preparation phase (Fig. 1a, 2a).
- Conservative: on the amount of cervical reduction (Fig. 5a, b).
- Stability: in relation to the possibility of housing on a circumferential support-plane (Fig. 5a).



However, this study does not want to propose or unify a single type of prosthetic preparation, but simply intends to introduce this marginal design into prosthetic dentistry practice.

Further research will be necessary and should include multiple analysis to confirm reliability of this new type of proposed tooth preparation.

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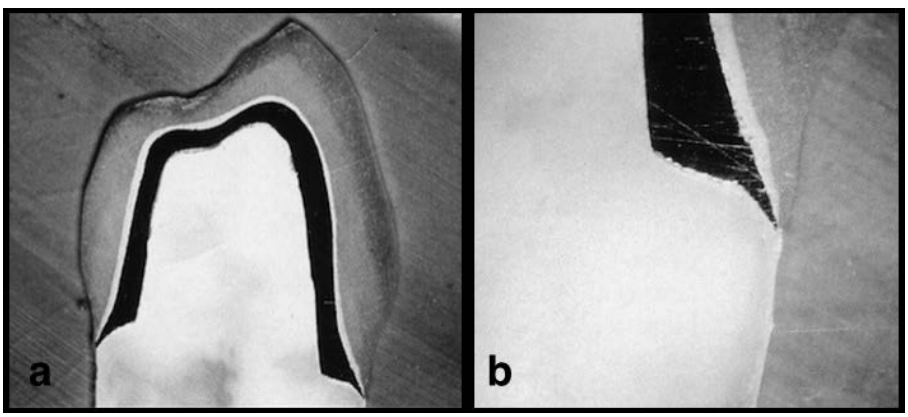

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