



Biologically oriented preparation technique (BOPT): a new approach for prosthetic restoration of periodontically healthy teeth

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Abstract

Tooth preparations for fixed prosthetic restorations can be done in different ways, basically of two kinds: preparation with a defined margin and the so-called vertical preparation or feather edge. The latter was originally used for prosthetics on teeth treated with resective surgery for periodontal disease. In this article, the author presents a prosthetic technique for periodontally healthy teeth using feather edge preparation in a flapless approach in both esthetic and pos-

terior areas with ceramometal and zirconia restorations, achieving high quality clinical and esthetic results in terms of soft tissue stability at the prosthetic/tissue interface, both in the short and in the long term (clinical follow-up up to fifteen years). Moreover, the BOPT technique, if compared to other preparation techniques (chamfer, shoulder, etc), is simpler and faster when in preparation impression taking, temporary crowns' relining and creating the crowns' profiles up to the final prosthetic restoration. (*Eur J Esthet Dent 2013;8:10-23*)





Introduction

One of the main clinical complications in fixed prosthodontics on natural teeth is the unsatisfactory esthetic result due to the apical migration of the gingival margin.^{1,2}

The tendency of the gingival margin to migrate apically in time, is related to different factors:

- Inadequate quality and quantity of keratinized gingiva (thin biotypes are more likely to have recessions).
- Reaction to a trauma during prosthetic work (preparation, gingival retraction).
- Chronic inflammation due to prosthetic errors (technical problems like open margins, violation of the biological width, horizontal overcontour).
- Trauma due to inadequate tooth brushing.

Among factors related to restorative procedures one is particularly relevant: preparation technique and the corresponding geometry of the finish line.

Traditionally, there are two types of dental preparations:³ preparations with finishing lines, also called horizontal; and preparations without finishing lines, described as feather edge.

Even if there is no universally accepted classification, in time different types of preparations and margin definitions have been proposed:^{4,5}

- Shoulder.
- Shoulder with bevel.
- Inclined shoulder (50 degrees and 135 degrees).
- Chamfer.
- Chamfer with bevel.

Horizontal preparations are preferred when clinical and anatomical crown coincide and there is good periodontal health. Prosthetic margins are located near the cemento-enamel junction (CEJ).

Preparations without finish lines are more conservative and are used when the clinical crown does not coincide with the anatomic crown for the loss of support due to periodontal disease. In these cases, the crown's margin is located on the root area.⁶⁻¹⁰

The difference between horizontal and vertical preparations is that in the first ones the margin is positioned by the dentist and leaves a well-defined line on the tooth, which is then replicated in the impression and the working model. This is probably the reason that has made prosthodontists prefer horizontal preparations. For vertical preparations, the margin is positioned by the laboratory technician based on the gingival tissue information. For the absence of a well-defined line, for the difficulties in obtaining good esthetic results, for the possible risk of distortion of the metallic margin during porcelain firing and functional load and for the resulting "over contour," some authors have considered this preparation a possible cause of inflammation and gingival recession.^{11,12}

BOPT

Clinical advantages:

- Erasure of anatomical cemento-enamel junction (CEJ) in unprepared teeth and deletion of the previously existing finish lines in already prepared teeth.
- The possibility to position the final finish line at different levels, either



Fig 1a The prosthetic crown on the left central incisor needs to be replaced. Note the asymmetry of the crown's dimension and gingival margin's architecture.



Fig 1b A thorough periodontal probing is made to "map" the intrasulcular space.

more coronally or more apically, within the gingival sulcus (controlled invasion of sulcus), without affecting the quality of marginal adaptation of the restoration.

- The possibility to modulate the crown emergence profiles to create the ideal esthetic gingival architecture (adaptive forms and profiles). In this way, a new prosthetic cementoenamel junction (PCEJ) will be created.^{15,16}
- Saving of dental structure.
- Easy and fast to execute.
- Ease in relining and finishing temporary crowns.
- Ease in impression taking.

Biological advantages:

- Increase in gingival thickness.
- Increased stability of the gingival margin over time.
- Possibility to coronalize the gingival margin by remodeling emergency profiles.

BOPT technique description

Preparation

Before starting the procedure, an accurate intrasulcular mapping is made with a periodontal probe in order to assess the level of the epithelial attachment (Figs 1a and 1b). If the tooth is intact, the initial phase is the preparation of the extragingival part of the tooth using a diamond flame shaped bur (100/120 micron granulometry). Then the intrasulcular preparation is started by entering the sulcus with the bur tilted obliquely, so that it cuts with its belly and not with the tip, working at the same time on the tooth and gingiva (gingitage technique) and connecting this preparation plane with the axial one, into a single and even vertical surface (finishing area) (Fig 2). In this way, the existing CEJ is erased and, in prepared teeth, the same is done with existing finishing lines. The bur interacts



Fig 2 With a 120 microns grit flame shaped bur, the existing chamfer preparation is eliminated, leaving a margin-free surface.



Fig 3 The tooth surface is then smoothed with a 30 microns grit bur. Note the intrasulcular bleeding due to the intentional "gingitage" procedure. The blood clot formation will initiate the gingival tissue biologic response, guided by the crown's profile.



Fig 4 The hollowed temporary crown is tried on the abutment.



Fig 5 The temporary crown is relined with self-curing methacrylate resin.

at the same time with the sulcular internal wall and with the epithelial component of the gingival attachment. While the gingitage technique proposed by Ingraham using a chamfer bur,^{13,14} leaves a neat finish line and is intended only to open the sulcus and help in impression taking, with BOPT the purpose is to eliminate the emerging component of

the dental anatomy or any pre-existing preparation margin. This will allow the creation of a finish area within which the crown margin can be moved coronally. The final step of the preparation is refining the entire surface with a 20-micron diamond bur to smooth out the surface (Fig 3).



Temporary crown relining

Based on a diagnostic wax-up, the technician has previously prepared a hollowed acrylic crown with a contour that follows the gingival margin. After verifying the fit (Fig 4), the crown is relined with cold cure metacrylate resin after isolating the abutment with glycerin (Fig 5). Once it has set, the crown clearly shows two distinct margins: a thin internal one, which reads the intrasulcular part of the prepared tooth, while the thicker external one follows the external portion of the gingival margin. The space between the two margins is the negative image of the gingiva (Figs 6 and 7).

The space between the two portions will be filled with fluid acrylic resin or with a light cured flowable composite resin to thicken the coronal margin and allow the creation of the crown contour (Figs 8a–8c). The excess material is removed, connecting the crown margin with the coronal profile at the gingival margin (Fig 9). In this way, a new angular component will be formed together with a new CEJ that will be positioned in the sulcus, no deeper than 0.5 to 1 mm, fully respecting the biologic width (controlled invasion of the gingival sulcus) (Fig 10).

After an accurate polishing, the crown is cemented and the excess cement material is easily removed.

As previously stated, gingivage preparation, together with the reduction of the tooth, will create a space that will be filled by a clot resulting from intrasulcular bleeding. The intrasulcular portion of the temporary crown's margin will support the gingival margin circumferen-



Fig 6 Slightly before the final setting of the resin, the crown is removed from the abutment.



Fig 7 Details of the relined crown's margin: the thin internal intrasulcular wall and the thicker external one delimit the negative image of the gingival profile.

tially, allowing the clot stabilization into a fully structured gingival tissue (clot preservation). The healing process will determine the reattachment and thickening of the gingival tissue, which will mold and adapt to the new emergence profile (Figs 11a–11e).

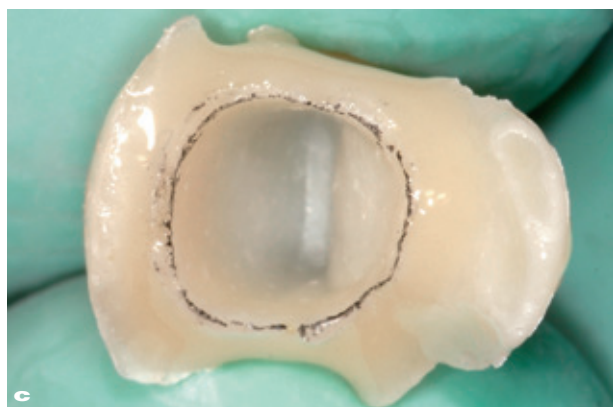
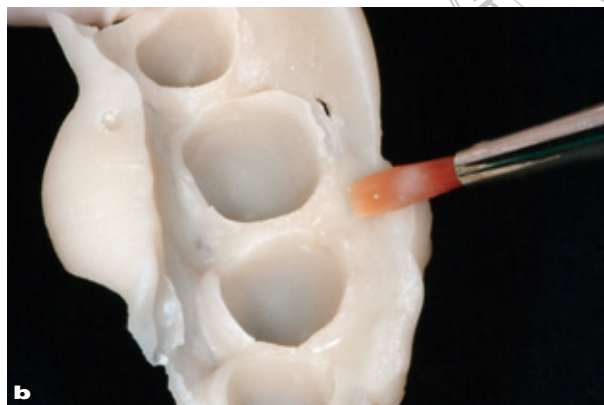
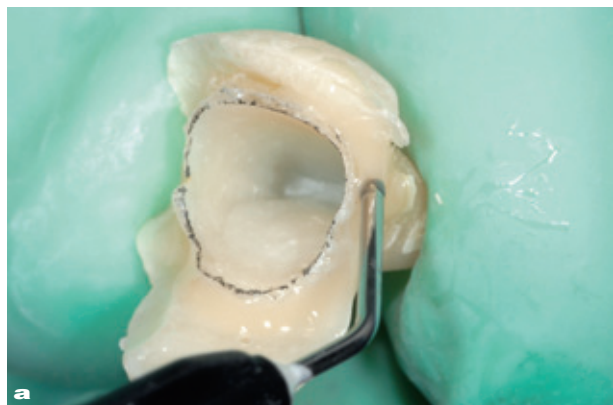


Fig 8 The space between the two walls is filled either with a flowable light-cure composite **(a)** or a fluid mix of acrylic resin **(b)**. After the setting, the internal margin is evidenced with a sharp pencil **(c)**.

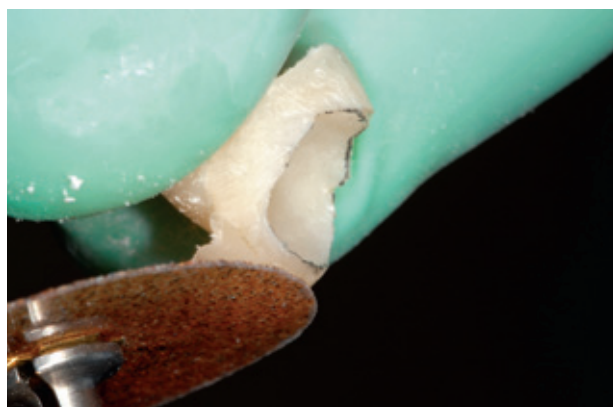


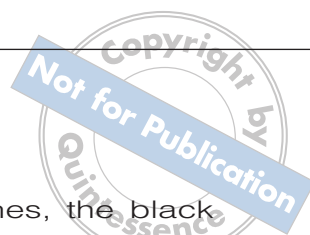
Fig 9 The excess resin is trimmed away with a paper disc and the emergence profile is shaped in order to support the gingival margin.



Fig 10 The finished and polished crown that incorporates the new CEJ with a new angular component of the emergence profile.



Fig 11 After 4 weeks the blood clot, protected by the crown's margin, has developed into new connective tissue and appears thickened and healthy, but still in maturation (a-c). Now the reshaping of the gingival margin can start. The crown's margin is shortened, mirroring the contour of the adjacent tooth (d). Within one more week the gingival margin moves in a coronal direction and the ideal scalloped architecture is completed (e).



Impression technique

After a minimum of 4 weeks, the gingival tissue will be stabilized and it will be possible to take the impression to finalize the restoration. The absence of any finish line will make the procedure faster and simpler. The use of two retraction cords is strongly suggested in order to have a good reading of the sulcus and to help the technician during laboratory procedures.

Laboratory procedures

The development of the impression will allow the technician to identify the finish area on the working model. Since an improved control over the gingival levels is needed before exposing the finishing area, a black mark is traced with a 0.5 mm pencil over the gingival contour projecting it on the abutment's wall (black line).

Afterwards, the gingival part around the abutment is removed, showing the subgingival area of the preparation reproduced on the model (Fig 12). The apical part of the model is now exposed and it will be marked with a blue line. The

area between the two lines, the black and the blue ones, is called the “finishing area” and the technician will mark the “finishing line” with a red pencil, on which will fall the coronal margin (Fig 13).

Positioning this line more apically or coronally will depend on the depth of the sulcus and on the esthetic needs, but the crown margin will never invade the epithelial attachment. The red line is now the reference margin for the ditching procedure and for eliminating the underlying useless segment.

As opposed to what other authors have proposed for restorations with feather edge preparations,^{15,16} the BOPT technique introduces a new concept based on an observation that it is the gingival profile that adapts itself in a specular way to the coronal emergence profile and not the opposite (adaptation forms and profiles concept).

Based on this concept, the creation of the profiles is done on the master cast without the gingival component, creating a morphofunctional and esthetic ideal contour (Fig 14). The prosthetic restoration is then transferred on the model with the gingiva (Figs 15a–15e) to evaluate the contours tridimensional-



Fig 12 The black line projects the gingival margin on the abutment. Then the gingiva is removed to expose the finishing area as recorded in the impression.

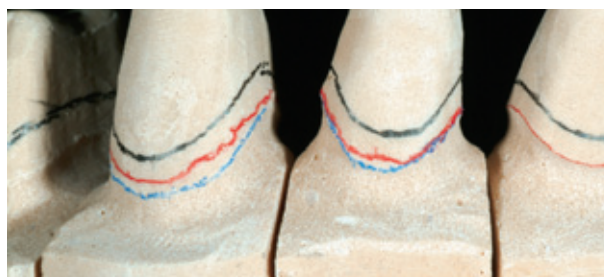


Fig 13 Markings of the three lines in the finishing area and ditching of the abutment.



Fig 14 First ceramic bake on the master model without the gingival anatomy.



Fig 15 The crown contours, esthetically shaped, cannot be seated on the “anatomic” model reproducing the gingiva **(a)**. With a scalpel the technician removes the interferences until the crowns are fully seated **(b)**. Filling with ceramic the new parabolic volume **(c and d)**. The new contours finished and polished **(e)**.

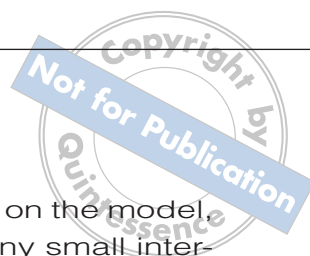


Fig 16 The case before treatment.



Fig 17 The case completed.



Fig 18 The patient's smile.

ly. In order to fit the crown on the model, the technician removes any small interference with the marginal gingiva using a sharp scalpel, simulating the interaction between the prosthetic contours and the gingiva that exists *in vivo* with the oral tissues¹⁷⁻¹⁹ (Figs 16–18).

Discussion

The results achieved in the last 15 years with the BOPT technique allow the authors to make some clinical and biological considerations.

The coronal seal is definitely better on feather-edge preparations than on horizontal ones. This is due, as it has been demonstrated by many authors,²⁰⁻²² to the decreased space between the teeth and crown as a result of vertical geometry. It results in a better fit, a lesser cement exposure and a diminished bacterial penetration.

Some authors have also demonstrated that a bad periodontal response depends more on a poor crown's margin adaptation rather than on the placement of the finishing margin inside the gingival sulcus.^{23,24}

This result confirms that margins can be placed within the sulcus and the BOPT efficacy is based on this. The other fundamental concept is that the finish line of horizontal preparations is located on the prepared tooth, while the finish line is the prosthetic crown's margin itself in the BOPT technique. This margin can be shortened or extended both in the temporary or final restoration at different intrasulcular levels, without harming the quality of fit and without invading the epithelial attachment because the finish



Fig 19 Another case before treatment.



Fig 20 The restoration completed in close up.



Fig 21 The pre-treatment situation of a case where new crowns on natural abutments are planned together with implant-supported restorations.



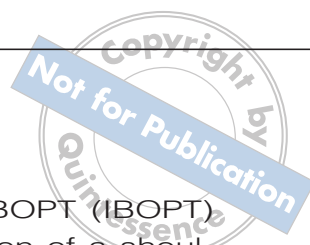
Fig 22 Master model with the finished crown before delivery to the patient.



Fig 23 Occlusal view before crowns' cementation. The same prosthetic concepts are applied to both natural and implant abutments and generate the same thickening effect on buccal gingival tissues.



Fig 24 Clinical aspect of the finished case.



area is always located above it (controlled invasion of the gingival sulcus).

With the BOPT technique it is possible to transfer the emergent anatomy to the prosthetic crown. This allows a free interaction with the gingiva that will adapt, shape and settle around new forms and profiles (adaptation forms and profiles concept). Apparently, the crown's contours obtained with the BOPT technique may appear excessively pronounced, based on the traditional definition of "overcontour". It is the authors' opinion that this concept should be reinterpreted. In fact, there is no consensus on what a "normal" contour should be. Sorensen suggested that a vertical contour up to 45 degrees can be still considered as normal.²⁵ Based on the authors' experience, there is no absolute overcontour, but instead different new contours and new PCEJs.

In contrast to what other authors suggest,^{11,12} in most BOPT cases it is very uncommon to observe inflamed gingiva and recession related to the crown's contours.

The BOPT technique, with the interaction between preparation–restoration–gingiva (gingitage, clot, new contour), enables the gingiva to thicken and to adapt to new forms, resulting in increased stability both in the short and in the long term. As previously mentioned, it is commonly observed that the apical recession of the marginal gingiva (Fig 19) can be corrected just by the elimination of pre-existing finish lines and by the new emergence profile of the crown (Fig 20).

The same concepts and procedures have been applied also in implant

dentistry in the implant BOPT (IBOPT) through the implementation of a shoulderless abutment design.²⁶ The IBOPT abutment has no finish line and it is the buccal gingival margin of the crown to create the soft tissue form. The reduced buccal width of the abutment gives more space to the gingival thickness and promotes stability (Figs 20–24).

Conclusions

In 15 years of clinical experience, the BOPT technique has proven successful in maintaining stability of pericoronal soft tissues in both anterior and posterior areas, in both natural teeth and implants. With the BOPT technique, the clinician and the laboratory technician can interact with the surrounding tissues modifying their shape and scalloped architecture regardless of any preexisting dental or gingival limitation. The advantages are relevant considering that most of the clinical results are obtained only through the restoration itself, both provisional and final (margin position, emerging profile, tooth form).

In order to give scientific value to this technique, more clinical and biological studies are needed. A prospective multicenter investigation will be designed to verify if the BOPT procedure can be used by clinicians with predictable results.

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References

1. Valderhaug J. Periodontal condition and carious lesion following the insertion of fixed prosthesis: a 10-years follow-up study. *Int Dental Journal* 1980;30:296–304.
2. Valderhaug J, Birkeland M. Periodontal conditions in patients 5 years following insertion of fixed prostheses. *J Oral Rehab* 1976;3:237–243.
3. Pardo GI. A full cast restoration design offering superior marginal characteristics. *J Prosthet Dent* 1982;48:539–543.
4. Shillenburg HT, Hobo S, Whitsett LD. *Fundamentals of fixed prosthodontics ed 2*. Chicago: Quintessence Publishing Co, 1981:90–93, 118.
5. Kuwata M. Gingival margin design of abutments for ceramometal restorations. *Quintessence Dent Technol* 1979;10:27–38.
6. Amsterdam M, Abrams L. Periodontal prosthesis. In H.M. Goldman and D.W. Cohen (eds). *Periodontal therapy, ed 4*. St.Louis: CV Mosby Co, 1968.
7. Amsterdam M, Rossman SR. Technique and hemisection of multirrooted teeth. *Alpha Omegan* 1960;53:4–15.
8. Carnevale G, Di Febo G, Trebbi L. A patient presentation: planning a difficult case. *Int J of Perio Rest Dent* 1981;6:51–63.
9. Carnevale G, Freni Sterrantino S, Di Febo G. Soft and hard tissue wound healing following tooth preparation to the alveolar crest. *Int J Periodont Rest Dent* 1983;6:37–53.
10. Di Febo G, Carnevale G, Freni Sterrantino S. Treatment of a case of advanced periodontitis: Clinical procedures utilizing the 'combined preparation technique'. *Int J of Perio Rest Dent* 1985;5:52–62.
11. Lang NP, Kiel RA, Anderhalden K. Clinical and microbiological effects of sub-gingival restorations with overhanging or clinically perfect margins. *J Clin Periodontol* 1983;10:563–578.
12. Martignoni M, Schonembergher A. *Precisione e contorno nella ricostruzione protesica*. Berlin: Quintessenza Biblioteca, 1987.
13. Ingraham R, Evens JK. Tissue management in cavity preparation. *Dent Dimen* 1975;9:9–11.
14. Ingraham R, Sochat P, Hansing FJ. Rotary gingival curettage: A technique for tooth preparation and management of the gingival sulcus for impression taking. *Int J Periodont Rest Dent* 1981;1:9–33.
15. Abrams L. *Graduate periodontal and prosthetic lectures*. Boston University School of Graduate Dentistry, 1971. Boston: Boston University Press, 1971.
16. Kay HB. Criteria for restorative contours in the altered periodontal environment. *Int J Periodont Rest Dent* 1985;5:42–63.
17. Loi I. Protesi su denti naturali nei settori di rilevanza estetica con tecnica BOPT: Case series report. *Dental Cadmos* 2008;76:51–59.
18. Loi I, Scutellà F, Galli F. *Tecnica di preparazione orientata biologicamente (BOPT). Un nuovo approccio nella preparazione protesica in odontostomatologia*, Quintessenza Internazionale 2008;5:69–75.
19. Loi I, Galli F, Scutellà F, Di Felice A. Il contorno coronale protesico con tecnica di preparazione BOPT (Biologically Oriented Preparation Technique): considerazioni tecniche. *Quintessenza Internazionale* 2009;25:4–19.
20. Rosner D. Function, placement, and reproduction of bevels for gold castings. *J Prosthet Dent* 1963;13:1160–1166.
21. Belser UC, Mac Entee MI, Richter W. Fit of porcelain-fused-to-metal marginal designs in vivo: a scanning microscope study. *J Prosthet Dent* 1985;53:24–29.
22. Cagidiaco MC, Ferrari M, Bertelli. Cement thickness and microleakage under metal-ceramic restorations with a facial butted margin: an in vivo investigation. *Int J Periodont Rest Dent* 1992;4:324–331.
23. Richter WA, Ueno H. Relationship of crown margin placement to gingival inflammation. *J Prosthet Dent* 1973;30:156–161.
24. Waerhaug J. Histologic consideration which govern where the margins of restorations should be located in relation to the gingival. *Dent Clin North Am* 1960;4:201–207.
25. Sorensen JA. Standardized method for determination of crown fidelity. *J Prosthet Dent* 1990;64:18–24.
26. Canullo L, Cocchetto R, Loi I. *Peri-implant tissue remodeling: scientific background and clinical implications*. Chapter 8: *Abutment Morphology and Peri-Implant Soft Tissues*. Milan, Italy: Quintessence Editions, 2012.