Letter to the Editor

Dear Editor,

We have read the article titled "Prospective Clinical Study of Zirconia Full-Coverage Restorations on Teeth Prepared With Biologically Oriented Preparation Technique on Gingival Health: Results After Two-Year Follow-up" in September/October 2018 (Vol. 43, Issue 5).[1] We appreciate the authors for their novel approach for previously failed restorations, meticulous explanation of the technique, and two-year follow-up of cases. The described technique is beneficial for us since we come across many cases with similar problems.

We have a few doubts regarding the technique that we would like the author to clarify. According to Ivkovic and others, autopolymerized acrylic produces more cytotoxicity because of monomer leaching out, depending on internal and external factors. This could hinder the healing the gingiva.[2] Subgingival restorative margin placement has demonstrated adverse inflammatory periodontal reaction due to the tooth-restoration interface being overcontoured, difficulty in finishing and polishing of restorative margins, challenges in applying oral hygiene measures, increased pathogenicity of the subgingival dental plaque, and violation of the biologic width.

Moreover, according to Gianluca Paniz and others, feather edge preparation of margins presents significantly more bleeding on probing than chamfer preparation. They studied the periodontal response to two different subgingival restorative margin designs where follow-up for 12 months concluded that significant differences were seen in regard to plaque index, gingival index, and periodontal probing depth, but there was no statistically significant difference between chamfer and feather edge finishing lines in regard to these parameters.[3] According to Schatzle and others, after 26 years of follow-up, full-coverage crowns with subgingivally placed finishing lines had a detrimental effect on periodontal health. They also found deterioration of the clinical periodontal parameters within one to three years after the delivery of the restorations.[4]

With all the background above, we would like authors to give their opinion regarding the outcome of the subgingival placement of knife-edge margins that they have described. We once again thank the authors and *Operative Dentistry* for publishing this eye-opening article.

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REFERENCES

1. Agustín-Panadero R, Serra-Pastor B, Fons-Font A, & Solá-Ruíz MF (2018) Prospective clinical study of zirconia full-coverage restorations on teeth prepared with biologically oriented preparation technique on gingival health: Results after two-year follow-up *Operative Dentistry* **43(5)** 482-487.
2. Ivkovic N, Božovic D, Ristic S, Mirjanic V, & Jankovic O (2013) The residual monomer in dental acrylic resin and its adverse effects *Contemporary Materials* **4(1)** 84-91.
3. Paniz G, Nart J, Gobbato L, Chierico A, Lops D, & Michalakis K (2016) Periodontal response to two different subgingival restorative margin designs: A 12-month randomized clinical trial *Clinical Oral Investigations* **20(6)** 1243-1252.
4. Schätzle M, Lang NP, Ånerud Å, Boysen H, Bürgin W, & Löe H.(2001) The influence of margins of restorations on the periodontal tissues over 26 years *Journal of Clinical Periodontology* **28(1)** 57-64.

Author Response

Thank you for your interest in our article. It is important to us that our work generates positive expectations, and in the case of the biologically oriented preparation technique (BOPT), it is well deserved, as the clinical results have been really spectacular.

Below are our responses to your questions:

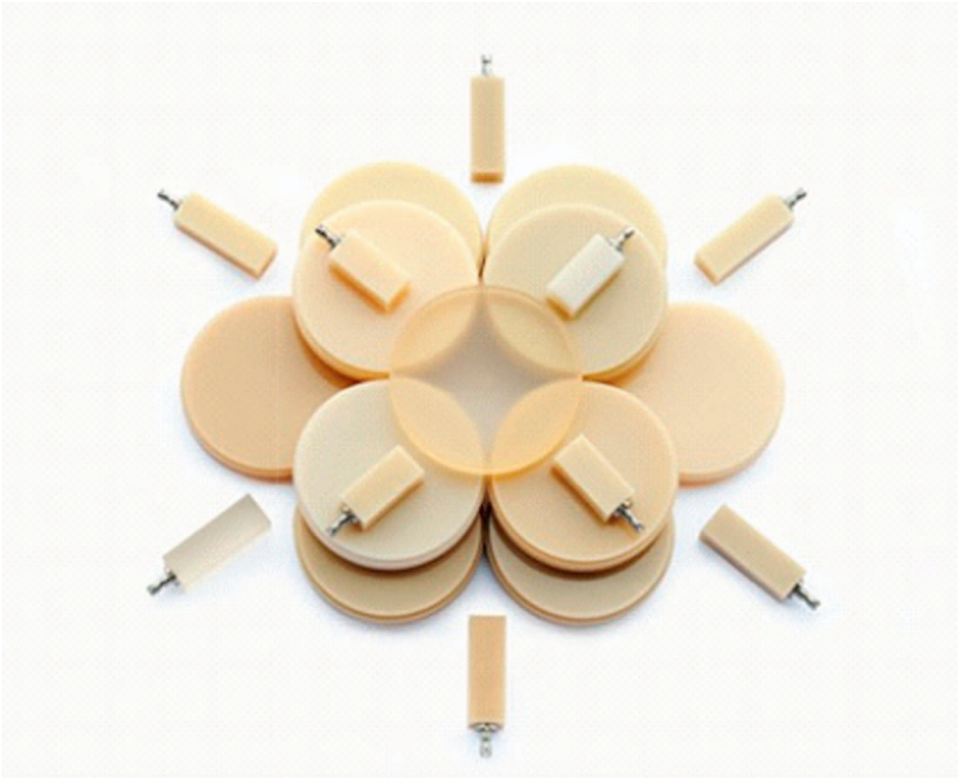

Figure 1. *Sintodent resin products for use with CAD/CAM methodology. Figure retrieved from http://www.sintodent.it on 1/Oct/19. Used by permission. http://www.sintodent.it/images/download/citotos-en.pdf; http://www.sintodent.it/images/download/certqualdisc-en.pdf).*

According to Ivkovic and others, autopolymerized acrylic produces more cytotoxicity because of monomer leaching out, depending on internal and external factors. This could hinder the healing the gingiva.

Reply: We are aware of what has been published regarding generalized monomer release deriving from self-polymerizing resins. However, we minimized the exposure to monomers by using a specific, carefully chosen resin: Sintodent (Sintodent S.r.l., Rome, Italy). This allowed us to design the provisional restoration digitally before dental preparation (CAD), which was milled in a five-axis milling machine (CAM) (Figure 1).

As soon as the tooth was prepared, the provisional restoration was relined with resin of the same composition but using a powder-liquid mixture. This particular acrylic resin has been investigated in several studies[1,2] that showed that its behavior is different from other acrylic resins, as it presents low contraction, a reduced exothermic phase, great strength, easy polishability, and a very important bacteriostatic function during the gingival healing phase.

In addition, once cured, we placed the resin in a high-temperature high-pressure kiln to achieve optimal polymerization, minimizing monomer release to avoid producing irritation or mucosa maceration. Afterward, we applied a layer of photopolymerizable resin nanofiller (GC Optiglaze varnish 15 ml, GC Corp, Tokyo, Japan) in the area of contact between the provisional restoration and tissue to isolate it from any released monomer and so improve the periodontal healing process. In addition, we used a light-curing elastomeric resin provisional cement, making it possible to remove excess cement *en bloc* (TempBond Clear, Kerr Corp, Orange, CA, USA).

Subgingival restorative margin placement has demonstrated adverse inflammatory periodontal reaction due to the tooth-restoration interface being overcontoured, difficulty in finishing and polishing of restorative margins, challenges in applying oral hygiene measures, increased pathogenicity of the subgingival dental plaque, and violation of the biologic width.

Reply: With BOPT, overcontouring is entirely different from what constitutes cervical overcontouring over a horizontal finishing line. We must distinguish between what is defined as the anatomical crown and what is described as a tooth's clinical crown. In BOPT, we modify the convexity of the anatomical crown so that the prosthesis imitates the

Due to Copyright Permissions, this figure cannot be printed. The figure can be accessed at:
http://www.sintodent.it/images/grafici/graficoattaccobatterico-it.pdf
as of 1/Oct/2019.

Figure 2. *Lifetime in contact with Sintodent resin of the most frequent microorganisms in the oral cavity. Ceded image of the manuscript: Albergo G, Sampalmieri F, Mattioli Belmonte M, Furore G, & Andreana S (2003) Attività antimicrobica di una resina acrilica [Antimicrobial activity of an acrylic resin]* Dental Cadmos ***71(2)*** *69-74.*

natural tooth, on which we have previously eliminated any horizontal-convex component that may present above the cemento-enamel junction (CEJ). But, with a horizontal finishing line, the emergence of the tooth's clinical crown is modified, which is where the well-known periodontal problems described in the literature arise, as this favors the accumulation of dental plaque resulting from aberrant anatomy. It must be understood that with BOPT, we imitate the convex anatomy of the natural tooth above its CEJ.

Moreover, according to Gianluca Paniz and others, feather edge preparation of margins presents significantly more bleeding on probing than chamfer preparation. They studied the periodontal response to two different subgingival restorative margin designs where follow-up for 12 months concluded that significant differences were seen in regard to plaque index, gingival index, and periodontal probing depth, but there was no statistically significant difference between chamfer and feather edge finishing lines in regard to these parameters.

Reply: We agree that Paniz and others in their articles after six months[3] and 12 months[4] found that there was gingival stability but slight periodontal inflammation around teeth prepared with BOPT. While these articles appear convincing, the BOPT protocol is not clearly defined. BOPT is very method and skill dependent and involves a learning curve of at least a year. We cannot be certain, but some results reported in these articles may be due to the following: 1) Methodological bias: the clinical protocol applied is not well defined in the article; randomization of the patient sample is not reported either (the patient-dependent periodontal variables of each subject conforming the sample are questionable), and 2) only one year follow-up is insufficient to assess clinical responses to a treatment.

The most important variable to consider in order to achieve a good outcome using BOPT is correct diagnosis of the tooth to be treated. The tooth must be free of active periodontal disease with a good prognosis for restoration. It is also important to carry out the right clinical-prosthetic protocol, as this technique is susceptible to iatrogenic damage through unmanaged invasion of the biological sulcus (Figure 3). BOPT must be the right choice for the case, and the clinician must be well trained to carry out dental preparation correctly. The fabrication of the provisional must be correct too; the dental technician must be instructed correctly so that the definitive prosthesis matches the biological parameters stipulated by the clinician in the provisional (Figure 4).[5,6]

According to Schatzle and others, after 26 years of follow-up, full-coverage crowns with subgingivally placed finishing lines had a detrimental effect on periodontal health. They also found deterioration of the clinical periodontal parameters within one to three years after the delivery of the restorations.

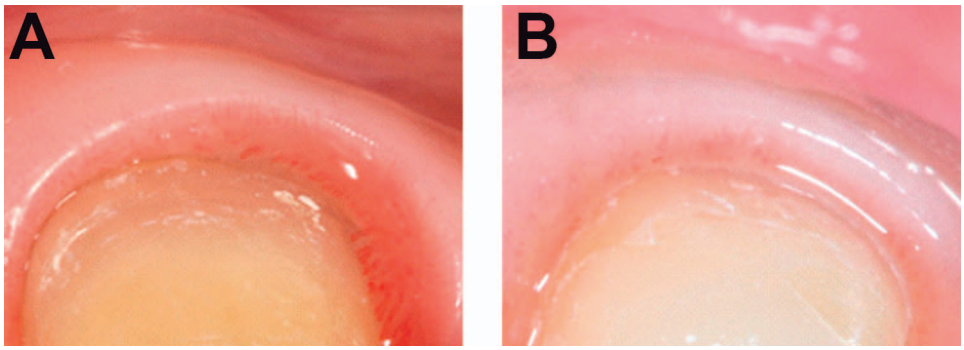

Figure 3. *(A, B): Healed gingival tissue after periodontal maturation around prosthesis emergence on tooth prepared with BOPT.*

Figure 4. *Stabilization of gingival tissue eight weeks after treatment with BOPT.*

Reply: It is important to understand that BOPT differs from knife-edge preparation, as it creates a vertical plane with contouring and a prosthetic emergence angle that imitates the anatomical crown of a natural tooth (the angulation of this emergence does not have to be the same as with knife edge, which can reach a maximum of 90°) (Figure 5).[6]

We can classify dental preparation techniques for full-coverage crowns as two types: with or without a finishing line. In cases where it is decided to create a finishing line, preparation can have a sliding-vertical line (knife edge) or a horizontal finishing line (curved or flat chamfer, straight shoulder, 120° shoulder, beveled shoulder, and so on). With these types of preparation, the tooth-prosthesis interface may be positioned at different apico-coronal levels in relation to the gingival margin (supragingival, juxtagingival, and subgingival). The other option is using no dental finishing line, known as BOPT, first described by Dr Ignazio Loi in 2013.[7-10] With this technique, the tooth-prosthesis interface is always placed subgingivally (managed invasion of the periodontal sulcus).

Gingival placement of the preparation margin in indirect restorations has always been a topic of debate among dental professionals. Some researchers defend placement of the margin away from the epithelial insertion of the periodontum (juxta- or supragingival) in order to eliminate any factor that might cause gingival inflammation. Others have not found significant differences derived from gingival placement of the margin. There are cases in which the dentist has no other option than to position the preparation margin inside the periodontal sulcus, for example, in cases of subgingival oblique fracture, the presence of radicular caries, a tooth stump of dark color, sensitivity, cervical abrasion, or insufficient retention due to a short dental post.[11-17]

BOPT eliminates—by means of dental milling with diamond burs—the emergence of the anatomical crown above the CEJ, making it possible to fabricate a restoration with a new anatomical crown that respects periodontal tissue, facilitating periodontal tissue stabilization around the cervical area.[10]

Recent studies, case series, and prospective studies (with up to four years of follow-up)[6] vouch for the positive periodontal behavior around teeth prepared with BOPT, which present healthy and stable pericoronal tissue. The clinical advantages of BOPT are the following: 1) it eliminates the CEJ of the tooth, creating a new junction with the cervical margin of the indirect restoration (prosthetic CEJ); 2) it is possible to position the restoration's cervical margin at different levels inside the gingival sulcus without affecting the marginal fit between the dental preparation and the restoration (restoration over-

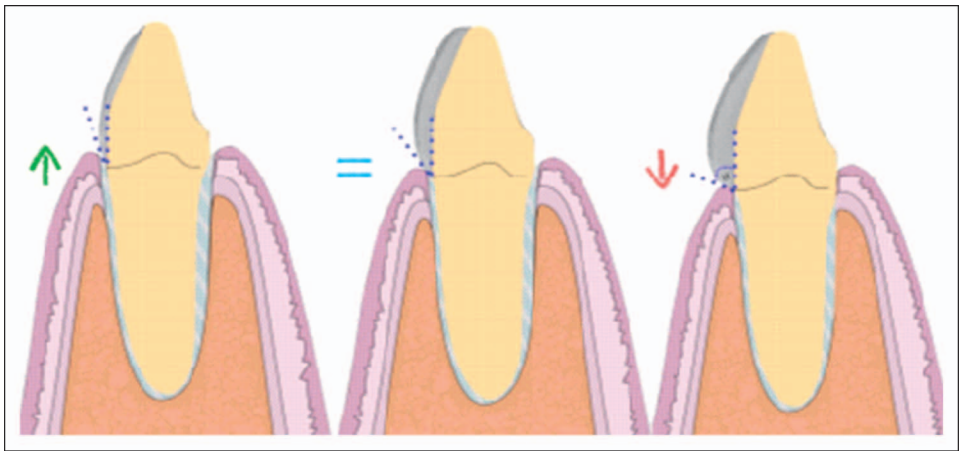

Figure 5. *Modification of the gingiva with respect to the prosthetic emergency. Ceded image of the manuscript: Agustín-Panadero R, Ausina-Escrihuela D, Fernández-Estevan L, Román-Rodríguez JL, Faus-López J, Solá-Ruíz MF (2017) Dental-gingival remodeling with BOPT no-prep veneers* Journal of Clinical and Experimental Dentistry ***9(12)*** *1496-1500. Figure used by permission.*

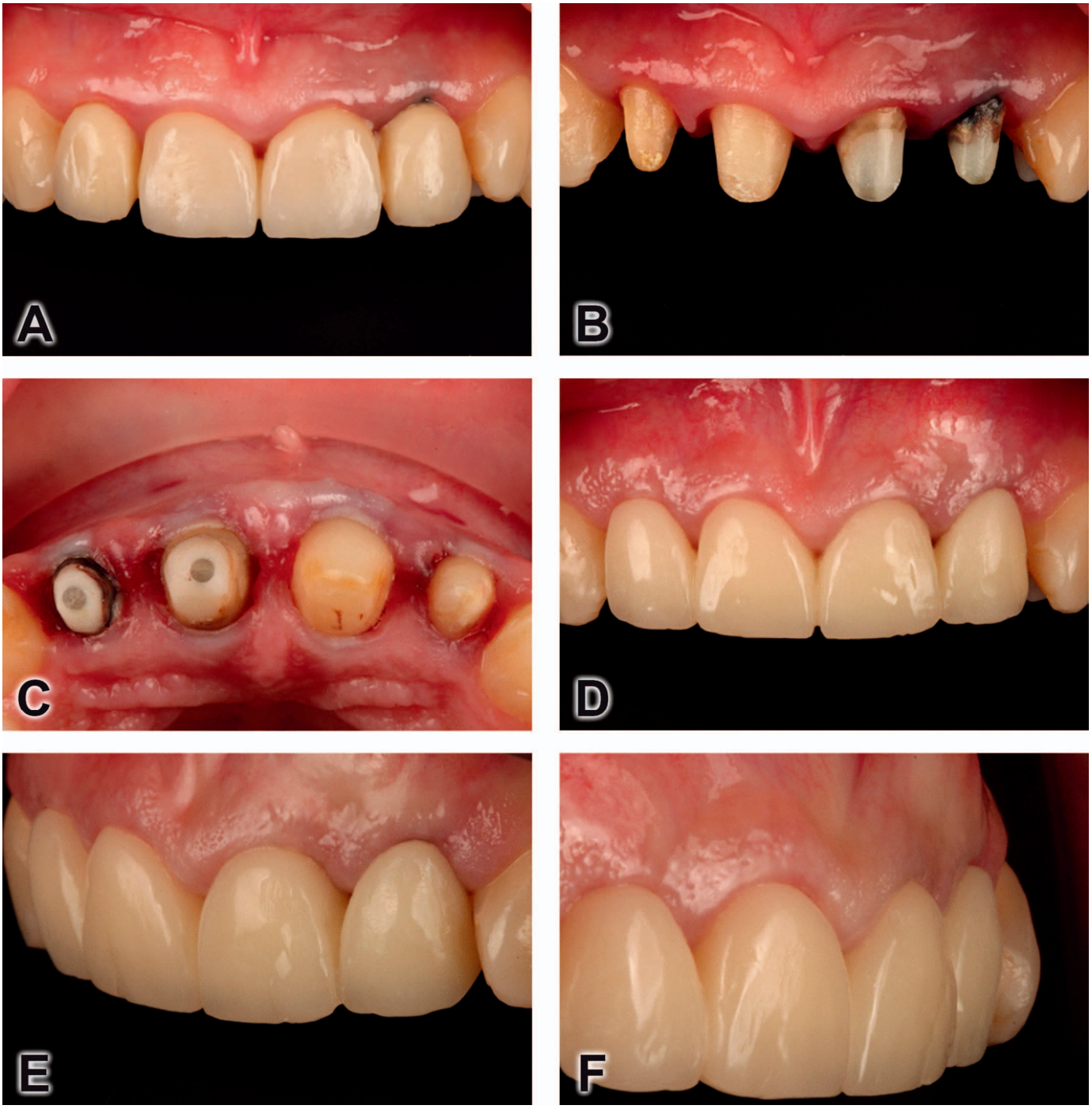

Figure 6. *Modification of the gingival emergence profile and periodontal health 12 weeks after treatment with vertical dental preparation. (A, B, C): Initial situation of the gingiva and old prosthesis in the anterior sector. (D, E, F): Soft tissue management with the provisional prosthesis. (G, H): Gingiva healed after BOPT treatment. (I, J): Final situation with the BOPT prosthesis.*

contouring); 3) it is possible to displace the gingival margin in an apico-coronal direction, modifying the convexity of the restoration's cervical area; and 4) the gingival margin is stabilized, and gingival thickness is increased.

On the other hand, the disadvantages of BOPT are the following: 1) it is a more complex technique that requires more clinical time and a learning curve, 2) situating the restoration margin in the right position is difficult given that there is no finishing line (risk

Figure 6. *Modification of the gingival emergence profile and periodontal health 12 weeks after treatment with vertical dental preparation. (A, B, C): Initial situation of the gingiva and old prosthesis in the anterior sector. (D, E, F): Soft tissue management with the provisional prosthesis. (G, H): Gingiva healed after BOPT treatment. (I, J): Final situation with the BOPT prosthesis. (cont.)*

Figure 7. *(A, B): Gingival emergence anatomy after retreatment with BOPT*

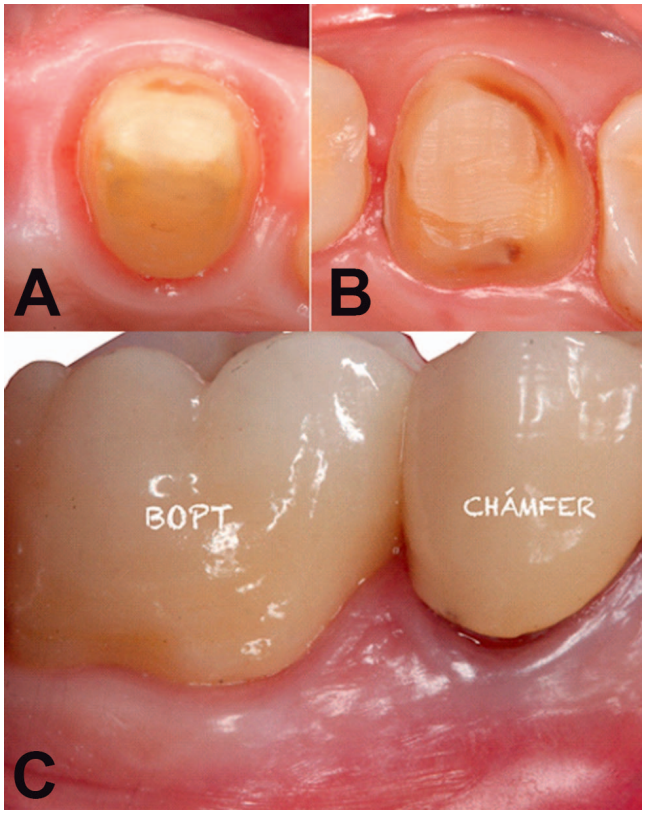

Figure 8. *(A, B, C): Gingival differences between restorations with and without dental finishing lines.*

of iatrogeny), and 3) removing excess cement when the dental preparation-restoration interface is positioned subgingivally is difficult (Figure 6).[7]

BOPT consists of milling the tooth to create a vertical axial plane between the dental anatomical crown and the apical area. The tooth reduced using BOPT has no dental finishing line (not knife edge), as this exists only on the prosthetic restoration and is characterized by cervical contouring determined in relation to the periodontal parameters of the tooth being restored (generating gingival margin stability) (Figure 7). Although BOPT has come into use only a short time ago, the literature published to date reports promising results in the medium term—a cause for optimism. These articles provide evidence of good clinical behavior, gingival marginal stability, and increased gingival thickness around the prosthetic emergence—all aspects of particular concern to restorative dentists (Figure 8).[5-10]

Many thanks for your interest in our article. We hope we have provided adequate responses to your queries. Below is an up-to-date bibliography for BOPT and the periodontal behavior of teeth prepared and restored with a finishing line.

REFERENCES

1. Albergo G, Sampalmieri F, Mattioli Belmonte M, Furore G, & Andreana S (2003) Attività antimicrobica di una resina acrilica [Antimicrobial activity of an acrylic resin] *Dental Cadmos* **71(2)** 69-74.
2. Albergo G, Accarisi E, Sampalmieri F, Bedini R, & Andreana S (1997) Effect of antimicrobial ingredients on mechanical performance in acrylic resin *Journal of Dental Research* **76(Special Issue 128)**.
3. Paniz G, Nart J, Gobbato L, Mazzocco F, Stellini E, De Simone G, & Bressan E (2017) Clinical periodontal response to anterior all-ceramic crowns with either chamfer or feather-edge subgingival tooth preparations: Six-month results and patient perception *International Journal of Periodontics and Restorative Dentistry* **37(1)** 61-68.
4. Paniz G, Nart J, Gobbato L, Chierico A, Lops D, & Michalakis K (2016) Periodontal response to two different subgingival restorative margin designs: A 12-month randomized clinical trial *Clinical Oral Investigations* **20(6)** 1243-1252.
5. Agustín-Panadero R, Ausina-Escrihuela D, Fernández-Estevan L, Román-Rodríguez JL, Faus-López J, & Solá-Ruíz MF (2017) Dental-gingival remodeling with BOPT no-prep veneers *Journal of Clinical and Experimental Dentistry* **9(12)** 1496-1500.
6. Serra-Pastor B, Loi I, Fons-Font A, Solá-Ruíz MF, & Agustín-Panadero R (2019) Periodontal and prosthetic outcomes on teeth prepared with biologically oriented preparation technique: A 4-year follow-up prospective clinical study *Journal of Prosthodontic Research* in press, published online **Apr 8** http://dx.doi.org/10.1016/j.jpor.2019.03.006
7. Loi I & Di Felice A (2013) Biologically oriented preparation technique (BOPT): A new approach for prosthetic restoration of periodontally healthy teeth *European Journal of Esthetic Dentistry* **8(1)**10-23.
8. Agustín-Panadero R & Solá-Ruíz MF (2015) Vertical preparation for fixed prosthesis rehabilitation in the anterior sector *Journal of Prosthetic Dentistry* **114(4)** 474-478.
9. Agustín-Panadero R, Serra-Pastor B, Fons-Font A, & Solá-Ruíz MF (2018) Prospective clinical study of zirconia full-coverage restorations on teeth prepared with biologically oriented preparation technique on gingival health: Results after two-year follow-up *Operative Dentistry* **43(5)** 482-487.
10. Agustín-Panadero R, Solá-Ruíz MF, Chust C, & Ferreiroa A (2016) Fixed dental prostheses with vertical tooth preparations without finish lines: A report of two patients *Journal of Prosthetic Dentistry* **115(5)** 520-526.
11. Pelaez J, Cogolludo PG, Serrano B, Serrano JF, & Suarez MJ (2012) A four-year prospective clinical evaluation of zirconia and metal-ceramic posterior fixed dental prostheses *International Journal of Prosthodontics* **25(5)** 451-458.
12. Håff A, Löf H, Gunne J, & Sjögren G (2015) A retrospective evaluation of zirconia-fixed partial dentures in general practices: An up to 13-year study *Dental Materials* **31(2)** 162-170.

13. Zenthöfer A, Ohlmann B, Rammelsberg P, & Bömicke W (2015) Performance of zirconiaceramic cantilever fixed dental prostheses: 3-year results from a prospective, randomized, controlled pilot study *Journal of Prosthetic Dentistry* **114(1)** 34-39.

14. Sailer I, Balmer M, Jürg H, Hämmerle CHF, Känel S, Thoma DS, & Hüsler J (2017) Comparison of fixed dental prostheses with zirconia and metal frameworks: Five-year results of a randomized controlled clinical trial *International Journal of Prosthodontics* **30(5)** 426-428.

15. Suarez MJ, Perez C, Pelaez J, Lopez-Suarez C, & Gonzalo E (2019) A randomized clinical trial comparing zirconia and metal-ceramic three-unit posterior fixed partial dentures: A 5-year follow-up *Journal of Prosthodontics* **28(7)** 750-756.

16. Valderhaug J & Birkeland JM (1976) Periodontal conditions in patients 5 years following insertion of fixed prostheses: Pocket depth and loss of attachment *Journal of Oral Rehabilitation* **3(3)** 237-243.

17. Valderhaug J, Ellingsen JE, & Jokstad A (1993) Oral hygiene, periodontal conditions and carious lesions in patients treated with dental bridges: A 15-year clinical and radiographic follow-up study *Journal of Clinical Periodontology* **20(7)** 482-489.

Dear R Agustín-Panadero, B Serra-Pastor, A Fons-Font, & MF Solá-Ruíz:

First of all, we would like to thank the authors for their prompt reply and detailed description of the work done. We appreciate the meticulous work and research you have done regarding the BOPT technique. The material used for the fabrication of provisional restoration and cementation along with its properties, which do not hinder the gingival healing, gives a clear idea of the differences from conventional acrylic. The explanation given on how the BOPT technique differs from various different finish lines and the advantage over others convinces us that this technique could be incorporated into our clinical practice. Even though the procedure is a more complex technique that requires more clinical time and a learning curve, it can be practiced because of the long-term success of this procedure along with maintaining good periodontal health, which you have shown in your cases. Thank you very much for sharing the information.

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