

BOPT: A VERTICAL PREPARATION TECHNIQUE FOR TEETH AND IMPLANTS

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Abstract: Objective. All available scientific evidence on the Biologically Oriented Preparation Technique (BOPT) is shown, including relevant, unknown and controversial aspects of the topic. **Methods.** This study focuses on the analysis and clinical cases reported with this technique in different dental areas, including the differences between digital and conventional protocols used to rehabilitate dental structures and their cementation. **Results.** 47 scientific articles have been compiled in digital databases through study quality assessment and established exclusion and inclusion criteria. BOPT has a stable periodontal-prosthetic relationship, however, more randomized studies are needed to support this dental preparation. **Conclusions.** The hours with the patient are increased and the clinician's experience is essential, taking into account that digital methods speed up the process, but increase the cost of the work.

Keywords : prosthodontic tooth preparation; periodontal diseases; dental Aesthetics; dental marginal adaptation; prosthodontics.

INTRODUCTION

The biologically oriented preparation technique (BOPT) described by Ignacio Loi in 2008 is a vertical dental preparation without a finishing line guided by an immediate provisional that achieves the displacement of the gingival margin, ensuring that the mucosa adapts to the emergence profile of the new anatomical crown, by eliminating the anatomical cerebrospinal junction; allowing a new gingival architecture^(1,2).

Dental preparations must preserve periodontal health, keeping it intact. One of the clinical complications in the fixed prosthesis is the apical migration of the gingival margin, this is the result of inadequate quality and quantity of keratinized gingiva, chronic inflammation caused by trauma to the tissues

during dental carving or an unfavorable reaction⁽²⁾. Horizontal preparations trigger these problems when the marginal finishing line is located at the subgingival level. On the other hand, the use of vertical preparations such as BOPT show gingival thickening in patients with periodontal disease.

The purpose of the research was to analyze the biologically oriented preparation technique in teeth and identify the dental areas that have implemented the BOPT technique in order to corroborate its use. Additionally, differentiate the conventional protocol with the digital protocol and determine adhesive cementation protocols.

METHODS

Scientific articles found in digital databases such as Scopus, Embase and Web of Science were collected, using a search equation with keywords and Boolean operators. Most of the free downloadable scientific articles in English were included with a time frame of 10 years. In the initial search, 412 articles were found. Mendeley was used as a bibliographic manager to eliminate duplicates and discard them through title and *abstract analysis*. Adding the quality assessment of studies thanks to the Scimago Journal Ranking (SJR), 47 valid articles for the research were obtained. A meta-analysis of all the information collected was carried out and the GRADEpro GDT tool allowed the preparation of summary tables of the scientific findings based on evidence⁽³⁾.

RESULTS

ANALYSIS OF THE BIOLOGICALLY ORIENTED PREPARATION TECHNIQUE

It is a vertical preparation without marginal limit that uses rotational curettage of the gingival sulcus at the same time as the tooth is carved. The blood clot is stabilized by the new provisional anatomical crown, achieving a process called “regenerative healing.” This technique allows modulating the cervical emergency angulation of the prosthesis for a more aesthetic gum. If the coronal emergence angle is greater than 60°, the gingiva tends to thicken and slide apically, but if the angle decreases to 45° or less, the gingiva tends to thin and slide coronally^(4,5). It begins with double probing; first to measure the gingival sulcus and then to measure the bone level and locate the CEJ^(4, 6, 7). The supragingival preparation continues, occlusally reducing the non-functional cusps by 1.5 mm and the functional cusps by 2 mm to an angle of approximately 45°^(4,6,8).

Then the subgingival part is prepared; 0.5 mm to 1 mm is entered into the gingival sulcus with a conical diamond bur at an inclination of 10 to 15°, in order to eliminate the CEJ (at this time the gingival sulcus begins to bleed). The key to this technique is to eliminate the existence of a finish line in any way; For this reason, the next step is to position the drill parallel to the tooth axis, so that it cuts with the body of the drill and not with the tip. Finally, the drill is placed 3 to 6° with respect to the axis of the tooth to give the necessary convergence to the stump.^(4,6,7,9-17).

Prior to a diagnostic wax-up and fabrication of a silicone key, the provisional crowns are relined with a self-polymerizing methacrylate resin. The impression of two well-defined lines is obtained on the temporary crown; an internal one that corresponds to the

sulcus and an external one that belongs to the gingival margin. This created space is filled with a light-polymerizable fluid resin, which results in a new emergence profile. The provisionals are removed after 4 weeks; However, this temporary must be reshaped within 8 to 12 weeks until the gum heals and looks healthy. The treatment is completed with a 2-step impression technique with elastomers and double gingival displacement thread for the fabrication of the definitive prosthesis.^(2,5-7,10,16,18,19-21).

It is indicated to perform this technique in patients who need a fixed prosthesis on implants, in those who need to modulate the gingiva, presence of deep fractures and when the clinical crown does not coincide with the anatomical one due to periodontal disease^(1,2,3)

REPORTED CLINICAL CASES

BOPT is used in several dental areas. In oral rehabilitation, 479 clinical cases were found using this technique in crowns, veneers and fixed bridges with a follow-up period of 6 years; The so-called “prosthetic orthodontics or POA” that allows dental movements draws attention; For example, if mesial movement of the abutment is required, its opposite distal side is worn more so that the tooth can move mesially. The scientific evidence of this prosthetic approach was scarce, only 3 clinical cases occupied POA with a minimum follow-up of one year^(4-5,8,12-16,18,19,22-35).

Now, in implantology, if they are rehabilitated with BOPT, the implants must have a convergent neck design, these are called “Prima Implants” and were designed by Ignacio Loi. 323 studies were found evaluated over a period of 1 to 5 years^(6,9,10,36-42).

Case-specific evidence has been investigated in surgical and magnetic extrusion rehabilitated with BOPT in teeth with extensive caries. In surgical extrusion, the tooth is dislocated with a fine flat elevator,

extruding the tooth to gain access to the amelocemental junction; It is splinted in its new position and its osseointegration is expected for future preparation. On the other hand, the use of magnetic extrusion consists of placing a magnet on the tooth remnant that will be attracted by its opposite placed in a provisional supported by occlusal rests on the adjacent teeth. Only 6 clinical cases were obtained, however, they had a follow-up of 18 months to 10 years with positive results ^(13,43-45).

The evaluation of all these patients after their follow-up period was positive, because there was a 100% survival rate in the prosthetic structures, without presenting mechanical or biological failures, in addition to an evident gingival thickening and better aesthetics with a papilla. complete interdental. The mucosa appeared healthy, stippled and pink with a low plaque index, gingival inflammation, depth and bleeding on probing. In addition, there is an increase in the peri-implant tissue ^(4-6,9,10,12-16,18,19,23-28,30-33,36-45).

DIFFERENCES BETWEEN CONVENTIONAL AND DIGITAL PROTOCOLS

When using BOPT, an established protocol must be followed, however, it changes when doing it using conventional or digital methods. This way, when working with a conventional method, we begin with a diagnostic impression, followed by waxing and making a silicone key for relining the provisionals that will be cemented for 12 weeks. After this time, a final impression is made with a two-step technique and double retractor thread; At this point, the dental technician comes into action when he obtains the working models; Three lines are established: the first marks the gingival margin, then the entire cervical part is worn away, exposing the end of the gingival sulcus where the second line will be drawn, the third line is placed in the middle

of the two drawn previously. The latter is the completion limit for the definitive crowns, so the biological width is not invaded ^(4,8,10-13,15,16,18,19,22,24,25,27,29-30,33, 34,43,44).

Compared to a digital protocol, an intraoral scanner takes care of all the work; from the making of the provisional ones to the making of the definitive crowns. The times for the final impression differ from conventional ones because the scanner intervenes in three stages: a first scan of the provisional in the mouth, followed by a second scan of the dental preparation and, finally, a third scan of the provisional outside the mouth. All information is received by computer *software* for the design of the prostheses using CAD-CAM technology.

It is worth mentioning that the research carried out shows lithium disilicate and zirconium as the main porcelains to rehabilitate dental structures prepared with BOPT. In both conventional and digital methods, if working with zirconium, it is necessary to perform a tribochemical coating with silica 30 um Al₂O₃ ^(4,8-13,15-19,22,24,25,27-30,33,34,43-47).

ADHESIVE CEMENTATION

In adhesive cementation, BOPT does not have a finishing line; For this reason, isolation of the gingival sulcus is essential at the time of cementation to avoid any type of contamination that alters adhesion.

To ensure control of crevicular fluid and remove excess cement, Teflon and retractor thread have been used. This way, the stump prepared with the BOPT technique is cleaned with the help of a pumice stone and a prophylactic brush, then it is washed with plenty of water and the tooth structure is dried; Approximately a 4x4cm square is cut from Teflon previously sterilized in an autoclave and with a dam perforator a hole is made in the center. The Teflon is placed on the stump and adjusted in the gingival sulcus

with the help of a packer, after which retractor thread #1 is placed⁽⁴⁸⁾

37% orthophosphoric acid is placed along with a desensitizer to prevent hypersensitivity. After washing and drying the dental structure, the tooth is coated with adhesive for 20 s. On the other hand, silane and adhesive are placed in zirconia prosthetic structures. If lithium disilicate is used, 10% hydrofluoric acid is used first. A resinous cement is used, before setting the prosthetic structure the retractor thread is removed, it is photocured for 1 second to remove excess material with a scalpel; Then the Teflon is removed and the photocuring is completed for 40 seconds. Glycerin is then placed to eliminate the oxygen-inhibited layer and finally the occlusion is evaluated with an articulating paper. ^{(8,9,11-14,19,20,28,31,33,35,45,48).}

DISCUSSION

BOPT increases coronal soft tissue volume by reshaping the cervical area of the provisional crown ⁽¹³⁾. The same is stated by Loi and Felice ⁽²⁾, the gingiva shows an increase in gingival thickness and greater stability of the margin over time ^(2,8,11).

On the other hand, the probing depth in dental preparations with this technique is lower compared to other preparations such as chamfering, as reported by Serra et al. ⁽¹⁴⁾, in their 5-year study; 26.3% of the teeth prepared with finishing line had pockets more than 3 mm deep, while the BOPT group had only 10%. Paniz et al. differ on this. ⁽¹⁵⁾, in their 12-month study; mention that there is no difference in probing depth between preparations with or without goal line.

BOPT is an alternative that maintains stable probing depth ⁽⁸⁾; however, Serra et al. ⁽¹⁶⁾, after 4 years, concluded that 2.1% of 149 teeth prepared with BOPT presented an increase in probing depth.

Serra et al. ⁽¹⁴⁾ state that gingival recession is evident in teeth prepared with horizontal

termination compared to teeth with BOPT evaluated over 5 years. The same is noted by Paniz et al. ⁽¹⁵⁾, in their 12-month study; No gingival recessions were observed in 96.7% of BOPT-prepared restorations compared to 88.5% of chamfer-prepared restorations. Preparations with BOPT present marginal stability in very high percentages; This was also observed by Serra et al. ⁽¹⁶⁾, for a period of 4 years, in which 98.6% of the teeth did not present recessions of the cervical margin.

BOPT presents greater bleeding on probing, compared to chamfered preparations. This was confirmed by Paniz et al. ⁽¹⁵⁾, in 12 months of follow-up; 52.2% of BOPT restorations had bleeding on probing, while only 36.5% of chamfered restorations had bleeding on probing. These results are different from those found by Ferrari et al. ⁽¹²⁾, in its 4-year evaluation; Bleeding was present in 48% of crowns in the BOPT group and 55.5% in crowns prepared with a finish line. In the same way, Serra et al. ⁽¹⁷⁾, there is a low percentage of bleeding in teeth prepared with BOPT ⁽⁴⁵⁾.

The BOPT has the lowest values of marginal opening compared to the shoulder, chamfer and mini-chamfer; Despite this, it is not suggested in zirconia crowns due to its mechanical resistance disadvantage.

In mechanical resistance, there are several *in vitro studies* that prove or deny this hypothesis. Among the authors who claim that preparations with a termination line show greater resistance to fracture, Panadero et al. ⁽⁵⁾, concluded that the average fracture resistance was 462.1 ± 66.3 N for abutments with a termination line and 343 ± 40 N for BOPT abutments. Like Comlekoglu ⁽⁴⁵⁾, who observes that the BOPT supports greater tension at the margin of the restorations compared to the shoulder and chamfer, which have lower values and, therefore, greater resistance. However, García et al. ⁽¹⁹⁾, demonstrated that the chamfer termination

and BOPT show better mechanical behavior than the shoulder. The bevelless shoulder is also recommended as a resistant preparation (42).

Other authors defend that BOPT has better mechanical resistance than a light chamfer design (34). Similarly, Jasim et al. (41), in their study of 40 extracted human premolars, state that the highest resistance was recorded with the BOPT group with monolithic zirconia (1347.6 ± 177.4 N) compared to the shoulder (1255.6 ± 121.3 N).

CONCLUSION

The biologically oriented preparation technique is minimally invasive with the tooth structure; In addition, it preserves complete periodontal health, allowing the creation of a new anatomical crown. More case studies on bleeding on probing and *in vitro studies* on mechanical resistance are needed.

Approximately 811 patients were found in whom BOPT was worked on in areas such as fixed prosthesis, implants, surgical and magnetic extrusion, showing favorable results with the mucosa; However, there is a lack of casuistry in prosthetic orthodontics. In this sense, it is suggested to take this approach as a research topic.

The conventional method for BOPT involves more time in the chair and greater expertise on the part of the clinician, unlike digital protocols that considerably reduce work time in the office, but the cost of the intraoral scanner is high.

Adhesive cementation in teeth prepared with this technique would be a failure if correct isolation of the gingival sulcus is not achieved; For this reason, it is advisable to carry out studies focused on this fundamental step when cementing.

Author	Application	Area	Effectiveness
(Agustín Panadero et al., 2016)	Crowns	Oral Rehabilitation	Better results for the health and aesthetics of soft tissues, free of inflammation.
(Agustin Panadero et al., 2018)	Veneers	Oral Rehabilitation	Stability of the gingival margin at 100% and thickening of the gum.
(Canullo et al., 2020)	Implants with a converging collar	Implantology and Oral Rehabilitation	Implants and prostheses with a 100% survival rate. No biological or mechanical complications were reported.
(Llaquet Pujol et al., 2020)	Surgical Extrusion with BOPT	Oral Rehabilitation	Aesthetic gingival contours without recession, no progressive root resorption or physiological pocket depths.
(Casula, 2021)	Prosthetic Orthodontics	Oral Rehabilitation	Healthy gingival tissues and odontomies did not affect pulp survival of vital teeth.

Table 1. BOPT Efficacy

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