Evaluation of Change in Gingival Thickness after Provisional Restoration in Anterior Fixed Prosthodontic Treatment by Using Biologically Oriented Preparation Technique

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Abstract

Background: Aesthetic demands in fixed prosthodontics have significantly increased in recent decades, with gingival thickness playing a vital role in treatment outcomes, patient satisfaction, and long-term stability. The Biologically Oriented Preparation Technique (BOPT) has emerged as a promising approach, promoting a thicker gingival biotype and enhancing both functional and aesthetic results, especially in anterior restorations.

Objective: This study aimed to evaluate the change in gingival thickness after cementation of provisional restoration in anterior fixed prosthodontic treatment by using BOPT.

Methods: This quasi-experimental study involved purposively selected 33 patients requiring full veneer crowns on natural anterior teeth at the Department of Prosthodontics, BSMMU, Dhaka. Gingival thickness was measured at the free gingival groove and mucogingival junction using transgingival probing with a sterile endodontic spreader and a digital Vernier caliper. Following BOPT-based tooth preparation, provisional restorations were cemented. After six weeks of healing, gingival thickness was re-measured to assess changes, and the before-and-after data were recorded for analysis.

Results: Prior to treatment, mean gingival thickness ranged from 1.15 mm to 1.41 mm across different anatomical sites, with an overall average of 1.28 mm. Following BOPT, mean thickness increased across all sites, ranging from 1.40 mm to 1.62 mm, with an overall average of 1.51 mm. The greatest increase was observed at the muco-gingival junction (0.25±0.10 mm), followed by the free gingival groove (0.21±0.12 mm). Statistical analysis revealed a significant increase in overall gingival thickness post-treatment ($p<0.00001$), indicating that BOPT effectively enhanced gingival volume.

Conclusion: This study demonstrated that the BOPT is effective in enhancing gingival thickness following the placement of provisional restorations in anterior fixed prosthodontic treatment.

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Introduction

Maintaining healthy, stable gingiva is essential for the long-term aesthetics of fixed prostheses. However, gingival recession associated with horizontal finish lines poses a challenge in achieving visually pleasing outcomes in fixed prosthodontics on natural teeth.[1] Several factors can contribute to gingival recession over time, including poor-quality or insufficient keratinized tissue, trauma from prosthetic procedures, persistent inflammation due to prosthetic errors, and improper brushing techniques.[2] Among restorative-related factors, the preparation technique and finish line geometry are especially critical.

Tooth preparation for fixed prostheses can follow three approaches: horizontal finish lines with a rounded shoulder, knife-edge finish lines, or no defined finish line known as the Biologically Oriented Preparation Technique (BOPT).[3] BOPT involves vertical tooth preparation within the gingival sulcus to remove the natural emergence profile and create a horizontal space between the abutment and sulcular epithelium. This promotes soft tissue thickening around the restoration during healing.[2] Distinctive horizontal preparations where the dentist defines the margin, in vertical preparations the technician determines the margin based on gingival contours.[4]

BOPT is a vertical tooth preparation technique focused on gingival tissue remodeling and preservation.[5] Studies have shown stable periodontal outcomes around anterior prostheses and fixed partial dentures, with long-term gingival stability and low complication rates.[4,6] Fundamental components include finish line–free preparation, gingitage, and a well-contoured provisional crown to guide gingival healing. After six weeks, final impressions are taken. The natural emergence profile is removed with a diamond bur to create a new prosthetic junction.[7]

Gingitage, a crucial feature of BOPT, involves controlled sulcus invasion to induce a healing response through clot formation, unlike standard vertical preparations. Care must be taken not to violate the 2.04 mm biological width.[8] A well-contoured provisional restoration helps guide gingival healing by shaping the zenith, supporting the clot, and protecting the tooth. This promotes tissue reattachment and gingival thickening around the new emergence profile.[2] Gingival thickness changes can be measured pre- and post-BOPT using the method.[9] While studies have shown favorable outcomes with BOPT.[4,10] While numerous studies on BOPT have been conducted in Europe and other regions, research in Southeast Asia remains limited. Since gingival characteristics can vary across ethnic groups, it is crucial to tailor treatment approaches to the biological traits of the target population for optimal outcomes. This study aims to evaluate gingival thickness changes following BOPT-based provisional restoration in anterior fixed prosthodontics.

Methods

This quasi-experimental study, conducted from February 2023 to March 2024 at the Department of Prosthodontics, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh, involved patients requiring full veneer crowns on natural anterior teeth to evaluate changes in gingival thickness after cementation of provisional restorations using the Biologically Oriented Preparation Technique (BOPT) in anterior fixed prosthodontic treatment.

A purposive sampling technique was used, and the final sample size was 33, accounting for a 20% dropout rate. The sample size was

estimated using PASS 15 software, targeting a detectable difference in mean gingival thickness before and after restoration using the BOPT technique, with 91% power and 5% significance level.[3] Inclusion criteria were patients over 18 years of age, with healthy gingiva, requiring anterior full veneer crowns on vital or endodontically treated teeth, and willing to maintain oral hygiene and follow-up. Exclusion criteria included periodontally compromised or grossly decayed teeth, patients with uncontrolled systemic conditions, hypersensitivity to Bis-Acrylic composite resin, or inability to complete follow-up.

A structured and pre-tested data collection sheet was used for patient interviews. Written informed consent was obtained in the local language, ensuring confidentiality. Participants were informed of their right to withdraw at any time, and proper care was provided for any minor injuries, though no monetary compensation was given for lost working time. Data were coded, tabulated, and analyzed using SPSS version 26. Descriptive statistics (mean and SD) were used to assess gingival thickness, and a paired t-test was applied to compare pre- and post-BOPT values. A p-value <0.05 at a 95% confidence interval was considered statistically significant. Ethical approval was obtained from the Institutional Review Board of BSMMU (Reference: BSMMU/2023/6345), and all procedures followed the principles outlined in the Declaration of Helsinki (2013).

Results

The study participants were 51.52% female and 48.48% male, with a mean age of 32.60 (±12.28) years (Figure 1).The table I showed gingival thickness measurements at different sites of the gingiva for 33 participants prior to undergoing the BOPT. The gingival thickness ranged from 0.90 mm to 2.0 mm, with a mean of 1.41 mm and a standard deviation (SD) of 0.34 mm, indicating moderate variability among participants. This site exhibited the lowest overall thickness, ranging from 0.60 mm to 1.8 mm, with a mean of 1.15 mm and an SD of 0.32 mm. Average thickness ranged from 0.75 mm to 1.9 mm, with a mean of 1.28 mm and an SD of 0.33 mm, reflecting the general gingival profile prior to BOPT.

Table II showed post-treatment gingival thickness measurements at various sites for 33 participants following the BOPT. After BOPT, thickness ranged from 1.00 mm to 2.4 mm, with a mean of 1.62 mm and a standard deviation (SD) of 0.39 mm, indicating a noticeable increase in thickness compared to pre-treatment values. Post-treatment thickness ranged from 0.8 mm to 2.0 mm, with a mean of 1.40 mm and an SD of 0.33 mm, also showing an increase from baseline. Overall gingival thickness ranged from 0.95 mm to 2.15 mm, with a mean of 1.51 mm and an SD of 0.36 mm, reflecting a general thickening of the gingival tissues following BOPT.

Figure 2 illustrated the comparative changes in mean gingival thickness at different anatomical sites before and after the BOPT. At the free gingival groove, the mean thickness increased from 1.41 mm to 1.62 mm, showing a mean difference of 0.21 mm (±0.12). At the muco-gingival junction, thickness increased from 1.15 mm to 1.40 mm, with a mean difference of 0.25 mm (±0.10) the greatest observed gain among the measured sites. The overall average gingival thickness rose from 1.28 mm to 1.51 mm, with a mean difference of 0.23 mm (±0.09).

Table III showed a statistical comparison of overall gingival thickness measurements before and after the BOPT. Before BOPT, the gingival thickness ranged from 0.75 mm to 1.9 mm, with a mean of 1.28 mm and an SD of 0.33 mm. After BOPT, thickness increased,

ranging from 0.95 mm to 2.15 mm, with a mean of 1.51 mm and an SD of 0.36 mm. Between before and after BOPT, there was a substantial difference in gingival thickness (p <0.00001).

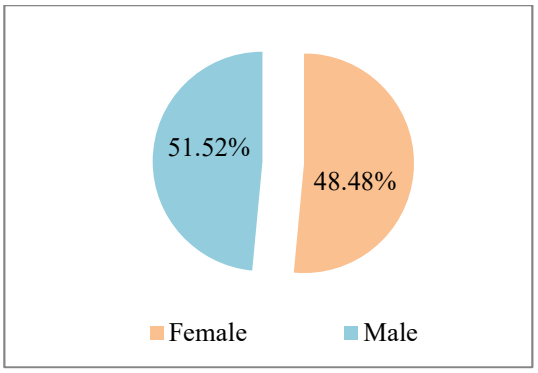

Figure 1. Distribution of the participants by gender (n=33)

Table I: Participant distribution prior to BOPT based on gingival thickness (n=33)

Gingival sites	N	Minimum (in mm)	Maximum (in mm)	Mean (in mm)	SD (in mm)
Free gingival groove	33	0.90	2.0	1.41	0.34
Muco-gingival junction	33	0.60	1.8	1.15	0.32
Average thickness	33	0.75	1.9	1.28	0.33

Table II: Participant distribution after BOPT based on gingival thickness (n=33)

Gingival sites	N	Minimum (in mm)	Maximum (in mm)	Mean (in mm)	SD (in mm)
Free gingival groove	33	1.00	2.4	1.62	0.39
Muco-gingival junction	33	0.8	2.0	1.40	0.33
Average thickness	33	0.95	2.15	1.51	0.36

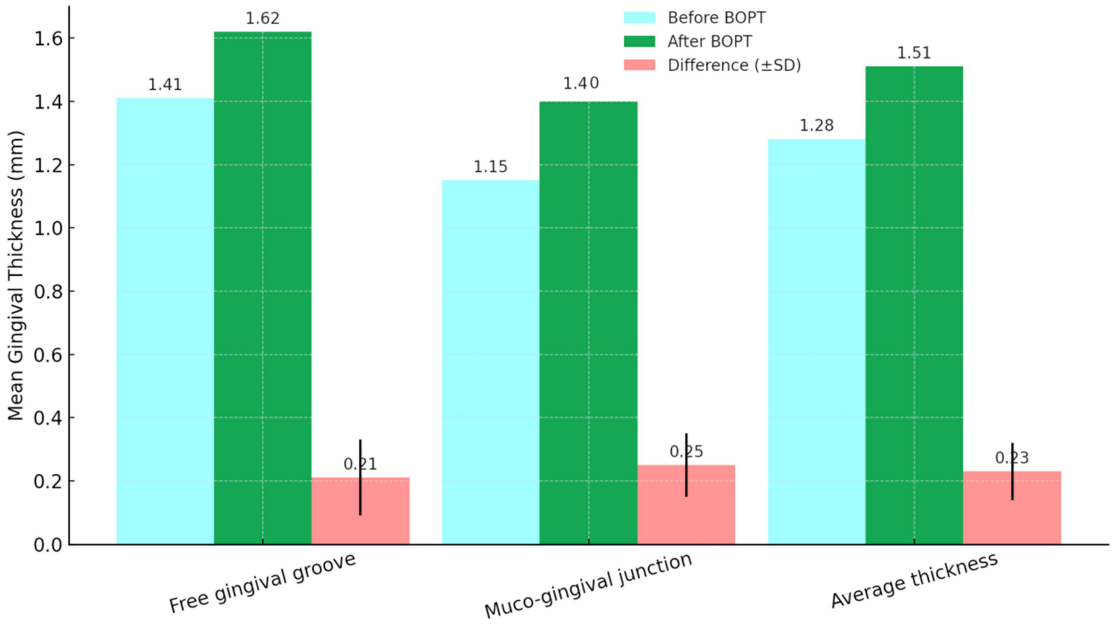

Figure 2. Changes of gingival thickness before and after BOPT (n=33)

Table III: Comparison of gingival thickness before and after BOPT (n=33)

Gingival thickness	Minimum (in mm)	Maximum (in mm)	Mean (in mm)	SD (in mm)	Minimum (in mm)	P value
Before BOPT	0.75	1.9		1.28	0.33	<0.00001
After BOPT	0.95	2.15		1.51	0.36	

Independent sample t-test done, $p<0.05$ considered as statistically significant value

Discussion

The mean age of participants was 32.60 (±12.28) years, with nearly half being male (48%). Gingival thickness showed notable improvement after BOPT application. At the free gingival groove, thickness increased from 1.41 mm (±0.34) to 1.62 mm (±0.39), and at the muco-gingival junction, it rose from 1.15 mm (±0.32) to 1.40 mm (±0.33); both changes were statistically significant ($p<0.00001$). The mean gingival thickness also increased significantly from 1.28 mm (±0.33) to 1.51 mm (±0.36), reflecting a mean gain of 0.23 mm (±0.09). These findings were consistent with the study reported a similar increase in gingival thickness two years after full veneer crown placement using BOPT.[3] Also, a four-year prospective study reported a 32.5% increase in gingival thickness following BOPT, with statistically significant gains observed in the first year. However, no significant increase was noted from the second year onward, suggesting initial effectiveness of BOPT, while its long-term stability warrants further investigation.[4]

A study explored the impact of prosthetic emergence angulation on gingival tissue in teeth treated with the BOPT technique. They found that BOPT contributes to increased

gingival thickness, though changes in gingival volume and position may vary depending on prosthetic design.[6] Similarly, in another study observed a substantial increase in gingival thickness ($p<0.05$) over a two-year follow-up, reinforcing the current study's findings.[11] Moreover, a clinical case report demonstrated the effective use of BOPT with soft tissue enhancement to manage volumetric bone defects, supporting BOPT's role in improving both tissue stability and esthetics.[12] The observed increase in gingival thickness following BOPT highlights its positive impact on gingival dynamics in anterior fixed prosthetic treatments. This enhancement reflects a favorable soft tissue response, promoting improved stability and esthetic outcomes.[13] The physiological basis for this improvement lies in the natural wound healing process characterized by neovascularization and the proliferation of fibroblasts and myofibroblasts which fills the space created by rotatory curettage during preparation. Furthermore, BOPT facilitates coronal migration of the gingiva, effectively addressing issues such as soft tissue recession and apical migration.[14,15]

The clinical success of BOPT, as demonstrated in previous literature, confirms its effectiveness in increasing gingival thickness and enhancing soft tissue stability in both short- and long-term follow-ups compared to conventional preparation techniques.[13,16] Consistent with these findings, the present study also observed gingival thickening and stable margin positioning following BOPT, supporting its role in achieving favorable esthetic outcomes and promoting healthy soft tissue development, especially within the first year of treatment. However, clinicians have noted some limitations of BOPT. These include the potential for over-contouring restorations, which may lead to bleeding during procedures, and variability in soft tissue regeneration. Due to the subgingival margins, managing extra cement might also be challenging. The healing period typically requiring a minimum of four weeks may be seen as a drawback. The technique's sensitivity necessitates advanced clinical and laboratory skills, emphasizing the need for specialized preparation.

Conclusion

This study demonstrated that BOPT is effective in enhancing gingival thickness following the placement of provisional restorations in anterior fixed prosthodontic treatment, suggesting a positive impact on soft tissue stability and aesthetics. However, to validate these findings and assess long-term outcomes, further longitudinal studies with larger samples, use of advanced tools like CBCT for precise measurement, and evaluation of gingival health indicators are recommended.

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Conflict of interest: The authors declare that there are no conflicts of interest related to this study.

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