How to Cite:
Mai, E., Omnia, N., Maha, T., & Lamia, K. (2022). Patient satisfaction of teeth prepared with vertical versus deep chamfer finish line for monolithic zirconia crowns (Randomized Clinical Trial). *International Journal of Health Sciences*, *6*(S5), 1420–1429.
https://doi.org/10.53730/ijhs.v6nS5.8905

Patient satisfaction of teeth prepared with vertical versus deep chamfer finish line for monolithic zirconia crowns (Randomized Clinical Trial)

Elgohary Mai
PhD candidate, Division of Fixed Prosthodontics, Faculty of Dentistry, Cairo University, Egypt
Corresponding author email: mai.afifi@dentistry.cu.edu.eg

Nabil Omnia
Lecturer, Division of Fixed Prosthodontics, Faculty of Dentistry, Cairo University, Egypt
Email: omnianabil@dentistry.cu.edu.eg

Taymour Maha
Associate Professor, Division of Fixed Prosthodontics, Faculty of Dentistry, Cairo University, Egypt | Associate Professor at Fixed Prosthodontics Department, Faculty of Dentistry, New Giza University, Egypt
Email: maha.taymour@dentistry.cu.edu.eg

Kheiralla Lamia
Professor at Fixed Prosthodontics Department, Faculty of Dentistry, Cairo University, Egypt
Email: lamia.kheiralla@dentistry.cu.edu.eg

***Abstract*---**Aim: Evaluate the patient satisfaction of monolithic zirconia crowns with vertical preparation technique and compare them to deep chamfer finish line preparation in single crowns restoring posterior teeth. Materials and methods: Fourty full coverage zirconia crowns were fabricated for posterior teeth. The patients were divided into two groups according to the preparation designs. Group1: (control group) horizontal finish line and Group2: (intervention group) vertical finish line. Monolithic zirconia was used for the final restorations. EXOCAD software was used to design the try-in & final restorations which were later produced by five axis milling machine. The cementation was done by using self-adhesive resin cement. Patient satisfaction was assessed immediately after cementation using the "Visual Analogue Scale" VAS. These measurements were repeated after one, three, six, nine, and twelve months respectively. Result: independent t-test was used to compare between the two groups. No

statistically significant difference was detected between both groups for patient satisfaction over one year. Conclusion: Both horizontal finish line and vertical finish line revealed successful clinical performance in terms of patient satisfaction for zirconia full coverage restorations.

***Keywords*---**Zirconia crowns, horizontal finishline, vertical finishline, USPHS criteria.

Introduction

Full-coverage ceramic crowns are traditionally prepared by removing a significant amount of tooth structure. This aggressive tooth structural loss is frequently accompanied by pain and post-operative sensitivity [1]. Various methods of tooth preparation with minimum loss of sound tooth structure have been developed over time [2]. Long-term success of prosthetic treatments depends on preserving the amount and integrity of healthy tooth tissue, as well as maintaining endodontic health. As a result, the concept of minimally invasive dental restorations with minimum-thickness full-ceramic restorations has become more prevalent.[3]. Dental preparation for fixed prostheses can take several forms, including horizontal preparation with a defined margin (deep chamfer) or vertical preparation with no margin/finish line [4]. To avoid overhangs and over-contouring of restorations, shoulder and deep chamfer finish lines are commonly used as horizontal finish lines for tooth preparation [5]. Vertical preparation was formerly recommended for periodontally affected abutments for fixed prostheses because it may be more conservative than horizontal preparation in certain clinical scenarios [4]. Numerous disadvantages of vertical preparation have been identified, such as overhangs, over-contouring, a lack of control over the marginal seal and integrity, unpredictable tissue healing, and difficulties in removing excess cement [6]. The inability of laboratory technicians to locate these tapered thin margins using gingival tissue data and the risk of restoration chipping have always complicated the option of adopting vertical preparation designs [7]. However, application of magnifying devices such as dental loupes and microscopes, as well as intraoral scanners and monolithic restorations, enhances preparation precision, accuracy, and marginal adaptability, resulting in an extremely high level of prosthetic restoration quality [8]. Null hypothesis of this study that there would be no significant difference between the patient satisfaction of vertical preparation technique and deep chamfer preparation design restored by monolithic zirconia crowns.

Materials and Methods

This randomized clinical study was performed in Fixed Prosthodontics' clinics of the Faculty of Dentistry, Cairo University, Egypt. It was approved by the University's Ethics Committee of Scientific Research in July 2019. Medical and dental history as well as a written informed consent, were obtained from all participants who were selected according to their need for a full coverage restoration.

All teeth enrolled in this in vivo investigation were posterior teeth with no active periodontal diseases, absence of tooth mobility or furcation involvement, patients with endodontically treated teeth and the tooth must require full coverage restoration. Uncooperative patients and those with parafunction habits, minimally destructed molars such that can be restored with direct composite fillings, or periodontal and apical infections, on the other hand, were eliminated from this investigation.

A total of 40 monolithic zirconia full coverage crowns were included in the study. They were divided equally into 2 groups (n=20), Group 1 (control group) represented the deep chamfer preparation and group 2 (intervention group) represented the vertical preparation. All procedures starting from diagnosis till delivery were carried out by the same investigator for standardization, following the same clinical protocol. The crowns were fabricated by the same dental technician to eliminate any variations. A complete assessment of the teeth's state, periodontal evaluation, oral health, and occlusal diagnosis were all performed.

For the control group, all the teeth were prepared by using recommended preparation guidelines of 1.5 to 2.0 mm occlusal reduction, and 1.0 to 1.5-mm axial reduction with a deep chamfer margin circumferentially using (Komet 6856.314.021; Germany) [9]. For the intervention group, 1.5 to 2.0 mm occlusal reduction and for axial preparation special diamond burs (Komet, S6863.314.012; Germany) with a non-working tip were used (batt bur). It has a coronal diameter of 1.2 mm, an apical diameter of 0.7 mm, and a non-cutting end of 1 mm, which minimizes or eliminates damage to the connective tissues and enables tooth-guided preparation [10]. After preparation, the teeth were isolated from the gingival tissues by placing appropriately sized displacement cord and the final impression was made using fast set addition silicone impression material (Elite HD+, Zermach,Italy).

Exocad software was utilised to analyze the preparation and ensure that it fulfilled the criteria set in this study and then, design the final restoration. Following the final restoration design, a temporary polymethyl methacrylate was milled by a 5-axis milling machine (Roland DGA Corporation, California) and used as a try in restoration to evaluate marginal adaptation, occlusal and proximal contacts, as well as temporary restoration for emergence profile formation, particularly with the intervention (F) group.

The zirconia (KATANA Zirconia STML, Kuraray Noritake Dental Inc.) crowns were then milled following the approved design and sintered following the manufacturer's recommendations. The intaglio surface of the attained zirconia crowns was treated with a layer of (ZirClean, Bisco, Inc.Schaumburg) for surface treatment and then cemented with a self- adhesive resin cement (Permacem 2.0, DMG) [11]. Immediately after cementation, the patient satisfaction was assessed in the form of questionnaire “Visual Analogue Scale” VAS using numerical (discrete) from “0” unsatisfied to “10” satisfied. Patients were asked about shape and food accumulation, chewing ability and ease of cleaning, taken as a baseline record. Then the records were taken at three months, six months, nine months, and twelve months later in follow-up visits over a one-year period. Comparison

between both groups and follow up records was performed by using independent t-test as P <0.05.

Results

In the control group (deep chamfer), Repetitive One Way ANOVA test was used to compare between different intervals which revealed insignificant difference between them as P > 0.05, as presented in table (1) and figure (1). In the intervention group (Vertical), One Way ANOVA test was used to compare between different intervals which revealed insignificant difference between them as P > 0.05, as presented in table (2) and figure (2). Comparison between both groups was performed by using independent t-test which revealed insignificant difference between both groups at all intervals (P>0.05), as presented in table (3) and figure (3).

Table (1): Mean & standard deviation of patient satisfaction in control group (Immediately post- cementation), 1st follow-up (after 3 months), 2nd follow-up (after 6 month), 3rd follow-up (after 9 month) & 4th follow-up (after 12 month)

Control group	Total N	Patient satisfaction		P value
		M	SD	
Baseline – Immediately post-cementation	20	9.7	2.8	0.99
1st follow-up after 3 months	20	9.6	2.6	
2nd follow-up after 6 month	20	9.7	2.9	
3rd follow-up after 9 month	20	9.8	2.9	
4th follow-up after 12 month	20	9.8	2.8	

M: mean SD: standard deviation
P: probability level which is significant at P ≤ 0.05

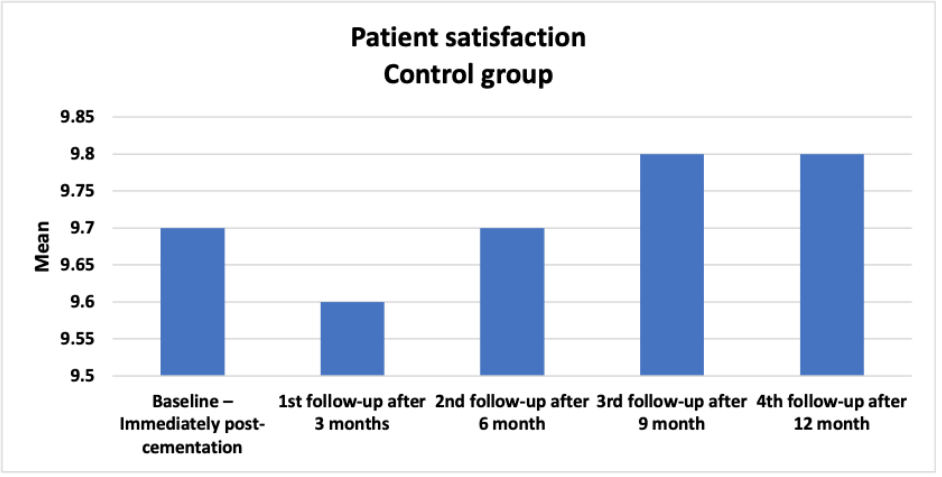


Figure (1): Mean of patient satisfaction at baseline (Immediately post-cementation), 1st follow-up (after 3 months), 2nd follow-up (after 6 month), 3rd follow-up (after 9 month) & 4th follow-up (after 12 month) in control group (Deep chamfer).

Table (2): Mean & standard deviation of patient satisfaction in intervention group at baseline (Immediately post-cementation), 1st follow-up (after 3 months), 2nd follow-up (after 6 month), 3rd follow-up (after 9 month) & 4th follow-up (after 12 month)

Intervention group	Total N	Patient satisfaction		P value
		M	SD	
Baseline – Immediately post-cementation	20	9.2	2.5	0.99
1st follow-up after 3 months	20	9.3	2.3	
2nd follow-up after 6 month	20	9.2	2.5	
3rd follow-up after 9 month	20	9.4	2.8	
4th follow-up after 12 month	20	9.1	2.7	

M: mean SD: standard deviation
P: probability level which is significant at $P \leq 0.05$

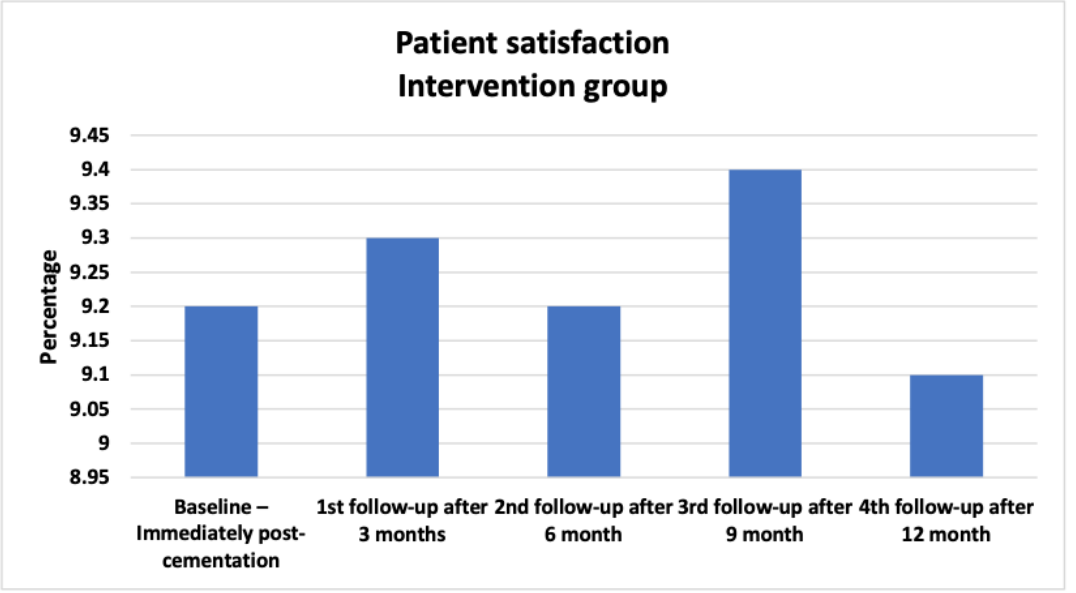


Figure (2): Mean of patient satisfaction at baseline (Immediately post-cementation), 1st follow-up (after 3 months), 2nd follow-up (after 6 month), 3rd follow-up (after 9 month) & 4th follow-up (after 12 month) in intervention group (vertical).

Table (3): Comparison between control & intervention groups regarding patient satisfaction at baseline (Immediately post-cementation), 1st follow-up (after 3 months), 2nd follow-up (after 6 month), 3rd follow-up (after 9 month) & 4th follow-up (after 12 month)

Intervention group	Total N	Control group		Intervention group		P value
		M	SD	M	SD	
Baseline – Immediately post-cementation	20	9.7	2.8	9.2	2.5	0.55
1st follow-up after 3 months	20	9.6	2.6	9.3	2.3	0.71
2nd follow-up after 6 month	20	9.7	2.9	9.2	2.5	0.56
3rd follow-up after 9 month	20	9.8	2.9	9.4	2.8	0.63
4th follow-up after 12 month	20	9.8	2.8	9.1	2.7	0.42

M: mean *SD: standard deviation*

P: probability level which is significant at $P \leq 0.05$

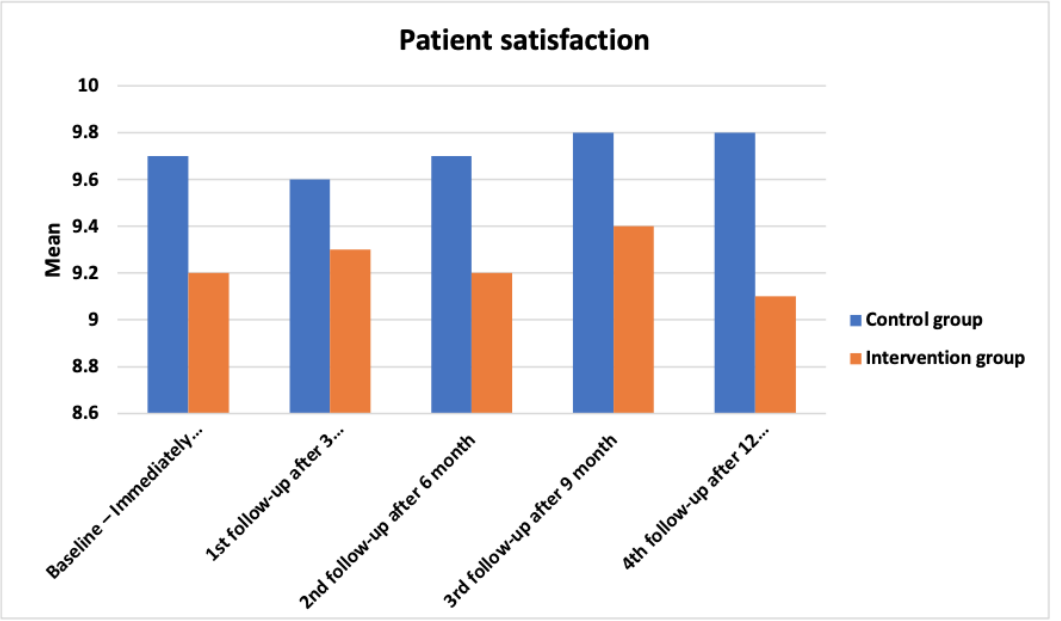


Figure (3): Comparison between control & intervention groups regarding patient satisfaction at baseline (Immediately post-cementation), 1st follow-up (after 3 months), 2nd follow-up (after 6 month), 3rd follow-up (after 9 month) & 4th follow-up (after 12 month).

Discussion

The patient satisfaction of posterior monolithic zirconia crowns with different finish lines (deep chamfer and vertical) was assessed using VAS scale through 12 months.In addition to clinical outcomes, patient satisfaction is critical in evaluating the entire quality of care and, thus, in improving dental care services [12]. It can also assist in identifying the strengths and weaknesses of dental services in order to improve treatment quality [13].

A visual analogue scale (VAS) is a type of psychometric response scale that is commonly used in surveys and questionnaires. VAS is a method for measuring subjective attributes that cannot be quantified, and it is an excellent instrument for computing perceptions. It is a straight line with designated endpoints that indicate the extreme limits of the response to be measured. Participants respond by drawing a line at a specific location within a minute to represent their perception of a specific phenomenon. VAS can be oriented either horizontally or vertically. The line can be any length, but it is most typically displayed as a horizontal line on which participants reply to the questionnaire by identifying a location between two end points of the scale. The distribution of scores on a horizontal VAS is more uniform than on a vertical VAS [14].

VAS has been used in dentistry to evaluate aesthetics, full denture satisfaction, dental anxiety, and postsurgical evaluation. In prosthodontics, it is used to assess

a variety of perceptions in both clinical and experimental situations. Treatment satisfaction, prosthesis retention, and psychological attitude can all be assessed using this tool [15]. Additionally, VAS can be effectively used to support and validate clinical study findings in prosthodontics. This helps clinicians reduce the perception gap and identify and resolve conflicts between them and their patients [16].

The present study assessed patients' satisfaction with the restorative treatment received by means of a VAS on a scale of 0– 10, comparison between both groups was performed by using independent t- test which revealed insignificant difference between both groups at all intervals (P>0.05). This was in agreement with Paniz et al.[17] who evaluated influence of deep chamfer preparation on the periodontium when compared to a feather edge preparation. They found a patient satisfaction value was 96.5% for esthetics and 98% for function.

Another study performed by Agustín-Panadero et al.[18] stated that The VAS patient satisfaction scores were eight out of a maximum score of 10. They concluded that after two years of treatment with vertical preparation without finish line on zirconia core with feldspathic ceramic veneer, it produces gingival thickening, margin stability, and optimal esthetics. Neither crowns nor FPDs presented any mechanical complications.

The null hypothesis was accepted and the factor that might have influenced the results is, the choice of monolithic zirconia as the final restoration. Zirconia has a high flexural strength, demands conservative dental preparation, reduces wear on the teeth, has appropriate aesthetics, requires reduced laboratory time and fewer dental sessions, and avoids the undesired complication of chipping. For patients with compromised occlusion or parafunction, monolithic zirconia crowns can be fabricated with a 0.5 mm occlusal reduction [19].

The results of this study are promising and guide the clinicians to apply the more conservative approach. Accordingly, we recommend further trails to investigate the clinical performance of these restorations over a longer period of time.

Conclusion

According to the results of this study, the vertical preparation technique using special burs and proper protocol combined with the great advantage in CAD/CAM technology, monolithic zirconia crowns were successfully accepted by the patients after a year of clinical use. These finding provides support for the application of minimal invasive approach and opens the field for future research in fixed prosthodontics.

References

1. Wolfart, S., Dent, M., Dent, M., Wegner, M., & Dent, M. (2005). 15. 2005 Inlay Retained, 18(6), 497–505.
2. Tripathi, S., Amarnath, G. S., Mudduganga dhar, B. C., Sharma, A., & Choudhary, S. (2014). Effect of Preparation Taper, Height and Marginal Design Under Varying Occlusal Loading Conditions on Cement Lute Stress: A

Three Dimensional Finite Element Analysis. Journal of Indian Prosthodontist Society, 14, 110-118.
3. Green, D., Mackenzie, L., & Banerjee, A. (2015). Minimally invasive long-term management of direct restorations: The “5 Rs.” Dental Update, 42(5).
4. Loi, I., & Di Felice, A. (2013). Biologically oriented preparation technique (BOPT): a new approach for prosthetic restoration of periodontically healthy teeth. The European Journal of Esthetic Dentistry : Official Journal of the European Academy of Esthetic Dentistry, 8(1), 10–23.
5. Ramos, R. M., Clark, D., Mazza, M., Venuti, P., Maiolino, M., Kopanja, S., ... Tawfik, A. A. (2015). The Shoulderless Approach A New Rationale in Prosthetic Dentistry, Tomorrow Tooth J, 1, 1-29.
6. Shillingburg, H. T., Hobo, S., & Fisher, D. W. (2003). Preparation design and margin distortion in porcelain-fused-to-metal restorations. Journal of Prosthetic Dentistry, 89(6), 276-284.
7. Kasem, A. T., Sakrana, A. A., Ellayeh, M., & Özcan, M. (2020). Evaluation of zirconia and zirconia-reinforced glass ceramic systems fabricated for minimal invasive preparations using a novel standardization method. Journal of Esthetic and Restorative Dentistry, 32(6), 560–568.
8. Tao, J., & Han, D. (2009). The effect of finish line curvature on marginal fit of all-ceramic CAD/CAM crowns and metal-ceramic crowns. Quintessence International, 40(9), 745-752
9. Wu, L., Sun, Z., Zhao, J., & Zheng, Y. (2021). Retrospective clinical study of monolithic zirconia crowns fabricated with a straightforward completely digital workflow. Journal of Prosthetic Dentistry, 1–6.
10. Łabno, P., & Drobnik, K. (2020). Comparison of horizontal and vertical methods of tooth preparation for a prosthetic crown. Journal of Pre-Clinical and Clinical Research, 14(1), 25–28.
11. Samran, A., Al-Ammari, A., El Bahra, S., Halboub, E., Wille, S., & Kern, M. (2019). Bond strength durability of self-adhesive resin cements to zirconia ceramic: An in vitro study. Journal of Prosthetic Dentistry, 121(3), 477–484.
12. Mills, I., Frost, J., Cooper, C., Moles, D. R., & Kay, E. (2014). Patient-centred care in general dental practice - a systematic review of the literature. BMC Oral Health, 14(1), 1- 13.
13. Ali, D. A., & Ali, C. D. A. (2019). Patient satisfaction in Dental Healthcare Centers, 309– 314.
14. Wewers, M. E., & Lowe, N. K. (1990). A critical review of visual analogue scales in the measurement of clinical phenomena. Research in Nursing & Health, 13(4), 227-236.
15. Katyayan, P. A., Katyayan, M. K., Shah, R. J., & Patel, G. (2014). Efficacy of appliance therapy on Temporomandibular disorder related facial pain and mandibular mobility: A randomized controlled study. In Journal of Indian Prosthodontist Society (Vol. 14).
16. Chander, N. G. (2019). Visual analog scale in prosthodontics. The Journal of Indian Prosthodontic Society.
17. 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.
18. Agustín-Panadero, R., Serra-Pastor, B., Fons-Font, A., & Solá-Ruíz, M. F. (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.
19. Kontonasaki, E., Rigos, A. E., Ilia, C., & Istansos, T. (2019). Monolithic Zirconia : An Update to Current. Dentistry Journal, 90(7), 23.