**Original Research Article**

# Discrepancy of vertical marginal fit of the cemented anterior ceramic restorations after periodic scaling

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## Abstract

**Background:** The accuracy of the marginal fit of fixed restorations is one of important factor for the successes of the ceramic restoration. The health of periodontium depends on the good oral hygiene, so periodic scaling and calculus removal is important. Therefore, it is important to investigate the effect of ultrasonic scalar on the vertical marginal fit.
**Aim:** The aim of this study was to study the disturbances on the vertical marginal fit of the cemented anterior restorations after routinely periodic oral hygiene measures.
**Materials and methods:** 16 anterior press glass, ceramic was fabricated (GC Initial LiSi Press Lithium Disilicate Glass Ceramics, GC Corporation, Tokyo, Japan) and cemented according to manufacturer's instructions to prepared tooth surface of mounted central incisors using Aureocem NE Self-adhesive, dual curing composite-based luting cement (Promedica Dental Material GmbH, Domagkstrasse 31,24537 Neumunster, Germany). Vertical Marginal gap was measured before and after using the scaler. The data was tabulated and analyzed statistically.
**Results:** It was found that the mean ±SD Vertical Marginal gap values recorded for a Vertical Marginal gap distance before ultrasonic were (11.96±2.7 um) with a minimum value (7.3 um) and maximum value (17.9 um). Meanwhile the mean ±SD Vertical Marginal gap values recorded for Vertical Marginal gap distance after ultrasonic were (13.48±2.8 um) with a minimum value (7.7 um) and maximum value (18.3 um).
**Conclusion:** It was found that and according to the conditions of this study that after using ultrasonic scalar, presences of disturbances on the vertical marginal gap of the cemented anterior restoration.

**Key words**

Ceramic anterior restoration, Disturbance of vertical marginal gap, Marginal integrity, Ultrasonic scaling.

## Introduction

The proper treatment planning and suitable design of the fixed restorations are very important to achieve the treatment successes for restoring both function and esthetics, as well dental material science, dental lab work and clinical procedures, all of these factors are essential for effective fixed restorations [1]. In recent technology, HDM (High Density Micronization), dispersed lithium disilicate micro-crystals were used instead of traditional larger size crystals to fill the whole glass matrix therefore, the GC Initial™ LiSi Press to provide high physical properties and best natural aesthetic appearance of pressed ceramic. Therefore, the restoration will be in a best combination of both strength and aesthetics and with a high level of transparency.

One of the most important factors for a perfect restoration, is the accuracy of the marginal fit of fixed restorations. Both the restorative materials and technique are responsible to establish a well marginal fit. Many authors reported the factors of marginal discrepancy of crowns as: measurements of crowns before and after cementation, treatment time as aging or storage time after cementation, abutment used, microscope used for measurements, and the location of measurements [2-4].

For cemented restorations, 25 to 40 μm marginal gap has been approved clinically. But; this range is difficult to achieve clinically. Studies for many types of all-ceramic crown systems was reported that a wide range of the marginal gap with a mean of 155 μm. Others examined more than 1,000 crowns after a 5-year period and reported that a marginal opening of ≤120 μm was clinically acceptable [5-9].

The complications of lack of marginal fit, and presence of gap, allows more plaque growth, the flow of gingival fluid, bone loss, microleakage, recurrent caries, periodontal disease and this will reflect on the durability of the fixed restorations. Therefore, the researchers should pay attention to the marginal fit and the adaptation of the restoration. Marginal gap is one of the main factors effect on the success of prosthetic restorations, Therefore, the purpose of this study was to investigate the disturbances of the vertical marginal fit of cemented GC Initial™ LiSi Press anterior ceramic crowns before and after ultrasonic scaling.

## Materials and methods

In this study, 16 teeth of human natural upper central incisors were used and prepared to receive all ceramic crowns. After all the teeth was completely cleaned, sterilized, and dried was vertically mounted, using specially designed and constructed cupper circular mold (10 mm height and 20 mm diameter), using chemically cured resin (a green powder and liquid Acrostone dental factory, Madinat Alsalam Industrial zone).

Standard ceramic tooth preparation was done with 0.8 deep chamfer finish line, and the axial surfaces was prepared using round tapered diamond stone, incisal surface was prepared using tapered diamond stone (Robot Point, FG All Ceramic Preparation Kit (PN 0955), SHOFU, UK. All The line and point angles were rounded and smoothed. All teeth blocks were stored in saline solution at room temperature.

Impression was taken for each prepared tooth, using heavy and light a poly-vinyl siloxane (VPS) impression material (Virtual, regular set Ivoclar-vivadent) and type IV stone die was fabricated. All the anterior press glass ceramic crowns (GC Initial LiSi Press Lithium Disilicate Glass Ceramics, GC Corporation, Tokyo, Japan) were constructed and prepared for ceramic crown according to the manufacturer's instructions.

**Bonding procedures of anterior press glass ceramic crowns**

All press glass ceramic anterior crowns were cemented with Aureocem DC, dual curing composite-based luting cement (Promedica Dental Material GmbH**,** Domagkstrasse 31,24537 Neumunster, Germany) 10 g auto-mix syringe, shade U, 5ml ceramic primer, 8 ml Compobond LCM, 5ml Cica, accessories (mixing tips, intraoral tips) Art.No.2685.

The fitting surface of each ceramic crown was treated with (9.5%HF) buffered hydrofluoric acid gel 5g for 90 Sec (Bisco, Inc 1100W. Irving park Rd. Schaumburg, IL 60193 847-534-6000 USA). Then washed carefully with water and dried. According to the manufacturer's instructions silane was applied, and was dried with air syringe (Pentron clinical, Technologies, LLC, and 68 N. Plains Industrial Rd. Wallingford, CT, USA 06492.203-265-7397) and ceramic primer was applied.

The prepared tooth surface was etched with 37% phosphoric acid Etchant gel for 30 seconds (Charm Etch, 37 (LV) DENTKIST, Inc., 1412004 Korea). Then, washed with water spray and air-dried. A bonding agent (Compobond LCM was applied to the tooth structure.

Finally, the fabricated anterior press glass ceramic crowns were cemented with composite-based luting cement light polymerizing. All samples were cemented with finger pressure, and all cervical margins was light cured for 20s (Ledition Germany). Finishing of the Cement margin was done using flexible polishing discs (Sof- Lex XT Pop-On, 3M ESPE). And all cemented samples were stored in saline solution. The fabricated cemented anterior press glass ceramic crowns became ready for marginal gap measurement tests.

**Measurement of Vertical Marginal gap before and after ultrasonic**

Each ceramic crown was photographed using USB Digital microscope with a built-in camera (Scope Capture Digital Microscope, Guangdong, China) connected to an IBM compatible personal computer using a fixed magnification of 40x. The analysis system of A digital image (Image J 1.43U, National Institute of Health, USA) was used to evaluate and measure the qualitative length of the vertical gap. The pixels were used to express about all measured parameters and, the system calibration was done to convert the pixels into absolute real-world units.

To calibrate the vertical marginal gap, an object of known size (in this study the ruler) was used to be compared with a scale generated by the Image J software. The cemented sample was held in place over their corresponding dies using a specially designed and fabricated holding device (**Figure - 1 and 2**). Shots of the margins were taken for each sample. Then morphometric measurements were done for each shot [4 equidistant landmarks along the cervical circumference for each surface of the specimen (Mesial, labial, distal, and palatal). Measurement at each point was repeated three times.

**Figure – 1:** Diagram of holding device.

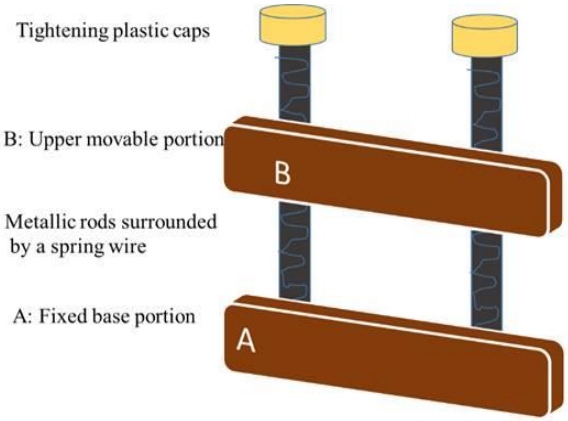
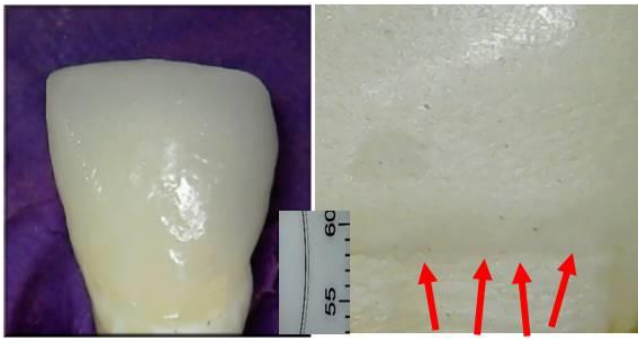



**Figure – 2:** Calibration 1.



The obtained data were collected together, arranged, tabulated and subjected to statistical analysis.

**Holding device**

An especially wood device was designed and machined to hold the cemented anterior ceramic samples during gap evaluation. It consisted of 2 parts (A and B). A: is a fixed base portion; rectangular in shape (10 cm length of 1.2 cm height and 2.3 cm width). The acrylic resin block will rest on this portion. B: is the upper movable portion rectangular in shape (10 cm length of 1.2 cm height and 2.3 cm width) to connected the base portion through 2 metallic rods surrounded by a spring wire to control the compressibility of the upper portion and fixed by tightening plastic caps. Also, it is lined by a rubber sheet to prevent friction that may cause any damage to the cemented samples.

**The application of ultrasonic scaling**

A piezoelectric ultrasonic scaler (Woodpecker ultrasonic scaler UDS-J2, China). The stainless-steel scaling tip (G2), was applied to scale the anterior teeth samples cemented with ceramic restorations. The lateral side of the tip was adapted cervically with surface angle ≤15˚, (A standardized scaling technique), at 30.000 cps (a full power) for 60 seconds with distilled water as a sufficient coolant.

**Measurement of Vertical Marginal gap after ultrasonic**

After ultrasonic was applied, the cemented fabricated anterior ceramic restorations were ready for marginal gap measurement tests using the same method and the same calibration used for vertical marginal gap distance measurements before ultrasonic.

All recorded data were collected, tabulated and then subjected to statistical analysis.

## Results

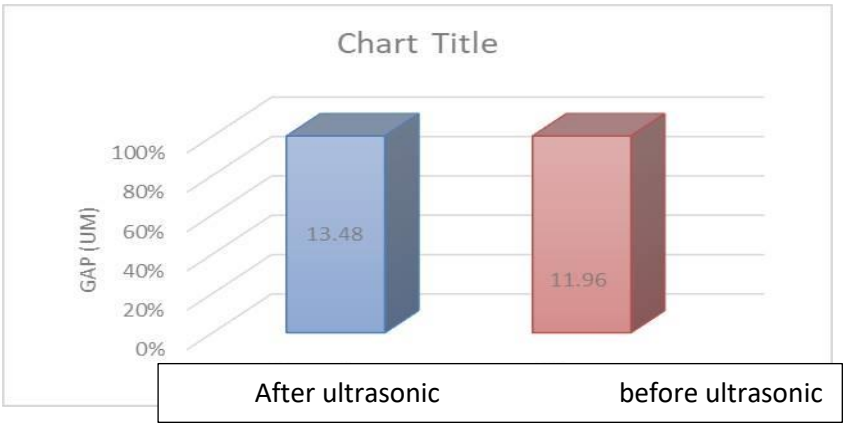
Descriptive statistics of vertical marginal gap (µm) showing the mean, standard deviation (SD) and 95% confidence intervals (low and high) values of ceramic groups before and after ultrasonic application were summarized in the **Table - 1** and graphically drawn in **Figure - 3**.

**Table – 1:** Descriptive statistics of marginal gap results (Mean values SDs) for both groups.

| **Variables** | | **Mean± SD** | **95% CI** | | **Statistics** | |
|---|---|---|---|---|---|---|
| | | | **Low** | **High** | **t-value** | **P value** |
| Group | Vertical Marginal gap distance before ultrasonic | 11.96±2.7(µm) | 10.69 | 13.23 | 1.7 | 0.089 ns |
| | Vertical Marginal gap distance after ultrasonic | 13.48±2.8(µm) | 12.17 | 14.8 | | |

***; significant (p < 0.05) ns; non-significant (p>0.05)**

**Figure – 3:** Gap results mean values.



It was found that the mean ±SD Vertical Marginal gap values recorded for a Vertical Marginal gap distance before ultrasonic were (11.96±2.7 um) with a minimum value (7.3 um) and maximum value (17.9 um). Meanwhile the mean ±SD Vertical Marginal gap values recorded for Vertical Marginal gap distance after ultrasonic were (13.48±2.8 um) with a minimum value (7.7 um) and maximum value (18.3 um).

It was found that Vertical Marginal gap distance before ultrasonic recorded statistically ($p>0.05$) higher mean value than Vertical Marginal gap distance after ultrasonic mean value as indicated by paired t-test. And There was no significant difference p value = 0.089

## Discussion

This research was to study the vertical marginal gap of anterior ceramic restorations, after and before routine ultrasonic scaling. The anterior restorations were constructed from most recent ceramic material (GC Initial LiSi Press Lithium Disilicate Glass Ceramics, GC Corporation, Tokyo, Japan), and cemented to natural tooth structure using adhesive resin cement.

For good oral hygiene measures, control the biofilm, and to preserve the periodontal health, the periodic Scaling and root planning (SRP) is needed. Some studies reported that ultrasonic scaling have superior properties than hand scaling, as effective mechanical removal of calculus and plaque, bactericidal, water lavage, time saving, best and more comfortable for operator ergonomics. Some studies registered the side effects of the ultrasonic scaling and returned the causes of damaging effects may be due to the instrumentation time, the tip angulation, tip design and the lateral force and Some researcher's advice to avoid ultrasonic scaling to veneers restorations, therefore, in this study we interested to investigate the effect of ultrasonic scaling on vertical marginal gap of lithium disilicate anterior restoration cemented to tooth structure with adhesive cement [10, 11, 12, 13, 14, 15, 16].

One of the most important factors that effect on the success of fixed prosthodontics restorations is the vertical marginal accuracy. Because lack of marginal adaptation permits dissolution of cement by saliva, some types of drinks and oral fluids, in addition to ingres of food and bacteria resulting in dental caries, more destruction of tooth structures and affect the durability of the fixed prosthetics restorations. Therefore, in this study we paid attention to the vertical marginal gap of anterior ceramic fixed restoration before and after using of ultrasonic scaler [4, 6].

The measurements of the vertical marginal gap length are considered as one of the most common method to check the accuracy of the fixed restorations. Therefore, in this research, the vertical marginal gap length of anterior ceramic crowns was performed. There are many testing methods and measuring tools are available in the dental field for this purpose, but the direct view method using the optical measuring microscope is preferred, because it more accurate, easy and rapid for determining the vertical marginal gap measurements therefore this method was used in this study [17, 18].

In this study, The vertical marginal gaps were measured in (μm) in different points before and after ultrasonic scaling and was statistically analyzed to all recorded data, it was found that the mean ±SD values was recorded for a vertical marginal gap distance before ultrasonic were (11.96±2.7 um) with a minimum value (7.3 um) and maximum value (17.9 um). Meanwhile the mean ±SD values recorded for vertical marginal gap distance after ultrasonic were (13.48±2.8 um) with a minimum value (7.7 um) and maximum value (18.3 um). The differences may be due to the effect of vibration of ultrasonic scaler. It was found that vertical marginal gap distance before ultrasonic recorded statistically ($p>0.05$) higher mean value than vertical marginal gap distance after ultrasonic mean value as indicated by paired t-test as in **Table - 1** and There was no significant difference where p value = 0.089.

In this study and due to wide advancement of ceramic materials and techniques, the margins of ceramic restoration are more adapted and more fit, and It was found that the obtained results are in the range of other studies that marginal gaps range from 100 to 120μm is clinically acceptable. Some authors reported that CAD/CAM-generated zirconia restorations have high precision. Others reported that the obtained vertical marginal gap data ranged from 47 to 59 μm are within the clinical acceptable values, since the criteria of 100 μm was considered by some authors as the maximum clinical acceptable marginal gap [19-26].

## Conclusion

It was found that and according to the limitations of this study: after using of ultrasonic scalar, the measurements of cervical vertical marginal disturbances was slightly higher than before. But the difference was not significant.

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