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Influence of cervical finish line type on marginal adaptation of two different all-ceramic CAD/CAM systems before and after veneering ceramic over the Zirconia copings: An in vitro study

Cherukuru Sameer Kumar Reddy[1], Nelluri Vizaikumar Vasudha [2], Madisetty Mahesh Babu [3], Kotagiri Satyendra kumar[4], Pulagam Mahesh [5], Pottem Srinivas Rao [6]

[1](Department of Prosthodontics, Priyadarshini Dental College & Hospital ,India) [2](Department of Prosthodontics, Meghana Institute of Dental Sciences, India) [3](Department of Prosthodontics, Meghana Institute of Dental Sciences, India) [4](Department of Prosthodontics, Meghana Institute of Dental Sciences, India) [5](Department of Prosthodontics , Narayana Dental College & Hospital,India) [6](Department of Prosthodontics , Narayana Dental College & Hospital,India)
Corresponding Auther: Cherukuru Sameer Kumar Reddy

Abstract:*The margins of fixed restoration should be closely adapted to the cavosurface finish line to survive in the harsh biological environment of the oral cavity. This invitro study was designed to evaluate and compare the influence of two different cervical finish line types (shoulder & radial shoulder) on the marginal adaptation of two different all-ceramic CAD/CAM systems (Cerec 3& Lava) before and after veneering ceramic over the Zirconia copings. Two nickel-chromium metal dies were fabricated which replicates all-ceramic crown preparations with two different finish line configurations i.e. shoulder & radial shoulder one each. A total of 28 Y-TZP (zirconia) coping samples were fabricated using Cerec 3 & Lava CAD/CAM systems (14 each). Out of 14 zirconia coping samples in each system, seven were fabricated with shoulder and remaining seven with radial shoulder margin. All coping were evaluated for absolute marginal opening (AMO) using Reichert Polyvar- Met 2 Optical Microscope using image processing software(Lucia) and all the measurements were subjected to statistical analysis using "unpaired't' test" with p<0.05 was considered as the level of significance. The mean AMO measurements (µm) of the Lava coping samples (68.03+20.29) were significantly lower than that of Cerec3 coping samples (88+15.72) with shoulder margins (p<0.05) whereas with radial shoulder margins, Lava coping samples (42.89+4.03) were slightly higher than Cerec 3 coping samples (41.39+3.35). 'P'-value between Cerec 3 and Lava coping samples with shoulder and radial shoulder margin were not statistically significant (p<0.05).The mean AMO measurements (µm) of the Lava coping as well as crown samples with shoulder margin were less compared to Cerec 3 coping and crown samples. The mean AMO measurements (µm) of Cerec 3 coping samples with radial shoulder margins is less than Lava coping samples but identical with crown samples.Within the limitations of the study, for better marginal adaptation, radial shoulder finish line is suggested for Cerec 3 and shoulder finish line for Lava CAD-CAM systems.*

Key words: *Marginal adaptation, Absolute marginal opening (AMO), shoulder finish line, radial shoulder finish line,Zirconia coping,veneering.*

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I. Introduction

Fixed prosthodontics is the branch of prosthodontics concerned with the replacement and/or restoration of teeth by artificial substitutes that not readily removed from the mouth.[1] The restoration can survive in the biological environment of the oral cavity only if the margins are closely adapted to the cavosurface finish line of the prepared tooth. Various forms of gingival finish lines are chamfer, shoulder, radial shoulder, heavy chamfer and shoulder with bevel.[2]

Inadequate adaptation of the restoration may be detrimental to the tooth causing secondary caries, periodontal, cosmetic problems.[3,4,5] Marginal discrepancies are inevitable despite careful attention to waxing, investing and casting. It is one of the tasks of the luting cement to close these discrepancies. However, cement can be washed out under the margins if gap is too large. Because of the solubility of luting cements there is subsequent of marginal opening .[6] Thus for the success of restoration marginal gap must be as minimal as possible.

The term "ceramic" refer to or relating to the manufacture of any product made essentially from a non-metallic inorganic mineral (as clay) by firing at a high temperature.[1] Since 1886, the first all-ceramic crown developed by Land known as porcelain jacket crown,[7] to fulfill esthetic demands several innovative systems, such as ceramics for sintering, slip casting, heat pressing and machining were developed for the fabrication of all-ceramic dental restorations.[8] Concurrently within the past twenty years two main types of all-ceramic materials are available for the sintering technique , they are alumina-based ceramic & leucite-reinforced ceramic. Heat-pressed all-ceramic the materials are leucite, lithium disilicate & lithium phosphate. Slip-cast all-ceramic the materials are alumina, spinel & zirconia. Machined all-ceramic materials include zirconia, alumina, feldspar, mica & leucite.[8]

The name zirconium comes from the Arabic word 'zargon' which means golden in color. In 1990's zirconia material, tetragonal zirconia polycrystals was used as implant abutments. This heralded the use of zirconium into dentistry due to its excellent physical properties, white colour and superior biocompatibility. It is being evaluated as an alternative frame work for full coverage all-ceramic crowns and fixed partial dentures.[9] Zirconium is a polycrystalline ceramic without any glass component. It is a polymorphic material that occurs in three crystallographic forms monoclinic, cubic & tetragonal. Pure zirconia at room temperature is monoclinic and stable till 1170^{o}c above this temperature it transforms itself into the tetragonal phase and then further into cubic phase at 2370^{o}c. During cooling T-M transformation takes place at the temperature range of approximately 100^{o}c below 1070^{o}c. This phase transformation which takes place during cooling is associated with volume expansion of approximately 3-4 percent.

Advantages of all-ceramics over porcelain fused to metal restorations include its superior aesthetics, its excellent translucency and its generally good tissue response. The main advantage of zirconia copings lies in the elimination of the galvanic current between the primary and secondary copings and thermal protection of abutment teeth.[10]

Yttrium tetragonal zirconia polycrystals (Y-TZP) frameworks can be fabricated mainly with the help of Computer Aided Designing/Computer Aided Milling (CAD/CAM) or Copy-Milling techniques by means of grinding a zirconia block. The milled frameworks are then veneered with feldspar or glass-ceramics appropriate for zirconia use which is performed at relatively higher temperatures. The framework is subjected to distortion and shrinkage during the sintering and veneering stages. This may consequently have a negative effect on the marginal adaptation. When the coping margin begins to deform under the stress of contracting porcelain, the shrinkage stress has been shown to spread further around the circumference of the margin. Because the porcelain shrinks towards its greatest mass, consequently, the fit of the coping changes due to non-uniform distortion during the porcelain firing and asymmetric form of the coping margin. It can be anticipated that thin margins due to finish lines could suffer more from shrinkage and thereby result in inferior marginal adaptation.[11] Several in-vitro studies demonstrated the marginal integrity of different types of cervical finish lines and its marginal adaptation with different all-ceramic systems.[12-16] But limited literature was found about comparison between all-ceramic CAD/CAM systems before and after veneering ceramic over the Zirconia copings.

The present invitro study was designed to evaluate and compare the influence of two different cervical finish line types (shoulder & radial shoulder) on the marginal adaptation of two different all-ceramic CAD/CAM systems (Cerec-3 & Lava) before and after veneering ceramic over the Zirconia copings.

II. Materials and methods

To prepare two nickel-chromium metal dies with shoulder and radial shoulder finish line each, initially a maxillary right central incisor phantom tooth stabilized over a maxillary typhodont jaw (Nissin Dental Products Inc.,Nakagyoku,Kyoto,Japan) was selected. Prior to the tooth preparation, a depth evaluation index was made by adapting soft putty material (Aquasil, Dentsply Ltd.,KT130NY,United Kingdom) to the facial and lingual surfaces of the tooth to be prepared. The putty was extended to one tooth on either side and the obtained index was sectioned along the mid-sagittal line of the tooth from the gingivo-facial to the gingivo-palatal aspects which helps in uniform reduction of the tooth in all planes.

The tooth was prepared using a new diamond bur with a high speed handpiece under water cooling to receive an all-ceramic crown. Approximately 2.5 mm incisal reduction, facial biplanar reduction was made with flat-end tapered diamond bur (171L,Mani Diamond Rotary Instruments, Mani Inc.,Jiapeng,China) upto 2mm, and convergence angle of 6^{o}with roughly cutting a shoulder finish line(1.5mm) at the same time. Lingual axial reduction was done upto 1mm. Overall preparation was checked with the putty index and necessary adjustments were made. After finishing of all the axial surfaces using tapered fissure bur and rounding off all distinct positive angles of the preparation the typhodont jaw impression was made with polyvinyl siloxane impression material using putty-reline technique (Aquasil,Dentsply Ltd.,KT130NY,United Kingdom).

To make the positive wax replica of the prepared tooth, the molten inlay wax (Blue wax, MDM Corporation, New Delhi) was flown into the rubber base impression of the prepared tooth. The hardened wax pattern of the prepared tooth was retrieved from the impression by attaching a 3mm sprue wax(Yeti Dental Products, GmbH,Germany). The pattern was invested using phosphate bonded investment (Cobavest, Yeti Dental Products, GmbH, Germany), casted with nickel chromium alloy (4all ceramic alloy, IvoclarVivadent

(India) Pvt.Ltd.,Mumbai,India) in an induction casting machine (LC-Cast 60A VOP Ltd, Botevgrad,Bulgaria). Divestment and sprue removal was done and metal die with shoulder finish line was sandblasted with 110µ aluminium oxide (Alminox-110µm, Delta Labs,Chennai, India) in the sandblasting machine(Ideal Blaster 15010, Delta Labs,Chennai, India).

Similarly, another maxillary right central incisor phantom tooth stabilized over the maxillary typhodont jaw (Nissin Dental Products Inc.,Nakagyoku,Kyoto,Japan) was selected. Prior to the tooth preparation, a depth evaluation index was made by adapting soft putty material (Aquasil, Dentsply Ltd.,KT130NY,United Kingdom) to the facial and lingual surfaces of the tooth to be prepared. The putty was extended to one tooth on either side and the obtained index was sectioned along the mid-sagittal line of the tooth from the gingivo-facial to the gingivo-palatal aspects which helps in uniform reduction of the tooth in all planes.

The tooth was prepared using a new diamond bur with a high speed handpiece under water cooling to receive an all-ceramic crown. Approximately 2.5 mm incisal reduction, facial bi-planar reduction was made with round-ended tapered diamond bur (877K-016, Mani Diamond Rotary Instruments, Mani Inc., Jiapeng, China) up to 2 mm, and convergence angle of 6^{o} with roughly cutting a radial shoulder finish line (1.5mm) at the same time. Lingual axial reduction was done up to 1mm. Overall preparation was checked with the putty index and necessary adjustments were made. After finishing of all the axial surfaces using tapered fissure bur and rounding off all distinct positive angles of the preparation the typhodont jaw impression was made with polyvinyl siloxane impression material using putty-reline technique (Aquasil, Dentsply Ltd., KT130NY, United Kingdom).

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The two finished metal dies were stabilized vertically on the toy clay and surface was sprayed with occlusal spray (Okklean, Occlusion Rouge, Elephant Dental B.V.,Pays-Bas) and scanned (inEosX5 scanner) using Cerec 3 software 4.4. A total of 28 Zirconia coping samples were manufactured by CAD-CAM milling system (Cerec MC XL Milling Machine, Sirona Dental Systems Inc., NY, USA) using pre-fabricated blanks of Zirconia ceramic, 14 (n=7 Zirconia copings/ finish line) with CerecIncoris ZI blocs (Sirona Dental Systems Inc., NY, USA) and 14 (n=7 Zirconia copings/ finish line) Lava Ultimate restorative blocks(3M ESPE, ESPEPlatz,Germany) which are compatible with Cerec. All the samples were fabricated by one experienced dental technician. After milling, all the zirconia coping samples were sintered raising temperature upto 1500^{o}c for approximately 8 hours in Infire HTC unit (Sirona Dental Systems Inc., NY, USA).

The marginal adaptation was evaluated by considering the parameter, absolute marginal opening[17] (AMO), referring to the gap from the most external point at the crown margin to the most external point at the preparation margin. Measurements were made under an optical microscope (Polyvar-Met-2.GA-E-1/85, Reichert Division der Leica, Aktiengesellschaft, Wein, Austria) with image processing software at 80 X magnification stabilizing the die horizontally with the clay. One calibrated examiner made and recorded all of the measurements. Four AMO measurements were made from each marginal aspect (labial, palatal, mesial & distal) and the marginal fit of the samples were defined as the mean values of (mean+standard deviation in µm) the individual coping. All the 28 coping samples were evaluated for marginal adaptation.

Later coping samples were veneered with overlay ceramic by free hand technique(Ceramic material, CZR, Noritake Co.,Ltd,Aichi,Japan/Cerec and Lava Ceram Veneering Ceramic/Lava) to achieve normal anatomical contour of the tooth. After the fabrication of zirconia crown samples the marginal adaptation was evaluated. Measurements were made under an optical microscope (Polyvar-Met-2.GA-E-1/85, Reichert Division der LeicaAktiengesellschaft, Wein, Austria) with image processing software at 80 X magnification stabilizing the die horizontally with the clay. One calibrated examiner made and recorded all of the measurements. Four AMO measurements were made from each marginal aspect (labial, palatal, mesial & distal) and the marginal fit of the samples were defined as the mean values of (mean+standard deviation in µm) the individual crown. All the 28 crown samples were evaluated for marginal adaptation. All the measured values were tabulated and subjected to statistical analysis by "unpaired't' test" to know any significant difference between the different variables. In this present study $P < 0.05$ was considered as the level of significance. The results of this in vitro study were tabulated.

III. Results

Tables 1 & 2 shows mean, standard deviation, t- value & p-value of Cerec-3 & Lava coping samples with shoulder and radial shoulder margin respectively. The mean AMO measurements (um) of the Lava coping samples (68.03+20.29) were significantly lower than that of Cerec3 samples (88+15.72) with shoulder margins($p<0.05$) whereas the mean AMO measurements (µm)of the Lava coping samples (42.89+4.03) were slightly higher than Cerec 3 coping samples (41.39+3.35) with radial shoulder margins. 'P'-value between Cerec 3 and Lava coping samples with shoulder and radial shoulder margin were not statistically significant ($p<0.05$).

Table 1: Mean, standard deviation, t- value & p-value comparison between Cerec-3 & Lava coping samples with shoulder margin.

Variable (Shoulder finish margin)	Sample No	MEAN(µm)	SD	t value	P VALUE
Cerec-3 coping	1	122.75	55.92	2.381	0.085
Lava coping		53.5	15.97		
Cerec-3 coping	2	129.25	32.43	3.063	0.022
Lava coping		58.75	32.67		
Cerec-3 coping	3	117	43.84	1.27	0.264
Lava coping		85.25	24.02		
Cerec-3 coping	4	93.5	4.12	0.861	0.451
Lava coping		78.5	34.59		
Cerec-3 coping	5	62.5	3.51	-0.61	0.584
Lava coping		71.5	29.27		
Cerec-3 coping	6	43	10.86	-1.381	0.218
Lava coping		69.25	36.42		
Cerec-3 coping	7	48	18.24	-0.719	0.502
Lava coping		59.5	26.29		
Over all comparison between samples					
Cerec-3 copings	All	88	15.72	1.523	0.182
Lava copings		68.03	20.9		

Graph 1: Mean values comparison between Cerec-3 & Lava copings with shoulder margin

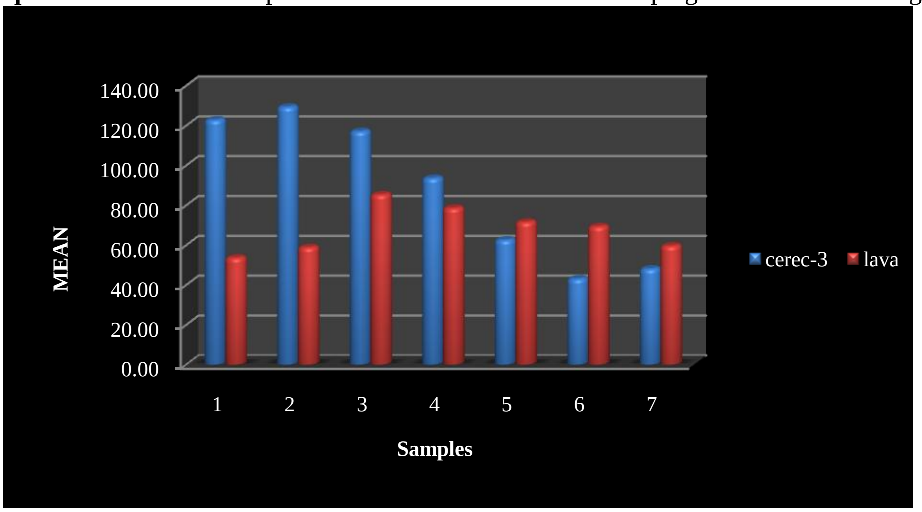
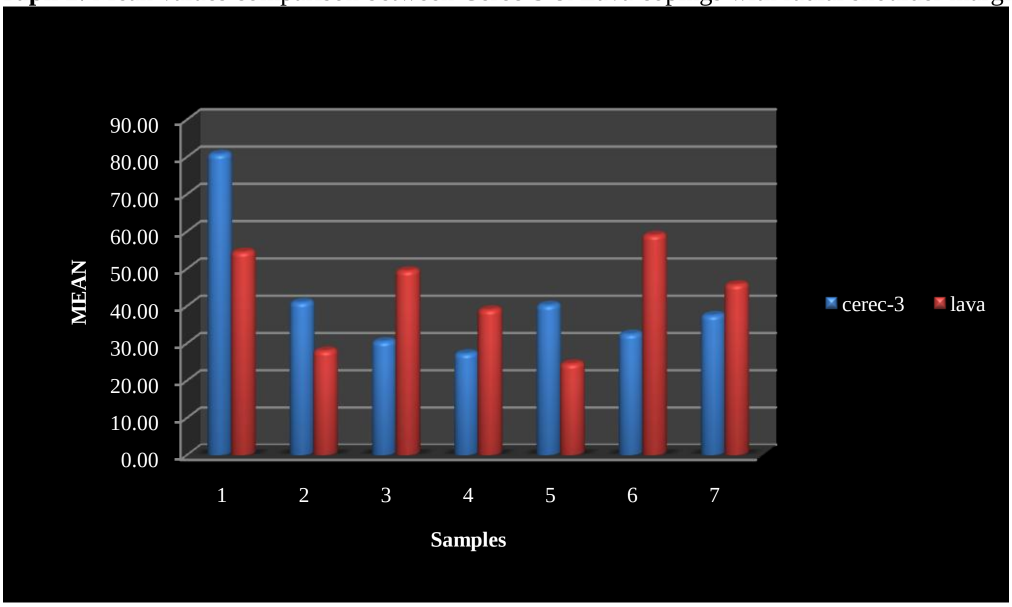


Table 2: Mean, standard deviation, t- value & p-value comparison between Cerec-3 & Lava coping samples with radial shoulder margin

Variable (Radial shoulder finish margin)	Sample No	MEAN(µm)	SD	t value	P VALUE
Cerec-3 coping	1	80.75	5.56	6.601	0.001
Lava coping		54.5	5.69		
Cerec-3 coping	2	41	6.73	2.213	0.085
Lava coping		28	10.23		
Cerec-3 coping	3	30.5	6.35	-1.696	0.175
Lava coping		49.5	21.49		
Cerec-3 coping	4	27.25	6.85	-1.605	0.173
Lava coping		39	12.94		
Cerec-3 coping	5	40.25	16.94	1.856	0.16
Lava coping		24.5	1		
Cerec-3 coping	6	32.5	8.58	-2.093	0.109
Lava coping		59	23.82		
Cerec-3 coping	7	37.5	7.55	-1.121	0.314
Lava coping		45.75	12.63		
Over all comparison between samples					
Cerec-3 copings	All	41.39	3.35	-0.307	0.776
Lava copings		42.89	4.03		

Graph 2: Mean values comparison between Cerec-3 & Lava copings with radial shoulder margin



Tables 3 & 4 shows mean, standard deviation, t- value & p-value of Cerec-3 & Lava crown samples with shoulder and radial shoulder margin respectively. The mean AMO measurements (µm) of the Lava crown samples (33.93+3.29) was less than Cerec 3 crown samples (40.96+3.56) with shoulder margins. 'P'-value between Cerec 3 and Lava crown samples were not statistically significant. Whereas the mean AMO measurements (µm) of the Lava & Cerec 3 crown samples were identical (28.46+4.76 & 28.25+6.03) with radial shoulder margins. 'P'-value between Cerec-3 and Lava copings with shoulder margin and radial shoulder margins were not statistically significant ($p<0.05$).

Table 3: Mean, standard deviation, t- value & p-value comparison between Cerec-3 & Lava crown samples with shoulder margin

Variable (Shoulder finish margin)	Sample No	MEAN (µm)	SD	t value	P VALUE
Cerec-3 crown	1	60.25	8.06	1.121	0.289
Lava crown		47.5	19.26		
Cerec-3 crown	2	42.5	18.93	0.667	0.539
Lava crown		35.5	9.04		
Cerec-3 crown	3	44.75	14.17	3.034	0.053
Lava crown		23	2.16		
Cerec-3 crown	4	45.25	19.03	0.45	0.678
Lava crown		40.75	6.18		
Cerec-3 crown	5	38	10.61	1.553	0.18
Lava crown		28.25	6.7		
Cerec-3 crown	6	31	2.58	-0.047	0.965
Lava crown		31.25	10.31		
Cerec-3 crown	7	25	4.76	-1.063	0.346
Lava crown		31.25	10.75		
Over all comparison between samples					
Cerec-3 crowns	All	40.96	3.56	1.587	0.170
Lava crowns		33.93	3.29		

Graph 3: Mean values comparison between Cerec-3 & Lava crowns with shoulder margin

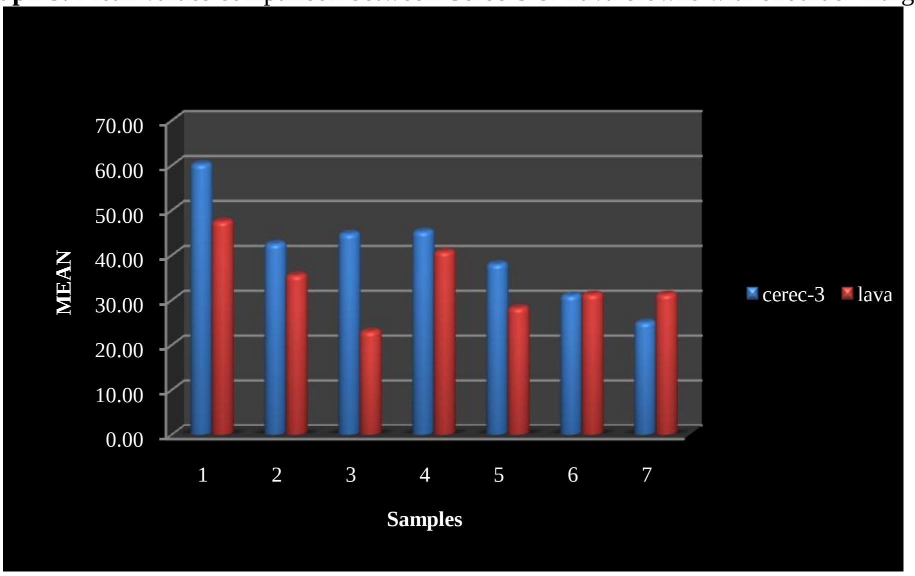
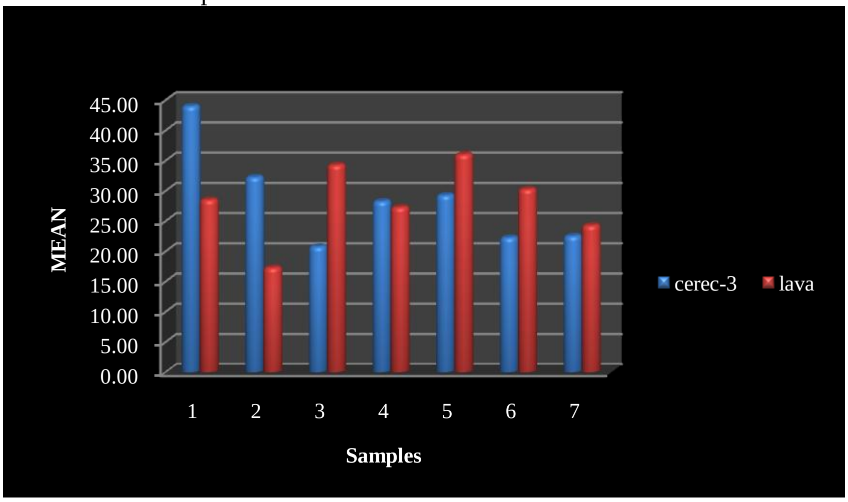


Table 4: Mean, standard deviation, t- value & p-value comparison between Cerec-3 & Lava crown samples with radial shoulder margin

Variable (Radial shoulder finish margin)	Sample No	MEAN(μm)	SD	t value	P VALUE
Cerec-3 crown	1	44	13.74	1.452	0.198
Lava crown		28.5	16.34		
Cerec-3 crown	2	32.25	16.68	1.783	0.169
Lava crown		17.25	2.22		
Cerec-3 crown	3	20.75	0.96	-2.466	0.089
Lava crown		34.25	10.9		
Cerec-3 crown	4	28.25	8.1	0.115	0.913
Lava crown		27.25	15.41		
Cerec-3 crown	5	29.25	9.22	-0.487	0.653
Lava crown		36	26.12		
Cerec-3 crown	6	22.25	5.32	-1.223	0.286
Lava crown		30.25	11.95		
Cerec-3 crown	7	22.5	2.08	-0.301	0.782
Lava crown		24.25	11.44		
Over all comparison between samples					
Cerec-3 crowns	All	28.46	4.76	0.032	0.976
Lava crowns		28.25	6.03		

Graph 4: Mean values comparison between Cerec-3 & Lava crowns with radial shoulder margin



IV. Discussion

Achieving close marginal adaptation is crucial for the long term clinical success of single or multiple unit fixed partial dentures and for the good prognosis of the restored tooth. Luting agent solubility may in time result in gap formation between the prepared tooth and the cemented crown leading to micro leakage, plaque accumulation, caries and subsequent failure of the restoration.

Several in-vitro studies demonstrated that the marginal adaptation of metal-ceramic FPDs is influenced by the type of cervical finish line, shrinkage after firing procedures of the veneering ceramic,[18] differences in coefficient of thermal expansion of the framework and veneering ceramic and, most importantly, the amount of circumferential ceramic thickness of the substructure.[19] However, the results on the effect of finish line design on the marginal discrepancies are controversial in the dental literature. Some studies performed on metal-ceramic restorations revealed that the finish line design had no influence on marginal adaptation while others reported that the shoulder type of preparation had less marginal distortion than the chamfer type after repeated ceramic firings.[11]

Available studies agree that a marginal discrepancy in the range of 100 to 200 microns seems to be clinically acceptable with regard to longevity of the restorations.[20] It is reported that the marginal gap of conventional all-ceramic crowns is within the range of 1 to 161 microns indicating that the Cerec-3 system offers the same level of marginal adaptation as conventional and Pressable all-ceramic crown systems.[16]

In a study conducted by Ester, the Lava and metal ceramic groups showed similar discrepancies with a range of 71 ± 45 microns & 76 ± 29 microns[21] and the results in the present study with Lava showed much lesser discrepancy of about 34 & 28.5 microns.

The discrepancy when a chamfer finish line is used also studied by many people and it ranged from 12.2 to 256 microns with a mean of 65.9 microns in chamfer and in shoulder with a mean of 46 microns. This is much higher when the shoulder is used as marginal finish line where the reading is from 15 to 78.7 microns.[23] The results in this study are closer to the shoulder finish line with a reading of 34 & 41 microns in Lava and Cerec-3 respectively.

Many people have studied the marginal discrepancy for Celay In-Ceram, for IPS Empress, CAD/CAM fabricated Procera, and Cerec Inlab copings by using conventional slip-cast and copy milling. Sung Yeo, reported the marginal discrepancy in Celay In-Ceram group is 83 microns where as conventional In-Ceram group is 112 microns and said that it is within the acceptable limits.[25] Whereas Bindl, stated that CAD/CAM Procera copings did not show much difference from the conventional slip-cast Procera copings. He concluded that Empress-2 copings showed greater marginal discrepancy of about 44 microns as compared to 25 microns in Procera copings.[23] In the present study the CAD/CAM milled Cerec-3 and Lava copings showed slightly higher marginal discrepancy than that is shown in the Procera copings.

The sintered copy-milled ceramic copings are subjected to different temperatures during the layering of the ceramic crown. During this procedure the coping is subjected to heat for an additional 4 to 5 times. This may influence the marginal fit and in this study it was decreased in both Cerec-3 and Lava after the crown fabrication. But these findings do not agree with the findings of Mehmet, who reported the measurements obtained after the crown build-up are significantly greater than in the coping itself. He also stated that conventional In-Ceram crowns do not show significant differences in the marginal fit after crown build-up.[24] The decrease in the marginal gap after ceramic build-up and firing compare to copings before build-up and firing may be attributed to the pyroplastic flow of the ceramic towards the margin.

The Procera All-Ceram is composed of densely sintered high purity aluminium oxide veneered with low-fusing dental porcelain. The system uses CAD/CAM technology to produce an all-ceramic restoration. In the present study the marginal discrepancy of Cerec-3 & Lava copings with radial shoulder margin showed 41.39 µm & 42.89 µm respectively. These findings are slightly on the higher side compared to the study conducted by Maria, who reported that the marginal discrepancy of Procera CAD/CAM copings with radial shoulder margin showed 40 µm.[15]

The use of all-ceramic materials for fixed restorations has become more and more important in esthetically oriented dentistry. In addition to fracture resistance and esthetics, good marginal fit is one of the most important preconditions for the long term success of all-ceramic restorations. In the present study, AMO of Cerec-3 & Lava crowns with shoulder margin showed 40.96 µm & 33.93 µm respectively. These findings are not coinciding with the study conducted by Stefan, who reported that the marginal discrepancy for heat-pressed lithium-disilicate glass ceramic crowns with shoulder margin showed 96 µm.[20]

More recently Pressable glass ceramic systems have gained in popularity due to their ease of fabrication, good mechanical properties and decreased porosity. Pressed all-ceramic crowns were fabricated with leucite-glass-pressed ceramic. In the present study the marginal discrepancy of Cerec-3 & Lava crowns with shoulder margin showed 40.96 µm & 33.93 µm respectively. These findings are in contrast with the study conducted by Jason, who reported that the marginal discrepancy of pressed all-ceramic crowns with shoulder margin showed 55.8 µm.[26] The probable reason for the less marginal gap observed for Radial shoulder finish line compare to shoulder finish line may be the bulk of the material which is less for radial shoulder at margins proportionately giving less shrinkage after sintering.

Denzir is a new dental restorative material made of Pressure Sintered Zirconium dioxide which is manufactured by CAD/CAM technique. Pierluigi reported that the marginal discrepancy of Denzir copings showed 22µm.[27] In the present study, Cerec-3 and Lava copings showed higher discrepancy in marginal adaptation.

In this study the Lava copings with shoulder margin showed lesser AMO than Cerec-3 copings. The Cerec-3 copings with radial shoulder margin showed slightly lesser AMO than the Lava copings. After the crown fabrication the Lava crowns with shoulder margin showed lesser AMO when compared to Cerec-3 crowns. After the crown fabrication both Lava and Cerec-3 systems with radial shoulder margin have shown mild variation in AMO.

V. Summary

In this in vitro study two nickel-chromium metal dies were fabricated which replicates all-ceramic crown preparations with two different finish line configurations i.e. shoulder & radial shoulder each one number. A total of 28 zirconia copings were fabricated with Cerec-3 & Lava CAD/CAM systems (14 each). Out of 14 zirconia copings in each system 7 copings were fabricated with shoulder margin and remaining 7 with radial shoulder margin.

All the 28 copings with two different margins and two different systems were evaluated for marginal discrepancy using Reichert Polyvar-2 Optical Microscope and readings were tabulated. Later all the copings were subjected to conventional ceramic build-up to achieve normal anatomical contour of the tooth and again analyzed for marginal discrepancy. The results were tabulated and subjected to statistical analysis.

VI. Conclusion

Within the limitations of this study the following conclusions were drawn

1. The Lava coping samples with shoulder margin showed lesser AMO than the Cerec-3 copings.
2. The Cerec-3 coping samples with radial shoulder margin showed slightly lesser AMO than the Lava copings.
3. The Lava crown samples with shoulder margin demonstrated lesser AMO when compared to Cerec-3 crowns.
4. The Lava and Cerec-3 crownsamples with radial shoulder margins have shown closer AMO values.
5. Marginal adaptation was good with radial shoulder finish line than shoulder finish line before and after veneering of Zirconia copings in both Lava & Cerec-3 CAD-CAM systems.

Interpretation

Within the limitations of the study, it was observed that the shoulder and radial shoulder cervical finish line types had no statistically significant different influence on the marginal adaptation of the tested Zirconia coping samples prior to veneering with both the CAD-CAM systems. The mean AMO measurements (µm) of the Lava coping as well as crown samples with shoulder margin were less compared to Cerec 3 coping and crown samples. The mean AMO measurements (µm) of Cerec 3 coping samples with radial shoulder margins is less than Lava coping samples but identical with crown samples.

Within the limitations of the study, for better marginal adaptation, radial shoulder finish line is suggested for Cerec 3 and shoulder finish line for Lava CAD-CAM systems.

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