EVALUATION OF MARGINAL/INTERNAL FIT OF CO-CR CROWNS: DIRECT-LASER-METAL-SINTERING VERSUS CAD/CAM

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INTRODUCTION

The clinicians should be focused on both qualitative and quantitative assessmentsin order to have a suitable and successfulmetalbasedceramicrestorations. Treatmentsuccess depends on perfect fit between tooth and the restoration. One of aspect of this assessmentisto evaluate the marginal adaptation of crown and bridge restorations.[1] In the fabrication of cast metal restorations, the lost-wax casting technique is one of the most widely used methods.[2-3] However, in recent years,technologyand equipment from other industries have regularly been adapted for use in the dental industry. Most of the computer-aided manufacturing (CAM) milling systems in use today in dental laboratory production processes came from other industries. Thus, 3D printing and rapid prototyping technologies used in general manufacturing have joined CAD/CAM milling and scanning as an emerging and new technology in dentistry.The use of this new technology machinery, as well as speed up production, allows significant savings in the production costs. Another important point in addition to these advantages, is the adaptation of restorations.[2-5] Fromthatpoint, the purpose of the study was to evaluate the internal and marginal fit of Co-Cr crowns were fabricated with laser sintering, CAD/CAM and conventional methods.

MATERIAL AND METHODS

One premolar and one molar teeth models were designed as having 360°chamfer preparations with 16°totalocclusalconvergence, with 3D designing software (Maya, Autodesk Inc.) (Fig. 1). 64 premolar, 64 molar polyamide (PA2200) models were produced with 3D printer (EOSINT P380 SLS, EOS). All models were standardized and prepared for the fabrication of specimens (crowns). 32 (16 molar/16 premolar) of the master models were used for fabrication of crowns using four different technique as; conventional lost wax method (CLW), Milled wax with lost-wax method (MWLW), Milled Chrome Cobalt (MCo-Cr) and Direct Laser Metal Sintering (DLMS). The working models for CLW group were coated with 5 layer of die-spacer (MegadentalGmbH,Büdingen, Germany). In total 128 single premolar and molar crowns were fabricated using these different production techniques with 32 specimens in each group. Nothing were performed for the produced crowns except polishing outer surface with a metal blur and cleaning inner surface using airborne particle abrasion using 125μmaluminum oxide with 3 bars pressure. In total 128 single premolar and molar crowns were fabricated using these different production techniques with 32 specimens in each group. Nothing were performed for the produced crowns except polishing outer surface with a metal blur and cleaning inner surface using airborne particle abrasion using 125μmaluminum oxide with 3 bars pressure. A blue ink was mixed withpolycarboxylatecement (AdhesorCarbofine,SpofaDental, Warsaw, Poland) and crowns placed to master models applying finger pressure. After cleaning the excess cement, 50 N force was applied for 1 hour with a loading device. After cementation, the crowns with master models were embedded in epoxy resin for 12 hours to stabilize their position. The models were sectionedmesio-distally from the center of the samples with a low speed saw (IsoMet, Buehler Ltd, Lake Bluff , USA). The half of the model was used to analyze the cement film thickness (Fig.2).Analysis was performed using a stereomicroscope. Three digital photos were taken with a magnification of 24x from different regions for each abutment. These photos analyzed in a measuring software program (LeicaApplicationSuite,v. 3.3.1,LeicaMicrosystems GmbH) For each crown, 17 reference measurement points were analyzed. These points were also divided into 4 locations as marginal (point 1,2, 16,17),occlusal(point 8,9,10) , axial (6,7,11,12) and chamfer (3,4,5, 13,14,15) points in order to make comparison among them (Fig.3). Statistical analyses were carried out using the SPSS 17.0.1 software (SPSS, Chicago, IL, USA). To assess intra-observer reliability, theWilcoxonmatched-pairs signed rank test was used for repeat measurements. Pearson Chi square and One-way ANOVA was performed for statistical analysis among the techniques and 4 measurement locations (p<0.05).

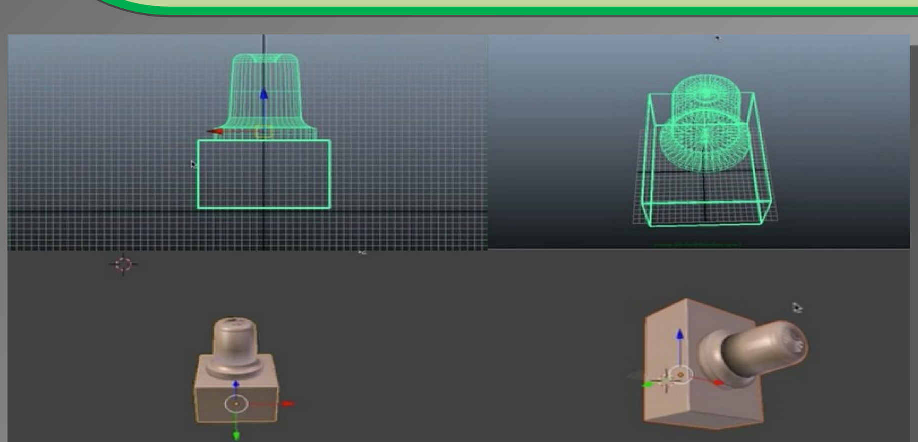

Fig.1.Thetoothdesignedlikecylindersandthedimesnsionsforeachmodel in 3Ddesigningsoftware (3DStudioMAX)

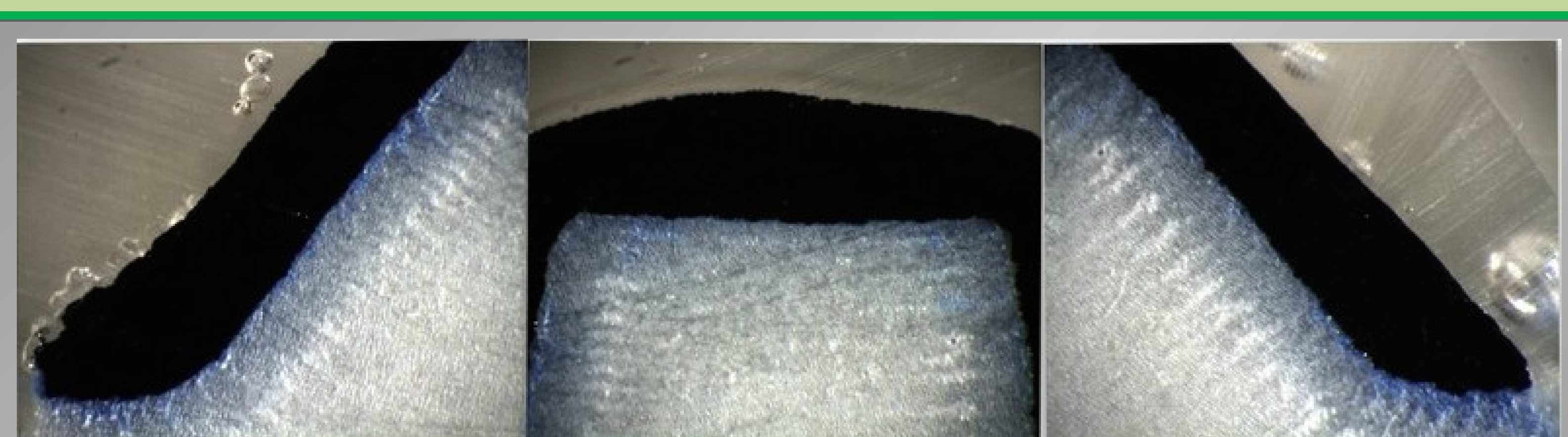

Fig.2.Cementfilmthicknessmeasurement

Fig.3.Analyze of 17 reference measurement point .Divisionofpointsinto4locationsasmarginal,occlusal,axialandchamferpoints

RESULTS

BestfitratesaccordingmeanandstandartdeviationsofallmeasurementswereinDLMS both in premolar (65,84) and molar (58,38) models in μm(Table1,Table2). Significant difference was found DLMS and the rest of fabrication techniques (p<0.05). No significant difference was found betweenMCo-CR and MWLW in all fabrication techniques both in premolar and molar models (p>0.05)(Fig. 4).

Premolar/Measuredareas	Groups	N	Mean (μm)	s.d.	Crossstatis.*pvalue*	
Marginal	CLW (1)[a]	16	85.75	19.72	1-2	*p > 0.05*
	MWLW (2)[e]	16	84.55	18.56	1-3	
	MCo-Cr(3)[d]	16	84.18	17.59	2-3	
	DLMS (4)[c]	16	51.60	11.0	1-4, 2-4, 3-4	*p*<0.05
Overall			76.52	15.14		
Occlusal	CLW (1)[a,b]	16	111.69	27.73	1-2	*p > 0.05*
	MWLW (2)[e]	16	87.02	19.24	1-3	
	MCo-Cr (3)	16	88.36	19.13	2-3	
	DLMS (4)	16	101.5	20.74	1-4, 2-4, 3-4	
Overall			97.14	24.18		
Axial	CLW (1)	16	101.15	25.78	1-2	*p > 0.05*
	MWLW (2)	16	99.54	22.34	1-3	
	MCo-Cr (3)[d]	16	91.84	21.65	2-3	
	DLMS (4)[c]	16	61.9	14.17	1-4, 2-4, 3-4	*p*<0.05
Overall			88.61	20.65		
Chamfer	CLW (1)[b]	16	91.15	24.23	1-2	*p > 0.05*
	MWLW (2)	16	90.25	22.17	1-3	
	MCo-Cr (3)	16	88.95	21.21	2-3	
	DLMS (4)	16	57.12	12.32	1-4, 2-4, 3-4	*p*<0.05
Overall			81.61	19.13		
Total			85.97	17.13		

Table1.Meanvaluesandstandartdeviationofpremolargapvaluesaccordingtospecificmeasuredlocations

Molar/Measuredareas	Groups	N	Mean(μm)	s.d.	Crossstatis. pvalue	
Marginal	CLW (1)	16	96.3	18.92	1-2	
	MWLW (2)	16	89.6	17.14	1-3	p > 0.05
	MCo-Cr(3)	16	87.6	16.22	2-3	
	DLMS (4)	16	39.5	9.8	1-4, 2-4, 3-4	p<0.05
Overall			78.25	16.75		
Occlusal	CLW (1)	16	174.3	25.46	1-2	
	MWLW (2)	16	129.1	21.37	1-3	p > 0.05
	MCo-Cr(3)	16	123.7	20.18	2-3	
	DLMS (4)	16	107.3	10.15	1-4, 2-4, 3-4	
Overall			133.6	22.79		
Axial	CLW (1)	16	124.6	21.18	1-2	
	MWLW (2)	16	107.3	20.72	1-3	p > 0.05
	MCo-Cr (3)	16	110.2	21.64	2-3	
	DLMS (4)	16	57.9	10.5	1-4, 2-4, 3-4	p<0.05
Overall			100	19.96		
Chamfer	CLW (1)	16	103.0	20.12	1-2	
	MWLW (2)	16	95.32	19.77	1-3	p > 0.05
	MCo-Cr (3)	16	94.4	19.67	2-3	
	DLMS (4)	16	43.9	9.8	1-4, 2-4, 3-4	p<0.05
Overall			84.15	18.84		
Total			99.0	16.42		

Table2.Meanvaluesandstandartdeviationofpremolargapvaluesaccordingtospecificmeasuredlocations

Fig. 4.Meanofgapsofsinglecrownsonmolarandpremolar

CONCLUSION

In conclusion, within the limitation of this study, best fit was in DLMS group, followed by CAD/CAM (MWLW,MCo-Cr) and conventional method. Best fit was found in marginal, the larger gap was found inocclusal. All fabrication techniques used in this study can be used for single crowns, however because of speed-up production and for cost effective DLMS should be used for single crown manufacturing.

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