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Reliability of Chair-side Monolithic CAD-CAM Generated Lithium Disilicate Single Crowns with Knife- Edge Finish Line: Up to 5-Year Retrospective Analysis of Clinical Performance

ABSTRACT

This clinical study evaluated the survival of monolithic lithium disilicate (MLD) single crowns. Between January-2010 and January-2015, 87 patients received 122 MLD (IPS e.max CAD) single crowns on natural teeth with knife-edge finish lines that were adhesively bonded (Maxcem Elite). MLD single crowns (N=122) were bonded on 60 molars (maxilla:35, mandible:25), 53 premolars (maxilla:27, mandible:26), 4 canines (maxilla:2, mandible:2), 3 laterals and 2 centrals (maxilla). One crown fracture, one retention loss and one endodontic complication were experienced (survival rate: 97.5%). MLD single crowns could be safely indicated on teeth with knife-edge preparations.

INTRODUCTION

Lithium disilicate ceramic offers better translucency with lesser mechanical strength compared to that of zirconia especially for anterior crowns.¹ With current optical impression and computer-aided design and computer-aided manufacturing (CAD/CAM) systems, it is possible to manufacture single crowns out of monolithic lithium disilicate (MLD).

Recently, zirconia in its monolithic or bilayered form indicated for fixed dental prosthesis demonstrated favorable clinical results on knife-edge preparations.² Limited information is available in this respect for MLD ceramics.^{3,4}

This clinical study evaluated the performance of MLD single crowns bonded to natural teeth. The null hypothesis tested was that survival rate of MLD single crowns would not show significant difference compared to those of zirconia and metal-ceramic bonded to natural teeth with knife-edge preparations presented in the literature.²⁻⁴

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MATERIALS AND METHOD

From the patient database, information was retrieved related to preparation, cementation and other restorative parameters on single crowns made using the CEREC system (CEREC, SIRONA Dental Systems, Long Island City, NY, USA) between January-2010 and January-2015 in a private practice in Como, Italy. All patients included were patients of the dental office who were also enrolled in a hygiene recall program. Altogether 87 consecutive patients (58 female, 29 male; mean age: 56.4 years old) received 122 MLD (IPS e.max CAD, Ivoclar Vivadent, Schaan, Liechtenstein) single crowns on natural teeth with knife-edge finish line preparation (occlusal: 2 mm, axial: 1.5 mm reduction with 12-20° convergence angle). One clinician (F.S.) performed all prosthetic procedures who was a specialist in prosthodontics.

Following tooth preparation, the provisional crown was re-lined and cemented (Temp Bond NE, Kerr Group, Scafati, Italia) (Figure 1a-c). Digital impressions were made 1 to 2 weeks after tooth preparation (CEREC 3D Blue-cam, SIRONA Dental Systems). After CAD proposal was selected and crown design was finalized, a lithium disilicate block (IPS e.max) was placed in the milling unit and a full monolithic crown was milled (Figure 2a-d). The crown was sintered (Programat P310, Ivoclar Vivadent) (800°/45 min), stained and glazed (GC Initial IQ Paste NF, GC Europe, Leuven, Belgium).

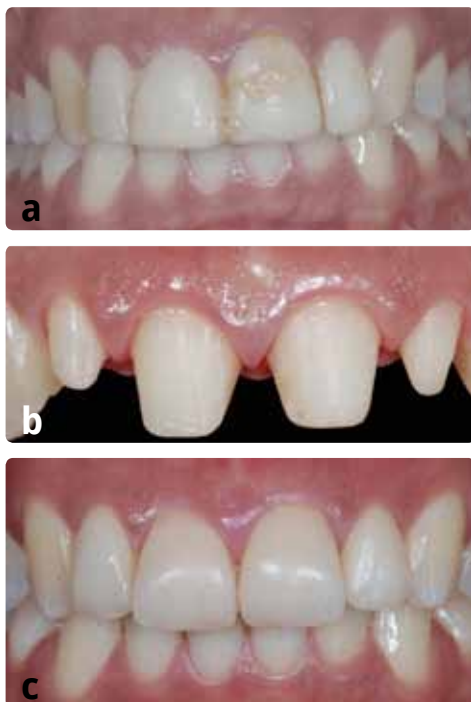


Figure 1a-c: Photos of a) pre-operative phase, a female patient presenting unpleasant anterior resin composite laminates on 22,21,11,12, b) tooth preparation with knife-edge finish line, c) 2 weeks control after tooth preparation. Note the complete soft tissue healing.

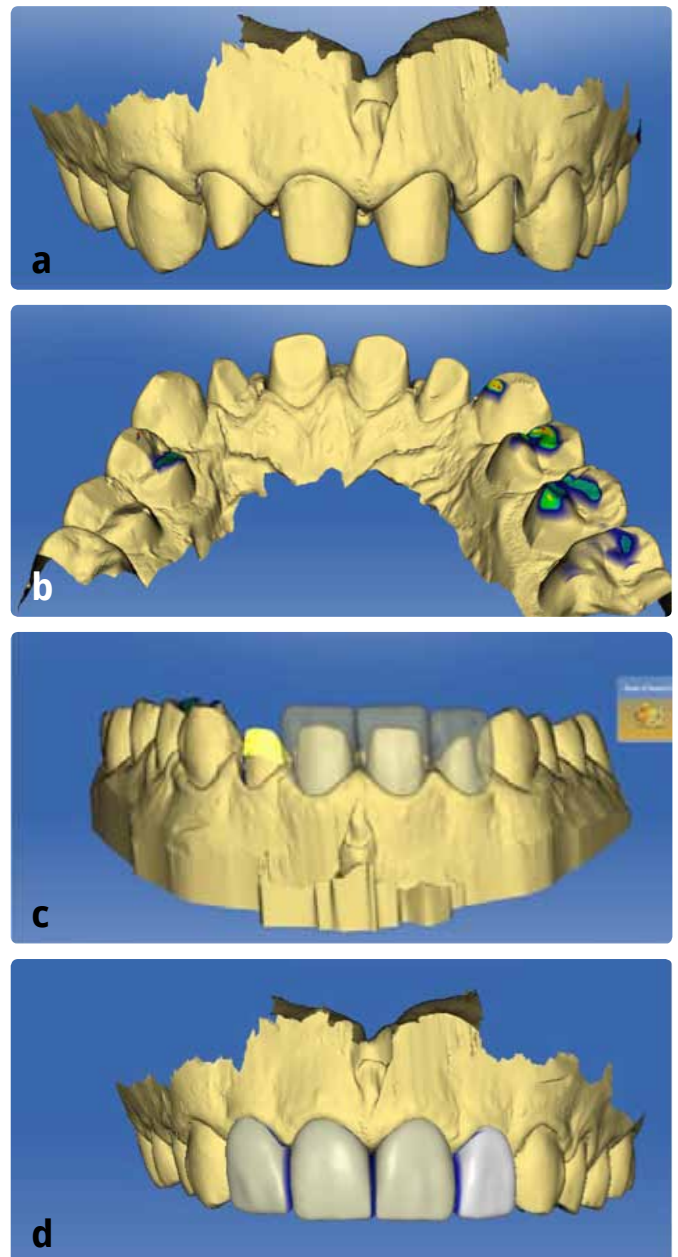


Figure 2a-d: Final digital impression (CEREC 3D Bluecam, Sirona) of prepared teeth from a) front, b) palatal view, c) finish line margin placed over the virtual dies, d) Cad project for the final crowns.

All crowns were manufactured using the chair-side protocol through an in-house milling unit (CEREC- Sirona). One technician (F.L.) together with the operator designed and monitored fabrication process including setting milling parameters and performing milling procedures, sintering, try-in, staining and glazing. The technician had experience with digital designing and also with zirconia reconstructions on knife edge designs for more than 10 years. No technical problems were experienced during this process.

After intaglio surfaces of the crowns were etched with 5% hydrofluoric acid for 20 s (IPS Empress Gel, Ivoclar Vivadent), each crown was cemented using self-adhesive cement (Maxcem Elite, Kerr, Orange, CA, USA). Following 3 s of initial

photo-polymerization (Valo LED Curing Light, Ultradent), and removal of excess cement, the crowns were photo-polymerized for 40 s from four directions (occlusal, lingual, mesial, distal) (Figure 3a-b).

Periapical x-rays were made to confirm the absence of any cement excess (Figure 3c). All patients were then included in 6 months recall program (Figure 3d).

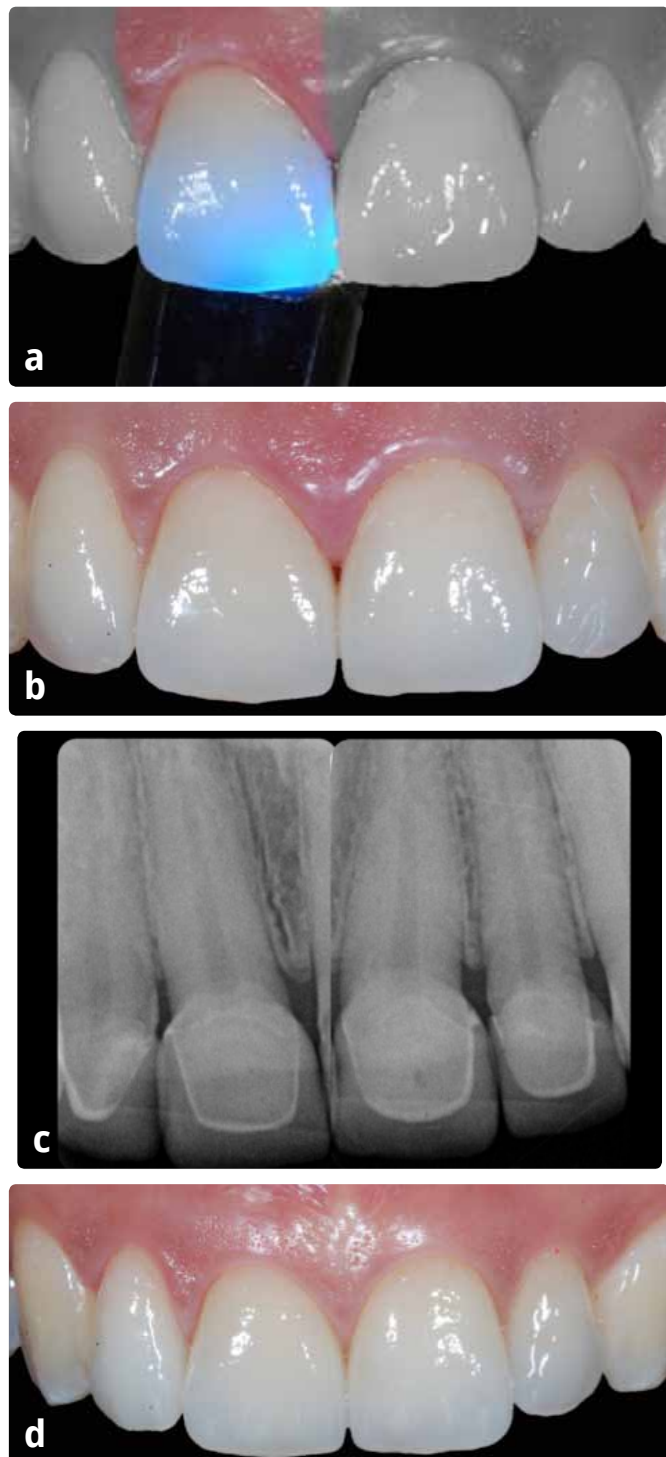


Figure 3a-d: a) Monolithic lithium disilicate single crowns during cementation, b) immediately after cementation, c) x-rays immediately after cementation confirming lack of cement excess, d) crowns 1 month after final cementation.

STATISTICAL ANALYSIS

Data were analyzed using Kaplan-Meier and Log Rank (Mantel-Cox) tests (SPSS 13.0; SPSS Inc., Chicago, IL, USA) ($\alpha=0.05$).

RESULTS

Mean observation time was 26.6 months.

MLD single crowns (N=122) were bonded on 60 molars (maxilla: 35, mandible: 25), 53 premolars (maxilla: 27 maxilla, mandible: 26), 4 canines (maxilla: 2, mandible: 2), 3 laterals and 2 centrals (maxilla). The crowns were indicated mainly for the posterior teeth where full coverage was needed due to lack of retention for a restoration after amalgam removal followed by endodontic treatment (n=69), for teeth after removal of discoloured resin composite restorations along with tooth discoloration (n=13), for metal-ceramic crown replacement due to soft tissue recession exposing metal collar that is not accepted by the patient or ceramic fracture (n=31) and for aesthetic reasons where shape and color of the teeth required massive change to meet patients' high aesthetic expectations, therefore laminate veneers were not suitable and orthodontic approach was not accepted by the patient (n=9). Of the 122 teeth, 24 of them were vital and 98 non-vital.

Two mechanical failures occurred in the form of crown fracture (tooth no. 47) and loss of retention (tooth no. 16), and one biological failure (endodontic complication with apical fistula in tooth no. 17) was observed.

No caries was observed in any of the teeth. Fractured crown was remade and was intact until the final observation. The reason for fracture was insufficient occlusal clearance. For the tooth with endodontic complication, the crown was removed, root canal therapy was performed and a new crown was cemented.

The cumulative survival rate of MLD crowns was 97.5% (Kaplan-Meier, CI:95%) (Figure 4).

DISCUSSION

In a systematic review comparing all-ceramic with metal-ceramic crowns, survival rate at 5 years was reported to be 93.3% (95% CI:91.1-95%) for all-ceramic and 95.6% (95% CI:92.4-97.5%) for metal-ceramic.¹ A retrospective evaluation on single lithium disilicate crowns (N=94) demonstrated a survival rate of 97.4 after 5 and 94.8% after 8 years.⁵ The results of this study are in accordance with these studies and the systematic review for lithium disilicate single crowns referring a 97.8% cumulative survival rate after 5-years.¹ Thus, the null hypothesis tested could be accepted. One clinical study on 235 teeth with knife-edge finish line restored with lithium disilicate full crowns, reported only one fracture and no biological complications at 18 months follow up.³ In a more recent

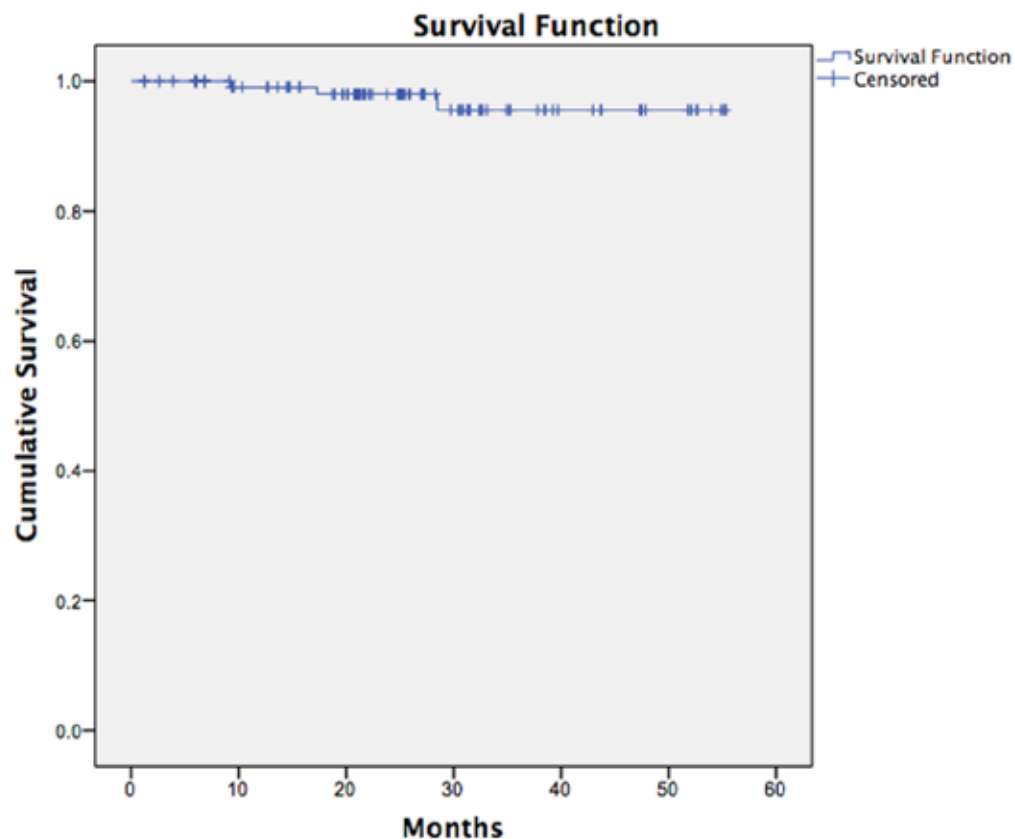


Figure 4: Event-free survival rates of monolithic lithium disilicate full-coverage single crowns on natural teeth with knife-edge finish line preparation design (N=122).

study on 110 teeth with feather-edge finish line over a 7-year period, survival probability was 96.9%.⁴ In this study, one fracture was observed at the moment of cementation. Similarly, in other studies occasional fracture of the MLD single crowns were reported.^{3,4}

CONCLUSIONS

From this study, the following could be concluded:

The very low incidence of mechanical and biological complications with monolithic lithium disilicate single crowns up during the mean observation time of 26.6 months, do not counter-indicate their use on teeth with knife-edge preparations.

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DISCLOSURE

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