Clinical Fit of Monolithic Zirconia Single Crowns

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Purpose: To analyze the clinical fit of monolithic zirconia single crowns (MZSCs) in a prospective cohort study. Materials and Methods: A total of 30 posterior teeth were restored with MZSCs. Silicone replicas were made to measure the clinical fit using a stereomicroscope. Measurements were conducted at 17 points per crown at the marginal and occlusal surfaces. Results: The mean clinical fit was 0.104 mm at the crown margin and 0.101 mm at the occlusal surface. Measured distances at the marginal and occlusal surfaces were comparable. Conclusion: MZSCs showed acceptable clinical fit.

Recently, monolithic zirconia has become a common material for manufacturing single crowns. However, clinical studies investigating the performance of monolithic zirconia restorations are rare.1 Momentarily, there are no prospective clinical trials available.

Zirconia was first introduced in dentistry as a framework material for crowns and fixed dental prostheses. A glass-ceramic veneer was common comparable to metal frameworks; however, this veneering showed significant rates of chipping.2,3 This chipping problem has still not been solved completely.4 As a consequence, the use of monolithic zirconia without a veneer has become popular, especially in the molar and premolar regions, where esthetic concerns are minor and stability is important.

The major indication for crowns made from monolithic zirconia is as an alternative to full metal crowns in molar and premolar regions. The mechanical properties of zirconia allow shallow and minimally invasive preparations comparable to those for full metal crowns. Although the esthetic appearance of an individually veneered crown cannot be reached, the esthetic appearance is unquestionably better compared to a full metal crown. The major disadvantage is in the hardness of the material; ie, there might be a negative long-term effect on antagonist teeth and restorations. At the moment, the clinical relevance of this disadvantage is controversially discussed.5,6

The aim of this prospective cohort study was to clinically analyze the marginal fit of monolithic zirconia restorations.

Materials and Methods

The study design was ethically approved (EK 104042012). All clinic patients over 18 years of age who needed a posterior crown were eligible. Molars and premolars were restored with monolithic zirconia single crowns (MZSCs) (Cercon ht, DeguDent). Preparations were done according to a clinical protocol related to the manufacturer’s guidelines. The teeth were prepared with a shallow chamfer margin, a minimal occlusal reduction of 0.5 mm, and a minimal circular reduction of 0.4 mm. For impressions, a one-step double-mix technique with an addition-curing silicone (Honigum, DMG) was used. The crowns were manufactured by one dental technician with a computer-aided design/computer-assisted manufacture (CAD/CAM) machine using fixed values for fit (0.045 mm) and gap (0.085 mm). The fit was analyzed with a stereomicroscope (Leica MZ 12, Leica AG) using the replica technique according to Boening et al.7 A silicone replica of the gap between crown and tooth was made directly before insertion (Honigum light and heavy body, DMG; Fig 1). First, the crown was filled completely with the light-body component (yellow), then clinically inserted using finger pressure comparable to a usual fit-checking procedure. After that, the crown with the silicone layer was removed from the tooth. Crown and connected silicone layer were then rinsed with ethanol, gently dried, and filled with a heavy-body component (blue). After setting, both connected silicone layers were removed from

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The thin yellow layer represented the gap between crown and tooth, and the thick blue layer stabilized this thin yellow layer. The color contrast between the two components enabled exact measurements of the thin layer. Replicas were cut into nine sections (Fig 2). One examiner measured the gap width at 8 points at the crown margin and at 9 points at the occlusal surface (Fig 2). The measurement at each point was done six times to minimize the measurement error. The mean value of these six measurements was used for further analyses. For each marginal and occlusal tooth surface, mean and maximum values were calculated. Descriptive statistical procedures were applied.

Results

A total of 30 patients received one posterior MZSC; 24 (80%) were female and 6 (20%) were male. The distribution between premolars and molars was nearly equal: 14 premolars (47%) and 16 molars (53%) were restored. Maximum distance values measured at the crown margin (mean: 0.150 mm, standard deviation [SD]: 0.099) were found to be smaller compared to those from the occlusal surface (mean: 0.155, SD: 0.096).

The range between minimum and maximum values was smaller for occlusal measurements than for marginal measurements. Details are shown in Table 1.

Table 1 Measurements of Distance (mm) Between Tooth Surface and Inner Crown Surface

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<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Standard deviation</th>
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<tr>
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<td>0.104</td>
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The mean values for the mean distance per tooth are in range with the CAD/CAM values.

Discussion

Unfortunately, there is no consensus as to how an acceptable clinical margin should be precisely defined.8 Reported values of acceptability vary between 50 and 200 μm;9–12 most authors usually accept a marginal fit between 100 and 140 μm.1,9 The present results are in this latter range. There are positive and negative deviations between the measured distances and the values set with the CAD/CAM machine, but these differences are expected and can be explained by unavoidable impression inaccuracies and transfer errors between the dental clinic and laboratory.

It is quite accepted that clinical fit is different with different ceramic systems,13 and variations within the same system have been described.1 There are several studies in which conventional full metal or porcelain-fused-to-metal crowns exhibit a better clinical fit compared to different all-ceramic systems.14,15 Despite these results, the same authors judge the clinical fit of all ceramic systems acceptable.

As expected, the distances measured in the present study are slightly higher compared to those measured with metal crowns in other studies. Based on previous interpretations, these differences can be judged as not clinically relevant.

There are no comparable clinical studies focusing on MZSCs, and comparisons are therefore difficult.1 Additionally, different measuring methods complicate the comparison of results. The silicone replica method is reliable to assess the in vivo adaptation of crowns to tooth surfaces.7 However, this method has its limitations, such as rupture of the silicone material and difficulties recognizing the crown margins. Despite this, the presented fit of MZSCs is comparable to other recent evaluations of the fit of single-tooth restorations.1

Fig 1 Silicone replica before evaluation. Light-body component (yellow) represents the gap between the crown and tooth.

Fig 2 Cutting lines and measuring points of silicone crown replicas.

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Conclusions

MZSCs showed acceptable marginal and occlusal fit found to be in the same range as single crowns from other materials. These results are promising.

Acknowledgments

This study was supported by the Degudent company. The authors report no conflicts of interest.

References


Literature Abstract

Intra- and Inter-Examiner Agreement when Assessing Radiographic Implant Bone Levels: Differences Related to Brightness, Accuracy, Participant Demographics, and Implant Characteristics

The purpose of this study was to evaluate intra- and inter-examiner agreement of radiographic marginal bone level (MBL) assessment around Brånemark single implants and agreement related to radiograph brightness, discrimination level (accuracy), participant demographics, and implant characteristics. A total of 74 participants assessed MBLs of 100 digital radiographs twice with normal brightness and twice with increased brightness. Cohen’s kappa was used to calculate intra-examiner agreement with and without increased brightness to the same thread and within one thread and inter-examiner agreement compared to the group (defined by the mode) for the first assessments with and without increased brightness to the same thread and within one thread. Relationships between agreement, thread discrimination level (accuracy), brightness, and participant and implant characteristics were explored. When assessing 100 “normal” radiographs twice, a participant on average assessed 24% differently from themselves (poor intra-examiner agreement, median κ 0.58, range 0.21–0.82) and 28% differently from other participants (poor inter-examiner agreement, median κ 0.53, range 0.05–0.80). Agreement within examiners improved when radiographs were “bright” (median κ 0.58 vs 0.62, P < .001, accuracy to same thread; median κ 0.94 vs 0.96, P < .001, accuracy within one thread). Agreement between examiners was neither better nor worse when radiographs were bright (median κ 0.53 vs 0.55, P = .84, accuracy to same thread; median κ 0.93 vs 0.93, P = .23, accuracy within one thread). Intra- and inter-examiner agreements were lower when accuracy to the same thread was required (P < .001 for both). Neither intra- nor inter-examiner agreement related to age, time since graduation, specialty, viewing device, implant experience, external hex familiarity, peri-implantitis treatment experience, or implant location or width was significant (P .05–.999). Intra-examiner agreement increased across dental assistants (n = 11), general dentists (n = 16), specialists (n = 47) (bright assessments: P = .045; median κ 0.55, 0.60, 0.65, respectively) and in women (n = 8, males = 58) (normal assessments, P = .019, median 0.68 vs 0.55), but the number of women included was low. Agreement within and between examiners when assessing MBLs was poor. Disagreement occurred around 25% of the time, potentially affecting consistent disease assessments. No participant or implant characteristic clearly affected agreement. Brighter radiographs improved intra-examiner agreement. Overall, perceived MBL changes below 1 mm are likely due to human, not biologic, variation.

—Terry Walton, Australia