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Influence of margin design on the fit of high-precious alloy restorations in patients

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KEYWORDS
Finishing line;
Marginal discrepancy;
Impression taking;
In vivo study;
Tooth preparation

Summary *Objective*. It was the objective of this study, to analyze the influence of the marginal design on the marginal accuracy of a casting in a clinical setup in patients.

Methods. Ninety volunteer patients' teeth—which were intended for extraction due to medical reasons—were prepared prior to extraction. Three different types of finishing line—chamfer, 135° shoulder and 90° shoulder—were employed.

Two each c-silicone and pvs impressions were taken of each tooth using either a two-stage or a one-stage putty-wash technique. After preparation and impression taking the teeth were extracted. Gypsum casts were poured from the impressions and high precious alloy castings fabricated on the dies and marginal discrepancies were determined on the extracted teeth.

Results. The median value of marginal discrepancies was lower than 150 μm for all groups. The difference between the three different preparation types was significant (*H*-test, $p<0.05$). The lowest median values were obtained for the chamfer preparations, while the 90° shoulders always produced the highest median values. Preparations at gingva level exhibited more accurate marginal fit than subgingival preparations. No significant differences could be observed between the pvs and c-silicone materials or the one-step and two-step putty-wash techniques.

Conclusions. The marginal designs of the preparations had much less influence on the marginal fit of high precious alloy castings than expected. There is considerable reason to assume that technical but clinical parameters influence the quality of fixed prosthodontics much more than has been believed in the past.

Introduction

The marginal fit of a (full) metal crown is a crucial factor claimed to affect the periodontal status of the tooth and longevity of the restoration.[1,2] Although it is generally accepted that the marginal errors should be minimized, very little information is available, in the real sense of evidence-based medicine, with regard to the relationship between marginal inaccuracy and longevity of the restoration. The geometry of the crown margin was the subject of many debates several years ago but this topic has faded out of the focus of interest in the current scientific discussion.

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The problems, associated with the quality of the crown margin, have remained the same. Overwhelming clinical evidence in daily practice shows that open crown margins are still common. Different marginal designs have been described and analyzed in laboratory studies.[3-9] Several studies have reported the effect of different margin designs, such as shoulder, chamfer and bevel preparations, on the marginal fit of a casting.[6,10-13] However, the results of these studies are partially contradictory, which may be due to the different study designs. Furthermore very often the target variables—though bearing the same name—differ extremely, e.g. Piemjai[11] defines the difference in the vertical heights of his crowns before and after cementation as 'marginal seating' which is completely different from the frequently used definition produced by Holmes et al.[14]

In general chamfer, bevel or 135° shoulder geometries are favored rather than the 90° shoulder,[15-17] though there is a lack of agreement regarding the ideal angle and length of the bevel or shoulder.[18,19] Some authors still regard the 90° shoulder preparation as the finish line of choice for all-ceramic restorations[20] as it resists occlusal forces well though it is not suitable for modern CAD/CAM technologies as these techniques are incapable of reproducing sharp angles.[21]

Nevertheless, clinical trials concerning the influence of the cross-sectional configuration (design) of the preparation margin on the quality of the impression and thus on the marginal accuracy of the crown are rare. This may be due to the fact that precise analysis of the marginal fit of a restoration is difficult in patients. Only accessible supragingival margins can be analyzed in vivo using a replication technique. In contrast, inaccessible subgingival margins cannot be quantified precisely in the patient's mouth.[22] Consequently, the latter marginal configuration can only be assessed precisely in the laboratory.

The only way to precisely determine the quality of subgingival margins is to prepare a tooth in the patient's mouth, take an impression and then extract the tooth to have it available for analysis under laboratory conditions.

Besides the potential influence of marginal design on the luting process,[11] the interactions between the marginal geometry and its reproduction during impression taking are worth discussing. As sharp line angles are always difficult to reproduce in an impression,[23] they may not be reproduced accurately. Also, moisture is a serious problem during impression taking in patients[24] especially where preparations are in close contact with the gingiva.

It was therefore the aim of this study to analyze the influence of marginal design on the marginal accuracy of a casting after taking impressions of subgingival preparations in the moist environment of patients' mouths.

Materials and methods

Clinical procedures

Adult patients with teeth planned for extraction due to medical reasons, were selected for this study. Teeth with high grades of mobility (III) or which had been damaged to extensively for preparation were excluded. The study-related treatment procedures were explained to the patients. According to the Helsinki Declaration, only those patients were included in the study who gave their informed consent.

Overall 90 teeth were prepared in two groups (group A: 30 teeth, group B: 2×30 teeth) by two independent investigators (experienced dental practitioners 5 years post-graduation) prior to being extracted in their respective dental offices. The investigator in group A had been trained to prepare chamfer preparations during his undergraduate studies and used this technique regularly since then. The dentist in group B had been trained to prepare shoulder (135°) preparations and also used this technique regularly. Both investigators worked independently and did not know each other. The preparation margin was created using one of the burs displayed in Fig. 1 (90° shoulder, 135° shoulder, chamfer) according to the definitions of

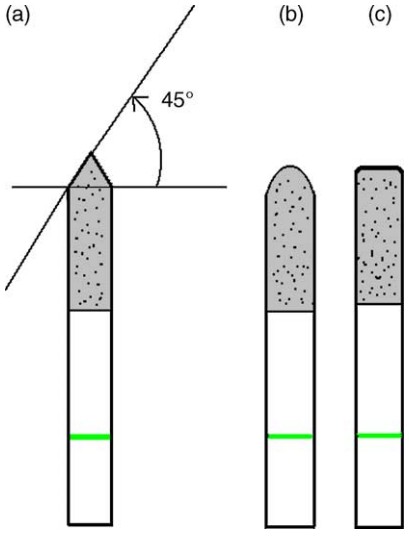

Figure 1 The three different types of diamond burs used to shape the geometry of the preparations.