

Analysis of Marginal Adaptation in Fixed Partial Dentures

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Abstract: Marginal discrepancy of crowns favors increase in microleakage that may cause pulpal inflammation. Besides, it may increase plaque retention leading to the onset of periodontal disease. Fit of restoration can be most easily defined in terms of "misfit," there are many different locations between a tooth and a restoration where these measurements can be made. The measurements of misfit can be made on different locations and geometrically related to each other such as internal gap, marginal gap, vertical marginal discrepancy, horizontal marginal discrepancy, overextended margin, underextended margin, absolute marginal discrepancy, and seating discrepancy. The best alternative is perhaps the absolute marginal discrepancy, which would be the largest measurement of error at the margin and reflect the total misfit at that particular point.

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I. Introduction

The marginal adaptation is one of the most important success criteria in full crown preparations, the factors which influence marginal adaptation are ceramic firing cycles, finish line configuration and the cementation protocol.

¹The inadequate marginal fit reduces longevity of the restorations due to reduced fracture strength, in addition to this there are greater chances of damage to the adjacent periodontium such as gingivitis, marginal caries and soft tissue recession.² The literature has proposed various value range for maximum accepted marginal gapwidth. Some define clinically acceptable values for marginal gap after cementation to be less than 150µm. While others consider only marginal values of less than 120µm to be within clinically acceptable limits.³ Marginal misfit can be measured at various points between the casting surface of the prepared restorations and the tooth⁴.

Suggested Nomenclature

The fit of a casting can be determined best in terms of the "misfit" measured at various points between the casting surface and the tooth. The measurements can be made between the castings and the tooth or from points along the internal surface, at the margin, or on the external surface of the casting.

Internal gap or Marginal Gap: The perpendicular measurement from the internal surface of the casting to the axial wall of the preparation is called the internal gap, and the same measurement at the margin is called the marginal gap.

Vertical Marginal Discrepancy: The vertical marginal misfit measured parallel to the path of removal of the casting is called the vertical marginal discrepancy.⁵

Horizontal Marginal Discrepancy: The horizontal marginal misfit measured perpendicular to the path of removal of the casting is called the horizontal marginal discrepancy. There is also the possibility of overextended or underextended casting margins.

An overextended margin is the perpendicular distance from the marginal gap to the casting margin.

An underextended margin is the perpendicular distance from the marginal gap to the cavosurface angle of the tooth.

The angular combination of the marginal gap and the extension error (overextension or underextension) is called the **absolute marginal discrepancy**.⁶ The angular combination of the vertical marginal discrepancy and the horizontal marginal discrepancy also defines the same absolute marginal discrepancy.

The absolute marginal discrepancy is measured from the margin of the casting to the cavosurface angle of the preparation. When no overextension or underextension is present, the absolute marginal discrepancy is the same

as the marginal gap.⁷ The absolute marginal discrepancy is the same as the overextension or underextension when no marginal gap is present.

Lack of seating of a casting as measured perpendicular to the path of removal by an arbitrary point (or points) on the external surface of the casting and tooth away from the margin is called the **seating discrepancy**.

Types of Marginal Misfit

A finite number of possible types of misfit exists if the marginal misfit is viewed as a combination of gap error and extension error.

Each of these categories of marginal misfit can pertain to any marginal configuration (beveled-shoulder, chamfer, or shoulder).⁸ Types of marginal misfit categorised as:

- No marginal gap with no overextension and underextension
- Marginal gap is present without any overextension or underextension
- Open marginal gap is present with overextension
- Open marginal gap is present with underextension
- No marginal gap is present but overextension is evident
- No marginal gap is present but underextension is evident

The casting margin and the cavosurface angle of the tooth would coincide in the perfectly fit castings. If the marginal dimension gap is zero it can still represent a poor fit with respect to the casting.⁹ For example, when a grossly overextended casting surface touch the cavosurface angle of the preparation there should be a perfect fit relative to marginal gap dimension. Although the margin would be closed (which is desirable), and it might lead to damaging effects on the gingival tissues due to plaque retention. On the other hand, a casting that was underextended it might also have a marginal gap dimension of zero but it would be less damaging to the gingival tissue, as it will not accumulate as much plaque, with better marginal fit.

Methods For Measurement of Marginal Fit

Marginal fit can be directly evaluated by visualization of the tooth/restoration interface.^{10,11} or indirectly, by seating the fabricated crowns on their respective tooth preparations.^{12,13} Marginal fit assessments can be qualitative or quantitative.

Visual inspection, probing and radiographic examination are qualitative methods. So, the marginal fit discrepancy can be classified with gauged probes or scales.¹⁴ The accuracy of these examinations is limited by the human visual acuity of 60 μm . For more precise evaluations it is mandatory to select an image magnification medium, a profile projector, or a microscope.^{15,16}

For more precise measurements high-powered microscope has been undoubtedly the most frequently used device for the marginal fit assessment.

A basic requirement for use of a microscope is to understand its mechanics. Images obtained with a microscope are within a specific focus plan, either perpendicular to the microscope objective or parallel to its stage. This means the specimen preparation and positioning are important. One method for the preparation of specimens is accomplished by sectioning a specimen at a certain plane. Specimens are usually placed and stabilised within a solid material or a fabricated jig, with their surfaces properly finished and polished after sectioning. This technique is comprised of two methods of evaluation: (1) sectioning of previously included specimens (restoration or tooth preparation)¹⁷ or (2) sectioning of elastomeric mold.¹⁸ This mold can include the entire interface of the inner space or only marginal areas. For non-sectioned specimens, marginal fit accuracy can only be examined with direct microscopic view of the interface between the margin of restoration and prepared tooth surface, but standardization is arduous.

Specific conditions are required so measurements for marginal fit can be repeatedly compared:

- (1) cervical margins of restorations and finish lines of tooth preparations must be clear and positioned at the same focal plane.
- (2) specimens should be reposition at the microscope x-y stage at the same dimensional position.
- (3) seating force must be standardized for the restorations seated on the prepared tooth.
- (4) Restorations should be stable while placed on their tooth preparation.
- (5) At least marginal fit should be measured thrice on three different points on each surface of fabricated restoration.

II. Summary

Further more studies will undoubtedly continue to measure fit in variety of ways. The nomenclature suggested here should serve as a starting point in that effort. The results of such studies can only be evaluated

relative to the specific method used to measure misfit. Although standardization of misfit measurement is probably not possible, clarification of nomenclature is required for consistency.

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