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Influence of explorer tip diameter in identifying restoration margin discrepancies

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Summary *Objectives*. Evaluations of the marginal adaptation of restorations in clinical trials rely on subjective assessments by evaluators. The purpose of the present study was to assess the use of dental explorers with different tip diameters to detect simulated marginal discrepancies.

Methods. Using three devices simulating vertical steps, horizontal gaps, and the combination of vertical and horizontal discrepancies and explorers with five different tip diameters, 10 experienced dental faculty members were asked to identify discrepancies at the boundary between Alfa (replacement unnecessarily) and Bravo (replacement questionable) ratings, according to modified United States Public Health Service criteria.

Results. A significant correlation was found between the tip diameters of the explorers and the Alfa/Bravo boundaries for the horizontal gaps, but not for the vertical steps.

Conclusion. It was concluded that the tip diameter of dental explorers had no significant effect on the detection of vertical steps, but had a significant effect on the detection of horizontal gaps. The diagnosis of restoration marginal discrepancies and the rating of marginal adaptation in clinical trials may subsequently be found to be best achieved using techniques other than the probing of restoration margins.

Introduction

Accurate evaluations of the marginal qualities of restorations included in clinical trials are considered important in identifying the risk of future failure, and in decisions to apply replacement, refurbishment and repair procedures-posterior composites with clinically detectable marginal discrepancies having been found to be more likely to fail than posterior composites considered clinically to have ideal marginal adaptation [1]. Modified United States Public Health

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Table 1 Modified USPHS criteria for marginal adaptation.

Alfa	The restoration appears to adapt closely to the tooth along the periphery of the restoration. An explorer does not catch when drawn across the margins, or, if it does catch it will only catch in one direction and no crevice is visible.
Bravo	The explorer catches and there is visible evidence of crevice into which the explorer will penetrate. However, neither dentin nor the base is visible.
Charlie	The explorer penetrates into a crevice that is of such depth that dentin or base is exposed.
Delta	The restoration is fractured, mobile or missing.

Raskin et al. (1999) Clinical Evaluation of a Posterior Composite 10-year Report. J Dent.

Service (USPHS) criteria [2] an example of which is detailed in Table 1 [3] have been used widely in the assessment of restorations included in clinical evaluations of restorative materials. These criteria involve visual inspection and use of a dental explorer for the evaluation of the marginal adaptation of restorations, according to four ratings: Alfa (A), replacement unnecessary; Bravo (B), replacement questionable; Charlie (C), replacement for preventive reasons; Delta (D), immediate replacement. The accuracy of the application of modified USPHS criteria and the resultant ratings may, however, be questionable since the detection of marginal discrepancies relies on many factors, including the visual acuity, manual dexterity and sensitivity, technique and the experience of individuals recruited to clinical studies to evaluate restorations at review recalls.

In a previous study, the quality of evaluations of marginal adaptation was assessed by analyzing the distribution of marginal steps in 435 posterior composites, rated according to modified USPHS criteria.[4] The maximum marginal step height was measured for each restoration by means of a digital step-height instrument. The results revealed an overlap in maximum marginal step heights for restorations with Alfa and Bravo ratings in the range of 101–321 μm. It was recommended that current methods of evaluating the marginal qualities of restorations should be improved to provide a reliable and reproducible distinction between clinical ratings. Such distinction is important clinically as a restoration with a detectable marginal discrepancy is likely to fail sooner than a restoration with ideal marginal adaptation.[1] Therefore, an approach to making existing clinical criteria more meaningful should contribute to more reliable decision making in the in-service evaluation of restorations.

A significant correlation between the detection of steps and the sharpness of the tip of a dental explorer has been reported.[5] It was concluded that an explorer with a sharp tip could detect a small vertical step with significant accuracy; however, the appropriate sharpness for the explorer was not established. Therefore, standardization of the sharpness of explorers to be used in assessments of the marginal adaptation of restorations may, as anticipated in part by Rappold et al.,[5] be effective in minimizing the overlap between Alfa and Bravo ratings as reported previously.[4]

The present series of studies was undertaking to establish a reliable, reproducible method to be used clinically to evaluate the marginal adaptation of restorations, primarily in clinical evaluations and possibly subsequently in everyday clinical practice. The purpose of the present study was to assess the use of dental explorers with different tip diameters to detect simulated marginal discrepancies. The present study was designed to test the hypothesis that the use of dental explorers of different tip diameter may have a significant effect on evaluator's ability to detect marginal discrepancies as observed in clinical trials.

Methods and materials

Devices for simulating marginal discrepancies were developed from the device reported by Rappold et al.[5]. In the present study, three devices simulating a vertical step, a horizontal gap and the combination of both a vertical step and a horizontal gap of increasing size were constructed from precisely milled metal plates attached to a metal base (Fig. 1). The plates were positioned next to each other so that the vertical and/or horizontal distance between them increased from 0 μm at the origin to 270 μm. The edges of the plates were sharp right angles with the discrepancies between the plates increasing continuously at the rate of 2 μm per mm. The size of a discrepancy in microns at any point could be determined by measuring the distance (mm) from the origin, by means of a precision ruler and doubling the value. The three devices were manufactured to a very high