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Effect of apical root resorption on periodontal support

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The occurrence of apical root resorption has been a concern to orthodontists as well as restorative dentists in evaluating teeth planned for restorative and prosthetic therapy. Ketcham¹ reported in 1929 that a large number of individuals who underwent orthodontic therapy exhibited loss of root structure. Mechanical, nutritional, or endocrine factors have been implicated^{2,3} as have occlusal forces,⁴ tooth malposition,⁵ trauma,⁶⁻⁸ and genetic factors.⁹

Clinical studies designed to evaluate the incidence of root resorption in humans have demonstrated a wide

variance of results.⁹⁻¹¹ Several studies have attempted to confirm the degree of susceptibility to root resorption exhibited by individual teeth. Maxillary incisors are the most affected, followed by maxillary second premolars, maxillary lateral incisors, and maxillary first premolars.^{9,12} Other investigators evaluating teeth treated orthodontically have found different frequencies of resorption.^{2,3,12,13}

Regardless of the etiology of the resorption or the location of the tooth, the presence of root resorption may play an important role in the treatment planning for a patient requiring prosthetic rehabilitation.¹⁴⁻¹⁶

Attempts have been made to calculate the periodontal attachment area for specific teeth. Mathematical formulas applied to geometric shapes¹⁷ and modifications of

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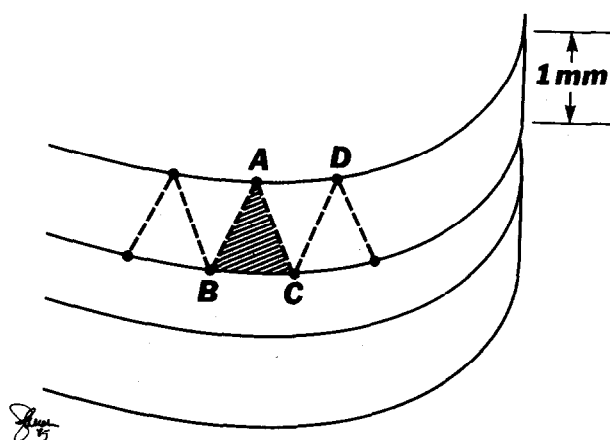


Fig. 1. Diagrammatic representation of root surface area calculations by computer-generated graphics.

surface measurement techniques have been used to calculate attachment area.¹⁸⁻²⁰ Recent developments in computer-assisted analysis have allowed authors to simulate the average anatomic configuration of teeth and calculate the periodontal attachment area.²¹⁻²³

The purpose of this study was to use a computer-generated graphics system to analyze the amount of periodontal attachment area lost secondary to apical root resorption.

METHODS

Cross-sectional shapes and dimensions of a right maxillary central incisor were calculated at 1 mm increments and stacked to provide silhouettes of the tooth by using computer graphics.²³ Digitized outlines, incremented at 30 degrees, were viewed at six different profiles. Calculations representing tooth loss commenced at the tooth apex and were computed at 1 mm increments to the cemento-enamel junction.

Areas were calculated for triangles on the surface of each section. As demonstrated in Fig. 1, the triangular areas were found by taking one point on the top level and two points on the bottom level (*ABC*) or two points on the top level and one on the bottom (*ACD*). Because all coordinates ($X_A, Y_A, Z_A; X_B, Y_B, Z_B; X_C, Y_C, Z_C$) are known, the side lengths can be obtained by the calculation:

$$AB = [(X_A - X_B)^2 + (Y_A - Y_B)^2 + (Z_A - Z_B)^2]^{1/2}$$

Denoting the side length of a triangle by ℓ_1, ℓ_2, ℓ_3 , its area can be calculated:

$$\text{Area} = [s(s-\ell_1)(s-\ell_2)(s-\ell_3)]^{1/2}$$

when $s = (\ell_1 + \ell_2 + \ell_3)/2$

RESULTS

The relationship of the root resorption to the percentage of remaining periodontal attachment area is demonstrated in Table I.

Table I. Relationship of root resorption and percentage of remaining periodontal attachment area (maxillary right, central incisor)

Vertical root resorption from apex (mm)	Periodontal attachment area remaining (%)
0	100.00
1	96.90
2	92.70
3	87.10
4	80.70
5	73.50
6	65.60
7	57.30
8	48.50
9	39.40
10	29.80
11	20.10
12	10.30
13	0.00

DISCUSSION

The maxillary central incisor was chosen as a model for this study because of its susceptibility to apical root resorption.^{9,12} It is assumed that the results would be similar for other teeth with a single conical root. The model appears to be compatible with the system used by Levy and Wright.²² They evaluated the effect of marginal bone loss on periodontal attachment levels of mandibular first premolars and found that 50% of the attachment area was lost when approximately 40% of the coronal alveolar bone support was removed. These findings are almost identical to those presented in Table I where it is demonstrated that 50% of the periodontal attachment area remains when slightly less than 5 mm (38.5% of bone height) of coronal support is intact.

PRACTICAL SIGNIFICANCE

Practical application of these findings should be considered on a relative basis during prosthetic treatment planning. Dentists should remember that apical resorption of the root is much less critical in its effect upon the area of remaining periodontal support than is loss of alveolar support at the coronal margin secondary to periodontitis. In the initial stages of root resorption and crestal bone loss, 3 mm of root resorption is approximately equivalent to 1 mm of crestal bone loss. Following more than 2 mm of loss, the ratio is closer to 2 mm of root resorption equalling 1 mm of crestal loss.

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Rubber dam isolation in a difficult situation

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Isolation of the distobuccal surfaces of molar teeth in the cervical third with the rubber dam is not always possible because of the cervical extent of the caries and the instability of the clamp (retainer). This article reports a modification of a rubber dam retainer that increases the potential for isolating teeth in these difficult locations.

MODIFICATION OF THE RETAINER

A W8ARE rubber dam retainer (Ivory; Columbus Dental, Columbus, Ohio) was chosen for modification

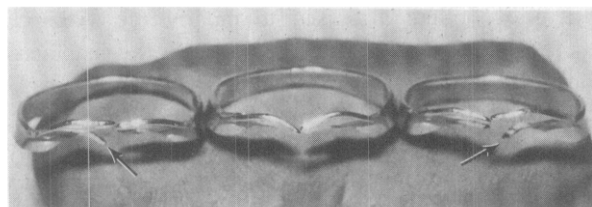


Fig. 1. Right and left are modified W8ARE retainers (arrows). Center retainer is left unmodified as comparison.

because it fits well on most mandibular and maxillary molar teeth. The RE series of rubber dam retainers has a greater angle between the bow and the jaws of the retainer that enables greater access for operating on the distal surface of the tooth being treated.¹

Bird-beak orthodontic pliers and standard square-

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