Grossmann Y, Sadan A. The prosthodontic concept of crown-to-root ratio: A review of the literature. J Prosthet Dent 2005; 93:559-62. (45 refs.**)**

Purpose: The purpose of this article was to review crown-to-root ratio assessment and criteria for evaluation of periodontally compromised teeth as abutments.

Materials and Methods: Literature review via Medline key word search.

Findings: The crown-to-root ratio (CRR) represents the biomechanical concept of class I lever for evaluating abutment teeth. The ratio is defined as "the physical relationship between the portion of the tooth within the alveolar bone compared with the portion not within the alveolar bone, as determined radiographically." The fulcrum, or center of rotation, of the Class I lever is in the middle portion of the root that is embedded in alveolar bone. The CRR may increase over time, primarily as a result of loss of alveolar bone support; the crown portion of the fulcrum (effort arm) would then increase, and the root portion (resistance arm) would decrease. The center of rotation moves apically, and the tooth is more prone to the harmful effect of lateral forces. The CRR definition has several inherent shortcomings. The ratio is based on linear measurements only. When clinically evaluating abutment teeth, the status of the alveolar bone height and the total supported root surface of the abutment tooth should be examined. The CRR does not express the actual area of bone support, and therefore, might underestimate the severity of bone loss around the abutment. The radiographic evaluation of CRR should be based on periapical radiographs.

A prosthodontic textbook considers a CRR for an FPD abutment of 1:2 to be ideal, but in practice this is rarely observed and this ratio is based on studies of periodontally healthy subjects. Teeth with a normal amount of bone support should be used for abutments and teeth with loss of more than 1/3 of the periodontal support should be of questionable value. A ratio of 1:1.5 has been suggested as an acceptable and desirable CRR for abutments, although a 1:1 ratio may be a minimum acceptable ratio when the periodontium is healthy and the occlusion is controlled.. If the opposing occlusion is composed of tissue-supported prosthesis, a CRR greater than 1:1 might be adequate because of the diminished occlusal forces.

Clinical procedures directly affect the CRR. Abutment preparation for overdentures has the most dramatic effect on the ratio, reducing the crown to 1-2 mm above the free gingival margin, which can improve the CRR from 1:1 to 1:3. The decrease in crown height shortens the corresponding lever arm length, and therefore, less lateral force is applied to the attachment apparatus, with an apparent reduction in the abutment horizontal mobility. Any increase in the vertical dimension of occlusion (VDO) increases the CRR. Surgical crown lengthening also increases the CRR. Forced eruption is preferred to because it preserves the biologic width and, at the same time, provides better CRR.

The prosthodontic concept of splinting teeth, especially abutments, evolved from the need to compensate for the increased CRR. Splinting abutments may enhance stability and may shift the center of rotation and transmit less horizontal force to the abutments. Studies had found that increasing the number of splinted teeth does not provide a proportional decrease in maximum stress levels. For a cantilever FPD with either normal periodontal support or a distal abutment with a moderate degree of mobility and bone loss, the occlusal forces were significantly distributed to only the 3 teeth closest to the loaded cantilever and increasing the number of splinted abutments beyond 3 did not result in a proportional reduction of stress in the periodontium. No objective criteria were identitfied in the literature to define the need or extent of splinting in relation to the abutment CRR, and the effect of splinting on abutment longevity has not been established.

The primary objective in evaluating clinical criteria for abutments and periodontally compromised teeth is to determine the best prognosis. McGuire and Nunn evaluated 100 periodontally treated patients (2,484 teeth) under maintenance care for 5 years to determine the relationship of assigned prognoses to the clinical criteria commonly used in the development of prognosis. The authors classified teeth as having either a favorable or unfavorable CRR, although no numeric measurement was mentioned. Unsatisfactory CRR and teeth used as fixed abutments were among the clinical

factors that resulted in worse initial prognosis. They were able to accurately predict the 5-year prognoses 81% of the time. None of the examined factors, including the CRR, was significant in worsening the prognosis; the assignment of prognosis was ineffective for teeth with an initial prognosis of less than “good.”

Conclusion: As a suggested clinical guideline for the evaluation of abutment teeth, the clinician should use the CRR only with other multiple clinical parameters, such as abutment mobility, total alveolar bone support, root configuration, opposing occlusion, presence of a parafunctional habit, pulpal condition, presence of endodontic treatment, and the remaining tooth structure.