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EVALUATION OF ABUTMENTS IN FIXED PARTIAL DENTURE

BY

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Abstract

The evaluation of abutments in Fixed Partial Dentures (FPD) is a crucial step in determining the long-term success and stability of the prosthetic restoration. Abutments, as the anchoring components of an FPD, bear the functional load and contribute significantly to the overall performance of the restoration. Proper evaluation ensures that the selected abutments can withstand masticatory forces, maintain periodontal health, and provide esthetic satisfaction.

and aesthetic success of the fixed partial denture, minimizing the risk of complications and

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INTRODUCTION

enhancing the overall patient outcome.

The evaluation of abutments in FPDs is a multifactorial process that involves assessing tooth health, occlusal forces, periodontal status, and esthetic demands. A comprehensive evaluation allows for the selection of suitable abutments that ensure the functional stability, longevity,

Fixed partial dentures (FPDs) have been the preferred solution for replacing missing teeth for many years. The dental literature includes around 7,000 articles on FPDs, yet only a small portion focus on patients' perceptions of clinical outcomes and their overall satisfaction with FPD treatment. Edentulism and dental disease can have significant negative effects on patients, often leading to a diminished self-image. Individuals with dental issues may be perceived as socially less competent or intellectually inferior. Furthermore, dentofacial concerns are known to impact a patient's satisfaction with their dentition, as these issues affect aesthetics, performance, and function. (1)

A fixed partial denture (FPD) is a dental restoration designed to replace missing teeth, which is permanently secured to the neighboring natural teeth or dental implants. The adjacent teeth or dental implants, known as abutments, serve as the supports for the FPD bridge. An FPD unit consists of three main components: the pontic, the retainer, and the connector, which are all securely joined together. (2)

TYPES OF ABUTMENTS IN FIXED PARTIAL DENTURE

- 1. Natural tooth abutments
- 2. Implant supported abutments

An abutment is defined as a tooth, root, or implant that provides support and/or anchors a fixed or removable prosthesis.

Natural teeth should be preserved whenever possible, as they serve as the ideal abutments in the oral cavity. However, periodontal disease and other conditions can weaken the teeth, leading to the loss of tooth structure. In such cases, dental implants may be used as replacements.

A dental implant is an alloplastic material or device that is surgically placed into the oral tissue, either beneath the mucosal or periosteal layer, or directly into the bone, for functional, therapeutic, or aesthetic purposes.(3)

FACTORS AFFECTING **ABUTMENT EVALUATION DIAGNOSTIC CASTS**

Diagnostic casts must be accurately positioned to align with the transverse hinge axis and the plane of occlusion on an articulator, simulating the eccentric movements that occur in the oral cavity. This procedure allows for a straightforward assessment and correlation of the occlusal relationship between both dental arches and the abutment teeth. It also makes it easy to identify rotated teeth. The position and contour of the abutment teeth, as well as their occlusion with the opposing teeth, can be clearly observed.(4)

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RADIOGRAPHIC EVALUTION

Periapical and bitewing radiographs are crucial for selecting appropriate abutment teeth. In some cases, additional images, such as TMJ radiographs for patients with temporomandibular joint dysfunction, or a panoramic radiograph, may also be helpful.

An intraoral radiographic examination provides the following information:

- Remaining bone support
- Root characteristics, including number, shape (e.g., long, short, slender, broad, bifurcated, fused, dilacerated), and proximity of roots
- Quality of supporting bone, including trabecular patterns and any changes due to functional forces
- Width of the periodontal ligament space and evidence of trauma from occlusion (TFO)
- Areas of vertical and horizontal bone loss, including furcation involvement
- Axial inclination of teeth (degree of nonparallelism, if present)
- Integrity and continuity of the lamina dura
- Pulpal anatomy and any prior endodontic treatment, with or without post and core restorations
- Presence of apical pathology, root resorption, or fractures
- Retained root fragments, radiolucencies, calcifications, foreign bodies, or impacted teeth
- Carious lesions, condition of existing restorations, and their proximity to the pulp
- Proximity of carious lesions or restorations to the alveolar crest (5)

CROWN ROOT RATIO

The crown-to-root ratio (CRR) measures the length of the tooth above the alveolar bone crest (occlusal to the crest) compared to the length of the tooth embedded in the bone. As the level of the alveolar bone moves apically, the lever arm of the tooth increases, which in turn raises the risk of harmful lateral forces. According to a prosthodontic textbook, an ideal CRR for a fixed partial denture (FPD) abutment is 1:2, though this is rarely observed in practice. An optimal CRR for an abutment is considered to be 2:3, with a 1:1 ratio being the minimum acceptable under normal conditions.(13) However, the CRR definition has limitations, as it relies solely on linear measurements. When evaluating abutment teeth, clinicians should also consider the height of the alveolar bone and the overall root surface area of the abutment tooth. Dykema suggested that a CRR of 1:1.5 is both acceptable and desirable for abutments, though this ratio may still be viable if the periodontium is healthy and occlusion is properly controlled. The longer the edentulous span and the greater the torque on the abutment teeth, the more favorable the CRR needs to be. In some cases, the use of multiple abutments can help compensate for poor CRR or a long edentulous span.(6)



ARCH FORM

The shape of the dental arch plays a crucial role in how occlusal forces are distributed. Different sections of the arch subject the teeth to varying types of forces. The direction of the buccolingual movement differs between the anterior and molar teeth, which are angled differently. When forces are applied to the pontics, the abutment teeth may experience rotational forces. The edge of a fixed partial denture (FPD) faces a vertical force. In this context, the fulcrum is defined as the point where the proximo-occlusal angle of the tooth preparation meets the line connecting the abutments adjacent to the span of missing teeth. The maximum lifting force occurs when replacing anterior teeth in a narrow, tapered arch. One way to minimize this force is by shortening the lever arm, which can be achieved by using multiple abutment teeth. For example, in a canine FPD, the first premolars may be used as secondary abutments.(8)



Secondary retention(R) must extend a distance from the primary inter-abutment axis equal to the distance that the pontic lever arm(P) extends in the opposite direction

BUCCOLINGUAL DIMENSION OF TOOTH

The occlusal surface of the pontics should align with the buccolingual dimensions of the natural, intact teeth, replicating the normal buccal and lingual contours up to the

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height of contour. Reducing the width of the pontics does not decrease the forces transferred to the abutments; instead, it results in increased stress per unit on the prosthesis.(9)



OCCLUSAL ANATOMY

Occlusal anatomy indirectly affects the loads transmitted during mastication. Ridges and grooves enhance the sharpness and shearing action of teeth, minimizing friction between opposing surfaces by reducing the contact area. This allows for more efficient chewing and less load transmission. Stallard notes that worn-down teeth require more muscle power and longer, more frequent masticatory strokes to adequately chew food. Much of this force is directed perpendicular to the long axis of the teeth. Properly articulated cusps on ridge-bearing teeth cut food quickly, requiring fewer strokes and less muscular effort, while directing most of the closure forces along the long axis of the teeth.(10)



ROOT CONFIGURATION

Roots that are broader labiolingually than mesiodistally are preferable to those with a round cross-section. Multirooted posterior teeth with widely spaced roots provide better periodontal support than teeth with short, converging, fused, or conically shaped roots. While a tooth with conical roots can serve as an abutment if other factors are ideal, a single-rooted tooth showing some irregularity or curvature in the apical third of the root is preferred over one with a nearly perfect taper. (13) Irregularly shaped, multiple, and divergent roots generally offer a better prognosis. Additionally, a well-aligned tooth provides better support than a tilted one, and alignment can often be improved with orthodontic treatment.(11)



Roots that are broader labiolingually than they are mesiodistally are preferable to roots that are round in cross section



Multirooted posterior teeth with widely separated roots will offer better periodontal support than roots that are short and converge

ROOT SURFACE AREA

In 1926, ANTE suggested that it is inadvisable to provide a fixed partial denture (FPD) when the root surface area of the abutment is smaller than that of the teeth being replaced. This principle has been adopted and further emphasized by other authors, including Johnston, Dykema, Shillinburg, and Tylman, and is known as ANTE's LAW.

ANTE's LAW (1926), proposed by Irwin H. Ante, states that "the total pericemental area of all abutment teeth supporting a fixed partial denture should be equal to or greater than the pericemental area of the tooth or teeth being replaced."(12)

When the periodontal surface area of the abutments is insufficient, multiple abutment teeth may be needed, depending on other biomechanical factors. Additionally, the total mesiodistal width of the cusps of the abutments should equal or exceed the width of the cusps of the teeth being replaced. This ensures that the occlusal load placed on the abutment teeth will not exceed twice the amount of stress they would typically bear individually. Larger teeth, with their greater surface area, are better able to handle the added forces.(7)



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Contraindication to ANTE's Law:

Newman and Ericsson stated that reduced bone support can still be successfully used for FPD abutments. In fact, many treatments described by various authors involved abutment root surface areas that were less than half the size of the teeth being replaced. Results: No loss of attachment was observed after 8–10 years. The success was attributed to thorough root planing during the active treatment phase, effective plaque control throughout the observation period, and the appropriate occlusal design of the prosthesis.

The study reported a FDP survival rate of 97.6% after five years and 92.9% after ten years, which was comparable to the survival rates of FDPs with abutments that met the requirements of Ante's Law.

A study on stress distribution in teeth and supporting structures of fixed prostheses with either normal or reduced bone support (using FEA analysis) concluded that when periodontally compromised abutment teeth were splinted with an additional abutment, an increase in stress was observed in the periodontally compromised abutments. Therefore, the study suggested that an additional abutment is not necessary. Even though the combined pericemental area of the compromised abutments with an additional canine abutment was larger than the total pericemental area of the pontics being replaced, the stress generated was higher on the abutments. This finding contradicts Ante's Law.(12)

PERIODONTAL DISEASES

After horizontal bone loss due to periodontal disease, the root surface area supported by the periodontal ligament (PDL) can be significantly reduced. Because most roots are conical in shape, when one-third of the root length is exposed, nearly half of the supporting area is lost. Additionally, the forces applied to the supporting area are altered due to the increased leverage created by the longer clinical crown. Therefore, potential abutment teeth must be carefully evaluated when significant bone loss has occurred.

In general, successful fixed prostheses can be fabricated on teeth with severely reduced periodontal support, provided the periodontal tissues are restored to optimal health and longterm maintenance is assured. Without this, the outcomes are likely to be poor. Healthy periodontal tissues are essential for the success of any fixed restoration. If the abutment teeth have normal bone support, occasional lapses in plaque control by the patient are unlikely to affect long-term prognosis. However, when severely periodontally compromised teeth are used as abutments, there is little room for error.(11)

CONCLUSION

The evaluation of abutments is a critical step in the success of Fixed Partial Dentures. Proper assessment ensures optimal support, stability, and longevity of the prosthesis. Key factors such as the periodontal health, crown-root ratio, root configuration, bone support, and alignment of potential abutment teeth must be thoroughly considered. By carefully analyzing these criteria, clinicians can make informed decisions that enhance both function and esthetics, ultimately leading to predictable and successful prosthodontic outcomes.

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