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RESEARCH ARTICLE

INFLUENCE OF ABUTMENT EVALUATION ON DESIGNING OF FIXED PARTIAL DENTURE: A NEW STUDY.

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Abstract

Fixed partial denture (FPD) substitution for teeth have taken a assortment of designs throughout the years. Many corpus involved in the preparation and construction of fixed prostheses are still dominating, although more compatible and resilient materials have been introduced in recent years. FPD transmits forces through the abutment to the periodontium. Failures are due to poor engineering, use of improper material, inadequate tooth preparation and faulty fabrications. Therefore, it is important to select abutment in FPD. The clinicians must recognize the forces developed by the oral mechanism and the resistance of the tooth and its supporting structures to them.

Objective: The purpose of the current study was to evaluate clinical, radiographic and mounted study cast assessment of the abutment on designing of fixed partial denture.

Conclusion : In the above discussion diverse guides have been suggested for option and construction of fixed partial dentures that should withstand the forces of oral function with maximum service. Abutments bear the stresses of mastication and the choice of abutment influences the prognosis of treatment. To conclude, the importance of selecting a suitable abutment for a fixed partial denture cannot be overemphasized. It forms the preliminary treatment planning for fixed partial dentures whose proper selection and preparation aids in long term durability of the restoration.

Introduction:-

Substitute of missing teeth exemplify the tumid category among patients in clinics who are looking for great esthetic and/or functional teeth.[2] The fixed partial denture (FPD) is one of the most commonly favour definitive treatment options for a single missing tooth.[1] For many years, FPDs were deliberate to be the best treatment prime for replacing a single missing tooth. Fixed prosthodontics treatment can scope from the restoration of a single tooth to the rehabilitation[3]. Single teeth can be restored to entire function, and betterment in cosmetic effect can be achieved.[12] Missing teeth can be replaced with prostheses that will improve patient comfort and masticatory efficiency, maintain the health and integrity of the dental arches.[21] Every restoration must not be able to withstand the occlusal forces to which it is subjected. This is to particular significance when designing and fabricating a FPD since the forces that would normally be absorbed by missing tooth are transmitted through the pontic, connectors, and retainers.[10] Abutment teeth are called on to withstand the forces normally directed to the missing plane teeth, in addition to those usually applied to the abutments. The replacement of the missing teeth in the posterior region is

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equally important as in the anterior segment of the mouth.[11,12,15,19] It is significant to determine the absolute need to fill a space and to perform a cost–benefit analysis for any designed restoration - not only in commercial terms but also in biological value to tooth structure and the surrounding tissues.[17] The maximum number of posterior teeth that allows replacing with a FPD is usually two. In rare circumstances, three can be replaced, but that should be attempted only under ideal conditions. As abutment selection places an important role in the success of fixed prosthesis, this review invigilates the evaluation of factors influencing abutment selection for FPD.[5,6,7,8]

Factors affecting abutment selection-

Diagnostic cast

Precise diagnostic casts must be correctly oriented to the transverse hinge axis and the plane of occlusion on an articulator to permit eccentric motion similar to those that take place in the mouth. Rotated and malposed teeth can be well observed. The shape and contour of prospective abutment teeth and the gingival tissues can be visualized as well as the alignment and contacts of opposing teeth.[14] This procedure provides a simple evaluation of the occlusal relationships of the dental arches and the abutment teeth.

Roentgenographic Examination

Periapical and bitewing films are most essential in selection of abutment teeth. On occasion additional views, such as TMJ radiographs for patients with TMJ dysfunction and panoramic radiograph can also be useful.[13,26] An intraoral radiographic examination reveals:

1. Remaining bone support.
2. Root number and morphology (long, short, slender, broad, bifurcated, fused, dilacerated etc.) and root proximity.
3. Quality of supporting bone, trabecular patterns and reactions to functional changes.
4. Width of periodontal ligament spaces and evidence of TFO
5. Areas of vertical and horizontal osseous resorption and furcation invasions
6. Axial inclination of teeth(degree of non parallelism if present)
7. Continuity and integrity of lamina dura.
8. Pulpal morphology and previous endodontic treatment with or without post and cores.
9. Presence of apical disease, root resorption or root fractures.
10. Retained root fragments, radiolucent areas, calcifications, foreign bodies or impacted teeth.
11. Presence of carious lesions, the condition of existing restorations, and proximity of carious lesion to the pulp.
12. Proximity of carious lesions and restorations to alveolar crest.
13. Calculus deposits.

Crown – Root Ratio

This ratio is a measure of the length of tooth occlusal to the alveolar crest of bone compared with length of root embedded in bone.[9,1,12,14] As the level of alveolar bone moves apically, the lever arm of that portion out of bone increases, and the chance for harmful lateral forces is increased. The optimum crown- root ratio for tooth to be utilized as a fixed partial denture abutment is 2:3. A ratio of 1:1 is the minimum ratio that is acceptable for a prospective abutment under normal conditions (such as number of teeth being replaced, tooth mobility and overall periodontal health is good) However there are situations where a crown –root ratio of greater than 1:1 might be considered adequate. If the occlusion opposing a proposed FPD is composed of artificial teeth, occlusal force will be diminished with less stress on the abutment teeth. The occlusal force exerted against prosthetic appliance has shown to be considerably less than that against natural teeth, 20lb for RPD and 54.5lb for FPD versus 150lb for natural teeth (*Klaffenbach A.H – 1936)* For the same reasons, an abutment tooth with less than desirable crown – root ratio is more likely to successful support a FPD if opposing occlusion is composed of mobile, periodontally involved teeth than if the opposing teeth are periodontally sound. The crown- root ratio alone is not adequate criteria for evaluating a prospective abutment tooth (*Penny, Kraal – 1979*) The longer the edentulous span and the grater the torque on the abutment teeth, the more favorable the crown- root ratio must be. The use of multiple abutments can sometimes compensate for poor crown- root ratio or for long spans. Optimum C: R ratio is 2:3. A ratio of 1:1 is minimum in FPD abutment that is acceptable.

Periodontal Surface Area

Introduced by Ante (1926) and later by Johnston *et al.*(1971). The combined pericemental area of the abutment teeth should be equal to or greater to the pericemental area than the teeth to be replaced (Ante's Law). In the case, where the periodontal surface area is inadequate, the multiple teeth abutment is indicated depending on other

biomechanical factors. The total mesiodistal width of the cusps of abutments should equal or exceed the width of the cusps of points. This relationship assures that the occlusal load transmitted to the abutment teeth will not be more than twice the amount normally supported by these teeth individually. Larger teeth have greater surface area and are better able to bear added stresses. The areas of various teeth are reported by Marcum.[13,14,15,17,10]

Root Surface Area (Mm2) Maxillary Mandibular

1. Central Incisor 204 (10%) 154(8%)
2. Lateral Incisor 179(9%) 168(9%)
3. Canine 273(14%) 268(15%)
4. I Premolar 234(12%) 180(10%)
5. II Premolar 220(11%) 207(11%)
6. I Molar 433(22%) 431(24%)
7. II Molar 431(22%) 426(23%)

Newman and Ericsson however cast a doubt on the validity of Ante's Law by demonstrating that teeth with considerably reduced bone support can be successfully used as FPD abutments. The majority of treatments presented by these authors had an abutment root surface area less than half that of replaced teeth and there was no loss of attachment after 8-10 years. They attributed this success to meticulous root planing during the active phase of treatment, proper plaque control during the observed period and the occlusal design of the prosthesis. The total mesiodistal width of the cusps of abutments should be equal or exceed the width of cusps of pontics. This relationship assures that the occlusal load is transmitted to the abutment teeth will not be more than twice the amount normally supported by these teeth individually. Most healthy organs are considered to have a reserve capacity equal to at least to their normal functional requirement. As a clinical guideline, there is some validity in the concept referred to as ANTE's LAW. FPD with short pontic spans have a better prognosis than do those with excessively long spans. It would be an oversimplification to attribute this merely to overstressing of the PDL, however, failures from abnormal stress have been attributed to leverage and torque rather than overload (Kaffelbach). Biomechanical factors and material failure play an important role in potential for failure of long span restorations. There is evidence that teeth with very poor periodontal support can serve successfully as FPD abutments in carefully selected cases. Teeth with severe bone loss and marked mobility have been used as FPD and splint abutments. Elimination of mobility is not the goal in such cases, but rather the stabilization of the teeth in a status quo to prevent an increase of mobility (Lindhe 1975). Abutment teeth in these situations can be maintained free of inflammation in the face of mobility, if the patients are well motivated and highly proficient in plaque control (Lindhe- 1975). Crowns that anchor rigid prosthesis to mobile teeth do require greater retention than do crowns attached to relatively immobile abutments. Follow up studies of these patients with "terminal dentitions" indicate a surprisingly low failure rate- less than 8% of 332 FPD exhibited technical failures in time span that averaged slightly more than 6years. What is the imprint of the success of this type of treatment on FPD for the average patient? The successful restoration of mouths with severe periodontal disease does have significance in everyday practice. It emphasizes the extreme importance of carefully evaluating the strengths and weaknesses of the remaining dentition on an individual basis.[21,22,23,24,25,1]

Root Proximities

There must be adequate clearance between the roots of proposed abutments to permit the development of physiologic embrasures in completed prosthesis. Malpositioned anterior teeth and the mesiobuccal roots of maxillary molars often present unfavorable root proximities where desired embrasure form is not possible. Selective extraction or root resection procedures maybe only solution to root proximity.[7]

Periodontal Disease

After horizontal bone loss from periodontal disease the PDL – supported root surface area can be dramatically reduced. Because of conical shape of most roots, when one third of root length has been exposed, half the supporting are is lost. In addition, the forces applied to supporting area are modified because of greater leverage associated with lengthened clinical crown. Thus potential abutment teeth need careful assessment where significant bone loss has occurred.[6] In general successful fixed prosthesis can be fabricated on teeth with severely reduced periodontal support, provided the periodontal tissues have been returned to excellent health, and long term maintenance has been ensured, otherwise results will be disastrous. Healthy periodontal tissues are a prerequisite for all fixed restorations.[8,9] If the abutment teeth have normal bone support, an occasional lapse in plaque removal by patient is

unlikely to affect the long term prognosis. However when teeth with severe bone loss due to periodontal disease are used as abutments, there is very little tolerance.

Periodontal Assessment
An examination of the periodontal tissues should be made. The aim is to provide a basic screening of the tissues and to obtain an indication of the treatment requirements of the patient.[19]

Basic Periodontal Examination
This is performed clinically using the CPITN (community periodontal index of treatment needs) periodontal probe. It is a simple and effective method which provides a rapid overview of the periodontal status. The mouth is divided into six sextants and the worst score in each sextant is recorded.[13]

Crown Form
Additional forces may result from good morphology of the adjacent teeth or pontics. The forces can be uniformly distributed by the presence of additional abutments.[12]

Crown Length
Pontics with increased occluso gingival height require additional abutment. Abutment teeth with <4 mm crown can be supported by splinting multiple abutments.[11]

Axial Alignment
The axial alignment is the long axis of the abutment teeth to each other. A tilt up to 25° for full veneer preparation and 15° for resin-bonded bridges. [8]

Alveolar Ridge Form
Ideally, the ridge should be flat and wide. Excessive resorption can lead to low and thin ridges, along with high pontics and increased torsional forces.

Span Length
Bending or deflection varies directly with the cube of the length and inversely with the cube of the occlusogingival thickness of the pontic. Long-span prosthesis provides greater flexion. [17]

Esthetics
Full coverage crown provides better esthetics and retention. Anterior abutments with long connectors also provide good esthetics. [19]

Pulpal Health
Vital teeth are often preferable due to better proprioception. Inadequate pulpal heath can lead to poor prognosis. Necessary treatment may be required before.[20,21,26]

Figure 1:-Diagnostic cast

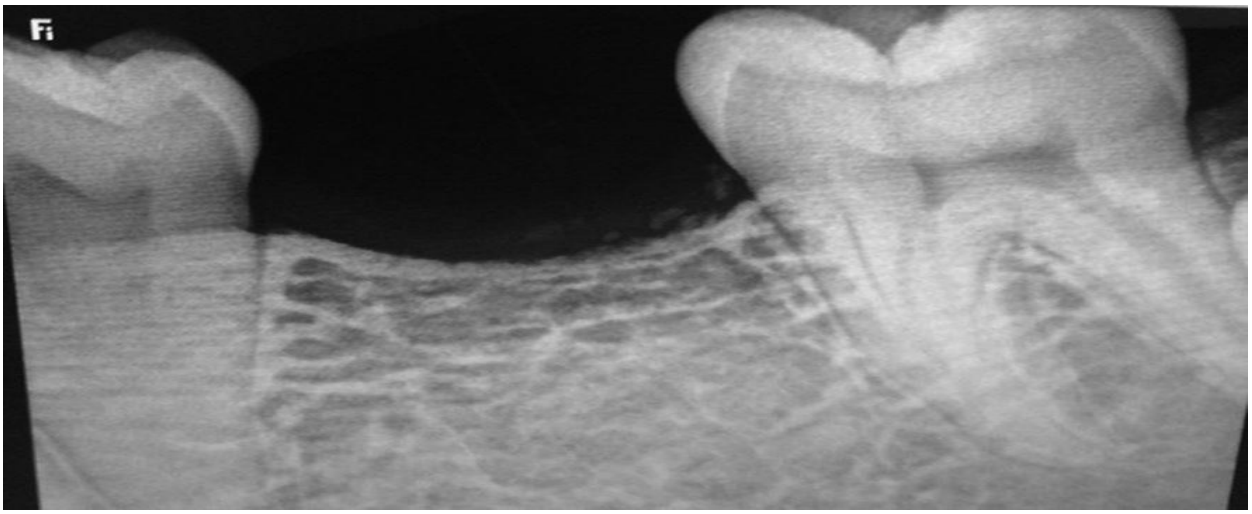
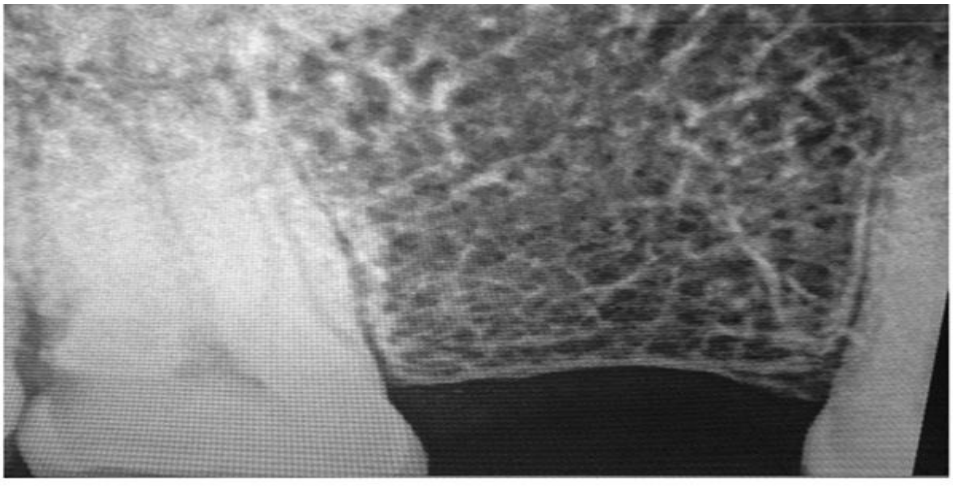


Figure 2:-Radiographic evaluation

Figure 3:-(a) Ratio- 3:1 (not accepted), (b) ratio- 1:1 (least accepted), (c) ratio- 2:3 (ideal)



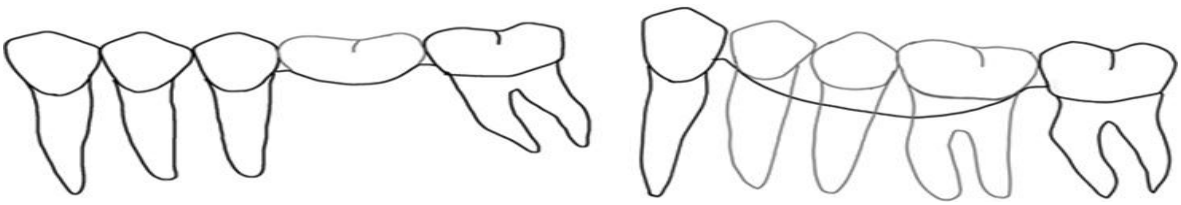


Figure 4:-(a-c) Periodontal surface area

Figure 5:-Abutment tooth width

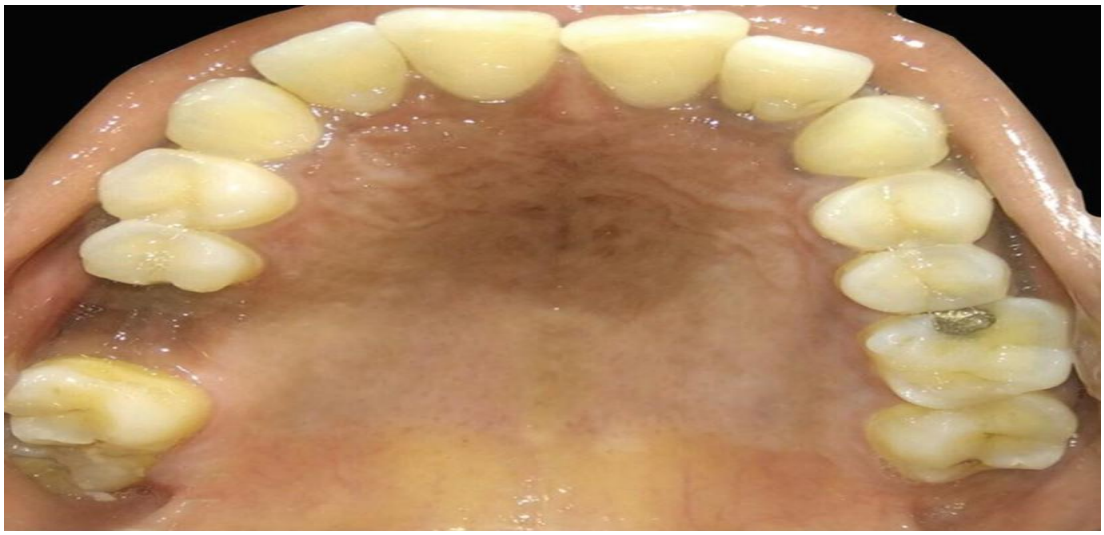


Figure 6:-Arch form

Figure 7:-(a) Long root, (b) curved root, (c) straight root (d) conical root

Conclusion:-

Competent treatment depends on the careful examination of all available information, a definitive diagnosis, and a realistic treatment plan that offers a favorable prognosis.[2] A comprehensive, sequential approach to treatment planning is essential. Planning for fixed prosthesis should not be independent of other disciplines of dentistry.[3]

When planning and treating fixed prosthesis cases, it is important that all the applicable parameters are taken into account. As a suggested clinical guideline for the evaluation of abutment teeth, the clinician should use the CRR, total alveolar bone support, root configuration, opposing occlusion, presence of a parafunctional habit, pulpal condition, presence of endodontic treatment, and the remaining tooth structure. Thus, this review provides an overview of the factors influencing abutment selection to facilitate long-term success of fixed dental prosthesis.[10,15,25]

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