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Abutment Selection In Fixed Partial Denture

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Abstract: *Forces are transmitted through the abutments to the periodontium. Main reason of failures involve poor designing, the use of impropermaterials, inadequate tooth preparation, and lack of knowledge of biomechanics. Successful selection of abutments for fixed partial dentures requires sensitive diagnostic ability and thorough knowledge of stomatognathic system.*

Keywords– *Abutment, abutment selection, periodontium, tooth preperation*

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I. Introduction

Fixed partial dentures transmit forces through the abutments to the periodontium. Failures are due to poor engineering, the use of improper materials, inadequate tooth preparation, and faulty fabrication. Of particular concern to dentists is the selection of teeth for abutments. They must recognize the forces developed by the oral mechanism, and resistance. Successful selection of abutments for fixed partial dentures requires sensitive diagnostic ability. Thorough knowledge of anatomy, ceramics, the chemistry and physics of dental materials, metallurgy, Periodontics, phonetics, physiology, radiology and the mechanics of oral function is fundamental.

II. Diagnostic Cast

Accurate diagnostics casts must be correctly oriented to the transverse hinge axis and plane of occlusion on an articulator to permit eccentric movements similar to those that take place in the mouth. This procedure allows a simple evaluation of occlusal relationship of dental arches and the abutment teeth. Rotated malposed teeth can be easily observed. The form and contour of prospective abutment teeth can be visualized as well as the alignment and contacts of opposing teeth.

III. Roentgenographic Examination

Periapical and bitewing films are most important 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.

An intraoral radiographic examination reveals:

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

IV. Factors Influencing Abutment Selection

The choice and number of abutments are determined by a combination of load- bearing ability of the abutment teeth plus the forced and stresses to which these will be subjected. The number of roots, their shape, length, alignment, and bone height has a direct relation to the load- bearing capacity of teeth. The shorter, more tapered the root and lower the bone level, the less satisfactory the tooth will be as an abutment.

4.1. Root Configuration Teeth must have adequate occlusocervical crown length to achieve sufficient retention. Teeth with short clinical crowns often do not provide satisfactory retention unless full – coverage preparations are used or additional length is achieved through periodontal surgery.

4.2. Crown Form Some teeth have tapered crown form, which interferes with preparation parallelism, necessitating full coverage retainers to improve their retentive and esthetic qualities. Egs: include anterior teeth with poorly developed cingula and short proximal walls and mandibular premolars with poorly developed lingual cusps and short proximal surfaces. Also, some incisors poses very thin highly translucent incisal edges making use of partial coverage retainers esthetically unacceptable.

4.3. 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. 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.

4.4. PDL Area and Surface Area This is an important point in the assessment of abutment's suitability from a periodontal standpoint. ANTE suggested in 1926 that it was unwise to provide a FPD when the root surface area of the abutment was less than the root surface area of the teeth being replaced; this has been adopted and reinforced by other authors (Johnston, Dykema, Shillinburg, Tylman) as ANTE's LAW.

4.5. ANTE's LAW – ***Irwin H. Ante*** Is an eponym in FPD Prosthodontics for the observation that the combined pericemental area of all abutment teeth supporting a FPD should be equal to or greater in pericemental area than the tooth or teeth being replaced.

Root Surface Area (mm^2)

		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.

4.6. Root Configuration Roots that are broader labiolinguallly 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 converge, fuse, blunted, or generally present a conical configuration. A tooth with conical roots can be used as an abutment if all other factors are optimal. A single rooted tooth with evidence of irregular configuration or with some curvature in the apical third of the root is preferable to the tooth that has a nearly perfect taper. Irregularly shaped, multiple, divergent roots offer better prognosis. A well aligned tooth will provide better support than a tilted one. Alignment can be improved with orthodontic treatment.

4.7. 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.

4.8. 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. 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. 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.

4.9. 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.

4.10. 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.

4.11. Recession. Any recession or loss of attachment around the teeth should be noted and recorded in the patient's notes. This is most likely to occur around those teeth that are prominent either buccally or lingually in the arch.

4.12. Long axis Relationship The long axis relationship of abutment teeth should be no more than 25- 30 degree from the parallel. The architecture of periodontal ligament is such that forces are withstood best when they are directed along the long axis of the tooth. A severely inclined tooth will not withstand forces as well as one that is erect. The less the force and the shorter the edentulous span, the more a tooth maybe inclined and still be used as an abutment. Abutment teeth to an FPD must be prepared with a common path of insertion for all retainers when rigid design is employed. Evaluation of diagnostic casts with a dental surveyor coincides with the radiographic evaluation.

4.13. Mesially tilted molars Loss of permanent mandibular first molars to caries early in life is still relatively common. If this space is ignored, the second molar will tilt mesially with eruption of the third molar. It then becomes difficult or impossible to make a satisfactory FPD, because the positional relationship no longer allows for parallel paths of insertion with out interferences from adjacent teeth. The mesial one- half crown preparation, the non - rigid attachment (semi- precision or stress breaker) and the telescopic prosthesis have been suggested to solution to the problem. With extreme malalignment orthodontic uprighting or space maintainer appliance maybe a logical approach, this also eliminates bony defects along mesial surface of root. The mesial one half crown requires an unblemished distal surface on the molar abutment. The non rigid attachment must not be used indiscriminately. Because of mesial component of force, the female portion of attachment is usually placed on distal surface of mesial abutment. The cantilever effect on the non- rigid design can pace additional stress on the abutment with the rigid connector, therefore rigid connector is only placed on a strong abutment, and the non rigid design is avoided altogether with long span pontics. Telescopic prosthesis requires radical tooth preparation to provide adequate space for the telescopic coping and the overcastting.

V. Clinical Guidelines for Establishing Parallelism

Developing a mutual path of insertion on multiple abutments without over tapering the preparations or exposing the pulp is a fundamental skill that can be mastered. While there is no mystique to the biomechanics of this process, malpositioned, tilted, rotated, and supraerupted teeth increase the need for planning the path of insertion with a dental surveyor. Once the path of insertion has been established, the base of the cast is scribed with multiple lines parallel to this path to aid in planning tooth preparations. The following clinical guidelines are suggested:

5.1 Select rotary instruments with a standard (2 to 3 degree) taper. Diamond stones without a taper must be tilted freehand to avoid undercut. Freehand tipping of the diamond common over tapers the preparations, causing a loss of retentive form and increasing the risk of pulp irritation or exposure

5.2 Occlusal or incisal reduction is accomplished first. They are reduced parallel to the planned occlusal plane.

5.3 Depth guides are placed on the buccal and lingual surfaces of all abutment teeth, parallel to the planned path of insertion, as indicated by the scribe lines on the base of the diagnostic cast.

5.4 With the diamond stone held parallel to the planned path of insertion (depth guides), the most inaccessible surface of the most inaccessible abutment is reduced first.

5.5 Tooth reduction is continued with the diamond stone held parallel to the prepared depth guides; the distal, lingual, facial, and mesial surfaces are reduced systematically. The most accessible surfaces are reduced last. Pay strict attention to parallelism between the mesial and distal surfaces of posterior teeth and the facial surfaces of incisors.

5.6 After bulk reduction, parallelism is verified with large intraoral mirrors. If there is any doubt about undercuts, an alginate impression is made and poured in impression plaster. The plaster cast is evaluated on the dental surveyor, and any undercuts are corrected intraorally.

5.7 The preparations are refined (i.e., two-plane reductions, elimination of external sharp line angles, development of discernable finish lines, etc.) taking care not to create new undercuts.

5.8 **Arch Form** Restorations involving anterior teeth are shaped in the form of an arc. When forces are applied to the pontics, a rotational effect occurs on the abutments and a vertical force is exerted on the terminal ends of the fixed partial denture. The counterbalancing force supplied by the abutments should equal or exceed that of the pontics as indicated by the length of the lever arm. The lever arm is determined by drawing a perpendicular line from the fulcrum line to the point on the pontics farthest from this line. The fulcrum is a line joining the abutments adjacent to the edentulous space at the proximo-occlusal angles of the preparation. The greatest leverage occurs when four- maxillary incisors are replaced in a narrow tapered arch. The presence of a single incisor will considerably shorten the lever arm. A long lever arm can be equalized by using additional abutments.

5.9 Span Length In addition to the increased load placed on the periodontal ligament by a long span fixed partial denture, longer spans are less rigid. Bending or deflection varies directly with the cube of the length and inversely with the cube of the occlusogingival thickness of the pontic. Compared with a fixed partial denture having a single-tooth pontic span, a two-tooth pontic span will bend 8 times as much. A three-tooth pontic will bend 27 times as much as a single pontic.

5.10 A pontic with a given occlusogingival dimension will bend eight times as much if the pontic thickness is halved. A long-span fixed partial denture on short mandibular teeth could have disappointing results. Longer pontic spans also have the potential for producing more torquing forces on the fixed partial denture, especially on the weaker abutment. To minimize flexing caused by long and/or thin spans, pontic designs with a greater occlusogingival dimension should be selected. The prosthesis may also be fabricated of an alloy with higher yield strength, such as nickel-chromium.

5.11 All fixed partial dentures, long or short, flex-to some extent. Because of the forces being applied through the pontics to the abutment teeth, the forces on castings serving as retainers for fixed partial dentures are different in magnitude and direction from those applied to single restorations. The dislodging forces on a fixed partial denture retainer tend to act in a mesiodistal direction, as opposed to the more common buccolingual direction of forces on a single restoration. Preparations should be modified accordingly to produce greater resistance and structural durability. Multiple grooves, including some on the buccal and lingual surfaces, are commonly employed for this purpose.

5.12 Double abutments are sometimes used as a means of overcoming problems created by unfavorable crown-root ratios and long spans. There are several criteria that must be met if a *secondary* (remote from the edentulous space) abutment is to strengthen the fixed partial denture and not become a problem itself. A secondary abutment must have at least as much root surface area and as favorable a crown-root ratio as the *primary* (adjacent to the edentulous space) abutment it is intended to bolster. As an example, a canine can be used as a secondary abutment to a first premolar primary abutment, but it would be unwise to use a lateral incisor as a secondary abutment to a canine primary abutment. The retainers on secondary abutments must be at least as retentive as the retainers on the primary abutments. When the pontic flexes, tensile forces will be applied to the retainers on the secondary abutments. There also must be sufficient crown length and space between adjacent abutments to prevent impingement on the gingiva under the connector.

5.13 Arch curvature has its effect on the stresses occurring in a fixed partial denture. When pontics lie outside the interabutment axis line, the pontics act as a lever arm, which can produce a torquing movement. This is a common problem in replacing all four maxillary incisors with a fixed partial denture, and it is most pronounced in the arch that is pointed in the anterior. Some measure must be taken to offset the torque. This can best be accomplished by gaining additional retention in the opposite direction from the lever arm and at a distance from the interabutment axis equal to the length of the lever arm. The first premolars sometimes are used as secondary abutments for a maxillary four-pontic canine-to-canine fixed partial denture. Because of the tensile forces that will be applied to the premolar retainers, they must have excellent retention.

5.14Rigidity The lack of sufficient rigidity in a fixed prosthesis is a frequent cause of failure. Rigidity is obtained by use of the proper materials arranged in the correct shape form and thickness in regard to the forces acting upon them. If a metal bar is doubled in length) keeping the same shape, the longer bar will distort eight times more than the shorter bar will distort when subjected to the same force. If the dimension of the bar parallel to the applied forces is doubled, the bar will be eight times stronger. If the dimension of the bar perpendicular to the forces is doubled, the bars' strength will be doubled. Rigidity of Fixed partial dentures and conservation of tooth structure result when engineering principles are applied. Flexure can cause damage to the abutments and may result in eventual loosening of the retainers, and fatigue of the metal. The induced stresses must not exceed the yield strength of the alloy.

5.15Margin Location Sound tooth enamel cannot be improved biologically or esthetically. Therefore when conditions permit, margins of restorations should be kept away from the gingival tissues. The most accurate margin for any restorative material irritates the gingiva when it is extended beneath the free margin.

5.16Occlusal Anatomy Occlusal anatomy has an indirect influence on the loads transmitted to the teeth. The occlusal surfaces of natural posterior teeth have distinct cusps with many primary and supplemental ridges. The cusps are convex in both directions with grooves interspersed between the ridges. Natures own anatomy and contour should be recreated in all restorations. The ridges and grooves increase the sharpness and shearing action of teeth and reduce friction between opposing surfaces by keeping tire contacting area to a minimum. Such anatomy permits the most efficient mastication of food, thus reducing the load transmitted.

5.17*Stallard* points out that worn-down teeth need more muscular power and longer and more masticator strokes in order to chew food enough. Much of this force is directed at right angles to the long axis of the teeth. Properly articulate ridge -bearing cusps will cut the food rapidly, with fewer strokes, with much less muscular effort, and will direct most of the closure forces perpendicularly in line with the long axis of the teeth. Occlusal forces are related to degree of muscular activity, the patient’s habits such as bruxism, the number of teeth being replaced, the leverage on the bridge and adequacy of bone support. Excessive occlusal forces cause loosening of prosthesis through flexure or can induce ceramic fracture. The force can also cause tooth mobility, particularly in presence of decreased bone support. The buccolingual width of pontics should harmonize with buccolingual dimension of natural unmutilated teeth, and recreate the normal buccal and lingual form to the height of contour. Reducing the width of the pontics does not materially reduce the forces transmitted to the abutments, but merely places heavier per unit stress on the restoration and produces conditions in the pontic similar to those of malposed and improperly contoured teeth.

5.18Mobility The mobility of the teeth is simply recorded using two ends of a mouth mirror and probe as grade I to III, where grade I indicates slight movement, II excessive side- side movement in the socket, and III both lateral and vertical movement. Abutments with greater than normal mobility are frequently capable of with standing force and are unsuitable as abutments. The magnitude of mobility and cause must be evaluated. A *Miller* mobility value of one is generally acceptable, whereas a mobility value of two require assessment. If the mobility is related to deflective occlusal contacts, that can be eliminated and if short span prosthesis is involved, the tooth is likely to be a suitable abutment. If mobility is caused by considerable bone loss and more than one tooth is to be replaced, it is unlikely the tooth to be a suitable abutment unless it can be splinted to another sound tooth. A tooth mobility value of three is not suitable for as an abutment.

5.19Splinting Immobilization of teeth by joining them to one another with soldered retainers was thought to prevent periodontal breakdown of healthy tooth and to arrest bone loss in compromised teeth. It is an arduous, expensive and time consuming. The completed restoration is difficult for patient to clean. Long term serviceability is significant disadvantage of splinting and failure of a single abutment or retainer can jeopardize the entire prosthesis. When in doubt do not splint. Hyper mobility is not necessary an indication for splinting since the mobility can often be reduced or resolved with an occlusal adjustment. Splinting will not prevent periodontitis and may actually increase the chances of inflammatory disease, since home care will be inhibited. A questionable tooth should not be splinted in an attempt to strengthen the weakened tooth. The result is often accelerated by periodontal deterioration of both teeth.

5.20Pontic tissue Contact The tissue contacting the surfaces on the pontic should be convex, smooth and free of porosity. The area of contact should be minimal, free of pressure and thought of as having saliva contact rather than tissue contact.

5.21 Available Tooth Structure The size, number and location of carious lesions or restorations in tooth affect whether full or partial coverage retainers are indicated. Extensive defective restorations or fractures require intentional endodontic therapy or post and core fabrication to provide a sufficiently retentive and resistant form to the preparations. Crown lengthening maybe indicated to expose sound tooth coronal to biologic width when caries, restorations fractures are in proximity to alveolar crest.

5.22Age of the Patient Fixed prosthesis is usually contraindicated in mouth of adolescents when teeth are not fully erupted or when the pulps are excessively large and prohibit retentive preparations. If a bridge is not to be made, then a space maintainer should be inserted to hold the abutments and opposing teeth in position. However tooth reduction should be kept minimal and prosthesis should be considered temporary to be remade when pulp size permits.

VI. Static or Dynamic Occlusion of Teeth

Abutment teeth are examined for tilting rotation, overeruption, malalignment) wear faceting and burnished areas on restorations. The patient is asked to close the teeth together and an assessment is made of the occlusal relationship. The occlusion is assessed as canine protected or group function, and any non-working side contacts are noted.The intercuspal position is the relation of the mandible to the maxilla when the teeth are together in maximum intercuspation. The majority of patients have a habitual intercuspal position (i.e. a comfortable position that they close into without any guidance).Lateral excursions are guided commonly by the canine and the premolar teeth. In canine guidance, the posterior teeth will disclude in lateral excursions. In group function, a group of teeth, such as the canines and premolar teeth; are contacting on the working side (i.e. the side to which the mandible moves). In protrusive movements the anterior teeth move over each other with the posterior teeth discluding. However, in tooth wear, the posterior teeth may be in function due to excessive wear of the anterior teeth. The retruded contact position of the mandible is where it is in its furthest distal position when contacting the upper teeth. Generally the patient can be guided into this position, which is usually 1-2 mm further posterior to the intercuspal position. Interferences are abnormal contacts that interfere with the smooth movements of the mandible and may be the cause of tooth fracture or cementation failure of a crown etc., or may lead to tooth mobility. Such deviations from the normal movements are recorded in the noted.

VII. Vitality Testing Of the Pulp

Vitality of the tooth may be tested using either electrical or thermal stimulation. Electrical testing will require a charge to be applied to the tooth. The charge is generated by a machine and the patient becomes part of the circuit when the tip is applied to the tooth. Good electrical contact is achieved by the use of prophylactic paste. The present machines do not require clinician contact, as the use of rubber gloves often prevents a good electrical circuit being formed. Thermal stimulation may be through either cold or heat, but cold stimulation is preferred. This is done using a ice stick or a pledget of cotton wool soaked in ethyl chloride, which will give a quick response. However, a more intense cold stimulus can be provided by use of dry ice. This way the prospective abutment teeth are tested for pulp vitality, if pulp in non- vital it should be endodontically treated before using as abutment for a FPD

VIII. Long Term Abutment Prognosis

When there is some question of the ability of remaining supporting structures to accept additional occlusal forces, the bilateral bracing afforded by a removable prosthesis may be advantageous. Also a tooth with sufficient loss of periodontal support and questionable long term prognosis may be best treated with a removable prosthesis.

Overloading of abutments The ability of abutment teeth to accept applied forces without drifting or becoming mobile must be estimated and has a direct influence on prosthodontic treatment plan. These forces are severe during Parafunctional grinding and clenching and need to be eliminated during restoration of damaged dentition.Studies show that faciolingual movement ranges from 56- 108μm and intrusion is 28 μm. teeth in different segments of arch move in different directions. Because of curvature of arch, the faciolingual movement of anterior teeth occurs at a considerable angle to the faciolingual movement of molar. These movements of measurable magnitude and in divergent directions can create stresses in long span prosthesis that will be transferred to abutments.

IX. Endodontic ally Treated Abutments

Teeth in which the pulpal health is doubtful should be endodontically treated before initiating fixed prosthesis. Although a direct pulp caps maybe acceptable, risk for a simple amalgam or composite resin, a conventional endodontic treatment is normally preferred for cast restorations, especially where the later need for endodontic treatment would jeopardize the overall success of treatment. Such endodontically treated teeth serve well as abutment with post and core foundation for retention and strength. Failures occur, however particularly on teeth with short roots or little remaining coronal tooth structure. Sometimes its better to remove badly damaged tooth rather than attempting endodontic treatment.

X. Unretired Abutments

An unrestored, caries free tooth is an ideal abutment. It can be prepared conservatively for a strong retentive restoration with optimum esthetics. The margin of retainer can be placed without modification to accommodate the existing restorations or caries. In an adult patient, an unrestored tooth can be safely prepared without jeopardizing the pulp as long as the design and technique of tooth preparation are wisely chosen. Certain patients are reluctant to have a perfectly sound tooth cut down to provide anchorage for FPD. In such situations, overall dental health has to be emphasized rather than looking at each tooth individually.

XI. Pier Abutments

Rigid connectors (e.g. solder joints) between pontics and retainers are the preferred way of fabricating most fixed partial dentures. A fixed partial denture with the pontic rigidly fixed to the retainers provides desirable strength and stability to the prosthesis while minimizing the stresses associated with the restoration. However, a completely rigid restoration is not indicated for all situations requiring a fixed prosthesis. An edentulous space can occur on both sides of a tooth, creating a lone, freestanding pier abutment. Physiologic tooth movement, arch position of the abutments, and a disparity in the retentive capacity of the retainers can make a rigid five-unit fixed partial denture a less than ideal plan of treatment. Studies in periodontometry have shown that the faciolingual movement ranges from 56 to 108 μm. and intrusion is 28μm. Teeth in different segments of the arch move in different directions. Because of the curvature of the arch, the faciolingual movement of an anterior tooth occurs at a considerable angle to the faciolingual movement of a molar. These movements of measurable magnitude and in divergent directions can create stresses in a long-span prosthesis that will be transferred to the abutments. Because of the distance through which movement occurs, the independent direction and magnitude of movements of the abutment teeth, and the tendency of the prosthesis to flex, stress can be concentrated around the abutment teeth as well as between retainers and abutment preparations.It has been theorized that forces are transmitted to the terminal retainers as a result of the middle abutment acting as a fulcrum, causing failure of the weaker retainer. However, photoelastic stress analysis and displacement measurement indicate that the prosthesis bends rather than rocks. *Standlee* and *Caputo* suggest that tension between the terminal retainers and their respective abutments, rather than a pier fulcrum, is the mechanism of failure. Intrusion of the abutments under the loading could lead to failure between any retainer and its respective abutment.The loosened casting will leak around the margin, and caries is likely to become extensive before discovery. The retention on a smaller anterior tooth is usually less than that of a posterior tooth because of its generally smaller dimensions. Since there are limits to increasing a retainer's capacity to withstand displacing forces, some means must be used to neutralize the effects of those forces. The use of a nonrigid connector has been recommended to reduce this hazard.In spite of an apparently close fit, the movement in a nonrigid connector is enough to prevent the transfer of stress from the segment being loaded to the rest of the fixed partial denture. The nonrigid connector is a broken-stress mechanical union of retainer and pontic, instead of the usual rigid connector. The most commonly used nonrigid design consists of a T-shaped key that is attached to the pontic and a dovetail keyway place within a retainer.Use of the nonrigid connector is restricted to a short- span fixed partial denture replacing one tooth 21 The magnification of force created by a long span is too destructive to the abutment tooth under the soldered retainer. Prostheses with nonrigid connectors should not be used if prospective abutment teeth exhibit significant mobility. There must be equal distribution of occlusal forces on ail parts of the fixed partial denture.A nonrigid fixed partial denture transfers shear stress to supporting bone rather than concentrating it in the connectors. It appears to minimize mesiodistal torquing of the abutments while permitting them to move independently. A rigid fixed partial denture distributes the load more evenly than a nonrigid design, making it preferable for teeth with decreased periodontal attachment. If the posterior abutment and pontic are either unopposed or opposed by a removable partial denture and if the three anterior units are opposed by natural teeth, the key and the posterior units that are subjected to little or no occlusal forces may supraerupt. The location of the stress-breaking device in the five-unit pier-abutment restoration is important. It usually is placed on the middle abutment, since placement of it on either of the terminal abutments could result in the pontic acting as a lever arm. The keyway of the connector should be placed within the normal distal contours of the pier abutment, and the key should be placed on the mesial side of the distal pontic. The long axes of the posterior teeth usually lean slightly in mesial direction and vertically applied occlusal forces produce further movement in eh direction. Nearly 98% of posterior teeth tilt when subjected to occlusal forces.

XII. Abutment Selection for Cantilever Fpd

A cantilever FPD is one that has an abutment or abutments at one end only, with the other end of pontic remaining unattached. This is a potentially destructive design with the lever arm created by pontic and it is frequently misused.A cantilever pontic can be successfully employed if the principles of leverage are understood and provisions are made to control deleterious forces. A classic FPD design is the lateral incisor cantilever pontic supported by a strong canine. A cantilever first premolar pontic can occasionally eliminate the need to prepare the canine, thus preserving the natural canine function. In routine three – unit FPD force that is applied to the pontic is distributed equally to the abutment teeth. If there is only one pontic and it is near the interabutment axis line, less leverage is applied to the abutment teeth or to the retainers than with a cantilever. When a cantilever pontic is employed to replace a missing tooth, forces applied to the pontic have an entirely different effect on the abutment teeth. The pontic acts as a lever to be depressed under forces with a strong occlusal vector.Prospective abutment teeth for the cantilever FPD must offer better than average support, tooth preparation must be extremely retentive, occlusal scheme must be close to ideal, the roots should have favorable configuration, long clinical crown, good crown- root ratio and healthy periodontium.

A cantilever replacing maxillary lateral incisor:

- Should have no occlusal contact on the pontic in either centric or lateral excursions.
- Canine is used as abutment and can be used as solo abutment only if it has long and good bone support.
- Should have rest on mesial of pontic against a rest preparation in an inlay or other metallic restoration on the distal of central incisor to prevent rotation of pontic and abutment.
- Mesial aspect of pontic is slightly wrapped around the distal portion of uninvolved central incisor to stabilize pontic faciolingually.
- Root configuration of central incisor does not make it desirable for cantilever abutment.

A cantilever pontic on first premolar.

- Will work best if occlusal contact is limited to distal fossa. Full veneer retainers are required on both second premolar and molar.

Cantilever FPD replacing molar.

- When no distal molar abutment is present
- Most commonly used to replace II molar to prevent supraeruption of opposing teeth. When pontic is located occlusally the adjacent abutment tends to act as

fulcrum with tilting tendency on the farthest retainer. To minimize the leverage effect the pontic should be kept as small as possible more nearly representing premolar than molar. There should have adequate occlusocervical height to ensure rigid prosthesis. A posterior cantilever pontic places maximum demands on retentive capacity of retainer. Thus its use to be limited to teeth with adequate clinical crown length an abutment for maximum retention.The success of cantilever in the restoration of periodontally weakened dentition is probably due to the fact that these teeth have extremely long clinical crowns. While cantilever FPD appear to be conservative, the potential for damage to abutment teeth requires that they be used sparingly.

XIII. Conclusion

In the above discussion various guides have been suggested for selection 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.

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