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Selecting Abutments in Fixed Prosthodontics - A Review

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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 the resistance of the tooth and its supporting structures to them.

Successful selection of abutments for fixed partial denture 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 fundamenta.[1]This article will review diagnostic procedures and list the conditions and requisites for the selection of abutment for fixed partial dentures.

DIAGNOSTIC CASTS

Accurate diagnostic casts must be correctly oriented to the transverse hinge axis and the 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 the occlusal relationships of the dental arches and the abutment teeth. Rotated and malposed teeth can be easily observed. The form and contour of prospective abutment teeth and the gingival tissues can be visualized as well as the alignment and contacts of opposing teeth.

ROENTGENOGRAPHIC EXAMINATION

Peripheral and bite-wing films are most important in selection of abutment teeth. On occasion, additional views may be required. The primary purpose of roentgenograms is to disclose hidden areas and structures such as the root morphology, pulp outline, the periodontal ligament space, the aveolar bone, infrabony defects, residual roots, impacted or supernumerary teeth, and the extent of present or past caries. However, a complete roentgenographic examination cannot replace a thorough physical examination of the clinical crowns and surrounding soft tissue. It can only complement a complete oral examination and history.

Once the facts have been found, a treatment plan can be developed. The various tissues that are integrated into the oral mechanism react according to certain biologic laws. However, the functional demands on the tissues of one person may be quite different from those made on another. The tissue response and tolerance vary among individuals : therefore, no two abutment teeth will react exactly the same under similar circumstances.

FACTORS INFLUENCING ABUTMENT SELECTION

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

Crown-to-ratio. A crown-to-root ratio of 1:2 is considered ideal.[3] This ratio is determined by a comparison of the linear measurement of the portion of the tooth above the bone to that within the bone. A 1:1 ratio is probably the absolute minimum, and such a tooth should be used as an abutment only when other conditions approach the ideal. The longer the edentulous span and the greater the torques on the abutment teeth, the more favorable the crown-to-root ratio must be. The use of multiple abutments can sometimes compensate for poor crown-to-root ratios or for long spans.

Surface area. The combined existing surface area of the periodontal ligaments of the abutment teeth should equal or exceed the normal area of the periodontal ligaments of the teeth to be replaced.[4]The surface area of the periodontal ligaments of normal teeth has been measured by several investigators.[5-7]

The total mesiodistal width of the cusps of abutments should equal or exceed the width of the cusps of points (Fig.1) 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. Most healthy organs of the body are consider to have a reserve capacity equal, at least, to their normal functional requirements.

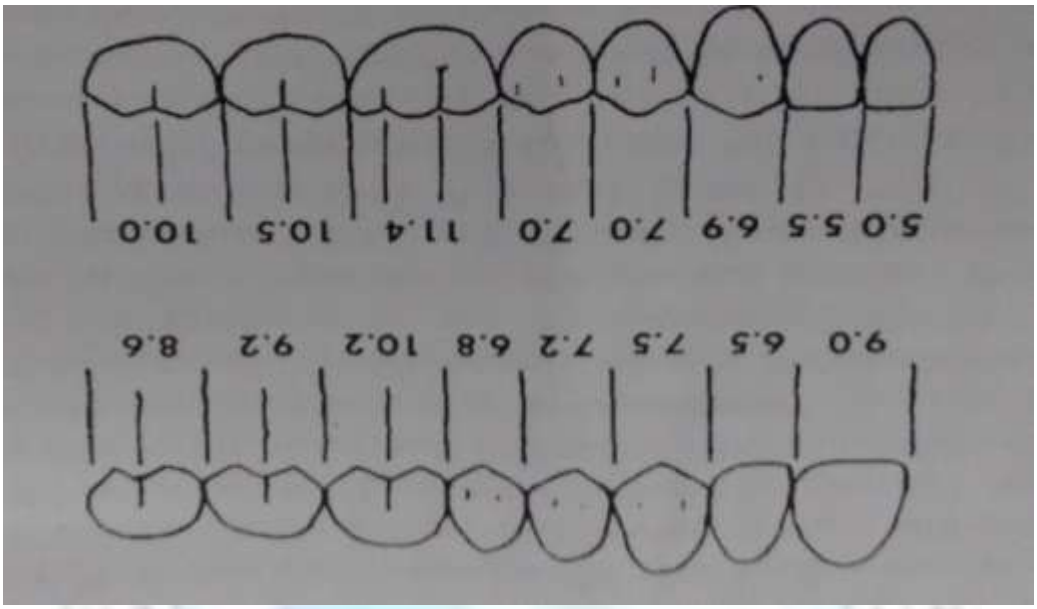

Figure 1: In selection of abutment ,the knowledge of meso distal width of average teeth is important

Long axis relationship. The long axis relationship of the abutment teeth should vary no more than 25^0 to 30^0 from parallel. The architecture of the 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 may be inclined and still be used as an abutment.

Arch form. Restortions involving anterior teeth are shaped in the form of any 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.[8] The counterbalancing force supplied by the abutment 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 the 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.

Rigidity. 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. Rigidity of fixed partial denture's and conservation of tooth structure result when engineering principles are applied. Flexure can cause damage to the abutmens 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.

Margin 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.

Occlusal 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. Nature's own anatomy and contour should be recreated in all relations .The ridges and grooves increase the sharpness and shearing action of teeth and reduce friction between opposing surfaces by keeping the contacting area to a minimum. Such anatomy permits the most efficient mastication of food, thus reducing the load transmitted.

Stalard[10]points out that worn-down teeth need more muscular power and longer and more masticatory strokes in order to chew food enough. Much of this force is directed at right angles to the long axis of the teeth. Properly articulated 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 eh long axis of the teeth.

Buccolingual dimension of the teeth. The occlusal surface of the pontics should harmonize with the buccolingual dimension of the natural unmutilated teeth, and recreatethe normal buccal and lingual form to the height of contour. Reducig the width of the pontics does not materially reduce the forces transmitted to the abutmetns, 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.

Pontic-tissue contacts. The tissue-contacting surface on pontics 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.

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