

Abutment Selection in Fixed Partial Dentures

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Abstract

Introduction: The most common treatment option for the replacement of a single missing tooth is a Fixed Partial Denture (FPD), where support is taken from the two adjacent teeth, and the missing tooth is replaced. Abutment teeth are exposed to forces applied on the missing tooth as well as those applied on the various parts of the prostheses and the abutment teeth themselves, and therefore prior examination of the abutment teeth is of utmost importance.

Aim of Work: This review aims at highlighting an overview of the selection of Abutment teeth for Fixed Partial Dentures.

Methodology: This review is comprehensive research of PUBMED and Google Scholar from the years 1990 to 2021.

Conclusion: Planning of a Fixed Partial Denture should always be executed as a multidisciplinary approach keeping the abutment teeth' pulpal and periodontal health in mind. The diagnosis of the case and thorough study of the diagnostic casts and radiographs is the primary step that helps decide the feasibility of the treatment option. Once the case has been taken up for a fixed prosthesis, the abutment teeth should be examined in detail regarding their crown height, crown root ratio, root configuration, mobility, etc. For a good prognosis, patients' compliance is of utmost importance, and hence patient education regarding good oral hygiene and maintenance of the prosthesis should also be given equal importance.

Keywords: Abutment; Crown Root Ratio; Clinical Crown; Biological Width; Telescopic Crown

Introduction

Patients in a dental clinic most often report with the complaint of a missing tooth and want replacement of the same for either esthetic and functional reasons. The most common treatment option for the replacement of a single missing tooth is a Fixed Partial Denture (FPD), where support is taken from the two adjacent teeth, and the missing tooth is replaced [1]. For many years, in fact, until implants became

a commonly executed clinical procedure, FPD was the most popular treatment option for a fixed replacement of the missing tooth. The main aim of providing an FPD to the patient is to improve the patient's esthetics, comfort, and functionality. FPD treatments range from replacing a single tooth to the rehabilitation of the complete occlusion for the patient. Multiple missing teeth can also be replaced by giving prostheses which improve the patient's comfort, condition of the dental arches, masticatory efficiency, and most importantly, especially in cases of anterior teeth, improves the self-confidence of the patient by refining the esthetics. Whenever any restoration is done in the patient's mouth, the most important thing to be kept in mind is that the restoration should be able to withstand all the occlusal forces applied to the tooth. During the fabrication of a fixed partial denture, the distribution of occlusal forces has to be particularly kept in mind as the force which is applied to the missing tooth prosthesis is then transferred to the adjacent teeth that are used for support via the retainers, pontics, and connectors [1].

An abutment is a term used to describe the teeth present adjacent to the edentulous area, which is used as a support upon which the missing tooth/teeth prostheses are placed. Abutment teeth are exposed to forces applied on the missing tooth as well as those applied on the various parts of the prostheses and the abutment teeth themselves. The replacement of missing tooth should always be analyzed for prognosis both in terms of commercial and biological load on the patient and his dentition [2]. Most commonly done FPDs are used to replace one or two missing teeth; three missing teeth can also be replaced in rare cases under ideal conditions. In cases where multiple teeth are missing in an arch with a few teeth present in between, pier abutments can be used. For example, the first premolar and first molar are missing; in this case, canine and second premolar can be used as abutments, with the second premolar as a pier abutment. In cases where multiple teeth require a cap in an arch, FPDs prove to be a better choice as compared to Removable partial dentures [2,3].

Diagnostic requirements during abutment selection diagnostic casts

During the fabrication of diagnostic casts, the orientation of the cast should be kept particularly in mind, mainly the occlusal plane and the transverse hinge axis, which helps in mimicking the eccentric movements of the mouth. The diagnostic cast helps us to evaluate the occlusal relationship of the abutment as well as the dental arches. Another benefit of using the cast is the evaluation of rotated teeth and the malocclusions and their respective effect on the occlusion. The alignment of the abutment teeth and gingival tissues can also be observed and studied with the help of a diagnostic cast (Figure 1) [4,5].



Figure 1: Diagnostic casts for FPD, which helps in the evaluation of the abutment teeth [5].

Radiographic examination

Radiographic evaluation is of extreme importance during the examination of the abutment teeth. It helps us to define the extent of caries, if any, in the abutment teeth that decides whether the tooth should go for endodontic treatment. Radiographs also give us an idea of the root morphology, bone defects, presence of any residual root fragments or impacted teeth. Another important role of x rays is determining the crown to root ratio, which later plays an important role in the prognosis of the abutment teeth [6].

Abutment selection- Governing factors and their effect

Gottlieb had divided the crown and root portion of the tooth into the anatomic and clinical crown and root, respectively. The anatomic crown, as described by him, consisted of the enamel-covered portion of the crown, and the part that is visible clinically is the clinical crown. The part which is covered by the cementum is the anatomical root. The clinical crown length increases with time and is maximum in older patients. The crown size of the tooth to be replaced depends on the dimension of the abutment teeth. According to Ante's law, the combined surface area of the abutment teeth should be equal to more than the surface area of the tooth that has to be replaced. The mesiodistal width between the cusps in the abutment teeth should also be more than that of the pontic [7].

Occlusal anatomy

The anatomy of the occlusal surface of the teeth plays an important role in chewing efficacy and load distribution while chewing. The occlusal surface of the tooth comprises distinct cusps and ridges, which have a sharp tip with grooves between them that help in the shredding and chewing of food [8] (Figure 2). In a study conducted by Stallard., *et al.* [9], they concluded that worn teeth needed more muscular energy and a higher number of masticatory strokes as compared to the teeth with defined cusps and ridges. When replacing a missing tooth with a pontic, it should be noted that the occlusal surface should have all the ridges and grooves as that would require a lesser amount of masticatory force and fewer strokes while chewing. The Buccolingual (BL) dimension of the pontic should also be kept in mind while designing the FPD as any reduction in the BL width of the tooth increases the per unity stress on the pontic, reducing its life, the force transmitted on the abutment remains unchanged to a large extent. The BL dimension should be in harmony with that of the dentition.

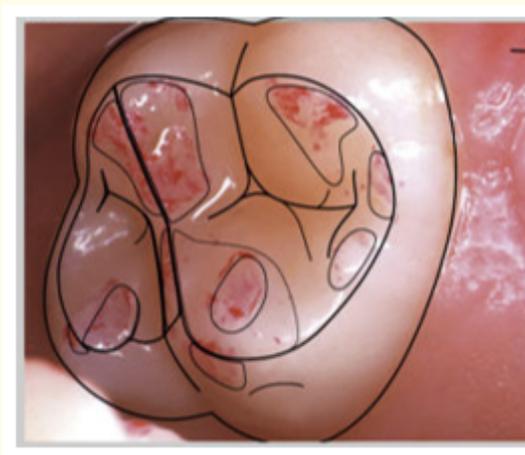


Figure 2: The cusps and grooves on the occlusal surface of the tooth make shearing and chewing of the tooth easier [10].

Root

Root morphology and shape also play an important role in the selection of abutment teeth. Teeth with longer roots tend to provide more anchorage compared to shorter roots. In the same manner, posterior roots with widespread multiple roots tend to distribute the occlusal load better than single conical roots. Roots with irregular curvature also provide good anchorage [11].

Crown to root ratio

The crown root ratio (CRR) is one of the most important clinical features to be kept in mind when designing a Removal of Fixed partial denture as it's a detrimental factor in the prognosis of the abutment. The CRR 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" [12]. CRR works on the principle of Class I lever, with the middle portion of the root acting as the center of rotation. The Crown root ratio increases with time due to loss of alveolar bone, which shifts the center of rotation apically. The apical shift in the center of rotation exposes the tooth to lateral forces, which can cause mobility in the abutment. This factor may play a pivotal role in cases where the patient has bruxism or increases vertical overlap [13]. As per Prosthodontic textbooks, a crown root ratio of 1:2 is supposed to be an ideal ratio for selection of the abutment, which is not found in the clinical practice readily. In clinical practice, the ratio of 2:3 was considered an ideal proportion (Figure 3). In 1965, Dykema, *et al.* [14] suggested that 1:1.5 was the most acceptable CRR in clinical practice. Shillingburg, *et al.* [15] suggested that a ratio of 1:1 was also acceptable CRR for an abutment tooth. They suggested that a 1:1 ratio was the minimum required ratio, and anything more than was considered remotely acceptable as it would decrease the occlusal forces (Figure 3). It can be concluded that a longer span FPD requires a more favorable CRR as the occlusal forces to be handled by that FPD is more. In cases where the Crown to root ratio is not acceptable but FPD is the best available treatment option, multiple abutment teeth or pier abutment can also be taken into consideration [16].



Figure 3: a- Crown root ratio of 1:1 b- CRR of 3:1 - unacceptable for abutment selection c-2:3- most acceptable CRR for abutment selection [17].

Arch form

The arch form plays an important role in the distribution of occlusal forces. Teeth in various sections of the dental arch are exposed to different kinds of forces. The buccolingual movement of the anterior and molars are at a different angle to each other. The abutment teeth tend to rotate on the application of forces on the pontics, and the edge of the FPD faces a vertical force. In such cases, the fulcrum is defined as the junction of the proximo-occlusal angle of the tooth preparation to the line joining the abutments adjacent to the span of missing teeth. The maximum lifting force is applied when the anterior teeth have to be replaced in a tapered narrow arch. The aim is to shorten the lever arm, which can be done by using multiple abutment teeth; for example, in a canine fixed partial denture, sometimes the first premolars are used as secondary abutments [18].

Tooth angulation

A tilted abutment tooth is one of the major issues that is encountered during tooth preparation for FPD. Most commonly seen is the second molar which is tilted medially. This tilt makes it impossible to form a common straight path of insertion. The best way to overcome this issue clinically is up righting the tooth with the help of fixed appliances. A helical spring is attached to the molar, which is banded, and the later part is hooked on the anterior segment [19]. A telescopic crown (Figure 4) and coping can also be given. Proximal half-crowns are also used in cases of tilted abutments where the half-crown is placed on the distal abutment. The tilted molar is prepared with heavy reduction along its long axis. A coping is first made on the tilted tooth, and later the proximal half-crown is placed over it [20].

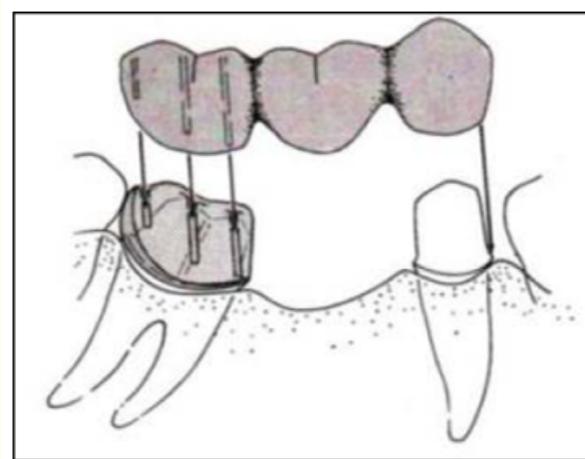


Figure 4: Telescopic crown preparation for tilted abutment [11].

Periodontal factors to be kept in mind while selecting abutments

Inflammation

Very frequently, patients who report missing teeth tend to show signs of gingivitis and periodontitis. In such cases, it is of prime importance that the patient’s periodontal health should improve before tooth preparation margins are placed on the gingiva. The main aim of periodontal therapy is to remove the inflammation, any periodontal pockets present should be eliminated, and normal sulcus depth should be achieved, adequate attached gingiva should be maintained, and physiological gingival health should be achieved. Patients

should be taught about maintaining good oral hygiene and its importance towards faster healing. In case of any surgical procedures for the periodontium, a minimum healing period of 6 - 8 weeks should be given before the tooth preparation margins are placed on the gingiva. Abutment teeth with furcation involvement should be removed if the prognosis seems to be poor in the future or should be treated accordingly [20].

Finish line for the tooth preparation

Finish lines of the tooth should be placed on healthy gingival tissue. The concept of Extension for prevention put forward by GV Black has become obsolete in today's era of conservative dentistry, and it is suggested that the preparation should be placed at least 1 - 2 mm above the gingival crest [21].

Biological width

Biological width, as described by Gargiulo, is a band of soft tissue which contains 1 mm of junctional epithelium and 1 mm of connective tissue that is present between the base of the gingival sulcus and alveolar crest. The biological width is of extreme importance and should not be violated by any caries or a fractured root segment or subgingival restorations as it may lead to a poor prognosis of the abutment. Cases where the crown height is reduced, should go for a clinical crown lengthening procedure to increase the retention of the FPD [21].

Additional factors to be kept in mind while a selection of abutment

Length of the tooth to be replaced

Cases that require an increased height of the pontic may require more than one abutment teeth for support which can be achieved by splinting multiple abutments.

Esthetics

FPDs in the anterior segment of the arch require good esthetics, which can be provided by full coverage crowns or long-span connectors.

Vitality

There are various schools of thought when it comes to the pulpal health of the abutment teeth. Research has shown that vital teeth tend to be more successful as abutments as compared to teeth with endodontic treatment. Teeth that have deep caries should be treated accordingly, and such teeth should go for an endodontic treatment before starting the preparation as the preparation further tends to remove a more sound tooth structure.

Psychological condition of the patient

Patients who are mentally compromised require splinting of multiple abutments as it helps to distribute the parafunctional forces applied by the patients.

Abutment height

The height of the abutment tooth should be 4 mm or more. Cases where the abutment height is less, should be increased clinically with restorative materials.

Mobility

Grade II mobile teeth are contraindicated as abutments, although teeth with Grade I mobility can be splinted with adjacent teeth [22].

Conclusion

Planning of a Fixed Partial Denture should always be executed as a multidisciplinary approach keeping the abutment teeth' pulpal and periodontal health in mind. The diagnosis of the case and thorough study of the diagnostic casts and radiographs is the primary step that helps decide the feasibility of the treatment option. Once the case has been taken up for a fixed prosthesis, the abutment teeth should be examined in detail regarding their crown height, crown root ratio, root configuration, mobility, etc. For a good prognosis, patients' compliance is of utmost importance, and hence patient education regarding good oral hygiene and maintenance of the prosthesis should also be given equal importance.

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