

How to deal with the real abutments in fixed dental prosthesis- questionable not ideal

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Abstract

Any extensively damaged, tilted, short, supra erupted, pier or a periodontally compromised abutment poses significant problems while restoring the edentulous space for a fixed dental prosthesis. In addition to these, patients with general disorders or congenital deformities also require careful observation and proper treatment planning. In general, the prognosis of an abutment can be good, questionable, or hopeless depending on its clinical and radiographic appearance. The objective of the article is to review the available treatment options for the questionable abutments and to impart a thorough knowledge of the same to the readers. By following an interdisciplinary approach and having a thorough knowledge of the various treatment options available, a general practitioner can succeed in providing a prosthesis that fulfills the esthetic and functional needs of the patient.

Keywords: extensively damaged teeth, tilted abutment, supra erupted teeth, periodontally compromised abutments, pier abutments.

Introduction

The abutment teeth are the force bearers due to their oral mechanism and tend to transmit these forces to the underlying periodontium.^[1] An abutment is classified as good, questionable, or hopeless based on its clinical and radiological assessment.^[2]

As stated by Rathika et al,^[2] the abutment is considered good if the pocket depth is less than or equal to three mm, periodontal attachment loss is less than 25%, and there is no furcation involvement. Endodontically, these abutments do not show any clinical signs, and there is no radiolucency present. Prosthodontically, they have enough remaining tooth substance, optimum retention, and resistance form with wall height four mm, convergence angle between 15-20 degrees and one and a half to two mm ferrule.

A questionable abutment has a pocket depth equal to or greater than six mm, and periodontal attachment loss is 50 % with grade II or III furcation involvement. Endodontically, there are no clinical signs, but there is persisting radiolucency. There is a reduction in retention and resistance form with wall height less than three mm, and convergence angle greater than 25 degrees.

A hopeless abutment has insufficient residual attachment, is symptomatic, and, has a persisting radiolucency. There is inadequate remaining tooth substance, and the ferrule is less than one and a half mm.

Categorization of questionable abutments

Questionable abutments can be discussed under abutments found in general disorders like amelogenesis imperfecta and fluorosis and congenital deformities like malformed dentition. We can also discuss abutments under local problems like pier abutment, tilted teeth, short teeth, or supra erupted teeth.

A) General disorder

1. Mineralization disorders
 - a. Amelogenesis imperfecta
 - b. Dentinogenesis imperfecta
 - c. Fluorosis.
2. Congenital & growth deformities

Malformed dentition, malposed teeth

B) Local problems

- a. Extensively damaged teeth
- b. Pier abutment
- c. Periodontally involved teeth
- d. Tilted teeth
- e. Short teeth
- f. Cantilever
- g. Supraerupted teeth

General disorders and their treatment strategies

- a. Mineralisation disorders ^[3-8]
- b. Amelogenesis imperfect (AI)

Malocclusion is a common finding with the children associated with AI. Treatment planning should be done from an early age by the combined efforts from a pediatric dentist, a restorative dentist, and an orthodontist. Surgical correction might be required if an anterior open bite is present. Prefabricated metal crowns for the posterior teeth and polycarbonate crowns or composite restorations for the anterior teeth is given to protect the primary dentition.^[4]

Dentinogenesis imperfecta (DI)

Treatment of DI cases with mixed and permanent dentition requires a multidisciplinary approach. Meticulous oral hygiene instructions and preventive treatment are essential in these cases to prevent caries from adding to the already present problems. In some cases, there might be a need to re-establish the vertical dimension of occlusion. Prosthetic rehabilitation involving full mouth diagnostic wax up ^[9 & 10] combined with orthodontic treatment may be beneficial, and proper evaluation of the occlusion before initiation of treatment is always recommended. ^[11]

Fluorosis

The aesthetic appearance of a fluorosis patient usually can be treated by bleaching.^[8] But not all cases achieve satisfactory results. A different method⁷ is suggested consisting of three principal stages: 1. 12% HCl is used for enamel etching to expose the micro-cavities containing the organic elements by removing the post-eruptive calcified layer covering the fluorotic enamel surface, 2. Pure sodium hypochlorite is then applied to eliminate the organic stains, and; 3. A dental adhesive (light cure) is then used to fill the chemically opened micro-cavities to make the tooth surface smooth, which would prevent any kind of restaining

Congenital & growth deformities' treatment strategies:^[12-14]

Esthetics is compromised in many adult patients due to malposed anterior teeth. Coronal reshaping might be helpful in some patients to solve this issue. ^[12] A combination of orthodontic positioning and recontouring of teeth or full coverage restoration are suitable options for the heavily malformed dentitions.

Treatment strategies for abutments with local problems

a. Extensively damaged tooth

An extensively damaged tooth poses several challenges during its restoration. The choice of material for restoration and the preparation design is dependent on the following factors: ^[1]

- The extent of the destruction.
- Location of the destruction which can be classified as peripheral, central, or combined.

A. Restoration of vital teeth ^[15]

1. Grooves: For a better retention and resistance form, 1.0 mm wide and deep grooves can be made in the vertical walls of bulk tooth structure. Also, multiple grooves/slots of such kinds are placed in the axial walls, which are less destructive and provides resistance as effective as the box form.

2. Box forms: Boxes can be made as a substitution for the grooves and are excellent means of retention. A box preparation can incorporate an interproximal carious lesion or an old restoration up to a moderate size.

3. Inlay onlay: ^[16 & 17] Restoring a severely damaged posterior vital teeth with ceramic inlays or onlays is minimally invasive and based on adhesion principles. These indirect posterior restorations have become scientifically recognized due to the following advantages:

a) The physical properties are much better than direct composite restorations.

b) Using inlays/onlays in large MOD preparations increases the fracture resistance.

c) The microleakage with ceramic inlay/onlay is less when compared to gold and amalgam.

d) Esthetics is much better when using a ceramic inlay/onlay as it permits the operator to achieve a pleasant shade.

The success rate of ceramic inlay/onlay

A success rate of around 85% with a fracture rate only of 8% has been reported for inlays for a period of 12 years. S. Jorgen has reported an 89% survival rate at 10 years for CEREC inlays. ^[18] Many factors such as proper case and material selection, the design of the preparation, and the creation of an uncontaminated adhesive tooth /ceramic interface ^[19] decide the long term success. It has been reported that the glass fiber reinforced ceramics has an acceptable success rate as compared to other materials. ^[20 & 21]

B. Restoration of non-vital teeth ^[22 & 23]

1. Endocrown

Endocrown is described in the literature as a monolithic (one- piece) ceramic bonded construction. ^[23 & 24] It is used as the post endodontic restoration of severely damaged posterior teeth. Endocrowns for maxillary premolars ^[25] and maxillary incisors ^[26] still lack adequate evidence. The preparation of an endocrown requires a specific technique.

Longevity and Effectiveness:

Bindl and Mörmann ^[27] concluded that “the overall clinical quality of the endocrowns was excellent” after evaluating the adhesively placed endocrowns for two years. Biacchi and Basting, ^[27] in 2012, compared the fracture strength of an indirect conventional crown retained by glass fiber posts and endocrowns, and it was found out that the endocrowns were much more resistant to compressive forces than the conventional crowns.

2. Post and core:^[28]

Post and cores are needed for the restorations of the endodontically treated teeth based upon the quantity of the lost tooth structure and the overall functional requirements of the tooth. Many post systems are available for the same. Active (threaded) post systems can provide better retention when compared with the passive such as smooth-sided or serrated posts, but the stresses introduced into the root are more. A prefabricated post is less retentive than a cast post. A parallel-sided post offers more retention when compared to a tapered post. The use of reinforced composite resin cement significantly increases the retention of parallel-sided posts and tapered posts when compared to zinc phosphate cement.

b. Pier Abutments

A pier abutment or an intermediate abutment is a natural tooth located between terminal abutments that provide support to a fixed or removable dental prosthesis.^[29] When occlusal forces act on the ends of the prostheses; a pier abutment will tend to lift the other end like a class I lever because of its strategic position. Failure of the prosthesis can occur due to the stresses on the terminal abutments and trauma to the periodontium. Thus, it is suggested to use a non-rigid connector in a case of pier abutment.^[30]

Indications for non-rigid connector:^[2, 31 & 32]

1. A pier abutment case (acts as a stress breaker).
2. Two abutments that cannot be prepared with a common path for the placement.
3. Abutment teeth with a doubtful prognosis.
4. A prosthesis (especially in the mandibular arch) having an anterior and a posterior segment.
5. When splinting mobile teeth together as connectors.
6. Malaligned teeth used as abutments.

Contraindications for the non-rigid connector

1. Significantly mobile abutment teeth.
2. Long edentulous span (longer than one pontic).

3. Two anterior retainers having natural dentition in opposite arch while the posterior retainer and pontic having a removable partial denture or an edentulous ridge in apposition.

Advantages of non-rigid connector:^[33 & 34]

1. The connectors are saved from the stress concentration as most of the stress is transferred to the supporting bone.
2. The mesiodistal torquing of the abutments is reduced, and the abutments are allowed to move much independently.

Disadvantages

1. The pier abutment might require more tooth reduction.
2. It is an expensive and time-consuming procedure.
3. The key lifts off from their keyway in the absence of occlusal stability.

Types of non-rigid connectors

1. Dovetail (key-keyway).
2. Cross-pin and wing-type connector.
3. Split type connector.
4. Loop type connector

Location of non-rigid connector:^[30] The stress breaking device or the non-rigid connector, in a five-unit pier-abutment restoration, is mostly placed on the middle abutment, since the pontic may act as a lever arm if the non-rigid connector is placed on either of the terminal abutments. The keyway is fabricated on the distal side of the pier abutment, whereas and the key is attached to the mesial side of the distal pontic. Such a placement reduces the areas of stress concentration when the non-rigid connector is integrated.

Inverted orientation design: The conventional design for placement of the non-rigid connector requires the preparation of the distal contour of the pier abutment. To prevent the over reduction of the preparation or over contouring of the retainer, an inverted orientation^[35] of the

non-rigid connector is suggested. In this inverted orientation design, the key is attached to the distal surface of the mesial retainer and the keyway to the mesial surface of the pontic. This type of arrangement has fewer disadvantages with several advantages.

c. Periodontally compromised abutments

Many studies have stated that the proper treatment of the periodontal disease followed by a thorough maintenance program prevents the disease recurrence, especially when dealing with extensive fixed prostheses where the abutment teeth exhibit reduced periodontal support. The primary importance should be given to the number and distribution of the abutment teeth during prosthetic designing of a cross arch bridge.^[36] At least four to six abutments are advocated, though 10-12 unit prosthesis cases with cross arch bridges using only two canines as abutments have shown good long term results in the past. The abutment teeth in such designs should also have a minimum of 30% remaining periodontal support.

According to literature,

1. A unilateral fixed dental prosthesis can be supported by a periodontally compromised abutment tooth for two years with a careful case selection and maintenance of good oral hygiene.^[37]
2. Combined restorative and periodontal treatment showed successful outcomes over three years' time in patients with the advanced periodontal disease having cross arch fixed dental prosthesis or a unilateral fixed prosthesis.^[38]
3. When hemisection and bicuspadization for periodontally compromised teeth is done, and it is used as an abutment for many years, the outcome is successful without complication.^[39]

d. Tilted molar abutments

The mandibular molar abutment tilting mesially into the anterior edentulous space is not an uncommon problem. Preparing such tilted teeth along the long axes and

achieving a common path of insertion and removal becomes difficult. Presence of the third molar makes the treatment more complicated.^[1]

Treatment options available for cases with tilted molars as abutments are:

1. Uprighting of the tilted molar with orthodontic treatment.^[40]
2. Avoiding full preparation and using a proximal half-crown as a retainer on the tilted molar.
3. Fixed partial denture using a telescopic crown and coping as a retainer on the tilted molar.
4. A non-rigid connector which compensates for the inclination of the tilted molar.
5. A bit more preparation of the mesial surface of the second molar or mesial half- crown on the second molar and addition of facial and lingual grooves on second molar for better retention
6. If tilting is severe, uprighting of the molar by the orthodontic treatment, which also helps in the axial distribution of forces under occlusal stresses and even helps to eliminate bony defects along the mesial surface of the root. The average treatment time is around three months.

The telescopic retainer

The telescopic retainer can help in achieving a common path of insertion in a tilted molar case. The abutments must first be prepared according to their individual vertical axis. The entire prepared surface is then covered by individual copings extending till the finish lines. The outer surface of these copings is known as the understructure and should be waxed parallel to each other. The superstructures are then waxed (short of the margin), casted and seated over the copings just like the conventional fixed partial denture units restoring the form and function of the entire quadrant.^[41-43] The gingival area of the tooth need not be prepared extra to accommodate

the thickness of both castings as the superstructure does not extend as far gingivally as the understructure.^[41, 44-46]

The understructure is first cemented on the teeth, followed by an over structure with a weaker cement.

e. Short abutments

Many times, the main prosthodontic challenge that occurs is the reduced restorative space because of the short cervico-occlusal height of the abutment teeth. A short crown might lead to decreased retention and resistance form. Before proceeding with tooth preparation in such cases, the tooth height must be increased using restorative build-up or by extending the gingival margin apically through a crown lengthening procedure.^[47]

f. Cantilever abutment

The cantilever fixed partial denture (FPD) is a restoration supported with one or more abutments only at one end and unsupported at the other end.^[48] Minor rotational movements of the abutments can occur due to the forces transmitting through the cantilevered pontics. Location

A cantilever fixed partial dentures should replace only one tooth and have at least one abutment. The abutments for cantilever FPDs should have long roots with favorable crown root ratios, and long clinical crowns. When compared to the replacement of maxillary central incisors and canines, the maxillary lateral incisor and premolar and the mandibular teeth are documented to be more successful.^[49] Usama N and Shawn R in 2006,^[50] reported a cantilever fixed dental prosthesis replacing a left maxillary lateral incisor using the left canine as a partly covered abutment, which remained in service for fifty three years.

It is important to replace the first premolar if full veneer retainers are used on the second premolar and first molar abutments. Also, to replace a mandibular first molar, both premolars should be used as abutment teeth. To minimize

stress on the abutments, the pontic should be the size of a premolar rather than a molar.^[1]

g. Supraerupted abutments

Supraerupted teeth are the most overlooked teeth clinically but will often complicate fixed partial denture design and fabrication. The most common problem is that it leads to inter-arch space obliteration.

Treatment modalities^[51]

- a. Enameloplasty / coronoplasty is the easiest and least invasive technique. If it leads to more removal of tooth structure, a cast metallic restoration must be placed.
- b. Intentional root canal treatment is done if the hyper erupted tooth or the drifted teeth must be reduced so much so that the pulpal involvement appears certain.
- c. Molar intrusion might be one of the treatment modalities,
- d. A dentoalveolar extrusion can be corrected with orthognathic surgical procedures like posterior segmental osteotomy.
- e. If the alveolar bone support is lost, like in cases of furcation involvement, extraction of the tooth is a better option than saving it and complicating the treatment.

Steps of Coronoplasty:^[51]

1. Most of the patients have a difference in the Retruded Cuspal Position (RCP) and the Inter Cuspal Position (ICP). The retrusive pre-maturities which might be present are removed to eliminate the deflective shift.
2. Fremitus test is used to check the excessive contacts on the incisor teeth. Also, the contacts are bilaterally distributed on the anterior teeth by removing posterior protrusive supra contacts.
3. The excessive cusp steepness is reduced on the laterotrusion (working) contacts and the mediotrusive (balancing) interferences are removed.

4. All the rough surfaces are polished after removing the gross occlusal disharmonies and re-evaluating the tooth contact relationships.

The Dahl Concept: ^[52]

The Dahl Concept or the fixed orthodontic intrusion appliance is based on the concept that a localized appliance/restoration placed in supra-occlusion can cause relative axial tooth movement and the occlusion attains full arch contacts after a certain time.

Conclusion

When making a treatment plan, it is important to re-evaluate the questionable tooth, especially if it is intended as an abutment for a fixed dental prosthesis. The complexity of the treatment increases manifold if the abutment teeth have many associated risk factors. A questionable tooth should be maintained or extracted depending upon the strategic position of the questionable abutment teeth, the condition of the remaining dentition, and the overall treatment plan.

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