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Different Techniques of Complete and Partial Denture Repair

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Fulfillment of the requirement for prosthodontic
department

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Declaration

This is to certify that the organization and preparation of this project have been made by the graduate student Aya Hussein Atiyah under my supervision at the College of Dentistry/University of Baghdad in partial fulfillment of the requirement for the degree of B.D.S.

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Dedication

I dedicate my project work to my beloved sister mareb and my family. A special feeling of gratitude to my loving mother whose words of encouragement and push for tenacity ring in my ears.

To my beloved friends Aya, Anfal, Esraa, and Mohammed

Acknowledgment

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List of abbreviations

| | |
|-------------|-----------------------------------|
| RPD | Removable Partial Denture |
| RCD | Removable Complete Denture |
| PMMA | Polymethylmethacrylate |

Introduction

There are various treatment options for replacing missing teeth such as removable partial dentures (RPD) which are an effective and reasonable treatment modality to restore function and aesthetics. RPD success mainly depends on proper design and components selection and another option is removable complete denture (RCD) which replaces the all-missing teeth of the jaw (**Gad et al., 2021**)

Removable dentures made of acrylic resin are subjected to fracture if dropped or stressed beyond their fracture strength. Fabrication of a new denture is an expensive and time-consuming procedure, and for this reason, the decision to repair a denture is a common one (**Sarac, 2005**).

The ultimate goal of any acrylic denture repair is to restore the original strength of the fractured denture and to avoid further fracture. Satisfactory repair should be easy, match the original material in color, rapid and inexpensive. Several techniques and materials have been developed to attain such a goal (**Stipho, 1998**).

There are many factors affecting successful repairs such as the materials used for repair, the surface contour of repair joints, the joint surface gap between the repair ends, repair technique, and treatment given to the joint surfaces before repair resin application (**Lin, 2000**).

Auto polymerizing acrylic resin has been the most popular material for repair because it allows easy handling and quick repair at a low cost. The auto polymerized resin was found to exhibit repair strength comparable to conventional heat-cured and light-polymerized resin (**Mohammed et.al, 2016**).

Aims of the review

- 1- Review the most common types and causes of denture fracture.
- 2-To review the best techniques and materials used in dentures repair.

Chapter One

Review of the Literature

1.1 Denture fracture

One of the most practical deficiencies of the present denture is a fracture. Three-quarters of a million dentures were repaired each year in England and Wales. Most of these repairs are due to failure of polymethylmethacrylate (PMMA) denture bases resin due to impact and fatigue fracture of a denture (**Hegde, et.al, 2020**).

In most situations, fractures occur in the midline of the denture base. This location of fracture occurs more often in maxillary dentures than in mandibular dentures (**A et al., 2015**).

1.2 Causes of fracture

The main causes of denture fracture may be accidental or patient carelessness, dropping of the denture, or due to resorption of the residual alveolar ridge which causes instability of the denture with the midpalate area acting as a fulcrum (**Ye and Sun, 2016**).

Most acrylic denture bases break because of impact failure or fatigue failure within a few years from denture wearing. The most common causes of fracture are lack of fitness and lack of balanced occlusion which leads to increased denture deformation (**Johnston, et.al, 1981**).

Denture fracture is generally related to faulty design, fabrication, and material choice. Another cause of fracture is the stress produced within the denture so the maxillary denture is subjected to bending deformation, with tensile stress occurring at the labial aspect and lingual to the incisors on the polished surface (Millar, 2000).

Basker et. al, in 2011 classified the causes of fractures into:

1-Denture factors: which include several factors like stress concentration, absence of labial flange, incomplete polymerization of the acrylic resin, previous repair, shape of the teeth on the denture, poor fit, and lack of adequate relief.

2- Patient factors: which include anatomical factors like a prominent labial frenum will require a deep notch in the flange resulting in stress concentration in the area and high occlusal loads, that patient with powerful muscles of mastication, or whose natural lower teeth are still present.

1.3 Mode of fracture

There are two mechanisms to describe the way dentures can break (impact fracture and fatigue fracture) (Jepson et. al, 1995).

1.3.1 Impact fracture

Occurs when the denture is accidentally dropped on a hard surface. The fracture by impact depends on the point of impact and direction of force applied which varies in each case. On being dropped, tensile and compressive forces are set up in the denture and their positions vary with the point of impact (**Sharma, 2016**).

This type of fracture usually happens when patients are coughing which pushes the denture out of the mouth. Or accidental dropping of the denture over the floor or sink or result from an accident in which the patient receives a blow to the mouth. Also, it may occur if the patient is involved in a violent accident involving the facial region (**Farret et al., 2013**).

A material may have reasonably high static strength values, such as compressive, tensile, and shear strength, and even reasonable elongation, but may fail when loaded under impact. The impact resistance of materials is determined by the total energy absorbed before fracture when struck by a sudden blow (**Bonsor and Pearson, 2013**).

Whenever possible the cause, or causes of the fracture must be identified before the denture is repaired or replaced. Unless this is done and the cause attended to, the denture is likely to fracture again within a short period (**Zarb, 2013**).

1.3.2 Fatigue fracture

Zarb in 2013 explain this phenomenon as follow: fatigue fracture results from repeated flexing of the denture by forces too small to fracture it directly. Failure of the denture base is due to the progressive growth of a crack originating from a point on the surface where an abrupt change in the surface profile causes a localized concentration of stress many times applied to the bulk of the denture. The crack often starts palate to the upper central incisors, grows slowly at first but undergoes an increased rate of growth just before the denture fractures. A failure of this type most commonly occurs in dentures that are about 3 years old (**Zarb, 2013**).

AlQahtani and Haralur in 2020 published that fracture of the denture base often occurs by a fatigue mechanism in which small flexural stresses, over some time, lead to the formation of a small crack, which then propagates through the denture that was ill-fitted or badly designed.

Bhattacharya et al. in 2014 noted that the common causes of fracture are poor fitness and lack of balanced occlusion, which leads to increased denture deformation.

A survey was done by **Kizim in 2013** to determine the prevalence of the type of fracture. The questionnaire was distributed to three different dental laboratories, they concluded that the most common cause of fracture is fatigue failure which either causes loosening of teeth or fracture of the denture base itself. The stress

concentration enables the initiation and propagation of cracks as notch or diastema, variation in the denture base contour; changes in the supporting tissue, and teeth wear, the presence of these may increase the denture base deformation.

Zarb and Bolender in 2004 suggested that when a single denture is opposed by a full or near full complement of natural teeth, a common complication is a fracture of the denture base.

Specific conditions that encourage such a fracture include heavy anterior occlusal contact, deep labial frenal notches, and high occlusal forces due to strong mandibular elevator musculature. The base material should have adequate fatigue life and a high value of fatigue limit (**Mccabe and Angus Walls, 2008**).

1.4 Reducing the incidence of fracture

If the fracture of the denture can be avoided, there will be major economic benefits to the community, reducing the inconvenience to the patient and reducing the possible hazard to the health due to swallowing or inhalation of parts of the plastic denture. A majority of the midline fractures can be avoided by the application of established prosthodontic principles during construction including (**Salama, 2017**):

- 1) Maximum denture stability and good denture fitness (**Thomas, 2015**).

- 2) Providing a denture with completely balanced occlusion to reduce wedging effect and locking of occlusion (**Chowdhary and Chandraker, 2010**).
- 3) Adequate bulk and uniform thickness of the dentures increase the strength and stiffness of the denture (**Mccracken, Carr and Brown, 2016**).
- 4) Reduce the need for a deep frenal notch by a frenectomy (**Deepak Nallaswamy Veeraiyan, 2017**).
- 5) Slow cooling to minimize the internal stress in the denture during processing (**Chowdhary and Chandraker, 2010**).
- 6) Avoid any deep notches that should be shallow and rounded at the bottom (**Mccracken, Carr and Brown, 2016**).
- 7) Good processing technique, which reduces residual stress within the denture and avoids surface defects and inclusions.
- 8) Relief over the non-compressive tissue in the center of the hard palate (**Takamiya et al., 2011**).
- 9) Increase the base thickness, which will increase the fracture resistance of the shallow palatal vault base (**Vikram and Chander, 2020**).

1.5 Denture repair

Dentures may need to be repaired when serious damage is present or when they are just in need of some minor adjustments, repairing a broken denture can be required for a variety of reasons from a simple hairline crack that the patient can feel with their tongue, like a hair stuck to the denture, to a complete separation of the denture into two or more pieces with the teeth loss So that the fractured denture is repaired by using several types of materials and techniques (Steel, 2010).

1.6 Materials used in denture repair

1.6.1 Cold-Curing resin materials.

Cold-Curing resin is the most commonly used material, but this material lacks the strength of heat-curing resin which make a repeat fracture more likely (McCord, 2003).

1.6.2 Heat-Curing resin materials.

Denture base repair with heat polymerized acrylic resin provided the highest fracture resistance and flexural strength but the denture repair procedures are time-consuming, higher cost, and require dental laboratory support. (Chander et. al, 2019).

1.6.3 light-curing resin materials

Light cured resin may be used but it is weaker than Cold Curing resin and insufficient long-term data are available to permit this system (**Basker et. al, 2011**).

1.7 Repair techniques of removable complete denture

1.7.1 Midline fracture

If the fractured parts of the dentures can't be accurately approximated together so the repair is not recommended. The techniques for maxillary or mandibular prostheses are similar (**Gleiznys, 2020**).

1.7.1.1 Midline repair technique

- The two broken parts of the dentures are aligned together in their right position and fixed by a sticky wax on the polished surface.
- Then the parts may be strengthened with burs or plastic sticks in their right position as in **Figure (1.1) (B)**.
- Blocking out of undercuts is on the surface with wax as in **Figure (1.1) (C)**.
- Then pour the stone into the fitting surface and allow the stone to set, then after that, the denture is removed from the cast, clean the denture from any traces of sticky wax.
- Reducing the Fractured edges and widened for about (8-10mm) along the fracture line and beveled towards the

polished surface to increase surface area for bonding as in **Figure (1.1) (D)**.

- To increase the strength of the repair joint, the dovetail cuts should be made.
- Painting the cast with a separating medium and securing the denture with rubber bands to the cast.
- Applying Cold-Curing resin to the modified fracture area until the area is overfilled.
- Relief of the median palate raphe (**Zarb and Bolender, 2004**).

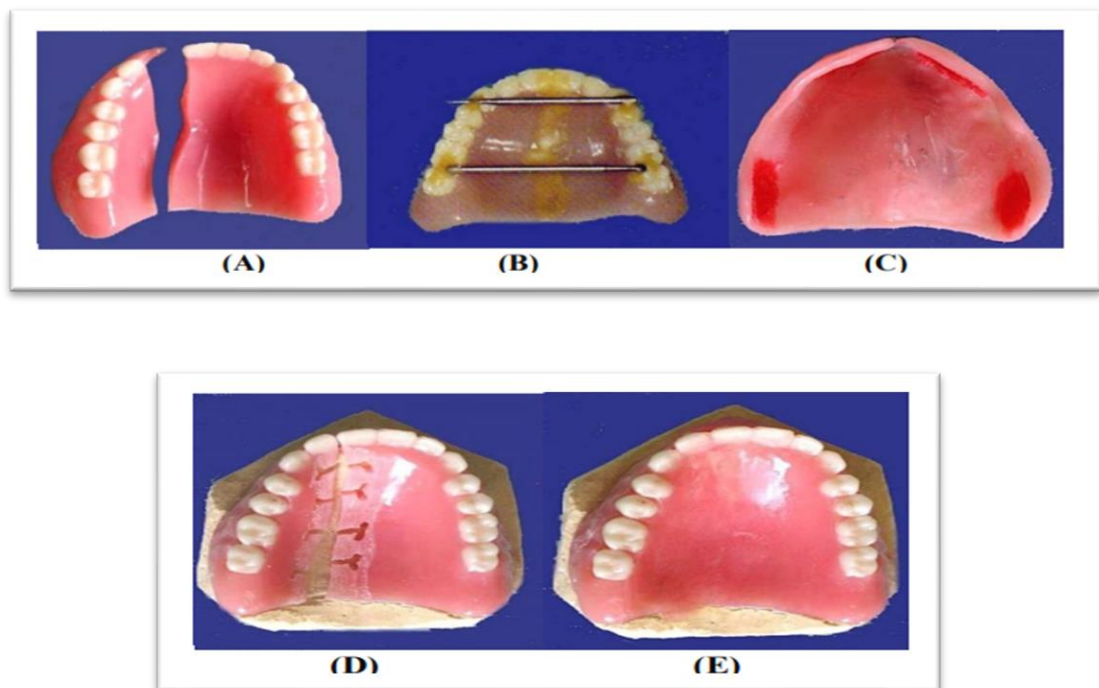


Figure (1.1): Midline fracture repair of the upper denture. (**Zarb and Bolender, 2004**).

1.7.2 Fractured flanges

- The missing piece of the flange is replaced by forming a tracing compound onto the lost area of the flange.
- Then the cast is poured and the tracing compound is replaced with acrylic resin after a suitable separation of the cast (**Grant et. al, 1994**).

1.7.3 Fractured flange plus tooth or teeth

This type of repair may be better combined with a re-base and it is often advantageous to replace the lost area of the flange with a tracing compound and to take an impression of the opposing arch plus an inter-occlusal record (**Grant et. al, 1994**).

1.7.4 chipped tooth

- If the tooth is acrylic and in a non-critical position (e.g., the incisal edge of an incisor), then the tooth could be polished, in some cases, this may impart a natural appearance to the denture as in Figure (1.2) (A).
- If the teeth are made of porcelain, or the fracture is so large that polishing is not acceptable as in **Figure (1.2) (B)**, remove the tooth or teeth concerned as in **Figure (1.2) (C)**, wax the replacement teeth in place, taking care to make plaster or silicon putty index of the repaired form as in **Figure (1.2) (D)** and place the wax with acrylic resin as in **Figure (1.2) (E)**, to facilitate union the prepared acrylic surface should be primed

with monomer, care must be taken to ensure that occlusal interferences do not occur (*Grant and Mccord, 1994*).



(A)



(B)



(C)



(D)



(E)

Figure (1.2): Chipped tooth repair (*Grant, and Mccord, 1994*).

1.7.5 Lost tooth or teeth

If the tooth or teeth are lost then thus the impression of opposing arch (if it is whether natural teeth or restored arch) and the interocclusal record will be required, those being required to articulate the arches together accurately, and the teeth set up without the creation of occlusal discrepancies as in **Figure (1.3) (Grant, and Mccord, 1994)**.

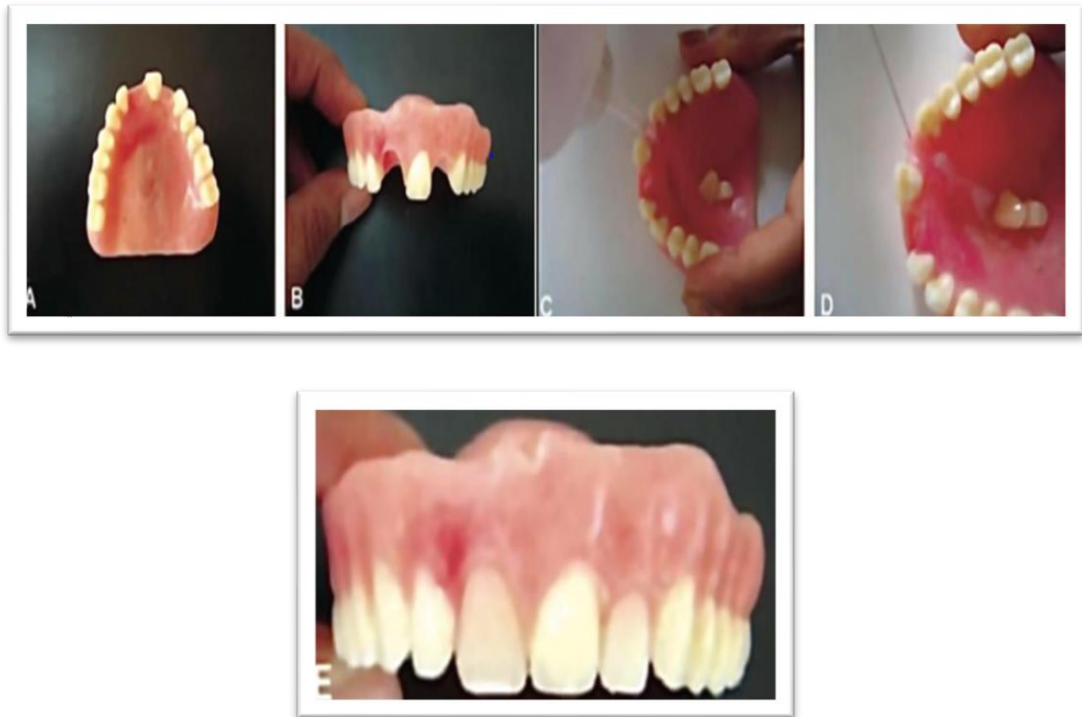


Figure (1.3): Tooth replacement in a complete denture. (Grant et al., 2016).

1.7.6 Replacement of posterior teeth

This may be necessary because of a need to alter the vertical dimension of occlusion, due to a gross error in occlusion, or patient preference (Ye and Sun, 2016).

The technique is as follows:

1. Ensure that both retruded contact position and occlusal vertical dimension are confirmed and that the casts are placed on a semi-adjustable articulator following face-bow transfer and appropriate settings of sagittal and lateral condylar inclines.
2. Block out undercuts on the fitting surface, pour a cast onto the impression surface of the denture, and articulate the dentures.
3. Remove the appropriate posterior teeth; if acrylic, by grinding and if porcelain by heating the acrylic enveloping the teeth, and removing with an appropriate instrument as in **Figure (1.4) (B)**.
4. Remove sufficient denture base to accommodate replacement teeth.
5. Wax teeth to replacement position as in **Figure (1.4) (C)**.
6. Make indices of the buccal and occlusal surfaces of the teeth in their new positions as in **Figure (1.4) (D)**.
7. Remove indices plus teeth.

8. Remove wax, roughen the surface of the prepared denture base, replace indices with attached teeth and add acrylic, incrementally.

9. When curing has been completed as in **Figure (1.4) (E)**, ensure occlusion is unaltered, polish the denture and re-confirm the occlusion clinically (**Ye and Sun, 2016**).



(A)

(B)

(C)



(D)



(E)

Figure (1.4): Posterior teeth replacement (**Ye and Sun, 2016**).

1.8 Repair techniques of removable partial denture

1.8.1 Broken clasp arms

The following are several reasons for the breakage of clasp arms:

1. Breakage may result from repeated flexure into and out of too severe an undercut. If the periodontal support is greater than the fatigue limit of the clasp arm, failure of the metal occurs first otherwise, the abutment tooth is loosened and eventually is lost because of the persistent strain that is placed on it however, locating clasp arms only where an acceptable minimum of retention exists, as determined by an accurate survey of the master cast can prevent this type of breakage.
2. Breakage may occur as a result of structural failure of the clasp arm itself, a cast clasp arm that is not properly formed or is subject to careless finishing and polishing eventually will break at its weakest point this can be prevented by providing the appropriate taper to flexible retentive clasp arms and uniform bulk to all rigid non-retentive clasp arms.
3. Breakage may occur because of careless handling by the patient. Any clasp arm will become distorted or will break if subjected to excessive abuse by the patient, the most common cause of failure of a cast clasp arm is distortion caused by the accidental dropping of the removable partial denture (**Carr et al., 2004**).

Repair is done in the following manner: -

- The remaining part of the original clasp arm is first to cut off flush with the point of origin of the clasp.
- A hole is then drilled just below the adjacent denture tooth as in **Figure (1.5) (B)**, from this hole a groove is cut in the resin base long enough to accommodate sufficient length of the wrought wire.
- A piece of 18-gauge wrought wire is shaped and adapted to fit the groove as in **Figure (1.5) (B)**.
- A right-angle bend is made at the end of the wire.
- A straight portion is left emerging from the resin base at the point of origin of the new clasp arm.
- The projecting wire is then cut off to the required length and adapted to the abutment tooth on the master cast to serve as a new retentive clasp arm as in **Figure (1.5) (C)**, the wire is fixed to the base with chemically activated resin (**Niarchou et al., 2011**).

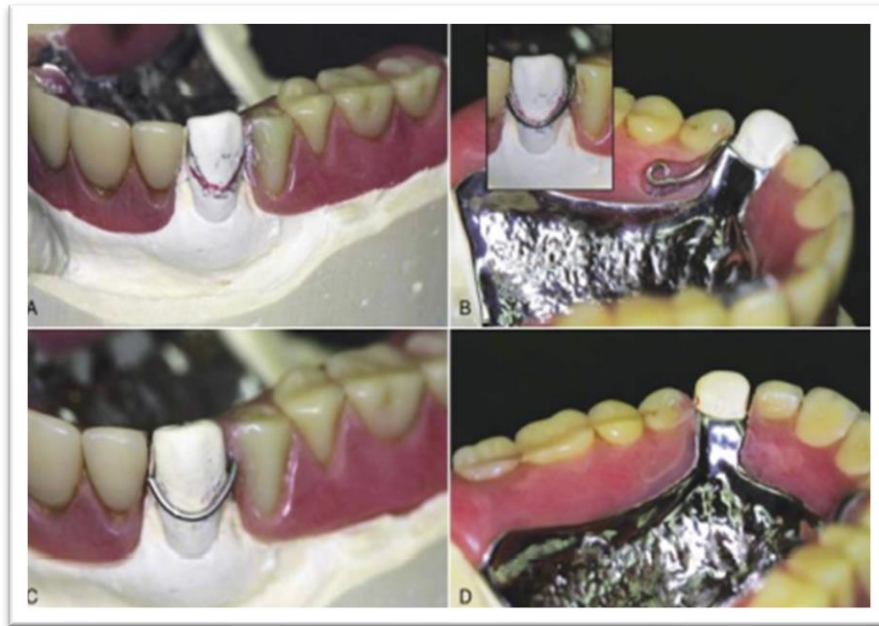


Figure (1.5): Fractured direct retainer on the canine abutment (Niarchou et al., 2011).

1.8.2 Occlusal rest repair

Breakage of an occlusal rest almost always occurs where it crosses the marginal ridge. Improperly prepared occlusal rest seats are the usual cause of such weakness. An occlusal rest that crosses a marginal ridge that was not lowered sufficiently during mouth preparations may be made too thin or maybe thinned by adjustment in the mouth to prevent occlusal interference. Failure of an occlusal rest rarely results from a structural defect in the metal and rarely if ever is caused by accidental distortion. Therefore, the blame for such failure must often be assumed by the dentist for not having provided sufficient space for the rest during mouth preparations (Singh, 2013).

Soldering repair technique of broken occlusal rests:

- In preparation for the repair, it may be necessary to alter the rest seat of the broken rest or to relieve occlusal interferences.
- With the removable partial denture in its terminal position, an impression is made in irreversible hydrocolloid and then is removed, with the removable partial denture remaining in the impression.
- The dental stone is poured into the impression and is allowed to set. The removable partial denture is removed from the cast, and platinum foil is adapted to the rest seat and the marginal ridge and overlaps the guiding plane.
- The removable partial denture is returned to the cast and, with a fluoride flux, gold solder is electrically fused to the platinum foil and the minor connector in sufficient bulk to form an occlusal rest.
- An alternative solder to use is an industrial brazing alloy, which is higher fusing but responds excellently to electric soldering and does not tarnish (**Singh, 2013**).

1.8.3 Repair of major or minor connectors

Major or minor connectors usually do not break because they have adequate bulk of the metal. A major connector may weaken due to frequent adjustments to overcome adaptation or tissue impingement problems. Additionally, major connectors which are

not rigid and indicated in only some particular situations like Kennedy bar may weaken after some time; and the weakened parts cannot tolerate intraoral stresses and may break as in **Figure (1.6)**, misuse of the patients may also be a reason of the distortion of the major or minor connectors usually, clinicians choose the option to reconstruct the RPDs when the major connectors are broken (**Geckili et al., 2016**).



Figure (1.6): Fractured connector. (**Aditama and Sabdayana, 2019**).

Repairing Procedures of Major or Minor connector:

- Breakage of major connector happens rarely, except for the lingual bar major connector which breaks at its junction with retentive latticework A new segment is cast and attached to the framework with solder the same can be done following breakage of the minor connector.

- Major and minor connectors also need repair when the denture has been distorted and does not completely and passively seat on the abutment teeth.
- The framework is sectioned with a carborundum disc and the sections are seated in the mouth. The sections should have an adequate fit or the entire framework should be remade
- A plaster or resin index is used to record the relationship of the sectioned parts in the mouth. The sectioned denture with the index is sent to the laboratory where they are soldered and finished.
- Following the loss of several teeth, a denture base minor connector may need to be added to the framework. An accurate repair cast with the existing partial denture is made along with an opposing cast for articulation. Loops of 18gauge wire can then be soldered to the framework for fabricating the minor connector. Alternately, sections of standard retentive mesh or latticework can also be soldered to the framework. An internal and external finishing line is mandatory (Deepak et. al, 2017).

1.8. 4 Denture base repair

If the broken segments are available and can be accurately repositioned the following is done:

- The sections are held together and luted with sticky wax along the fracture line as in **Figure (1.7) (A)**.

- Dental stone is poured against the tissue side of the denture base, when the stone sets, the denture is removed and the sticky wax is cleaned.
- The denture is separated along the fracture line.
- The fractured margins are dovetailed as in **Figure (1.7) (B)**.
- The separating medium is applied over the cast.
- The pieces of the denture are assembled and held in position. Auto-polymerizing resin is added along the fracture line by the sprinkle-on method as in **Figure (1.7) (C)**.
- It is placed in a heated pressure pot to complete the curing (**Stig et. al, 2013**).

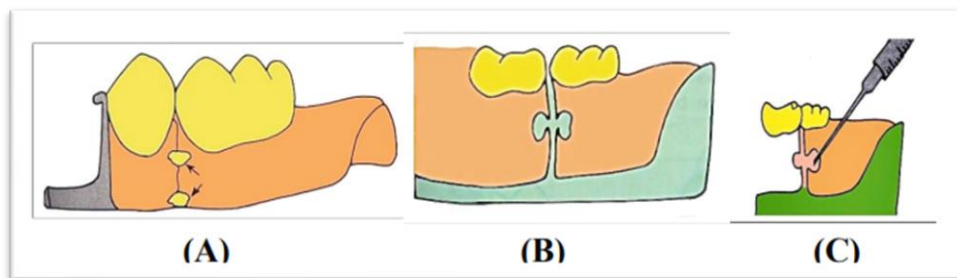


Figure (1.7): Denture base repair (**Stig et. al, 2013**).

If the broken segments are lost or cannot be re-positioned the following is done:

- They are discarded in such cases, and the modeling plastic is added and contoured in the defective area as in **Figure (1.8)**.
- the impression is made without displacing soft tissues.
- the repair is done as a ‘rebase’ procedure (**Stig et. al, 2013**).

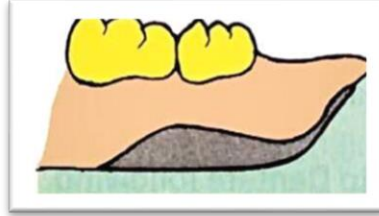


Figure (1.8): Molding of the border of the denture base(Taylor, 2017).

1.8.5 Replacement of additional lost natural teeth

If for some reason a tooth is to be extracted such as decay or periodontal disease, the addition of a denture tooth to the RPD to replace a natural tooth loss is usually a simple procedure when the partial denture base is made of resin, but when the base is made of metal the procedure is more complex and necessitates either casting a new component and adding it by soldering or creating retentive elements for the attachment of a resin extension carrying Loss of an additional tooth (Nakai, 2020).

Often adding of a tooth could be considered a real emergency if the tooth loss is for an anterior tooth also, the tooth can be replaced as an addition after the natural tooth has been extracted and initial healing has taken place, and this is often the preferred way, as an Immediate replacement followed by the extraction (Nakai, 2020).

1.8.5.1 Adding an Individual Tooth

- This procedure varies according to the design of the major connector.
- If there is a lingual plate, a retention loop for the added tooth can be directly soldered to the framework. Later the denture tooth is trimmed and placed over this retention loop.
- If there is no plate on the lingual side then a new retentive loop with a plate is cast and soldered to the existing framework.
- An internal finish line should be created for better adaptation of resin (**Renne, 2010**).

1.8.5.2 Adding Multiple Teeth

- The base is redefined with modeling plastic in the area of the missing tooth.
- Alginate over-impression is made over the partial denture.
- A cast is poured.
- An opposing cast with a centric occlusion record is articulated.
- Denture base is prepared with resin.
- A retentive clasp arm is made of wrought wire and attached to the resin or electro soldered to the framework near the added denture teeth (**Davda and Davda, 2014**).

1.8.6 Fractured or lost artificial teeth repair

When the acrylic resin denture tooth is fractured, the procedure for repair and replacement of acrylic resin denture teeth is as follows:

- the fractured tooth must be carefully cut out to create space in the denture base for a similarly sized new denture tooth. This should be accomplished at slow speed with an acrylic bur.
- A new denture tooth is selected, adjusted to fit the repair site, and checked to ensure that there is adequate room for the auto polymerizing acrylic resin.
- The denture tooth is luted in position with sticky wax, an index is made as shown in **Figure (1.9)** and **Figure (1.10)**, and new auto polymerizing acrylic resin is applied, processed, and finished.
- Occasionally the anterior denture teeth are positioned against the residual ridge to eliminate a denture flange. In these instances, when an anterior denture tooth is fractured, an impression must be made with the RPD in place and the repair must be carried out to completion on a dental stone cast.
- An alternate, temporary method to repair a fractured or lost denture tooth on an RPD is to add tooth-colored acrylic resin to the prepared defect site. The mass can be reshaped to simulate the denture tooth after the polymerization of the acrylic resin is completed as in **Figure (1.11)**.

- When denture teeth are repaired on an RPD, the occlusion of the RPD in centric and eccentric positions must be carefully checked and adjusted as necessary (**Fayyad and Nassouhy, 2017**).

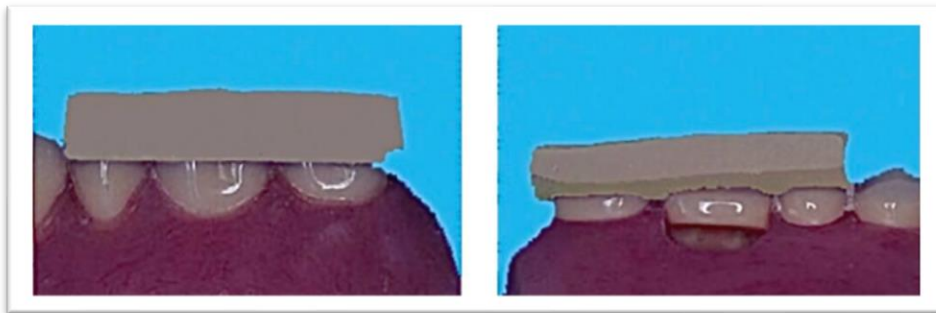


Figure (1.9) Making of the stone index (**Fayyad and Nassouhy, 2017**).



Figure (1.10) Removal of the stone index. The stone index is removed, the denture tooth is removed and cleaned and small retentive undercuts are provided (arrow) for mechanical retention as well as chemical bonding (**Fayyad and Nassouhy, 2017**).



Fig. (1.11) Adding of auto polymerizing acrylic resin (**Fayyad and Nassouhy, 2017**).

Chapter Two

Conclusion

- 1- There are several types and causes of dentures fractures.
- 2- It is possible to repair an existing denture to extend its life and maintain the dentures.
- 3- The dentures could repair with several techniques depending on the type and site of fracture.
- 4- Clarifying the best materials used in repairing the denture.
- 5- Repair is a useful tool in dental practice to keep an existing denture serviceable and is often very popular with the patient.

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