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FLEXIBLE DENTURE

A project submitted to the
College of Dentistry, University of Baghdad, Department of
Prosthodontics in partial fulfillment for the degree in Dental Surgery

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CERTIFICATION OF THE SUPERVISOR

This is to certify that this project entitled " flexible denture" was organized by the fifth-year student (Kawther Taleb) under my supervision at the College of Dentistry/University of Baghdad in partial fulfilment of the graduation requirements for the degree of dental Surgery.

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DEDICATION

As well as everything that I do, I would be honor to dedicate this compilation to my parents. The two persons that gave the tools and values necessary to be where I am today.

My rock , mom, I want to express my deepest gratitude for your unconditional love and care. I will always know what it’s like to be loved and protected because of you.

My hero , dad, I was never afraid to go off on my own because I knew you would be there anytime I needed you. You are my role model in life. I appreciate you for allowing me to be like you.

My lovely persons (sister, brother, friends) , I always feel special because of you. Thank you for making the time to listen , giving advice with loving intentions and always support me. Grateful to have you in my life.

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Loss of teeth, which may be due to trauma, dental diseases, pathology, or otherwise not only alters the psychological thought of the patients but also disturbs the esthetics, phonetics, and functional occlusion (Mahmood, 2013).

Many treatment modalities are available for replacing missing teeth; removable partial denture, fixed partial denture or dental implant. Each modality is a possible treatment option and has its own advantages and disadvantages **(**Erazo and Hussain, 2020).

If missing only a few teeth scattered over either arch (upper or lower teeth), or even if there is a minimum of two teeth on both sides of the arch, then it can most inexpensively replace the missing teeth with a removable partial denture. There are several types of RPD's. All of them use standard denture teeth as replacements for the missing natural teeth (Caesar and Lehmann 2002).

Polymethyl methacrylate has been used to fabricate the dentures. Metal cast / metal frame / metal base dentures are also used to restore the defects. Some of the problems with acrylic are difficult to address, such as insertion in undercut areas, brittleness of methyl methacrylate which leads to fracture, and allergy to methyl methacrylate monomer (Atulya and Shashidhara, 2014).

The application of nylon materials to the fabrication of dental appliances has been seen as an advance in dental materials. This material generally replaces the metal, and the pink acrylic denture material used to build the framework for standard removable partial dentures (Negrutiu et al. ,2005).

Flexible dentures are an excellent alternative to conventionally used methyl methacrylate dentures, which not only provide excellent aesthetics and comfort but also adapt to the constant movement and flexibility in partially edentulous patients (Singh et al., 2011)**.**

AIMS OF THE STUDY

This study was aimed to review various design of clasps in flexible denture for treatment of partially or completely edentulous patient. Different materials of flexible dentures were clarified and compared with other types of removable denture materials.

CHAPTER ONE
REVIEW OF LITERATURE

REVIEW OF LITERATURE

1.1 Definition

Flexible denture is an alternative treatment modality for removable partial denture (RPD) that aid the retention by ensuring seal around the entire border of the denture. It is also referred as hypoallergenic denture especially for those who are allergic towards conventional acrylic denture which is the poly-methyl-methacrylate monomer (PMMA) and metal (cobalt chromium). It exhibits lower flexural modulus than conventional type of baseplate material denture that makes it nearly unbreakable. Nowadays, there are a handful of different flexible materials in the dental market for the general dental practitioners to choose but somehow the studies on the properties of these different types of flexible materials are sparse (Lim et al., 2021).

1.2 Classification of the flexible denture according to the materials

1.2.1 Thermoplastic polyamide (nylon)

Thermoplastic nylon is a polyamidic resin derived from diamine and dibasic acid monomers. Nylon is a versatile material, suitable for a broad range of applications. Nylon exhibits high flexibility, physical strength, heat and chemical resistance. It can be easily modified to increase stiffness and wear resistance. Because of its excellent balance of strength, ductility and heat resistance, nylon is an outstanding candidate for metal replacement applications. They are used primarily for tissue supported removable dentures because their stiffness makes them unsuitable for usage as occlusal rests or denture parts that need to be rigid. Because of its flexibility, it cannot maintain vertical dimension

when used in direct occlusal forces. Nylon is a little more difficult to adjust and polish, but the resin can be semi-translucent and provides excellent esthetics (Donovan and Cho, 2003).

1.2.1.1 Pro-flex

Pro-flex is the flexible denture base material, which can be used for Full & Partial flexible denture. Pickett Dental Laboratory has been offering pro-flex full and partial flexible dentures since 1998. Pro-flex is easy to work with the quality, aesthetics and most importantly the results. Pro-flex denture material may be indicated in some of the anatomical considerations where tooth and tissue undercuts are a hindrance. It enables the material to effectively engage those undercuts. Also pro-flex being hypoallergenic is recommended for patients with known acrylic or metal sensitivities. Aesthetically the material is semi-translucent, allowing the prosthetic to better blend with the colour of the natural gum tissue. With pro-flex flexible partials, there are no metal clasps. Pro-flex full and partial flexible dentures are easily adjusted by the dentist (Parvizi et al., 2004).

1.2.1.2 Valplast

Valplast is a flexible denture base resin that is ideal for partial dentures and unilateral restorations. The resin is a biocompatible nylon thermoplastic with unique physical and aesthetic properties that provides unlimited design versatility and eliminates the concern about acrylic allergies.The valplast flexible partial allows the restoration to adapt to the constant movement and flexibility in the mouth. The flexibility combined with the strength and light weight, provides total comfort and great looks. The valplast partial is virtually invisible because there are no metal clasps and the material itself blends with the tissue in the mouth. The Valplast flexible partial involves only non-invasive procedures (Parvizi, 2004 and Stafford et al., 1986).

1.2.1.3 Sunflex

Sunflex Partial Dentures are made from a strong biocompatible nylon thermoplastic, and are unbreakable, yet lightweight and translucent which allows natural tissue to show through. The sunflex flexible denture base materials are virtually Invisible, unbreakable, metal free, lightweight and comfortable to wear (Thumati et al., 2013).

1.2.2 Acetal

Thermoplastic acetal is a poly(oxy-methylene)-based material, which as a homopolymer has good short-term mechanical properties, but as a copolymer has better long-term stability. Acetal resin is very strong, resists wear and fracturing, and it's flexible, which makes it an ideal material for pre-formed clasps for partial dentures, single pressed unilateral partial dentures, partial denture frameworks, provisional bridges, occlusal splints and implant abutments, partial denture frameworks, artificial teeth for removable dentures, orthodontic appliances. Acetal resins resist occlusal wear and are well suited for maintaining vertical dimension during provisional restorative therapy. Acetal does not have the natural translucency and esthetic appearance of thermoplastic acrylic and polycarbonate (Arikan et al., 2005).

1.2.3 Thermoplastic polyester

Another group of thermoplastic materials used in dentistry are polyester resins. Polycarbonate resins are particular polyester materials. They exhibit fracture strength and flexibility, but the wear resistance is lower when compared to acetal resins. However, polycarbonates have a natural translucency and finishes very well, which make them proper for producing temporary restorations. They are not suitable for partial denture frameworks (Negrutiu et al., 2005).

1.3 Advantages of flexible denture

Flexible denture has got various advantages over the traditional rigid denture bases

1. Management of undercuts being flexible, the denture base adapts well in the undercut areas. The amount of adjustment required at time of denture insertion is greatly reduced. Also, this reduces post insertion denture bases complaints of denture induced trauma (ulceration) (Ditolla, 2004).
2. Aesthetic translucency of the material picks up underlying tissue tones, making it almost impossible to detect in the mouth. No clasping is visible on tooth surfaces (when used in manufacturing of clear clasp) (Lowe, 2004).
3. Strength flexible denture material is so strong that it can be made very thin which make it comfortable to wear and esthetically pleasing (Dhiman and Chowdhury, 2009).
4. Accuracy as the flexible denture are fabricated by the injection molded techniques (Dhiman and Chowdhury, 2009).
5. Complete biocompatibility this was achieved because the material is free of monomer and metal, these being the principle causes of allergic reaction in conventional denture materials (Prashanti et al., 2010).
6. Flexible denture may be used as alternate treatment plan in rehabilitating the anomalies such as ectodermal dysplasia (Naylor and Manor, 1983).
7. Better comfort of the patient flexible denture for man excellent alternate to traditional hard fitting denture. Patient show excellent compliance as there is no metal display. Material being soft and strong can be made thinner and are light in weight compared to conventional acrylic dentures. This promotes better adaptation of the tongue and check to the denture base (Shamnur et al., 2007).

8. The post insertion maintenance is easy, which make it a very "user-friendly" denture base material (Nishigawa et al., 2003).
9. It has no porosity, no biological material build-up, it provides high dimensional stability (Dhiman and chowdhury, 2009).

1.4 Disadvantages of flexible denture

1) De-bonding of teeth a major drawback observed was debonding of teeth from denture base. The polyamide denture base material has a unique property that it does not chemically bonds with any of the acrylic resin or porcelain, so mechanical bonding is the only mode to use in polyamide denture base material. Sufficient height of the selected teeth is required for mechanical bonding. Mechanical undercuts (diatorics) should be made in the center of each tooth so that melted fluid polyamide could flow into the undercuts so as to retain the tooth in the denture base (Dhiman and Chowdhury,2009).
2) It was found that nylon-based material after 24-hour storage in normal disinfectant baths lose elasticity (Yunus et al., 2005).3)
3) Discoloration the flexible denture has been reported with gradual fading of denture base color over a period of 12-24 months. Further research and improvement in the material is needed to overcome this drawback (Prashanti et al., 2010).
4) When grinding this prosthesis, proper ventilation, masks, and vaccum systems should be used and the procedure is a sensitive technique. Extreme caution is necessary when processing to avoid skin contact with the heated sleeve, cartridge, furnace, heating bay, hot cartridge, injection insert, piston head adapter, hot flasks and heat lamps (Shamnur et al., 2007).

5) Flexible denture generally is not used for long-term restoration and are intended only for provisional or temporary applications (Shamnur et al., 2007).
6) Another problem faced with the material is that no repair or relining is feasible (Thakral et al., 2012).
7) Need special flask (Manappallil, 2007).

1.5 Indications for flexible denture

1) Patients with maxillary tuberosity undercuts often pose challenges in denture fabrication. Flexible denture flanges for patients exhibiting undercut tuberosities can solve this problem (Lowe, 2004).
2) Patient who demonstrate repeated fracture of dentures due to the high fracture resistance with high elasticity (low modulus of elasticity) (Stafford et al., 1986).
3) In small oral cavity which are relatively easy to insert, for example, in children or scleroderma patient are often the only option acceptable for a removable denture represents (Samet et al.,2007).
4) Patient with allergy to PMMA (Stafford et al., 1986).
5) Flexible denture is also suitable for pre-formed clasps for partial dentures, single pressed unilateral partial dentures, partial dentures frameworks, provisional bridges, occlusal splints, obturators, speech therapy appliances, orthodontic retainers and implant abutments (Yavuz and Aykent, 2012).

1.6 Contraindications of flexible denture

1) Patients with insufficient interarch space (< 4mm space for placement of teeth), prominent residual ridges where there is less space for placement of teeth (Nair, 2019).
2) Flat flabby ridges with poor soft tissue support which require more rigid prosthesis (Antonelli and Hottel, 2001).
3) Bilateral free-end distal extension on maxilla with extremely atrophied alveolar ridges (Thakral et al., 2012).

1.7 Flexibility of the flexible denture

The Flexible denture have ability to engage undercuts for retention (Kaira et al., 2012).

The resins currently in use have high flexibility and softer surface compared with acrylic resin, meaning that patients feel better when worn. There is also appears to be no problem with fit. As there is a low risk of breakage of dentures made solely resin, which are highly elastic and not at all rigid, the denture base can be made thinner. This makes them lighter and thinner than Removable dentures using an acrylic resin or metal framework to ensure rigidity (Fucki el al., 2014).

The strong and flexible nature of material is perfectly suited to the variety of natural conditions in the mouth, simplifying design and enabling the flexible nylon resin to act as a built-in stress-breaker in order to provide superior function and stress distribution in a removable partial denture (Thakral et al., 2012).

1.8 Flexible denture versus other types of removable dentures

1.8.1 Flexible denture versus cast partial dentures

To compare between the two from the viewpoint of a dentist, time consuming mouth preparations are needed followed by some high skilled surveying techniques in the fabrication of cast partial dentures (Kaplan, 2008).

On the part of patients, he/she finds the cast partial dentures much expensive than the Flexible denture. Further the cast partial dentures are quite heavy as compared to the flexible denture and hence relatively uneasy to wear. The next big comparison between the two is esthetics. The thermoplastic nylons are translucent material that allow the underlying tissue to be seen resulting in excellent esthetics. Moreover in Flexible denture there are no metal clasps at all. Clasps are also made up of thermoplastic nylons. So clasps can be given on canines without compromising esthetics which is not possible in cast partial dentures (Feuki et al., 2014).

1.8.2 Flexible denture versus conventional rigid acrylic rpd (temporaries)

Dentures with thermoplastic nylon do not fracture even if are thrown intentionally from some height whereas patient with full acrylic partial or complete dentuers often visit the dentist with broken or fractured prosthesis as these are brittle. Flexible denture show excellent biocompatibility but Acrylic dentuers cause allergic reactions due to free monomer content, high porosity, high water sorption, foul smell and are difficult to insert when undercuts are present. Moreover, laboratory techniques used in the fabrication of Flexible denture are more stable and accurate than those used in full acrylic dentures (shumnar et al., 2007).

Effect on oral mucosa Flexible dentures exhibit viscoelastic behavior that lead to improvement in masticatory function and patients comfort compared with hard dentures .Flexible dentures show little effects on the mucosa of denture bearing area and little changes on the mucosa. Denture bearing area of flexible denture are more healthy with less tissues changes compared with traditional acrylic denture. Flexible removable partial dentures can adapt to the shape and movement of mouth and for this reason, these are far more comfortable to wear (Mustafa et al., 2013).

1.9 Design of the Flexible denture

The design of flexible removable partial denture made from thermoplastic materials depends on the following (khalaf and Abass, 2016)

First Support

Thermoplastic material is used primarily for tissue supported removable dentures because its flexibility makes it unsuitable for usage as occlusal rest denture parts that need to be rigid. The support of such a partial denture is derived entirely from the residual and no support is gained from the natural teeth. Thus this type is tissue supported whether for bounded or in distal extension cases.

Second Connection

The main types of major connectors for the maxillary arch are the full palatal coverage and U-shaped major connectors. For the mandibular arch, the only major connector used is lingual plate. The borders of major connectors should be placed adjacent to the palatal and lingual surfaces of natural teeth without any gingival relief.

Third Retention

There is no metal clasps used in FRPDs. The clasps are also made up of flexible thermoplastic material with excellent esthetics. The clasps can be placed labially (buccally) or lingually (palatally) depending on the undercuts areas present.

Fourth Reciprocation

There should be reciprocation for retentive clasp arm is and this is achieved with the nylon plate lingually (palatally) or labially (buccally) to the abutment tooth. This plate should come in contact with the palatally or lingually surface of tooth on or above the survey line to provide stability.

Finally Outline of edentulous areas

The outline of edentulous areas that will be covered by denture bases supporting the artificial teeth. The distal extension bases should be extended to retromolar pads and the maxillary tuberosities as these structures provide comfort and a peripheral seal for retention.

1.10 Clasps of flexible partial dentures

1.10.1 Terms and definitions-

According to the GPT (2017), a clasp is defined as "the component of the clasp assembly that engages a portion of the tooth surface and either enters an undercut for retention or remains entirely above the height of contour to act a reciprocating element, Generally it is used to stabilize and retain a removable dental prosthesis."

According to this definition, a "clasp" is not described as being made of metal. The resin retentive elements known as arms, fingers, and wings may thus be regarded as genuine clasps according to this definition, a(s they use undercuts

to retain and stabilize RPDs,and they are also known as "resin clasps" or "esthetic clasps" (Kaplan, 2008).

During function, the RPD is to subjected to functional movements. A well designed denture should have components that resist these movements. The component that prevents the RPD from dislodging away from teeth and tissue is called direct retainer. Direct retainer is responsible for primary retention of the prosthesis and there are many types of direct retainers of which are clasp retainers (Carr and brown, 2011).

1.10.2 Types of clasp

1.10.2.1 Wrap-around Clasp

The wrap around clasp is a type of retainer that rests on the surfaces of the natural gum tissues in order to hold a flexible partial denture in place. It is the most common type of clasp used for partial denture. The wrap-around clasp originates from the buccal or labial flange of the denture base and traverses soft tissue to approach the abutment tooth from a gingival direction. For aesthetic purposes, this type of clasp often terminates ≤ 1mm onto the abutment tooth from a gingival direction, the tip of which falls into the embrasure between the abutment tooth and the next proximal tooth to it. It is essential to recognize incorrect clasp design and placement to understand better how a correctly designed clasp will provide predictable results and proper function. This type of clasp is very retentive as it makes use of both tooth and tissue undercuts. It is a good choice for retaining distal extensions and long spans of replacement teeth. In order to ensure patient comfort, it is important to note that these clasps do not actually compress the tissues for retention, but should always be resting in direct contact with tissue while in a relaxed position. If a gap is created by over-relief between the clasp and tissue, irritation could develop (Alan et al., 2005).

Figure 1.1 the wrap around clasp (Alan et al., 2005)

1.10.2.2 High spur clasp

In cases where the abutment tooth tilts to create a severe undercut making a wrap around clasp unfeasible, a high spur may be placed on the natural tooth. As this is not ideal for aesthetic considerations, it is used mainly in posterior regions. The high spur is a common retainer for Kennedy Class III cases and modifications where natural posterior teeth bound the edentulous span. The high spur should be placed so that it enters along the height of contour and terminates in the infra bulge area of the abutment tooth as shown in (figure 1.2) (Alan et al., 2005).

Figure 1.2 High spur clasp (Alan et al., 2005)

1.10.2.3 Low spur clasp

Low spurs are placed on the natural abutment tooth next to the replacement and positioned close to the neckline in a roughly triangular form so as to appear as natural interproximal papillae. As they are more aesthetic than high spurs, they are mainly used in anterior areas. Because they are placed so low on the labial surface of the natural abutment teeth they are seldom used in cases where the abutment teeth are tilted or flared to create severe undercuts as shown in (figure 1.3) (Alan et al., 2005).

Figure 1.3 Low spur clasp (Alan et al., 2005)

1.10.2.4 Split clasp

The split clasp is used whenever the supra bulge portion of the abutment tooth is very wide and narrows substantially towards the infra bulge area, or when a flared or tilted condition of the abutment tooth requires that the retentive arm pass over a very severe high point before engaging undercuts. The split clasp resembles a roach clasp (from metal frame RPD design) in concept and basic design structure, with flexibility along both the vertical and horizontal axes of the junction as shown in (figure 1.4) (Alan et al., 2005).

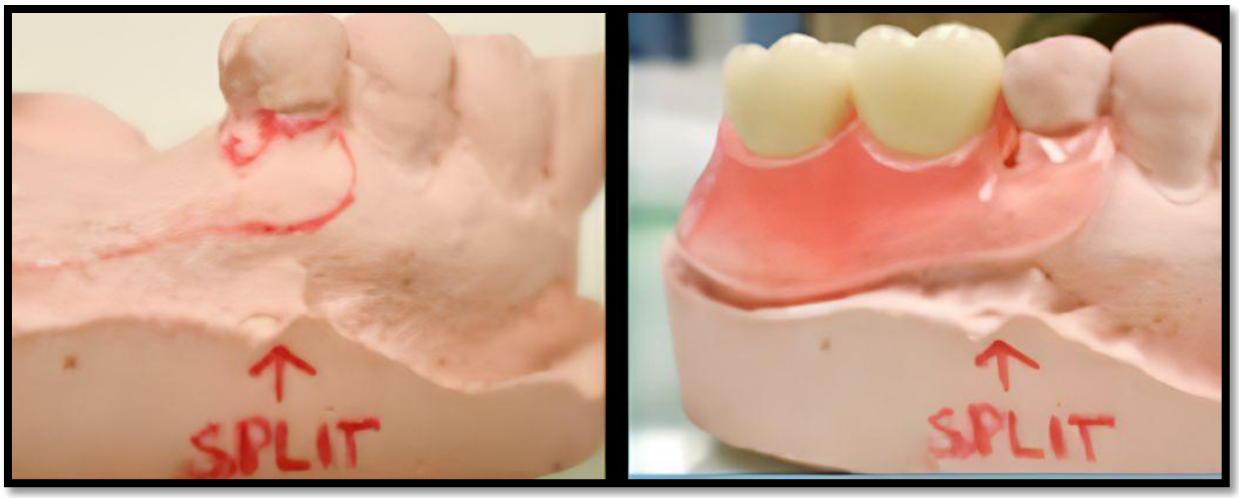

Figure 1.4 Split clasp (Alan et al., 2005)

1.10.2.5 Anchor clasp

A seldom used but occasionally useful design is the labial or buccal anchor clasp. This clasp type is used mainly on maxillary full dentures in the labial region when large undercuts are present. These should extend a two-tooth length from the junction point where the clasp meets the adjoining buccal or labial flange as shown in (figure 1.5) (Kaplan, 2008).

Figure 1.5 Anchor clasp (Alan et al., 2005)

1.10.2.6 Labial clasp

In cases where abutment teeth exhibit a high degree of mobility, they may be splinted by use of a thin, flexible labial (or buccal) clasp. the labial clasp may be fabricated with what is essentially a series of continued split clasps so as to avoid placing excessive strain on the abutment teeth upon insertion and removal of the denture as shown in (figure 1.6) (Alan et al., 2005).

Figure 1.6 Labial Strap clasp (Alan et al., 2005)

1.10.2.7 Circumferential Clasp

This type of clasp completely encircles an abutment tooth for retention, ideal for free standing distal abutments as shown in (figure 1.7) (Kaplan, 2008).

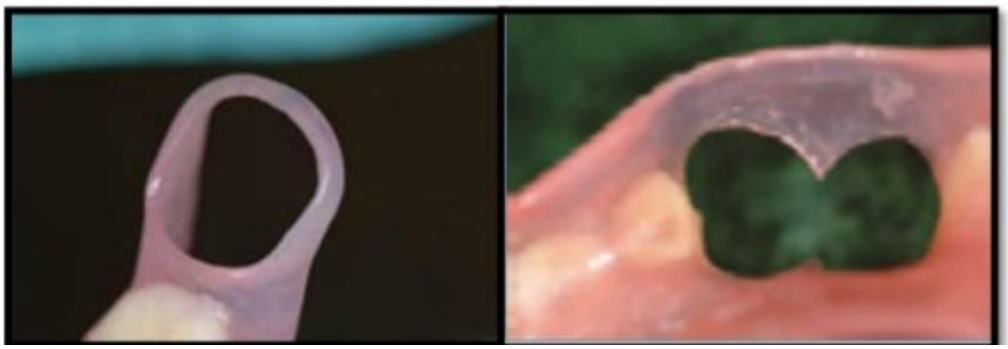

Figure 1.7 Circumferential Clasp (Kaplan, 2008).

1.10.2.8 Combination Clasp

This clasp is a combination of wrap-around and circumferential clasps that connect palatal/lingual and buccal components by crossing the occlusal table. This clasp may provide more retention of the denture and stability of free end saddles than a standard wrap-around clasp, but does require some tooth preparation in order to be placed correctly as shown in (figure 1.8) (Kaplan,2008).

Figure 1.8 Combination Clasp (Kaplan, 2008).

1.11 Clinical and laboratory procedure of flexible denture

Singh and Gupta, 2012 suggested the following steps

1. Mouth preparation is usually not required for fabrication of flexible partial dentures as required for removable cast partial denture. Just Make an impression with hydrocolloids or elastomeric impression material and obtain a master cast. Duplicate the master cast in any suitable duplicating material. Make wax occlusal rim, record jaw relations and mount the casts on the articulator.
2. Make 'T' shape holes (diatorics) in teeth of selected shade. The holes are made for mechanical retention of acrylic teeth to flexible denture base as shown in (figure 1.9).

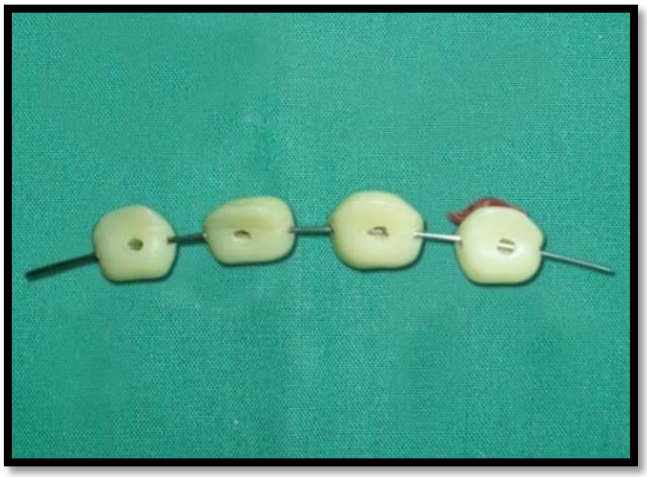

Figure 1.9 wire showing orientation of holes (Singh and Gupta, 2012).

3. Arrange the teeth, do the try in and wax up and attach the sprue formers to make the channels for flowing of fluid resin into mold.
4. After investing in a special flask, dewaxing is done by placing flasks in boiling water for 3 to 5 minutes to soften the wax. Open the flask and flush with clean boiling water to remove all the residue of wax as shown in (figure 1.10).

Figure 1.10)injection molding flask (Singh and Gupta, 2012).

5. Select a cartridge of suitable size and spray silicone spray on it. Place it in cartridge carrier which is then placed in electric cartridge furnace used for softening of flexible denture base material as shown in (figure 1.11 A and B).

Figure 1.11 A and B electric cartridge furnace (Singh and Gupta,2012).

6. Finish the prosthesis. The sprue formers are cut with special type of knife or disk and finishing is done with valcinate burs and green and pink mounted stones.

7. The staining resistance of the prosthesis depends on its shiny/lustrous appearance. The surface of prosthesis should be highly shiny without any roughness to resist the staining as shown in (figure 1.12).

Figure 1.12 flexble partial denture (Singh and Gupta, 2012).

8. The flexible prosthesis must be placed in hot water for about 1 minute prior to insertion in patient's mouth. Remove and allow it to cool just to the point where it can be tolerated by the patient. This process makes the partial denture as flexible as it would be at body temperature. Gently insert the prosthesis in patient's mouth. The hot water treatment permits a very smooth initial insertion and a good adaptation with the natural tissues in the mouth. If patient senses any discomfort because of the tightness of a clasp, the clasp may be loosened slightly by immersing that area of the clasp in hot water and bending the clasp outward. If a clasp required tightening, the clasp area is immersed in hot water and bent inward to tighten. After insertion of prosthesis, a) instruct the patient to remove the prosthesis during night, b) keep it in water, c) Remove the prosthesis during brushing of remaining natural teeth because toothbrush may produce scratch on the prosthesis, d) Clean the prosthesis after every meal.

CHAPTER TWO
CONCLUSIONS

CONCLUSIONS

Within limitation of this review, the following can be conclude:
1- There were many types of materials that could be used to fabricate the flexible denture and each one of them has its advantages and limitations.

2- The choice of the design of the clasp should be under careful evaluation of the condition to provide the maximum esthetic, stability or function.

3- The number of visits was less but is it not recommended for long term use and the impossibility of the relining or repair.

4- The laboratory manipulation of the thermoplastic material of the flexible denture done by injection moulding technique. The acrylic teeth do not bond chemically with the thermoplastic nylon so diatorics are prepared in the artificial tooth to create a mechanical bonding.

5- Flexible dentures was become an elective treatment option for partial/complete edentulous conditions.

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