

A study on flexible dentures

Revuru Pradusha

Post graduate student, Department of Prosthodontics,
Vishnu Dental College, Bhimavaram

M.C. Suresh Sajjan

Professor of Prosthodontics and Principal, Vishnu Dental
College, Bhimavaram

A.V. Ramaraju

Professor of Prosthodontics and Vice Principal,
Vishnu Dental College, Bhimavaram

Bheemalingeswara Rao D.

Professor, Department of Prosthodontics,
Vishnu Dental College, Bhimavaram

K. Chandrasekharan Nair

Scopus Author ID 51564168300
Professor Emeritus,
Department of Prosthodontics,
Vishnu Dental College, Bhimavaram

Edentulism is an indicator of oral health. More than 70% of Indian population especially the rural population suffers partial edentulism which is an alarming situation because of the limited facilities available in rural areas. Partially edentulous situations can be treated with different options viz. removable dentures, fixed dentures and dental implant supported. Support status of abutment teeth, duration of edentulousness, general health profile and patient's affordability are major influencing factors that decide the treatment in partial edentulism^{1,2}. Removable dentures always had unquestionable popularity in India because of the affordability acceptable to most of the socioeconomic classes^{3,4}. Conventional RPD designs with metallic retainers, especially those appearing in the aesthetic zone has been the primary deterrent to many patients in accepting removable dentures. Attachments have high aesthetic quotient but the technique sensitivity and the necessity of large quantity of tooth tissue loss has reduced the popularity. Common man's partial denture is acrylic based but its mechanical properties pose a limitation for long term use.

Era of flexible dentures was ushered in ever since the introduction polyamide resin (nylon) in 1950's. Very

soon it has become an alternative to fabricate RPDs that do not contain metallic elements. Since 2007, a number of thermoplastic resins were made available in the market exclusive for RPD fabrication.^{5,6} Some of the commercially available products are Valplast, Sunflex, Duraflex, Flexite, Proflex, Lucitone, and Impak. Valplast, Sunflex and Lucitone are monomer free. Presently available flexible materials are listed below.

Table I. Flexible resins

Generic Name	Product Name
Polyamide	Valplast
	Flexiplast
	Flexite
	Flexite plus
	Sunflex
	Leucitone FRS
	Ultimate
Polyester	Estheshot bright
	Estheshot
Polycarbonate	Reigning N
	Reigning
Acrylic resin	Acrytone
Polypropylene	Unigum



Accepted: 30/05/2019

Address for correspondence: Dr. Revuru Pradusha
Postgraduate Student, Department of Prosthodontics,
Vishnu Dental College, Bhimavaram
Email: pradusha09@gmail.com

Some of the advantages and disadvantages of these materials are mentioned below^{6, 7, 8}.

Advantages

- Denture wearers, both men and women, are highly concerned about the aesthetic appearance. With flexible dentures it is possible for the retentive parts to actively utilize a vital tooth, increasing the opportunities for both patients and dentists to choose RPDs.
- More acceptable aesthetics, since there are no metal clasps.
- Translucency of the material picks up underlying tissue tones, making it almost impossible to distinguish in the mouth.
- The material is exceptionally strong and flexible. Free movement is allowed by the overall flexibility. Therefore, even if there is a little bit of bending, it comes back to the original shape and position.
- The resins currently in use have a lower elastic modulus and a softer surface compared with acrylic resin^{9, 10}, meaning that patients feel better when worn. There also appears to be no problem with fit. As there is a low risk of breakage of dentures which are highly elastic and not at all rigid, the denture base can be made thinner. This makes them lighter and thinner than RPDs using an acrylic resin or metal framework to ensure rigidity.
- Ease of insertion in the mouth with alveolar undercuts because of the flexibility.
- Complete biocompatibility is achieved because the material is free of monomer and metal, these being the principal causes of allergic reactions in conventional denture materials¹¹.
- Flexible dentures will not cause sore spots due to negative reaction to acrylic resins and will absorb small amounts of water to make the denture more soft tissue compatible.
- There is very limited need of modification of the remaining teeth to receive occlusal rests as in the case of metallic clasps.
- Rebasings (Changing the entire plastic / tissue area except the acrylic teeth) is possible.

- A real boon for patients with compromised oral conditions anomalies such as ectodermal dysplasia.

Disadvantages

- Flexible dentures tend to absorb water content and tend to discolour very often¹².
- Surface roughening after a few months of denture delivery was identified. As the surface is not as hard as that of acrylic resin, the depths and the widths of marks were greater than in the acrylic resins by the scratch test, thus the polished surface loses its lustre.
- Debonding of acrylic teeth from nylon denture base since teeth in these flexible dentures are bonded mechanically (diatorics) and not chemically.
- It does not conduct heat and cold like metal.
- The resin clasp covers the cervical area of the abutment teeth over a wide area on both the crown and root sides, being designed to be part of the gingiva. This means that the area covered by the resin clasp is large, and the undercut and relief regions may easily become dead space, with the risk of exacerbating periodontal conditions. Meticulous cleaning is therefore essential.
- Breakage of retentive elements from denture is not uncommon.
- Mobile teeth are not splinted by flexible dentures.
- The laboratory charges are on the higher side.
- Flexible denture is very hard to repair if fractured. No additions can be made onto it. In such cases, rebasing is recommended.
- Lacks important elements of conventional RPD like occlusal rests and rigid framework hence transmission of functional load is not very efficient.
- Difficulty in polishing.
- Requires more chair-side time for adjustment.
- Requires special instruments (knives and polishing kit) to make the adjustment.
- When grinding this prosthesis, proper ventilation, masks and vacuum systems should be used and the procedure is technique sensitive.
- 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.

Indications

- In every partially edentulous situation.
- They utilize the undercuts in the ridge for retention so it is indicated in ridges where bilateral undercuts are present and where pre-prosthetic surgery is contraindicated.
- The unique physical properties of the material also make it more adaptable in challenging cases and situations involving paediatric patients, cancerous mouths and cleft palates.
- A patient with systemic sclerosis and microstomia.
- Because of its excellent biocompatibility, it is also an ideal replacement for acrylic when patients are allergic to denture acrylics.
- Flexible partials could be a treatment of choice in cases of patients having a history of repeated partial denture frame breakage.
- They can also be used as an easy and affordable alternative to implants or fixed partial dentures
- Flexible Partial are ideal for people in high-risk situations like: Athletes, Police and Fire-fighters, Military Personnel, Prison Officers, Any person who might be exposed to physical harm or injury etc.

Additional applications of Flexible denture material include:

- o Cosmetic gum veneers
- o Bruxism appliances
- o Implant retained over-dentures and full dentures for patients with protuberant bony structures or large undercuts
- o Unilateral Space Maintainers
- o Temporary Protheses (short and long-term)
- o Obturators and speech therapy appliances
- o Orthodontic Devices
- o Occlusal splints and sleep apnea appliances
- o Anatomical bite restorer (Used during full mouth rehabilitations)

Contraindications

- Inter-arch space (<4mm space for placement of teeth), prominent residual ridges where there is less space for placement of teeth.
- Flat flabby ridges with poor soft tissue support which require more rigid prosthesis.

- Deep overbites (4mm or more) where anterior teeth can be dislodged in excursive movements
 - Little remaining dentition with minimal undercuts for retention.
 - Bilateral free-end distal extensions with knife edge ridges or lingual tori in the mandible⁷.
 - Bilateral free-end distal extension on maxilla with extremely atrophied alveolar ridges.
- Flexible dentures vs cast partial dentures(Table 2,3)

Table 2: Comparison between flexible and cast partial dentures

	Flexible dentures	Cast partial dentures (CPD)
Time period for preparation	Less time	Time consuming
Cost	Less expensive compared to CPD	More expensive
Weight	Light weight	heavier
Aesthetics	Highly aesthetic	Unaesthetic due to metal clasps
Clasps	Nylon clasps	Metal clasps
Occlusal rest	No preparation required	Preparation required

Table 3. Comparison between Flexible dentures and Acrylic dentures

	Flexible dentures	Acrylic dentures
Bilateral undercuts	Can be used	Cannot be used
Easiness of fracture	Wont fracture easily	Fracture easily
Biocompatibility	Excellent biocompatible	In some patients allergic reactions due to presence of monomer
Lab procedures	More stable	Less stable
Comfort	More comfort	Less comfort
Irritation to mucosa	No irritation	irritant
Bonding of teeth to denture	Mechanical bonding	Chemical bonding
Hardness	Less	Higher hardness
Repair or reline	Can't be relined or repaired	Can be relined or repaired

The thermoplastic nylons are translucent material that allow the underlying tissue to be seen resulting in excellent aesthetics and there are no metal clasps at all. Clasps are also made up of thermoplastic nylons. So clasps can be given on canines without compromising aesthetics which is not possible in cast partial dentures. Flexible dentures exhibit viscoelastic behaviour that lead to improvement

in masticatory function and patient's comfort compared with hard dentures. Flexible removable partial dentures can adapt to the shape and movement of mouth and for this reason, these are far more comfortable to wear. In a study¹³, conducted by Singh et al about the preference among the two types of denture base material; flexible dentures versus conventional acrylic, 100% patients



Fig 1a. Flexible dentures



Fig 1b. Flexible denture



Fig 1c. Flexible denture



Fig 1d. Flexible denture



Fig 1d. Flexible denture



Fig 2. Valplast denture



Fig 2a. Valplast denture



Fig 2b. Valplast denture



Fig 3. Acetal resin clasp



Fig 4. Sunflex denture

preferred the flexible dentures over customary methyl methacrylate dentures.

Material and its properties:

Thermoplastic resins which become pliable or mouldable above a specific temperature and return to a solid state upon cooling are used for the fabrication of flexible dentures. There are different kinds of thermoplastic resins available viz.

- Polyamide
- Acetal
- Polyesters
- Polycarbonate
- Polypropylene
- Acrylic

Polyamide

Polyamide resin was proposed as a denture base material in the 1950s. Nylon is a generic name for polyamides. These polyamides are produced by the condensation reactions between a diamine and a dibasic acid. Nylon is a crystalline polymer, whereas PMMA is amorphous. This crystalline effect accounts for the lack of solubility of nylon in solvents, as well as high heat resistance and high strength coupled with ductility, higher elasticity than common heat polymerizing resins, toxicological safety for patients with resin monomer and metal allergy^{16,17}.

Valplast (Fig 2)

Valplast is a pressure-injected, flexible denture base resin that is ideal for partial dentures and unilateral restorations. The resin is a biocompatible nylon thermoplastic with unique physical and esthetic properties. Valplast is chemically a polyamide resin with 99.9% of poly(lauryl) lactam

Properties:

- It has lower elastic modulus than acrylic resins
- Its flexural strength and flexural modulus are 1/3rd higher than that of acrylic resins
- It is soft, easily deformable, and elastic.
- Its high amount of flexion means it is unlikely to fracture.
- It has lower specific gravity
- Its excellent elasticity means it can be used even in abutment teeth with a large undercut.

Availability:

- Available in three basic shade categories (medium pink, light pink and meharry). Valplast is uniquely formulated to allow patient's natural It easily blends in with the colour of the gums, giving it the aesthetic advantage that the border between base and gums is difficult to distinguish.

Advantages

- It can be used to make thinner denture bases than those possible with acrylic resins minimizing discomfort when dentures are worn.
- It possesses sufficient strength and elasticity not to fracture even under the application of maximum stress
- It has no risk of allergy, and is highly resistant to both acids and alkalis. There is almost no change in its surface roughness even after immersion in glutaraldehyde or sodium hypochlorite.
- It may also be used to provide retention when inserting a denture base into the undercut of the residual ridge.
- The material is a specialized form of nylon in the family of superpolymides (a very pure nylon) that will not deteriorate chemically when it comes into contact with the fluids, bacteria, and physical environment of the mouth.

Disadvantages:

- Its surface is easily damaged and the polished surface gradually loses its lustre though limited repolishing is a possibility.
- It does not bond to acrylic resins and hence reline and repair are difficult to carry out at the chair side. This problem has reportedly been addressed by methods such as the use of resin repair materials or treating the surface with 4-META/MMA-TBB resin after sandblasting to enable bonding to acrylic resins.

Indications:

- It is the most suitable for patients with intermediary defect of 1–2 incisors that require only a retentive area and a minimalized denture base.

- It may also be used for patients with intermediary defect of molars.
- The low elastic modulus of Valplast means that dentures are lacking in rigidity, but this can be overcome by using it in combination with a metal framework.

Lucitone FRS flexible denture resin

Designed for use with injection System. Lucitone FRS Flexible Denture Resin is a temporary thermoplastic injectable resin that offers customizable flexibility, high-impact resistance and transparency, delivering aesthetic removable partial dentures and clear or colored clasps. Lucitone FRS enables dental laboratories to provide a range of flexibility from a firmer more resilient design (2mm thickness) all the way to a super flexible partial (1.5mm thickness) for an individualized restoration. This is made of semi-crystalline nylon composition for improved color stability and stain resistance. It is easy to finish and polish due to the microcrystalline structure. It is monomer free and non-irritating. Available in Original, Light Pink, Light Reddish Pink, Dark Pink and Clear shades. Clear shade is used for fabrication of clear clasps, occlusal splints, and night guards.

Acetalresins (Fig 3)

Acetal as a homo-polymer has good mechanical properties, but as a co-polymer has better long-term stability. Acetal resin is very strong, resists wear and fracturing, and is quite flexible¹⁸. These characteristics make it an ideal material for pre-formed clasps for partial dentures, unilateral partial dentures, partial denture frameworks, provisional bridges, occlusal splints, and even implant abutments. Acetal resins resist occlusal wear and are well suited for maintaining vertical dimension during provisional restorative therapy.

While stronger, Acetal does not have the natural translucency and vitality of thermoplastic acrylic and polycarbonate, and these materials might offer better results for short-term temporary restorations.

Polyesters

There are two types of polyester material Esthe Shot and Estheshot bright. According to the manufacturer's published figures, EstheShot Bright has a flexural modu-

lus of 1490 MPa, close to that of polyamides, making it softer yet with an impact resistance eight times greater than that of EstheShot One important characteristic of polyesters is that they bond well to self-curing resins. This means that repair, adding lost teeth, and relines can be performed at the chair side. EstheShot is a polyester resin that has polyethylene terephthalate copolymer as its main ingredient

Esthe Shot Bright has lower flexural modulus than Esthe-Shot, and has been developed as a novel polyester resin that combines strength and flexibility. Both have outstanding safety, esthetic appearance, and functionality. Shear bond strength tests comparing EstheShot and acrylic resins have shown that this product has higher bond strength than polyamide, polycarbonate, or acetyl resins. This is regarded as the most important advantage of Esthe-Shot, and in practice it can be easily repaired with self-curing resins. Fitting tests also indicated better results than polyamide or polycarbonate resins. In clinical practice, it is easier to polish the polyester dentures.

Polycarbonates

Polycarbonates have superior flexural strength and flexural moduli which are higher than those of polyamides and polyesters. According to the manufacturer's published figures, JET CARBO-S® and Reigning N® have lower elastic moduli and can be used effectively in patients with large undercuts. Fracture risk is seldom reported and the material has high impact resistance. Although their fit is poorer than EstheShot®, it is better than Valplast®. Their bonding to self-curing resins is around the same level as that of acrylic resins. The color change when exposed to heavily coloured food materials is observed to be similar to acrylic resins.¹⁹

Acrylic resin

ACRY TONE is the only acrylic resin currently used for flexible dentures. This product uses an acrylic resin that is much softer than other thermoplastic resins.

Sunflex (Fig 4)

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 wear²⁰.

Proflex

Pro-flex is a flexible denture base material which can be used for complete and partial dentures. Pickett Dental Laboratory has been offering Pro-flex full and partial flexible dentures since 1998. This can engage undercuts effectively. It is hypo-allergenic and hence recommended for patients with known acrylic or metal sensitivities. Aesthetically the material is semi translucent, allowing the prosthesis to blend with natural gum tissue. Proflex full and partial flexible dentures are easily adjusted by the dentist. Simply warm the denture with running water to bring it up to body temperature before inserting it. It can engage undercuts and hold the teeth under masticatory load.

Biodentplast (Bredent)

It is a semi-crystalline thermoplastic material with a linear structure characterized by high crystallinity. The material shows good physical and chemical properties such as increased hardness, tensile strength, and good dimensional stability. The high rigidity and full restoring capacity of Bio Dentaplast allows usage of the material for a wide indication range. Classic indications recommended by bredent are:

- clasp free partial dentures
- tooth coloured clasps
- temporary (max. 2 years) crowns and bridges
- tooth-coloured occlusal appliances

Manipulation and Design

a. The laboratory manipulation of these thermoplastic materials is done by injection moulding technique.

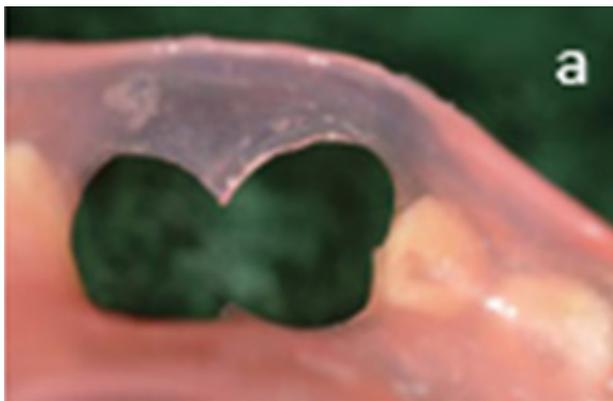


Figure 5.1 Continuous Circumferential clasp

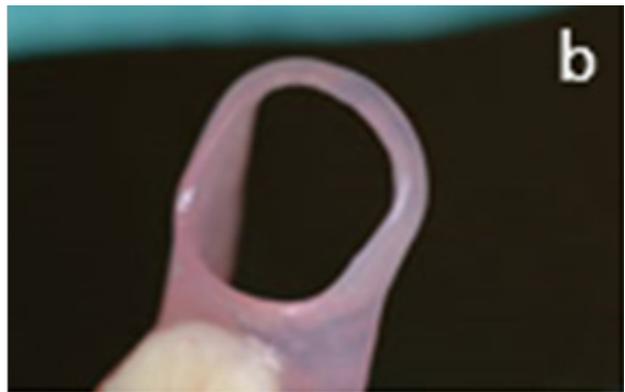


Figure 5.2 Circumferential clasp for a mesially-tip tipped distal molar



Figure 5.3 Combination clasp

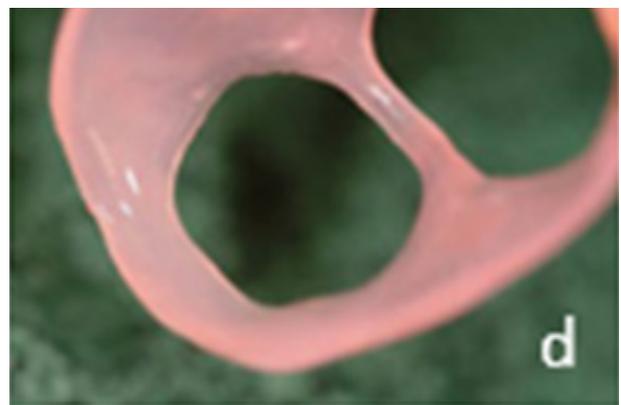


Figure 5.4 circumferential clasp

Acrylic teeth do not bond chemically with the thermoplastic nylon so diatorics are prepared. Clasps are also made up of flexible thermoplastic material with excellent esthetics. Different clasp designs that are used are: a. continuous circumferential clasp (Fig.3.1) b. Circumferential clasp for a mesially-tipped distal molar (Fig.3.2) c. Combination clasp (Fig.3.3) and d. Circumferential clasp (Fig.3.4)¹⁴

Flexible dentures have challenged the basic principles of conventional designs. However constant improvements on the properties of flexible resins might improve the acceptability.

References

1. Mericske-Stern R. Removable partial dentures. *The International journal of prosthodontics*. 2009;22(5):508-11.
2. Henderson D, McCracken WL, McGivney GP, Castleberry DJ. *McCracken's removable partial prosthodontics*. CV Mosby Company; 1985.p406-10
3. Kamber-CesirA, Dzonlagic A, Ajanovic M, Delalic A. Assessment of patient's satisfaction with the partial removable denture therapy. *PesquisaBrasileiraemOdontopediatria e ClínicaIntegrada*. 2011;11(2):171-5.
4. Sharma A, Shashidhara HS. A review: Flexible removable partial dentures. *J Dent Med Sci*. 2014 Dec;13(12):58-62.
5. Suzuki T, Shimpo H, Kitano N, Sato M, Kawai Y, Kanki Y. A questionnaire survey on the thermoplastic dentures. *Ann JpnProsthodont Soc*. 2011;3:133.
6. Fueki K, Ohkubo C, Yatabe M, Arakawa I, Arita M, Ino S, Kanamori T, Kawai Y, Kawara M, Komiyama O, Suzuki T. Clinical application of removable partial dentures using thermoplastic resin—Part I: Definition and indication of non-metal clasp dentures. *Journal of prosthodontic research*. 2014;58(1):3-10.
7. Thakral GK, Aeran H, Yadav B, Thakral R. Flexible partial dentures-a hope for the challenged mouth. *People's Journal of Scientific Research*. 2012 Jul;5(2):55-9.
8. Jain AR. Flexible denture for partially edentulous arches—case reports. *Int J Recent Adv Multidisciplinary Res*. 2015;2:182-6.
9. Sano M. Properties of thermoplastic polymers used for non-clasp dentures. *J JpnSoc Dent Prod*. 2009;23:28-34.
10. Ucar Y, Akova T, Aysan I. Mechanical properties of polyamide versus different PMMA denture base materials. *Journal of Prosthodontics: Implant, Esthetic and Reconstructive Dentistry*. 2012 Apr;21(3):173-6.
11. Stafford GD, Huggett R, MacGregor AR, Graham J. The use of nylon as a denture-base material. *Journal of dentistry*. 1986 Feb 1;14(1):18-22.
12. Takabayashi Y. Characteristics of denture thermoplastic resins for non-metal clasp dentures. *Dental materials journal*. 2010;1007010034-.
13. Singh JP, Dhiman RK, Bedi RP, Girish SH. Flexible denture base material: A viable alternative to conventional acrylic denture base material. *Contemporary clinical dentistry*. 2011 Oct;2(4):313.
14. Kaplan P. Flexible removable partial dentures: design and clasp concepts. *Dentistry today*. 2008 Dec;27(12):120-2.
15. Negrutiu M, Sinescu C, Romanu M, Pop D, Lakatos S. Thermoplastic resins for flexible framework removable partial dentures. *TMJ*. 2005 Sep;55(3):295-9.
16. Matthews E, Smith DC. Nylon as a denture base material. *Br Dent J*. 1955 Apr 5;98(7):231-7.
17. Vojdani M, Giti R. Polyamide as a denture base material: A literature review. *Journal of Dentistry*. 2015 Mar;16(1 Suppl):
18. Negrutiu M, Sinescu C, Romanu M, Pop D, Lakatos S. Thermoplastic resins for flexible framework removable partial dentures. *TMJ*. 2005 Sep;55(3):295-9.
19. Fueki K, Ohkubo C, Yatabe M, Arakawa I, Arita M, Ino S, Kanamori T, Kawai Y, Kawara M, Komiyama O, Suzuki T. Clinical application of removable partial dentures using thermoplastic resin. Part II: Material properties and clinical features of non-metal clasp dentures. *Journal of prosthodontic research*. 2014;58(2):71-84.
20. Thumati P, Padmaja S, Raghavendra RK. Flexible dentures in prosthodontics--an overview. *Indian Journal of Dental Advancements*. 2013 Oct 1;5(4):1380-6.