



LONG WAY OF ADHESIVES IN PROSTHODONTICS

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INTRODUCTION:

The three factors which aid for success of a prosthesis are stability, retention and support which have physiological effect, psychological effect, longevity to the prosthesis respectively. Adhesives are the chemical retentive aids which may also give psychological confidence for the patient as it supplements retention and stability especially during occasions of public interaction. Adhesive Dentistry is a, relatively, new field that has totally revolutionized the face of dentistry. It is based on the concept of adhesion. Innovations in dentistry have always been related to the development of new materials, techniques & equipment's and thus, were always subject to changing and disappearing with the evolution of newer ones. For the first time, the innovation related to adhesion is **concept related**, whereas the materials & techniques are revolving and changing around this concept to satisfy it and improve it without **changing it**.^{1,2}

Terminology

Adhesion is the bonding of dissimilar materials by the attraction of atoms or molecules.

Adhesive is the material used to produce adhesion, and is always a liquid.

Adherend is the surface to which the adhesive is applied, and is always a solid.

The components of an adhesive system are present in the process of restoring teeth, i.e., the tooth tissues (enamel & dentin) represent the adherend while the adhesive restorative material represents the adhesive .

Wetting

-It is very difficult to make two solid surfaces to adhere completely, regardless of how smooth their surfaces appear to be, they are likely to be rough when considered on a microscopic level.

When they are placed in apposition, only the high spots will be in contact. One method to overcome this, is to place a fluid between them which will flow into the irregularities and provide for a wider area of contact between the two solid surfaces.

Contact angle is the angle formed by the adhesive with the adherend at their interface.

It may be 0 or 180 degrees = maximum adhesion
less than 90 degrees = moderate adhesion
more than 90 degrees = poor adhesion

MECHANISMS OF ADHESION:

- Mechanical adhesion**
- Adsorption adhesion**
- Diffusion adhesion**

d. Electrostatic adhesion**a. Mechanical Adhesion**

In this type, solidified adhesive interlock micro mechanically in surface roughness and irregularities of adherend by formation of resin tags within tooth surface.

b. Adsorption Adhesion

In this type, adhesive makes chemical bonding with substrate or adherend (inorganic hydroxyapatite & organic collagen fibers of tooth).

- Contain all types chemical bonds like;
- Primary bonds (ionic & covalent)
- Secondary valence bonds
- Hydrogen bonds,
- Van der waals forces (dipole interaction, London dispersion)

c. Diffusion Adhesion

- In this type, adhesion or bonding occurs between mobile molecules.
- Polymers from one surface come out and react with other surface and eventually adhesive disappears and both parts become one.
- Precipitation of substance on tooth surface to which resin can bound mechanically or chemically.

d. Electrostatic Adhesion

- In these two surfaces are joined by electro-static forces.
- Usually one surface is resin and other is metal.

REQUIREMENTS OF GOOD ADHESION:**Requirements of Good Adhesion**

- The materials which are being joined should be close as much as possible.
- **Adhesive should have**
- Sufficient wetting of the adhesive means spread of liquid.
- Measured by contact angle of droplet placed on adherend.
- Low contact angle.
- High the contact angle less the wetting, complete wetting means 0-degree contact angle.
- Low surface tension of adhesive.
- affinity for one another that causes them to stay together rather than interact with the surface they contact
- Adherend must be rough
- Increases the surface area & increase the potential for adhesion.
- Adhesive should not be too viscous nor too fluid.
- Requirements of Good Adhesion
- Adherend should have high surface energy.
- In nature, there is a desire for all objects to seek a reduced energy state, simply because

reduced energy is the most stable condition.

- Surfaces, in general, are of higher energy than the internal aspects of an object because molecules present at the surface have unsatisfied bonds.
- In other words, molecules on surface would prefer to be covered" by other molecules to satisfy their bond complexes and reduce their overall energy state.
- This covering can occur by;
 - oxygen,
 - water, or
 - other molecules.
- The higher the energy of the surface, the more receptive it is to being bonded to by another material, such as an adhesive.
- Methods of Increasing Surface Energy
- Surface cleaning by pumice or prophylactic paste
- Etching with acids
- Cleaning with solvents to remove contaminants

ADHESIVES IN COMPLETE DENTURE:^{2,3}

Though the usage of denture adhesives dates back to the late 18th century, the first mention of adhesives in literature was only in the 19th century. Denture adhesives were initially formulated by mixing vegetable. The mucilaginous substratum formed when they absorbed saliva stuck to the tissues and to the prosthesis.

Kapur's study in 1967 on 26 denture wearers, highlighted that concomitant use of denture adhesives added to the retention and improved denture wearers' incisive ability.

Figueiral et al. evaluated the retentive effect of different denture adhesives on maxillary complete dentures using an intraoral transducer and demonstrated retention of complete maxillary dentures were improved with the use of denture adhesives. The denture adhesives improved denture retention and stability and found that patients perceived improved confidence and comfort, better stability, and retention and decreased accumulation of food particles beneath the denture.

Coates⁵ studied about the incidence of usage of denture adhesive and found that only 6.9% used denture adhesive on a regular basis. The effectiveness of denture adhesive in improving the stability and retention of the maxillary complete denture were determined in vivo by Chew et al. using Kinseography.

Panagioutouni et al. in his studies found that denture adhesive materials showed a greater retentive ability compared to saliva, and when the adhesives were used in combination with artificial saliva their retentive ability was found to be significantly increased. Chowdhry et al. in their studies found that the paste form of adhesive materials is more resistant to dislodgement compared to the powder form. Abdelmelak and Michael in their studies demonstrated that the cushioning effect of denture adhesives reduced the pressure and friction transmitted to the underlying mucosa.

Indications

1. Recording jaw relations and denture try in should be done using stable and retentive bases. Denture adhesives stabilize the trial denture bases which show inadequate retention and stability due to various reasons.
2. Use of adhesives will increase denture try-in accuracy and decrease the patient apprehension about the fit of the final prosthesis.
3. Use of adhesives in patients with compromised denture bearing areas adds to their confidence thereby increasing the ability to adapt to the new prosthesis.
4. Immediate denture gets loosened soon due to tissue healing and resorption requiring relining, rebasing, or a new denture fabrication. Comfort and function during the interim period are aided by the use of a denture adhesive.
5. Reduced clinical findings of ulcers, tissue irritation, inflammation and compression of the oral mucosa of denture wearers were seen with concomitant use of adhesives.
6. Xerostomia in denture wearers either drug or radiotherapy induced can be alleviated with the use of denture adhesives.
7. Stabilization of dentures in patients with hormonal changes and neuromuscular disorders such as myasthenia gravis, Parkinson's

and Alzheimer's disease, etc., can be achieved with denture adhesives.

8. Prosthesis to rehabilitate gross maxillofacial defects requires denture adhesives for retention.
9. Denture adhesives are valuable adjuncts to the retention of radiation carriers or radiation protection prostheses.
10. Usage of minimal amounts of adhesives provides high profile patients like attorneys, executives, speakers, etc. with psychological security in social situations.

Contraindications

1. Allergies to denture adhesives or any of its components.
2. Gross inadequacies in retention and function.
3. Excessive bone resorption and soft tissue shrinkage leading to loss of vertical dimension.
4. Adhesives should not be used to retain fractured dentures or dentures with lost flanges.
5. Patients with inability to maintain proper hygiene of the denture should avoid the use of denture adhesive.

ADHESIVES IN FIXED PROSTHODONTICS:^{5,6,7}

After observing the industrial use of phosphoric acid to improve adhesion of paints and resin coatings to metal surfaces, Buonocore, in 1955, applied acid to teeth to "render the tooth surface more receptive to adhesion". Buonocore's pioneering work led to major changes in the practice of dentistry. Traditional mechanical methods of retaining restorative materials have been replaced, to a large extent, by tooth conserving adhesive methods. The concepts of large preparations and extension and prevention, proposed by Black in 1917, have gradually been replaced by smaller preparations and more conservative techniques. One major problem in restorative dentistry is the lack of proper union between the restorative material and the tooth surface. The process of inventions over a period of time have led to the development of ariso technique and modalities which help in adhesion and thereby reducing the tooth restoration gaps. Bonding / adhesion which was introduced into dentistry by the concept of acid etching by Buonocore in 1955 has changed the term to esthetic dentistry. Bonding in dentistry has improved stabilization and retention of restoration / excessive removal of sound tooth structure and the restorations are better able to transmit and distribute functional stresses across the bonding interface.

Clinical significance of adhesion (benefits)

- 1- Inhibition of marginal leakage which refers the ingress of saliva, food debris, microorganisms and stains at the tooth-restoration interface with its sequelae of recurrent caries, hypersensitivity, discoloration, looseness of the restoration and possible pulp involvement.
- 2- Re-inforcement of the tooth since adhesion bonds the restorative material to the remaining tooth structure, making them to behave clinically as one single structural entity in sustaining and distributing the forces of mastication.
- 3- Solving the problem of retention especially in anterior teeth, where trying to establish adequate mechanical retentive features through undercutting would involve more destruction & weakening of the tooth, if not impossible at all &/or would not be sufficient to retain the restorative material securely in place .
- 4- Adjusting esthetic defects without the need to grossly reduce the teeth for crowning (anterior cavities , minor discolorations , diastemas , malformed teeth , facings...)
- 5- Fulfilling the requisite of the modern esthetic practice in placing successful posterior cosmetic restorations.

- Types of adhesives

1-Etch & rinse adhesives(smear layer removing)

a- three steps : etching , priming and bonding are done in 3 separate steps.

b- two steps : etching is in one step and primer and bonding in one step (incorporated in one bottle) .

Etch& rinse adhesives represent the golden standards for adhesives with proven long-term success.

2- Self-etch adhesives (smear layer dissolving) No separate etching step.

a- two steps : acidic primer in one bottle and an adhesive in another bottle .

b- all-in-one : acid , primer and adhesive in one single bottle .

3-Glass ionomer adhesives (smear layer modifying)

Based on the glass ionomer self adhesive capacity technology. Conditioning of dentin with weak acids (10-20% polyacrylic acid) removes the smear layer and leaves the smear plugs.

These adhesives are simple to apply but exhibit low bond strength values .

4. Universal adhesive systems/“multi-mode” or “multipurpose” adhesives:

they may be used as self-etch (SE) adhesives, etch-and-rinse (ER) adhesives, or as SE adhesives on dentin and ER adhesives on enamel (a technique commonly referred to as “selective enamel etching)

ADHESIVES IN MFP:⁸

The selection of a suitable adhesive involves consideration of the prosthetic materials used in the construction of the prosthesis.

Factors To Be Considered When Selecting Adhesive System For Facial Prosthesis

- Strength of the adhesive bond to skin and to the facial prosthetic material
- Biocompatibility of the adhesive
- Design and material of the prosthesis
- Composition of the adhesive
- Type and quality of the patient's skin
- Convenience of handling and removing the adhesive

Advantages:

- Ease of application and manipulation
- Readily available
- No need to undergo any surgical procedures
- Less expensive as compared to implants

Disadvantages

- It may tear at the margins
- Routine removal may damage external pigmentation
- Patients with poor dexterity or coordination may have difficulty in applying
- Some patients may develop allergic or irritative responses to adhesives

Classification Of Adhesives In Mfp:

- a. Double sided tapes
- b. Paste
- c. Liquid
- d. Spray type

Technique

- Apply adhesive 6 to 7mm periphery of the surface
- Repeated cleaning might lead to breakage
- Not to apply at the edges of the prosthesis to increase the life of the prosthesis

Adhesive Remover

- Adhesive remover are used to remove adhesive from the skin .e.g. plastic remover , acetone

Technique To Remove Adhesive

- Cotton bud is soaked in remover and apply slowly under and around the fitting surface of the prosthesis.

Problem With Adhesive

- **SEBUM** – fatty substance release from gland can cause barrier between skin and adhesive.
- **MOISTURE** – can affect the action of adhesive
- **HAIR**- prevent adhesive layer contacting skin.
- **SOLVENT** – continue use of removal solvent can be allergic to skin

ADHESIVES IN LABORATORY PROCEDURES:¹

Adhesives are most commonly used in our day to day for attaching any two surfaces. Similarly, cyanoacrylates are used for attaching the broken casts or tooth structures on the cast, attaching die pins to the cast.

CONCLUSION

With proper use adhesives are beneficial to the patient in increasing retention and stability, enhanced comfort, improved function, and in providing psychological satisfaction. They should not be used as an aid to compensate for denture deficiencies even though adhesives enhance prosthesis performance.

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