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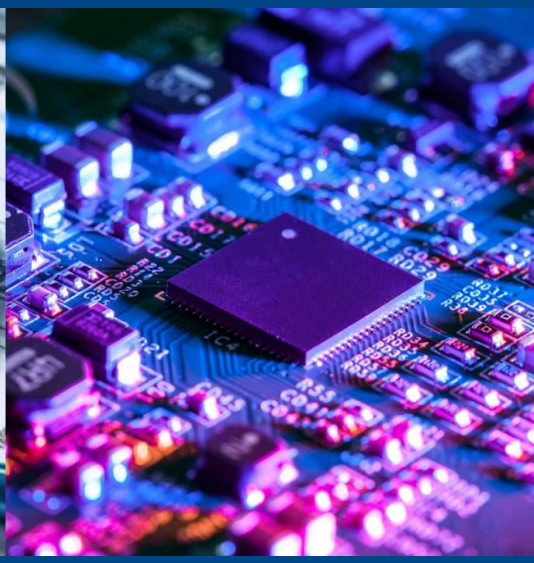

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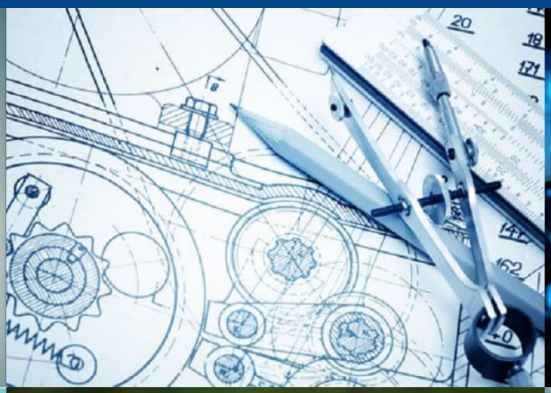

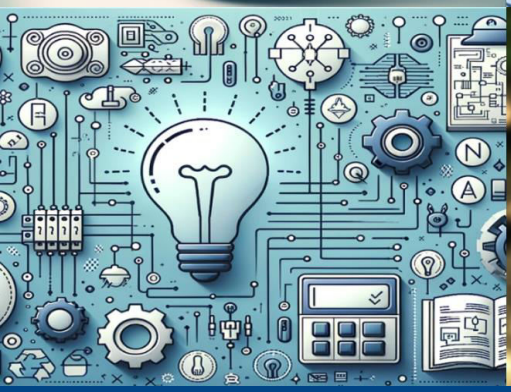

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'Tissue Conditioners' A Staunch Material -A Narrative Review

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ABSTRACT: In prosthodontics, tissue conditioners are strong, viscoelastic substances that improve dentures' comfort, functioning, and ability to conform to oral tissues. In order to treat problems such mucosal irritation, trauma from poorly fitting dentures, and effective impression-making for full denture creation, they are essential. Tissue conditioners, which offer short-term support and cushioning for the healing or adaptation of oral tissues, are typically made of acrylic polymers and plasticisers.

The efficacy and range of applications of tissue conditioners have been greatly enhanced by recent developments in material science and nanotechnology. Among the changes are the addition of antimicrobial compounds to prevent microbial colonisation and the introduction of nanomaterials to improve longevity, biocompatibility, and mechanical strength. These developments provide more robust and efficient solutions by addressing the drawbacks of conventional materials, such as their shorter lifespan and vulnerability to microbial growth.

The basic makeup, characteristics, and uses of tissue conditioners are highlighted in this abstract, along with the revolutionary effects of current technical developments. In prosthodontics, tissue conditioners are still a vital tool, and new research is opening the door to better clinical results and happier patients.

I. INTRODUCTION

In prosthodontics, a tissue conditioner is a soft, malleable substance that is used to temporarily enhance a removable denture's fit and comfort. It aids in stabilising and adjusting the denture to the oral tissues, particularly in cases when the soft tissues that support it are irritated, inflamed, or healing. Tissue conditioners reduce stress by creating a cushioning effect that more uniformly distributes functional pressures across the tissues. **[1]**
Usually, a basic polymer (such polyethyl methacrylate), a plasticiser, and an alcohol make up these polymers. The material loses its softness over time due to the plasticiser leaking out, thus it must be replaced. **[2,3]**

Functions of a Tissue Conditioner:
Healing Aid: Allows traumatized oral tissues to recover by minimizing pressure.
Functional Impression Material: Can capture the shape of the soft tissues in a functional state.
Temporary Relining Material: Improves the fit of ill-fitting dentures until a permanent solution is provided.

Other Names for Tissue Conditioners:
Soft liner; Temporary relining material;Functional impression material [**1,2,3**]
Applications of Tissue Conditioners in Prosthodontic Treatments
Tissue conditioners are compounds that can be used in a variety of prosthodontic procedures. They are essential for boosting prosthesis functionality and the condition of oral tissues. Here are some of their main uses:

1. Complete Denture Prosthodontics
Improving Fit of Ill-Fitting Dentures: Temporarily relines ill-fitting dentures to improve retention and stability. **[1]**
Healing Traumatized Tissues: Cushions and reduces pressure on inflamed or ulcerated tissues caused by denture wear. **[2]**
Functional Impression Material: Records functional impressions of the oral tissues during mastication, allowing for accurate fabrication of new dentures. **[3]**

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2. Removable Partial Denture (RPD) Prosthodontics
Adjusting Fit and Comfort: Relieves localized pressure points caused by RPD frameworks. **[4]**
Tissue Recovery in Overloaded Ridges: Prevents mucosal inflammation in partially edentulous patients by redistributing occlusal forces. **[5]**

3. Implant Prosthodontics
Temporary Relining of Overdentures: Used in implant-retained overdentures to cushion the supporting mucosa and implants while healing is ongoing. **[6]**

4. Pre-Prosthetic Treatment
Conditioning Tissue Before Final Prosthesis: Prepares traumatized or inflamed tissues for definitive impressions or prosthesis placement. **[7]**
Alveolar Ridge Maintenance: Helps reduce bone resorption by evenly distributing functional stresses. **[8]**

5. Geriatric Prosthodontics
Managing Atrophic Ridges: Provides relief and stabilization for patients with severely resorbed ridges or thin mucosa. **[9]**

6. Post-Surgical Applications
Immediate Denture Relining: Relieves pressure on surgical sites after extractions or implant placements. **[10]**

7. Maxillofacial Prosthetics
Support for Obturators: Improves tissue adaptation and comfort in patients wearing obturators for maxillofacial defects. [11]

Uses of Tissue Conditioners
Because tissue conditioners have special qualities including being soft, malleable, and adaptive to oral tissues, they are frequently employed in prosthodontics. Their uses are intended to improve prosthetic function, promote tissue healing, and increase patient comfort. The main applications are listed below:
A. Healing and Recovery of Oral Tissues [1-3,7-11]
Relief for Inflamed or Ulcerated Tissues: Tissue conditioners reduce pressure on inflamed mucosa, promoting healing in areas traumatized by ill-fitting dentures.
Treatment of Denture Stomatitis: Reduces microbial irritation and trauma caused by poorly fitting dentures.

B. Temporary Relining of Dentures
Improving Denture Fit: Temporarily corrects the fit of ill-fitting dentures, improving retention and stability until a permanent solution is provided.
Post-Surgical Use: Temporarily relines immediate dentures following extractions to protect healing surgical sites.

C. Functional Impression Material
Recording Functional Impressions: Used to capture the functional contour of oral tissues under dynamic conditions, aiding in the fabrication of well-fitting prostheses.

D. Redistribution of Masticatory Forces
Minimizing Pressure on Atrophic Ridges: Distributes masticatory loads evenly across the denture-bearing tissues, reducing the risk of further resorption or irritation.

E. Conditioning of Oral Tissues
Pre-Prosthetic Tissue Conditioning: Prepares traumatized or inflamed tissues for definitive impressions or final prosthesis placement.

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F. Geriatric Prosthodontics

Management of Thin Mucosa and Atrophic Ridges: Provides cushioning for elderly patients with fragile oral tissues and severely resorbed alveolar ridges.

G. Support for Obturators and Maxillofacial Prostheses

Improving Fit and Comfort of Obturators: Enhances tissue adaptation and reduces pressure for patients wearing obturators in maxillofacial rehabilitation.

Classification of Tissue Conditioners

Tissue conditioners can be classified based on their composition, duration of use, and clinical applications. Here is a detailed classification:

1. Classification Based on Composition **[5]**

a) Powder-Liquid Systems

Composed of polyethyl methacrylate (powder) and a plasticizer such as dibutyl phthalate (liquid).
Commonly used due to ease of manipulation and cost-effectiveness.
Example: Coe-Comfort.

b) Pre-Mixed Systems

Composed of silicone-based materials, supplied as ready-to-use pastes.
Known for superior elasticity and dimensional stability.
Example: Mucopren Soft.

2. Classification Based on Duration of Use **[1]**

a) Short-Term Tissue Conditioners

Used for immediate relief of tissue irritation or trauma.
Retain their softness for 2–7 days.
Example: Lynal.

b) Long-Term Tissue Conditioners

Designed to remain functional for weeks or months, offering extended cushioning.
Example: Coe-Soft.

3. Classification Based on Clinical Application **[3]**

a) Functional Impression Materials

Adapt to the functional shape of oral tissues during mastication and swallowing.
Serve as a basis for fabricating new dentures.
Example: Viscogel.

b) Tissue Conditioning Materials

Provide a cushion effect to relieve inflamed or traumatized tissues.
Example: GC Soft-Liner.

c) Relining Materials

Temporarily improve the fit and stability of dentures.
Example: Softone.

4. Classification Based on Chemical Composition **[7]**

a) Acrylic Resin-Based Conditioners

Typically consist of polyethyl methacrylate and a plasticizer.
Easy to manipulate but have limited durability.

b) Silicone-Based Conditioners [7]

Composed of silicone elastomers; provide excellent elasticity and long-term softness.
More expensive but preferred for extended use.

5. Classification Based on State **[10]**

a) Hardening Type

Initially soft but gradually harden over time due to leaching of plasticizer.

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b) Non-Hardening Type
Maintain softness over an extended period.

Composition of Various Tissue Conditioners
The main ingredients of tissue conditioners are liquid plasticiser and powdered polymers. Their durability, suppleness, and flexibility are all determined by their makeup. A comprehensive list of the ingredients in popular tissue conditioners can be found below:

1. Powder-Liquid Based Tissue Conditioners [1,4]
General Composition:
Powder: Polymer: Polyethyl methacrylate (PEMA) or polymethyl methacrylate (PMMA).
Liquid: Plasticizer: Dibutyl phthalate or butyl glycolate.
Solvent: Ethanol or isopropanol.
Examples: **Coe-Comfort**:
Powder: Polyethyl methacrylate.
Liquid: Dibutyl phthalate + ethanol.
Viscogel: **[1]**
Powder: Polyethyl methacrylate.
Liquid: Dibutyl phthalate + ethanol.
Softone: **[10]**
Powder: Polyethyl methacrylate.
Liquid: Dibutyl phthalate + aromatic esters.

2. Silicone-Based Tissue Conditioners
General Composition:
Base Material: Polydimethylsiloxane (PDMS).
Catalyst: Platinum-based compound.
Filler: Silica (to provide mechanical strength).
Examples:
Mucopren Soft: **[4]**
Silicone elastomer + fillers.
Long-lasting with high elasticity.
GC Soft-Liner: **[3]**
Silicone elastomer with reinforcing agents.

3. Long-Term Tissue Conditioners
General Composition:
Polymer: Polyethyl methacrylate (PEMA) or PMMA.
Plasticizer: Less volatile plasticizers like butyl glycolate for extended softness.
Examples:
Coe-Soft: **[8]**
Powder: Polyethyl methacrylate.
Liquid: Dibutyl phthalate + butyl glycolate.
Lynal: **[12]**
Powder: Polyethyl methacrylate.
Liquid: Dibutyl phthalate + benzyl benzoate.

4. Pre-Mixed Tissue Conditioners [11]
General Composition:
Base Material: Silicone-based elastomer.
Modifiers: Added stabilizers or antimicrobial agents.
Example:
Molloplast-B:
Silicone elastomer + antimicrobial agents.

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Known for its long-lasting softness and biocompatibility.

Properties of Various Tissue Conditioners

Tissue conditioners are appropriate for prosthodontic applications due to their distinct mechanical, biological, and physical characteristics. Depending on their composition and intended purpose, these attributes change. An extensive summary of the characteristics of popular tissue conditioners may be found below:

1. Physical Properties

a) Softness and Elasticity

Tissue conditioners are initially soft and pliable, providing cushioning to relieve pressure on oral tissues.

Silicone-based conditioners maintain their elasticity longer than acrylic-based materials. **[2]**

b) Dimensional Stability **[4]**

Powder-liquid materials (e.g., Coe-Comfort, Viscogel) show a gradual loss of softness due to leaching of plasticizer.

Silicone-based materials (e.g., Molloplast-B) exhibit better dimensional stability over time.

c) Flowability **[3]**

High initial flow allows adaptation to irregular tissue surfaces, making them suitable for functional impressions.

2. Mechanical Properties

a) Compressive Strength **[1]**

Low compressive strength is a characteristic feature, allowing the material to deform under functional loads.

Silicone-based materials have higher compressive strength compared to acrylic-based conditioners.

b) Hardness **[2]**

Acrylic-based tissue conditioners harden over time due to plasticizer leaching.

Silicone-based materials maintain their softness and resist hardening.

c) Tear Strength **[8]**

Silicone-based materials like Molloplast-B have better tear resistance, making them more durable for long-term use.

3. Biological Properties **[1,11,12]**

a) Biocompatibility

Tissue conditioners are biocompatible and non-toxic, suitable for direct application to oral tissues.

Silicone-based materials exhibit superior biocompatibility due to their inert nature.

b) Antimicrobial Activity

Some materials are impregnated with antimicrobial agents to reduce microbial colonization (e.g., Molloplast-B).

Acrylic-based materials are more prone to Candida albicans colonization.

c) Tissue Healing

By distributing masticatory forces evenly, tissue conditioners promote healing of traumatized tissues.

4. Longevity and Durability **[1,3,13]**

a) Duration of Effectiveness

Short-term conditioners (e.g., Coe-Comfort) are effective for 2–7 days.

Long-term conditioners (e.g., Coe-Soft) can be used for several weeks.

b) Resistance to Degradation

Silicone-based materials resist degradation better than acrylic-based materials, making them ideal for long-term applications.

5. Handling Properties **[2,3]**

a) Ease of Mixing

Powder-liquid systems require careful proportioning to achieve the desired consistency.

Silicone-based conditioners are supplied as pre-mixed pastes for convenience.

b) Setting Time

Most tissue conditioners set quickly, allowing for immediate application.

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Step-by-Step Procedure for Using Tissue Conditioners

Depending on their clinical purpose—tissue conditioning, temporary relining, or functional impressions—tissue conditioners must be applied in a certain order. Here are comprehensive protocols for a range of applications:

A. Procedure for Tissue Conditioning

Objective: To relieve trauma or inflammation of oral tissues caused by ill-fitting dentures or trauma.

Steps:

Patient Examination: Examine oral tissues for signs of inflammation, ulceration, or irritation. Remove the ill-fitting denture for a few hours, if needed, to assess the tissue.

Denture Preparation: Clean and disinfect the denture thoroughly. Roughen the fitting surface of the denture using a bur to enhance bonding.

Mixing the Material:

For powder-liquid systems: Mix the powder and liquid as per manufacturer instructions until a uniform consistency is achieved.

For pre-mixed systems: The material is ready to use.

Application: [1]

Apply an even layer of the tissue conditioner (2-3 mm thick) to the denture's fitting surface. Avoid air bubbles to ensure proper adaptation.

Placement in the Mouth: Seat the denture in the patient's mouth. Ask the patient to close gently in centric relation and maintain this position for a few minutes.

Adjustments: Remove the denture and inspect for even distribution of the material. Trim excess material using a scalpel or bur.

Follow-Up: Instruct the patient on care (e.g., cleaning with a soft brush and avoiding harsh cleaners). Review the patient after 2-3 days to evaluate tissue response and replace the material if necessary.

B. Procedure for Temporary Relining [2]

Objective: To improve the fit and comfort of an ill-fitting denture temporarily.

Steps:

Preparation: Clean and roughen the fitting surface of the denture. Ensure the denture is dry.

Mixing: Prepare the tissue conditioner material according to the manufacturer's instructions.

Application: Apply the material to the fitting surface of the denture in an even layer.

Seating: Place the denture in the patient's mouth and ensure proper occlusion. Have the patient bite gently and maintain the position for 3-5 minutes.

Trimming and Polishing: Remove the denture and trim any excess material. Smoothen the edges for patient comfort.

Patient Instructions: Advise the patient to handle the denture with care and avoid soaking it in alcohol-based solutions.

3. Procedure for Functional Impression [3]

Objective: To record the functional form of denture-bearing tissues under masticatory loads.

Steps:

Preliminary Steps: Ensure the patient's tissues are in a healthy condition before starting. Adjust the denture borders to avoid overextension.

Mixing the Material: Mix the tissue conditioner according to the manufacturer's guidelines.

Application: Apply the material to the tissue-contacting surface of the denture, ensuring uniform coverage.

Placement in the Mouth: Insert the denture and instruct the patient to perform functional movements (e.g., swallowing, speaking, chewing motions).

Setting Time: Allow the material to set intraorally while maintaining functional movements.

Evaluation: Remove the denture and inspect the material for accurate impression detail.

Trim excess material and polish the borders as needed.

Casting: Pour the impression in dental stone for the fabrication of a new denture.

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4. Procedure for Post-Surgical Applications [10]
Objective: To provide cushioning and protection for healing tissues after surgery (e.g., extractions, implant placement).
Steps:
Immediate Denture Preparation: Roughen the fitting surface of the immediate denture.
Application: Apply a thin, even layer of tissue conditioner to the surgical site area.
Placement: Insert the denture gently over the surgical site, ensuring minimal pressure.
Follow-Up: Schedule regular follow-ups to monitor healing and replace the material as needed.

5. Silicone-Based Tissue Conditioner Application [13]
Objective: For long-term use in cases of atrophic ridges or fragile oral tissues.
Steps:
Preparation: Clean and dry the denture.
Application: Apply the pre-mixed silicone-based conditioner to the denture surface.
Seating: Seat the denture and allow the material to adapt to the oral tissues.
Trimming: After setting, trim excess material and smooth the edges.
Care Instructions: Advise the patient on cleaning and handling to maintain the material's longevity.

Advantages and Disadvantages of Various Tissue Conditioners
The two main types of tissue conditioners are silicone-based (pre-mixed) and acrylic-based (powder-liquid). Each type has unique benefits and drawbacks that affect how they are used in therapeutic settings. A comparative analysis can be seen below:
1. Acrylic-Based Tissue Conditioners **[1,3,4,10]**
Advantages:
Ease of Use: Simple mixing process for powder-liquid systems.
Adaptability: High flow initially, enabling accurate adaptation to tissue surfaces. Suitable for functional impressions and tissue conditioning.
Cost-Effective: Relatively inexpensive compared to silicone-based materials.
Versatility: Widely used for short-term applications, such as temporary relining.
Disadvantages: **[1,2,8,12]**
Plasticizer Leaching: Gradual leaching of plasticizer leads to hardening, reducing effectiveness.
Short Lifespan: Typically effective for only 2–7 days, requiring frequent replacement.
Susceptibility to Microbial Growth: More prone to colonization by Candida albicans and other microbes.
Mechanical Weakness: Poor tear resistance and compressive strength, making them unsuitable for long-term use.

2. Silicone-Based Tissue Conditioners **[2,10,11,13]**
Advantages:
Longevity: Maintains elasticity and dimensional stability for extended periods (weeks to months).
Tear Resistance: Higher tear strength compared to acrylic-based conditioners, enhancing durability.
Biocompatibility: Inert and less likely to cause irritation or allergic reactions.
Resistance to Microbial Growth: Can be infused with antimicrobial agents to reduce colonization.
Ease of Handling: Pre-mixed formulations reduce the risk of inconsistencies during mixing.
Disadvantages: **[2,3,4]**
Higher Cost: More expensive than acrylic-based tissue conditioners, limiting widespread use.
Lower Initial Flow: Less flowability compared to acrylic-based materials, which may affect initial adaptation.
Complex Adjustments: Difficult to modify or reline once set, requiring precise application.

Clinical Recommendations
Short-Term Use: **[14,15]**
Acrylic-based conditioners (e.g., Coe-Comfort, Viscogel) are preferred for temporary tissue relief and functional impressions.
Long-Term Use:
Silicone-based conditioners (e.g., Molloplast-B, GC Soft-Liner) are ideal for extended cushioning and atrophic ridge management.

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Recent advancements in tissue conditioners such as modifications and nanotechnology

The goal of recent developments in tissue conditioners has been to improve their qualities by incorporating nanotechnology and changing the substance. These advancements are intended to enhance mechanical strength, biocompatibility, antibacterial activity, and overall clinical performance.

Material Modifications:

Antimicrobial Agent Incorporation: Researchers have looked into adding antimicrobial agents to tissue conditioners in order to combat the problem of bacteria colonisation. One study, for example, looked into adding copper oxide nanoparticles to tissue conditioners, showing improved antibacterial activity against common mouth infections. **[14]**

Better Formulations: Materials with improved physical characteristics and longer functional lifespans have been developed as a result of improvements in tissue conditioner composition. The goal of these advancements is to offer more long-lasting and efficient prosthetic therapy options**. [13]**

Nanotechnology Applications:

Nanofiber Integration: To promote wound healing, electrospun nanofibers have been investigated for use in tissue conditioners. Nanofibers with antibacterial and biocompatible qualities that support tissue regeneration have been made from materials such chitosan, gelatin, curcumin, and rutin. **[7]**

Tissue Engineering with Nanomaterial Enhancement: The use of nanoparticles in tissue engineering has demonstrated potential for tissue reconstruction or repair. The efficiency of tissue conditioners can be increased by customising these nanoparticles to offer certain functions, such increased mechanical strength or targeted medication delivery.

These developments are part of a rising movement to use material science and nanotechnology to get beyond the drawbacks of conventional tissue conditioners and provide better results in tissue engineering and prosthetic applications. **[7]**

II. CONCLUSION

Because they offer substantial advantages in terms of tissue healing, adaptability, and functional impression-making, tissue conditioners are crucial components in prosthodontics. They are a common component of therapeutic practice because of their primary function of improving the comfort and fit of dentures, especially when it comes to treating pressure sores, inflammation, and tissue damage brought on by poorly fitting prostheses.

Recent developments have greatly enhanced the qualities of tissue conditioners, especially in the application of nanotechnology and antibacterial compounds. By addressing major shortcomings of conventional materials such deterioration over time and low mechanical strength, these advancements have improved their biocompatibility, durability, and resistance to microbial growth. In particular, nanomaterials have the potential to enhance mechanical qualities while simultaneously facilitating tissue repair and regeneration.

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