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Influence of Denture Cleansers on The Surface Roughness and Abrasion Resistance of Acrylic Resins

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Abstract

Tooth loss and the development of dental prostheses have prompted significant advancements in materials used for denture bases. Poly Methyl Methacrylate (PMMA), introduced in the 20th century, remains a popular choice for its aesthetic and functional qualities. However, maintaining denture hygiene poses challenges, within appropriate cleaning methods often leading to surface degradation and increased microbial colonization. This invitro study evaluated the impact of three clean sing agents—Pepsodent, Palmolive soap water, and Clandendenture cleansing paste—on the surface roughness and abrasion resistance of two acrylic resins, DPI and Lucitone. A total of 120 acrylic specimens (60 each of DPI and Lucitone) were subjected to simulated brushing regimens mimicking 1.5 years of manual brushing. The results revealed that Pepsodent caused the most material loss and surface roughness, particularly in DPI resin. In contrast, Palmolive soap water demonstrated the least abrasive effect, with water showing the highest resistance to abrasion and maintaining the smoothest surfaces. Lucitone exhibited superior abrasion resistance and lower surface roughness than DPI. These findings highlight the importance of

selecting non-abrasive cleansers for denture care to preserve prosthetic integrity and enhance patient satisfaction.

Keywords: Irregularities, Poly Methyl Methacrylate, aesthetics, hygiene.

Introduction

Tooth loss, a challenge faced by many individuals over centuries, has led to remarkable advancements in dental prostheses. From the use of animal teeth in ancient dentures to modern acrylic resins, the evolution of denture materials reflects an ongoing quest for improved aesthetics, functionality, and durability. Among the significant materials introduced in the 20th century is Poly Methyl Methacrylate (PMMA), which remains widely used due to its favorable characteristics such as aesthetics, strength, and biocompatibility.(1)

However, maintaining denture hygiene has become a crucial aspect of prosthetic care. Denture-related conditions, such as candidiasis, are often linked to inadequate cleaning practices. Although mechanical cleaning is commonly recommended, it can lead to abrasion and surface damage. Consequently, the search for effective yet gentle denture cleansers continues to be a priority in dental research.

This study aims to evaluate the impact of various denture cleansing agents on the surface roughness and abrasion resistance of two acrylic resins: DPI and Lucitone. By comparing these materials under different cleansing conditions, this study seeks to guide dental professionals and patients in selecting optimal denture care products.

Aims and Objectives

Aim: To determine the most effective cleansing agent with the least impact on surface roughness and abrasion resistance of different acrylic resin bases.

Objectives

- Compare surface irregularities and mass loss caused by Pepsodent on DPI and Lucitone.
- Assess surface irregularities and mass loss caused by Palmolive soap water on DPI and Lucitone.
- Evaluate the impact of Clanden denture cleansing paste on DPI and Lucitone.
- Compare the cumulative effects of Pepsodent, Palmolive soap water, and Clanden denture cleansing paste on DPI and Lucitone.

Materials and Methods

Study Design: This in vitro study was conducted at the Department of Prosthodontics, Crown, Bridge, and Implantology, Kanti Devi Dental College and Hospital, Mathura. A sample size of 120 acrylic specimens (60 from each resin base) was prepared. Standard-sized acrylic disc specimens (25 x 1.5 mm) were divided into four subgroups based on the cleansing agent tested: water, Pepsodent, Clanden, and Palmolive soap water.

GROUPS	HEAT CURE ACRYLIC RESIN	DENTURE CLEANSING MATERIAL
A1	DPI	WATER
A2		PEPSODENT (NORMAL DENTRIFICE)
A3		CLANDEN (DENTURE CLEANSING PASTE)
A4		PALMOLIVE (SOAP WATER SOLUTION)
B1	Lucitone	WATER
B2		PEPSODENT (NORMAL DENTRIFICE)
B3		CLANDEN (DENTURE CLEANSING PASTE)
B4		PALMOLIVE (SOAP WATER SOLUTION)

Testing Methodology: The next step involved mounting the specimens onto plaster blocks. These prepared assemblies were then placed onto a brushing stimulation machine fitted with Denture brushes (CLINSODENT), ina configuration that allowed for the simultaneous

brushing of 15 specimens. The brushing regimen mimicked a linear toothbrush abrasion movement, executing 356 brushstrokes both forwards and backwards.

Each of the four groups were exposed to a specific dentifrice like water, Palmolive soap water, Clandendenture cleansing paste, pepsodent administered with adenture brush (CLINSODENT).

The specimens underwent simulated brushing using a machine that applied 11,000 brushing strokes, replicating approximately 1.5 years of manual brushing. Surface roughness was measured before and after brushing using a Mitutoyo surface roughness tester, and the results were analyzed using ANOVA and Tukey's post hoc tests.

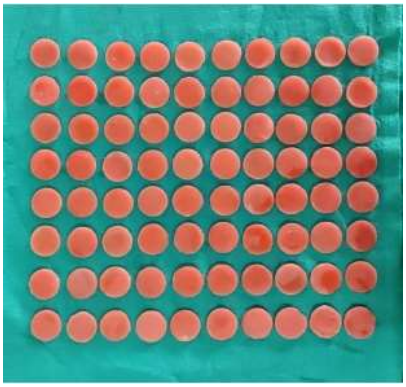


Figure 1: Prepared wax samples

Figure 2: Invested wax pattern placed in hanau dental flask

Figure 3: Shaper customised for brushing

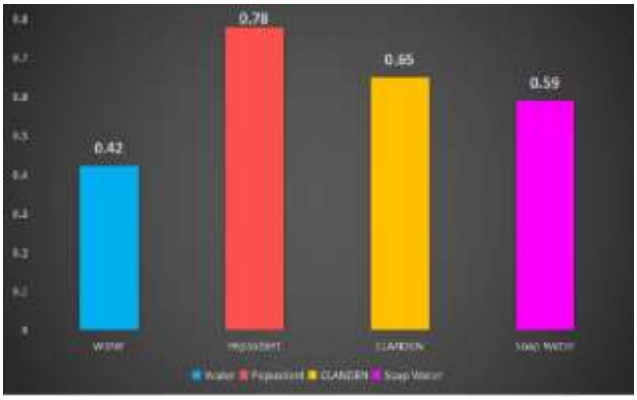
Figure 4: Acrylic sample brushed with Soap water

Figure 5: Surfcoder measuring surface roughness

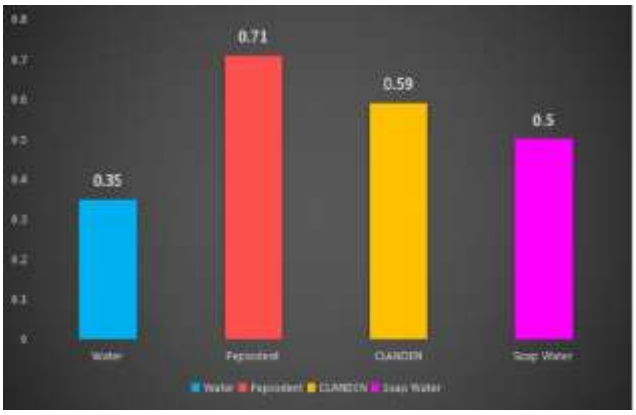
Results

Abrasion Resistance

- DPI Group: Pepsodent caused the most material loss (0.78g), followed by Clanden (0.65g), Palmolive soap water (0.59g), and Water (0.42g).
- Lucitone Group: Pepsodent again led to the most material loss (0.71g), followed by Clanden (0.59g), Palmolive soap water (0.50g), and Water (0.35g).
- Comparison between DPI and Lucitone: Lucitone demonstrated better abrasion resistance across all cleansing agents.



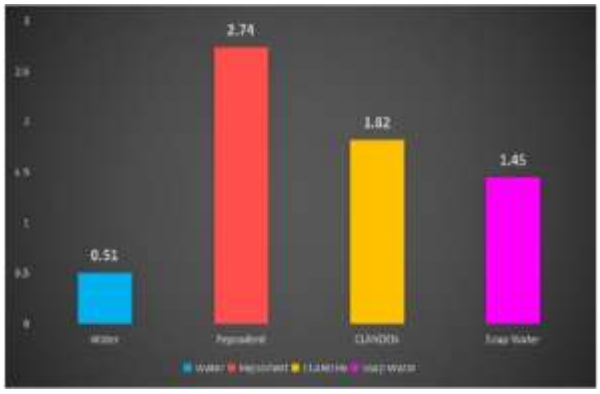
Graph 1: Comparison of material lost due to abrasion using different cleansing agents in DPI Denture base group



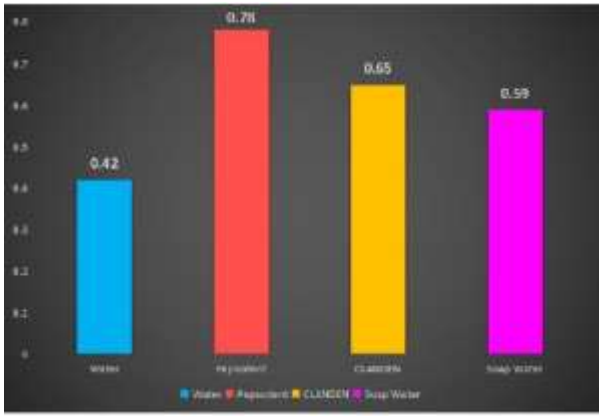
Graph 2: Comparison of material lost due to abrasion using different cleansing agents in Lucitone Denture base group

Surface Roughness:

- DPI Group: Pepsodent caused the highest roughness (3.54 Ra), followed by Clanden (2.35 Ra), Palmolive soap water (1.97 Ra), and Water (0.73 Ra).
- Lucitone Group: Pepsodent also resulted in the highest roughness (2.74 Ra), followed by Clanden (1.82 Ra), Palmolive soap water (1.45 Ra), and Water (0.51 Ra).
- Comparison between DPI and Lucitone: Lucitone exhibited lower surface roughness compared to DPI across all cleansing agents.



Graph 3: Comparison of Surface roughness using different cleansing agents in Lucitone Denture base group.



Graph 4: Comparison of Surface roughness using different cleansing agents in DPI Denture base group.

Discussion

The evolution of denture materials and cleaning practices has been driven by the need to balance efficacy with preservation of prosthetic integrity. The study aimed to evaluate the impact of different cleansing agents on the surface roughness and abrasion resistance of two commonly used acrylic resins, DPI and Lucitone. This discussion highlights the significance of the findings in the context of current denture care practices and material science.

Impact of Cleansing Agents on Surface Roughness and Abrasion

The study reveals that Pepsodent, despite its popularity, significantly increased the surface roughness of both DPI and Lucitone resins. This finding is consistent with

previous research indicating that toothpaste, particularly those with abrasive agents like silica, can degrade denture surfaces over time [1][2]. The abrasiveness of Pepsodent led to a rougher surface, which could potentially increase microbial colonization and plaque accumulation, further exacerbating denture-related conditions [3].

Palmolive soap water showed intermediate abrasiveness. Clanden, while somewhat abrasive, was less impactful than Pepsodent, suggesting it is a more suitable option for maintaining the surface integrity of dentures. Palmolive soap water, lacking abrasive components, demonstrated the least impact on surface roughness and material loss, supporting its use as a gentler alternative for routine denture cleaning [4][5].

Water emerged as the most benign cleaning agent, with the lowest levels of surface roughness and material loss. This aligns with the notion that non-abrasive cleaning methods are preferable for maintaining the longevity of denture materials [6]. The findings suggest that while water alone may not offer comprehensive cleaning, it minimizes the risk of surface degradation associated with more abrasive agents.

Material Differences and Clinical Implications

The study also highlighted significant differences between DPI and Lucitone resins. DPI resin exhibited greater surface roughness and material loss compared to Lucitone, indicating inherent material differences that affect durability and resistance to cleaning agents. These differences could be attributed to variations in the resin's composition or processing methods, which affect its hardness and susceptibility to abrasion [7][8].

The higher material loss observed in DPI compared to Lucitone suggests that denture material selection is critical. Denture bases made from more resistant materials like Lucitone may offer better performance in terms of longevity and resistance to cleaning-induced wear. This is particularly relevant for patients who use more abrasive cleaning agents or have a high frequency of cleaning [9].

Recommendations for Clinical Practice

The study's findings underscore the importance of selecting appropriate denture cleaning agents to balance cleaning efficacy with material preservation. Dental professionals should be aware of the potential for certain cleansers to increase surface roughness and cause material loss. Advising patients to use non-abrasive options, such as Palmolive soap water, or employing mechanical cleaning methods with caution, can help maintain both the functionality and aesthetics of dentures [10][11].

In conclusion, while traditional dentifrices may offer effective cleaning, their abrasive nature poses risks to denture surfaces. The study highlights the need for ongoing research into denture care products that effectively clean while minimizing surface damage. By selecting suitable cleaning agents and advising patients accordingly, dental professionals can enhance the durability and comfort of denture wearers, contributing to better overall oral health and patient satisfaction.

Conclusion

1. Abrasion Resistance: Water demonstrated the highest resistance to abrasion, while Pepsodent caused the most material loss. DPI resin bases exhibited greater abrasion than Lucitone.
2. Surface Roughness: Pepsodent led to the highest surface roughness, whereas water maintained the smoothest surfaces.
3. Base Material Impact: DPI bases had higher roughness and material loss compared to Lucitone, underscoring the importance of material choice.

4. Denture Care: Denture cleaning solutions significantly influence surface roughness and abrasion. Water is a gentle yet effective option for maintaining denture surfaces.
5. Clinical Considerations: Dental professionals should carefully advise patients on denture cleansers that ensure effective cleaning while minimizing potential damage to the denture base material.

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