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COMPARATIVE EVALUATION OF WEAR RESISTANCE OF HYBRID COMPOSITE VS CENTION N

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ABSTRACT
Dental restorative materials are constantly exposed to complex conditions in the oral environment, including mechanical forces, temperature changes, moisture, and chemical challenges. Among the mechanical properties required for long-term success of restorations, wear resistance is considered one of the most important. Among the mechanical properties required for long-term success of restorations, wear resistance is considered one of the most important.Hybrid composite resins were developed to improve the mechanical properties of earlier composites by combining macrofill and microfill particles within the resin matrix. Cention N restorative materials using an in-vitro wear simulation method, in order to determine which material demonstrates better resistance to surface wear under simulated oral conditions.Composite resins are among the most widely used restorative materials in modern dentistry due to their excellent aesthetics, good mechanical properties, and adhesive capabilities. Hybrid composite resins, in particular, consist of a combination of fine and microfill particles within a resin matrix, which enhances their mechanical strength and wear resistance. Wear of restorative materials may lead to loss of anatomical form, marginal breakdown, surface roughness, and eventual restoration failure.Cention N is a relatively new alkasite restorative material designed as an alternative to amalgam and composite restorations. It contains alkaline glass fillers capable of releasing fluoride, calcium, and hydroxide ions, which contribute to its anticariogenic properties.

Keywords: Hybrid composite, cention, wear resistance .

INTRODUCTION:

Dental restorative materials must withstand occlusal forces, abrasion, and mastication in the oral cavity. Wear resistance is a crucial property because excessive wear leads to loss of restoration anatomy, marginal breakdown, and reduced longevity.Among modern restorative materials, hybrid composite resins and Cention N (an alkasite restorative material) are widely used for posterior restorations due to their good mechanical properties and esthetics. Their wear behavior determines their clinical durability.[1] Dental restorative materials are constantly exposed to complex conditions in the oral environment, including mechanical forces, temperature changes, moisture, and chemical challenges. Among the mechanical properties required for long-term success of restorations, wear resistance is considered one of the most important. [2]Wear refers to the gradual loss of material from the surface of a restoration as a result of mastication, attrition, abrasion, and fatigue.[3] Excessive wear can compromise the occlusal anatomy, marginal integrity, and overall longevity of the restoration, eventually leading to restoration failure.[4]. With the increasing demand for esthetic and durable restorative materials, resin-based composites have become widely used alternatives to amalgam for posterior restorations.[5] Hybrid composite resins were developed to improve the mechanical properties of earlier composites by combining macrofill and microfill particles within the resin matrix.[6] This combination results in improved strength, wear resistance, and polishability, making hybrid composites suitable for stress-bearing areas of the dentition. Their high filler content and strong bonding between filler particles and resin matrix contribute significantly to their resistance against surface degradation and occlusal wear. In recent years, newer restorative materials have been introduced with additional bioactive properties.[7] One such material is Cention N, which belongs to a relatively new category known as alkasite materials. Cention N is a tooth-colored, bulk-fill restorative material designed as an alternative to amalgam and conventional composite resins.[8] It contains alkaline glass fillers capable of releasing fluoride, calcium, and hydroxide ions, which can help neutralize acidic environments and support remineralization of adjacent tooth structures. [9]. Although hybrid composites have been extensively studied and widely used in clinical practice, newer materials like Cention N require further evaluation to determine their mechanical performance. Comparing the wear resistance of hybrid composite and Cention N will help clinicians make informed decisions regarding the selection of restorative materials for posterior teeth, where restorations are subjected to significant occlusal forces.[10]

Therefore, the present study aims to comparatively evaluate the wear resistance of hybrid composite and Cention N restorative materials using an in-vitro wear simulation method, in order to determine which material demonstrates better resistance to surface wear under simulated oral conditions.[11] Restorative dentistry has undergone significant advancements with the development of tooth-colored restorative materials that provide both aesthetic and functional restoration of damaged teeth. Among the essential properties required for restorative materials, wear resistance plays a critical role in determining the longevity and clinical success of restorations, especially in posterior teeth that are subjected to high occlusal forces. [12]Wear of restorative materials may lead to loss of anatomical form, marginal breakdown, surface roughness, and eventual restoration failure. Composite resins are among the most widely used restorative materials in modern dentistry due to their excellent aesthetics, good mechanical properties, and adhesive capabilities. Hybrid composite resins, in particular, consist of a combination of fine and microfill particles within a resin matrix, which enhances their mechanical strength and wear resistance.[13] The high filler content and improved filler–matrix bonding contribute to better resistance against abrasion and occlusal wear. Because of these advantages, hybrid composites are commonly used for posterior restorations where durability and resistance to masticatory forces are essential.[14]

MATERIALS AND METHODS

Study Design

The present study was designed as an in-vitro experimental study to evaluate and compare the wear resistance of hybrid composite resin and Cention N restorative material under simulated masticatory conditions.

Materials Used

Two restorative materials commonly used for posterior restorations were selected for this study:

- Hybrid Composite Resin (Nanohybrid composite restorative material)
- Cention N (Alkasite restorative material)

Cention N is a tooth-colored alkasite material composed of alkaline glass fillers and a UDMA-based resin matrix, which is capable of releasing calcium, fluoride, and hydroxide ions. Hybrid composite resin contains high filler loading with fine filler particles, which contribute to improved mechanical properties and wear resistance.

Sample Size and Grouping

A total of 20 specimens were prepared and divided into two groups:

Group	Material	Number of Samples
Group I	Hybrid Composite	10
Group II	Cention N	10

Specimen Preparation

Standardized cylindrical specimens were fabricated using a Teflon mold measuring 6 mm in diameter and 4 mm in thickness.

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The restorative materials were prepared according to the manufacturer's instructions and placed into the mold. A mylar strip and glass slide were placed over the mold to produce a smooth and uniform surface.

- For Hybrid Composite, the material was incrementally placed and light-cured for 20 seconds using an LED curing unit.
- For Cention N, the powder and liquid components were mixed and placed into the mold and allowed to self-cure, followed by optional light curing.

After polymerization, the specimens were removed from the mold and any excess material was finished using fine abrasive discs to obtain uniform surfaces.

Storage of Specimens

All prepared samples were stored in distilled water at 37°C for 24 hours to simulate oral conditions and allow complete polymerization of the restorative materials.

Wear Resistance Testing

Wear resistance testing was performed using a chewing simulator / wear testing machine. Each specimen was subjected to simulated masticatory cycles under controlled conditions.

The testing parameters included:

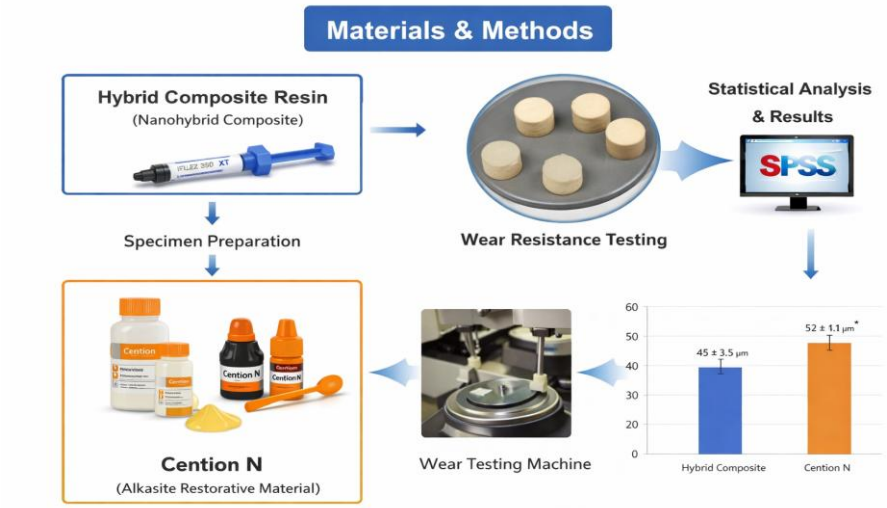
- Load applied: 20 N
- Number of cycles: 50,000 cycles
- Testing environment: Artificial saliva / distilled water

The wear depth and surface loss were measured using a digital profilometer / stereomicroscope, and the results were recorded in micrometers (µm).

Statistical Analysis

The collected data were tabulated and analyzed using Statistical Package for Social Sciences (SPSS) software.

- Mean and standard deviation were calculated for both groups.
- An independent t-test was used to compare the wear resistance between the two groups.
- A p-value < 0.05 was considered statistically significant.



RESULTS:

The present in-vitro study evaluated and compared the wear resistance of hybrid composite resin and Cention N restorative materials after subjecting the specimens to simulated masticatory wear cycles.

A total of 20 specimens were tested, with 10 samples in each group. The wear loss values were measured using a profilometer and expressed in micrometers (µm). The mean wear loss and standard deviation for both groups were calculated.

The Hybrid Composite group showed a mean wear loss of 45 ± 3.5 µm, whereas the Cention N group demonstrated a mean wear loss of 52 ± 4.1 µm.

The results indicated that the hybrid composite exhibited lower wear loss compared with Cention N, suggesting comparatively higher wear resistance under the tested conditions.

Statistical analysis was performed using an independent t-test, which revealed that the difference between the two groups was statistically significant ($p < 0.05$).

The findings of the present study indicate that although both materials demonstrated acceptable wear resistance, hybrid composite maintained better surface stability and resistance to wear compared to Cention N.

Table: Comparison of Wear Resistance

Material	Sample Size (n)	Mean Wear Loss (µm)	Standard Deviation
Hybrid Composite	10	45	±3.5
Cention N	10	52	±4.1

DISCUSSION

Wear resistance is a crucial property of restorative materials because restorations are continuously exposed to masticatory forces, abrasion, and occlusal stresses in the oral cavity. Excessive wear may result in loss of anatomical contour, marginal deterioration, and reduced longevity of restorations. Therefore, evaluating the wear behavior of newly introduced restorative materials is essential for determining their clinical performance.[15]

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In the present study, the hybrid composite demonstrated lower wear loss compared with Cention N, indicating better resistance to abrasive forces under simulated masticatory conditions. The improved wear resistance of hybrid composite can be attributed to its high filler content and strong filler–matrix bonding, which enhance the mechanical strength and surface stability of the material.[16]

The findings of the present study are consistent with research conducted by investigators from Saveetha Institute of Medical and Technical Sciences, where in-vitro simulations using mechanical loading or brushing cycles were used to evaluate the surface properties and durability of restorative materials.[17] These studies commonly use profilometers, wear simulators, and standardized specimen preparation to analyze material performance under simulated oral conditions. [18]

Hybrid composite resins contain silica or glass filler particles embedded in a resin matrix, which provide improved hardness, fracture resistance, and resistance to surface degradation. Because of the smaller filler particle size and uniform distribution, the composite surface tends to exhibit reduced filler dislodgement and less matrix wear, thereby improving wear resistance.

Cention N is a relatively new alkasite restorative material designed as an alternative to amalgam and composite restorations. It contains alkaline glass fillers capable of releasing fluoride, calcium, and hydroxide ions, which contribute to its anticariogenic properties. Studies from Saveetha researchers have also highlighted that Cention N demonstrates good mechanical strength and fluoride release, making it a potential material for posterior restorations. [19]

However, despite its bioactive advantages, the wear resistance of Cention N may be slightly lower than that of hybrid composites due to differences in filler distribution and resin matrix composition. During mechanical wear, the resin matrix may undergo micro-abrasion and filler particle exposure, which can lead to increased surface roughness and greater material loss compared with composite resins.[20]

From a clinical perspective, both hybrid composite and Cention N demonstrated acceptable wear resistance, indicating that both materials may be suitable for posterior restorations. Hybrid composites may be preferred in areas subjected to high occlusal stress, whereas Cention N may be beneficial in cases where fluoride release and bioactivity are desired.[21]

However, the present study has certain limitations. Since it was conducted under in-vitro conditions, factors such as saliva, thermal fluctuations, dietary habits, and patient-specific occlusal patterns could not be fully simulated. [22]Previous chewing simulation studies conducted by researchers from Saveetha institutions also emphasize that laboratory simulations cannot completely replicate the complex environment of the oral cavity. [23]

The longevity and clinical success of restorative materials largely depend on their ability to withstand occlusal forces, abrasion, and mechanical stresses present in the oral cavity. Wear resistance is therefore considered a critical property for restorative materials, particularly for posterior restorations where masticatory forces are significantly higher. Excessive wear can lead to loss of occlusal anatomy, marginal discrepancies, increased plaque accumulation, and eventual restoration failure.[24]

In the present study, the wear resistance of hybrid composite and Cention N restorative materials was evaluated under simulated masticatory conditions. The results demonstrated that hybrid composite showed comparatively lower wear loss than Cention N, indicating better resistance to mechanical abrasion. This finding may be attributed to the high filler loading and improved filler–matrix interaction present in hybrid composite resins, which contribute to enhanced mechanical properties and resistance to surface degradation.[25]

CONCLUSION

Hybrid composite also demonstrated acceptable wear resistance; however, it showed comparatively greater surface wear when subjected to continuous frictional forces. Despite this, hybrid composites remain clinically reliable restorative materials due to their aesthetic properties and ease of handling.

Therefore, Cention N may serve as a promising alternative restorative material in stress-bearing posterior regions where improved wear resistance is desirable. Nevertheless, further long-term clinical studies are recommended to validate these findings and evaluate their performance under actual oral conditions.

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