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Research Article

Comparative Evaluation of Fracture Resistance of Silver Amalgam, Composite and Alkasite Restorative Material- An *In vitro* Study

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Abstract

Restoration of carious teeth is generally done with various restorative materials. Which include Metallic and Non-Metallic materials like Silver Amalgam, Light cured Composite resin, Glass ionomer cement etc. which partially fulfill the objectives of restoration. This invitro study was conducted to evaluate the fracture resistance of Silver Amalgam, Light cured Composite resin (Solare sculpt), and an Alkasite restorative material (Cention N). A total of 30 specimens, with 10 specimens in each of 3 groups were fabricated using Teflon coated stainless steel die with 8.5 mm diameter and 3 mm depth mold space. Group1 – Silver Amalgam, Group 2 – Light cured Composite resin, Group 3- Alkasite Restorative Material (Cention N). All Samples were tested for fracture resistance by a universal testing machine. The results obtained after fracture were analyzed using ANOVA and post hoc Tukey test. The results shows significant difference between the 3 groups with Group 3 Alkasite restorative material exhibits the highest fracture resistance compared to the remaining groups.

Keywords: Amalgam; Composite; Alkasite; Universal Testing Machine; Fracture Resistance

Introduction

Removal of tooth structure via cavity preparation may weaken teeth and increase their susceptibility to fracture [1]. In the oral cavity, Restorative material undergoes stress from masticatory forces producing different reactions that lead to deformation, which can ultimately compromise their durability overtime [2]. The common form of failure of posterior restorations is fracture. This is limited if the strength of the restorative material is equal to or more than the strength of the tooth structure. The quest for ideal restorative material with optimum physical properties and durability always exists.

Numerous Restorative Materials are available to the modern dental practice ranging from Silver Amalgam, Glass ionomer cement, Light cured resin Composite etc.

As described above, the economic, basic filling materials i.e, Silver Amalgam, Glass ionomer cement, Light cured resin Composite remain popular under particular dental circumstances. Silver Amalgam offered unparalleled longevity and strength but are coupled with poor esthetic and controversial ingredients. GIC, is known to have better esthetics but provides less strength and longevity. Where as, Light cured composites though esthetic enough, clinical compromise in one respect to another. Restorative resins are modified from macro filled to nanocomposites [3]. In the present study, SOLARE SCULPT nanohybrid has been used.

Dentists have long sought after a real alternative to Silver Amalgam or Glass ionomer cement and composite which should be cost-effective, esthetic, durable and fluoride releasing. Cention N (Ivoclar, Vivadent, Liechtenstein) a new restorative material based

with characteristics of both Silver Amalgam and Glass ionomer cement has been launched recently. The manufacturers claim advantages over the existing materials [4]. This alkasite restorative material redefines the basic restorative materials, combining bulk placement, ion release and durability and esthetic properties that satisfies both the patient and clinician.

Physical properties are of critical importance when deciding a suitable material, because they strongly influence the clinical durability of the restoration. One of the most important property is fracture resistance, which is used to predict the resistance of a material against masticatory forces.

Aim

Aim of the study is to evaluate the fracture resistance of Silver Amalgam, Light cured composite resin and an Alkasite restorative material.

Methodology

10 samples each of Silver Amalgam, Light cured composite resin and Alkasite restorative material were prepared from Teflon coated standardized stainless steel dies with mold space of 8.5mm diameter and 3mm depth as follow:

Silver amalgam samples preparation

Silver alloy triturated with mercury in 1:1 ratio (Eames technique) manipulated using Amalgamator. The mold space is incrementally condensed with amalgam using amalgam carrier and cylindrical serrated condenser, so that the greatest possible density is attained.

Composite sample preparation

Light cured resin Composite (Solare Sculpt) was placed in the mold space using Teflon coated plastic filling instrument in an incremental technique and cured with LED light cure unit for 30sec. Mylar strip was placed on the final increment followed by glass slab to provide flat and smooth surface and was cured, after removal of glass slab.

Alkasite restorative material (Cention-N) samples preparation

Alkasite Restorative material (Cention-N) samples were prepared by manual mixing for 45 - 60sec as per manufacturer instructions and were filled in mold spaces using plastic filling instrument and glass slab was placed on it in order to provide a flat surface and were allowed to set for 5min.

All these samples were polished using carbide paper

- Group 1 – Silver Amalgam – 10 samples
- Group 2 – Composite - 10 samples
- Group 3 – Alkasite Restorative Material - 10 Samples

All these specimens were stored in distilled water in 3 separate beakers with 10 samples each, for 24 hrs.

All Samples were tested using a universal testing machine at a strain rate of 1mm/min using the universal testing machine (DAC system inc. series 7200, Model no.T-72502) using 0.5mm round bar parallel to the long axis of the pellets.

Results

Results were measured in peak load [newtons (N)] when the fracture was noted. The Results of the present study showed that alkasite restorative material has the highest fracture resistance when compared to the other two restorative materials. Silver Amalgam exhibited the inferior numerical value of fracture resistance.

Statistical analysis

Statistical Analysis was done using SPSS version 18 software. A p-Value of < 0.05 was considered statistically significant. Comparison of mean peak load was done using ANOVA with post-hoc Tukey's test. Comparison of mean peak among the 3 groups.

	Group						P-value
	Alkasite		Composite		Silver		
	Mean	SD	Mean	SD	Mean	SD	
Load	1419.27	298.77	1292.42	437.78	582.23	236.56	<0.001; Sig

Table 1

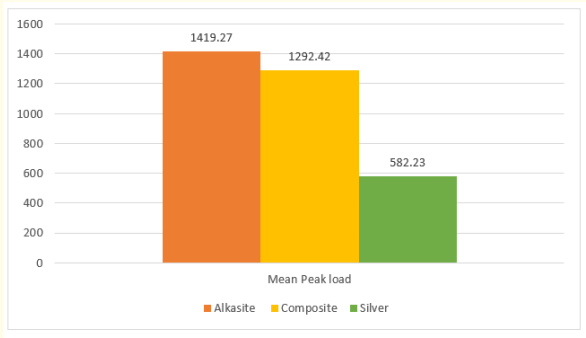

Figure 1: Comparison of mean peak load among the three groups.

Interpretation

There was an overall significant difference in the mean peak load among the three groups ($P < 0.001$). The post-hoc test showed that Alkasite and Composite had significantly higher mean peak load than silver ($p < 0.001$ and < 0.001) respectively. However, no significant difference was seen between Alkasite and composite ($p = 0.678$).

Discussion

A Fracture is a complete or incomplete break in the integrity of a material resulting from the application of excessive forces. Masticatory forces on restored and unrestored teeth have a tendency to deflect the cups under stresses, even though invitro studies are not actual reproduction of typical chewing stroke, in that they apply a continuously increasing force until the tooth fractures, they represent an important source of information on the structural integrity of the tooth [5].

In this study, fracture resistance of different posterior restorative materials, i.e., Amalgam, Composite, Alkaisite restorative Material, have been evaluated.

The basic problem of traditional Silver Amalgam restoration is its inability to bond to dental hard tissues which necessitate the use of micromechanical retentive features which cause further weakening of remaining tooth structure [6]. Sangwan., *et al*. 2016 stated that microcrack formation had been reported with silver Amalgam under fatigue loading; hence, it may not provide good fracture resistance of the remaining tooth [7,8].

Since the introduction of composite resin restorative material in the 1980s, these were widely used.

As Composite resin restorations retained with an adhesive resin. Much attention was focused on polymerization shrinkage of these materials. If the polymerization shrinkage is great enough, the resulting stresses can compromise the union (Chemical Bending and micromechanical interlocking) of the composite with cavity surface of the leading to breaking and causes a gap to form between the tooth and restoration. So various measures were taken in comparison of composite resin to reduce polymerization shrinkage and the addition of various type of fillers to increase strength [6].

In this study, solare sculpt, a light-cured universal Nanohybrid compactable composite, was used. It has high strength and wear resistance. It has unique homogenous 300 nm strontium glass filler dispersed for high strength and pre polymerized nanofiller with high density and uniform dispersion silane treatment technology which imparts strength to the composite restoration.

Cention-N an alkasite Restorative material which exhibited highest compressive strength contains organic monomer in the liquid consisting of four different dimethacrylates a combination of UDMA, DCP, PEG-400 DMA, Aromatic Aliphatic UDMA.UDMA forms the major component of monomer matrix Vandhana Sadhananda., *et al*. stated that the stronger mechanical properties might be attributed to its higher viscosity and lack of hydroxyl side groups which are hydrophobic in nature hence exhibit low water absorption [4]. DCP (Tricyclodecan- dimethanoldimethacrylate) has cyclic Aliphatic structure which facilitates the enhancement of strength. Scheck L., *et al*. stated Cention N exhibited higher strength values due to the dense polymer network [9].

The fillers found in the powder of Cention are barium aluminum silicate glass filler (which imparts strength), ytterbium trifluoride, Isofiller (Tetric-NCeram technology), calcium barium Aluminium fluorosilicate glass filler and calcium fluorosilicate an alkasite glass filler.

The particle size of fillers ranges between 0.1 micrometers to 35 micrometers. These fillers are responsible for imparting adequate strength. The isofiller which is patented filler functionalized by silanes is bonded to other filler particles. This enhances the bond between the organic monomer matrix and an inorganic filler [4].

Patel MU., *et al*. stated that increase in strength of cention compared to other restorative materials might be due to finely controlled micronization of the glass component which is achieved during manufacturing [10].

Vandana Sandananda., *et al*. Evaluated the flexural and compressive strength among Cention-N, Fuji IX, Ketac™ Molar, 3M ESPE, and Zirconomer where results show that Cention-N exhibited higher flexural and compressive strength values.

Paromita., *et al*. conducted *in vitro* study on a comparative evaluation of hardness of different restorative material (Restorative GIC, Cention-N, Nano-hybrid composite Resin, and Silver Amalgam). Where results show that Cention-N showed better microhardness properties, becoming a more clinically suitable option for minimally invasive treatments.

Emrullah Bahsi., *et al*. Conducted a study on the comparison of fracture resistance of Silver Amalgam and Composite in Abraded teeth. Results show that posterior composite may be used in molar teeth which have suffered abrasion. Whereas in premolars, the selection of restorative material must be made taking aesthetic expectations into consideration [11].

Conclusion

Silver Amalgam has been used in the field of dentistry from decades known for its high strength similarly composite, known for its esthetics. Interestingly, a newly emerged material Cention N beats up Silver Amalgam and composite both in terms of strength and esthetics. This material showed an overall promising clinical success. Cention N might be an undoubted alternative in the armamentarium of dental clinician (Figure 2 to 10).

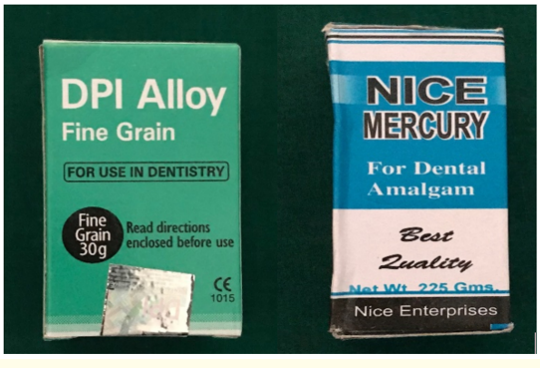

Figure 2: Silver Amalgam.

Figure 3: Composite.

Figure 4: Alkasite Restorative Material (Cention N).

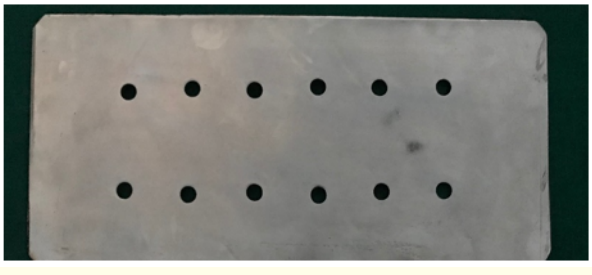

Figure 5: Teflon Coated Stainless Steel Die (8.5mm Diameter, 3mm Depth).

Figure 6: Silver Amalgam Sample Preparation

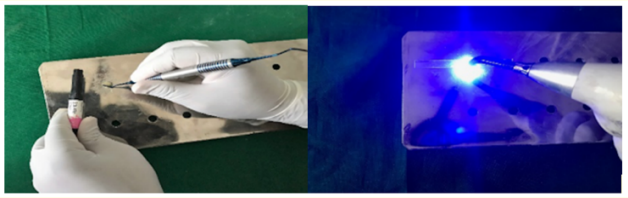

Figure 7: Composite Sample Preparation.

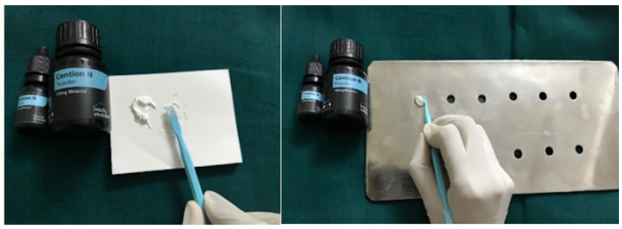

Figure 8: Alkasite Restorative Material Sample Preparation.

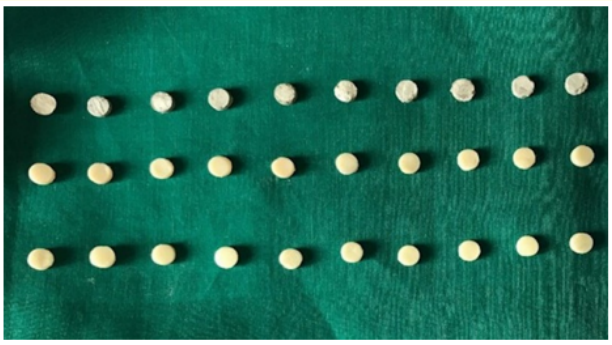

Figure 9: 3 Group of 10 Specimens Each.

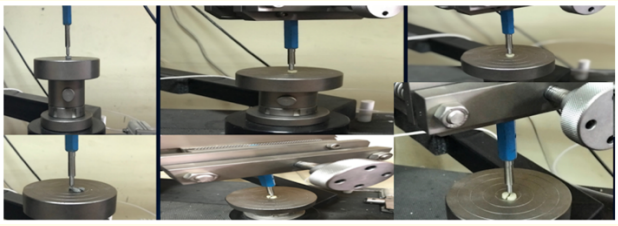

Figure 10: Measurement of Fracture Resistance Using Universal Testing Machine.

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