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ORIGINAL RESEARCH

COMPARATIVE EVALUATION OF COMPRESSIVE STRENGTH OF FLOWABLE COMPOSITE TO BE USED AS RESTORATIVE MATERIAL FOR MINIMALLY INVASIVE DENTISTRY

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ABSTRACT

Background: Dental restorative materials aim to replicate the structural and aesthetic properties of natural teeth. Flowable composites, with advancements in filler technology, offer enhanced adaptability and versatility for minimally invasive dentistry. Newer formulations like GC G-Aenial Universal Injectable and Ivoclar Tetric N-Flow have expanded their applications. This study evaluates their compressive strength to assess suitability for stress-bearing restorations.

Aim: The aim of the present study was to evaluate and compare the compressive strength of GC Aenial with Ivoclar flowable composite as a restorative material.

Materials and Methods: Cylindrical moulds were used to fabricate 10 samples each of GC Aenial and Ivoclar Tetric N-Flow composite. Then, samples were tested for evaluation of compressive strength using Universal Testing Machine (UTM). This was connected to a load measuring cell, which continuously recorded the load applied to the samples at a crosshead speed of 1mm per 1 minute till the samples fractured.

Results: The values were recorded and subjected to statistical analysis for comparison of compressive strength (MPa) between the two materials using SPSS software. In order to compare the means of two materials, Mann Whitney Test was used. The results of the study showed that there is no statistically significant difference between the two groups.

Conclusion: Within the limitations of this study, it can be concluded that both GC G-aenial and Ivoclar Tetric-N flow composite can also be used as a restorative material since its compressive strength was found to be statistically significant. However, long term clinical studies are required to draw any substantial conclusion.

***Keywords*:** GC G Aenial; compressive strength; ivoclar Tetric-N flow; posterior restoration.

INTRODUCTION

The primary goal of dental restorative materials is to replicate the biological, functional, and aesthetic properties of natural tooth structure. For over a century, materials like dental amalgam and gold alloys have been the cornerstone of restorative dentistry, particularly for posterior teeth.[1] These materials offer mechanical properties comparable to those of natural teeth, ensuring durability and functionality. However, their metallic appearance limits their aesthetic appeal, which has become a growing concern in modern restorative practices. [2,3,4]

Since their introduction to the dental market 40 years ago, dental resin composites have gained significant success as restorative materials. Their versatility and aesthetic appeal have made them a preferred choice, particularly in posterior restorations, with usage expected to continue rising.[5] While substantial advancements have been made in the properties of resin composites over the years, the monomer systems have remained largely unchanged since Bowen introduced dimethacrylates, specifically bis-GMA, in 1962. Instead, major improvements have focused on filler technology, leading to the evolution of resin composites from traditional macrofilled types to microfilled, hybrid, microhybrid, and, most recently, nanocomposites. [6,7,8]

The advent of flowable composites has significantly expanded the range of options available in restorative dentistry. These materials are low-viscosity resin composites, formulated with 20%–25% lower filler content and higher resin concentration compared to conventional composites. [9,10,11] This composition reduces viscosity, enabling their application through injection syringes while minimizing stickiness during placement. Initially, first-generation flowable composites were primarily utilized as liners due to their low elastic modulus. However, advancements in material science have led to the development of second-generation flowable composites, which are now suitable for bulk restorations and as liners in Class I and Class II restorations.[12,13,14]

A newly introduced nano-hybrid flowable composite resin system, GC G-aenial Universal injectable (GC America), has demonstrated potential to meet essential physical, mechanical, and optical requirements. The performance and clinical efficacy of this biomaterial depend significantly on its structural composition. This innovative resin filler technology enables higher filler loading due to the fine particle size, consistent shape, and uniform particle distribution. The advanced chemistry of this resin allows the particles to be closely packed, resulting in minimal interparticle spacing. This homogeneous dispersion within the resin matrix enhances reinforcement and provides added protection to the matrix. [15]

The durability of a restorative material largely depends on its ability to endure the stresses exerted during mastication. Compressive strength is a vital parameter for evaluating this durability, as chewing forces predominantly generate compressive stress. Assessing this property helps determine the material's capacity to withstand the mechanical pressures involved in biting and chewing.[16,17] Hence, the aim of this study was to compare compressive strength of two different flowable composites to be used as a restorative material.

MATERIALS AND METHODS

A comparative in vitro study was proposed to compare the compressive strength of GC G-Aenial universal injectable with the conventional Ivoclar composite. The study was approved from the institutional scientific and research committee (SRB/SDC/PEDO-2203/23/088)

A total of 20 specimens (n = 20) were prepared with the two materials used for the study

Group I- GC G-Aenial universal injectable (n=10)

Group II- Ivoclar Tetric N-Flow (n=10)

Injectable GC Composite, developed by GC Corporation, is a flowable composite material designed to provide excellent adaptability and ease of application. It is commonly used for small restorations, cavity lining, fissure sealing, and other minimally invasive dental procedures. The flowable nature of this composite makes it particularly useful in situations where precise adaptation to cavity walls and complex anatomy is required. Tetric N-Flow Composite, manufactured by Ivoclar Vivadent, is another flowable composite material known for its versatility and esthetic properties. It is often used in a range of restorative procedures, including small to medium-sized cavities, class V restorations, and as a liner for larger restorations.Tetric Flow offers a balance between flow ability and strength, making it suitable for a broader spectrum of applications.

Testing procedure:

Cylindrical specimens were fabricated using molds designed according to the standards specified by the American Dental Association (ADA), with a diameter of 6 mm and a height of 12 mm. The materials were handled strictly as per the manufacturer's guidelines. Composite materials were placed in the molds in increments and each layer was cured for 20 seconds using an LED curing light. The compressive strength was evaluated using a Universal Testing Machine (UTM) operating at a crosshead speed of 1.0 mm/min. The flat ends of each specimen were carefully aligned between the plates of the testing machine. The highest load (P) that each specimen could withstand before failure was recorded to determine its compressive strength.

Statistical Analysis

The results were tabulated and statistically analysed and comparison was done with Mann-Whitney test. A p-value of 0.05 or less was considered as statistically significant.

RESULTS

Table 1 shows mean, standard deviation and Intragroup comparison of the compressive strength of Group I and Group II. Results shows that there is no statistically significant difference between two groups (p>0.01)

Table 1. Compressive strength of group I and group II. p Value<0.05 is considered statistically significant

GROUP	N	Mean ±SD	p Value
I	10	194± 34.15	0.714
II	10	213± 48.94	

DISCUSSION

The present study compared the compressive strength of two flowable composite materials, GC G Aenial Composite and Tetric-N Flow Composite, to assess their suitability for minimally invasive dentistry. The results revealed no statistically significant difference between the two groups ($p > 0.05$). Both materials demonstrated similar resistance to compressive forces, suggesting that either could be effectively utilized in restorative procedures requiring durable materials under masticatory stress.

The mechanical properties of restorative materials play a crucial role in their effectiveness, particularly in withstanding masticatory and parafunctional forces. Various factors influence these properties, directly impacting the clinical success and performance of the restorative materials.[18] Compressive strength is a critical factor in the mastication process, making it a key focus in evaluating restorative materials. As a result, the mechanical properties of these materials are commonly assessed through in vitro studies.For this reason, the compressive strength test was utilized in this study to examine the mechanical properties of restorative materials, particularly those used in pedodontics.[19,20]

Birant et al evaluated the compressive strength, Glass Carbomer Fill exhibited lower compressive strength value than the universal composite (G-aenial Posterior). But there was no statistically significant difference between two restorative materials. [21]

Nandita et al, compared the hardness between injectable GC composite and Tetric Flow composite would typically depend on various factors, including the specific formulations of these materials, curing techniques, and testing methods. [22]

The findings underscore the suitability of both GC Aenial and Tetric-N Flow composites for minimally invasive dentistry, particularly in stress-bearing restorations. Clinicians can select either material based on other factors, such as handling properties, esthetics, or cost, without compromising mechanical performance. The versatility of these materials expands their applicability in pediatric and general restorative dentistry, offering a reliable solution for achieving long-lasting restorations with minimal tooth structure removal.

Limitations of the study include the inability to replicate the complex and dynamic oral environment fully. Factors such as thermal cycling, occlusal loading variations, and long-term degradation could influence the materials' performance in vivo. Additionally, the study focused exclusively on compressive strength, leaving other critical properties like wear resistance and polymerization shrinkage unexplored.

Future research should address these limitations by incorporating clinical trials to evaluate the long-term performance of these materials under real-world conditions. Such studies could further validate the findings and explore additional mechanical and aesthetic parameters essential for comprehensive restorative care.

CONCLUSION

The present study compared the compressive strength of GC G-Aenial Universal Injectable and Ivoclar Tetric N-Flow composites, demonstrating no statistically significant difference between the two materials. Both composites exhibited comparable mechanical performance, indicating their suitability for use in minimally invasive restorative dentistry, particularly in stress-bearing applications.

DECLARATIONS

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Competing Interests

The authors have no competing interests to declare.

Informed Consent

Not applicable.

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