IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 24, Issue 6 Ser.6 (June 2025), PP 52-57
www.iosrjournals.org

"Comparative Evaluation of Flexural Strength and Compressive Strength of Provisional Crowns Using Four Different Materials"- An In-Vitro Study.

Dr. Karn Anjali Yateendra[1], Dr. Rajesh Kumar[2], Dr. Sunil Kumar MV[3], Dr. Rhythm Saxena[4], Dr. Krishan Kumar[5]

[1](Final year PG, Dept of prosthodontics, Jaipur dental college),
[2](Professor & Head of the department, Dept of prosthodontics, Jaipur dental college),
[3](professor, Dept of prosthodontics, Jaipur dental college),
[4](Reader, Dept of prosthodontics, Jaipur dental college),
[5](Senior Lecturer, Dept of prosthodontics, Jaipur dental college)

Abstract:
Introduction: *The provisional crown is an interim restoration that is used for a variable time period while the definitive restoration is being fabricated. To be successful, these restorations should fulfill biological, mechanical, and esthetic requirements. The maintenance of these long-term restorations can present significant problems for the patient and dentist.*
Aim: *To compare and evaluate the compressive strength and flexural strength of four provisional crown material at different interval of time in artificial saliva.*
Materials and methods*: This in-vitro study involves 160 samples that are tested for compressive strength and flexural strength. This test was carried out in the dept. of prosthodontics, crown and bridge, Jaipur dental college in the year 2025. The material used in this study are DPI, PYRAX SC10, PROTEMP, AND INTEGRITY. Each group were further divided into two subgroups to measure flexural strength and compressive strength (immersed in artificial saliva for 24hrs and 1 week). This test is done using universal testing machine. Statistical analysis was done using a one-way Analysis of Variance (ANOVA).*
Result: *From all the four provisional crown materials, all the material showed the statistical significance (P=0.000).*
Conclusion: *Within the study's limitations, Integrity showed the highest compressive and flexural strength. Minimal variation between its subgroups indicates strong stability in a simulated oral environment.*
Key Word: *Provisional Crown, Flexural Strength, Compressive Strength, PMMA, Bis-Acryl, Artificial Saliva, Universal Testing Machine.*

Date of Submission: 07-06-2025 Date of Acceptance: 18-06-2025

I. INTRODUCTION:

A provisional crown serves as a temporary restoration placed for a specific duration while the final restoration is being prepared [1]. In the prosthodontic management of partially edentulous patients, ongoing planning of provisional restorations is essential, as it allows the clinician to evaluate the mechanical performance, aesthetics, and functionality of the anticipated definitive restoration.[2]

Provisional restorations play a vital role in prosthetic procedures involving fixed prostheses such as crowns and bridges. They serve essential functions throughout the tooth preparation phase and remain in place until the final fixed restoration is fitted and cemented [3]. Mechanical considerations, such as resistance to functional loads and dislodging forces, are crucial when selecting an appropriate provisional restorative material for clinical application [4].

Consideration of all these factors and requirements is important because provisional resin restorations may be worn over a long period to assess the results of periodontal and endodontic therapies, and also during the restorative phase of implant reconstructive procedures.[5]

These cases require provisional materials and techniques that provide greater flexural strength and extended durability. Flexural strength refers to the ability of a material to withstand bending forces, typically measured by applying a static load to a bar supported at both ends [6]. The flexural strength test is a combination

of tensile and compressive strength tests and includes elements of proportional limit and elastic modulus measurements. The flexural strengths of provisional restorative materials vary within and between chemical classes of materials. [7]

Based on processing, provisional restorative materials have been divided into four classes according to how they change from plastic to solid masses: (1) chemically activated acrylic resins, (2) heat-activated acrylic resins, (3) light-activated composite resins, and (4) dual-activated composite resins. Based on chemistry, there are two main groups: (1) Methacrylate Resin (Methylmethacrylate, Ethylmetacrylate, Vinylmethacrylate, Butylmethacrylate) and (2) Composite Resin (bis-GMA, bisacryl, UDMA)

Artificial saliva

Artificial saliva preparations are designed to mimic natural saliva both chemically and physically. They have a viscoelastic pattern similar to normal human saliva to provide similar viscosity and film-forming properties[8]. Artificial saliva closely resembles natural human saliva in the following characteristics: (i) viscosity (mucin, carboxymethylcellulose and glycerin are used to mimic natural saliva viscosity); (ii) mineral content (all products contain calcium and phosphate ions, besides also containing fluoride); (iii) preservatives (methyl-or propyl paraben); (iv) palatability (the most common flavorings are mint, sorbitol, and xylitol).[9]

TABLE-1: Composition of Artificial saliva.

Composition	Quantity per 1000 g
Potassium chloride	0.96 g
Sodium chloride	0.67 g
Magnesium chloride	0.04 g
Potassium phosphate	0.27 g
Calcium chloride	0.12 g
Methyl Paraben	0.01 g
Propyl Paraben	0.1 g
Methyl p-hydroxybenzoate	8.0 g
Sorbitol	24 g
Water	1000 ml

AIM OF THE STUDY

Aim of this study is to evaluate and compare the compressive strength and flexural strength of four different provisional crown materials at different interval of time in artificial saliva.

II. MATERIALS AND METHODS

The present study was carried out to evaluate and compare the compressive strength and flexural strength of four different materials used in fabrication of provisional fixed restoration. In this study, there are four groups of provisional crown material were selected.

Group A auto-polymerizing acrylic (DPI), Group B auto- polymerizing acrylic (PYRAX SC 10), Group C bis- acrylate composite resin (PROTEMP), Group D Bis- acrylate composite resin (INTEGRITY), (fig.1). The above mentioned groups had two subgroups, Subgroup 1 conditioned in artificial saliva for 24hrs, Subgroup 2 conditioned in artificial saliva for 1 week.

A Stainless steel die for compressive strength with dimension of 10mm*10mm and for flexural strength 80mm*10mm*2mm were machined with vent holes so that excess material can be removed (fig 2).

Ten samples were created for each group and mixed and prepared according to the manufacture's instructions, placed into the mold, and allowed to set,every samples were created at room temperature. The specimens were taken out of the mold after setting. Defective specimens were disposed of after the specimens were checked for any voids. Every test specimen was polished and ground using silicon carbide paper of 1000 grit.

Ten samples of each group (Group A, B, C, D) were immersed in artificial saliva for 24hrs and 1 week, and were subjected to universal testing machine (Model: WDW 10 KN, Taiwan made) at a crosshead speed of 0.5mm/min for compressive strength and flexural strength. Data were collected for all the samples.

(a) (b) (c) (d)

FIGURE 1: Materials (A) Group-1 DPI; (B) Group-2 Pyrax Sc-10; (C) Group-3 Protemp; (D) Group-4 Integrity.

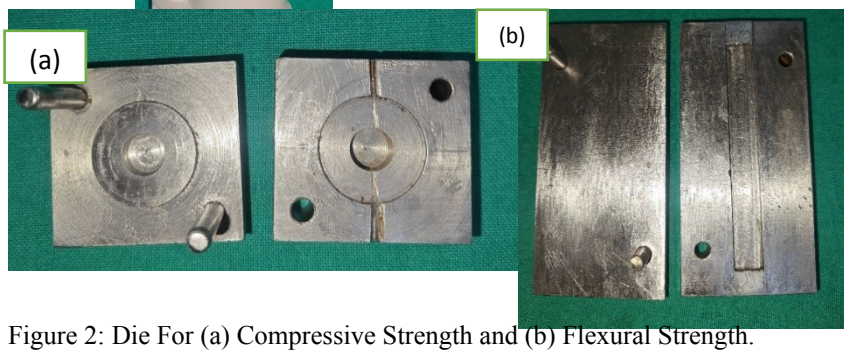


Figure 2: Die For (a) Compressive Strength and (b) Flexural Strength.

Figure 3: UNIVERSAL TESTING MACHINE (Machine Model: WDW 10 KN Taiwan made).

III. RESULT:

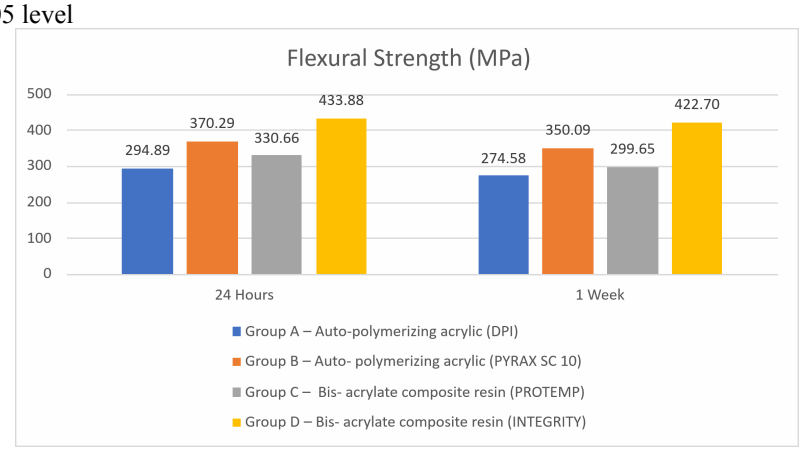
TABLE-2 ANOVA TEST

		Sum of Squares	df	Mean Square	F	Sig.
Flexural Strength 24 Hours	Between Groups	106380.854	3	35460.285	1024.373	0.000
	Within Groups	1246.197	36	34.617		
	Total	107627.051	39			
Flexural Strength 1 Week	Between Groups	128064.615	3	42688.205	665.796	0.000
	Within Groups	2308.176	36	64.116		
	Total	130372.791	39			

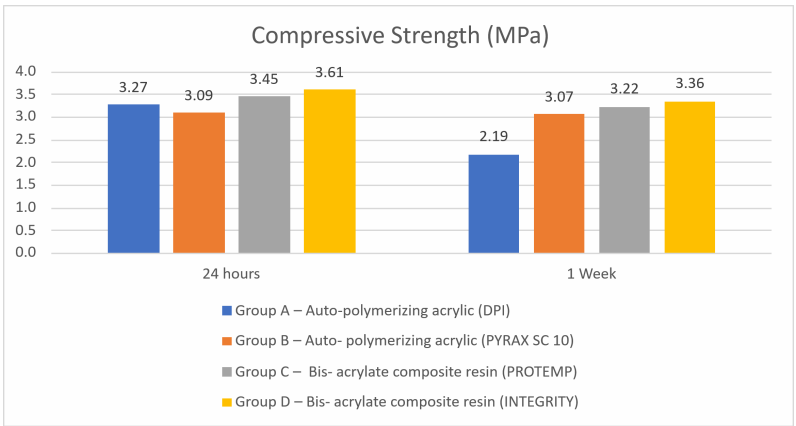
Compressive Strength 24 Hours	Between Groups	1.492	3	0.497	36.170	0.000
	Within Groups	0.495	36	0.014		
	Total	1.987	39			
Compressive Strength 1 Week	Between Groups	8.335	3	2.778	167.258	0.000
	Within Groups	0.598	36	0.017		
	Total	8.933	39			

		Sum of Squares	df	Mean Square	F	Sig.
Difference (24 Hours to 1 Week) Flexural Strength	Between Groups	1972.530	3	657.510	7.745	0.000
	Within Groups	3056.140	36	84.893		
	Total	5028.671	39			
Difference (24 Hours to 1 Week) Compressive Strength	Between Groups	6.550	3	2.183	69.595	0.000
	Within Groups	1.129	36	0.031		
	Total	7.679	39			

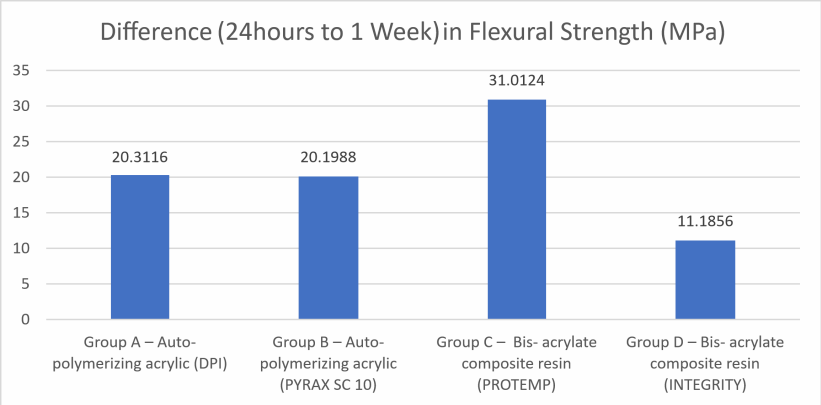
Significant at <0.05 level



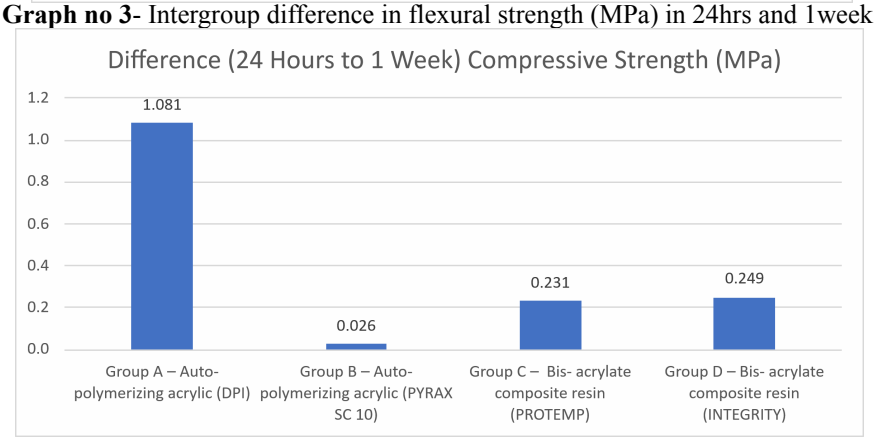
Graph no 1: Intergroup comparison of flexural strength (MPa) in artificial saliva for 24hrs and 1week.



Graph no 2: Intergroup comparison of compressive strength (MPa) in artificial saliva for 24hrs and 1 week.



Graph no 3- Intergroup difference in flexural strength (MPa) in 24hrs and 1week



Graph no. 4 - Intergroup difference in compressive strength MPa) in 24hrs and 1week.

IV. DISCUSSION:

Provisional restorations form an integral part of fixed prosthodontic procedures.

In the past, a variety of provisional materials have been used, having different desirable and undesirable properties [9]. Ideal provisional must fulfill biological, mechanical, morphological, psychological, and esthetic requirements, with the introduction of composite-based materials, which may be chemical, light, or dual cured acrylic resins has lost their popularity [4]. A provisional restoration must fulfill several functions, not least of which is that it must be strong enough to resist fracture. [10]

Among the tested materials, [Dpi, Pyrax Sc 10, Protemp, and Integrity], Integrity demonstrated the highest compressive strength in artificial saliva for 24hrs that is 3.61MPa, consistent with its known high-density microstructure and resistance to deformation under load. This finding supports its widespread use in posterior restorations where masticatory forces are greatest. Protemp showed moderate compressive strength that is 3.45MPa followed by DPI that is 3.27MPa and least showed in Pyrax SC10 that is 3.09MPa, as shown in Graph no. 2.

The compressive strength of materials [Dpi, Pyrax Sc 10, Protemp and Integrity] in artificial saliva for 1 week demonstrated statistical difference with the highest compressive strength in integrity (3.36MPa), then moderate in Protemp (3.22MPa) followed by Pyrax SC 10 (3.07MPa) and the least showed in DPI (2.19MPa), as shown in graph no. 2.

The flexural strength of tested material immersed in artificial saliva for 24hrs showed statistical difference with a result of highest flexural strength in Integrity (433.88MPa) followed by Pyrax sc-10 (370.29MPa) and then in Protemp (299.65MPa) and least showed in DPI (294.89MPa), as shown in graph no. 1.

The flexural strength of tested material immersed in artificial saliva for 1 week showed statistical difference with the result of flexural strength in Integrity (422.88MPa) followed by Pyrax SC 10 (350.29MPa) and then showed in Protemp (299.65MPa) and the least showed in DPI (274.58MPa), as shown in graph no. 1.

There was statistical difference between the compressive strength of materials done in 24hrs to 1 week conditioned in artificial saliva. The highest compressive strength changes seen in DPI (1.081MPa); followed by integrity (0.249MPa); then in Protemp (0.231MPa); and the least difference seen in Pyrax SC10 (0.0026MPa), as shown in graph no. 4.

There was a statistical decrease in flexural strength and compressive strength of materials immersed in artificial saliva from 24hrs to 1 week.

The ANOVA test showed the significance value is 0.00 which is less than 0.05, which states that this study is statistically significant, as shown in table no.1.

V. LIMITATIONS:

1. Effect of Thermocycling and cycling loading effect was not used.
2. Properties other than compressive strength and flexural strength were not considered in present study.
3. Effect of Natural saliva on compressive strength and flexural strength of provisional restorative materials was not studied.
4. Effect of samples in dry state on compressive strength and flexural strength was not studied.
5. Effect of other type of provisional crown material other than Chemically active PMMA and bis-acrylic composite resin were not studied.

VI. CONCLUSION:

Within limitations of my study following conclusions were drawn:

- Bis-acrylic based temporary crown material (Integrity) showed the highest flexural strength and compressive strength in artificial saliva for 24hrs and after 1 week.
- Bis-acrylic based temporary crown material (Integrity) showed the least difference in flexural strength at 24hrs in artificial saliva to 1 week in artificial saliva, followed by Pyrax SC 10 and DPI; and the highest difference seen in protemp.
- There was statistical difference seen in flexural strength and compressive strength after conditioning in artificial saliva for 24hrs and 1 week. There was decrease in flexural strength and compressive strength after immersing in artificial saliva from 24hrs to 1 week.

According to the findings in my study, *Integrity* demonstrated the highest compressive and flexural strength among the tested materials. Furthermore, the differences in mechanical properties within the *Integrity* subgroups—conditioned in artificial saliva for 24 hours and 1 week—were minimal, indicating greater stability and resistance to degradation in a simulated oral environment. These findings suggest that *Integrity* may be a more durable and reliable material of choice, especially in clinical situations where exposure to saliva over time is a critical factor. Further, Pyrax SC 10 can be the material of choice for clinical use.

REFERENCES:

[1]. Ireland MF, Dixon DL, Breeding LC, Ramp MH. In vitro mechanical property comparison of four resins used for fabrication of provisional fixed restorations. J Prosthet Dent. 1998 Aug;80(2):158-62.
[2]. Rashmi Rajput et al., Comparative Evaluation of Flexural Strength and Surface Roughness of Three Different Commercially Available Provisional Restorative Materials: An In-vitro Study, Journal of Clinical and Diagnostic Research. 2022 Jan, Vol-16(1): ZC08-ZC12.
[3]. Davis S, O'Connell B. The provisional crown. J Ir Dent Assoc. 2004 Winter;50(4):167-72
[4]. D. Saisadan, P. Manimaran, and P. K. Meenapriya. In vitro comparative evaluation of mechanical properties of temporary restorative materials used in fixed partial denture; J Pharm Bioallied Sci. 2016 Oct; 8(Suppl 1): S105–S109.
[5]. Fritts KW, Thayer KE. Fabrication of temporary crowns and fixed partial dentures. J Prosthet Dent. 1973 Aug;30(2):151-5. doi: 10.1016/0022-3913(73)90049-8.
[6]. Digholkar S, Madhav VN, Palaskar J. Evaluation of the flexural strength and microhardness of provisional crown and bridge materials fabricated by different methods. J Indian Prosthodont Soc. 2016 Oct-Dec;16(4):328-334.
[7]. Federick DR. The provisional fixed partial denture. J Prosthet Dent. 1975 Nov;34(5):520-6.
[8]. Ekta N Ingle; Artificial Saliva for Therapeutic Management of Xerostomia: A Structured Review; Journal of Oral Health and Community Dentistry (2020): 10.5005/jp-journals-10062-0064.
[9]. Vally Z, Sykes LM, Aspeling ME, van de Merwe J, Ballyram R. In vitro comparison of the compressive strengths of seven different provisional crown materials. SADJ. 2013 Mar;68(2):64-7.
[10]. Gordon J. Christensen. The fastest and best provisional restoration. J Am Dent Assoc 2003;134(5):637-9.
[11]. Surya Prakash Sharma, An In Vitro Evaluation of Flexural Strength of Two Provisional Restorative Materials Light Polymerised Resin and Autopolymerised Resin, IOSR Journal of Dental and Medical Sciences, 2279-0861. Volume 6, Issue 5 (May- Jun. 2013), PP 05-10.