Original Research Paper

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Comparative Evaluation of Fracture Resistance of Fractured Denture Base Repaired by Heat Cure Acrylic Resin Reinforced by Woven Glass Fiber

Abstract:
The repair of fractured denture bases is a common clinical challenge in prosthodontics practice. The study aimed to compare the fracture resistance of fractured denture bases repaired using heat cure acrylic resin alone versus heat cure acrylic resin reinforced by woven glass fiber. A total of 160 fractured denture bases were repaired using each technique and subjected to a series of standardized fracture resistance tests. The fracture resistance was measured and the results were statistically analyzed. The findings revealed that denture bases repaired with heat cure acrylic resin reinforced by woven glass fiber exhibited significantly higher fracture resistance compared to those repaired with acrylic resin. These results underscore the potential of incorporating woven glass fiber reinforcement in denture base repair protocols to enhance fracture resistance and improve clinical outcomes.

Key-words: denture base repair, fracture resistance, heat cure acrylic resin, woven glass fiber

Introduction:

Structure fashioned to resemble denture from hardwood, ivory or bone, with natural teeth held by screws or other means were reported to be common before 1800. The practice of complete denture service has since then traversed the long path from being just an "art" to its present status of being "art and science". In 1937, Dr. Walter. H. Wright revolutionized the field of dentistry by using acrylic resin as a denture base materials[1]. It satisfied the demands for esthetics, colour, stability, cost and ease of manipulation. Despite its popularity as an almost perfect denture base material, they fracture due to fatigue failure. Denture base fracture became a common clinical occurrence.

Many methods were devised either to overcome the fracture or to repair it. Various techniques are used to repair the fractured denture base resin. This study is an effort to find the appropriate method which can provide the long lasting result and can prevent the recurrence of fracture.

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Materials and Methods:

The study was conducted in Haldia Institute of Dental Sciences And research, West Bengal and Department of Bioscience and Engineering, Jadavpur University, West Bengal. A total of 160 acrylic specimens were made using heat cure acrylic resin. A total of 160 specimens were fabricated with the dimension 65.0 mm X 10 mm X 2.5 mm were used in accordance to the previous study conducted by Nagai E.et.al (2001)[2] and Polyzois G.L. et.al (2001)[4]. To prepare the sample Stainless steel metal mould of dimension

[1]SHAMBADITYA PAHARI, [2]SREETAMA TARAPHDAR, [3]ANUMITA MANNA, [4]SANJOY DAS
[1-4]Department of Prosthodontics, Haldia Institute of Dental Sciences & Research, West Bengal

Address for Correspondence: Dr. Sreetama Taraphdar
Assistant Professor
Dept of Prosthodontics and Crown & Bridge
Haldia Institute of Dental Sciences And Research
Banbishnupur, Balughata, Purba Medinipur
Email: staraphdar@gmail.com

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65.0 mm X 10 mm X 2.5 mm were fabricated. Each mould had a ditch on one surface of the mould measuring 30 mm X 4.5 mm X 1.5 mm (Fig. 1) for placement of reinforcement material. A wax pattern of the required specimens were prepared and acrylization was done using short curing cycle (74ºC for 2 hours followed by 100ºC for 1 hour)[3]. A 3 mm gap area of the profile was marked in the middle of the specimens. The specimens were then vertically cut into two halves with a high-speed diamond disc cutter under copious irrigation. The specimens then divided into 4 groups for repairing and they were repaired subsequently.

The 4 groups are:

1. Repaired by heat cure acrylic resin using short curing cycle,
2. Repaired by heat cure acrylic resin using long curing cycle,
3. Repaired by heat cure acrylic resin reinforced with woven glass fiber using short curing cycle,
4. Repaired by heat cure acrylic resin reinforced with woven glass fiber using long curing cycle (Fig. 2).\

Glass fibers of dimension of 0.2 mm X 4 mm X 20 mm (Fig. 2) were used as reinforcement material for repair. The specimens were finished and polished and they were stored in water at room temperature for 48 hours. The repaired specimen's transverse strength was measured using Universal testing machine (Instron model no.: 4204). In this study the specimens were subjected to the measurement of transverse strength using a three point bending test technique. The transverse strength was calculated using the following formula:

Transverse strength (S) = 3 PL / 2bd² (KN/mm²)

Where P = Fracture load, L = Span length ( ), b = Sample width and d = sample thickness.

Result:

This study was conducted to compare the fracture resistance of denture base acrylic resins repaired by different methods. Fracture loads for each group were obtained using universal testing machine and the respective load values were used to calculate the transverse strength of each group. The mean transverse strength of each group was statistical analyzed. **A** comparison of mean fracture load across all groups reveals that in specimens repaired with woven glass fiber reinforced heat polymerizing resin polymerized by long curing cycle (group 4) resulted in the highest mean fracture load (0.07965 KN) compared to all other groups.

GROUP	FRACTURE LOAD (KN) (mean value)	TRANSVERSE STRENGTH(KN/mm²) (mean value)
1	0.06685	0.06418
2	0.07046	0.06764
3	0.07619	0.07313
4	0.07965	0.07646

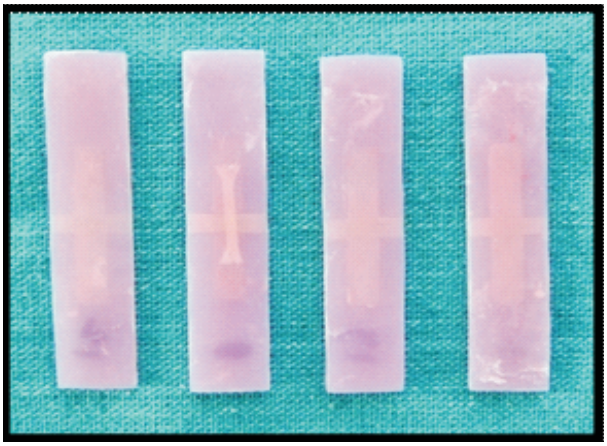

Fig. 1

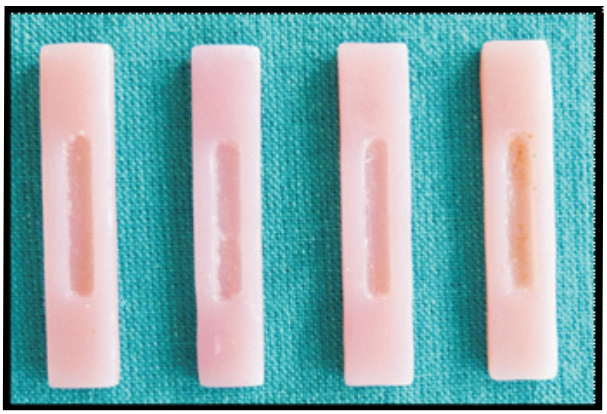

Fig. 2

Discussion:

Acrylic Denture fracture is due to mainly flexural fatigue and impact force. Midline fracture of a denture base is a flexural fatigue failure.*The prime objective of repair of fractured denture base is to achieve a joint that matches the original material in strength.* The test specimens joining surface was prepared as butt joint was based on studies done by Polyzois G.L. et.al (2001)[4], Shimizu H. et.al. (2006)[5] and Kostoulas I et.al. (2008)[6] where butt joint profile was used during repairing denture base to get better result. On comparison of transverse strength of specimens repaired by heat cure resin using short curing cycle and long curing cycle it was observed that mean value of transverse

strength of long cured heat polymerizing resin was higher than short cured heat polymerizing resin. This is in agreement with the observation of Vallittu P.K. et.al. (1998)[7], who reported that repair by heat polymerizing resin cured by long curing cycle was superior in fracture resistance than repair by short cured heat polymerizing resin. The probable cause could be attributed to the increased curing time and its positive influence in reducing residual monomer content. The effect of direction of fibers of the reinforcement material in the polymer matrix on the bond strength of the repair joint was studied by (Kostoulas I. et.al. 2008)[6]. The authors observed that woven glass fibers achieved better bond strength in the both auto polymerizing resin and heat polymerizing resin. In this study the use of woven glass fibers in reinforcement material resulted in improve bond strength. However comparison between woven and unidirectional glass fibers was not made. In the study for repair with heat cure resin, the long and short cure cycle were employed. Also comparisons were drawn for both the curing cycles with and without the use of reinforcement material. When the transverse strength were compared the highest mean value of was observed when heat cure repair material reinforced by woven glass fibers was cured by long curing cycle.

Conclusion:

The comparative evaluation of fracture resistance of the fractured denture bases repaired by heat cure acrylic resin reinforced by woven glass fiber present significant insights in to the efficacy of this repair technique. Through this conducted study, it becomes evident that the incorporation of woven glass fiber reinforcement enhances the fracture resistance of repaired denture bases when compared with the traditional repair methods using heat cure acrylic resin alone. The mechanical properties and the bonding characteristics of the woven glass fiber provide additional strength and stability to the repaired denture base, thereby reducing the likelihood of the fracture recurrence.

Moreover the findings underscore the utilizing advanced materials and techniques in the prosthodontics practice to improve the longevity and durability of denture repairs. By leveraging the benefits of woven glass fiber reinforcement, clinicians can offer patients a reliable and long lasting solution for fractured denture bases, enhancing their quality of life and the satisfaction with the dental prosthesis.

However, further research is warranted to explore the long term performance and clinical outcomes of the denture repairs reinforced with woven glass fiber. Additionally, comparative studies with other reinforcement materials and techniques could provide valuable insights into the optimal approaches for enhancing the fracture resistance in denture repairs. Overall, the findings of this study contribute to the ongoing advancements in the prosthodontics care, highlighting the potential of woven glass fiber reinforcement, improving the structural integrity and the longevity of denture prosthesis.

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