Evaluation of Fatigue and Impacted bond Strengths of Denture Base Repaired by Using Different Type of Surface Treatment

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Key words
acrylic resin, repairing, impact bond strength, fatigue bond strength and surface treatments

Abstract

Objective: Since the 1930s, a variety of resins have been introduced into dental treatments for the construction of dental prostheses and their efficacy has been based on physical, chemical and biological properties. Denture breakage is usually related to faulty design, faulty fabrication, and/or poor materials choice. **Purpose**: of this study is to investigate (in vitro) the fatigue bond strength and impact bond strength of the denture repaired by light-cured acrylic resins by using different chemical solvents such as acetone, monomer and thiner. **Materials and methods:** The acrylic resin used are heat-cure, specially designed molds are use to prepare 6 groups of specimens following the manufacturer's instruction (5 specimens for each cured polymerization). Specimens were cut in guiding by standardized positional jig. The ends of specimen saturated by different solvents acetone, thiner and monomer before repairing. To evaluate the impact strength, plastic strips were fabricated as per the dimensions (50×5×4) mm. Alternating bending fatigue machine was used to test the ten samples with the dimension of (70×10×2.5) mm. **Result:** impact bond strength with monomer solvent higher than thiner solvent and acetone solvent. Fatigue bond strength with acetone solvent higher than thiner solvent and monomer solvent. Acetone, thiner and monomer were applied as solvents, the results of all surface treatments revealed significant difference at (P- value <0.05) in mean value (no significant for fatigue bonde strength but significant with impact bond strength.

Introduction

Since the 1930s, a variety of resins have been introduced into dental treatments for the construction of dental prostheses and their efficacy has been based on physical, chemical and biological properties. Previously, materials such as nitrocellulose, vulcanite, venylplastics, phenol formaldehyde, and porcelain were used for denture bases. The acrylic resins were so well received by the dental profession that by 1946, about 98% of all denture bases were fabricated from methyl methacrylate polymers or copolymers. [(1)]. The polymerization of this resin is an additional reaction that required the activation of the monomer to polymer, heat which is usually supplied by using a hot water-bath or microwave [(2,3)]. The properties that have contributed to the success of acrylic resin as denture bases are excellent esthetic properties, adequate strength, low water sorbtion, low

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solubility, in addition free from toxicity, easily repaired, have the ability to reproduce accurately the details and dimensions of pattern, simplicity of molding and processing technique [4,5].

Denture breakage is usually related to faulty design, faulty fabrication, and/or poor materials choice. Denture failure outside the mouth occurs from impact due to accidents as a result of expelling the denture from the mouth while coughing or dropping the denture. Inside the mouth, excessive biting force may also cause fracture [6,7]. Fractures are more common in the midline of maxillary complete dentures [6,8]. Furthermore, Fractures of dentures often occurs at the junction of an old and new material rather than through the center of the repair [9]. The ultimate goal of denture repair is to attain the original shape and strength of the denture with minimum cost and time. Several techniques and materials have been used to repair fractured dentures. Broken acrylic resin dentures are repaired with auto polymerized acrylic resin,[6] heat-curing acrylic resin,[9] and more recently, visible light-curing acrylic resin[10,11]

The failure rate of acrylic resin dentures due to fractures have been reported to be an acceptably high [12]. Acrylic plastic have been the most widely used and accepted among all denture base materials and were estimated that they represent 95% of the plastics in prosthodontics [13,14]. The materials that are used as a denture base can be classified into metallic and non-metallic types [15,16]. Nothing yet has been found that will match the appearance of the soft tissues of the mouth with as great fidelity as will acrylic resin. It is not only esthetically good when it is first placed in the mouth, but the appearance is permanent, provided that the patient follows a simple routine of cleansing and general hygienic care [17]. Such dental resins are usually supplied in two components, one is methyl methacrylate (MMA) which is the monomer and is a liquid while the other component is the polymer which is a powder [18].

The purpose of this study is to investigate (in vitro) the fatigue bond strength and impact bond strength of the denture repair of light-cured acrylic resins by using different chemical solvents such as acetone, monomer and thiner.

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Material and Methods

The acrylic resin were used heat-cur, with special designed molds to prepare 6 groups of specimens following the manufacturer's instruction (5 specimens for each cured polymerization). A mix powder and liquid is prepare and left to reach the dough phase for 20 minutes at room temperature (± 23˚C). After filling the molds fully with the dough resin. The heat-polymerized acrylic resins are pack in molds and processing according to the manufacturer's recommendations.

Curing was carried out by placing clamped flask in a water bath and processed by short curing cycle (1.5 hour at 74C˚ followed by half hour at 100˚C) according to ADA specification No.12;1999 [19] for the curing of the acrylic denture base material. Following completion of curing, the flask was allowed to cool slowly at room temperature before deflasking. Then the specimens were removed from the stone mould. All flatter shape access were removed with an straight acrylic bur. To get a smooth surfaces, the stone bur would be used followed by sand paper to remove any remaining small scratches. Polishing was done with bristle brush and pumice with lathe polishing machine. A glossy surface was obtained when polishing with wool brush and soap. Specimen is placed under compression in 74˚C water for 8 hours [20].

Specimens were cut in guiding by standardized positional jig Cut surfaces were made parallel to each other and perpendicular to the long axis of the specimens by abrading under water with silicone carbide paper to simulate roughing of the repair surface of the denture with laboratory burs. The ends of specimen saturated by different solvents (acetone, thiner and monomer before repairing) figure 1.

1- Impact Bond Strength Test:-

To evaluate the impact bond strength, plastic strips were fabricated as per the

dimensions (50×5×4) mm. Specimens were prepared stored in a distilled water at 37˚C until fully saturated (2 weeks). The impact specimens were taken from the water and stored in air for 1 hour prior to testing [19].
The impact bond strength is usually measured by the work required to break a test piece. The testing machine was a charpy type machine tester, and this was designed in such a way that tubs (pendulum) of different weights could be used according to the strength of the materials to be tested. The specimen was clamped at two ends and strict by the swinging pendulum in the area at the center of the tested piece, the average readings gave the impact energy in joules. The absorbed energy by the specimen was noted, figure 2.

2- Fatigue bond Strength Test:-

Alternating bending fatigue machine was used that was made by (Hi-Tech company, England) to test the ten samples with the dimension of (70×10×2.5) mm. High speeds are possible so millions of cycles can be achieved within hours. However the drawback is that only stress regime is that of exact reversal. To overcome this problem a different design of fatigue machine was produced whereby a cantilever could be deflected to impose a varying bending stress in the cantilever. The basis of such a machine is to drive the free end of a cantilever up and down by a reciprocating mechanism, figure 3.

Results and discussions

Table 1, showed impact strength with monomer solvent (3.162 ± 0.597) higher than thiner solvent (2.299 ± 0.658) and acetone solvent (1.985±0.998), figure 4. This in agreement with [21,22], were they found that monomer solvent material increase the stiffness, toughness and cohesion chemical bond of the old and new acrylic.
Table 2, showed that fatigue strength with acetone solvent (77600 ± 1366) higher than thiner solvent (9800 ± 8874) and monomer solvent (2210 ± 1298), figure 5. Our finding were agreement with [23,24,25,26,] they demonstrated that some treatment solvent materials increase the cohesion between old and new acrylic resin and led to had a higher fatigue life value compared with the acrylic resin.
Acetone, thiner and monomer were applied as solvents, the results of all surface treatments revealed significant difference at (P- value <0.05) in mean value (no significant for fatigue bond strength but significant with impact bond strength as shown in tables,1and 2).

Table(1) Descriptive of impact strength

Solvent	Acetone	Thiner	Monomer
Mean	1.985	2.499	3.162
SD	0.998	0.658	0.597

ANOVA F-test=2.772 P=0.049 P<0.05 Significant

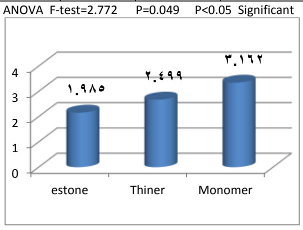

Figure 4: Impact bond strength according to type of solvent

Table(2) Descriptive of fatigue strenght

Solvent	Thiner	Acetone	Monomer
Mean	9800	77600	2210
SD	8874	1366	1298

ANOVA F-test=0.957 P=0.412 P>0.05 Non Significant

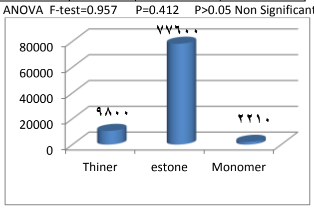

Figure 5: Fatigue bond strength according to type of solvent

Figure 1: Specimens were cut surfaces parallel to each other

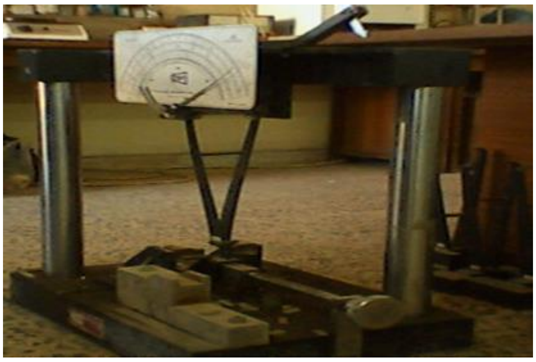

Figure 2: Impact bond strength machine

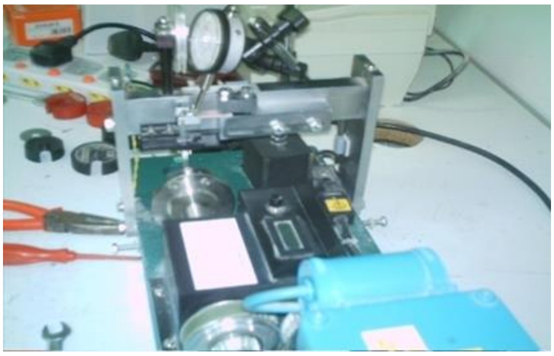

Figure 3: Fatigue bond strength machine

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