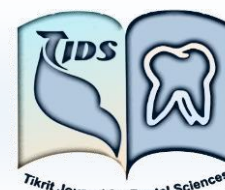




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The Effect of Polishing Techniques on Surface Hardness of De-flex Denture Base

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Abstract

Background: As usual "Poly methyl methacrylate (PMMA)" resin was still the greatest material used for denture foundations despite their identified disadvantage. Attempts to overwhelm these difficulties were advanced through the introduction of new denture base materials counting the injection-moulded thermoplastic resins. Aim: To assess and compare the surface hardness of thermoplastic resin material before and after different treatments. Material and Methods: Whole of 40 circular specimens of dimensions (30 mm × 2 mm- diameter and thickness respectively) divided into four group according to the surface treatment. Each group of material have (10) specimens. The first group was polished with pumice, the second group was polished with pumice and then glazed, the third group was polished with burning investment and then glaze and the fourth group was finished and glazed without adding any polishing material. Digital surface hardness tester meter Shore (D) device was used for indicating the value rigidity of specimens after surface polishing treatment. Results: After comparing the results, In General, there were significance difference among the control and experimental groups ($P \leq 0.05$). Conclusions: - The mean values of the surface rigidity test were decreased in the control groups of De-flex material, while the surface hardness test was increased in the experimental groups after polishing with Glaze material.

Introduction:

Thermoplastic resins (i.e., polyamides or nylons) became a common exchange from Poly methyl methacrylate resin because of their appropriate chemical and physical properties (1). Such materials are biocompatible and have singular aesthetic and physical properties that offer

indefinite design versatility and eliminate the concern concerning acrylic allergies (2). Thermoplastic PMMA is a polymerized acrylate, prepared through the blending of methyl methacrylate with other polymers to improve the impact strength, and is mostly used for the

fabrication of completing denture bases. Among the important features of thermoplastic PMMA are biocompatibility, non-allergenic (monomer-free), enhanced esthetics, and smooth dense texture; therefore it is more comfortable for the patients (3). Flexible denture base materials are nylon-based (polyamide), it is nearly non-breakable, pink in color resembling gums, can be constructed very thin, and can form not only the denture base nonetheless also the clasp as well. These materials don't bond chemically with any porcelain / acrylic teeth. Hence, mechanic attachment is the only utilized method in the polyamide denture base material (4). These polyamides are created by the condensation reaction between a di amine "NH₂-(CH₂)₆-NH₂" and a dibasic acid, "CO₂H-(CH₂)₄-COOH" (5). It is described that this material has numerous difficulties such as water sorption, surfaces roughness, bacterial contaminations, warpage, color deteriorations, and difficulty in polishing (6). The polishing process is important for removing extra materials and smoothing roughened surfaces. Pumice was the most common fine abrasive used in dentistry, and pumice was used as an agent for polishing acrylic samples which were considered a useful improving agent. An investment material after burning it used as an abrasive material to assess their effect on the flexible resin specimens as an alternative to conventional pumice. Hardness is a property of solid objects that represents surface resistance to scraping, breaking, tear, indentation, pressure, and durability when a hard point is added to it, as well as a measure of surface hardness. Processing the denture base material produced unfit distortion in differences sizes. The magnitude of these dimensional changes depends on the condition of the molding, the shapes of the mold, and the directions in which it is measured (7). Some specialists question the use of these resins in making RPDs due to its basic structure, contradicting the traditional principles of biomechanics, such as the absence of supports and its structural flexibility (8). However, the use of thermoplastic resins for the manufacture

of flexible RPDs has increased over the years (9). There is an increasing number of thermoplastic RPDs every year, demonstrating their popularity in dental practice. However, in the academic world, they are still seen with certain restrictions, especially because the number of works evaluating the physical and mechanical properties of this material are still scarce in the literature. To date, the existing works show promising results indicating that the use of this material is practical in clinical daily life (10). Thermoplastic resins are usually collected of long linear chain which is accountable for their suppleness in use but the hydrophilic nature of this thermoplastic resin will lead to their hydrolysis and finally harm the polymer chain through longterm usage. Also, the polymer chain breakdown can damagingly influence the physical features of the thermoplastic resin (11). Recently, one injection molded thermoplastic material: De-Flex(De-flex – M10 XR – L 32.6g diameter 22mm)(Made in Argentina) Modern polymer-based thermoplastic material for universal use. Flexible with increased hardness compared to other thermoplastic materials. Low contraction (0.6%) guarantees a good fit of the denture. It is chemically combined with a traditional acrylic "cold" so that the material can be repaired and relined in a traditional way. These materials have been supposed by the manufacturer to have enhanced hardness and have been recommended for use by patients who have a sensitivity reaction to PMMA monomer. Surface hardness may provide an impression regarding the density of material since dense substances frequently have a high resistance to superficial wear (12). This study was designed for evaluating the influence of polishing methods on the surfaces rigidity of De-flex denture base material.

Materials and Procedures

Specimens grouping

A total number OF 40 of specimens were divided into four groups due to the surface treatment:

1. The first group was polished with pumice.
2. The second group was polished with pumice and then glazed.
3. The third group was polished with burning investment and then glaze.
4. The fourth group was finished and glazed without adding any polishing material.

Preparation of Custom-Made Plastic Mold

For the present study, A Plastic patterns mold was invented which delivered a circular form of 30 mm × 2 mm diameter and thickness for the preparation of De-flex disc specimens of standard dimension. Specimens were prepared according to the ADA (13). A Plastic pattern is designed using Auto CAD 2013 "(Autodesk Inc., San Rafael, CA, USA) and processed using a computer numerical control machine (Changzhou Jaida CNC Machine Co, Ltd, China)" (14) Fig.(1).

Specimen Preparation

After the plastic patterns were fabricated, the stone slurry was prepared and decanted in the lower half of the special flask designed for the injection molding technique. Before the stone was hardened, the plastic disc was positioned above the stone surface, where the plastic disc level would be with the level of the stone surface. The sprue former was devoted to making the channel for flowing of fluids resin into the mold when the stone began to set. the stone surfaces was lubricated with a separating medium. The upper half was then located over the lower half of the special flask and another mix was poured into the flask. After a complete set of dental stone, the wax elimination procedure was done by immersion the flask in boiling water for 5 min. to soften the wax. The flask was opened and washed to remove all residue wax with clean boiling water. The flask was opened and a thin coat of separating medium was applied to the model and left to dry fully (15). A cartridge of suitable size was nominated and spray (wax surface reducing agent) was applied to the cartridge, the cartridge carrier was then placed in an automatic plastic injection

machine which is used for softening the De-flex material (M10xr) at a temperature of 305°C for 15 minutes (according to manufacturer instructions) Fig.(2.A, B). The sprue former is cut with a special type of disk and finished with carbides bur and handing finished using a increasingly finer degree of silicon carbide paper (grade 320 µm) with continuous draining water.

Preparation Burning Investment

The investment material after burning was getting it after completing the casting procedure of the crown and bridge in a dental lab. The investment material was mixed according to the manufacture instruction. The burning temperature which is used for burning the investment material in this study was 950°C, after burning the investment it was crushed with a hand hammer and grinding it by using Retch. PM 100 Then sifting grind burning investment from any impurities by using the sieve analysis device to get particle size (150 micron) (16).

Polishing Procedure

Samples are fixed in the dental lathe unit as shown in Fig.(3). The spaces between samples and the encounter was fixed 1-2 mm. The quickness of the dental lathe was fixed at a low quickness which was (1425 rpm) The time of the polishing process for each specimen was 2 min. The quantity of water added to each of these polishing resources (pumice, burning investment) was 2ml measuring by using a plastic disposable syringe (17). After the Polishing Procedures, the sample test groups (second group, third group and the last group) were glazed by using light-cured glaze (Vertex) with a soft brush. A layer of glaze was applied to the sample surfaces using a soft brush by a light-cured device for 3 min (18) Fig.(4) and Fig.(5). All specimens were placed in a glass jar with a plastic cap of 100ml containing distilled water and placed in the incubator at 37°C for (48 hours) before testing (19).

Hardness Test

In the present research, the rigidity test was performed by using the durometer rigidity device, type (shore-D) scale due to (ASTM D2240) Fig.(6). The testing loads were applied equally to 50 N, and the specimens were located under the indenter area with a depressing time of measuring equal to 10Sec. the indenter of the digital shore D devices is 0.8 mm in diameter, tapering to a cylinder of 1.6 mm. the indenter was pushed down firmly, and the reading was attained from the digital scale. Each scale outcomes in a value between (0 to 100) rigidity numbers, with higher values indicating a harder material.

Statistical Approaches

"IBM SPSS statistical program Version 20" was used for the performance the statistical investigation of the present study and Microsoft Excel 2010 for graphics presentation. The usual statistical approaches were used to elevate and analyze the outcomes; these included: Descriptive statistics (mean, standard deviation, Minimum, Maximum) And Inferential statistics (One way ANOVA) followed by post-hoc Games-Howell test to compare study data).

Results

Table(1) and Fig.(7) show the result of the surface hardness of De-Flex. In General, there was a significant difference among each group ($P \leq 0.05$) except between (pumice polish) and (pumice polish and Glaze) is the non-significant difference ($P > 0.05$). also a non-significance difference among (pumice polish) and (investment polish and Glaze) ($P > 0.05$).

Discussion

The purpose of the polishing process for dental material is to produce properly smooth and shiny surfaces and so prevent the formation of bacterial plaque by gradually removing rough layer from the denture base materials. . Surfaces rigidity of a material is its capability to resist abrasion or wear while this is measured by

the material's ability to resist depressing. In this study, a shore (D) rigidity tester was used which is suitable for measuring the rigidity of De-flex denture base materials. Shore durometer category (D) rigidity tester eliminates the problematic with elastic retrieval owing to its use of methods that measure the depth of the loaded indentation directly by the screen which shows the numbers it (20). Surface stiffness of a materials are effect by many factors, including surfaces unevenness. Irrespective of the polishing technique and type of polishing materials used (21). In the De-flex materials after polishing with light cure Glaze material shows that under SEM (Microscopic Study Examination) formation of a layer on the surface of the sample This layer gave hardness to the sample, which led to an increase in hardness. After comparing the findings for Surface hardness, significant differences was noticed in the surface hardness between each group. This has a positive influence on the denture base material. This gives extra strength to the material to resist breakage at the base of the dentures. Maintains strength and rigidity of the denture and bears pressure during chewing food. Resistance to the micro crack because of the De-flex acrylic resin contains extra hard fibers in the material. The outcomes of the current researches are in agreement with Goiato et al (22) the glaze polished groups presented higher surface hardness results. Also in agreement with Sesma et al (23) glaze crack may have happened due to the inflexibility that the glaze layer need after the heating of light and an elevated surface rigidity and a reduction in the influence strength and transverse winding strength of resins surface coated with a surfaces glaze.

Conclusion

Inside the boundaries of this study: -

1. It concluded the hardness of the surface was decreased in the control group of De-flex material, while it was increased in the experimental groups after polishing with Glaze material.

2. It was concluded the surface rigidity of the control group was not affected by pumice polishing material.
3. The surface rigidity of the experimental group was significantly affected by Glaze polishing material.
4. The polishing material (Light Cure Glaze) is significantly harder than

pumice and burning investment materials.

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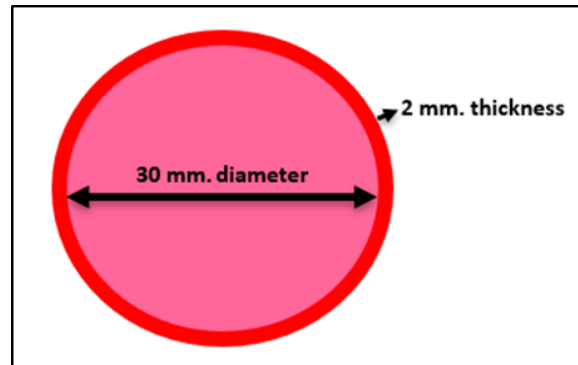


Fig. (1) :The mold of the specimen's shape for the plastic pattern.

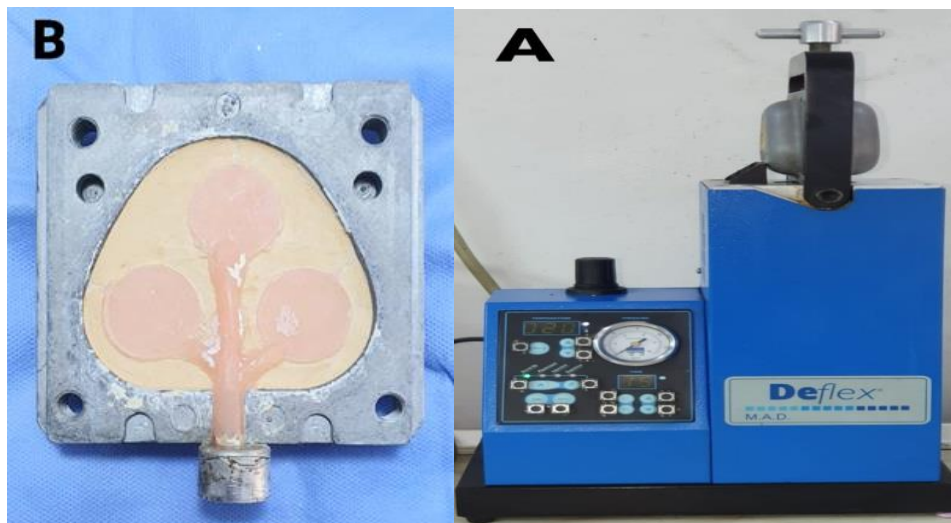


Fig. (2): (A)- Automatic injection of De-flex material (B)- Dental flask mold.

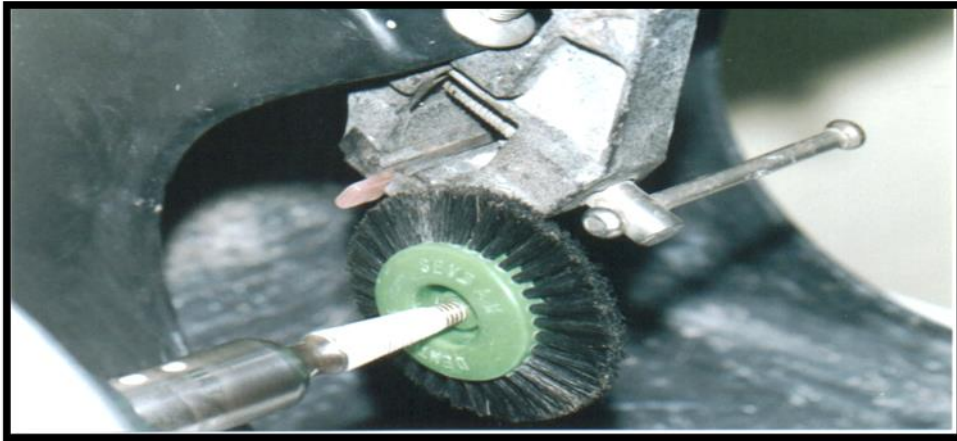


Fig. (3) : Bristle brush with the specimen.



Fig. (4) : A layer of a light-cured glaze (Vertex) with a soft brush for 3 min.

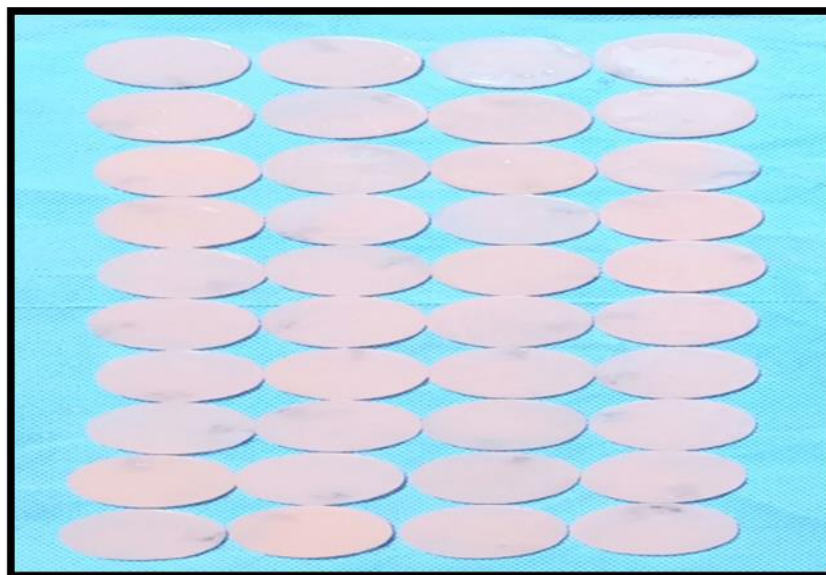


Fig. (5) : Specimens after finishing and polishing.

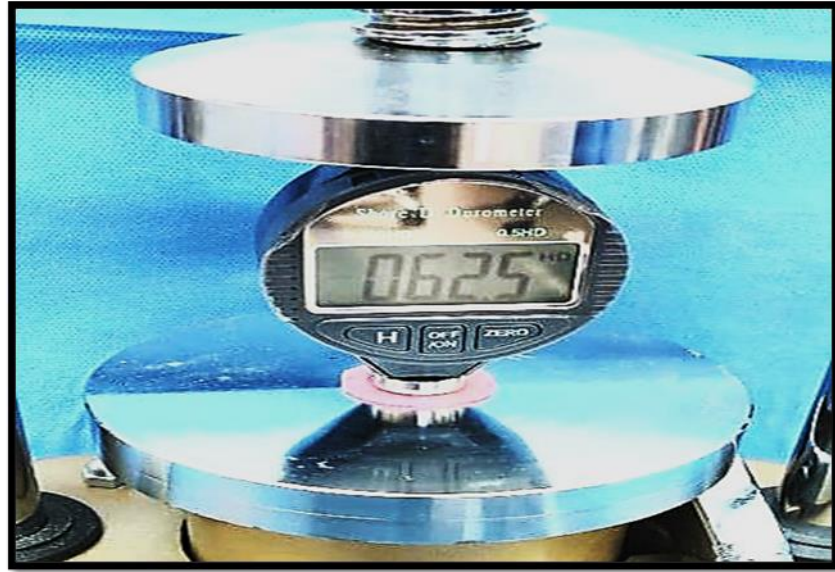


Fig. (6) : hardness device (Shore-D).

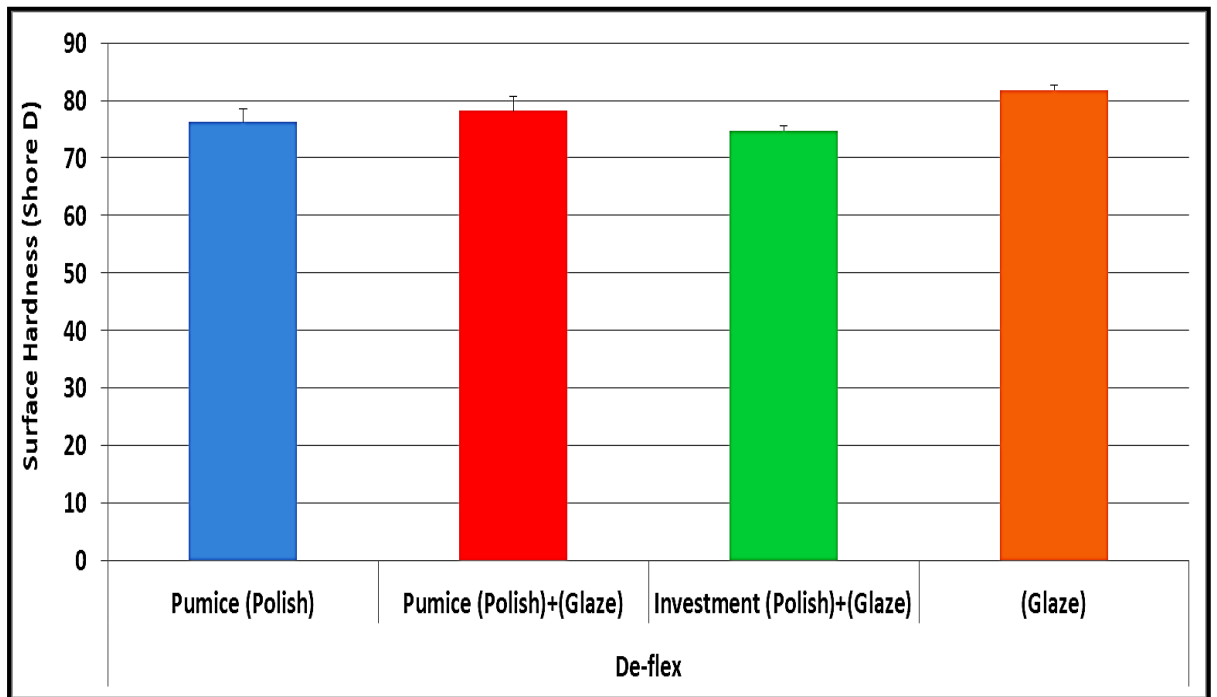


Fig. (7) : Bar-chart showing the mean distribution of the surface hardness of polished tested groups.

Table (1): ANOVA (post-hoc, Games-Howell) showing the surface hardness of the polished group specimens.

(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Pumice (Polish)	Pumice (Polish)+(Glaze)	-1.9500	1.08476	.307	-5.0164	1.1164
	Investment (Polish)+(Glaze)	1.4500	.79894	.316	-.9424	3.8424
	(Glaze)	-5.6500*	.79320	.000	-8.0347	-3.2653
Pumice (Polish)+(Glaze)	Investment (Polish)+(Glaze)	3.4000*	.82951	.008	.9096	5.8904
	(Glaze)	-3.7000*	.82398	.004	-6.1833	-1.2167
Investment (Polish)+(Glaze)	(Glaze)	-7.1000*	.37491	.000	-8.1600	-6.0400

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