j. port. sci. res.
ISSN: 2616-7441 (Online)
ISSN: 2616-6232 (Print)
ISSN: 2616-7220 (USB)
INTERNATIONAL IDENTIFIER FOR SERIALS

Journal port Science Research
Available online www.jport.co
Volume 8, issue 1. 2025

# Influence of Polypropylene Fibre Reinforcement of Different Methods and Lengths on Some Properties of Denture Base Resin Processed by Autoclave

Nagham Bahjat Kamil

*College of Dentistry, Mustansiriyah University, Baghdad, Iraq.*

dr.nagham_b@uomustansiriyah.edu.iq

**Abstract** Acrylic resins are the most common denture materials because of their valuable optical property. Their impact strength is limited, therefore they require different methods and processes of reinforcement. The reinforcements could be performed by the application of fibres such as polypropylene fibres. In this study, the influence of randomly oriented polypropylene fibre (2%) in two lengths (6mm, 12mm) and different applied methods (without impregnation, impregnation) on impact strength, surface roughness, and water sorption and solubility of heat-cured acrylic resin processed by autoclave was investigated. Specimens (150 samples) were prepared and divided into a control group and a reinforced group. The reinforced group was divided according to the fibre lengths 6mm and 12mm; then each one was subdivided according to the method of fibre addition (direct fibre addition to powder and fibres immersed in monomer). There were ten specimens in each group for each test. Acrylic resin reinforced with 2% randomly oriented polypropylene fibres regardless of the applied method and length, showed significant improvement regarding the impact strength and water solubility. However, a non-significant effect was detected on surface roughness and water sorption test according to (ANOVA f-test). The surface roughness and impact strength of reinforced autoclave processed acrylic resin with randomly oriented polypropylene fibres (2%, 12mm) with monomer impregnation were significantly improved in comparison to other groups, with no effect on water sorption property.

10.36371/port.2025.1.11

**Keywords:** *Acrylic resin, autoclave, polypropylene fibre, impact strength, and physical properties.*

## 1. INTRODUCTION

To improve dentures' strength, a wide range of chemicals used is polymethyl methacrylate (PMMA), also called acrylic resin. Several features characterize acrylic resin. Firstly, it is considered one of the materials routinely used in dentistry for several purposes. Secondly, it can be effortlessly polished and manipulated which permits its use in combination with equipment. Also, it is stable in the environments of the oral cavity. Hence, acrylic resin has been comprehensively and extensively used as a denture-base polymer (1). However, acrylic resin is a significant problem: poor strength represented by the low impact and poor flexural strength (2-4). In other words, acrylic including indenture has low impact strength for base materials with the tendency to break down when dropping on hard surfaces (5); it is known as the energy required to cause a fracture on the fabric under impact force (6). Several attempts have been made to enhance the polypropylene fibre by integrating and combining various threads and the acrylic resin. Such interventions have shown considerable improvement in the mechanical properties of materials used in dentistry (7). Recently, several types of fibres have been added to an acrylic resin, including carbon (8), aramid (9), polyethene (10), and glass (11). Polypropylene fibres are characterized by several advantages such as high impact strength, inexpensive and biocompatible (12, 13). The reinforcement of fibre is influenced by several factors, such as fibre, length, form and arrangement, and matrix bond. A wide range of methods has been suggested to enhance the interface between the denture base material, like plasma treatment, salinization, and other forms of pre-treatment (14, 15, 16). An autoclave is a widely used device in microbiology, medicine, and dentistry, designed to utilize pressure to sterile aqueous solutions by heating them above their boiling point (17). The water bath processing technique is the most common polymerization technique since it is convenient, inexpensive, and straightforward. However, the long processing time is the main disadvantage (18). The methods used in acrylic polymerization could be derived from chemical, light, and microwave energy (19). Researchers in India use the pressure cooker polymerization technique and conventional acrylic resin material, which requires less than one hour for polymerization. Previous studies have shown that the mechanical and physical properties of pressure cooker polymerization were comparable to the water bath technique (20).

## 2. MATERIALS AND METHODS



Nagham Bahjat Kamil. 2025 Influence of polypropylene fibre reinforcement of different methods and lengths on some properties of denture base resin processed by autoclave. *Journal port Science Research*, 8(1), pp.62-70. https://doi.org/10.36371/port.2025.1.11

j. port. sci. res.
ISSN: 2616-7441 (Online)
ISSN: 2616-6232 (Print)
ISSN: 2616-7220 (USB)
INTERNATIONAL IDENTIFIER FOR SERIALS

Journal port Science Research
Available online www.jport.co
Volume 8, issue 1. 2025

Samples of 150 were collected, prepared, and divided into control groups and study groups (reinforced with 2% polypropylene fibres) (21). The fibres were weighed by an electronic balance of (0,0001g) accuracy to the required weight needed for each specimen group. There were two subdivision processes of groups, according to the fibre length (6mm and 12mm) and according to the method used for fibre application (a direct approach by adding powder and an indirect by soaking fibres in a Petri dish filled with monomer for 10 minutes (22). After the fibres were removed from the monomer, they were dried and thoroughly mixed with the acrylic powder. Each tested group contained ten specimens.

Heat-cure acrylic specimens preparation:

Heat cure specimens were prepared for testing impact strength, surface roughness, water sorption, and solubility. According to the test's purpose, the metal was constructed (Fig.1, table 1) (23).

***Table 1:*** *Dimensions of metal constructed according to the test required.*

| Test | Dimensions |
|---|---|
| Surface roughness test | 65mm x 10mm x 2.5mm |
| Impact strength test | 80mm x 10mm x 4mm |
| "Water sorption and solubility test" | "50 ± 1 mm in diameter and 0.5± 0.1 mm thickness" |

The mould was prepared according to the adapted specimens' required measurements using a conventional method, the flashing technique. After coating each metal block with petroleum jelly, the Type III slurry stone (thixotropic, Zhermach/ Italy) was mixed and poured into the flask. The metal blocks were immersed in the prepared stone and left to set (Fig2). Then, a layer of separating medium (Isodent, Spofadental/ Czech) was placed on the surface followed by adding another layer of stone. The added material was left for one hour before separating the flask halves and removing the metal block. The gypsum surface in the remaining half of each flask was painted by separating medium followed by packing the mould with (3:1) by volume mixed acrylic dough (Vertex/J.v.Oldenbamevetin Zeist, The Netherlands) under 20 bar for 5 minutes followed by clamping. The clamped flasks were cured by placing them into a preprogrammed autoclave (SW 22 plus stern-weber, Italy) at a temperature of 121ºC/210KPa for 15 min (Fig.3). In this process air removal, steam admission, and sterilization cycle (heating up, holding/exposure, and cooling stages) were performed (24, 25). Finally, flasks were left for 30 min to cool at room temperature., followed by a further 15 min for complete cooling of the metal flask, then deflating, and removing acrylic patterns from the mould (24).

**Surface roughness test:**

Before the surface roughness test, all the specimens were stored in distilled water at a temperature of 37 ºC for 48 hours (20.) with no polishing. The surface roughness was investigated by a profilometer device (Fig. 4). This determines to which extent the reinforcement of fibre influences the test surface's micro geometry. A sharp stylus surface is made from a diamond responsible for detecting and analyzing the surface irregularities' profile. The acrylic specimens were placed on the stage, and a selected test area was then analyzed. This is performed by traversing the device with a traverse length of 11mm along the tested area and calculating the mean of three readings.

**Impact strength:**

A Charpy-type impact testing instrument was used in this study (26), as shown in (Fig.5). The specimens were stroked by a free-swinging pendulum of 2 joules testing capacity after holding them horizontally at their ends. The scale supplied recorded (in Joules) the impact energy absorbed to fracture the specimen after a sudden blow. All tested specimens were kept in distilled water at 37 ºC for 48 hours before the testing process (20).

The Charpy impact strength of the un-notched specimen was calculated by the below equation in KJ/mm²:

Impact strength = (E/ b.d) ×10³ Where

"E is the impact absorbed energy in joules".

"b: is the width in millimetres of the test specimens".

"d: is the thickness in millimetres of the test specimens". (6)

**Water sorption and solubility test:**

Disks were dried in a desiccator filled with dried silica gel at temperature 37ºC ± 2ºC for 24 hours (Fig.6), then transferred to another desiccator, stored at room temperature for 1 hr. and weighed. This procedure was repeated until reaching constant weight, i.e., the weight loss called for each disk is ≤ 0.5mg in 24 hours (W1). After that, all disks were kept in distilled water at a temperature of 37ºC ± 1ºC for seven days, then removed with tweezers, and wiped with a clean, dry hand towel. Finally, the disks were waved in the air for 15 seconds and weighed immediately (W2).



Nagham Bahjat Kamil. 2025 Influence of polypropylene fibre reinforcement of different methods and lengths on some properties of denture base resin processed by autoclave. *Journal port Science Research*, 8(1), pp.62-70. https://doi.org/10.36371/port.2025.1.11

j. port. sci. res.
ISSN: 2616-7441 (Online)
ISSN: 2616-6232 (Print)
ISSN: 2616-7220 (USB)
INTERNATIONAL IDENTIFIER FOR SERIALS

Journal port Science Research
Available online www.jport.co
Volume 8, issue 1. 2025

The water sorption value was calculated by the below equation:

S= (W2- W1) / SA

"W2= Weight after immersion (mg)"

"W1= Conditioned weight, SA= Surface area ($cm^2$), S= Sorption ($mg/cm^2$)"

The disk average values were verified to the nearest 0.01 $mg/cm^2$ .

For testing the disk solubility value, the discs were reconditioned to a constant mass in the desiccator at a temperature of 37 ºC ±2 ºC as previously done for the sorption test and measured as the reconditioned mass (W3).

The disk solubility values were calculated from the below equation:

"Solubility (mg/cm2) = condition mass W1 (mg) - reconditioned mass W3 (mg)/ Surface area ($cm^2$)"

**Statistical analyses**

The descriptive statistics of the surface roughness test for control and experimental groups are shown in Table (3). To evaluate the effect of polypropylene fiber (2%) reinforcement on acrylic resin processed by autoclave One Way Analysis of Variance (ANOVA f-test) was performed and the data with P(<0.05) were considered as significantly different.

## 3. RESULT:

A non-significant difference was shown between experimental groups (P=0.15) (table 3). LSD showed significant improvement in surface roughness between reinforced acrylic with 12mm length polypropylene fibres immersed with monomer (C2) and control group (A) (P<0.05). For impact strength, table (4) listed the descriptive values of control and experimental groups. ANOVA f-test revealed a highly significant difference between the control group and experimental groups (P-value 0.000) (table 5). LSD showed there was a substantial difference between C2 (12mm, immersed with monomer) and B1 (6mm without immersion) (SE=0.001, t=0.016) and C1 (12mm engaged with monomer) (SE=0.014, t=0.049), respectively. According to the water sorption test, the descriptive values are listed in Table (6), and the ANOVA f-test showed there was a non-significant difference (P- 0.847) (table 7). For water solubility, the descriptive statistics are listed in Table (8), and there was a highly significant difference between the control group and reinforced groups (P-value 0.000) (table 9).

## 4. DISCUSSION:

The denture base polymer's main component was the heat-cured polymethyl methacrylate (PMMA). Sometimes, this denture base polymer was fractured or cracked if accidentally dropped due to low strength. To resolve such a problem, the incorporation of some reinforcement as polypropylene fibres into the denture base polymer was recommended (27) (28). The reinforcement of fibre can be influenced by several factors, such as fibre, length, form, arrangement, and matrix bond.

In this study, a 2% concentration of randomly oriented polypropylene fibres was used. Such a procedure is characterized by a simplicity that is more likely to be acceptable for widespread (29). Another significant advantage is the random orientation of fibres, making the mechanical properties the same in different directions (30). To have effective reinforcement of fibre, the stress needs to be transferred from the polymer matrix to the fibre. To achieve that, the fibre's length must be equal to or greater than the required fibre length. In addition, the fibers-matrix interface mustn't be overemphasized otherwise; these poorly bonded fibers can act as voids (31). A wide range of interventions has been presented for improving the interface between the denture base materials, such as the impregnation of fibres (18).

Stains, debris, and plaque were reduced or prevented by having acrylic resin with a smooth, and shiny surface. Surface deterioration can lead to a loss of surface details with the increase in the number and bacteria penetrating the acrylic (32, 33). It can be recognized from the obtained result; that the reinforced groups have a non-significant effect on surface roughness compared with the control group. This result could be due to the smooth surface and similar diameter of polypropylene fibres used. The reinforced fibres' diameter had a more significant effect on the surface roughness than that of length and concentration. This result agreed with Zeina HS (34). Simultaneously, there was considerable improvement in surface roughness in group (C2) reinforced by (impregnated 2%, 12mm) polypropylene fibres. This result may be due to a smooth surface, good adhesion of fibres with matrix, and no protruding ends in the finish specimens associated with short fibres (35).

A common problem associated with denture failure is impact failure, and this was avoided by adding impregnated and non-impregnated polypropylene fibres. The impact strength was significantly increased after the addition of the above-mentioned fibres with 6mm, and 12mm lengths when compared with the control group. Such improvement may be related to the fibers' presence, which helped overcome two unwanted events; the propagation of cracks and change in cracks, which results in more minor cracks between the fibers. Similar findings were reported by Mowade et al. (36). Also, there was a significant difference in impact strength between groups reinforced by impregnated 12mm polypropylene fibres (C2) and non-impregnated 12mm fibres (C1). This could be due to good adhesion between the fibres and the matrix, which in turn enables a more significant load to be transferred from the matrix to the fibres. Mowade T.K. et.al stated that the fibre-polymer connection is important in transmitting the load to the fibres from the matrix material (37). For impact strength, the


Nagham Bahjat Kamil. 2025 Influence of polypropylene fibre reinforcement of different methods and lengths on some properties of denture base resin processed by autoclave. *Journal port Science Research*, 8(1), pp.62-70. https://doi.org/10.36371/port.2025.1.11

j. port. sci. res.
ISSN: 2616-7441 (Online)
ISSN: 2616-6232 (Print)
ISSN: 2616-7220 (USB)
INTERNATIONAL IDENTIFIER FOR SERIALS

Journal port Science Research
Available online www.jport.co
Volume 8, issue 1. 2025

results revealed that impact strength was increased between (C2) and non-impregnated fibres 6mm in length (B1). This may be related to the increase in fibre length, when the length increases the ineffective portion of the fibre has a smaller effect (14), in addition to that good adhesion between fibres and matrix along the whole border, enables the transfer of a more significant load from the matrix to the fibre (38).

Material sorption is represented by the absorbed water amount on the surface and into the body of the material during fabrication or restoration (39). The value of polymers' water sorption is influenced by the monomer's composition. This in turn depends on the content of fillers in resin materials and the polymerized resin hydrophilicity. Hence, PMMA was documented to show more negligible water sorption (40). This study showed a non-significant difference between control groups and reinforced groups regardless of length and method. This may be related to the voids and/or defects in the free fibre-matrix interface due to good impregnation. The current result was disagreed with Mohammed (29).

High solubility is not recommended when formulating denture materials. To be suitable for the oral environment, the denture base resins are expected to be insoluble in water and most fluids. An important indicator that the specimen is highly soluble is the loss of the resin's weight, which is observed when measuring the specimen's solubility (41). Such a problem was solved in this study by decreasing the solubility by incorporating 2% polypropylene fibres that participated in reinforcing the denture materials compared to the control group (42). The transverse interlocking between the acrylic resin and reinforced polypropylene fibres is another factor that might reduce the acrylic resin's solubility. However, the findings are not consistent with those obtained by Mohammed (2013) (29)

**Table 2** Descriptive statistics of Surface roughness test

| | N | Minimum | Maximum | Mean | Std. E | Std. D |
|---|---|---|---|---|---|---|
| A | 10 | 2.237 | 3.756 | 2.77500 | 0.260248 | 0.637474 |
| B1 | 10 | 1.443 | 3.196 | 2.22950 | 0.275838 | 0.675661 |
| B2 | 10 | 1.737 | 3.935 | 2.48417 | 0.318345 | 0.779782 |
| C1 | 10 | 1.780 | 3.370 | 2.54467 | 0.230127 | 0.563694 |
| C2 | 10 | 1.483 | 2.371 | 1.87783 | 0.135115 | 0.330962 |

**Table 3** ANOVA test for the means of Surface roughness of all groups

| | **SS** | **Df** | **MS** | **F-test** | **P-value** |
|---|---|---|---|---|---|
| **Between groups** | 2.813 | 4 | 0.703 | 1.852 | 0.150 |
| **Within groups** | 9.491 | 25 | 0.380 | | |
| **Total** | 12.304 | 29 | | | |

There is a non-significant difference.
LSD shows
Non-significant difference between all groups
Only between A&C2 (t=0.018, SE=0.355, P<0.05), there was significant difference

**Table 4:** Descriptive statistics of impact strength test (KJ /mm²)

| | N | Minimum | Maximum | Mean | Std. E | Std. D |
|---|---|---|---|---|---|---|
| A | 10 | 0.21 | 0.48 | 0.3233 | 0.04462 | 0.10930 |
| B1 | 10 | 0.73 | 1.25 | 0.8950 | 0.07663 | 0.18770 |
| B2 | 10 | 0.83 | 1.65 | 1.1183 | 0.13698 | 0.33552 |
| C1 | 10 | 0.63 | 1.41 | 0.9533 | 0.10726 | 0.26273 |
| C2 | 10 | 0.85 | 1.48 | 1.1933 | 0.11721 | 0.28710 |

**Table 5:** ANOVA test for the means of impact strength of all groups

| | **SS** | **Df** | **MS** | **F-test** | **P-value** |
|---|---|---|---|---|---|
| **Between groups** | 2.814 | 4 | 0.704 | 11.305 | 0.000 |
| **Within groups** | 1.556 | 25 | 0.062 | | |
| **Total** | 4.370 | 29 | | | |

There is a highly significant difference.
LSD shows
There is a significant difference between
Group A & B1(SE=0.014, t=0.001)
And Group A& B2(SE=0.014, t=0.000)
And Group A& C1(SE=0.014, t=0.000)
And Group A& C2(SE=0.014, t=0.000)
And Group B1& C2(SE=0.001, t=0.016)



Nagham Bahjat Kamil. 2025 Influence of polypropylene fibre reinforcement of different methods and lengths on some properties of denture base resin processed by autoclave. *Journal port Science Research*, 8(1), pp.62-70. https://doi.org/10.36371/port.2025.1.11

j. port. sci. res.
ISSN: 2616-7441 (Online)
ISSN: 2616-6232 (Print)
ISSN: 2616-7220 (USB)
INTERNATIONAL IDENTIFIER FOR SERIALS

Journal port Science Research
Available online www.jport.co
Volume 8, issue 1. 2025

And Group C1& C2(SE=0.014, t=0.049)
There is a non-significant difference between other groups

**Table 6:** Water sorption test (mg /cm²) with related descriptive statistics

| | N | Min | Max | Mean | Std. E | Std. D |
|---|---|---|---|---|---|---|
| A | 10 | 0.212 | 0.251 | 0.22683 | 0.005558 | 0.013615 |
| B1 | 10 | 0.216 | 0.244 | 0.23233 | 0.004638 | 0.011361 |
| B2 | 10 | 0.200 | 0.247 | 0.22900 | 0.007559 | 0.018515 |
| C1 | 10 | 0.227 | 0.238 | 0.23400 | 0.001528 | 0.003742 |
| C2 | 10 | 0.222 | 0.239 | 0.22950 | 0.002405 | 0.005891 |

**Table 7:** Water sorption (ANOVA between and within groups with related statistics including the p-value with no significant difference)

| | **SS** | **Df** | **MS** | **F-test** | **P-value** |
|---|---|---|---|---|---|
| **Between groups** | 0.000 | 4 | 0.000 | 0.342 | 0.847 |
| **Within groups** | 0.004 | 25 | 0.000 | | |
| **Total** | 0.004 | 29 | | | |

**Table 8:** Water solubility test (mg/cm²) with related descriptive statistics

| | N | Min | Max | Mean | Std. E | Std. D |
|---|---|---|---|---|---|---|
| A | 10 | 0.001 | 0.010 | 0.00567 | 0.001563 | 0.003830 |
| B1 | 10 | -0.008 | 0.000 | -0.00400 | 0.001291 | 0.003162 |
| B2 | 10 | -0.006 | -0.001 | -0.00300 | 0.000775 | 0.001897 |
| C1 | 10 | -0.008 | 0.000 | -0.00255 | 0.001156 | 0.002831 |
| C2 | 10 | -0.008 | -0.002 | -0.00433 | 0.000855 | 0.002338 |

**Table 9:** Water solubility test (ANOVA between and within groups with related statistics including the p-value)

| | **SS** | **Df** | **MS** | **F-test** | **P-value** |
|---|---|---|---|---|---|
| **Between groups** | 0.001 | 4 | 0.000 | 16.569 | 0.000 |
| **Within groups** | 0.000 | 25 | 0.000 | | |
| **Total** | 0.001 | 29 | | | |

There is a highly significant difference.
LSD shows
There is a significant difference between
Group A & B1 (SE=0.001, t=0.000)
And Group A& B2 (SE=0.001, t=0.000)
And Group A& C1 (SE=0.001, t=0.000)
And Group A& C2 (SE=0.001, t=0.000)
There is a non-significant difference between other groups

***Figure 1 (****Metal patterns)*



Nagham Bahjat Kamil. 2025 Influence of polypropylene fibre reinforcement of different methods and lengths on some properties of denture base resin processed by autoclave. *Journal port Science Research*, 8(1), pp.62-70. https://doi.org/10.36371/port.2025.1.11

j. port. sci. res.
ISSN: 2616-7441 (Online)
ISSN: 2616-6232 (Print)
ISSN: 2616-7220 (USB)
INTERNATIONAL IDENTIFIER FOR SERIALS

Journal port Science Research
Available online www.jport.co
Volume 8, issue 1. 2025

*Figure 2 (Metal flask)*

***Figure 3*** *(Autoclave)*

***Figure 4*** *(Profilometer device)*



Nagham Bahjat Kamil. 2025 Influence of polypropylene fibre reinforcement of different methods and lengths on some properties of denture base resin processed by autoclave. *Journal port Science Research*, 8(1), pp.62-70. https://doi.org/10.36371/port.2025.1.11

j. port. sci. res.
ISSN: 2616-7441 (Online)
ISSN: 2616-6232 (Print)
ISSN: 2616-7220 (USB)
INTERNATIONAL IDENTIFIER FOR SERIALS

Journal port Science Research
Available online www.jport.co
Volume 8, issue 1. 2025

***Figure 5*** *(Impact strength machine)*

***Figure 6*** *(Desiccator)*

## REFERENCES

[1] Mohammed, N. H. (2010). "The effect of fiber reinforcement on tensile bond strength of acrylic denture resin". *AL-TAQANI*, *23*(5), 59-65.

[2] Katja K. Narva*, Lippo V. Lassila, Pekka K. Vallittu "The static strength and modulus of fiber reinforced denture base polymer".Department of Prosthetic Dentistry and Biomaterials Research, Institute of Dentistry, University of Turku, Lemminka¨isenkatu 2, FIN-20520 Turku, Finland (2004).

[3] Johnston EP, Nicholls JI, Smith DE. Flexure fatigue of 10 commonly used denture base resins. J Prosthetic Dent (1981); 46:478-83.

[4] Darbar UR, Huggett R, Harrison A. Denture fracture--a survey. Br Dent J (1994); 176:342-5**.**

[5] Robinson JG, McCabe JF. Impact strength of acrylic resin denture base materials with surface defects. Dent Mater 1993; 9:355-60.

[6] McCabe J. F., Walls A.W.G. (2008):"Applied dental material."9th Ed. Blackwell Publishing Ltd Ch. 13 p: 110-112.

[7] Anusavice K. J.:" Phillips's sciences of dental materials." 11th Ed. Saunders Co. Philadelphia, (2007) p: 162-169.

[8] Kassab Bashi T, Al-Nema LM. Evaluation of Some Mechanical Properties of Reinforced acrylic Resin Denture Base Material (An in Vitro Study). Al–Rafidain Dent J. 2009; 9(1):57-56.

[9] Bowman AJ, Manley TR. The elimination of breakages in upper dentures by reinforcement with carbon fibers. Br. Dent. J.1984; 156: 87–9.

[10] Berrong JM, Weed RM, Young JM. Fracture resistance of Kevlar–reinforced polymethylmethacrylate resin a preliminary study. Int. J. Prosthodontic. 1990; 3:391–5**.**

[11] Ladizesky NH Pang MKM Chow TW and Ward IM. Acrylic resin reinforced with woven highly drawn linear polyethylene fibers. Mechanical properties and further aspects of denture construction. Aust. Dent. J. 1993; 38: 28–38 **.**

[12] Vallittu PK. The effect of glass fiber reinforcement on the fracture resistance of a provisional fixed partial denture restoration. J. Prosthet. Dent. 1998; 79: 125–30**.**

[13] Dr. Kumar Shalabh, Dr. Gupta Ajay,Dr. Tomar Leena:" Comparison of Transverse Strength of Conventional Denture Base Resin and Reinforced Denture Base Resin with glass fibers, polyethylene and polypropylene fibers." J. Orofacial and health science, vol. 1 and issue 2, (2010).

[14] Mowade T.K., Dange Sh.P., Thakre M.B., and Kamble V.D.: "Effect of fiber reinforcement on impact strength of heat polymerized polymethyl methacrylate denture base resin: in vitro study and SEM analysis". J Adv. Prosthodont (2012); 4(1): p.30-36 **.**



Nagham Bahjat Kamil. 2025 Influence of polypropylene fibre reinforcement of different methods and lengths on some properties of denture base resin processed by autoclave. *Journal port Science Research*, 8(1), pp.62-70. https://doi.org/10.36371/port.2025.1.11

[15] Rafid M. Hashim, Yahya Yahya Zaki Farid : "Design, Synthesis, In Silico Study and Anti-Inflammatory Evaluation of New Ketoprofen Thiourea Derivatives". APPLIED MEDICAL SCIENCE, vol7(1), pp.69-76.

[16] Sadeq R. Atiyah and Sarmad Al-Edresi.: "Preparation And Characterization of Polyvinyl Alcohol Nanofiber Loaded With Mafenide For Sustain Release." https://doi.org/10.36371 /port.2024.1.7

[17] AMJAD RAHAMNEH, BDS, and MSc: 'Impact strength of acrylic resin denture base Material after the addition of different fibers '. Pakistan Oral & Dental Journal Vol 29, No. 1, (June 2009).

[18] Abdul Wahhab S.S:" The effect of autoclave processing on some properties of heat cured denture base materials. "A thesis submitted to the Council of College of Dentistry at the University of Baghdad.( 2012)

[19] Banerjee R, Banerjee S, Prabhudesai P.S., Bhide SV:"Influence of the processing technique on the flexural fatigue strength of denture base resins: An in vitro investigation." Indian Dent Assoc., (2010), 21:3915 .

[20] Azzari M.J.,Cortizo M.S., Alessandrini J.L:" effect of the curing conditions on the properties of an acrylic denture base resin microwave polymerized." J. Dent. (2003); 31: 463-468.

[21] Undurwade J.H, Sidhaye A.B. (1989):"Curing acrylic resin in a domestic pressure cooker: A study of residual monomer content."Quintessence Int.; 20(2): 123-129.

[22] Tushar Krishnarao Mowade, MDS, Shankar Pandurang Dange, MDS, Mrunali Balkrushna Thakre, BDS, and Vaibhav Deorao Kamble, MDS.:-" effect of fiber reinforcement on impact strength of heat polymerized polymethyl methacrylate denture base resin: in vitro study and SEM analysis". The Journal of Advanced Prosthodontics is provided here courtesy of Korean Academy of Prosthodontics.(2010)

[23] American Dental Association Specification No.12.Guide to dental materials and devices. 10th ed. Chicago; 1999. p.32.

[24] Judelson H.S.:" Operation of the autoclaves." An excellent overview of autoclave operation posted by Dr. Howard Judelson at University of California (2004).

[25] Oyawale, F.A. and Olaoye. AE: "Design and Construction of an Autoclave". Pacific Journal of Science and Technology (2007).8 (2):224-230.

[26] Craig R.G., Powers JM:"Restorative dental materials."11th Ed. St. Louis Mosby Co.(2002) ch.21, p: 636-689.

[27] ISO 179-1(2000) international organization for standardization. (Plastics. Determination of charpy impact properties-Part 1: Non instrumented impact test).

[28] Kanie T., Arikawa H., Fuji K., and Ban S.:-"Light curing reinforcement for denture base resin using a glass fiber cloth pre- impregnated with various urethane oligomers." Dent. Mat. (2004); 23: 291-296.

[29] Dr. Kumar Shalabh, Reader, Dr. Gupta Ajay, Professor and Head, Dr. Tomar Leena, Professor:-" Conventional Denture Base Resin and Reinforced Denture Base Resin with Glass fibers and Polypropylene Fibers in Concentration of 1 wt% and 2 wt% - An in Vitro Study". Department of Prosthodontics, DJ (2005). College of Dental Sciences and Research, Modinagar.

[30] Mohammed W.I.: "The effect of addition of untreated and oxygen plasma treated polypropylene fibers on some properties of heat cured acrylic resin." A master thesis, Department of Prosthodontic, University of Baghdad.(2013)

[31] Vallittu PK.:-"Flexural strength of acrylic resin polymers reinforced with unidirectional and woven glass fiber." J. Pros. Dent.(1999); 81(3): 318-326.

[32] British Standard Specification for Denture Base Polymers. BS 2487: 2000. British Standards Institution, London, UK .

[33] Dina H. Obaid, Rusul J. Hadi, Alaa F Albo Hassan, Nameer Al-Taai:-" Herbal Extract and White Spot Lesion: A Review". APPLIED MEDICAL SCIENCE; Vol. 7 No. 1 (2024) p.1-5

[34] Harrison Z., Johnson A., and Douglas CWI. (2004):-"An in vitro study into the effect of a limited range of denture cleansers on surface roughness and removal of candida albicans from conventional heat cured acrylic resin denture base material." J Oral Rshabil; 31: 460-467.

j. port. sci. res.
ISSN: 2616-7441 (Online)
ISSN: 2616-6232 (Print)
ISSN: 2616-7220 (USB)
INTERNATIONAL IDENTIFIER FOR SERIALS

Journal port Science Research
Available online www.jport.co
Volume 8, issue 1. 2025

[35] Zeina HS. (2006):-"The effete of fibers reinforcement on some properties of visible-light cured acrylic denture base material." A Thesis of Master, Department of Prosthetic, University of Baghdad.

[36] Nakamura M., Takahashi H., and Hayakawa I. (2007):-"Reinforcement of Denture Base Resin with Short-rod Glass Fiber." Dent. Mate. J; 26(5): 1-8.

[37] Mowade T.K., Dange Sh.P., Thakre M. B., and Kamble V.D.:" effect of fiber reinforcement on impact strength of heat polymerized polymethyl methacrylate denture base resin: in vitro study and SEM analysis". J Adv. Prosthodont (2012); 4(1): p. 30-36 .

[38] Herrena-Franco PJ. And Drzal LT.:-"Comparison of methods for the measurement of fiber bond composites." Composites (1992); 23: 2-27 .

[39] Ante Loncar, Denis Vojvodic, Dragutin Komar: "Fiber- reinforced polymers Part I: basic and construction problems". Acta Stomatol Croat.(2006); 40(1): 72-82.

[40] Powers JM and Sakaguchi R.L.: "Craig's Restorative Dental Materials". 12th edition.t. Louis, Mosby Co. (2006), p.46, 79, 150,152, 514,519.

[41] Lassila LJV, Nohrston T, and Vallittu PK.:-"The influence of short-term water storage on the flexural properties of unidirectional glass fiber-reinforced composite." Biomaterial,(2002), 23:2221-2229 .

[42] Ferial M. Abdulrida:-" THE RELATION BETWEEN LOSS OF A FAMILY MEMBER AND ORAL LICHEN PLANUS IN IRAQI POPULATION". APPLIED MEDICAL SCIENCE; Vol. 5 No. 1 (2022),p.9-20



Nagham Bahjat Kamil. 2025 Influence of polypropylene fibre reinforcement of different methods and lengths on some properties of denture base resin processed by autoclave. *Journal port Science Research*, 8(1), pp.62-70. https://doi.org/10.36371/port.2025.1.11