

Antibacterial and Mechanical Performance of Nano Selenium Reinforced Acrylic Denture base

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ABSTRACT

Background: Acrylic resins are commonly used for denture fabrication since they exhibit adequate physical, mechanical, and esthetic properties¹, Also act as reservoirs for microorganisms.

Aim: To investigate poly methyl methacrylate (PMMA) by using different concentration of particles (nano-selenium) composite materials for prosthetic dentures, and study the mechanical properties (transverse, impact and hardness) of these materials.

Methods: At that stage, selenium nanoparticles were impregnated with the monomer of methyl methacrylate at 5%, 10% and 15% by weight. Mixed with powdered acrylic. Antimicrobial movement against staphylococcus aureus tried . One hindered and twenty tests were arranged in add up to to watch its impact on transverse quality , affect quality and hardness

Results: transverse quality , affect quality and hardness values uncovered a measurably noteworthy distinction ($p < 0.05$) among the three concentrations. The comes about shown a lessening within the cruel esteem for 5% ,10% and 15% when compared to control.

Conclusion: Interior the restrictions of this consider, it can be concluded that the extension of SELENIUM nanoparticles caused a reducing in mechanical quality of warm cure acrylic but for 5% , 10% and 15% properties attempted

Keywords: Acrylic resin, selenium nanoparticles, transverse strength, impact strength, hardness

INTRODUCTION

complete and partial dentures made from acrylic are considered the first prevailing strategy as it provides a very fair option for redoing than other usable prostheses¹. Over a long period of time, researchers are trying to advance the quality of biomaterials for denture-based makeup on the side, raising human animals' life expectancy and progressively asking patients for better². Different materials were seen to advertise with overhauled mechanical and natural properties with their alterations; in demonstrated disdain for this, there is still no single texture that can satisfy the ultimate need for denture base material³.

The material most commonly utilized for manufacturing removable partial and complete dentures is polymethyl methacrylate⁴. An perfect denture base material ought to have satisfactory mechanical and physical properties, other than biocompatibility and aesthetics. Poly(methyl methacrylate) (PMMA) is regularly utilized to manufacture denture bases due to its different preferences, counting low cost, biocompatibility, ease of preparing, steadiness within the oral environment, and worthy aesthetics. In any case, it isn't considered an perfect material since of its second rate physical and mechanical properties⁵.

PMMA outlines tall porosity and visit break underneath stack due to exhaustion and chemical degradation.^{6,7} It also serves as a microorganism supply and leads to re-infection in denture wearers⁸.

Oral candidiasis is the preeminent common defilement tallying of verbal mucosal tissues to include denture wearers^{9,10} This treatment is complicated in advance for elderly and institutional patients with restricted motor skills and extraordinary needs, because components

such as memory incidence, burden in having the denture properly cleaned and taken after a strict arrangement¹¹. Selenium is normally found in people and creatures as a portion of seleno-proteins, which play an imperative part in antioxidant defense framework thyroid hormone digestion system and redox control of cell responses¹².

L. McDowell in 2003 expressed the mechanisms of antibacterial impact of selenium which is due to its capacity to create superoxide radicals and to catalyze oxidation of intracellular thiol coming about in thiol consumption that leads to cell passing¹³.

In this study, investigated the poly methyl methacrylate (PMMA) that is used for upper or lower complete and partial denture base material with having desirable properties, by using different concentration of particles (nano-selenium) to product (nano to micro) composite materials for prosthetic dentures, and study the mechanical properties (transverse, impact and hardness) of these materials.

MATERIALS AND METHODS

For this purpose, prepared 120 sample were isolated into three groups for 3 tests chosen. One group (consisted of 40 samples) for each test and group were subdivided into four sub-groups corresponding to the concentration of Se(Selenium Nano filler) as follows

(30 specimens of acrylic without Se).	Group A control group
(30 specimens of acrylic + 5% by weight (Se)	Group B
(30 specimens of acrylic +10% by weight (Se)	Group C
(50 specimens of acrylic +15% by weight (Se)	Group D

plastic models were produced from plastic sheets by cutting different measuring (0.5mm, 2.5mm & 4 mm) into

mold for shape and measurement using laser cutting system.

- 1 Specimen with measurements of length, width, thickness (65 , 10 , 2.5 ± 0.1) mm, individually formed by a transverse consistency test bar ¹⁴.
- 2 Specimen with measurements of length, width, thickness (65 , 10 , 2.5 ± 0.1) mm, individually formed by a surface hardness test bar ¹⁴.
- 3 Quality assay impact: bar-formed specimen measuring (80, 10, 4)mm in length, width and thickness separately ¹⁵.

The standard flasking technique for complete denture introduced after the mold arrangement. In order to coat the plastic show, the insulating medium (cold type seal) was used and allowed to dry before investing the lower part of the metal flask filled with dental stone and blended, agreeing with vibration specifics of the manufacturer to release the captured air. After setting the block, the plastic demonstration mounted to approximately half of its diameter and quickly evacuated.

In four groups, the addition of Se modified powder was carried out by weight, the addition consists of 5 percent , 10 percent , and 15 percent monomer. The filler was well distributed within the monomer by ultrasonic mixing for three minutes using the test sonication system (120W, 60KHZ) to break them into individual Nano crystals, using an electronic equilibrium with an accuracy of (0001g) ¹⁶. To minimize molecule conglomeration and stage separation plausibility, The Se Nano filler monomer suspension was immediately mixed with acrylic powder. When the acrylic came to arrange the batter, packing began, expelled the gum from the Jostle and rolled, pushed into the shape at that point with the aid of polyethylene sheets already coated with insulating medium. The two sections of the jar is closed together and put under the press, fueled by water and eventually added to the weight on the flask so that the batter moves in the space of the mold equally pressure was removed, the flask was opened, and a sharp surgical blade evacuated the material. A second road closure has been carried out. Secondly, the stone surface was covered with a polyethylene coat, separating medium, dry and vacuumed.

At the long end, before contact was obtained, the two portions of the jar were closed and cleared under pressure (20 bars) for 5 minutes a few times after late clamping and then traded to the water bath. By putting the clamped jar in a shower of water and coping with heating for 90 min at 74 ° C, this was done. The temperature stretched for 30 minutes at that point to the bubble stage ¹⁴. All the examples were wrapped and cleaned with a machine-cleaning machine, acrylic flashes were cleaned with W&H office motor inquiry and an acrylic bur was used after (120) grain sandpaper with ceaseless cooling was used to promote smooth surface stone bur (immersed in flexible holler with cold water, cleaning was wrapped with bristle brush and ruge wheel with pumice wheel).

Antimicrobial Activity:The antimicrobial action of the selenium nanoparticles was analyzed with G Gram-positive microscopic organisms *Staphylococcus aureus*. The SeNPs were sonicated each time some time recently the action was performed. The agar plate dissemination strategy was performed in triplicate utilizing the well

procedure. For getting the inoculum, the reference microscopic organism's strains were reproduced in Brain Heart Implantation. After brooding at 37 C for 24 hours, To create the base layer, 25 ml of Brain Heart Infusion-Agar at 50 C were stored on sterile Petri plates (25 • 125mm). After cementing, 12.5ml of the culture media immunized with the test living beings (2.5ml) were included .The plates were kept at room temperature for 120 min for dissemination the new societies were at that point treated with SeNPs for 24 h at 37 °C at 150 rpm. Of the antimicrobial operators 48 .The zone of hindrance breadths were measured

Impact strength test:The specimens were arranged by estimation (80 x 10 x 4) mm (15) for unnoticed charpy specimens Affect quality test. Up to (40) specimens were prepared to include 10 specimens from each concentration for quality estimates of effect.

Acrylic specimens were put on the hatchery for 48 hours absence in refined water at 37 ° C a few times as of the end of test¹⁴.

Following the methodology suggested by the use of the influence testing gadget, the effect consistency test was measured ¹⁵. At each conclusion, the specimens were held uniformly and hit by the free swinging pendulum of two joules and advanced, apparently affecting vitality. In Joules, the scale analysis gives the vitality of the effect. The quality of unnotched specimens was measured in kilo joules per square meter (KJ/M2) by the Charpy effect.

Transverse strength test: The specimens used were prepared with estimations of (65 x 10 x 2.5) mm ¹⁴. In addition, ten specimens for each concentration would include up to (40) specimens for transverse consistency estimation for the control. At 37 ° C, all the specimens were immersed in refined water at the hatchery for (48) hours a few times after late research ¹⁴.

The tests were carried out using a comprehensive Instron testing machine, each sample was arranged on a turning unit consisting of two separate parallel underpins (50) mm, the total

scale was 50 Kg, and the stack was connected to a cross-head speed of 1 mm/min by a bar placed centrally between the underpins allowing redirection until a break occurs.

Surface hardness testing:The samples were orchestrated with estimates of (65 x 10 x 2.5) mm corresponding to ¹⁴. In addition, ten specimens for each concentration will provide up to (40) specimens for surface hardness testing. For (48) hours, both specimens were submerged in refined water a few times after late testing ¹⁴.

Using a durometer hardness analyzer (shore D hardness) developed by (HARTIP 3000compant) consistent with¹⁴, which is suitable for the acrylic plan fabric, the test was carried out.

The instrument consists of an indenter (0.8 mm separately over) of the restriction point that occurs in a barrel (1,6 mm wide). A computerized scale graduating from 100 units to 100 units was linked with the indenter. The standard technique was to immovably and rapidly force down the indenter and stated the most prominent test as the shore D's hardness.

Estimates were drawn from the advanced test scale in particular.

Five estimates were reported for each specimen's assorted zones (the same zone selected for each specimen) and an ordinary five were estimated for scrutiny.

RESULTS

Assessment of antimicrobial activity : Antimicrobial activity was demonstrated by none of the control groups and 5% of the group. The addition of 10 percent and 15 percent of selenium was adequate for all acrylic resins to allocate antimicrobial activity against the test strains *S. aureus* . This activity was increased with selenium percentage.

Transverse Strength: The table shows the means, the standard mean error, the standard deviations and the minimum and maximum values of the different concentrations of Se Nano filler Transverse Strength measurement experimental samples.

Impact Strength: The table shows the means, the standard mean error, the standard deviations and the minimum and maximum values of the different concentrations of Se Nano filler impact strength measurement experimental samples

Surface hardness: The table shows the means, the standard mean error, the standard deviations and the minimum and maximum values of the different concentrations of Se Nano filler hardness measurement experimental samples.

In order to determine the effect of adding NPs at three concentrations, transverse, hardness and impact strength test data were calculated using one way ANOVA with HSD (5, 10 and 15 percent). Statistically significant differences (p< 0.05) between each selenium concentration in relation to the control were seen in the findings.

Figure 1: Mean value of Inhibition halos of *S. aureus* densities of the acrylic resins with different selenium percentages

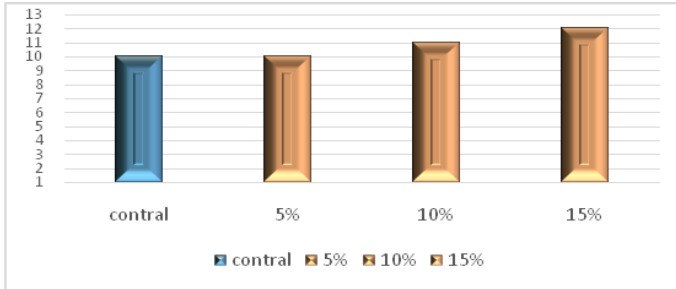


Table 1: Distractive data parameters from the study of Transverse strength (Kj/m2)

		Group A	Group B	Group C	Group D
N		10	10	10	10
Mean		171.2333	51.0567	51.0100	41.8300
SD		1.58507	43.57594	1.00504	.71253
SE		.91514	25.15858	.58026	.41138
Range	Min.	169.91	75	50.01	41.02
	Max.	172.99	77.10	52.02	42.36

Table 2: Distractive data parameters from the study of impact strength .

		Group A	Group B	Group C	Group D
N		10	10	10	10
Mean		83.0667	68.2000	66.6000	62.3333
SD		2.60832	1.65227	2.68514	5.77350
SE		1.50591	.95394	1.55027	3.33333
Range	Min.	80.20	66.30	63.70	59.00
	Max.	85.30	69.30	69.00	69.00

Table 3: Distractive data parameters from the study of hardness (Mpa)

		Group A	Group B	Group C	Group D
N		10	10	10	10
Mean		9.5233	8.9490	6.9490	6.5557
SD		.19630	.20958	.45120	.60086
SE		.11333	.12100	.26050	.34691
Range	Min.	9.41	8.71	6.69	5.90
	Max.	9.75	9.07	7.47	7.08

Table 4: ANOVA test for transverse , impact strength and surface hardness for all experimental groups

Test	df	Mean Square	F	Sig.	
Transverse Strength	10	11452.677	24.074	.000	HS
Impact strength	10	244.306	19.515	.000	HS
hardness	10	6.412	39.635	.000	HS

*. The mean difference is significant at the 0.05 level.

DISCUSSION

Resin composites are broadly utilized in dental clinics for the substitution of hard tissues. In spite of the fact that the mechanical properties and wear resistance of these materials have been moved forward considerably, their antibacterial properties are still of awesome interest.¹⁸ The expansion of selenium to warm polymerized acrylic tars is steady with the current drift of joining antimicrobials into dental materials.¹⁹⁻²² In any case, its achievability is related to either support or enhancement of the material's physical, mechanical and organic properties. This paper presents the comes about of antimicrobial action, hardness, transverse quality and affect quality tests performed with heat-polymerised acrylic gums containing diverse sums of a selenium.²³⁻²⁵

The control specimens (created with no consolidation of selenium), did not have antimicrobial movement, which concurs with the comes about of past thinks about that report small or no antimicrobial movement of the tried materials. The addition of 10% selenium was sufficient give antimicrobial movement against the test strains. The higher the rate of selenium, the more prominent the antimicrobial action. The littlest restraint corona were watched for 10% of selenium against staphylococcus aureus whereas the biggest inhibition halos were watched for 15% of selenium against staphylococcus aureus. These comes about may be credited to selenium (dynamic elements), which filter out from the resins.

When Se was scattered in acrylic at 5 percent, 10 percent and 15 percent, causing an extreme decrease in consistency, the results for this consideration appeared. The results were in accordance with Arora et al.²⁶ and K orođlu et al.²⁷ re-search, where a decline in quality appreciation for different selenium concentrations was seen. This could be due to less selenium substances per PMMA network unit range that triggers moister incorporation.²⁸ . In terms of quality effect, 5 percent selenium induced a decrease in quality. Increasing the filler substance in expansion to poor diffusion would result in suspending the movement of tar organization and make a deformation inside the material that weakens it inside the result, creating an increase in uncreative monomer as a plasticizer that continues. The plasticizer can get into polymer chains that start to make the divided chains more brittle and reduce the fascination between molecules, resulting in a more flexible but fragile acrylic. In expansion to this, might have acted as contaminations interior the PMMA which driven to an unfavorable reduce in mechanical quality. The first probable cause of diminishment for the mechanical quality of tar may possibly be credited to the moo concentration of filler which comes almost in down and out interaction between PMMA and Se. It may be a well-known truth that Se needs chemical bond that comes approximately in poor connection between PMMA and Se. It may be a well-known truth that Se needs chemical bond that comes approximately in down and out connection between the atom and acrylic gum. Agglomeration interior the network will result in a reducing in quality. since as well various fillers will act as a thrust concentrating point that will change the modulus of

flexibility of the tar and mode of break expansion through the polymerized case moreover perform as an interferometer calculate inside the astuteness of polymer arrange. Other than, agglomeration will bring around microcracks and miniaturized scale pores as assistant deformation which imperils mechanical properties of the polymer. The comes about for this consider appeared when Se were scattered in acrylic at 5%, 10% and 15% causing a lessening in hardness as concentration of nano selenium increment which may be credited to moo hardness of selenium (Mohs hardness 2.0)

CONCLUSION

Within the limits of this in vitro consideration, it can be assumed that the addition of selenium nanoparticles has contributed to a decrease in the mechanical quality of hot-curing acrylic, provided that it has a negative impact effect on mechanical quality and, as a consequence, jeopardizes the tasteful value of acrylic, such that the added material is not sufficient to improve the intended properties.

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Ethical Clearance : ethical Clearance: Taken From Institutional Ethics Committee, college of dentistry.

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