

**The effect of glass flakes reinforcement on some
mechanical properties of heat-cured
poly(methyl methacrylate) denture base
material**

A thesis

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By

Haitham Tawfeeq Abdulrazzaq

B.D.S.

Supervised by

Assist. Prof.

Dr. Mohammed Moudhaffer Mohammed Ali

B.D.S., M.Sc.

Abstract

Statement of problem: heat-cured poly(methyl methacrylate) the principal material for the fabrication of denture base have a relatively poor mechanical properties. Many methods for improving these properties have been investigated; most of these have not been adopted due to: increased cost, the need for special processing equipment or increased laboratory time due to more complicated procedures.

Materials and methods: silanated glass flakes were added in 2%, 3%, 5%, and 7% w/w to Triplex[®] denture base powder. The material was mixed, invested, packed, processed, finished and polished in accordance to the manufacturer's instructions. The transverse strength was determined using the 3 Point Bending (3PB) test, in an Instron[®] testing machine, specimen dimensions were (65 x 10 x 2.5) mm. The impact strength was determined using the Charpy impact test, in a tmi[®] impact tester, specimen dimensions were (80 x 10 x 4) mm. The surface hardness was measured using the Shore D hardness tester, specimen dimensions were (65 x 10 x 2.5) mm. The roughness of unpolished surfaces was measured using a profilometer, specimen dimensions were (65 x 10 x 2.5) mm.

Results: the addition of glass flakes produced 17.24% increase in the transverse strength for the 2% content of flakes as compared to the control Triplex[®], the increase was statistically significant $p < 0.05$. As the content of glass flakes was increased to exceed 3%, the flakes tended to significantly weaken the material's strength with 11.74% reduction for the highest loading level (7%). On the other hand, the addition of glass flakes had a deteriorating effect regarding the impact strength of the

material; a statistically significant decrease in impact strength $p < 0.05$ was recorded as the test groups were compared against the control, as the material samples exhibited less impact resistance with the increasing flakes content. The surface hardness tended to increase significantly $p < 0.05$ with the increasing flakes concentration, as an increase of 5.12% was recorded in surface hardness for the highest loading level; while the roughness showed a significant increase that remained within the tolerable range –less than $2\mu\text{m}$ – (significant bacterial colonization would occur if the surface roughness is more than $2\mu\text{m}$).

Conclusion: the addition of glass flakes to PMMA denture base resin considerably improved the transverse strength of the material for the lowest loading level (2%), at the same time, the same concentration had an adverse effect on the impact strength of the material but at lesser extent, the surface hardness and surface roughness were significantly affected at the 2% addition. Other loading levels may not be considered due to their deteriorating effects on the material.