MECHANICAL PROPERTIES OF LASER WELDED JOINTS IN DISSIMILAR ALLOYS

A dissertation submitted in fulfilment of the requirements for the degree of Master of Dental Science

By

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ABSTRACT

Aim

The objectives of the present study were as follows: (i) to investigate the feasibility of laser welding in fusing a dissimilar joint of cobalt-chromium and titanium metal alloys (ii) to evaluate the properties of the welded joints between cobalt-chromium and titanium alloys.

Materials and method

Thirty plastic models of (1×3×42) mm were prepared with conical shoulder shape as following ISO 6871-1dental base metal casting alloys. Models were divided equally into two experimental groups (15 cobalt-chromium and 15 titanium) and one control group of 26 specimens of cobalt-chromium. Each model was invested and moulded into mould rings with a special investment material. The specimens were placed in oven at room temperature. Temperature of the oven was then increased gradually for each alloy following manufacturer's recommendations. Following casting, the specimens were allowed to cool down at room temperature. All cast specimens were then retrieved from the investment and finished. Each specimen was cleaned utilizing acetone solution. All specimens of titanium were then checked by using X-ray to ensure that all specimens were porosity free before cutting and laser welding. Specimens of each alloy were laser welded using Nd-YAG (Manfredi Jewellaser 50, Italy) laser welding machine under power voltage of 270W, pulse duration of 10ms, and welding spot diameter of 1.0mm. Tensile strength and three-point bending tests were carried out using Universal Testing Machine(Shimadzu Autograph AG-X, Japan). Two specimens were selected randomly for examination under Scanning Electron Microscope to investigate the topography of the specimen after laser welding. All data were then statistically analysed using *t*-test and/or Mann Whitney test.

Results

Tensile strength tests results showed that the value of stress was significantly lower in laser welded specimens 401.87MPa, (124.64) when compared to the control specimens 813.07MPa, (50.075), at p=0.000. The mean flex. strength of laser-welded joints was 714.38MPa (165.73) was significantly less than control unwelded specimens 2211.07MPa (442.64) at p=0.000. However the modulus of elasticity values were not significantly different (p = 0.254)between the welded and control specimens. The *t*-test showed no significant difference in the modulus of elasticity between welded specimens (5046.42MPa ± 2262.52) and control specimens (5635.05MPa± 2138.47). SEM shows some porosity inside laser welding joints.

Conclusion

The results showed that the flexural and tensile strengths in laser welded joint of cobalt-chromium and titanium alloys were significantly lower than in control group. However, there were no significant differences between both groups for modulus of elasticity. Fusing titanium and cobalt chromium in removable partial dentures (RPD) would be feasible for repair work.

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