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A Comparative Evaluation of Microstructure of Welded Joints with Spot Resistance Welder Using Two Different Grade Titanium Wires under Different Electrical Impulses and Different Gaseous Shielding: An In Vitro Scanning Electron Microscopic Study

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Abstract

Aim of the Study: The purpose of this study was to evaluate whether one impulse, two impulse and three impulse of current under argon and regular gas environment has any effect upon the microstructure of the titanium framework joined with two different grades of titanium wires using Spot Resistance welding.

Materials & Methodology: a customized fixture which is used to stabilize the implants in position during the welding procedure was milled under CNC milling using a stainless-steel block, into which two standard titanium implants of diameter 5 x 10 mm were glued using commercially available glue. ASTM Grade II and Grade V Ti wire of diameter 2 mm were welded using Intra-oral welding machine with 1 impulse, 2 impulse and 3 impulse of current under argon and regular gas environment to straight shoulder titanium abutments which were screwed onto the implants. The experimental specimens were grouped into 3 groups. Group 1 included non-welded Grade II and Grade V parent metal. Group 2 specimens included welded Ti abutments with Grade II Ti wire. Group 3 specimens included welded Ti abutments with Grade V Ti wire. All the welded specimens were cut at the welded joints by a wire EDM machine. The cut specimens were subjected to SEM analysis under 2 μ m, 10 μ m, 100 μ m magnification at the FZ and HAZ of the weld-joints area. The analysis was evaluated and compared within the groups and the control group.

Results & Conclusion: Based on the results and within the limitations of the analysis, it could be concluded that, the use of argon during the welding process protects the welding zone from detrimental

influences of the atmosphere and therefore results in a good bonding. Since there is technical limitation in including an inert gas intraorally, clinically obtaining a homogenous weld-joints without contamination is practically impossible. Among the Group 2 specimens welded under 1 impulse and 3 impulse of current exhibited better microstructural characteristics to say the weld joint has a better strength. Among the Group 3 specimens welded with 2 impulse of current exhibited better microstructural characteristics to say the weld joint has a better strength. Grade II performed under all the current impulses exhibited better weld-joint characteristics than Grade V Ti wire.

Keywords: Titanium; abutment; Argon gas; Impulse of current; Electrical discharge machining (EDM); Spot Resistance welding; Intra-oral welding; weld-joint; Scanning electron microscope (SEM); Microstructure.

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