Modification of Implant Prosthetic Abutments with Laser Welding and Titanium

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Abstract: A clinical case is described to show the properties of laser welding in implant prostheses related to versatility and flexibility at the time of modification of prosthetic abutments. The technique consists of adding a cast titanium fragment to a prepared titanium abutment with laser welding, joining them together in order to achieve more volume of metal beneath ceramic in single-crown implant-retained restorations.

Key words: implant prostheses, titanium, titanium abutments, laser welding.

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Due to its biocompatibility and resistance to corrosion, titanium is the metal of choice in dental implants, implant abutments, and frameworks of implant prostheses.[1] It likewise affords superior physical and chemical properties, including high hardness and mechanical resistance, high surface energy, and a medium elastic modulus.[2,3] It is neither mutagenic nor cytotoxic,[4] possesses neutral taste, and is light weight thanks to its relatively low relative density.[5]

The utilization of titanium in implant abutments offers a series of advantages over other alloys, since the use of a single metal reduces the risk of corrosion by eliminating bimetallism, and its excellent biocompatibility makes it ideal for these treatment modalities.[6,7]

Laser welding is fast, clean and precise, provided it is performed in the presence of argon to prevent oxidation.[8] The technique has been available for more than 20 years,[9] and although is not very widespread, the number of technical laboratories using it is increasing. Laser welding has in fact prevailed over all other joining techniques, because it allows welding without adding another alloy or metal with different properties, thereby yielding a framework composed of a single metal.[10] Studies of the laser-welded titanium joints in dental prostheses have shown the method to be effective.[8,11-15]

Well-defined and localized joints can be achieved with laser welding. The energy diffused by laser welding is highly circumscribed: the zones affected by heat are very small, since high temperatures are generated in very brief intervals of time.

In addition to these advantages, another important characteristic of laser welding in prosthetic dentistry is the versatility and flexibility with which structural modifications can be made.[16] With laser welding, a new piece can be easily added to an existing framework. A fractured framework can also be repaired with this simple method, eliminating the need of manufacturing a new one. Another possibility is expanding an existing framework by adding bridging or abutments, connecting implants, or any other modification, always employing the same metal.[17]

Changes can also be made in the morphology of the prosthetic abutments, adding a titanium structure to the latter to afford an increased volume of metal beneath the ceramic and thus avoid the presence of excessive ceramic thickness without metal support, which

Fig 1 Preoperative clinical situation.

Fig 2 Palatal position of the implant.

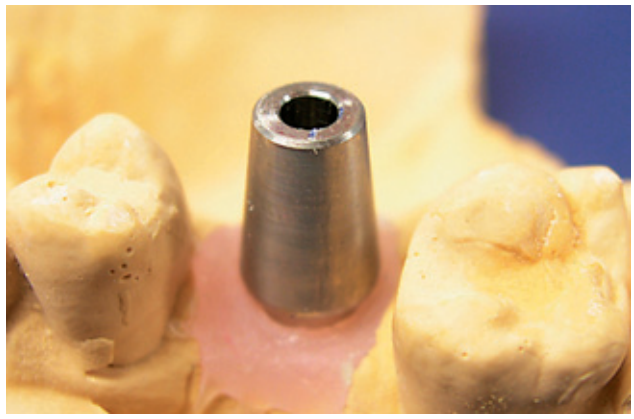

Fig 3 Titanium solid abutment, buccal view.

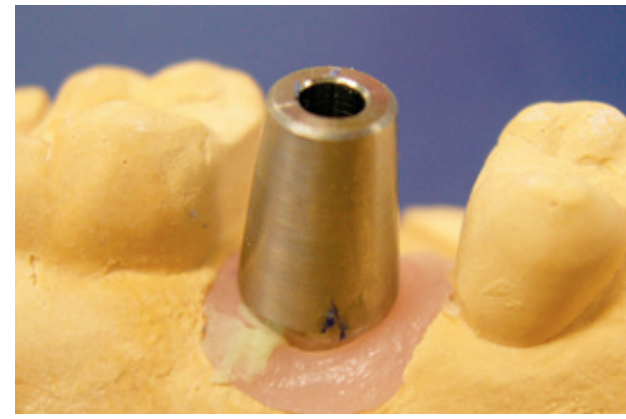

Fig 4 Titanium solid abutment, palatal view.

could cause structural weakening of the restoration. This technique avoids the presence of impurities or microdistortions that can appear on the fitting surfaces after overcasting of cylinders or the casting of burn-out plastic abutments.[8]

A clinical case is described to present the advantages and conveniences of laser welding related to versatility and flexibility at the time of modification of prosthetic abutments.

CLINICAL CASE

A 30-year-old patient was scheduled for restoration of a missing first maxillary right molar (Fig 1) using a single-crown implant-retained restoration. Due to considerations of bone availability, the implant was positioned slightly palatal in relation to the adjacent teeth and to the center of the planned occlusal surface of the restoration (Fig 2). This means that in order to achieve an esthetically satisfactory outcome, the volume of the prosthetic crown must be increased buccally. To this effect, we first prepared a titanium solid abutment (Figs 3 and 4), reducing the excess volume and height (Fig 5). Waxing-up was performed on this abutment structure with the volume and contour required to achieve good metal support for the ceramic, while at the same time offering a good esthetic result (Fig 6).

This waxed standard was cast in titanium (Fig 7), and after finishing and polishing (Figs 8 and 9), it was pre-welded to the abutment onto which it was waxed, by means of two laser welding points in the apical zone: one lingual (Fig 10) and the other buccal (Fig 11). After clinically testing the correct fit of the modi-

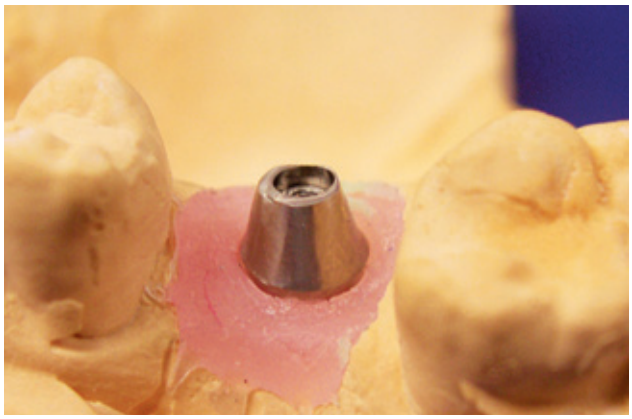

Fig 5 Titanium abutment prepared, buccal view.

Fig 6 Waxup, palatal view.

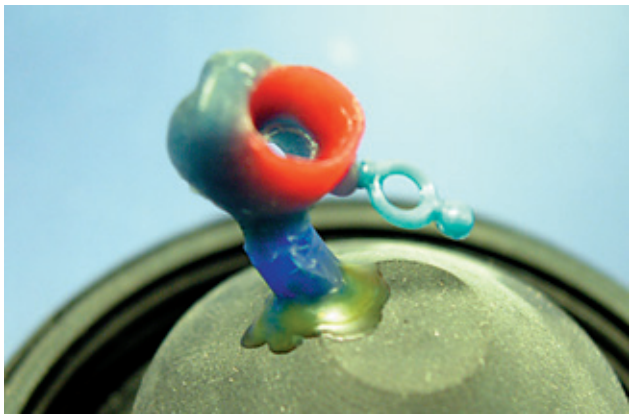

Fig 7 Waxup prior to casting.

Fig 8 Cast titanium structure onto abutment without pre-welding, palatal view.

fied pre-welded abutment (Fig 12), definitive welding was performed and the ceramic processed (Fig 13).

The final restoration satisfies all the requirements of a single-crown implant-retained restoration (Figs 14 and 15). In this simple manner, and thanks to laser welding, it was possible to achieve esthetic and functional results in this highly challenging case.

DISCUSSION

Laser welding represents a high-quality procedure in joining parts of the same metal vs other, more traditional welding procedures based on the use of a different alloy with a lower melting point to join the two parts. Furthermore, it is the elective method for joining metals in dental prostheses because of its properties: it is a clean, fast, and precise procedure. It must be added the fact that titanium is the metal best suited for laser

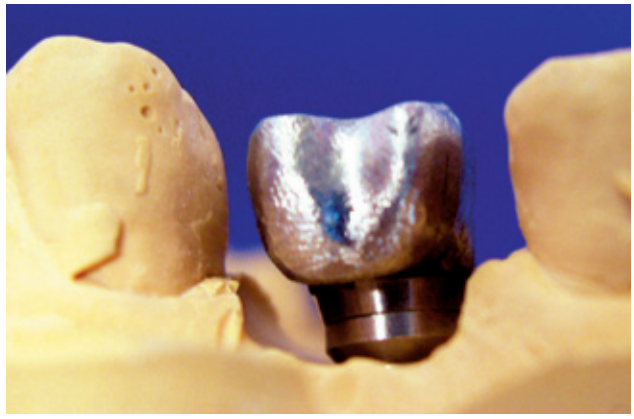

Fig 9 Cast titanium structure onto abutment without pre-welding, buccal view.

Fig 10 Cast titanium structure pre-welded onto abutment, palatal view.

Fig 11 Cast titanium structure pre-welded onto abutment, buccal view.

Fig 12 (left) Intraoral test of modified pre-welded abutment.

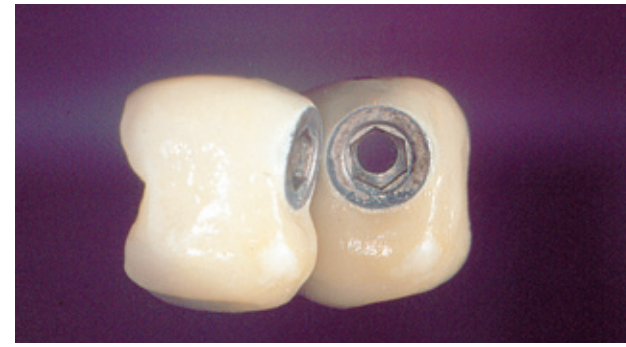

Fig 13 Single crown processed.

Fig 14 (left) Final restoration, occlusal view.

Fig 15 Final restoration, buccal view.

welding. Other advantages are versatility and flexibility in making modifications in the framework, allowing the addition of a new piece, the repair of fractured frameworks or any other modification which interests the clinician, without the need of manufacturing a new framework.

The present clinical case shows a technique to modify implant abutments, welding a fragment onto an implant abutment easily and very reliably using the same metal. Such versatility of laser welding is a highly advantageous property, since only with burn-out abutments or with the technique presented here is it possible to achieve an optimal screw-retained restoration in the case described. This laser-welding procedure avoids the casting of burn-out abutments and the overcasting of cylinders, which may cause dimensional changes or discrepancies in the fitting surfaces. The original premachined abutment affords precise shaping characteristics, thereby securing improved surface fits compared to burn-out abutments, because the original abutment is not placed in the furnace and therefore does not undergo casting thermal processes.

In this simple manner, thanks to laser welding, optimal functional and esthetic results can be achieved, respecting the morphology of the fitting surface, utilizing the same metal as that of the original abutment, and welding with high predictability.

CONCLUSIONS

1. The versatility afforded by laser welding in the application of dental prostheses makes this technique the method of choice for joining fragments of the same metal rapidly, cleanly, and precisely – thereby yielding high quality structural joining.
2. The flexibility of laser welding in modifying implant prosthetic abutments of implant-supported prostheses can be an optimal technique to increase the volume of metal, avoiding lower-quality procedures such as casting of burn-out abutments.

REFERENCES

1. Lautenschlager EP, Monaghan P. Titanium and titanium alloys as dental materials. Int Dent J 1993;43:245-253.
2. Santamaría J, Martínez-Conde R, Goiriena de Gandarias FJ. Materiales implantarios de uso más frecuente en el territorio oro-maxilo-facial. Rev Esp Estomatología 1989;37:101-104.
3. Kasemo B, Lausmaa J. Selección del metal y características de la superficie. En: Branemark PI, Zarb GA, Albrektsson T (eds). Prótesis tejido-integradas. La osteointegración en la odontología clínica. Berlin: Quintessenz, 1987:99-116.
4. Wang RR, Li Y. In vitro evaluation of biocompatibility of experimental titanium alloys for dental restorations. J Prosthet Dent 1998;80:495-500.
5. Parr RG, Gardner LK, Toth RW. Titanium: the mystery metal of implant dentistry. Dental material aspects. J Prosthet Dent 1985;54:410-414.
6. Iglesia MA, Moreno J. Obtención de ajuste clínico pasivo en prótesis sobre implantes. Rev Int Prótesis Estomatológica 2000; 2:290-297.
7. Iglesia MA, Moreno J. A method aiming at achieving passive fit in implant prostheses. Case report. Int J Prosthodont 2001;14:570-574.
8. Yamagishi T, Ito M, Fujimura Y. Mechanical properties of laser welds of titanium in dentistry by pulsed Nd-YAG laser apparatus. J Prosthet Dent 1993;70:264-273.
9. Gordon TE. Smith DL. Laser welding of prostheses-an initial report. J Prosthet Dent 1970;24:472-476.
10. Hasson JN, Grande V. Aplicación clínica de estructuras de titanio soldadas por láser sobre implantes dentales ITI. Quintessence técnica (ed.esp.) 1997;8:351-364.
11. Sjögren G. Laser welding of titanium in dentistry. Acta Odont Scand 1988;46:247-253.
12. Jemt T. In vivo load measurements of precision of fit involving implant-supported prostheses in the edentulous jaws. Int J Oral Maxillofac Implants 1996;11:151-158.
13. Wang RR, Welsch GE. Joining titanium materials with tungsten inert gas welding, laser welding, and infrared brazing. J Prosthet Dent 1995;74:521-530.
14. Monday JJ, Asgar K. Tensile strength comparison of presoldered and postsoldered joints. J Prosthet Dent 1986;55:23-27.
15. Berg E, Wagner WC, Davik G, Dootz ER. Mechanical properties of laser-welded cast and wrought titanium. J Prosthet Dent 1995;74:250-257.
16. Iglesia MA, Moreno J, Grimal E. Aportaciones de la soldadura láser en prótesis sobre implantes. Periodoncia 2002;12:283-290.
17. Iglesia MA. Versatility of laser welding for structural modifications of metal frameworks in implant prostheses. J Oral Laser Applications 2003;3:157-161.

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