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MONDANI INTRAORAL WELDING: HISTORICAL PROCESS AND MAIN PRACTICAL APPLICATIONS

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The intraoral welder was invented by Dr. Pierluigi Mondani during the early 70's to weld titanium needle implants to a titanium bar in patient's mouth and to load them immediately by means of resin prosthesis. The clinical use documented dates back to 1972. Over the years, many practical applications have been added to the initial one, which have expanded the use of this device. In this scientific work, main applications are described. The aim of the work was to trace the historical process of intra-oral welding according to Mondani and describe the main practical applications. Intra-oral welding is a process introduced by dr. Pier Luigi Mondani of Genova (Italy) which allows to firmly conjoin titanium implants of any shape by means of a titanium bar or also directly between them in the mouth during surgery. The immediate stabilization achieved by intraoral welding increases implants success rate, allows immediate loading even in situations of bone atrophy, saves implants that are running into failure, re-evaluates fractured implants, allows to stabilize submerged implants postponing prosthesis management, allows to achieve efficient rehabilitation protocols to deal with difficult cases. The 40-years' experience with intra-oral welding described in this article, confirms the ease of use and efficiency in providing immediate stabilization of titanium implants of all types.

The fact that immediate solidarization increases the success rate of immediately loaded implants is accepted in the international literature (1-3).

The first insights proven by clinical series, were described by Ugo Pasqualini in 1972. He published the following, describing his experience: "In our experience, even in light of quite a few puzzling exceptions, we can prudently recommend to block implants on each other or to other natural elements as early as possible, noting that immediate prosthesis (performed according to the rules of gnathology) helps to decrease the number of failures" (4).

The most important innovation in the field of implants solidarization occurred during the 70's, when Dr. Pier Luigi Mondani, a dentist of Genoa (Italy), presented his intraoral welder, created in collaboration with the University of Modena (Fig. 1). It was finally possible to firmly conjoin implants together in a single structure, without any play between the parts put in solidarization. Mondani brought his invention to the GISI congress, the main event in Italy, held in Bologna twice a year by Prof. Giordano Muratori. He published the technical description only later, in 1982 (5).

Mondani strove to create this device to put titanium needle implants into immediate contention, enabling the needle technique to become a repeatable technique and therefore, scientifically reliable (6-9).

Key words: intra-oral welding, titanium implants, retention, Mondani

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The needle implant solution is particularly suited to thin bone crests and the exploitation of very small recesses in the context of the alveolar process, utilizing the principle of bicorticalism. This proves particularly suitable to ridges containing rarefied cancellous bone (10-17).

Numerous colleagues soon began to think about how to apply this technique of intra-oral welding to other forms of implants. Several applications were identified.

MATERIALS AND METHODS

The welding procedure according to Mondani is performed immediately after the placement of the titanium implants.

The "intraoral welder" unit comes with an energy accumulator, a potentiometer and a clamp. This device emits a very intense electric charge, but for such a short period (4 sec) that with proper material, the heat released does not propagate over the areas adjacent to the point at which the gripper is applied. As a safety precaution, the welding should be carried out under continuous cooling with cold water.

A fundamental requirement is that the two pieces of titanium to be welded are in contact with each other and contact the spouts of the clamp, so that there is a fluid passage of energy. It is possible to weld two or more implants between themselves directly or by means of a titanium bar.

By welding the bar, a single structure is created, formed by implants and bar, without solution of continuity. This produces a single body, known as implant structure. The solidarization can also be achieved by means of several titanium wires.

To try to reduce the internal volume of the bar to a minimum, you can mold it before performing the welding, in order to ensure that it overhangs the ridge occlusal surface (Fig. 2).

In general, the intraoral welder can be used to join any titanium implant type. Specifically, we list below its most common uses, dividing them in two categories: main and additional.

Main uses

1. Join endosseous implants during intervention
2. Join new implants to already osseointegrated implants
3. Stabilize other implants

Additional uses

4. Connect already osseointegrated implants
5. Join endosseous and iuxtaosseous implants
6. Join teeth and implants with appropriate connectors
7. Rebuild abutments of inadequate length
8. Rebuild fractured implants
9. Connect new implants to fractured implants
10. Join implants between the submucosa

1. Join endosseous implants during intervention

This is the main use of intra-oral welding proceedings. The immediate solidarization of the implants positively affects their stability, promoting bony inclusion without interposed connective tissue. Immediate loading of the implant structure causes bone apposition that follows trajectories lead by force.

Immediate solidarization by welding can be made between two or more implants, to allow immediate load and to protect implants from the expansive action of the tongue during swallowing (18, 19). A surgical protocol for the superior arch was published in 2005 and 2015, with exhaustive indications about prosthesis management (20, 21). In Fig. 3, you can see a full-arch inferior jaw implant structure with prosthesis including the bar. Recent studies have demonstrated that the presence of the bar does not create inflammatory problems (22, 23).

One of the advantages of this method of solidarization is that emerging and submerged implants of different shape can be welded together, allowing to freely choose the suitable implant. This aspect frees the dentist from a single implant factory, facilitating treatment of difficult cases in which a single type of implant does not fit anatomical ridge variations.

Normally, when the plan is to maintain the welded bar also in the final phase, one-piece implants are used. When the plan is to eliminate the welded bar before building the final prosthesis, you can either use one-piece implant planning to mill them as if they were natural teeth, or use submerged implants to postpone and manage the prosthetic stages at will.

In general, the choice of keeping the bar depends on the difficulty of the clinical case. The bar gives strength to the structure not only when there is poor bone depth,

but also when the implants are inserted in a tilting manner so as not to damage deep anatomical structures, such as the mental foramen. A study on the rules of keeping or eliminating the bar has been recently published (24). The presence of welded bar allows you to mitigate the effect of negative factors, extending the possibility of treatment even in difficult cases (25).

The welding of a titanium bar can be used to join implants at the end of surgery, which is then removed before performing the definitive prosthesis.

After osseointegration is reached under load, the bar is removed. The subsequent prosthetic steps are facilitated by the fact that soft tissues are already healed and stabilized around the circumference of the stumps (Fig. 4) (26).

Connecting submerged implants by intra-oral welding is described in literature since 1998 (27-29).

2. Connect new endosseous implants to already osseointegrated endosseous implants

This type of management of the clinical case can be programmed in the therapeutic plan [Auriga technique, (30)] or may arise from the fact that included implants placed years before are already exploited.

3. Stabilize other implants to prevent or correct stability problems

In situations where, due to the need for immediate loading and scarceness of bone offered by the "receptor" site, the inserted implant does not guarantee stability *per se*. A needle implant can be soldered to the main implant to provide immediate stability, making this implant structure suitable to immediate loading (Fig. 4) (31). In particular cases, the welding is also used to solder an implant to an adjacent tooth (32).

RESULTS

The analysis of the statistical studies performed by our research group lead us to suggest the use of intraoral welding as a standard aid when you want to load implants immediately. The choice of whether to keep it in the final prosthesis or remove it before completing it depends on the evaluation of the biomechanical requirements of the implant structure in the context in which it is inserted. Some rehabilitation protocols long tested by our research group have given very encouraging statistical results. In particular, as noted above, a study of 193 screw and blade implants used in cases of higher atrophy with Auriga technique gave results of complete success (30) and a study of 351 thin cylindrical titanium implants inserted in the posterior atrophic mandible gave results of 99% at 5 years and 95.8% at 10 years (8). It must be underlined that the correct use of the intra-oral welding implies an adequate learning curve.

DISCUSSION

The solidarization of the implants is a solution whose effectiveness is now universally accepted by the world literature (1-3). In Italy and in Latin

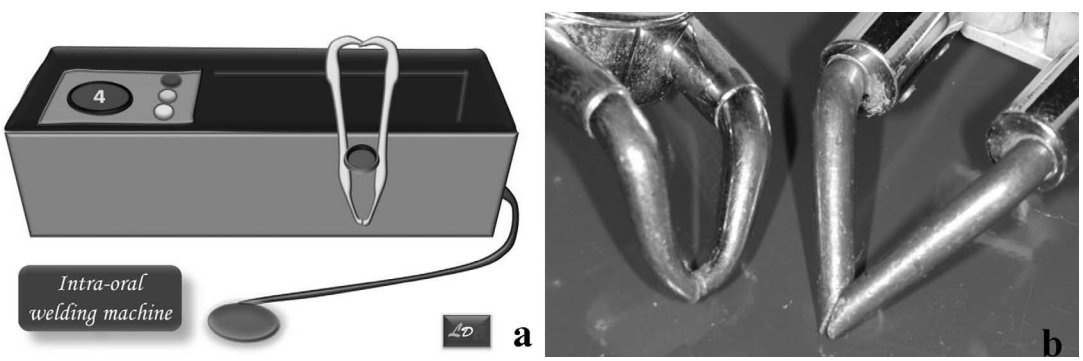

Fig. 1. ***a****): drawing of the intra-oral welding machine;* ***b****); different types of clamps fit to different situations. Flat edges are suitable to buccal-palatal welding, chamfer edges to mesio-distal welding between teeth.*

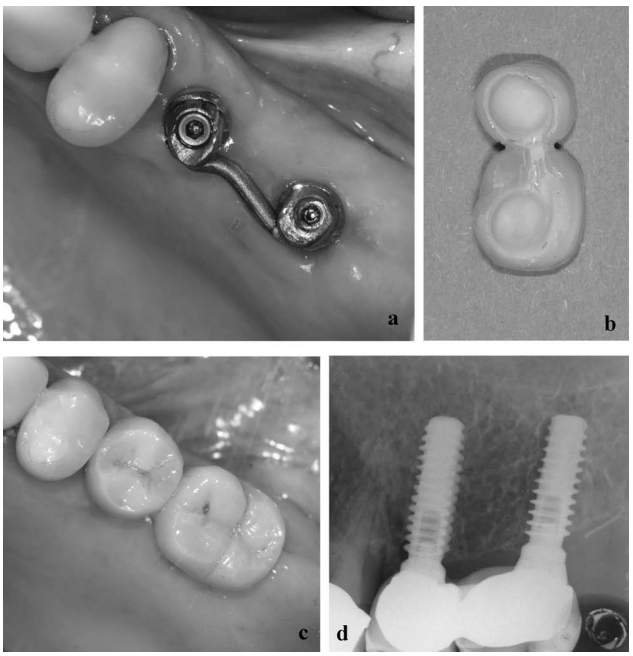

Fig. 2. ***a)****: a titanium bar has been curved and then welded to the abutments of two titanium screw implants;* ***b)****: the zirconia fix prosthesis including the bar;* ***c)****: due to bar shaping, no volume augmentation has been necessary;* ***d)****: X-ray. The bar is inside the prosthesis.*

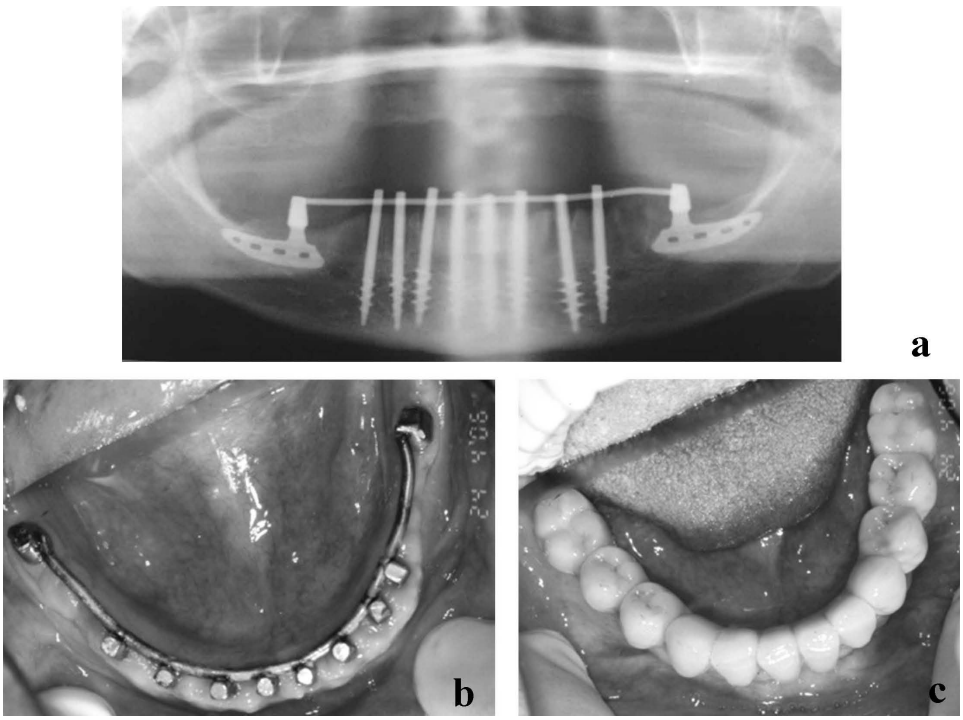

Fig. 3. ***a)****: panoramic X-ray taken at end of intervention in which 10 one-piece implants were intraorally welded after insertion in the inferior jaw. Immediate load by means of provisional prosthesis was applied immediately after;* ***b)****: view of the gums after healing;* ***c)****: final prosthesis.*

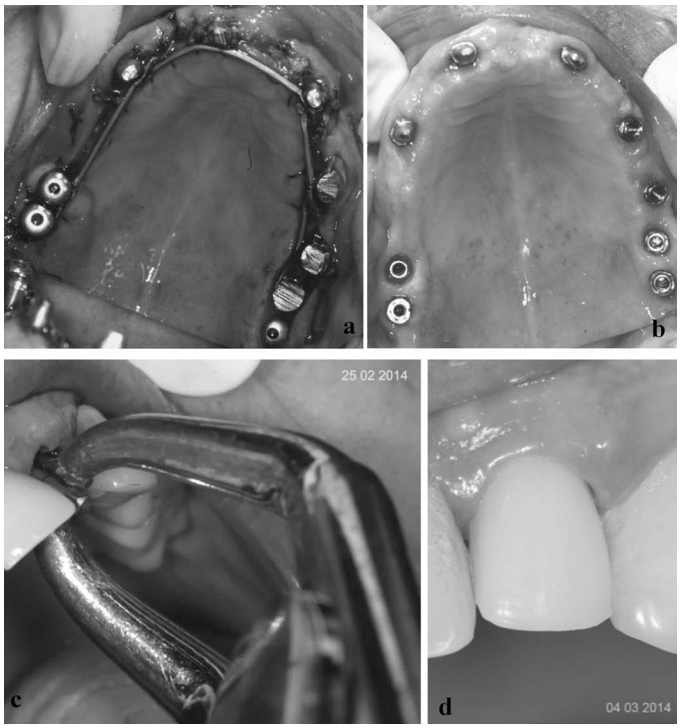

Fig. 4. ***a)****: upper atrophic arch treated with 9 implants of different shapes (3 one-piece blades in the area in which ridge was thin and 6 submerged screws) joined together with welded bar and immediately loaded;* ***b)****: after 4 months, provisional prosthesis was removed, bar was cut and implants were ready for impressions;* ***c)****: intra-oral welding of screw and needle inserted in 2.2.socket immediately after extraction;* ***d)****: clinical view one week after intervention.*

American countries, it has been continuously used since the 70's. It is the quickest and safest way to join the implants between them. To get CE recognition, welders today must pass a series of safety tests. This device allows welding with any titanium implant of any shape or brand. We leave readers to imagine the resistance there is in the industry and in its "opinion-leaders", engaged in the promotion of complex and expensive screwed solidarization methods.

Even with submerged implants, welding is a much more simple and efficient procedure, and has documented the support of over 20 years of clinical experience. The welding of emerging and submerged implants for immediate loading follows coded rules where possibility of failure is minimum.

The intraoral welder is a simple and versatile device to use, allowing you to improve and simplify the procedure of solidarization of titanium implants. Its applications are numerous. This makes it a safe investment in the dental profession, changing for the better the quality of work.

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