Mini-invasive rehabilitation with removable total prosthesis with mixed conometric connection on 1.4-1.5-2.2 (2.9 mm) implant abutments and 1.6-2.3-2.4 dental abutments: a two-year follow-up

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Nowadays, the best possible approach in respect to the patient is that tailored on the "person", intended as the result of the balance between the patient's requirements and expectations, the latter being influenced by contemporary society's over-information without a proper preparation. It is therefore possible to obtain an efficient and effective treatment by recovering the doctor-patient relationship, which is fundamental to guarantee the respect of the therapist's pragmatic and common-sense guidance whilst satisfying the patient's needs. The reported case serves as an example of this choice, combining the psychological support with a valuable minimally invasive surgical implant-prosthetic rehabilitation.

In our contemporary society, the dental professional needs to balance the best possible approach for the specific patient with his/her requirements and expectations, the latter being influenced by different socio-cultural and economic factors. Among these elements, the symptom of pain is particularly relevant, conceptualised in the dual paradigm "pain-avoidance *versus* reward-seeking" (1): if pain, or the expectation of it, comes between an individual and reaching a goal, the number of people who put their achievement above pain is lower than those who delay or completely abandon that achievement, proportionally to the expected or felt pain intensity and the determination in reaching the goal itself.

Nowadays, this model needs to be correlated to how the sociological concept of physical and psychological pain has changed, in accordance with Illich's view in 1976. Traditionally, pain was interpreted as an essential component of existence, being part of both life and death; in the 21st century, with the development of the cosmopolitan culture, the above-mentioned element has progressively disappeared. Indeed, pain is now identified as the failure of the modern socio-economic system, implying its alienation from social existence, as well as from the individual daily life, and thus legitimating the avoidance of pain in all its forms as a social goal (2-5), rather than an individual choice. Consequently, the new millennium has brought a wide offer of ancillary drug therapies in the medical and dental sector, based on the large demand from patients, also paediatric (6); however, these treatments have not been accompanied by an equal offer of adjuvant psychological therapies, thus allowing the patient to avoid pain, rather than dealing with it.

Key words: minimally invasive; 2.9mm implant; conometry

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The combination of the above-described aspects with the recent economic and ethno-demographic changes, which have determined a general impoverishment of the population (7), drives the patient to prefer minimally invasive, quick, and less painful procedures, which are more respectful of the patient's approach to the pain (8).

Corroborating the above-mentioned elements, which are all part of the same extremely complex and heterogeneous social framework, the identification of a common goal between the clinician and the patient is fundamental and crucial for the success of the treatment in the dentist's daily practice. This shared objective allows to reach the right balance between the treatment's invasiveness, its suitability in respect to the clinical circumstance, and the emotional-economic impact the patient is willing to handle (9-12).

In this perspective, the reported case reprises the need for an implant-prosthetic rehabilitation that is in line with the patient's scarce propensity to undergo invasive and/or lengthy procedures, nonetheless guaranteeing the appropriate clinical value (13-17) of the cutting-edge treatment (18), which is supported by the scientific community (19-24).

The case takes into consideration the treatment of a male adult patient (48 years old) with a negative medical history, but with a limited propensity towards dental treatments due to previous regrettable experiences. The said patient consequently required a minimally invasive approach that avoided any kind of exodontic surgery, thus preserving the existing dental elements and strictly precluding any form of bone regenerative surgery, expansive or appositive, vertical or horizontal.

Following the oral cavity physical examination, studying the case by analysing the gypso and radiographic documentation – the latter including maxillary computed tomography – permitted to develop a minimally invasive planning. This procedure was obtained by implementing cutting-edge technologies (11), techniques (13-17) and materials (25) and has been validated by the scientific community (19-22), linked to a pragmatic clinical "common-sense". The patient's oral cavity rehabilitation therefore consisted in maintaining the dental stumps in positions 1.6-2.3-2.4 and inserting the implants - with the related differed implant stumps - in positions 1.5-1.4-2.2, to support a removable full denture, anchored to the aforementioned elements through conometric attachments (26). Occlusal elevations on dental elements 4.5-4.4-3.4-3.5 were necessarily combined with the outlined therapeutic project to rebalance the curve of Spee (27). Moreover, upon the patient's request, it was agreed to preserve the dental element 4.8 and the implant element 1.2 after conservative treatment; however, the patient was informed concerning the uselessness of element 4.8 in terms of chewing. Regarding this, the final mesial odontoplasty of element 4.8 is expected, as well as the impossibility to use element 1.2 for prosthetic purpose, due to the fracture of a portion of the implant margin that makes any load unbearable.

MATERIALS AND METHODS

The preparation of the patient's case consisted in taking initial pictures, realising study models, conducting a preliminary radiographic analysis of the bone availability, to measure the implant length and diameter in advance, and carrying out preliminary occlusal analysis, to obtain a pre-surgical guide indicating the prosthetic ideal inclination (Figs. 1, 2, 3).

Firstly, a professional oral hygiene session and dental element 2.3 conservative restoration in composite resin – exploiting the existing pivot - were performed. Then, the said element was subjected to the sub-gingival preparation with feather edge margin and covered with a conometric primary prosthetic work made in Chromium-Cobalt alloy. Furthermore, the pre-existing conometric primary prosthetic works on dental elements 1.6-2.4 were polished. Thereafter, the pre-existing mobile prosthesis was set up as a provisional prosthesis, temporarily anchored to the solely "ball attachment" on the previous implant 1.2. This procedure was feasible upon condition of stabilising the mentioned on-site attachment with cyanoacrylate, with the aim of impeding its rotation, which would otherwise cause the disinsertion from the implant due to fracture in the mesial margin of the peri-implant collar initially encountered.

Secondly, after a few weeks, the first surgery phase was initiated by preparing the patient through an ancillary psychological pre-surgical treatment in the hour

beforehand to help him deal with the procedure, and a supportive drug treatment through the administration of 20 drops of Diazepam just before the surgery. The patient was then seated and prepared in accordance with the traditional health and hygiene norms to guarantee the maximum sterility.

Initially, perioral skin disinfection (povidone iodine 10%) was performed combined with Vaseline to moisten the tissues. The gingival surface was then treated with a topical anaesthetic (Lidocaine + cetrimonium bromide 15%) and, afterwards, the peripheral anaesthesia was inoculated at the vestibular fornix micro-circulation and the palatal levels

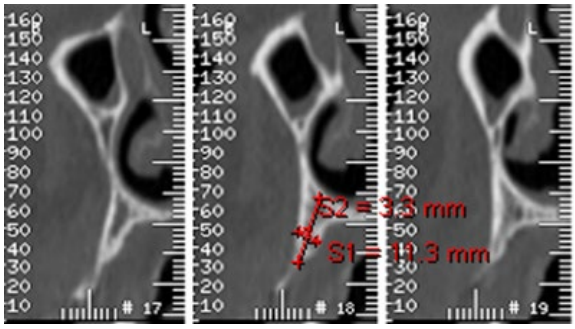

Fig. 1. *Implant-prosthetic project by cone beam computer tomography*

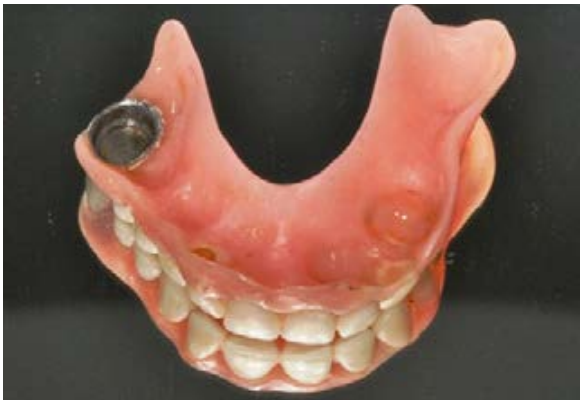

Fig. 2. *Previous removable prothesis*

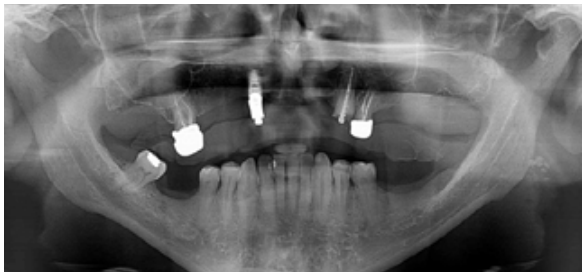

Fig. 3. *Pre-implant surgery orthopantomography*

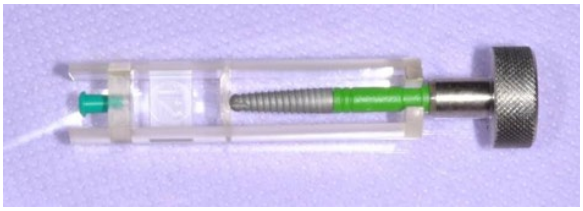

Fig. 4. *Implant 2.9mm diameter*

(Articaine 4% + adrenaline 1/200,000). Following these steps, an oblique incision with tissue decollement was made at the vestibular para-crestal level, with a mid-thick incision at vestibular level and a full-thick incision at the palatal level (scalpel # 12C). The total bone exposition allowed to carry out the explorative milling at 5 mm with a lanceolate cutter (1.9 mm diameter) at the sites 2.2, 1.4 and 1.5, following the presurgical guide dictates. After checking the bone density (D3 Misch classification) (28), the first milling at 5 mm was performed (2.2 mm diameter) by using an implant probe, always keeping the pre-surgical guide, which was then removed to complete the milling by following the obtained inclination up to 13 mm.

A second milling for 3 mm (2.8mm diameter) was subsequently performed, to avoid an excessive bone pressure during the insertion of the implant element. Three implants were inserted (Titanium 5 HRS surface) with a diameter of 2.9 mm and length of 12 mm up to 2 mm under the bony crest, to favour the prosthetic aesthetics (25). After inserting the screw tap on each implant element, a check-up orthopantomography was carried out to verify the quality of the procedure (Figs. 4, 5). The site was then accurately sutured by executing a closing flap through single intra-papillary stitches in positions 1.6-2.3 and a crossed horizontal mattress suture between the vestibular and palatal portions. The suture in vestibular para-crestal position obtained from the initial incision is therefore exploited, such that, due to the lateral position of the incision - thus the suture - in respect to the insertion site (glycolic/lactic acid absorbable suture), a decreased risk of implant stump infection is expected. Finally, the temporary total prosthesis was rebased with a soft silicon, to allow the smallest load possible on the surgical site.

The patient was then discharged, after being provided with bactericidal and anti-inflammatory antibiotic pharmacological indications (amoxicillin with clavulanic acid 1 g every 8 hours for 6 days, and paracetamol with

codeine 500mg + 30mg when needed), combined with post-surgery indications. A thorough hygiene and a soft diet for the first month were also recommended to the patient. After two weeks, the suture was removed, and the patient had to undergo monthly radiographic checks with hygiene for three months.

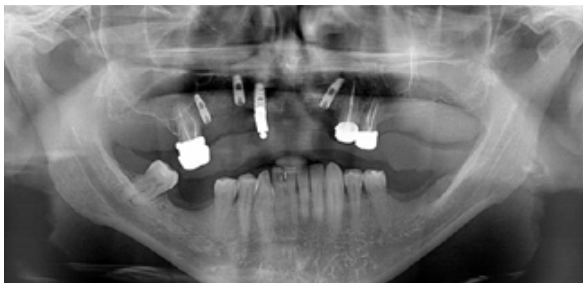

Fig. 5. *Post-implant surgery orthopantomography*

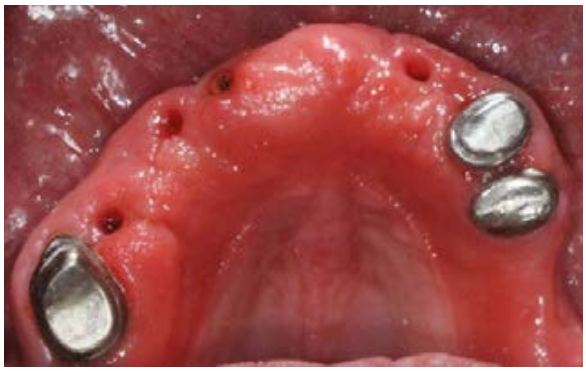

Fig. 6. *Mucosa during implant activation*

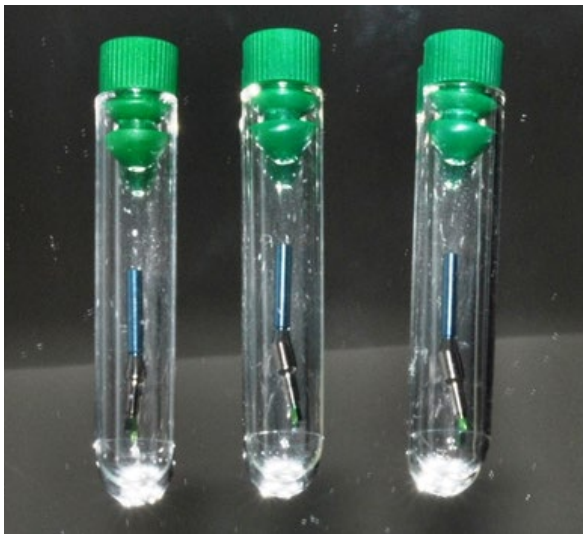

Fig. 7. *Intermediate supports for screwing the conometric primary stumps.*

Three months after surgery, the final radiographic control was performed to assess the full osseointegration of the implant elements. The positive outcome of this check-up authorised to proceed with the second surgical phase of re-opening, with the aim of initiating the prosthetic rehabilitation. The patient was then prepared once more with an ancillary psychological pre-surgical therapy and a drug treatment, identical to that described previously. The patient was seated and prepared in accordance with the traditional health and hygiene norms to guarantee the maximum sterility, as already reported.

Initially, the perioral skin disinfection (povidone iodine 10%) was performed, combined with Vaseline to moisten the tissues. The gingival surface was then treated with a topical anaesthetic (Lidocaine + cetrimonium bromide 15%) and, afterwards, the peripheral anaesthesia was inoculated at the vestibular fornix micro-circulation and the palatal levels (Articaine 4% + adrenaline 1/200,000). Following these steps, an oblique incision with tissue decollement was executed at the vestibular para-crestal level, with a mid-thick incision at vestibular level and a full-thick incision at palatal level (scalpel # 12C). The total bone exposure allowed the immediate display of the implant elements' peri-implant collar in positions 2.2, 1.4 and 1.5.

The implemented approach consisted in immediately utilising the intermediate supports for screwing the conometric stumps, thus avoiding the usage of healing screws. On site 1.5, a support with a 7.5° angle and 5 mm in length was employed, on site 1.4, a 5 mm length support with a 15° angle and on-site 2.2, a 7 mm length straight support. Finally, primary conometrics were tightened in all sites, with a 3.3 mm diameter, a 4.3 mm height and a 5°angle. Following an additional orthopantomography check-up to verify the correct insertion with of the conometric stumps' intermediate supports in the implant elements, the site was accurately sutured (Figs. 6, 7, 8, 9). As in the previous intervention, the suture consisted in executing a closing flap through single intra-papillary stitches in positions 1.6-2.3 and a crossed horizontal mattress suture between the vestibular and palatal portions. The suture in palatal para-crestal position obtained from the initial incision was therefore exploited, expecting an increase in the thickness of the vestibular attached gingiva and a concurrent soft tissue guide towards a recovery suitable for the conometric stumps' intermediate supports (glycolic/lactic acid absorbable suture). Finally,

the temporary total prosthesis was rearranged to allow its permanent usage while keeping the already mentioned supports and the related stumps.

The patient was discharged, after being provided with bacteriostatic and anti-inflammatory antibiotic pharmacological indications (azithromycin 500 mg every 24 hours for three days, and paracetamol with codeine 500mg + 30mg when needed), combined with post-surgery indications. After two weeks, the suture was removed to proceed with the development of the permanent mobile total prosthesis. A first polysulfide precision impression was performed in relation to pictures of the patient's face and smile, starting from the previously-made individual spoon. By placing wax rims on the temporary flange, it was possible to identify the vertical dimension, assure the correct occlusion "key" through a precise mastication on auxiliary dedicated wax and point out the interdental midline related to the nose tip and the chin (Figs. 10, 11). Finally, the teeth trial - anterior aesthetic first, posterior functional after - was conducted, accompanied with the concurrent development of composite resin occlusal elevations on dental elements 3.4-3.5-4.4-4.5 to balance the mastication and improve the patient's curve of Spee (27). During the same session, the phonetic trial was also carried out, combined with an additional aesthetic evaluation by a relative.

The final step consisted in incorporating three secondary conometric crowns of alloy (Chromium-Cobalt)

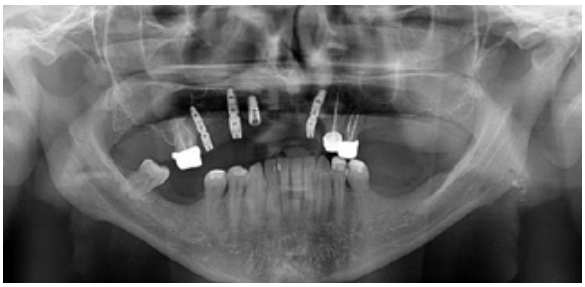

Fig. 8. *Orthopantomography after intermediate supports for screwing the conometric primary stump insertions*

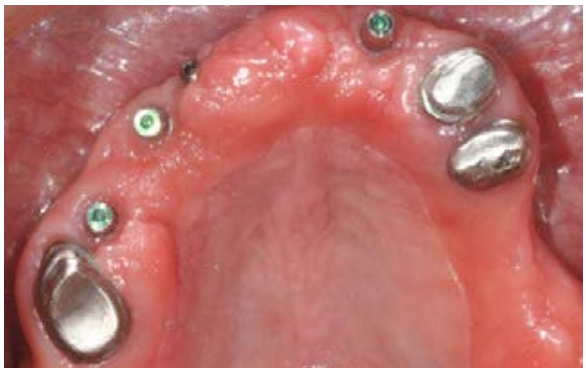

Fig. 9. *The conometric primary stumps*

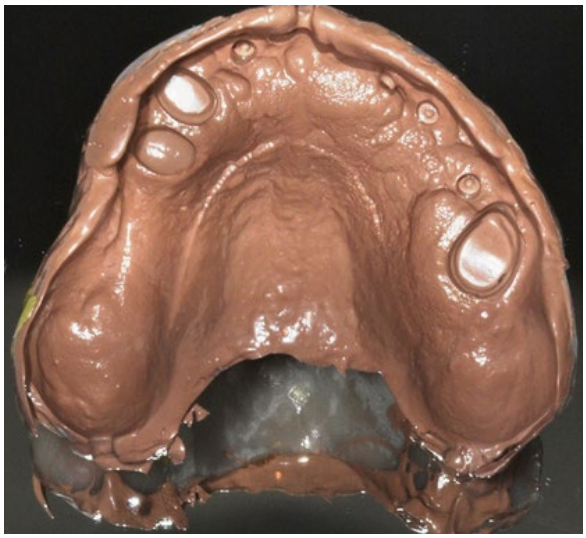

Fig. 10. *Accurate impression in order to achieve removable prothesis*

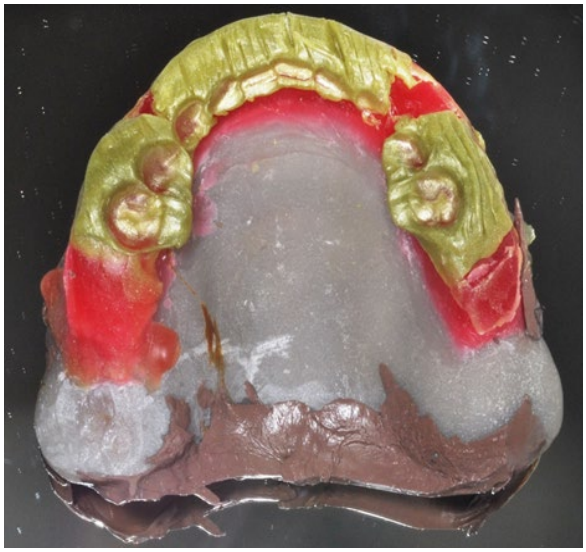

Fig. 11. *Structure - vertical dimension - chewing test*

Fig. 12. *Peek® secondary conometric crowns*

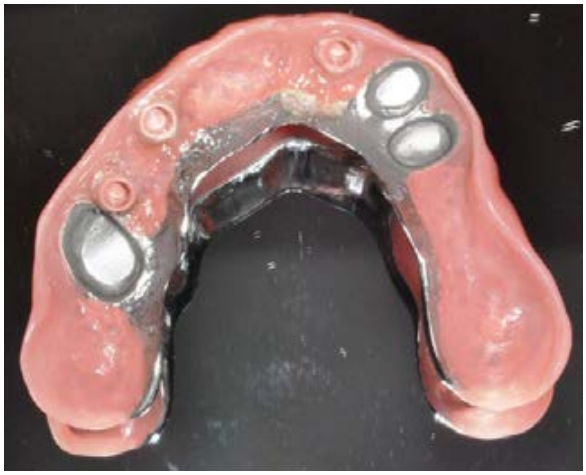

Fig. 13. *Peek® secondary conometric crown insertion*

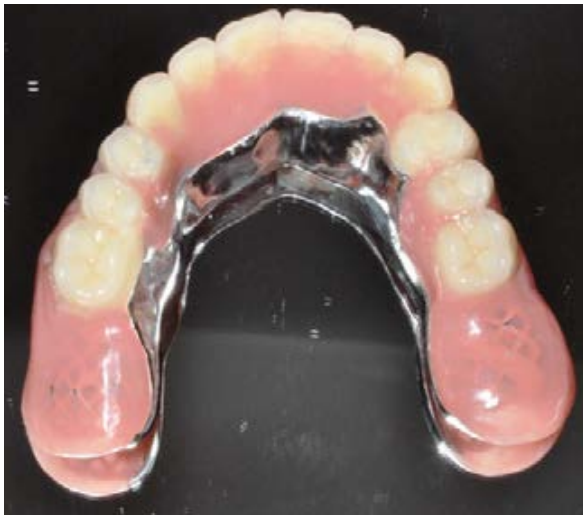

Fig. 14. *Removable prothesis*

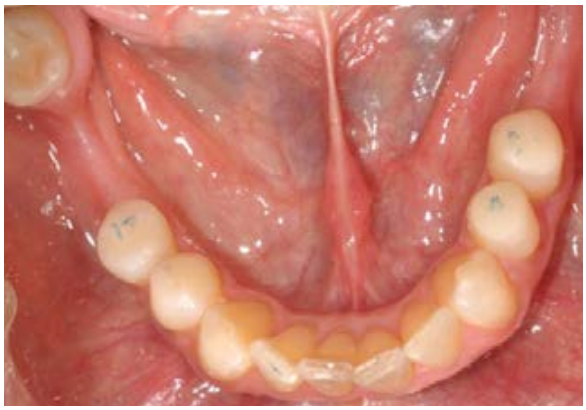

Fig. 15. *Occlusal rises in lower jaw*

to the prosthesis, which had been calibrated on the three primary conometric crowns on elements 1.6-2.3-2.4 and consolidated to a supporting base of alloy (Chromium-Cobalt). Moreover, three secondary conometric crowns of PEEK were inserted into the prosthesis through resinous rebasing (polymethylmethacrylate), calibrated on the primary conometric stumps of implant elements 1.5-1.4-2.2 (Figs. 12, 13, 14). In addition to this, the mesial-occlusal odontoplasty of dental element 4.8 was executed, to avoid its interference with achieved chewing balance (Fig. 15).

RESULTS

After a month from the procedure, the first clinical monitoring took place, focusing on the stability of implants, intermediate prosthetic components, and gingival and tissue structure. Then, after the first post-delivery quarter, a second clinical and radiographic test to analyse the stability of the above-mentioned elements was performed, together with professional hygiene. In both observations, the implants, prosthetic components, and gingival and tissue structure stability proved to be optimal; furthermore, the second test showed radiographic evidence of a full osseointegration. Following another 3-month period, a new professional hygiene was carried out, together with the collection of additional photographic documentation (Fig. 16).

During the first year, professional hygiene was performed every 3 months, thus guaranteeing a gingival maintenance treatment of extra-implant mucous canals and making the patient aware of the importance of these regimens to maintain an optimal prosthetic rehabilitation.

The annual clinical and radiographic control of implant, intermediate prosthetic components, and gingival and tissue stability showed both clinical and radiographic positive results, observing only one mucositis episode affecting the implant at site 1.2, which was unexploited due to fractures. This inflammation was resolved with a laser-assisted supportive peri-implant treatment (laser diode – 810nm wavelength). At the end of the treatment, the patient received instructions to undergo professional hygiene every four months, to favour the durability of the realised implant-prosthetic rehabilitation.

After two years, a clinical and radiographic control of stability was performed and showed positive results (Fig. 17).

DISCUSSION

The urge to identify a treatment that encounters the patient's clinical requirements and needs is essential nowadays in the dental profession. In the reported case, the patient requested a procedure to restore the functionality, as well as the morphology, of the stomatognathic system, although refusing a classical implant approach, which would have implied changes to the available bone thicknesses (29-31). The patient had also turned down the possibility to perform the exodontics of the elements in position 1.2 (implant) and 4.8 (dental) inside the oral cavity, hence complicating even more the rehabilitative procedure. In the perspective of achieving a common goal, the patient finally accepted to undergo a removable prosthetic rehabilitation, assisted by the clinician's decision-making flexibility. In particular, the rehabilitation would be supported, through conometric connection, by last-generation dental implants, which have demonstrated to handle the masticatory forces generated in the oral cavity (26) despite the limited diameter.

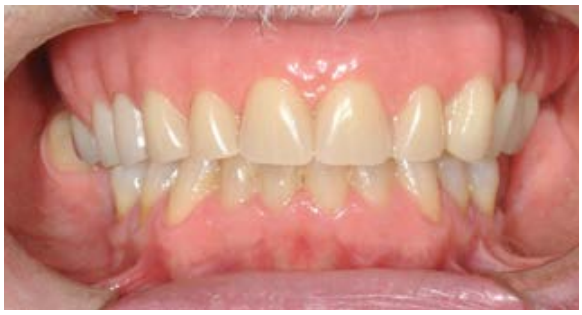

Fig. 16. *Smile*

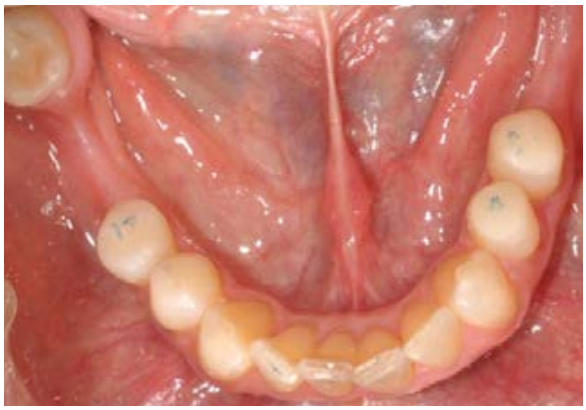

Fig. 17. *Two-year follow-up orthopantomography*

In the last decade, the scientific community already approved removable prosthetic rehabilitations supported by dental implant through conometric connection (12-14). However, the reported case describes a procedure that, exploiting the original bone availability without additional changes, employs minimum-diameter dental implants (2.9 mm). These implants were inserted at sites 2.2, 1.4 and 1.5 and linked to the residual dental stumps on sites 1.6, 2.3 and 2.4 by means of a prosthetic device, developed in total conometric removable coupling on a mixed dental-implant support (26).

As a completion to the rehabilitative project, it was also decided to rebalance the masticatory plane, by applying composite occlusal suspensions on the antagonist dental elements in positions 4.5, 4.4, 3.4 and 3.5. This procedure guarantees more stability to the entire stomatognathic system (27) and thus more durability to the applied implant-prosthetic rehabilitation. The medical hazard of exploiting implants with a 2.9 mm minimum diameter was then rebalanced by the concurrent secure additional support on the residual dental stumps, allowing an equal distribution of the masticatory load.

Finally, there are two observations to be made. Firstly, the removable prosthesis anchored on dental and implant stumps allows to overcome the potential long-term stability issues, which are caused by the different mobility of the afore-mentioned elements (dental 150 μm - implant around 0 μm) (13). In case of a cemented or screwed fixed bridge prosthesis, this kind of problems would have been more probable (13, 29, 32-37). Secondly, the conometric connection permitted to grant a reinforced implant-dental mixed anchoring system (38-42) and a proper distribution of the masticatory forces perpendicular to the stumps. Moreover, the tangential forces to the stumps, (43-45) which are generated by the daily removal, were reduced to minimum, due to the strict disconnection mode, almost perpendicular to

the stumps, that is almost impossible to obtain with simpler ball connection systems.

In this scenario, the chosen therapeutical plan permitted not only to achieve optimal clinical results in a patient who would otherwise reject any kind of treatment, but also to obtain additional benefits (46). Firstly, the application of a removable device enables a better domestic cleansing of the stumps, reducing the rate of the medium-long-term failures in patients with a scarce oral hygiene and easing the device readaptation in case of compromised stability of dental pillars over time. Secondly, the operating invasiveness reduction, together with the patient acknowledging the orthodontist as a person who understands their fears and demonstrates medical flexibility, leads to a reduction of anticipatory anxiety in the subject. Consequently, it was possible to apply an anxiolytic psychological and pharmacological approach, which otherwise would have probably shifted towards a higher level of unconsciousness, reaching the state of sedation.

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