

Oral Rehabilitation with Implant-Supported Overdenture and a New Protocol for Bar Passivation

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Abstract: Every prosthetic rehabilitation aims to restore the stomatognathic apparatus and to achieve a satisfactory aesthetic, harmonized with the patient's face and able to support lips and cheeks after the loss of teeth and alveolar bone. In this situation, the choice of the type of prosthesis (fixed or removable) and its creation acquire great importance. In this case a 56 years old patient suffering from aggressive periodontitis was treated by placing 3 implants into the upper jaw to support an overdenture and 4 implants into the lower jaw to support a fixed titanium-composite prosthesis. The upper bar was passivated using the Elastic Seeger system with its acetabular rings, which are able to compensate the blank space between the bar and the Equator abutments creating, thereby, a monoblock with warranty of absolute passivation. The protocol followed in the present study with the use of low-profile attachments in OT Equator and the Elastic Seeger system simplified the procedures of dental clinics and reduced the working time. The study also underlined the importance of musculoskeletal analysis when the right prosthetic rehabilitation had to be chosen.

Keywords: Aesthetic, Overdenture, Lip support, Bar retention, Elastic Seeger, Face analysis.

1. INTRODUCTION

Complete dentures are not sufficient for reestablishing the oral function either in relation to chewing efficiency or bite force [1]. In case of extreme bone resorption, with an appropriate impression technique, adequate prosthesis stability may be achieved, but rarely sufficient retention [2]. Implants could be used to restore lost or missing teeth and anchor dentures improving stability and retention [3]. This fact has greatly expanded the range of treatments allowing a better oral function, patient satisfaction, comfort and psychological benefits in comparison of conventional dentures [4-6]. Prosthetic rehabilitation aims to restore the stomatognathic system creating a satisfactory aesthetic harmonized with the patient's face, in order to support the lips and cheeks after the loss of teeth and alveolar bone. [7-9]. In this situation the choice of the type of prosthesis (fixed or removable) and its realization acquire a great importance [10,11]. The support of perioral tissues, the mobility of the lips and the smile line are important parameters that influence the type of prosthesis that should be chosen for the patient. In particular, the relationship between the emergence profile of the teeth and the volume of the hard and soft tissues, that need to be replaced with the prosthetic body, becomes very important in the choice of the treatment plan to be followed [7]. This is why a general patient analysis, which is not only limited in intra-oral considerations, but also which consider extra-oral

aspect (frontal and lateral photos), the smile line, the perioral tissues, the musculoskeletal features, the phonation and the hygiene habits must be done. In case of severe alveolar ridge and soft tissues resorption, removable implant-supported prosthesis is the best choice because the lost volumes can be compensated and perioral tissues supported by the prosthetic flange. Moreover, oral hygiene is simplified and the patient feels the implant-supported overdenture like a fixed rehabilitation thanks to its great stability [12]. The present study showed the clinical situation of a 56 years old patient who came to our attention with pain, mobility of teeth and poor aesthetics caused by a chronic periodontitis. The therapeutic goal was to rehabilitate the patient with an implant-supported overdenture in the upper jaw and a screwed implant-supported prosthesis in the lower jaw.

2. CLINICAL CASE

A 56 years old patient came to our attention in September 2014 at the private office of the Author with pain and mobility of all upper and lower teeth. The extra-oral examination showed a convex face with prominent nose, and mesocephalic characteristics. Perioral tissues were little turgid and poorly supported by the upper teeth. The nasolabial angle was about of 90° and the nasolabial folds were evident (Figure 1).

An assessment was made of the periodontal health status of the patient. The intraoral examination showed poor hygiene and the presence of dental elements with marked mobility (horizontal and vertical) and periodontal disease. Periodontal examinations showed diffused

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bleeding and a severe bone loss, especially in the second quadrant. The upper teeth on the right side showed pockets deeper than 6 millimetres in interproximal area with bleeding during probing and a mobility of grade II (horizontal). The upper teeth on the left side



Figure 1: An extraoral examination of the patient showed convex face and mesocephalic characteristics.

showed pockets of about 10 millimetres all around every tooth with bleeding during probing and a mobility of grade III (horizontal and vertical). Lower teeth showed mobility of grade II (horizontal) in particular for central incisors with pockets of deeper than 5 mm. The smoking habits and tooth brushing were recorded. The patient was a heavy smokers poor hygiene. The patient wore two removable prosthesis, which became incongruous and caused pain during chewing. The x-ray examination with orthopantomography confirmed the presence of a severe bone loss with a generalized periodontitis and bone loss of the buccal plane in the 22, 23 and 24 areas. The pneumatization of the sinuses was severe and the height of the alveolar ridge in the area of the upper molars was only 2 mm (Figure 2).

The patient had the desire to replace the teeth with two fixed prostheses and asked to minimize the number of surgical steps being very fearful. Several possible treatment plans were evaluated. A fixed prosthesis in the lower jaw and an upper implant-supported overdenture were identified as the best solution for the rehabilitation of the present clinical case. Two impressions with an irreversible hydrocolloid were taken in order to realize two provisional prosthesis. The lower teeth were extracted and four tapered implants were

placed (Classic, Cortex Implant, Israel) of 4.2 mm in diameter and 13 mm in length in the 32, 42, 35, 45 areas.

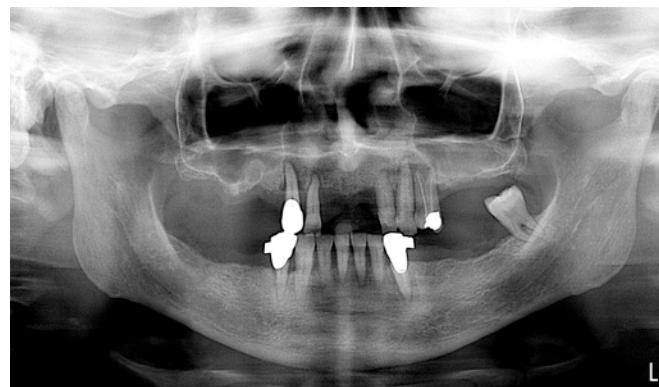


Figure 2: Orthopantomography that confirms the presence of important periodontal defects with generalized bone loss and a radio-translucence of 22, 23 and 24, indicating the bone loss of the buccal plane and pneumatization of the sinuses.

In the upper jaw all the teeth were extracted as atraumatic as possible and three tapered implants were placed (Dynamix, Cortex Implant, Israel) two of them with 4.2 diameter and 13 mm in length in 12 and 22 areas, and one with diameter 4.2 and 8 mm in length in 14 area (Figure 3).



Figure 3: Post-operative orthopantomography that showed implants placement in the upper and lower jaw.

Both lower and upper implants were placed with a torque that exceeds 50 N/cm. It was not possible to place implants in the 24 area because of the bone loss of buccal plane due to periodontal disease. The patient refused any bone regeneration surgery or sinus lifting; consequently it was not possible to place the fourth implant in the upper jaw.

In the upper jaw two low profile attachments were placed (OT Equator, Rhein 83, Bologna, Italy) on implants 12 and 22 areas, while the implant in 14 area was left submerged in order to obtain a good osseointegration.

A totally removable superior prosthesis was provided to the patient and was anchored to the two OT Equator attachments using the green gummy caps that are designed to be used in immediate loading protocols thanks to their shock absorber function. In this way, they were able to reduce the chewing forces without overloading the implants and, at the same time, to provide a better prosthetic retention (Figure 4).



Figure 4: Placement of the green gummy caps on the OT Equator attachments.

After 3 months a polyether impression of the lower jaw was taken to record the new soft tissues situation and a new titanium-composite fixed prosthesis was delivered (Figure 5).



Figure 5: Construction of the lower definitive screwed prosthesis in titanium and composite.

Four months after the surgical procedure the implant in 14 area was uncovered and, using a cuff height measurer (Rhein 83, Bologna, Italy), another OT Equator low profile attachment was chosen and mounted immediately. In this way it was used to increase the retention of the upper provisional prosthesis, with a further improvement of the patient comfort (Figure 6).



Figure 6: Implant uncovering in the 14 area and insertion of the OT Equator attachment used to improve the stability and retention of the provisional prosthesis.

Impression copings were placed on the OT Equator attachments and a polyether impression using a customized tray properly functionalized with thermoplastic paste (Isofunctional GC, Japan) was taken (Figure 7).



Figure 7: Insertion of the impression copings on the OT Equator attachments to take an impression using a polyether.

In the laboratory, the OT Equator analogs were inserted into the impression copings. After the placement of the pink silicone for the reproduction of the gums, the master model is poured in extra hard plaster (CI. IV).

The dental technician, then, made a resin basis with the wax rims for the upper prosthesis in order to perform the registration of intermaxillary relations by mean of the face bow (Artex, Amann-Girrbach). The correct vertical dimension, the ala-tragus line and the

interpupillary line were detected with the Fox plane (Candulor, Zurich, Switzerland) (Figure 8).



Figure 8: Oral registration of occlusion and evaluation of the parallelism of the wax rim with the ala-tragus line and the interpupillary plane using the Fox plane.

The rim basis was anchored over low profile attachments with three retentive caps in order to improve stability during functional and aesthetic evaluations. The rim basis, once back in the laboratory, were mounted in the articulator.

Thanks to the information obtained with the wax rims the teeth were mounted (Figure 9).



Figure 9: Wax rims with set-up for the aesthetic and phonetic evaluation.

Some pictures of the patient during her young age, were used to reproduce the shape and position of her

natural teeth. Then, an aesthetic exam was made with the set up of the teeth paying particularly attention to the phonetic evaluation. The patient was asked to pronounce words with sibilant phonemes "s", and to count from 60 to 70 and to pronounce the labiodental fricatives ("v, f") in order to evaluate the correct position of the upper incisors and the correct shape of the "S" channel. During the phonetic tests and the pronunciation of the labiodental consonants, incisors came into contact with the lower lip, while during the release of the sibilant consonants the S channel and the free way space was evaluated. The aesthetic evaluation showed a well-harmonized set-up with the physiognomy of the patient that retrieved a correct profile and adequate support of the lip and peri-oral tissues (Figure 10).



Figure 10: Aesthetic evaluation with teeth mounted on the wax rim. The patient showed a correct face profile and an adequate lip support thanks to a correct teeth set-up.

After performing the correct set-up, the prosthetic space available for the supporting bar was evaluated. After patient approval of aesthetics, the laboratory started a protocol that allowed, step by step, a positive outcome of the definitive prosthesis. The main goal was to maintain unchanged the volumes and to position the teeth as established in the former tests and the consequent creation of the bar, the framework and the retentive attachments. For this purpose a verticator system was used; on its base was placed the model with the set-up of the teeth. Then a silicone mock-up, that reproduced faithfully the volumes and the shaping of the gums, was created providing thus an accurate indication of the prosthetic space for the creation of the bar, attachments and a framework.

The model and the silicone mock-up were sent to the milling center to be scanned and then, with a touch probe scanner, it was detected with accuracy the position of the OT Equator analogs. Then, the silicone

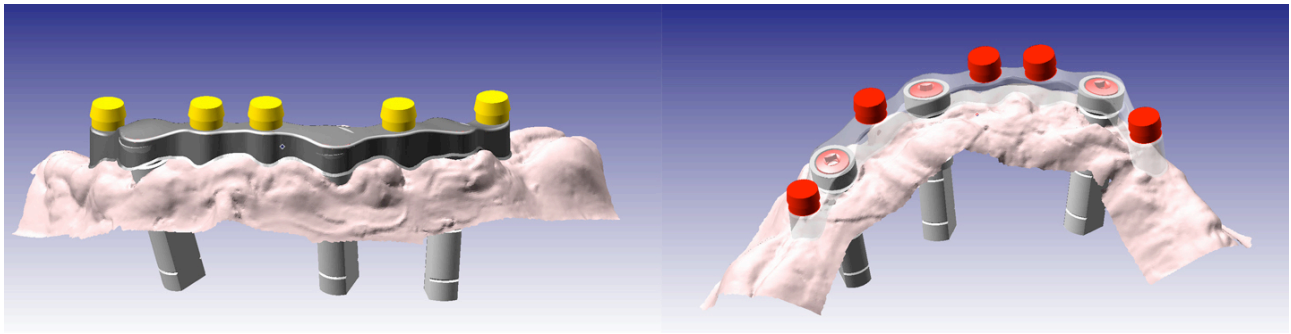


Figure 11: Virtual modeling of the bar where OT CAP Micro spherical attachments were included (Rhein 83, Bologna, Italy) to obtain a good retention of the prosthesis.

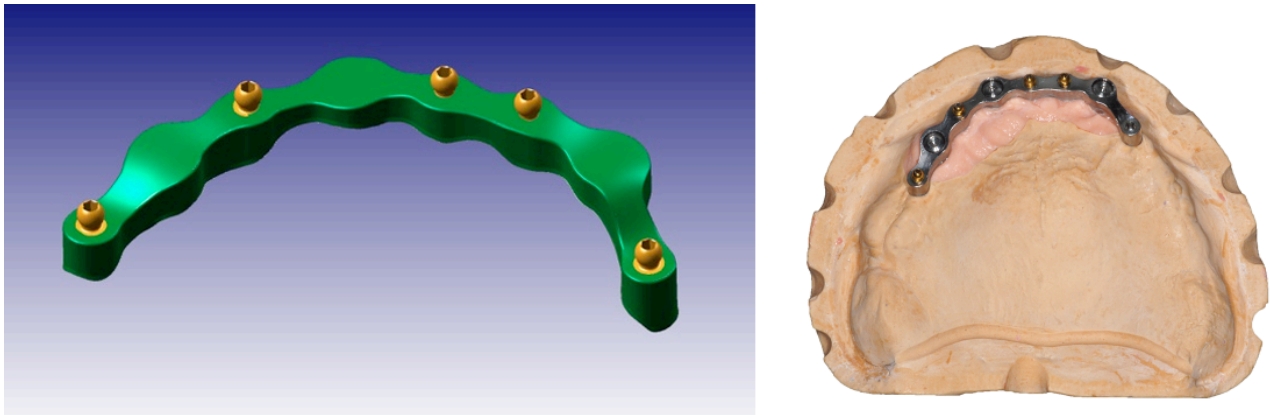


Figure 12: Designed milled titanium bar where the threaded spherical attachments OT CAP Micro could be seen.

mock-up with lower teeth impression was scanned too. Subsequently the dental technician virtually created the structure (Figures 11 and 12) and, analyzing the effective spaces available, designed the bar (Figures 16 and 17), the kind, location and the number of the attachments and the framework (Figure 18).

After evaluating the prosthetic space five threaded spherical attachments OT CAP Micro were placed (Rhein 83, Bologna Italy) on the bar and the counter-bar was milled (Figure 13).

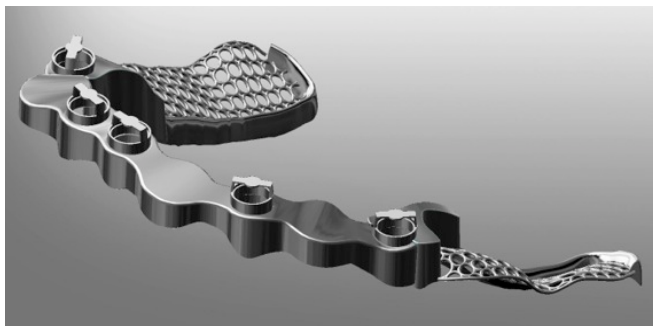


Figure 13: Designed counter-bar milled in titanium alloy.

Then, for a try-in, the bar was connected to OT Equator, which at the moment acted no more as direct

attachments but as a multi-unit abutment able of anchoring the bar (Figure 14).



Figure 14: Try-in of the titanium bar after its connection to the OT Equator attachments that acted as multi unit abutment.

The bar showed a proper fitting and a perfect passivity over the implants. This advantage was possible thanks to the particular design of the bar. It showed, in fact, a circular container that seated over the OT Equator without engaging the retentive surface of the attachment. The left space around the OT Equator abutment was compensated with an acetabular elastic ring called Elastic Seeger (Rhein 83, Bologna, Italy). This device



Figure 15: Bar placed over the OT Equators. The acetabular rings called Elastic Seegers allowed anchoring the superstructure to the abutments creating a solid system with guarantee of passivation. The use of this protocol allowed to compensate small inaccuracies that could be produced during the impression and the pouring of the cast model producing harmful tensions between implants.

compensated the space between the OT Equator and the bar surface creating a solid monoblock connection between each other with guarantee of absolute passivity. The tolerance of the container around the abutment aimed to compensate for minor imprecisions that could be produced during the impression and the pouring of the cast model. Above each abutment was placed a titanium locking screw with the aim to increase the contact of the Elastic Seeger over the internal walls of the bar improving its stability (Figure 15).

After the final try-in, the prosthesis was finalized with an injection technique. For this operation a double silicone mould and an aluminum muffle was used. To ensure the stability of the counter-bar OT CAP MICRO analogs were used in the silicone mould. Before the injection of the resin, the metal surface was treated with sandblasting (Al₂O₃), and silica bonding (ROCA TEC, 3M-ESPE, St. Paul, MN, USA), and self-curing opaque composite material.

After the injection and the curing of the pink resin, a portion of the flange was discarded, some intensive pigments were used for the characterization of the gingiva and a new pink resin coating was placed. The final restoration was completed and marked with stains to mimic the keratinized gingiva in order to improve the camouflage. In addition the median frenulum and the iugae alveolaris were created to improve the overall natural appearance (Figure 16).

The upper prosthesis, as the lower one, were delivered and then evaluated in patient's mouth showing a

good harmonization with the surrounding tissues (Figure 17).



Figure 16: Prosthesis finished and characterized with stains to mimic the keratinized gingiva and the iugae alveolaris to improve the camouflage.



Figure 17: Prosthesis completed and evaluated in patient's mouth where it showed a good integration and harmonization with the surrounding tissues.

The extra-oral photos showed a good support of the perioral tissues and an improved nasolabial angle (Figure 18).



Figure 18: Extraoral photo with the prostheses inserted with the improved nasolabial angle and the good support of the perioral tissues.

An orthopantomography confirmed the correct connection of the upper bar as well as of the lower denture to the respective implants and the excellent maintenance of the bone volumes (Figure 19).

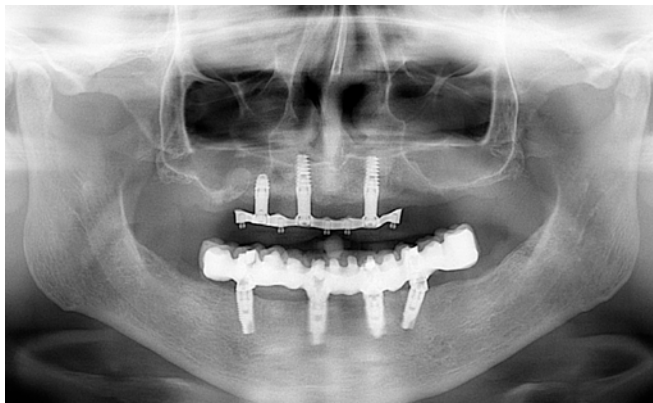


Figure 19: The orthopantomography showed the proper connection of the upper bar and the lower fixed prosthesis to the implants and the excellent maintenance of bone volumes.

The cephalometric examination performed at the end of the rehabilitation showed the correct position of the upper incisors teeth in the sagittal plane and the correct support of the upper lip. The distance between the upper incisors and the alveolar bone crest was about 10 mm confirming the correct choice of a removable prosthesis (Figure 20). In fact a fixed rehabilitation would not allow a proper support of the perioral tissues because of the lack of prosthetic flange [2]. The cephalometric examination confirmed the mesocephalic musculoskeletal characteristics of the patients that did not represent an occlusal negative factor because the masticatory forces were not so elevated like in brachycephalic patients. The patient was followed-up every six months to evaluate the hygiene maintenance, perform scaling of the implants abutment and bone level check-up with a radiographic examination.



Figure 20: Cephalometric examination that showed the correct position of the upper incisors teeth in the sagittal plane and the correct support of the upper lip.

3. RESULTS AND DISCUSSION

Periodontitis is an infectious disease that affects the supporting tissues of teeth (alveolar bone, cementum, periodontal ligament, marginal gingiva) determining a severe bone loss resulting in the formation of periodontal pockets, mobility, gingival bleeding, abscesses and suppurations, until the loss of one or more teeth [13]. In the periodontitis aetiopathogenesis play an important role not only incorrect habits, such as smoking and incorrect oral hygiene, but also other factors, such as individual genetic based susceptibility and the presence of systemic diseases, which exacerbate the periodontitis effects [14,15].

In periodontitis, the normal balance between the effect of bacterial plaque [16] and the immune system is impaired and leads to incorrect adjustment of the inflammatory response, with a resulting increased destruction of the marginal periodontics [15].

The opportunity to screw the low profile attachments immediately after placement of the implant, without removing them during the subsequent prosthetic phases, represents a significant biological advantage because it avoids damaging the epithelial ligaments and the connective fibers that grow circumferentially around the titanium neck of the abutment. These epithelial fibers are the biological seal and play a vital role in preventing infections of the deep tissues [17]. At this stage the OT Equator abutments were used as direct retentive attachments in order to improve the stability of the provisional prosthesis. The advantage of the OT Equator attachments is their small dimensions both in height and in width, associated with the possibility of using the OT Equator retentive caps or the OT CAP normo retentive caps (Rhein 83, Bologna, Italy). In fact both attachments show the same retentive diameter (2.5mm) being the OT Equator an evolution of the OT CAP.

A peculiar feature of the present study was the use of a CAD-CAM technology capable to produce the bar and the counter-bar at the same time. In fact, usually, the bar is designed and milled and then it is re-scanned in order to mill the counter-bar and the framework. In the present study a careful study of the tolerances, the coupling and of the "drill paths" allowed a precise, fast and reliable work.

When two or more implants are connected with a bar, a possible problem is that a poor passivity of the bar can transmit the tensions to the implants leading at first to an incorrect connection of the prosthesis and then to an implant failure [18]. To obtain a good passivity of the bar several tests are often required during the try-in in the dental clinic and the corrections are not always easy. In the present study the passivity of the bar was obtained by inserting inside the bar and over the OT Equator abutment an acetabular ring called Elastic Seeger. This device compensates the space between the bar and the retentive equator of the abutment creating, thus, a solid system with guarantee of passivation. The tolerance between the bar and the OT Equator abutment has been designed to compensate for minor misalignments that can be produced during the impression and the pouring of the cast model. The retention of the prosthesis was obtained using spherical attach-

ments (OT CAP, Rhein 83, Bologna, Italy) and their retentive caps that can be changed by choosing between different colors that identify different retention degrees. This choice was based on several factors: the time requested by the patient to accept the new prosthesis, his/her manual skills in handling the prosthesis during the insertion and the required degree of retention. The titanium locking screw contributes only in a minor amount to the retention of the bar over the abutment because the major retention is devolved to the Elastic Seeger. The function of the screw is to compress the Elastic Seeger on the walls of the bar improving the anchorage. The musculoskeletal analysis showed a middle divergence of the upper jaw associated with a convex profile typical of a mesocephalic subject with a low tendency to dolicocephalic characteristics. This type is commonly associated with a poorly developed masticatory musculature capable of weak forces [19]. The face analysis of the patient, in fact, showed no marked masseter muscle development or squared mandible [20]. This musculoskeletal conformation allowed to choose, with relative security, a upper rehabilitation supported by only three implants avoiding the insertion of the fourth, which would have required some complicated bone regenerative surgery or a sinus lift [21,22]. This decision was taken taking into consideration the patient's request to minimize the number of surgical operations, increasing the simplicity of the therapy and reducing, thus, the final costs. In addition, it was possible to perform an immediate loading technique on the two upper front implants using two gummy caps capable of anchoring the prosthesis to the OT Equator abutments without overloading the implants during the complete osseointegration. In fact, those gummy caps act as shock absorbing devices allowing the dissipation of the masticatory stresses. However, the temporary prosthesis base need to be as wider as possible, involving all those non-compressible areas of the palate, that provide support in the distribution of the occlusal loads and improve prosthetic stability. With brachycephalic patients, who are capable of developing higher masticatory forces, a higher number of implants would be necessary and it wouldn't be possible to adopt an immediate loading technique [21].

The use of the "Elastic Seeger" compensates for the inevitable inaccuracies due to the manufacture of a casted bar allowing creating a passive system. Certainly at the state of the art the CAD design and CAM milling, attain standards of precision unattainable with the common casting technique [23].

The protocol followed in the present study, which involved the use of low-profile attachments supporting a bar with retention for the overdenture, demonstrates to be a successful therapy. The use of low-profile OT Equator abutment and the Elastic Seeger simplified the clinical and laboratory procedures. Digitization, mainly in recent years, is more and more spreading into the dental word, and seems to provide new job opportunities and raise the quality of the prosthesis [23]. However, it must not forget that the “analogical” technique part and the digital one can't be separated each other. This is because despite the great help that the machine can provide, only manual intervention in the early stages as assembly, set-up of the artificial teeth and the aesthetics, can give that individual touch unattainable to the machines.

4. CONCLUSION

In conclusion, within the limit of the present study, the use of OT Equator associated to Elastic Seeger seems to be a suitable treatment to obtain a good passivation of the bar when an implant-supported overdenture is made. In fact this device compensates the space between the bar and the retentive equator of the abutment creating, thus, a solid system. The tolerance between the bar and the OT Equator abutment has been designed to compensate for minor misalignments that can be produced during the impression and the pouring of the cast model. The soft tissues and musculoskeletal analysis simplify the decision-making process regarding the type of prosthesis that should be choose and increase predictability of esthetic and functional treatment outcome allowing to know the occlusal load that the patient is able to develop and the perioral tissues support.

Nevertheless, further investigations on wider patient population are needed to confirm this finding.

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