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Prosthetic Rehabilitation of Completely Edentulous Patient by the Means of Digital Technologies

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Abstract: ***Introduction*: Nowadays the digital technologies become an essential part of daily practice. They offer faster, easier, cheaper and more predictable treatment result to be achieved.The major advantage of this new approach is the opportunity to merge different images). By collecting data from intraoral or extraoral scanners, CBCT, MRI or/and facial scanner the whole planning procedure and denture fabrication can be done digitally. This reduces the patient's visits, saves clinical time, can make the treatment cheaper and provides much more clinical information which dental technician can use for the denture fabrication. Actually, this approach has one major negative – the error accumulation.Having in mind the errors accumulated during these two stages (data collecting and data processing) the discrepancies between the real intraoral structures and their digital image can be significant.In order to reduce the possible discrepancies, a specific hybrid approach in restoration planning and fabrication can be used.Actually, this well arranged treatment protocol that uses both digital and conventional methods not only reduce the time but can increase the accuracy (in esthetic, functional and fitting aspect) of the final restoration. *Aim*: The aim of the current case report is to propose an approach for digitally driven implant treatment planning. As this case is just one of many treatment options, the main goal of the report is to extend the conventional treatment approach and to be an initial point in development of innovative ones. *Case report*:A full mouth restoration was done by means of both digital and conventional techniques for planning and denture fabrication. *Conclusion*: The digital approach in implant restorations planning allows a surgical guide fabrication that integrates all the data planned (for the final restoration and the implant position). By this way the planning stage becomes essential as it allows all the possible treatment plans to be evaluated and the best one to be chosen before actions were taken. At the same time, the data should be collected precisely and carefully studied for any error accumulation.***

Keywords: prosthetic dentistry, digital approach, conventional approach, implant prosthetics, hybrid approach

1. Introduction

Nowadays the digital technologies become an essential part of daily practice. They offer faster, easier, cheaper and more predictable treatment result to be achieved [1,2,8,9]. The major advantage of this new approach is the opportunity to merge different images. This assembly of various data information allows better treatment planning to be done as also better dentures to be fabricated as far as esthetics, function and fitting accuracy are concerned [15]. By collecting data from intraoral or extraoral scanners, CBCT, MRI or/and facial scanner the whole planning procedure and denture fabrication can be done digitally [3,4,5,12]. This reduces the patient's visits, saves clinical time, can make the treatment cheaper and provides much more clinical information which dental technician can use for the denture fabrication [15]. This makes the digital approach very useful in current pandemic situation and it reduces the appointment number and shortening the treatment protocol. Actually, this approach has one major negative – the error accumulation [3-5,10]. The more the digital data is processed the more inaccurate can be the final restoration. Another issue that can be presented is the inaccuracies in data collecting. Having in mind the errors accumulated during these two stages (data collecting and data processing) the discrepancies between the real intraoral structures and their digital image can be significant [13, 14].

In order to reduce the possible discrepancies, a specific hybrid approach in restoration planning and fabrication can be used [11]. These hybrid approaches combine both the digital and conventional methods. As the conventional ways in denture planning and fabrication are well-known and predictable, the fully digital methods are faster and can be very accurate if some specific conditions are presented. For this reason, by converting specific conventional stages of the planning or fabrication process into digital, this not only saves time but make the hybrid approach more accurate and predictable. Actually, this well-arranged treatment protocol that uses both digital and conventional methods not only reduce the time but can increase the accuracy (in esthetic, functional and fitting aspect) of the final restoration [6,7].

2. Aim

The aim of the current case report is to propose an approach for digitally driven implant treatment planning. As this case is just one of many treatment options, the main goal of the report is to extend the conventional treatment approach and to be an initial point in development of innovative ones.

3. Case report

A 74-year-old female patient visited the dental office with a complaint of mobile restorations. She shared that she didn't feel any pain or any other inconvenience. During the examination many carious lesions that engaged almost every single tooth of the dentition were observed. For this reason an orthopantomogram was prescribed in order to allow better options for evaluation of the current situation. After the OPG was observed, all the teeth of the maxillary and mandible were defined as irrational for treatment and the patient was sent to an oral surgeon for a further examination and extraction**(fig. 1)**.

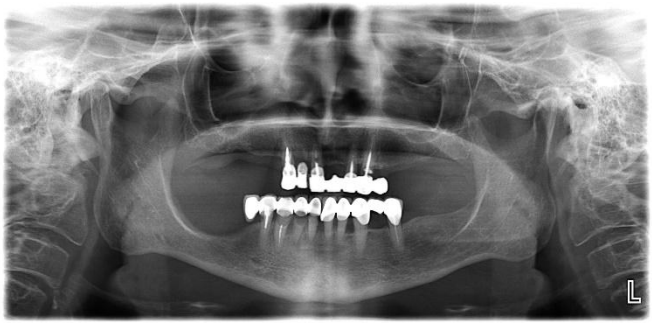

Figure 1: The OPG which contains essential information for the initial intraoral situation.

After an appointment with oralsurgeon a treatment plan was discussed with the patient. It contained immediate complete dentures fabrication and further a definitive maxillary complete denture and lower implant retained overdenture to be made. Another option for maxillary and mandibular fixed bridges fabrication was rejected by the patient due to financial issues. During the same the immediate dentures fabrication started with preliminary impression taking procedure. The cast made of these impressions would serve as a base for custom tray fabrication. The next stage consisted of the final functional impression making. During the same visit a facebow and bite registers were recorder assome basic parameters of the future restoration were discussed such as the color, form and size and some arrangement options of the artificial teeth.

During the next laboratory stage two cast were poured one for the upper and one for the lower jaw whichwould serve as mater cast. Then the models were mounted in articulator class 3. Becauseof the fact that the teeth were still available and are also presented at the master cast, they have to be trimmed in order to allow edentulous alveolar ridge creation. Once the edentulous ridges were ready, artificial teeth with suitable parameters were arranged as the dentures were waxed up and then finished by the commonly known protocol. It is important to be noted that the denture try-in procedure could not be done because the patient natural teeth were still presented at this moment. Actually, the extraction was planned and made just after the immediate dentures were ready.

During the next visit the oral surgeon extracted all the patient's teeth and the pair of immediate complete dentures was inserted (**fig. 2**). The patient was invited in 48 hours for final adjustment of the dentures. During the next two weeks there were some other visits for any articulation, denture flanges modifications which are caused because the changes of the initially swollen soft tissues and the progression healing process.

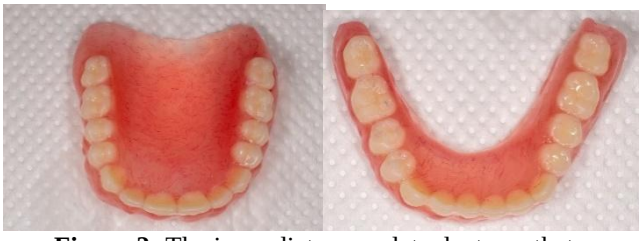

Figure 2: The immediate complete dentures that were made and ready for insertion.

After three mounts the patient was invited and the lower complete denture was modified in way to serve as CBCT (Cone beam computed tomography) template (**fig. 3**). For this purpose some radiopaque markers were arranged at specific places. They would allow proper further alignment of the different .stl files (which represents the edentulous alveolar ridge, the CBCT scan of the denture or some other images) and theCBCT of the patient's jaws. For this reason the CBCT should be made with the template inserted.

Figure 3: Mandibular immediate complete denture modified as CBCT template by adding some radiopaque markers.

The image collected from the CBCT was used for digital 3D implant planning with a specialized dental CAD software. The software allows a surgical guide fabrication, which corresponds to the 3D planning as incorporates all the data gained as result of the digital planning procedure (**fig. 4**).

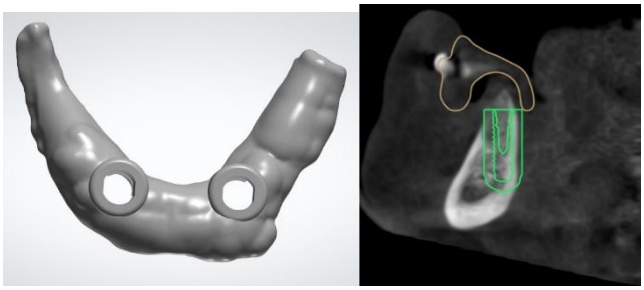

Figure 4: The digital image of the surgical guide. The picture presents the desired position of an implant (in green) which is determined by the CBCT image of the lower jaw and a separate .dicom image of the complete denture (in yellow). After the surgical guide creation, the same as planned position of the implant is incorporated in its structure.

Once the digital image of the surgical guidewas created then a .stl file was created and prepared for 3D printing. The fabrication process was done by DLP 3D printer by using special resin which is indicated for surgical guides. Once the process finished, some post-processing operations were done (rinsing with alcohol, post-polymerization and supporting structures removal). Finally.the fitting accuracy of the guide was checked and it was packed, autoclaved and prepared for the surgical stage.

During the surgical stage two implants were placed – both of them were (Straumann - BL, Ø 3.3mm NC). The implant

bed was done by the surgical guide support. It allows the operator to move the drill only in one direction, the rest were indexed and limited by the guide. A month after the stage the mandibular immediate complete denture was relined and after 2 more months the corresponding healing abutments were inserted. After a healing period for the soft tissue regeneration the locator abutments (Locator®, Straumann®) were selected and inserted (**fig. 5**). During the same visit an impression were taken for the definitive dentures fabrication (**fig.6**). They were made by the commonly known protocol. Once the lower complete denture wasready the Locator® (Straumann®) males and the housings were permanently fixed to the denture base by acrylic resin during the same visit of.the denture delivery.

Figure 5: TheLocator® abutments (Straumann®) properly selected and inserted

Figure 6: The maxillary complete denture and the mandibular implant retained overdenture finished and inserted.

4. Discussion

The presented clinical case is very demonstrative for the role of the digital approach to the implant planning, surgery and further prosthetic rehabilitation. A 3D surgical guide fabrication ensures proper position of the implants, which corresponds to the further prosthetic restoration.Actually, this approach allows a lot more than the conventional implant restorations planning. It makes possible a surgical guide fabrication that integrates the 3D position of every single implant, making the surgical stage more predictable as it allows the operator's attention to be focused to the rest of the issues that should be overcome. This approach makes the final treatment result more predictable as a prototype of the restoration is done initially, which further will serve as reference point for the implant placement and final restoration. There is no other way to plan and fabricate a tool that ensures the communication between the patient's desire, prosthodontist and the oral surgeon. A it known the conventional surgical guides offers only basic information for the final restoration as it may allow wrong implant position to be chosen during the surgical stage. Actually, these kind of issues are result of the lack of completecase information that is stored and showed at one place. The digital implant surgery planning allows all the information needed to be presented altogether, on one screen. If the position of any implant should be changed according to the surgical considerations, then the consequences for the final restoration can be evaluated before treatment. This allows the most optimal treatment plan to be chosen for each patient. At the same the ability of "digital representation" of the treatment plan reduces the possible error.

As the presented approach is digital it is very susceptible toerror accumulation. For this reason, every digital image should be done as accurate as they are possible, as the amount and the quality of the completed data should be evaluated wisely.However, the possible error accumulation the digitally driven implant surgery and restoration ensures good and predictable results to be achieved.

5. Conclusion

The digital approach in implant restorations planning allows a surgical guide fabrication that integrates all the data planned (for the final restoration and the implant position). By this way the planning stage becomes essential as it allows all the possible treatment plans to be evaluated and the best one to be chosen before actions were taken. At the same time the data should be collected precisely and carefully studied for any error accumulation.

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