Chapter 1

Introductory Chapter : Dental Implantology, The Challenging Scenarios between Training, Resources, and Patients' Demands

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Additional information is available at the end of the chapter

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1. Introduction

Dental implant is a dynamic science that practitioners are relying on for oral rehabilitation. Due to the higher success rate, dental care is turning more and more toward using implant-based oral prosthetics. However, the drawbacks are still of concern in this field due to errors occasionally encountered among practitioners with improper training, weak knowledge, or underestimating the case difficulty. Those errors can accumulate at each phase during the process of planning, taking records, interpreting data, surgical intervention, prosthetic rehabilitation, and finally the maintenance program. Furthermore, the misleading marketing messages that can introduce novel tools or ideas if not handled carefully especially by junior or nonspecialist practitioners. What adds more to the complexity of this aspect is what I like calling the "case requirement," (CR) which is not a secret neither a mysterious side in the field, it is just being forgotten occasionally. "Case requirement" is indicating another dimension to the field of rehabilitation based on the applicability factor, patient's preference, and demands that are becoming sophisticated more and more in the 21st century [1]. As the rhythm of life is moving faster, communication is following and hence the patients' outcome demands, to be faster and precise.

In this chapter, we are aiming to introduce the textbook to readers in the field of oral maxillofacial rehabilitation through cases of special challenges that might face practitioners in the field. The consideration of the CR aspect and the anticipation of future research will enlighten possible solutions and pitfall tactics. Yes, we are trying to be as idealistic as we can; nonetheless, we will always be facing factors that might modify our intervention. The trick is to find this perfect customized management plan [2].

Hence, the dynamic advancement in the field is taking place on different levels that are important for any implantologist to comprehend, at the clinical, micro, and nano levels. The implant surface characteristics, the implant soft tissue interface, alveolar bone reconstruction, the involvement of micro-organisms, the indications of antibiotics in implant surgery, osseointegration, cellular attachments, and the advancement of implant designs are all areas of important research topics nowadays that are going to be explored in the book hoping to present more options for future care.

It is well known that training in the dental implant field usually starts with the basics of planning, starting from case interview, examination, investigational images, analyzing the data, considering case requirement, finalizing the rehabilitation plan, dental extraction, alveolar reconstruction, implant surgical installment, prosthetic rehabilitation options, patient cooperation, and establishing a recall schedule. It is unfortunate that a lot of training programs are focusing mainly on the technicalities including implant placement and prosthetic restoration while forgetting the importance of the scientific background in applying the clinical practice. And it causes a dilemma via producing graduates who are not able to connect the basic science, research, clinical application, and the future potential to improve the field. Therefore, it is not uncommon that during residents teaching, rounds, and board exams, candidates might show technicality excellence without knowing the justification, and hence, reaching into a block when facing a challenge in a case, a complication, or an examination question.

The technical advancement in dental and medical care is continuously improving and producing ideas; however, still a lot of doubts that one day technology might replace a human surgeon to operate on another human solely. The reason behind that doubt is the simple existence of human race that will always show variable clinical conditions that can never be the same and might differ on three major categories, patient's, operator's, and material's pertinent factors.

2. Patient-related factors

These are defined as factors mainly pertinent to the patient him/herself that include and not limited to the medical background, anxiety, allergy, smoke history, anatomical variations, implant site local challenges, local bone type, local topography, and the personal preference. The patient preferences can be limitless, which include a demand in implant type, surgical intervention, grafting technicality, prosthetic end result, and the mostly challenging the time frame demand. The reason that time frame is very challenging, as it is mainly affected by the body's healing power, which some time can never add much except of waiting few more weeks [3]. However, research shows promising results by modifying the implant surface itself, as will be discussed in the forthcoming chapters. On the patient's level, the use of stem cells, growth factors, and systemic drugs to improve osseointegration is being experimented to improve the healing power [3,4].

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2.1. Surgical site alveolar deficiency

Surgical site evaluation to identify vertical or horizontal deficiency has been an area of continuous challenge to implantologist [5]. The techniques of management are beyond the scope of this chapter, but the importance of mastering more techniques to manage such challenges is an area that should be considered while training. Not to mention that not all cases would accept manipulating their jaws in a way to reconstruct it back to its original. And hence, the necessity to formulate boundaries in the practice according to what can be done for a patient or what has to be compromised (**Figures 1–5**).

Figure 1. Intraoral clinical images showing bone deficiency at the vertical and horizontal levels leading to minimal gingival recession pertinent to the lower canine teeth.

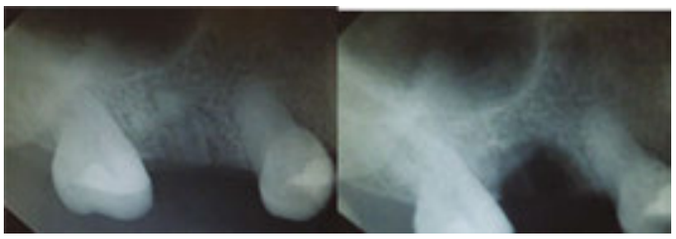

Figure 2. A periapical radiograph showing remaining roots of a previously attempted dental extraction performed in another practice few months ago. The patient was upset and demanding dental implant treatment on site without delay. Therefore, after thorough discussion on the operative procedure, risks, benefits, alternatives and modification plan, careful manipulation of the surgical site was exercised to remove the buried roots aiming to preserve the surrounding bone structure otherwise placing an implant immediately can be aborted and switching the procedure to alveolar bone grafting only will take place. However, the extraction was performed successfully with preservation of the buccal plate and confirming the socket dimension area with the periapical radiograph on the right side.

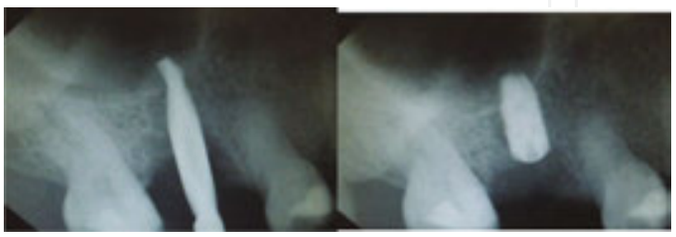

Figure 3. The surgical site was carefully prepared and the implant osteotomy was performed aiming at bone conservation and immediate implant placement that was accomplished successfully with good primary stability achieved at the apical portion at the sinus cortical boundary.

Figure 4. A radiograph of a 50-year-old patient showing limited vertical bone height to place dental implant. The patient was offered a sinus lift procedure and was not a choice of preference to the patient. The option of short implant insertion was discussed including risks, benefits and alternatives, and it was more appealing to the patient. The figure on the right shows the pin guide indicating the length and parallelism.

Figure 5. A periapical radiograph showing the short implant in situ and the crown placed in favorable status. The restoration and functional result were satisfying to the patient and achieved the "case requirement" demands.

2.2. Local blood supply deficiency

The era of osseointegration is based on the viable existence of an implant and bone interface. The former is anatomically defined via a viable osseous region containing adequate blood perforates to facilitate the implant-bone relation. Sometimes, missing to identify cortical areas of poor blood perforates, especially in older patients, can be the reason behind the success or failure. The following cases show examples of local compromise (**Figures 6–9**).

Figure 6. A 75-year-old female patient who was known to be diabetic that is controlled and followed by an endocrinologist. The clinical image shows alveolar bone local limited blood supply at the crestal level when compared to the buccal plate perforates. It has to be carefully considered when planning osteotomies for implant placement.

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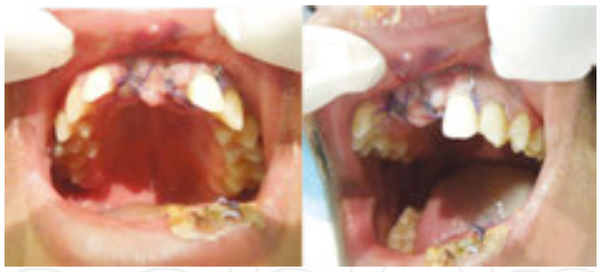

Figure 7. A 19-year-old male patient went through road traffic accident leading to avulsion of the anterior central incisors, dentoalveolar fracture, and a minimally displaced left lateral incisor. The primary care was undergone at the emergency department as localized dentoalveolar reduction and lateral incisor reduction with wire splinting. The patients presented to the clinic 3 days after the accident are concerned about the rehabilitation of the anterior maxilla. This scenario might lead to significant post-trauma alveolar bone loss and gingival deformity if not planned carefully for dental implant-based rehabilitation.

Figure 8. Periapical radiographs showing the central incisors intact socket status, and the implants were placed 10 weeks after the accident to minimize the bone resorption trauma effect especially at the buccal plate aspect. The dental implants were placed carefully aiming at keeping sufficient hard and soft tissue for future cosmetic rehabilitation in addition to buccal plate augmentation. The radiograph on the right shows the preservation of the vertical height of the interimplant site to help supporting the interdental papilla later on.

Figure 9. The radiograph shows a favorable crown coping and favorable interimplant bone level as being counted for the future support to interdental papilla, avoiding black triangles in the anterior maxilla, a dangerous cosmetic region.

3. Operator-related factors

The operator's factors include the expertise, training background, operator's capabilities, personal interest to introduce new techniques, knowledge of data interpretation, the presence of a supporting team, and the talent to adjust with the challenging case requirement. As much as it is fair to all patients, as much being part of the code of ethics at any area of practice around the world, the capabilities of practice must be clearly disclosed. An example of the surgical specialties is oral and maxillofacial surgery (OMS or OMFS) that is a practice of intensive training in the oral, facial, head, and neck regions that would share continuous interventional skills at the maxillomandibular complex. It can include major interventions or millimeter cosmetic part of care. OMFS intensive training around the area usually produces practitioners of crucial sense when it comes to estimating details of blind maneuvers, osteotomy direction, depth gauging, tactile dexterity to length and width, tactile sense to osteotomy structure of nature, and confidence in managing perisinus structures and jaw components [5]. As more specialties are sharing the implant part of health care practice, it is important to consider such reality in managing cases of special challenges, systemically as well as locally. Especially those implant survival studies show variable success outcomes depending on the specialty of practice [6–8]. Nonetheless, the interspecialty consultation to manage a case is what matters to clients seeking dental implants. The multispecialty consultations and teamwork practice will always provide the best care possible.

3.1. Narrow dental implant

In locations of limited mesiodistal width, the ability to place an implant can be jeopardized by a lot of factors, such as the flap design, root angulation, coronal tilting, alveolar bone dimension, and operator's clinical skills to place an implant usually via one or two drilling sequences only, which can leave no room for corrections neither over preparation of osteotomy sites (**Figures 10–12**).

Figure 10. A clinical image showing a challenging narrow location of missing left lateral incisor. The patient is 70 years old and asking for implant-based rehabilitation. The plan was to place a narrow implant in the area with minor odontoplasty to plan for cosmetically pleasant maxillary lateral incisor. This area constitutes part of the cosmetically challenging region, the anterior maxilla.

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Figure 11. A flap was raised to carefully prepare the narrow implant site as a single osteotomy attempt is usually valid for such cases with limited opportunity to redirect. Hence, a flapless procedure is discouraged in such cases. The clinical picture on the right shows favorable position for future rehabilitation based on the case requirement.

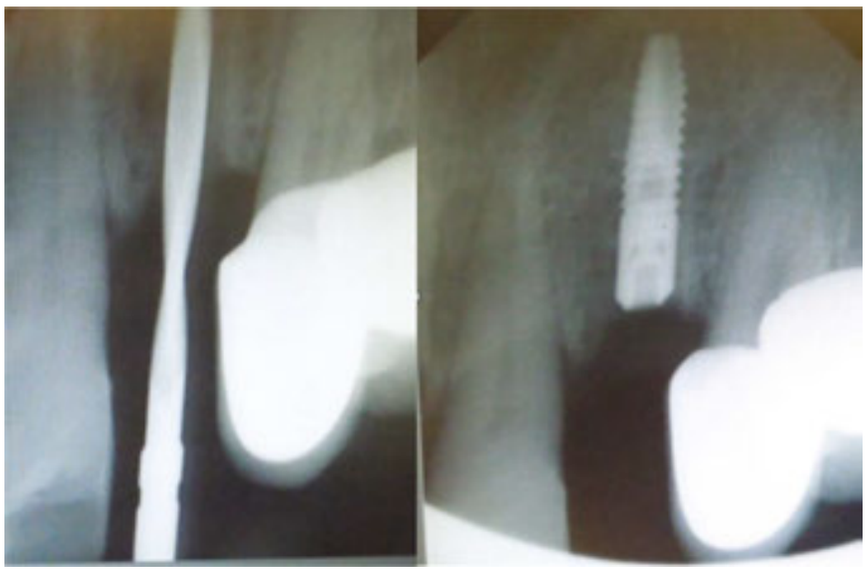

Figure 12. An intraoperative pin direction X-ray indicating the limited space and favorable inclination for drilling in correlation with the intraoperative clinical setting. The aforementioned counts are necessary to adjust location and direction on the first attempt. The postoperative radiograph on the right shows the implant position in accordance with the plan in the three dimensions, apicocoronal and mesiodistal. The clinical correlation is of prime importance to adjust all the dimensions including the buccolingual dimension as presented in Figure 11.

3.2. The challenge of onlay bone grafting

The science of onlay bone grafting is evolving rapidly to match up the challenges that are facing the surgeons in the field or oral implantology and reconstruction. It is well known that inlay defect bone fill is much more predictable than onlay defects [9–11]. The technique of application and the materials used are variable, including allogenic, alloplastic, bone morphogenetic proteins, and xenograft graft materials. Not to mention the time factor of managing extraction sockets in either immediate or late phase to prepare implant placement [12–14]. The operators have to have the ability to properly select the best reconstructing

technique in each case separately and to avoid limited techniques to do so. The cases will always be different as introduced in the following cases (**Figures 13–15**).

Figure 13. A 33-year-old male patient presented with missing left central incisor for more than 6 years secondary to trauma. The clinical examination and investigatory cone beam CT scan images were suggesting the possibility of having an alveolar bone space for implant placement with simultaneous grafting.

Figure 14. A clinical intraoperative image of the previous case showing the flap raised and indicating an extremely poor alveolar bone horizontal width that prohibits the implant placement and switch the procedure to a local grafting using particulate allogenic graft with calcium sulfate carrier to improve the consistency and bulk.

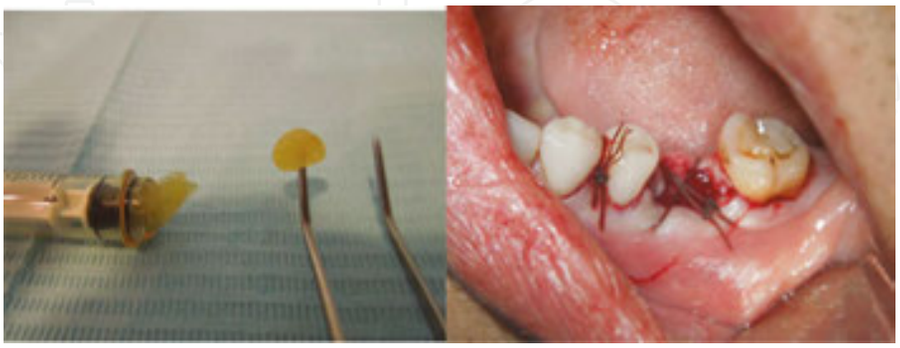

Figure 15. A clinical picture showing a putty-like bone graft that can be molded and sustain acceptable consistency and bulk for alveolar bone reconstruction. The picture on the right shows the location postgrafting that did not require any membranes to be placed due to the consistency of the material and the carrier barrier [11,12]. The option of either using bone mophogenic protein delivered via carriers or using a graft contained in an alloplastic membrane cover is amenable for onlay or inlay alveolar defects reconstruction [13,14].

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4. Material-related factors

When it comes to the material's factors, it includes the implant surface type, length, diameter, internal design, external design, laboratory capabilities, managing challenges, images capabilities, surgical stents, radiographic imaging, cone beam CT scanning (CBCT), and finally, the proficiency to manage the time factor.

It is not uncommon these days to observe cases being treated while omitting the role of case planning in the laboratory and mocking future results. The former is much critical when planning a case going through comprehensive care including orthodontics management. The controversy of completing the dental alignment before implant insertion is advocated in order to avoid any misplacement of the dental implant [15]. Proponents claim the loss of alveolar bone by the time of completing the orthodontic care couple of years later that warrants more challenging reconstruction, grafting, implant insertion, and delaying the rehabilitation care, not to mention the cumulative cost. Proper planning and inter specialty consultations can provide better results and can always manage such cases either way (**Figures 16–18**).

Figure 16. The planning of implant insertion while performing orthodontic treatment is an issue of discussion. It has the advantage of utilizing the bone while in favorable width and height better than waiting for the prolonged time of orthodontic treatment that will lead to significant alveolar bone resorption and hence a future challenge of implant placement, root exposure, not to mention the further delay in oral rehabilitation [15]. This can only be applied in selected cases based on careful planning.

Figure 17. This case was planned for multiple dental implants in the upper right maxillary region using surgical stent that was reviewed in the lab by the prosthetic team. The stent was used in the presence of the right wisdom tooth helping in precise stability of the stent in localizing the future implant sites, AKA, tooth-supported surgical guide, that is considered more precise compared to the other two types of surgical guides, the mucosa-supported and the bone-supported surgical guides. However, the wisdom tooth will be extracted once the objective is achieved intraoperatively [16].

Figure 18. The implant locations were precisely identified using pin guides with clinical relevance to carefully place the implants in this limited site from buccopalatal dimension. The right maxillary wisdom tooth (third molar) was extracted at that point. The buccal plate deficiency reconstruction was considered at earlier stage in addition to the expected inlay defect post third molar removal [17].

4.1. Dental wax-up and surgical stent fabrication

The dental wax-up is a necessary tool used to plan dental implant treatment. It is not only used for estimating the exact location and size of an implant, it is used as well to plan orthodontic movement and future grafting sites [16,17]. The application of the conventional laboratory surgical stent or CBCT-based stent might lead to the same result. The comprehension of the best utilization and avoiding possible errors are the factors that matter. Hence, interspecialty consultation at the primary visits would save time and interventions from the surgical point of view. As more time elapsed, the more bone loss, and the more challenging alveolar reconstruction and implant care.

4.2. Cone beam scan application in dental implant therapy

Part of the advancement in dental implantology care is represented by the use of cone beam CT scan (CBCT). Although not all cases might require CBCT image-based planning, the significance does exist among specific cases where the three-dimensional orientation is the key to success [16,18]. Hence, it requires knowledge and skills for analyzing the images and supporting the clinical correlation (**Figures 19–21**).

Figure 19. A 42-year-old female patient presented with a missing left second premolar that is challenged horizontally by crown tilting and pneumatized maxillary sinus. The radiographic image shows the shadow of maxillary sinus pneumatization leaving limited alveolar height, radiographically. Therefore, CBCT scan was carried out and showed an overimposed sinus floor distopalatally with an extraction socket space barely limited for an implant placement without sinus lifting. The case review, risks, benefits, and alternatives were discussed and consented to proceed.

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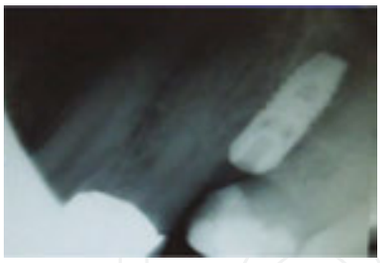

Figure 20. The surgical site was exposed and the previous socket space was identified and carefully followed to place the implant in situ. The evaluation of the osteotomy site confirmed intact edges without sinus violation, and hence, the implant was inserted. The postoperative periapical radiograph can be deceiving to the position of the implant as it shows a superimposition on the sinus floor and close proximity to neighboring teeth which was double confirmed clinically and using a postoperative CBCT scan (see Figure 21).

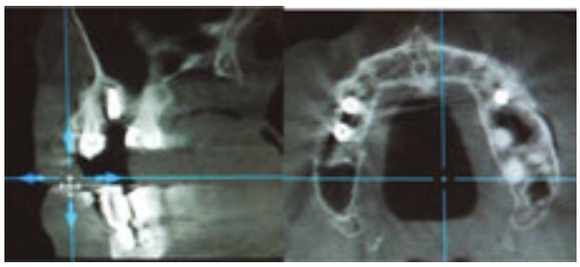

Figure 21. A postoperative CBCT scan shows the previous case of proper implant location that is not violating the sinus or dental structures as confirmed by parasagittal and axial views.

It can be noticed that all the former categories, such as the patient's, operator's, and material's, are linked to all the implant cases, in this chapter, forthcoming chapters, and possibly all over the world. Improving the service, survival, time factor, esthetics, and final results are the factors that result in success. And that is the involvement of current research to improve the implant therapy. Hence, cases are not going to be the same, and the difficulty levels will always dictate the methodology of intervention.

5. Challenges of implant training vs. iatrogenic issues

Just like anything in life, improper training will lead to disasters. The current observation of awkward complications is presented due to the jeopardized weekend diplomas, nonaccredited training programs, downgrading the training duration, and mixing the specialties of care. The phenomena of picturing dental implantology as a practice of placing a pin in the bone and then sticking a crown on top is putting this field in a lot of danger, not to mention the marketing twists in using medical terminologies such as flapless, sutureless, graftless, painless, harmless, and so on. The former will send false massages to the community, the students, and general practitioners. It is imperative to communicate evidence-based clinical application when it comes to health care science. The importance of basic science, the comprehension of variable

methods of practice, and the advent of current technology will add up to the training products and will never facilitate shortcuts.

The last section of this chapter will be showing few examples of cases that could have been carried out in a better way. I had the chance to view these cases as consultations showing up as early as a month postimplant placement and up to two years postinsertion. All practitioners in the field would have cases that are not proud of, facing difficult cases, or probably incorrect choice at one time or another. The purpose of sharing some of these cases is for educating the target readers, to prophylactically avoid some of these pitfalls, and to introduce the current era of implant care discussed in the next chapters.

Managing challenges are areas of special concerns in the field of dental implants. It can be found secondary to any shortcomings of what were mentioned earlier, such as patient's, operator's, and material's. A deficiency in one aspect might lead to transferring a challenge into an actual complication [19]. Novel practitioners might be surprised with the power of handedness tendency even if all aspects of care were taken, still the vision of placing that implant in three dimensions can be deceiving and requires a plateau of proper training to gain accuracy (**Figures 22** and **23**).

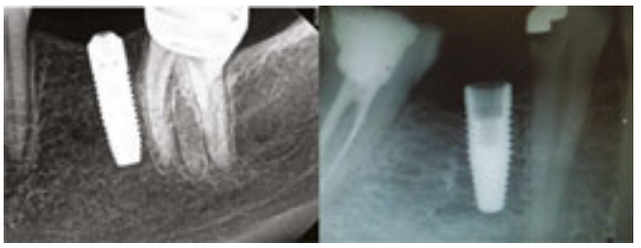

Figure 22. A radiograph showing dental implant with unfavorable positioning, tilting, and improper apicocoronal seating. It will lead to a challenging restoration with diverged emergence profile angle, AKA, "a tomato on a stick."

Figure 23. A periapical radiograph showing an implant not seated deep enough apicocoronally, leading to extremely diverged emergence profile, AKA, "a tomato on a stick." The 42-year-old patient presented as an emergency visit complaining of tenderness at the implant of mandibular left molar site attempted in a different practice about a year ago. The patient stated that the pain is repeatedly eliciting providing the fact of changing the crown few times. The diverged emergence profile formed a "housing" curve to collect food debris leading to subgingival abscess infection as seen on the right clinical picture. The patient underwent an emergency intervention of conservative incision and drainage of the purulent discharge, copious irrigation, antibiotic prescription, and analgesics until deciding for a definitive care.

In other situations, underestimating the necessity of proper planning to calculate the implant space available for future prosthetic rehabilitation can lead to bizarre outcomes (**Figures 24**

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and **25**). Hence, even if the care is going to take place through the conventional laboratory wax-up and surgical stent fabrication or through the soft-wear simulation programs, the result will be the same, and the surgeon is still in charge when deciding to place those implants in place or not [16]. The practitioner should comprehend that any data gathered will only be an additive item aiming to assist in placing the implant onsite, whereas the surgeon is the only person in charge at the intraoperative stage to place those implants, review the data again, modify the plan, or abort the procedure [18,19] (**Figure 26**).

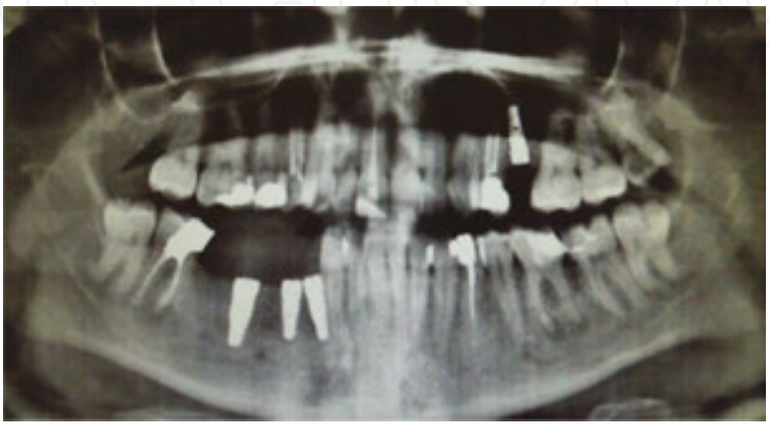

Figure 24. A panoramic radiograph showing three implants placed at the right mandible region. The implants are placed at improper locations pertinent to each other, surrounding structure, future rehabilitation, and opposing occlusion. Not using proper surgical stent to guide the future rehabilitation plan might lead to such devastating results.

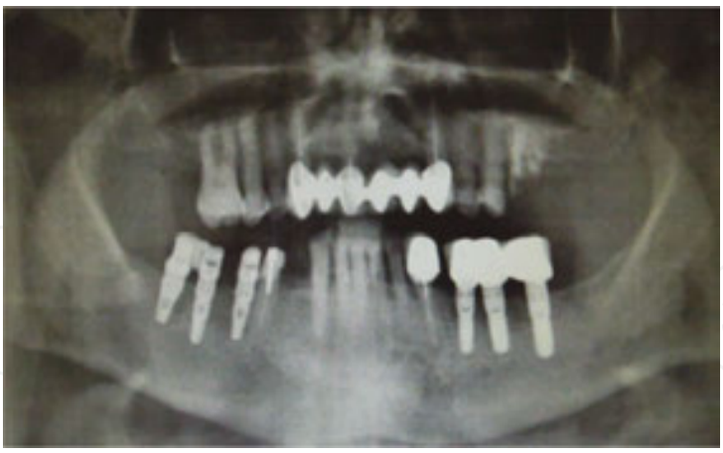

Figure 25. A panoramic radiograph showing three implants placed at the right mandible posterior region. The three implants were placed at a location where a single posterior implant might suffice. Poor planning, careless intervention, or untrained practitioner will lead to such horrifying outcomes and unnecessary expenses. The improper relation and the close proximity to the neighboring right premolar will jeopardize the implant itself. As the premolar sounds to be poorly treated, and hence it will be a source of infection or extraction. Either will be placing the extremely close implant in jeopardy. The most distal implant is placed at a negative functional zone; hence, it has no role in the rehabilitation plan not to mention the unnecessary surgery and cost. Therefore, the general rehabilitation plan of the maxillomandibular complex does require careful revision especially considering the existence of poor prognostic teeth in both arches [18,19].

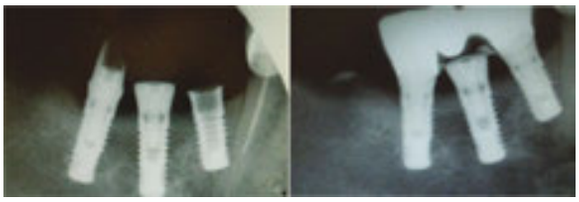

Figure 26. A periapical radiograph showing three implants next to each other with improper relation pertinent to future rehabilitation and as a relation to the neighboring tooth structure. The result showed leaving the implant in the middle in a sleeping status with questionable outcomes, indicating an unnecessary surgical intervention and cost [19].

6. Conclusion

As the dental implantology science is growing very fast, the demand to perfectionism is becoming more challenging. The obstacles of grafting techniques, faster osseointegration, completing cases faster than what used to be, and perfectionism in cosmetic results all play partial role in the current era of implant therapy. Obstacles are still configured in the form of questionable training, nonevidence-based applications, and limitless case requirement demands. Hence, there is the need to consider reviewing the actual capabilities of training programs, stabilizing the basics among trainees, probing the application of new tactics as per the evidence-based recommendations, potentiating research projects in the field of oral maxillofacial surgery, rehabilitation, and dental implantology. Last but not the least, advocating the transparency of more outcome-related studies in different programs and practices is necessary in order to identify what more can be carried out to improve the dental implantology health care.

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