

Case Report

Short Dental Implants on Rehabilitation of Atrophic Maxillary Ridge Utilizing Digital Planning

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Abstract— This is a clinical case of a healthy man with a missing upper right lateral incisor (#12) and canine (#13) who requested for a permanent prosthetic replacement due to a history of trauma. An orthodontic alignment was performed to idealise the spaces in the upper and lower arches. A horizontal guided bone regeneration (GBR) was then performed on the residual ridge on #12 and #13 using the xenograft [Cerabone®, Botiss gmbh, Berlin, Germany] and resorbable collagen membrane (Lyoplast®). After 12 months, the radiographic analysis showed apparent bone-fill with an adequate horizontal bone gain which was further analysed using a specialized software for digital implant planning [R2GATE v1.1.1; Megagen, Daegu, Korea]. Two short dental implants (7.0 mm) were incorporated as part of the overall treatment plan. In this case, the utilization of the short implants on a previously augmented ridge with the aid of a digital implant planning showed excellent clinical outcome.

Keywords— implant-supported dental prosthesis, prosthetic implants, dental implant, short dental implant, digital implantology

I. INTRODUCTION

Loss of anterior teeth due to trauma will affect a patient's appearance and self-confidence. Restoring the aesthetic and functionality of these anterior segments with permanent restorations such as implant supported prosthesis possess great challenge especially if there is a presence of buccal plate deficiency and minimal alveolar bone volume. There have been multiple techniques used including autogenous onlay bone grafting techniques, sinus lifting, guided bone regeneration (GBR) and distraction osteogenesis to allow ideal implant placement [1,2,3,4]. Nonetheless, the

techniques mentioned are often associated with high risk of surgical morbidity, high cost, excessive duration of treatment, low patient acceptance and incidence of post-operative surgical complication [5, 6, 7]. Apart from these techniques, short dental implants is one of the viable treatment options that can be considered as the most minimally invasive treatment in comparison to other treatment approach and modalities [8].

The definition of the short dental implants is considered controversial since there were numerous opinions in the body of the literature in classification of the short implants. The widely agreed short dental implants is for the dental implants

to be at the length of <10 mm [9, 10]. An extra short dental implant should be in the region of ≤ 6 mm [11]. Contemporarily, the shortest dental implant available in the global market is at 4mm in length [12].

The usage of short dental implants in replacing missing teeth is well documented in the body of literature and comes with a high survival and success rate [10, 13]. A recent systematic review by Carosi P. et al showed that short dental implants with ≤ 6 mm in length scored $\geq 90\%$ in biological and biomechanical survival rate within a 5 year follow up [14]. This showed that a short dental implant is a valid treatment option in the rehabilitation of atrophic ridges. This case report was intended to report on the utilisation of short dental implants on previously augmented anterior maxillary region utilising modern digital implant planning software.

II. CASE REPORT

A 48-year-old healthy male visited the Faculty of Dentistry, USIM for a replacement of his missing anterior teeth. Initially, he was presented with a complaint of a difficulty to eat due to missing teeth on his upper anterior and lower posterior right-side teeth. He had been wearing an upper partial acrylic denture for 6 years which was substituted to a partial cobalt-chrome denture in 2016 and the intraoral condition is as depicted in Figure 1a-1b. The patient provided a written and oral consent for photography recording, treatment, and data publishing. The patient was referred to the Specialist Orthodontic Clinic, USIM for an orthodontic alignment prior to an implant surgical placement.

The use of an orthodontic alignment was selected to idealise the spaces in the upper and lower arches. This was decided and consented before a full mouth rehabilitation was performed with implant and prosthesis. The orthodontic treatment aims were to; i) reduce space at 22 for build-up of the tooth at mesial and distal aspects ii) to derotate 14 and reduce space at the upper right quadrant as much as possible for the placement of implant and crowns and lastly iii) to intrude 42,43 teeth. The orthodontic bond up was completed in April 2017 and the patient was debonded in November 2018 and further issued an Essix retainer with pontics to replace missing 12 and 13.

The patient was then referred to the Specialist Oral and Maxillofacial Surgery Clinic for the management of the missing dentition which required an implant treatment to replace the missing 12 and 13. Horizontal guided bone regeneration (GBR) was performed on the residual ridge on #12 and #13 using the xenograft (Cerabone®, Botiss gmbh, Berlin, Germany) and resorbable collagen membrane (Lyoplant®). The patient was back after 12 months, post ridge augmentation surgical stage for an implant surgical placement (Figure 2). After 12 months, there was an apparent bone fill with an adequate horizontal bone gain as depicted in Figure 3.



Figure 1a-1b. Pretreatment clinical pictures prior to the orthodontic treatment.



Figure 2a-2b: Frontal and occlusal view showed clinical platform for implant surgical placement on 12 and 13.

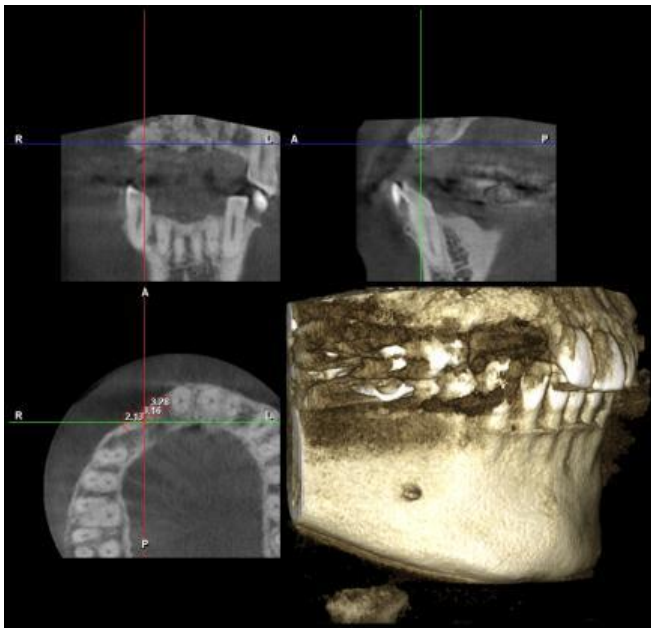


Figure 3: Cone beam Computed Tomography (CBCT) scan showed adequate horizontal bone gain with ranges from 2.13-3.28mm after horizontal bone graft performed.

A digital implant planning was performed using a specialized software (R2GATE v1.1.1; Megagen, Daegu, Korea). From the digital implant planning, it was noted that the missing teeth span was considered excessive for the replacement with 2 units of implants, so the decision was made to replace it with 3 implants to prevent any future possibility of spacing in between the teeth and also to allow the possibility for a screw retained implant crown (Figure 4). The 3 implants used were 4.0 diameter in size with 2 of them being 7.0mm and 1 10.0 mm in length respectively as depicted in Figure 5. An implant surgical guide was fabricated by using 3-dimensional printer (MegPrinter; Megagen, Daegu, Korea) as in Figure 6.

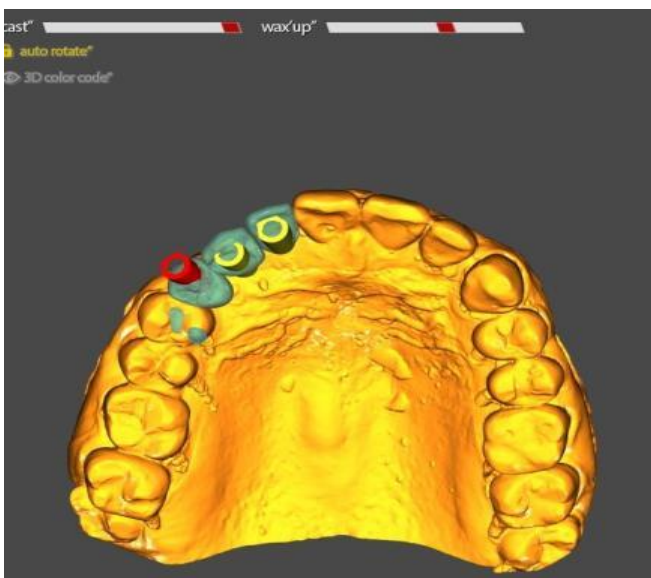


Figure 4: Digital diagnostic wax up showed 3 implant supported crown as future prosthesis.

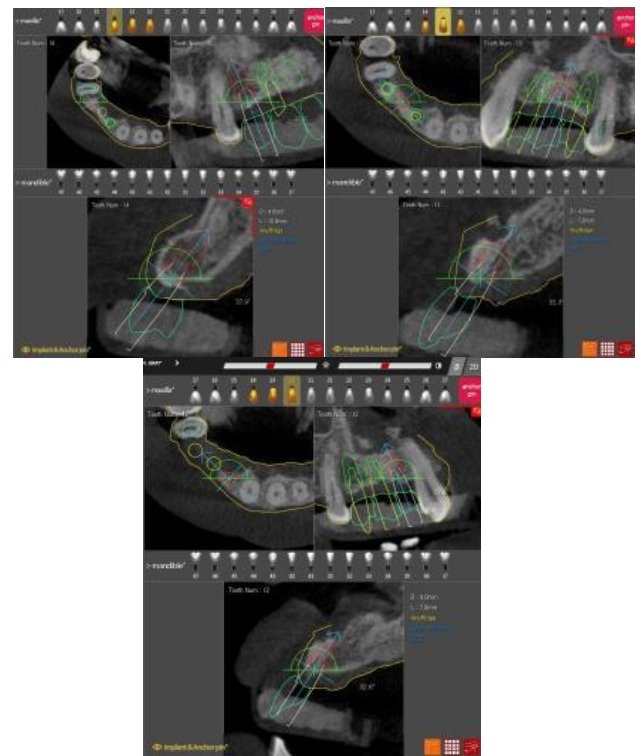


Figure 5: Digital implant planning showed the digital planning of implant supported crowns with 4.0 mm implant diameter for each implant and 10mm implant length for 14 and short implant 7.0mm for 12 and 13, respectively.



Figure 6: A sleeveless surgical guide was fabricated to allow accurate placement of dental implants utilizing R2GATE® full surgical kit (Megagen, Daegu, Korea).

The implant surgical placement and prosthetic restoration were carried out by an experienced dental surgeon and prosthodontist (MSA) under magnification (2.5x). Local anaesthesia of 2% of lignocaine hydrochloride with 1:80000 solution was administered, and a full mucoperiosteal flap was raised using a surgical scalpel blade from the mid buccal and palatal of 15 and 11. Periosteal and vertical releasing incisions were then made on the buccal flap to ensure flap mobility and passivity with the intention of a final primary closure at the surgical site. An implant placement using Anyridge® (Megagen, Daegu, Korea) was performed on the surgical site after an implant osteotomy utilising R2GATE® full surgical kit (Megagen, Daegu, Korea) as per Figure 7. The insertion torque value (ITV) was attained for 30 Ncm which indicated that a primary stability was achieved on each of the implant. The flap was sutured using resorbable vicryl

5-0 followed by some postoperative instructions. The patient was then prescribed with amoxicillin 500 mg, three capsules per day for the subsequent 5 days, and arcoxia 90 mg for pain management and only to be taken when needed.

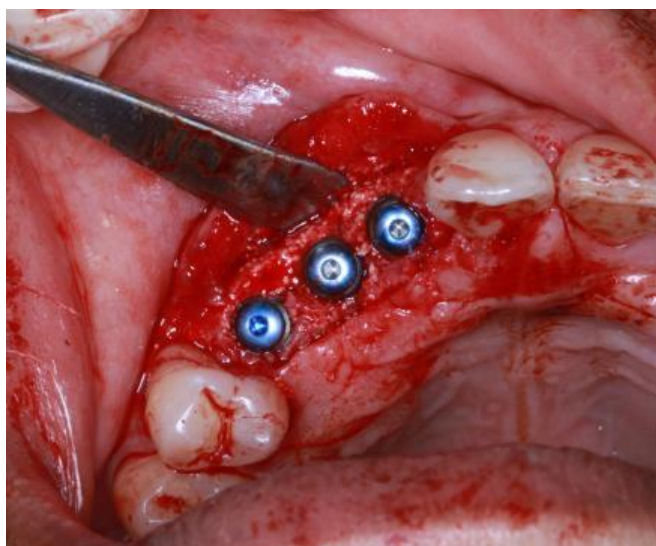


Figure 7: Implant surgical placement followed by placement of cover screw on previously augmented surgical site. Implant placement utilizing surgical guide allow an adequate inter-implant distance and to the adjacent teeth as per digital planning as depicted on the picture.

After 3 months, a second stage surgery was performed and healing abutments with a diameter of 4.0mm were placed on each implant. Adequate soft tissue emergence profile was achieved clinically after healing abutments were placed for 1 month. The impressions were recorded with heavy body and light body polyvinylsiloxane (Aquasil Ultra, Dentsply Sirona, Charlotte, North Carolina, USA) and prefabricated plastic tray (Figure 8). The implant crowns were then fabricated (Ivoclar Vivadent, Schaan, Liechtenstein) and the crowns issued to the patients with the final ITV of 30 Ncm for each crown (Figure 9).

At a 6-month follow-up maintenance recall visit, the patient turned up with healthy perimucosal and stable peri-implant conditions. There was no evidence which might indicate the presence of a perimucositis and periimplantitis condition. The patient was pleased with the functional and aesthetic outcome. In addition to that, there were also no post-operative complications on the superstructure such as chipping, delamination or loose implant crown which indicate 100% success rate at 6 months recall interval.

III. DISCUSSION

An anterior dentition is the area of high aesthetic interest, so the replacement of the missing teeth in this area with fixed dental implant prosthesis is highly desirable. The degree of the horizontal and vertical atrophy was not severe in this case; however, the first stage of GBR was performed to allow for the possibility of a screw retained implant instead of a cement retained restoration based on the initial observation of the clinical and digital radiography situation [15]. The advent of modern technology especially in implant dentistry allowed clinicians to preplan the surgical stage, thus, enabling the utilisation of the additive manufacturing advancement in the construction of an implant surgical guide [16].



Figure 8: Final impressions were recorded using polyvinylsiloxane (PVS) with an open tray technique.



Figure 9: Frontal photograph view showed the implant supported crowns were inserted.

This clinical case was described step by step, from the initial stages involving an orthodontic treatment to allow the ideal placement of a dental implant up to the implant crown placement. The report also focused on the surgical placement of short dental implants (7.0 mm) in previously augmented site with xenograft utilizing digital implant planning. The digital planning showed that the feasibility placement of 3 units of dental implant crowns, instead of 2 dental implants followed by fixed retained bridge, allowing a screw retained restoration. The short dental implants with screw retained restoration are the treatment modalities of choices in this case due to retrievability of the implant crown abutment, thus, making it easier for future maintenance work [17]. The encouraging medium and long-term result of short dental implants survival especially on the key criteria such as bone loss and future potential of biological and prosthetic complications also plays a role in the treatment option for this case [18].

A few literatures showed the risk of prosthetic complication considering the short dental implants empirically will have less than ideal crow-to-implant ratio [19]. With digital designing, the future crown can be planned at the initial stage prior to the surgical stage, allowing a better understanding at the rehabilitation stage. A static computer guided, implant surgery protocol allows a more accurate placement of implant fixture compared to traditional and conventional acrylic stent.

This is due to the accuracy of data acquisition from the state-of-the-art cone beam computed Tomography (CBCT) and with the aid of specific digital implant software such as R2GATE® which was as described above allow a clinician to previsualize and preplan the surgical placement of the implant fixture prior to the surgical procedure [7,20, 21]. In this case, the digital implant planning allowed a proper designing of the implant with a screw retained connection as it could easily be retrieved for future maintenance during the recall period [22]. In addition, the occlusal concept such as minimal loading during the functional movement and mutually protected occlusion could be applied accordingly.

IV. CONCLUSION

A short dental implant is seen as a viable treatment option as it adheres to the concept of a minimal invasive implant surgery combined with a shorter rehabilitation period. The authors' suggestion of a digital implant planning as part of the fundamental step in treatment using short dental implants especially in the anterior region of the dentition is able to ensure a good predictability in the outcome.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Written informed consent was obtained from the patient for the anonymised information published in this article.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest.

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