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A Novel Technique for the Treatment of Severely Atrophied Maxilla with Immediate Dental Implant Loading

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Abstract

Aims: This article aims to present a novel technique of dental implant placement for atrophied cases of maxilla without bone graft and/or sinus lifting and with early loading of the prosthesis. **Material and Methods**: In a clinical study fifteen cases of the severely atrophied maxilla were treated with the following approach; 8 implants were placed (2 implants in the pterygoid region, 2 implants in the trans-nasal region, and 4 implants in the anterior segment of the maxilla) with early loading of the prosthesis. With follow-up regarding Clinical complications, implant success/failure, and radiographic parameters were evaluated. Consent forms were taken from the patients. The data were tested by Descriptive data analysis using the Statistical Package for Social Sciences (SPSS, version 29). **Results**: Out of a total of 120 inserted implants, 8 implants in 15 patients (10 males and 5 females with mean age of 60.8 years), were placed to treat a severely atrophic upper jaw and with a mean follow-up of 28.27 months without any unwanted complications and without failure of the implants. **Conclusions**: With in limited cases that enrolled in our research; We concluded that the rehabilitation of difficult cases of severely atrophied maxilla can be achieved within a short period with early loading, and the patient need was met without additional surgical operations.

الخلاصة

الأهداف: تهدف هذه الدراسة إلى تقديم تقنية جديدة لوضع زرعات الأسنان لحالات الضمور في الفك العلوي دون ترقيع العظام و / أو رفع الجيوب الأنفية ومع التحميل المبكر للتعويض الاصطناعي. **المواد والطرائق العمل**: في هذه الدراسة السريرية تم علاج خمسة عشر حالة من الفك العلوي الضمور بشدة بالنهج التالي ؛ تم وضع 8 غرسات (2 غرسات في المنطقة الامامية، 2 غرسات في المنطقة عبر الأنف ، و 4 غرسات في الجزء الأمامي من الفك العلوي) مع التحميل المبكر للتعويضات الاصطناعية. مع المتابعة فيما يتعلق بالمضاعفات السريرية ، تم تقييم نجاح/فشل الزرع ، والمقاطع الشعاعية. تم أخذ نماذج الموافقة من المرضى. تم اختبار البيانات عن طريق تحليل البيانات الوصفية باستخدام الحزمة الإحصائية (spss ، الإصدار 29). **النتائج**: من بين ما مجموعه 120 عملية زرع تم إدخالها ، تم وضع 8 عمليات زرع في 15 مريضا (10 ذكور و 5 إناث بمتوسط عمر 60.8 سنة) ، لعلاج الفك العلوي الضموري بشدة وبمتابعة متوسطة تبلغ 28.27 شهرا دون أي مضاعفات غير مرغوب فيها ودون فشل الغرسات. **الاستنتاجات**: مع وجود حالات محدودة مسجلة في بحثنا ؛ خلصنا إلى أن إعادة تأهيل الحالات الصعبة من الفك العلوي الضمور بشدة يمكن تحقيقه خلال فترة قصيرة مع التحميل المبكر ، وتم تلبية حاجة المريض دون عمليات جراحية إضافية.

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INTRODUCTION

Rehabilitation of atrophied maxilla is a big challenge for practitioners working in the field of dental implantology. Severe maxillary atrophy, resulting from factors such as long-term edentulism, trauma, or congenital deficiencies, can lead to compromised bone volume and density, posing limitations on the conventional placement of dental implants [1]. Despite the challenge and depending on the degree of maxillary bone atrophy, there are many approaches like bone grafting techniques and sinus lifting, zygomatic implants, the all-on-four principle, and other techniques provided. All the previous approaches are very complex and associated with a high degree of morbidity [2]. Autologous bone augmentation techniques are regarded as the "gold standard" in the treatment of severely atrophic maxilla [3]. These procedures are often time-consuming, pose a risk of graft loss, and are commonly associated with donor site morbidity, which is why elderly patients in particular, or patients who previously experienced reconstruction loss often refuse repeat treatment with these techniques. Other techniques like the placement of implants in the pterygomaxillary region; distal to the maxillary tuberosity and engaging pterygoid bone were proposed [4]. In pre-maxilla when there is Insufficient bone volume; trans-nasal implants were used [5].This article aims to present a novel implant placement technique for atrophied cases of maxilla without bone graft and sinus lifting and with early loading of the prosthesis.

MATERIALS AND METHODS

A clinical study was conducted on Fifteen edentulous patients with severely atrophied maxillary bone from Jun 2020 to October 2022; a total of 120 implants were placed for the 15 cases. Ethical approval was obtained by the Ethical Committee of the College of Dentistry-Hawler Medical University-Erbil-Iraq.

The research adhered to globally recognized standards for the protection of human research participants, aligning with key international guidelines such as the Declaration of Helsinki. Before the commencement of the study, explicit informed consent was obtained from each participating patient.

Patient Selection

Patients with total edentulous arch in the upper jaw with severe bone atrophy, who intend to undergo rehabilitation of the maxilla with implant-supported dental prosthesis were selected for the study. And without medical diseases or with controlled medical problems and drugs or remedies that affect bone healing.

Clinical and Radiographic Evaluation

After clinical evaluation, a radiographic evaluation of Orthopantomogram *(OPG)* and Cone beam computed tomography (CBCT) was done for all patients (Figures 1 and 2).

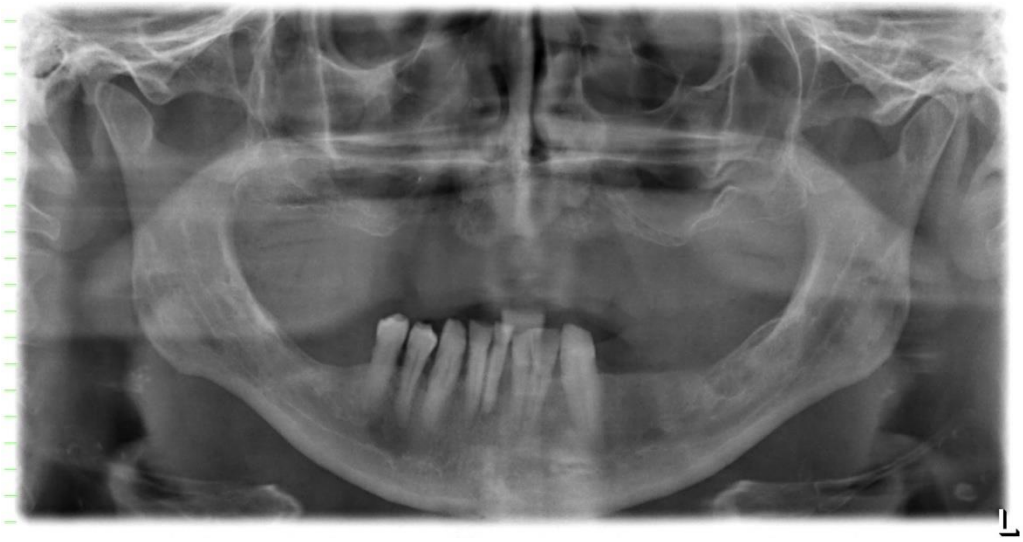


Figure (1): OPG of the patient with severe atrophy of the upper jaw.

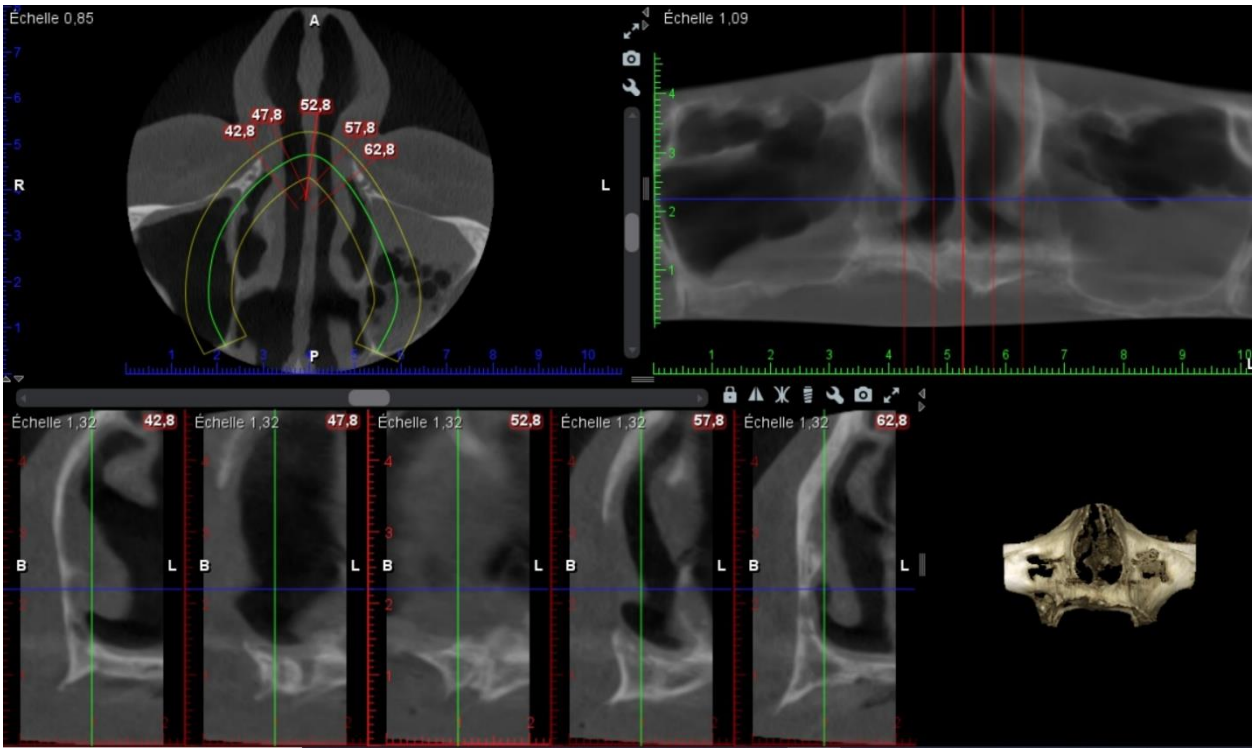


Figure (2): CBCT of the patient with severe atrophy of the upper jaw.

In this step, we measured the quantity of bone (Height and width) of available bone. The treatment options were presented to the patients and then the proposed approach was illustrated for them; 8 implants were placed for each patient (2 implants in the pterygoid region, 2 implants in the trans-nasal region, and 4 implants in the anterior segment of the maxilla) with flap approach and early loading of the prosthesis (Figure 3).

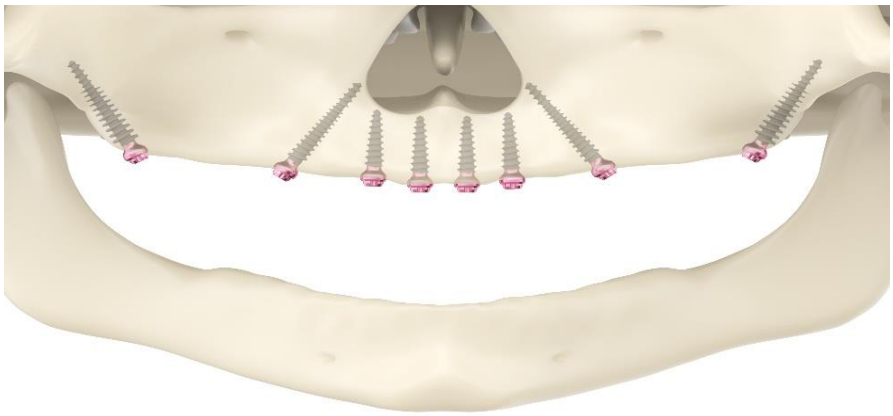
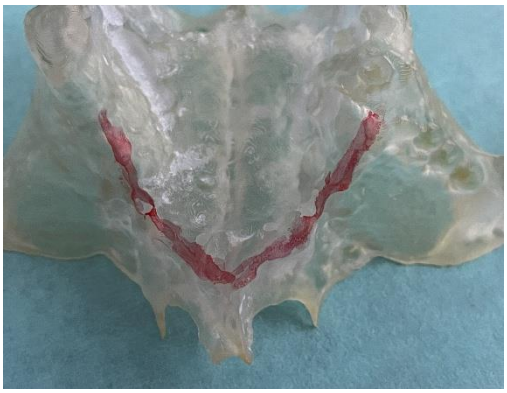


Figure (3): The illustrative photo of the proposed technique.

Implant Placement on Stereolithographic Models

After clinical and radiographical evaluation; surgical simulation on stereolithographic models was performed (Figure 4). During simulation, it is possible to verify the availability of bone in the pterygoid region and frontal process of the maxilla; which is a strong plate that projects upward, medial ward, and backward from the maxilla, forming part of the lateral boundary of the nose, and perform implant placement. Implant placement on stereolithographic models allows better prediction of all the implants' diameter and length and helps the operator for better implant placement inside the patient's mouth.



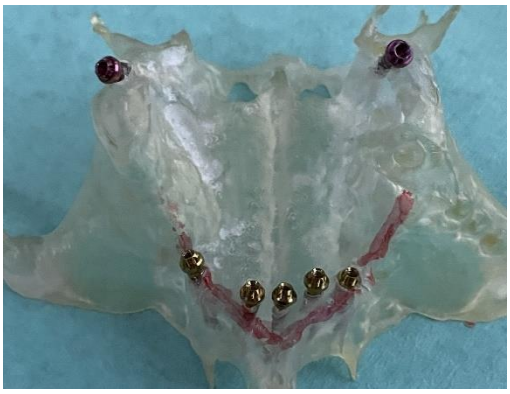


Figure (4): Surgical simulation on the stereolithographic model and Implant placement.

Type of Implants used for the patients

Compressive Multi-unit Implants from the ROOTT Implant System (TRATE AG, Swiss) were used in the present study (Figure 5). Implants are specifically engineered for use in narrow ridges and atrophied cases. The implant body is tapered, it ensures a high implant stability which encourages an immediate loading process [(6)].

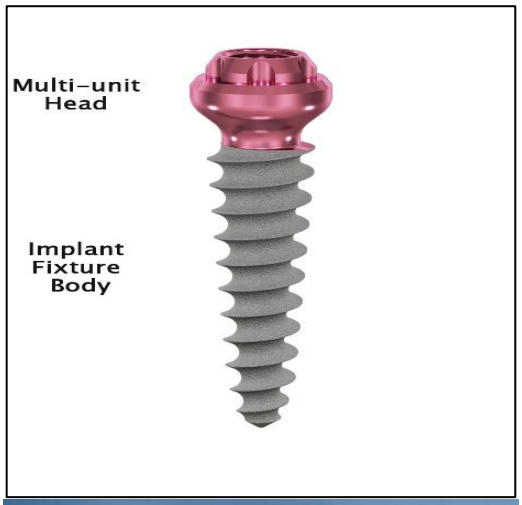


Figure (5): Compressive Multi-unit Implants, ROOTT Implant System (TRATE AG, Swiss)

One of the major advantages of this type of implant is that they have a fixed multi-unit head which allows the angulation of the implant to be easily solved in the prosthetic phase, especially the approach that followed in this study in which implants placed in a tilted way in both pterygoid and trans-nasal region. Another point regarding this type of implant is the type of fixation of the prosthesis which is screw-type fixation.

Surgical procedure

Local anesthesia with a vasoconstrictor was administered to contain local bleeding and intra and post-operative pain. After anesthesia achievement, a crestal linear incision was made extending to the distal of the maxillary tuberosity, the flap was reflected and 8 implants were placed for each patient (2 implants in the pterygoid region, 2 implants in the trans-nasal region and 4 implants in anterior segment of maxilla) (Figure 6).

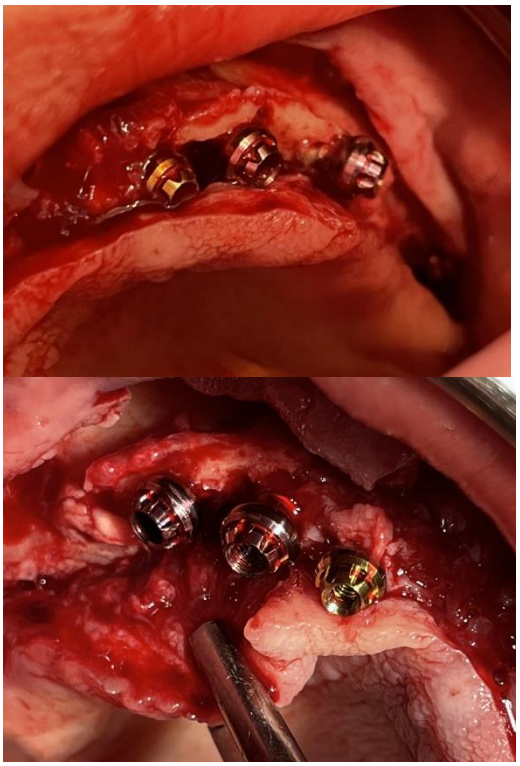


Figure (6): Compressive Multi-unit Implants in the anterior segment of the maxilla

All implants were placed with high primary stability. The flap returned back in place and sutured with monofilament suture material (Polyamide 4/0, LUX Sutures, Luxemburg) (Figure 7).

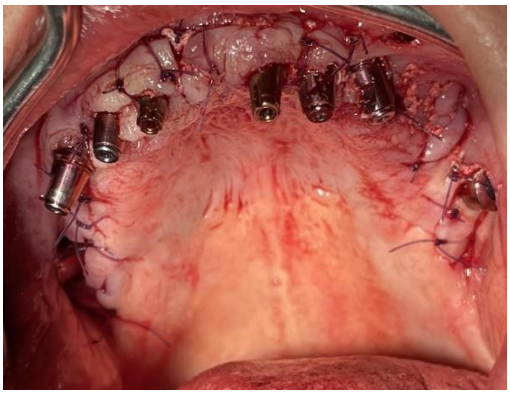


Figure (7): Flap closed and sutured with monofilament stitches

Prosthetic Phase

After the surgical procedure, direct impressions were taken using open-tray impression transfers and silicon impression materials (Figure 8).

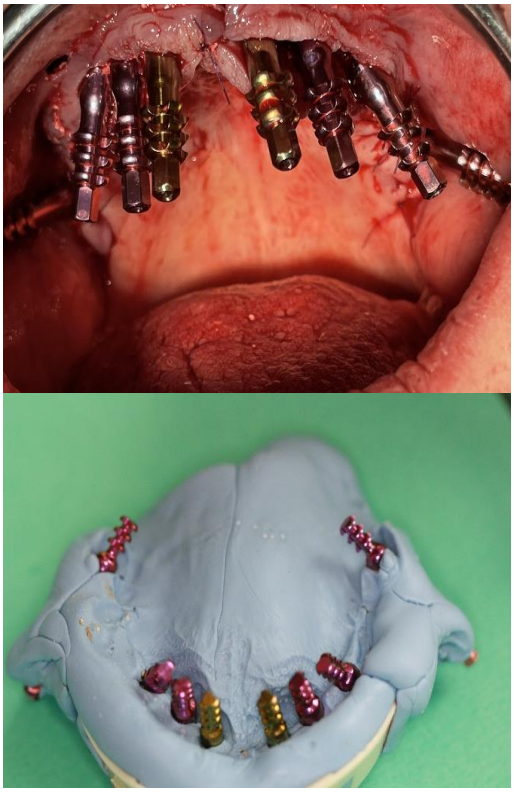


Figure (8): Prosthetic phase.

On the next appointment (After 1 week) a verification jig was tried to control the impression and to ensure that your final screw-retained framework has the optimum passive fit (Figure 9). Plus a verification jig is used to verify that the master model is accurate before manufacturing the framework (7). The material used for verification jig fabrication was pattern resin from (GC Company, USA).

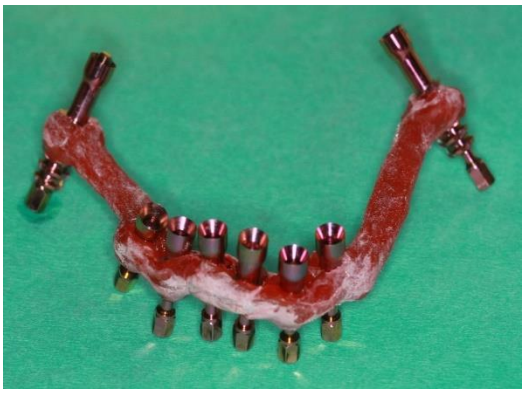


Figure (9): Indirect verification jig

On the next visit, the fitness of the prosthetic frame and occlusal bite were checked. As there was severe atrophy of hard and soft tissue in all fifteen cases and with increased inter-arch space with opposite dentition ; the size of the prosthesis was very large, so we made the prosthesis with a metal frame with Acrylic prosthesis and acrylic resin prosthetic teeth, and we ended having a prosthesis not too much heavy and increasing patients satisfaction. The final prosthesis is fixed to the implants with fixation screws (Figure 10).

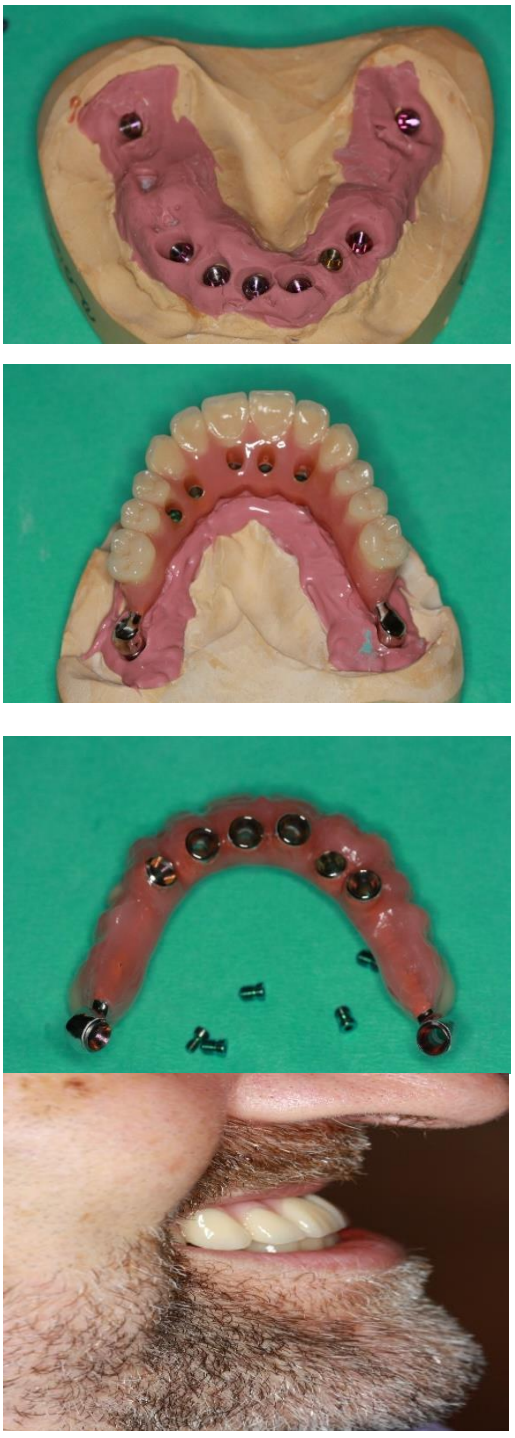


Figure (10): Master cast, Final prosthesis, and Clinical picture of the patient with final bridge work.

Follow-up and Data Analysis

The cases were followed up for a minimum of 12 months and more as the cases were treated at different time intervals (Figure 11), Clinical complications, implant success/failure, and radiographic parameters were evaluated using Smith and Zarb success criteria [8]. The data were tested by Descriptive data analysis using the Statistical Package for Social Sciences (SPSS, version 29).

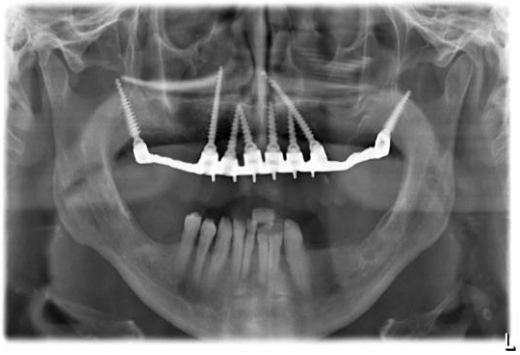


Figure (11): OPG of the patient after implant and prosthetic placement.

RESULTS

Fifteen cases were enrolled in the current study from Jun 2020 to November 2022; 10 cases were male with a mean age of 58.2 years and 5 cases were female with a mean age of 70.6 years; and the mean age of all 15 cases was 60.8 years, the details of dates were patients treated, age and gender of individuals participated in the research is presented in Table 1.

A total of 120 implants were placed for the fifteen cases; 8 implants were placed for each patient (2 implants in the pterygoid region, 2 implants in the trans-nasal region, and 4 implants in the anterior segment of maxilla); all with early loading and screw type fixation of the prosthesis. With follow-up of a minimum of 12 months and a maximum of 41 months (the mean follow-up period is 28.27 months), without any implant failure, no evidence of peri-implant

radiolucency, no persistent pain, discomfort, or infection is attributable to the implants and the implant design does not preclude placement of a crown or prosthesis with an appearance that is satisfactory to the patient and dentist. Table 2 presents the details regarding the number of implants, duration of follow-up, and implant success/Failure

Table (1): age and gender of patients enrolled in the study.

No. of Cases	Day/Month/Year	Age/Years	Sex
1	09/06/2020	52	M
2	22/01/2021	65	M
3	17/03/2021	57	F
4	25/03/2021	76	F
5	03/04/2021	55	F
6	05/04/2021	50	M
7	09/04/2021	47	M
8	07/05/2021	50	F
9	06/06/2021	65	M
10	09/06/2021	52	M
11	03/11/2021	54	M
12	25/11/2021	52	M
13	02/03/2022	45	M
14	07/04/2022	82	M
15	9/10/2022	81	F

F=Female, M=Male

Table (2): Number of the implants, duration of follow-up, and implant success/Failure

No. of Cases	No. of Pterygoid Implants Per Case	No. of Trans-nasal Implants Per Case	No. of Implants in Anterior Segment Per Case	Total of implants placed for each Case	Type of Loading	Type of Prosthetic Fixation	Follow-up/ in months	No. of implants failed
1	2	2	4	8	EL	SF	41	0
2	2	2	4	8	EL	SF	34	0
3	2	2	4	8	EL	SF	32	0
4	2	2	4	8	EL	SF	32	0
5	2	2	4	8	EL	SF	31	0
6	2	2	4	8	EL	SF	31	0
7	2	2	4	8	EL	SF	31	0
8	2	2	4	8	EL	SF	30	0
9	2	2	4	8	EL	SF	29	0
10	2	2	4	8	EL	SF	29	0
11	2	2	4	8	EL	SF	24	0
12	2	2	4	8	EL	SF	23	0
13	2	2	4	8	EL	SF	20	0
14	2	2	4	8	EL	SF	19	0
15	2	2	4	8	EL	SF	12	0

EL= Early Loading, SF = Screw Fixation

The sizes of implants used in the pterygoid region were between 3.5 to 4 mm^2 in diameter of implants, and with lengths between 16 to 20 mm^2. The sizes of implants were placed trans-nasally with a diameter between 3 to 3.5 mm^2, and with length between 18 to 20 mm^2. The sizes of implants used in the anterior segment of the maxilla between canine to canine were between 3 to 3.5 mm^2 in diameter of implants, and with lengths between 8 to 10 mm^2.

DISCUSSION

The rehabilitation of severely atrophied maxilla remains a formidable challenge in dental implantology. Traditional approaches, involving bone grafting, sinus lifting, and various other complex techniques, often present high morbidity and prolonged treatment periods. In this study, we introduced a novel technique for dental implant placement in severely atrophied maxilla cases, bypassing the need for bone grafts or sinus lifting, which exhibited promising results in terms of success rates, absence of complications, and patient satisfaction. Our outcomes align with the growing interest in techniques offering a less invasive alternative for atrophied maxilla rehabilitation.

The study successfully implanted 120 implants in fifteen severely atrophied maxilla cases, with a follow-up period ranging from 12 to 41 months (with a mean follow-up of 28.27 months). The high success rate and absence of complications or implant failures highlight the efficacy of the proposed technique. This success aligns with the contemporary trend toward less invasive approaches in complex dental implant cases.

Comparisons with previous studies indicate a shift toward exploring techniques that avoid extensive surgical interventions [9,10]. Traditional methods, including bone grafts and sinus lifting, are associated with prolonged treatment periods, increased patient discomfort, and higher costs. Our approach, emphasizing early loading and minimal invasiveness, aligns with this contemporary paradigm.

Mersel (2018) [11] reported success rates in atrophied maxilla cases using different techniques, emphasizing the importance of tailoring approaches to individual patient needs, contributes by presenting a specific technique tailored to severely atrophied maxilla cases without the need for bone grafts or sinus lifting.

The success observed in the study can be attributed to various factors. Meticulous patient selection, involving individuals with severe bone atrophy but without significant medical problems, ensured a cohort that could benefit from the proposed technique. Advanced imaging techniques, such as Orthopantomogram (OPG) and Cone beam computed tomography (CBCT), allowed for precise evaluation of available bone, guiding the implant placement strategy.

Surgical simulation on stereolithographic models provided an additional layer of precision, enabling the verification of bone availability in critical regions. This step proved crucial in predicting the diameter and length of implants and optimizing their placement during the actual surgical procedure. The choice of Compressive Multi-unit Implants from the ROOTT Implant System, designed specifically for narrow ridges and atrophied cases, played a pivotal role in achieving high implant stability. The tapered implant body ensured stability and facilitated the immediate loading process. The fixed multi-unit head allowed for easy angulation in the prosthetic phase, a crucial aspect, especially when implants were placed in a tilted manner in both the pterygoid and trans-nasal regions. Table 3 presents the comparison between the surface area of two types of implants (Root Form implants and Compressive Multi-unit Implants both lines the ROOTT Implant System, TRATE AG, Swiss), the same diameter and length of Root Form implants is bigger and pose more surface area than Compressive Multi-unit Implants; so, this is mean Compressive Multi-unit Implants needs less amount of bone for placement and its easier for placement foe severely atrophied cases.

Table (3): Comparison between surface area of Root Form implants and Compressive Multi-unit Implants, ROOTT Implant System, TRATE AG, Swiss).

Implant Diameter and length	Root from Implant (mm^2) 	Compressive Muti-unit Implant (mm^2) 
3010*	113.95	73.43
3510	137.32	81.83
3810	159.15	-
4010	-	91.95
4210	154.7	-
4510	-	116.78
4810	182.16	-
5010	-	131.23
5510	219.79	138.76

*3010=means an implant with diameter of 3 mm^2 and length of 10 mm^2

The clinical implications of the study are significant for practitioners dealing with severely atrophied maxilla cases. The new proposed approach is an option for conventional techniques that are long-lasting, have very short treatment periods, and meet the needs of patients without additional surgical operations. Avoidance of bone grafts and sinus lifting simplifies this procedure and reduces patients' morbidity and discomfort as well as increasing their satisfaction.

Our approach allows early loading of the prosthesis which helps in quick restoration of function and aesthetics. The use of screw-type fixation for the prostheses facilitated by Compressive Multi-unit Implants specific design leads to prosthetic phase convenience allows for easy adjustments and ensures a stable final result.

However, we must acknowledge several limitations in our study. The sample size used though enough for this study may limit the generalization of findings. This technique's effectiveness should be validated through future studies with larger sample sizes, longer duration of follow-up, and the presence of control groups.

CONCLUSION

In conclusion, the current study introduces a novel approach for implant placement in severely atrophied maxilla cases without the need for complex procedures like bone grafts or sinus lifting. The high success rate, absence of complications, and patient satisfaction observed in the study suggest that this approach has the potential to revolutionize the rehabilitation of challenging cases. By emphasizing minimal invasiveness, early loading, and the use of specific implant systems, clinical practitioners can provide more efficient and patient-friendly alternatives to conventional methods. While acknowledging the limitations of this study, we believe that this novel technique represents a significant step forward in the pursuit of optimal outcomes in the field of dental implantology.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

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