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Immediate Tooth Extraction, Placement of a Tapered Implant, and Provisionalization in the Esthetic Zone: A Case Report

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***Abstract*---**Purpose: This clinical report describes an immediate tooth extraction, followed by placement and pro- visional restoration of a dental implant in the prepared socket of a left maxillary central incisor. Materials and Methods: The tooth was extracted with minimal hard and soft tissue trauma and without flap reflection. A flapless, transmucosal surgical approach was used to prepare the socket and insert a tapered implant. The implant was immedi ately restored with a provisional abutment and crown without occlusal contacts. Results: During the period of provisional progressive loading, no significant soft tissue contraction was observed related to noninvasive operating techniques and the immediate insertion of the provisional restoration. The patient exhibited no clinical or radiologic complications through 8 months of clinical moni toring after loading. Conclusion: The Pivot Morse Line® implant and all-ceramic restoration provided the patient with immediate esthetics, function, and comfort without any complications during the postloading follow-up period.

***Keywords*---**immediate provisionalization, progressive loading, single-tooth.

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Introduction

The anterior region of the maxillary jaw is frequently termed the "esthetic zone," due to its high visibility and influence on facial appearance. Single-tooth replacement in this region can present a number of clinical challenges In contrast, removable partial dentures may provide an acceptable esthetic appearance, but compromise masticatory function and survival of the adjacent supporting teeth.[1] Implant-supported, single-tooth re- placement is a treatment option that can replicate the missing dental anatomy and restore full function without altering or damaging the adjacent teeth. 3-10 years long term studies have shown success rate of more than 90 percent in Dental Implants placed in esthetic zone.(Table 1).[2–10]

One drawback to the conventional placement of dental implants is the amount of time required to complete a procedure because conventional implantology requires the implant to be submerged beneath the soft tissues to facilitate the achievement of osseointegration.[11,12] Three to six months later, a second surgery is performed to expose the implant and clinically confirm its anchorage in bone. A gingival former is then attached to the implant and allowed to heal for approximately 2 weeks before restorative procedures are commenced.[11,12]

In a case where the hopeless teeth must be removed, a post extraction healing period of approximately 1 year has been recommended to allow for the maturation of new bone within the socket prior to osteotomy and implant placement.[11,12] This means that around 18 months must elapse before a definitive prosthesis can be delivered to the patient. This significant delay in prosthetic rehabilitation is disconcerting and inconvenient for the patient.[13] To shorten treatment time,[13] research in animal[14 –18] and human[13,19 –26] models have been conducted on the immediate placement of dental implants into ex- traction sockets. Longitudinal studies have reported survival rates exceeding 90% for immediately placed implants, 6 months to 11 years post functional loading. (Table 2).[19 –26]

At the extraction site success depends on the flattening of crestal irregularities, debriding of the socket with curettes and files to re- move any residual infection, inflammatory tissue or periodontal ligament, and socket shaping and deepening with appropriate drills so that lateral contact can be achieved with the im- plant body.[28] The diameter of the implant head must also match the mesio distal width of the socket's coronal aspect, or guided tissue regeneration techniques with or without osseous grafting must be employed to address the resulting interfacial gap. To prevent compromising the thin labial plate of a socket by perforation or overstressing, use of a tapered implant design has also been advocated.[29]

Some researchers have taken the additional step of immediately placing provisional single-tooth restorations at the time of implant insertion, if adjacent teeth were able to provide partial stabilization for the prosthesis.[29 –35] Rather than immediate, full occlusal/ incisal loading, the transitional prostheses were

non-occluding in centric and excursive mandibular movements. The adjacent anatomical structures and parafunctional behaviors of the patient provided a gradual application of force on the dental implants, which has been termed "progressive loading."[36] Relatively short-term studies of immediately provisionalized and progressively loaded single-tooth restorations have reportedly achieved survival rates above 90% for up to 3 years of functional loading (Table 3). This paper presents a clinical case report of a dental implant that was immediately placed into an extraction site and progressively loaded with a non-occluding, single-unit, provisionalfixed partial denture.

Clinical case report

Patient evaluation and case planning

A 21-year-old woman presented with fractured maxillary left central incisor (Fig. 1). Oral Examination revealed Elis Class 8 Tooth Injury (Fig. 2). Dental probing showed no presence of periodontal lesions around the central incisor or the adjacent teeth. CBCT scans (Dentium CBCT) (Fig. 3) using the correlation of the Hounsfield scale indicated that the bone quality ranged between thick porous compacta and coarse trabecular (D2 category: 850 – 1250 Hounsfield units) to porous compacta and fine trabecular (D3 cate- gory: 350 – 850 Hounsfield units) according to the Misch[37,38] classification. Based on these assessments, the decision was made to immediately place a wide-diameter (4.3 X 11 mm) Pivot Morse Line® implant with a microtextured surface into the extraction site and provisionally restore it with a single-unit, fixed partial denture. The implant was pack- aged on a multifunctional post that would serve as a fixture mount for insertion and as a transitional post for the provisional prosthesis (Fig 4).

Presurgical preparation

A dental stone cast was made of the patient's maxillary jaw, and the right central incisor was removed from the model. The modified cast was mounted on a semi-adjustable articulator with the opposing arch cast to assess the maxillomandibular jaw relationship,[39] and the vertical dimension between the edentulous area and the opposing dentition. A prosthetic tooth was waxed directly into the edentulous area of the working cast to establish optimal tooth location. An impression was made of the entire cast, then it was poured in dental stone and a second working cast was separated from the impression material after setting. To help position the implant for optimum support of the proposed prosthe sis, a vacuformed acrylic mold was made of the second working cast and trimmed to function as a surgical template that included only the edentulous area and two adjacent teeth bilaterally.

Surgical procedure

The patient was prepared for surgery and sedated with local anesthesia. A Transmucosal surgical approach without creating a mucoperiosteal flap was utilized. The periodontal ligament was severed, and the interproximal enamel of the left maxillary central incisor was filed to enhance the dislocation. Sectioning of the tooth to facilitate removal was unnecessary. The extraction was performed

as atraumatically as possible to avoid damaging the bony socket, which was vital for achieving immediate stabilization of the implant. Soft tissue remnants were carefully debrided from the internal aspect of the extraction site with curettes. Internally irrigated drills were used to sequentially enlarge and deepen the bony socket so that the implant could be placed 3 mm apical to the cementoenamel junction (CEJ) of the adjacent teeth (Fig. 5). After seating the implant according to the manufacturer's directions, the coronal portion of the socket was completely filled by the implant, which eliminated need for bone augmentation procedures.

Immediate provisionalization procedures

To prevent excessive heat generation, traumatic vibration, and irritation to the surgical site, the fixture mount/transfer post was removed from the implant, attached to a corresponding implant analog, placed into a holder, and prepared chairside to receive the provisional prosthesis. The prepared post was delivered to the implant in the patient's mouth (Fig. 6). A non-occluding provisional crown was filled with autopolymerizing acrylic resin and bonded on the day of surgery (Figs. 7).

Discussion

Osseous integration of a dental implant occurs gradually over time, and can be destroyed if excessive early loading damages the immature woven bone that initially forms at the bone– implant interface.[41] Progressive loading, or the gradual increase in applied occlusal forces to a dental implant, has been advocated to allow bone to remodel and organize in accordance with Wolff's law, which states that trabecular bone will place and displace itself in relationship to the forces around it.[37,42] Progressive prosthetic transference has been cited as the clinical application of the progressive loading concept, and involves the gradual functional loading of dental implants through the use of acrylic resin transitional prostheses that minimally disturb the integration process and avoid shock and stress to the implant-bone interface.[43] While use of the transitional appliance for a substantial amount of time (6 –24 months) may be indicated in order to satisfy the needs of progressive prosthetic transference in multiple-unit, screw- retained restorations,[43] it was felt in the present study that the protected occlusion afforded by the adjacent residual dentition in the maxillary anterior jaw and the lower occlusal bite forces associated with the incisal region (240 –290 N)[44] compared to the molar region (600 – 800 N)[44] warranted limited use of the transitional prosthesis until final soft tissue con- tours were obtained.

Creating an esthetic dental implant restoration in the anterior region of the maxillary jaw can present a significant clinical challenge, even when optimal positioning of the implant can be achieved. The titanium prosthetic abutment that emerges through the mucosa can discolor the implant-gingival complex.[45] Further contour changes in the surrounding hard- and soft-tissues over time can make this esthetic defect more pronounced. The application of porcelain directly to the prosthetic abutment and the use of an all-ceramic crown in the present case can greatly enhance the esthetics in this region and will

potentially help to maintain the appearance of the restoration in the event of additional abutment exposure in the future. The emergence profile of the prosthetic abutment also has a profound effect on the appearance of the final restoration.[46] The cylindrical form of root-form dental implants traditionally required a buildup of the abutment from the tissue line to provide an adequate transition to the prosthesis,[47] which could result in over- contouring of the prosthesis. In the area of the maxillary central incisor, for example, the alveolar bone may often only accommodate a 4-mm- diameter implant, but the emergence profile of the tooth can be 7 or 8 mm wide.[42] When the buccolingual and/or mesiodistal dimensions of the prosthesis are considerably larger than the diameter of the implant, excessive bending and loading of the implant can occur during functional loading.[48] Such overloading conditions have been cited in the dental literature as leading causes of peri-implant marginal bone loss, and can eventually lead to implant failure, if left untreated.[48 –51] In recent years, some implant manufacturers have attempted to address the problem by introducing abutments in a variety of emergence profiles and con- figurations,[47,52] while custom cast abutments[46,53–57] have been widely used for over two decades, especially in cases where implant placement was compromised. The use of a wide- diameter implant in combination with a custom cast abutment in the present case eliminated the need for excessive buildup of the abutment pattern, and effectively restored the emergence profile, angulation and function of the lost dental anatomy.

The selection of Pivot Morse Line® implant for this case offered several advantages. Achieving maximum use of available bone is axiomatic in oral implantology.[11,12] In the anterior region of the maxillary jaw, the contour of the residual ridge necessitates implant placement with a labial inclination in order to access the available bone as seen in CBCT(Fig. 3). The degree of implant angulation is dictated, in part, by the amount of resorption present in the ridge, and the location of the facial plate relative to the implant. Encroaching on the integrity of the facial plate by the implant can result in perforation and/or overstressing of the bone during implant insertion. One prospective, multicenter study of 3061 implants measured the thickness of the residual facial plate in prepared osteotomies immediately preceding implant insertion, and reported that facial bone loss significantly decreased and some bone gain was observed as the residual facial plate approached 1.8 to 2 mm in thickness.[58] In the same study, implants that failed to osseointegrate exhibited thinner facial bone plates with significantly greater amounts of resorption.[58] Immediate placement of the tapered implant design in the present case helped to maintain the integrity of the ridge by avoiding classical post-extraction resorption patterns, and thus limited the degree of required labial inclination for implant placement. Avoidance of the facial plate by the tapered design also enabled use of a longer implant than a straight implant body would allow as seen in CBCT(Fig. 3). A positive correlation between increasing implant length and greater implant survival has been widely documented in the dental literature.[2,59] In addition, the 4.3-mm diameter of the implant neck completely filled the occlusal aspect of the natural

alveolus, which eliminated the presence of an interfacial gap and the attendant need for guided bone regeneration procedures.

Despite enormous gains in the long-term predictability of titanium dental implants, failure rates have been documented to range approximately 10% higher in the maxilla compared to the mandible.[60 – 63] In this case, the self-tapping implant with three external threads demonstrated no discernable clinical mobility upon full seating. When aging, tooth loss and artery degeneration curtail blood supplies to edentulous regions, the associated periosteum and soft tissues may alternately serve as the primary blood source for the area.[64,65] A canine study reported that the vascular supply to implant sites was derived from the terminal branches of larger vessels from the periosteum at the implant site, and that peri-implant soft tissue lateral to the implant had sparse blood vessels.[66] In this case, a flapless, transmucosal surgical approach was utilized to preserve the vascular network and the natural contours of the soft tissue anatomy around the implant.

Conclusion

Immediate extraction, immediate implant placement, and provisionalization with progressive loading may improve the prognosis relative to the final esthetic results and decrease the number of surgical procedures required. The Pivot Morse Line Implant, provisionally restored with a non-occluding transitional prosthesis on the day of surgery and definitively restored 60 days later with a custom cast abutment and all-porcelain crown, achieved excellent results in the esthetic zone of the anterior maxilla.

Disclosure

The author claims to have no financial interest in any company or product mentioned in this article.

Table 1. Documented Longitudinal Survival Rates of Implant-Supported Single-Tooth Restorations

Study			Number of Implants			
Investigators	Maximum Follow-up Period (y)	Design	Placed	Purged*	Failed	Survival (%)
Orenstein et al[2]	3	Prospective	222	0	6	97.3
Gomez-Roman et al[3]	5	Prospective	696	17	19	97.2
Henry et al[4]	5	Prospective	107	18	3	96.6
Andersson et al[5]	5	Prospective	65	0	1	98.5
Schwartz-Arad et al[6]	5	Retrospective	78	0	6	92.3
Naert et al[7]	3.2	Retrospective	233	0	16	93.1
Schmitt and Zarb[8]	6.6	Prospective	40	0	0	100
Priest[9]	10	Retrospective	112	3	3	97.4
Polizzi[10]	3	Retrospective	38	0	3	92.1

* Lost to follow-up or not restored.

Table 2. Documented Longitudinal Survival Rates of Implants Immediately Placed into Extraction Sites

Study			Number of implants			
Investigators	Maximum Follow-up Period (y)	Design	Placed	Purged*	Failed	Survival (%)
Tolman and Keller[19]	6	Retrospective	303	10	2	99.3
Wagenberg and Ginsburg[20]	11	Retrospective	1081	0	54	95
Cosci and Cosci[21]	7	Retrospective	423	0	2	99.53
Gomez-Roman et al[22]	6	Prospective	124	13	4	97
Mensdorff-Pouilly et al[23]	1	Retrospective	93	8	7	91.8
Schwartz-Arad and Chashu[24]	7	Retrospective	95	0	5	94.7
Rosenquist and Ahmed[25]	0.5	Prospective	34	0	2	94.1
Becker et al.[26]	5	Prospective	49	17	3	90.6

* Lost to follow-up or not restored.

Table 3. Documented Longitudinal Survival Rates of Implants Immediately Placed into Extraction Sites and Progressively Loaded with Provisional Restorations

Study			Number of Implants			
Investigators	Maximum Follow-up Period (y)	Design	Placed	Purged*	Failed	Survival (%)
Garber et al[29]	2.8	Prospective	39	0	3	92.4
Wo¨ hrle[30]	3	Prospective	14	0	0	100
Cooper et al[31]	3	Prospective	58	5	2	96.2
Kupeyan and May[32]	0.5	Prospective	10	0	0	100
Gomes et al[33]	0.5	Prospective	1	0	0	100
Malo` et al[34]	2	Retrospective	94	0	4	95.7
Misch[35]	3	Retrospective	22	0	0	100

* Lost to follow-up or not restored.

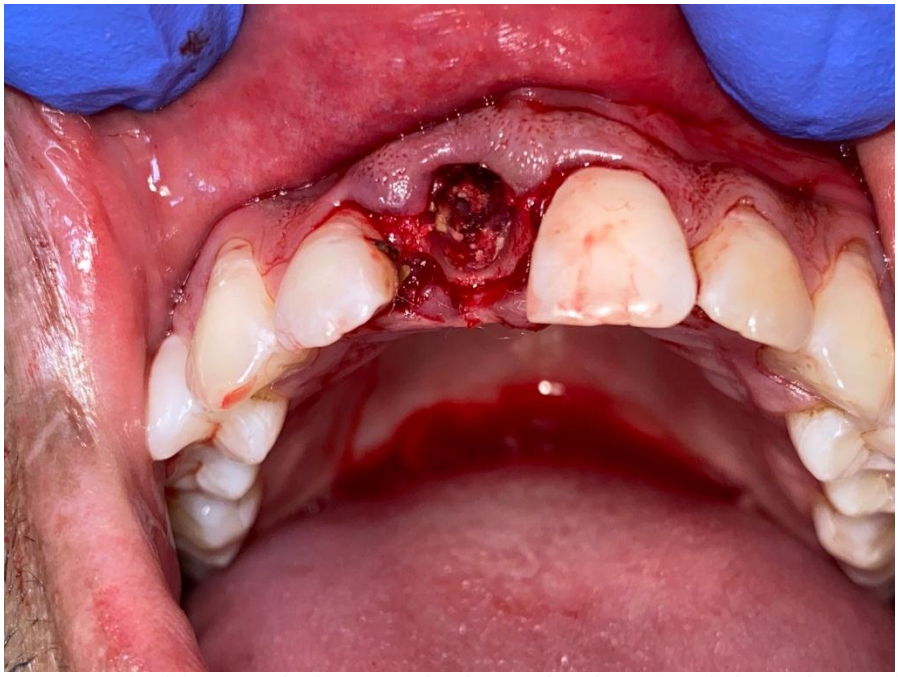

Fig. 1. Presurgical intraoral photograph shows dyschromia of the right maxillary incisor

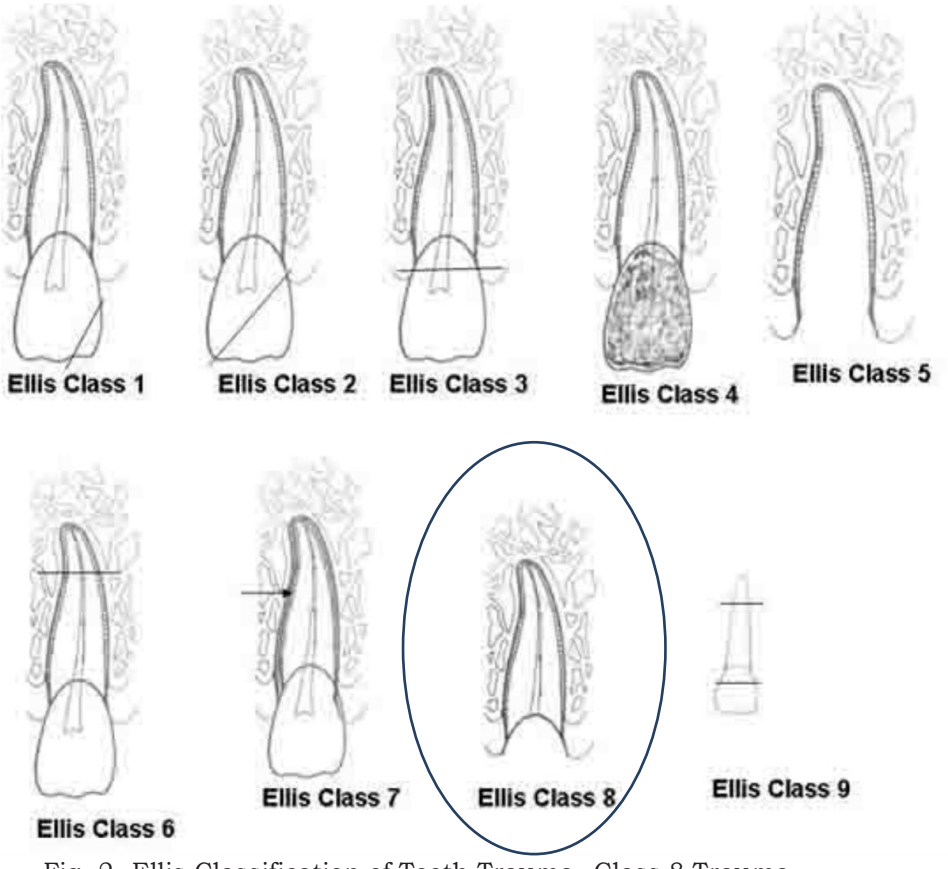

Fig. 2. Ellis Classification of Tooth Trauma- Class 8 Trauma

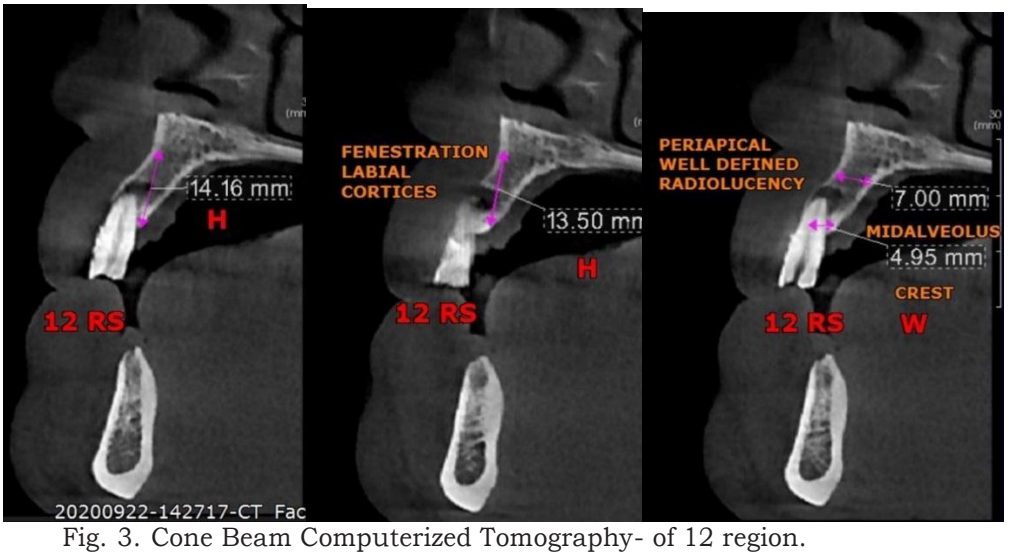

Fig. 3. Cone Beam Computerized Tomography- of 12 region.

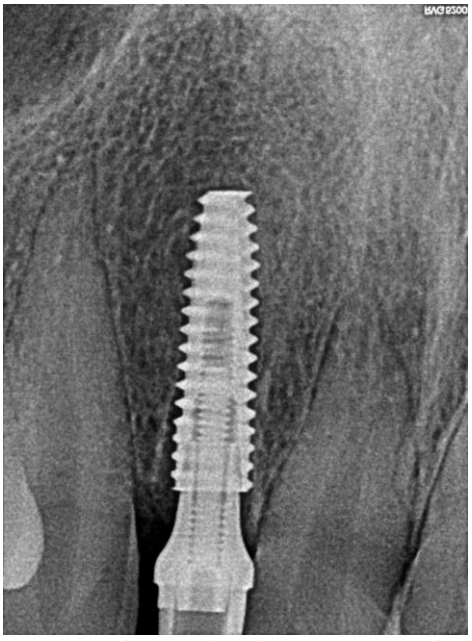

Fig. 4. Transitional Post for the Provisional Prosthesis

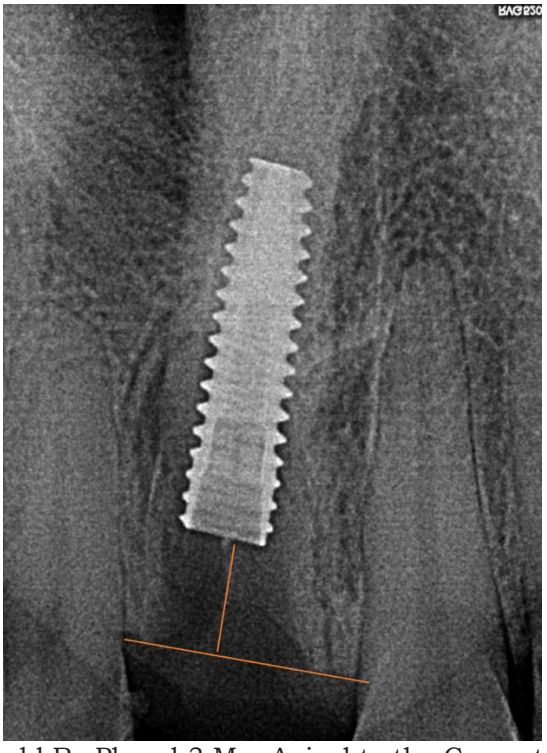

Fig. 5. Implant Could Be Placed 3 Mm Apical to the Cementoenamel Junction (CEJ) Of the Adjacent Teeth

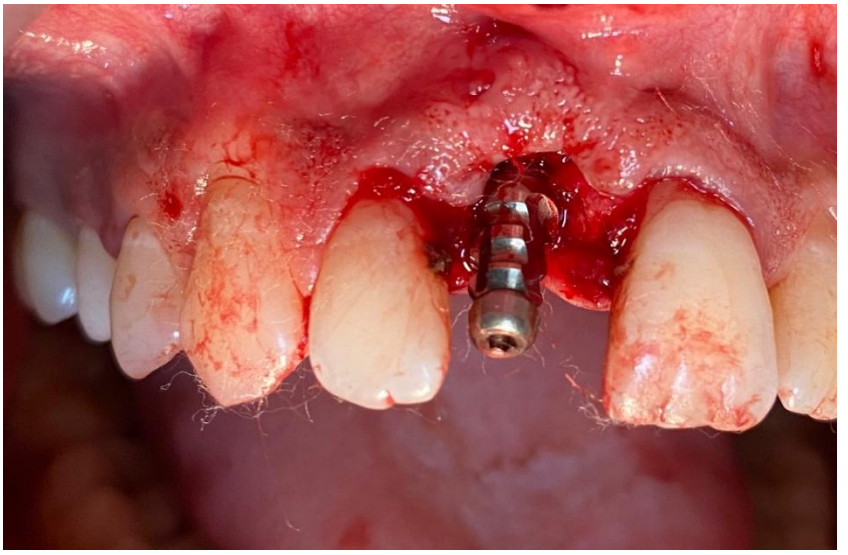

Fig. 6. Prepared Post Was Delivered to The Implant In the Patient's Mouth

Fig. 7. Temporization using Self Polymerizing Resin- 3M Protemp

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