Case Study 27

Immediate Dental Implantation

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Overview

Despite the great scientific and practical experience accumulated worldwide and in Ukraine with regards to the issues pertaining to dental implantology, the number of studies in the field of immediate implantation remains insufficient, as there is no universal approach to carrying out surgical operations, time frames loading time frames, selection of bone substitutes and implants, as well as variations in temporary and permanent prosthetics.

Relevance

In the last 40-50 years in Ukraine and similarly around the globe, research has been underway to study the essential scientific and clinical issues in dental implantation [5, 9, 12]. Advances deployed in fundamental and interdisciplinary applied sciences, versatile experimental inventions and clinical successes, have made dental implantation a mandatory technique in daily dental practice. Today, discussions continue on enhancing the list of dental implant indications, expanding the use of implants to restore dental arch defects as well as adjusting surgical and prosthetic protocols and procedures.

One of the developments is replacing the tooth with a dental implant, where by an implant is inserted into the socket at the time of tooth extraction, referred to as immediate implantation [1, 7, 8]. The idea of restoring the extraction site with an artificial tooth inserted into the socket similar to the natural one was implemented years ago and remains the basis of intraosseous implantation. The majority of experimental and clinical studies from the middle of the 19th century until the 1950s were in fact, on immediate implantation (Znamenskiy N. N., 1891; Vares E. Ya., 1955; Greenfield E.J, 1913; Strock A.E, 1938) [6, 10]. The winner, however, was the concept of surgical implantations into a fully intact bone tissue of the mandible and maxilla. A full regeneration of bone tissue within the limits of the extraction socket is possible no earlier than six months upon the extraction. Most patients receive implants in the site of teeth extracted 1-10 years prior to the procedure [2, 4]. During this time, however, alveolar bone atrophy inevitable occurs coupled with distortions and deformations in the

other elements of the dentoalveolar system, including adjacent and antagonistic teeth, as well as contralateral teeth, due to overload, periodontal tissues, TMJ, and neuromuscular apparatus, which, in turn, creates an unfavorable context for dental implantation or even renders it impossible [3, 11].
At this point, the defect could only be managed with conventional prosthetics techniques such as bridges or removable dentures.

The relevance of immediate dental implantation is evident. This approach is more than just a treatment modality, as in addition to therapy, it plays a prophylactic role. Implant insertion is performed together with tooth extraction, merging two surgical procedures into one, which alleviates the psychological stress for the patient and injury and trauma to the tissues. Further, the time span between tooth loss and its replacement with a dental restoration becomes shorter, i.e., restoring esthetics and function ensues more rapidly [1].

Studies on immediate implantation however, remain insufficient, as most of them focus primarily on single-rooted teeth, incisors, canines and premolars. This is the result of inevitable challenges related to implant insertion into post-extraction socket. Firstly, it is difficult to establish congruency of the implant and the socket, particularly in the presence of alveolar bone defects. Secondly, it is hard to ensure a complete contact of the implant surface with the site in the bone and achieve primary stability. Thirdly, it is imperative to consider the pathological modification of the bone tissue resulting from chronic inflammation and/or infection or dental trauma [4, 6, 9].

Materials and methods

Thirty five patients, 19 female and 16 male, in overall normal psychosomatic health, participated in the study. Informed consent was obtained from each patient for the clinical study and further use of its results in academic work. All patients underwent conventional preoperative clinical and laboratory examination. Complaints and history were recorded including symptom on set time and causes of the tooth lesion. General diseases and surgical interventions previously undergone by the patient were recorded, as well as allergies, bad habits and other circumstances, including diagnosis and correction of emotional responses, such as asthenic response, anxiety, hypochondriac and hysteric reactions.

Dental status investigation began with the observation of the face appearance and examination of the oral mucosa, noting its color, wetness, presence of bleeding, epithelial desquamation, ulcers, atrophy and/or hyperplasia. Periodontal probing was conducted noting any exudation from the pockets, if present. Presence of plaque and calculus was noted. A special probe was used to determine mucosa thickness and type, as well as its attachment. Dental exam included diagnosing caries and its complications, non-carious hard tissue lesions, tooth stability and mutual positioning, as well as occlusion type. Tongue characterizations, salivary gland function, mouth opening and amount of soft tissue subcutaneous fat were recorded. Complete oral hygiene and conservative treatments were performed, where the patient was instructed in oral hygiene.
At treatment planning stage, impressions were taken to cast diagnostic models and conduct their anthropometric analysis in the articulator, upon which the wax-up of prospective superstructure was performed (Fig. 1a, 1b). Imaging techniques included panoramic X-ray, computer tomography, and spot X-ray (Fig. 2a-2d). This enabled evaluation of the mandibular and maxillary topography and anatomy, determining relative positioning of the mandibular canal and maxillary sinus floor, assess the bone tissue structure, as well as the status of periapical and marginal bone around intact teeth and teeth requiring extraction.

Immediate Dental Implantation

Immediate implantation includes the stage of alveolar ridge augmentation with autologous bone or its synthetic or xenograft substitutes. In this study, bone substitutes produced by Alpha-Bio's GRAFT (Israel) were used.

The immediate dental implantation surgery was conducted both in the sites of the front and posterior teeth under local anesthesia with Sol.Septanest 4%. More often, nerve block anesthesia was used with additional infiltration anesthesia directly at the surgical site. Some patients (with expressed gag reflex, hypertension or phobia) received intravenous general anesthesia. Amnesia, analgeia and neurovegetative protection were achieved with the use of the following medicaments: propofol, sibasone, antalgic substances (pentazocine, nubaine, tramal) (Fig. 3 a-c). The circular ligament was then separated with the extration performed to preserve interradicular septum, bony walls and the floor of the socket as much as possible. The emptied alveola was curetted in order to remove all pathological soft tissue growth. A round drill was used to reduce and perforate the internal cortical plate of the socket to trabecular bone.

The implant site was prepared with Alpha-BioTec's internal irrigation drills at a speed of 400-1000 rpm under the depth probe and implant pin control, and with continuous cooling with saline NaCl 0.9%. Implant was inserted, and, in case of soft tissue deficit for would closure, soft tissue augmentation was conducted with an immediate healing cup placement (Fig. 4a-4d). Post-operatively, patients were prescribed broad-spectrum antibiotics, hyposensibilization medication and NSAIDs administered orally or intramuscularly. Antiseptic treatment of the surgical site was performed daily in all patients, with gentle hygiene recommended.

The second stage of immediate implantation commenced only upon X-ray confirmation of alveolar bone regeneration and implant osseointegration. With infiltration anesthesia incisions were made in the mucosa, with oral repositioning; cover screw was removed and healing cup was installed. Two to three weeks later, impressions were made in conventional tray with alginate putty. Models were cast to create customized impression trays with transfer openings and residual dentition stoppers (Fig. 5a). Following, with the help of transfers, anatomical impressions were taken with A-silicone or polyether materials (Fig. 5b), and fixed temporary and final prosthesis were produced according to the protocol.

Subsequent to examining the clinical picture and X-ray data, the following indications for post-extraction immediate implantation were determined:

1. Dental trauma (Fig. 6a-6e)
2. Chronic periodontitis with extensive coronal tissue and partial root tissue destruction (Fig. 7)
3. Ineffective conservative treatment of chronic periodontitis
4. Periodontal disease (I and II degree), tooth dystopia and indication for extraction for prosthetic purposes
5. Deciduous dentition with lysed root without permanent tooth buds (Fig. 8a, b)

Immediate implantation is performed exclusively upon the completion of bone growth, i.e., not early than the age of 18 or 20. It is necessary to have a socket with the bone available circumferentially around the implant inserted in it.

Immediate Implantation: main surgical stages

Osteotomy and Implant Insertion in the Maxilla

Tooth extraction was performed according to the generally accepted rules of dental surgery and with minimal socket and surrounding bone trauma. Special attention was paid to separating the mucosa off the neck and root of the tooth. During extraction, a separator was used together with angulated and straight elevators with thin grips. While working, care was taken to avoid trauma to the bone of the socket. If the tooth was mobile, it was removed using for ceps, generally universal, with thin grips. It is not recommended to perform luxating movements, particularly in the buccal direction. Having selected an implant from among those prepared for the surgery, socket depth was examined and compared against root measurements and X-ray data in order to establish the potential available bone dimensions for implant insertion.

Further, the relationship between the prospective element's apical part and the nasal cavity floor, maxillary sinus, mental foramen and mandibular canal was examined. Drilling was performed with a pilot implant drill with external irrigation (0.9% isotonic solution of sodium chloride). When the site was prepared, Alpha-Bio Tec's SPI implant was inserted. It is imperative to achieve the implant's primary stabilization in the bone; if found in the socket, cavities were filled with a biomaterial, i.e., either autologous or artificial bone (Fig. 9a). It is more challenging to create implant site in the canine and premolar areas. When insufficient bone was available, often on the buccal aspect in the area of central incisors, the implant site was prepared palatally (Fig. 9b).

If the cortical plate in the area of the maxillary sinus floor was too delicate, the preparation was performed distal of the top of the cortical bone, while preserving no less than 1-2 mm of bone between the implant's apex and the adjacent intact tooth. In the case of a double-rooted premolar, it is preferable to insert the implant into the socket of the buccal root whenever impossible. As long as there is insufficient distance to the maxillary sinus floor, the palatal root socket was used or a closed (open) sinus lifting procedure was conducted. The alveola of the second premolar has quite a wide orifice and a narrow diameter apically. Moreover, it may be oval in the bucco-palatal direction. The implant should be selected according to the bucco-palatal dimension of the alveola. The distance between the implant to the buccal root of the first molar and first premolar should be no less than 2 mm.

Osteotomy and Implant Insertion in the Mandible

Implant insertion in the mandible in the incisor and canine area is similar to the procedure in the maxilla (Fig. 10a, b), whereas in the premolar area, the surgery required meticulous analysis of the site's anatomy, such as the position of the mental foramen, and shape and position of the mental nerve loop, with the aid of computer tomography (Fig. 11). This determined the location of the soft tissue incisions and the shape of the flap raised. With implant insertion in the molar area of the mandible, predictable stability was possible as long as the roots were not merging and the interradicular septum was wide. To replace a mandibular molar (first or second), it is desirable to insert two implants in the projection of the medial and distal roots or with one large diameter implant (5.0-6.0 mm) in the furcation area.

Bone Wound Care

Curettage was only performed in the case of granulating periodontitis or when locating a granulome or fibrous thickening at the root apex. Curetting in the socket must becarefully executed. Excess mucosa,

as well as tissues modified by the inflammation process and grown into the root cavity, were removed. When granulation was located on the internal surface of the gingival margin, it was also removed. The socket was rinsed with chlorehexidine solution, gentamycin or 0.9% saline.

The implant was selected based on the root assessment and root diameter measurement at different levels. The choice should be based on the following criteria: the implant should be 2-4 mm longer and 1-2 mm winder than the extraction socket (Fig. 12). Ensuring that the soft tissue volume is sufficient for the wound closure without tension, the final stage of the implantation was completed with the suturing of the flap. When strong tension was present, a 1 cm long releasing incision was performed near the transitory fold (mucogingival junction). Mucoperiosteal flap was repositioned and sutured with Catgut chromic sutures, polyamide thread or thin silk sutures. In the central incisor area 1-2 mattress sutures were made. Post-operatively, cold (for 2-3 hours) and a pressure dressing (on the surgical site's soft tissue) were applied. Antibiotic therapy was prescribed on the day of surgery (amoxyclav 375 mg, 1 pill 2-3 times daily; loratadine 0.1 mg, 1 pill once daily), as well as mouth wash with 0.12% chlorehexidine solution. Patients were asked to take only soft and liquid food during the 7-10 days following the surgery. Implant position was checked with the X-ray on the day of surgery.

Results

Two months following immediate implantation, 33 patients demonstrated the implants' stability, both clinically and radiologically, with the absence of inflammatory modifications in the soft tissues. Two patients had a different outcome: Due to trauma, inflammatory processes developed (on day 10 in one patient and after 2 months in the second patient) leading to the implants' mobility and extraction. Further post-operative period for the 33 patients continued without complications.

Table 1
Location and indications for extraction and immediate implantation with immediate restoration

Location	Tooth fracture	Endodontic treatment failure	Root resorption	Total
Maxillary central incisor	4	10	2	16
Maxillary lateral incisor	1	2	1	4
Maxillary premolars	5	4	0	9
Maxillary molars	0	6	0	6
Maxillary canine	1	2	0	3
Mandibular central incisor	2	6	1	9
Mandibular laterla incisor	1	3	1	5
Mandibular premolars	0	5	0	5
Mandibular molars	0	8	4	12
Mandibular canine	1	2	0	3
Total	15	48	9	72

Implant exposure was performed via an incision above the neck of the implant. The cover screw was then removed, hygienic treatment was conducted on the internal part of the implant with chlorehexidine solution or hydrogen peroxide, and healing cup was place to remain fixed for 2-3 weeks. Check-ups were performed on days 2 and 10 following the exposure. Tissues were treated with disinfecting solutions, dressings were applied containing metrogyl, sea buckthorn and briar oils, Solcoseryl gel and conventional periodontal emulsions and ointment, which assisted in anti-inflammatory control and rapid would healing around healing cups.

All patients were invited for a radiological check-up to examine the implant's position and the condition of the surrounding bone. The data of spot X-ray filming were analyzed to see the implant position relative to the bone margin and bone resorption level during the time in function. When the implant was positioned 2 mm deeper than the socket edge, bone was forming above the cover screw, which created certain difficulties when installing superstructures (excess bone was reduced with a bur or a drill). Inserting the implant at the bone margin level created optimal conditions for prosthetic rehabilitation, with bone resorption during the first year being within normal limits. Filling cavities with biomaterials resulted in less inflammatory response during the early post-operative period and less bone resorption at a later stage. Bone resorption during the first year was within 1.0-1.1 mm and increased by 0.1 mm every year following. The structure of peri-implant bone tissue was denser. The best results were obtained when combining autologous bone with Alpha-Bio's GRAFT in the 1:1 ratio.

Table 2
Immediate implantation and immediate prosthetic rehabilitation: aggregated probability of success

Follow-up time (mo.)	Number of implants	Number of failures	Success rate (%)
1-12	15	0	100
13-24	15	0	100
25-36	18	0	100
37-60	24	1	96
Total	72	1	98,6

Between 2007 and 2012, 35 patients between the ages of 18 and 65 (mean age = 36.5 yrs.) received 72 Alpha-Bio Tec screw-type implants in the sockets of newly extracted teeth. The patients were followed up during a five year period. In total, 25 central incisors, 9 lateral incisors, 6 canines, 14 premolars and 18 molars were extracted (see Table 1). Indications for extraction included tooth fracture (15 cases), endodontic treatment failure (48 cases), and root resorption (9 cases) (see Table 1). Follow-up time varied from 1-60 months. As a result, a 5-year success record of the implantation has reached 98.6% (see Table 2).

At the time of temporary crowns, four patients developed fistulas at the level of crown-abutment interface and implant-abutment interface (i.e., between 1-3mm subgingivally). In three patients, temporary crowns lost cement fixation, with two out of these three patients having repeated crown adhesion loss. Loosening of the temporary abutment screw was observed twice in two patients. After permanent crowns were fixed, no further complications were observed.

Conclusions

The outcome demonstrates that immediate implantation is an efficient tooth replacement method when tooth extraction is indicated. Atraumatic surgical intervention, good esthetic results, and the possibility of using implants of other dimensions in case of initial failure, may all point to that it is desirable to implement this method in the clinical practice as a factor in dentoalveolar deformation prevention. The positive results obtained by this study at the success rate of 98.6% make it possible to recommend immediate implantation with the use of Apha-Bio Tec SPI implants to replace teeth immediately upon extraction. Clinical selection of patients based on the functional status of health and immunity, both generally and locally, enables the increased efficiency of the interventions. Clinical, immunological and radiological follow-up as well as maintaining proper oral hygiene determine the longevity of the implant functioning as a denture support.

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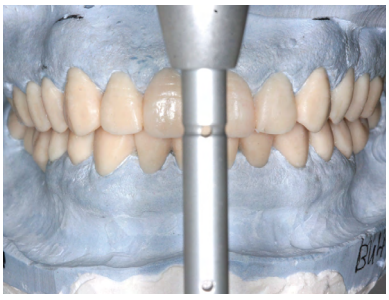
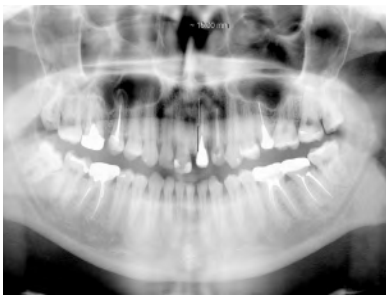
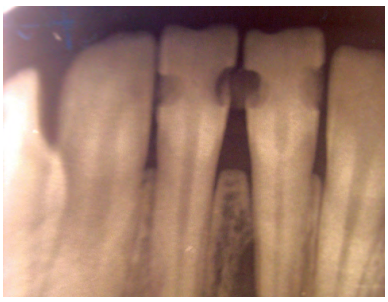
1 **Fig. 1a:** Wax-up of the future prosthesis in the articulator.



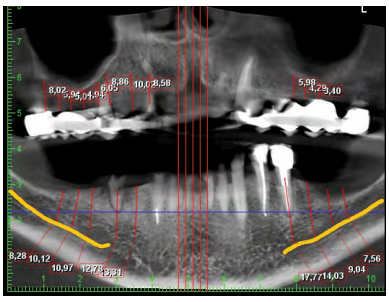
2 **Fig. 1b:** Wax-up of the future prosthesis in the articulator.



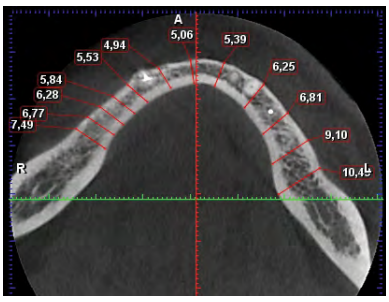
3 **Fig. 2a:** Radiological examination and treatment planning techniques used in dental implantation.



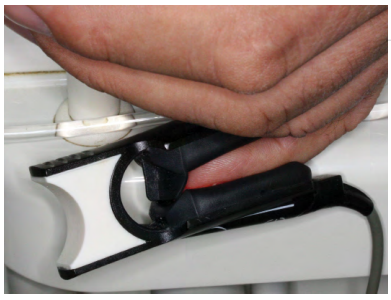
4 **Fig. 2b:** Radiological examination and treatment planning techniques used in dental implantation.



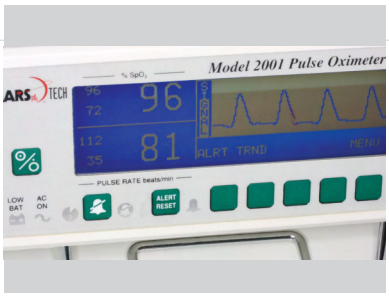
5 **Fig. 2c:** Radiological examination and treatment planning techniques used in dental implantation.



6 **Fig. 2d:** Radiological examination and treatment planning techniques used in dental implantation.

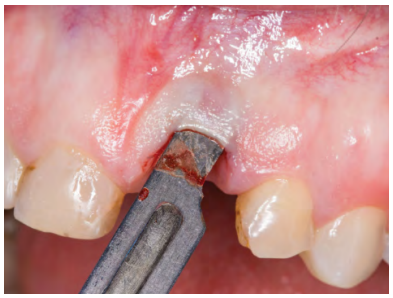


7 **Fig. 3a:** Electric sensor to monitor arterial blood pressure, pulse and oxygen saturation.

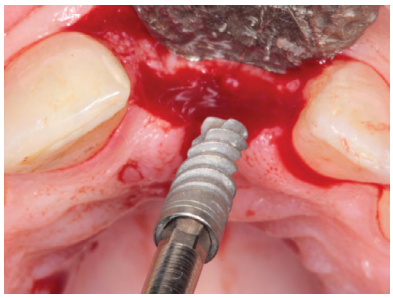


8 **Fig. 3b:** Oxymeters to monitor arterial blood pressure, pulse and oxygen saturation.

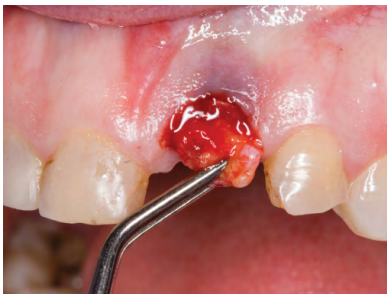
9 **Fig. 3c:** Oxymeters to monitor arterial blood pressure, pulse and oxygen saturation.



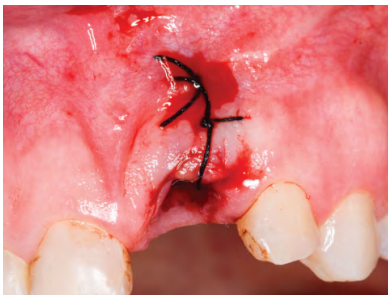
10 **Fig. 4a:** Connective tissue grafted buccally during immediate implantation in regio 21.



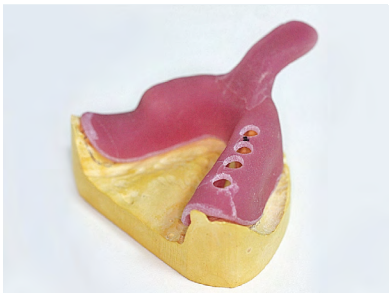
11 **Fig. 4b:** Connective tissue grafted buccally during immediate implantation in regio 21.



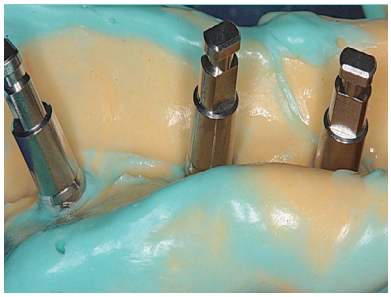
12 **Fig. 4c:** Connective tissue grafted buccally during immediate implantation in regio 21.



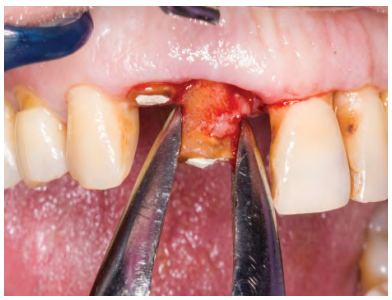
13 **Fig. 4d:** Connective tissue grafted buccally during immediate implantation in regio 21.



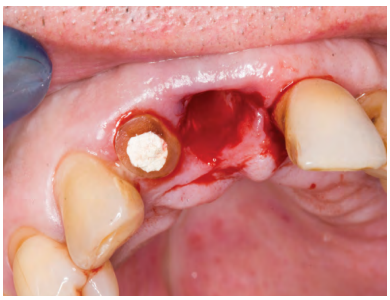
14 **Fig. 5a:** Customized tray with openings for transfers.



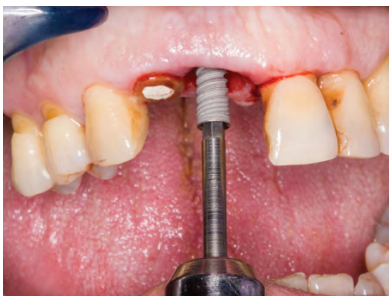
15 **Fig. 5b:** Implant analogs connected to transfers in the impression tray.



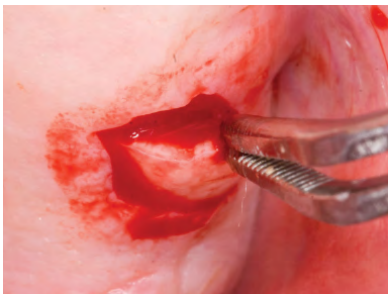
16 **Fig. 6a:** Immediate implantation following injury to tooth 11, with maxillary tuberosity graft transplanted to compensate for soft tissue deficiency.



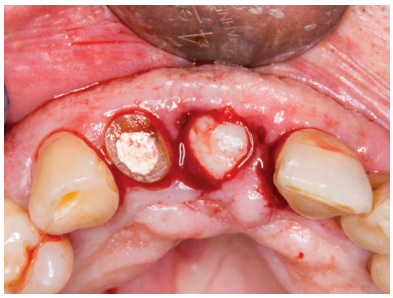
17 **Fig. 6b:** Immediate implantation following injury to tooth 11, with maxillary tuberosity graft transplanted to compensate for soft tissue deficiency.



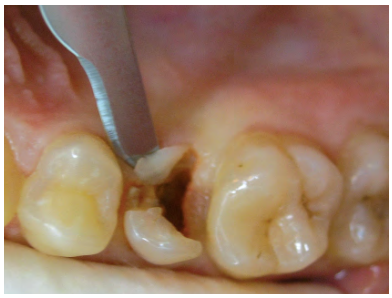
18 **Fig. 6c:** Immediate implantation following injury to tooth 11, with maxillary tuberosity graft transplanted to compensate for soft tissue deficiency.



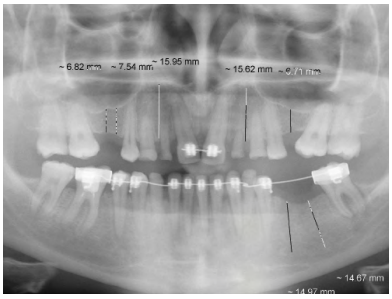
19 **Fig. 6d:** Immediate implantation following injury to tooth 11, with maxillary tuberosity graft transplanted to compensate for soft tissue deficiency.



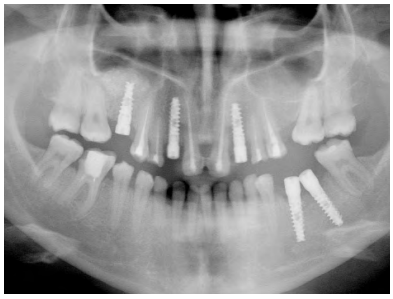
20 **Fig. 6e:** Immediate implantation following injury to tooth 11, with maxillary tuberosity graft transplanted to compensate for soft tissue deficiency.



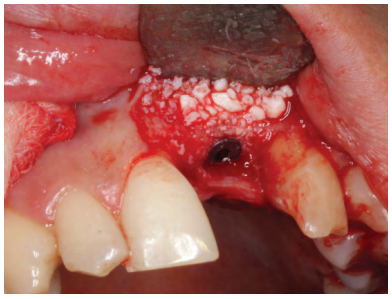
21 **Fig. 7:** A significant destruction of the crown of tooth 15 is an indication for dental implantation.



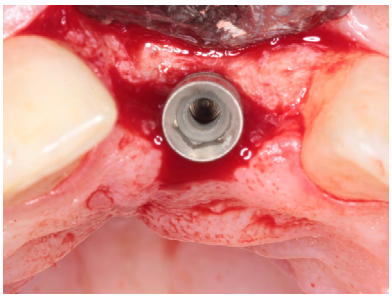
22 **Fig. 8a:** Congenital agenesis of permanent teeth is an indication for dental implantation.



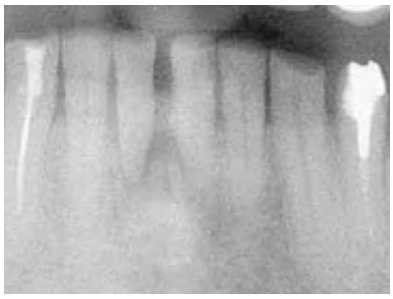
23 **Fig. 8b:** Congenital agenesis of permanent teeth is an indication for dental implantation.



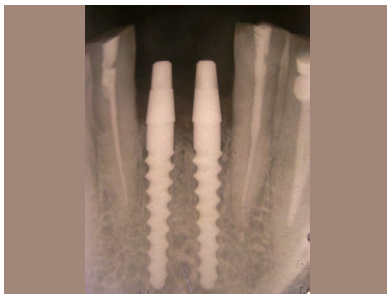
24 **Fig. 9a:** Augmentation during immediate implantation in regio 21.



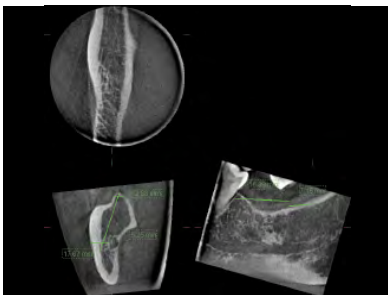
25 **Fig. 9b:** SPI implant inserted with a palatal inclination in regio 21.



26 **Fig. 10a:** Immediate implantation in regio 31, 4: ARRP implants (Alpha-Bio Tec).



27 **Fig. 10b:** Immediate implantation in regio 31, 4: ARRP implants (Alpha-Bio Tec).



25 **Fig. 11:** CT-scan to examine for the inferior alveolar nerve position.

26 **Fig. 12:** SPI implant, l = 6.0 mm.

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Alpha-Bio Tec's products are CE-marked in accordance with the Council Directive 93/42/EEC and Amendment 2007/47/EC. Alpha-Bio Tec complies with ISO 13485:2012 and the Canadian Medical Devices Conformity Assessment System (CMDCAS).