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Chapter 2

Immediate Implantation at Fresh Extraction Sockets

Belir Atalay

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Abstract

The term 'osseointegration' was first defined by Branemark in 1952. Osseointegration means direct connection between implant surface and live bone cells. At the beginning, the original protocol for installation of the dental implants was 6–8 months after extraction. After installation of the implant, waiting period for osseointegration time was 6 months for upper jaw and 3 months for the lower jaw. In 1990s, implant placement was mostly performed in 100% healed bone tissue. Today this approach has lost its dominance due to the evolution of the implant shape and surface features. Various studies show that immediate implantation has a 90–100% success in survival rate. However, primary stability of the implant at the fresh extraction socket still has a priority. Particularly after extraction of single root teeth implant, installation into the fresh extraction socket by filling the gap with graft materials come into prominence. Many types of graft materials can be used with or without plasma-rich materials like Plasma Rich Fibrin (PRF). Recent studies have shown that these kind of materials enhance the osteogenic regeneration. Immediate implantation proved that it reduces the total treatment time, prevents the loss of gummy tissues and gains esthetic success.

Keywords: immediate implant, bone graft, bone healing, fresh extraction socket, tooth extraction, osseointegration

1. Introduction

Amler describes the healing process into five stages. In the first stage after tooth extraction, hemorrhage and coagulum formation occurs. In the second stage, resorption of the coagulum and granulation formation over the clot occurs after 5 days period. In the third stage, new form of connective tissue begins to form over granulation tissue with early angiogenesis and this occurs over 14–16 days. At the fourth stage, apparently osteoid tissue begins to identify and to fill the whole socket with bone takes about 6 weeks. At the last stage, complete epithelial

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closure of the socket occurs in almost 25 days and the extraction socket is fulfilled with bone approximately in 16 weeks [1]. The highest osteoblastic activity occurs between 4 and 6 weeks and after 8th week, this process begins to slow down [2]. This progress has been found by histologic examination of human extraction socket biopsies and animal histologic materials [3–5].

After extraction, there will be a resorption period at the same time with the healing process. It is a physiological mechanism and in the first year after extraction its effect is higher than the following years. There are many studies that measure the resorption of the alveolar bone quantity after tooth extraction. Different methods were used for this purpose, direct measurement by the time of implant surgery [6–9]. Study cast measurement, cephalometric measurements and subtraction radiography methods were also used for this purpose [6, 7, 10–13].

During post-extraction period in the first year, the alveolar bone loss is calculated about 4 mm in bone height and 25% loss in total volume [12]. At the same study, scientists report that 40–60% of bone loss occurs in 3 years after tooth extraction. Christensen et al. reported that in long-term period, the resorption at the extraction site was 0.5–1%. These physiological changes can potentially be seen in every patient. Approximately 6 mm bone resorption is identified over 6–12 months and 50% of this bone resorption is horizontal alveolar ridge reduction [10, 14]. The vertical ridge loss was measured as 2–4 mm by researchers. And this can be more than 4 mm. when multiple extractions performed [14, 15]. After 6 months post extraction, approximately 50% of the vertical resorption has been reported [6, 7]. Both vertical and horizontal bone resorption over a 12 month period occurred simultaneously together. Most of this process occurs in the first 3 months after the extraction. After 12 months, crestal bone levels at the tooth surfaces neighbor to the extracted tooth remained almost same with the amount of 0.1 mm bone loss. The newly formed bone at the extraction socket cannot reach the bone level of the neighbor teeth [11, 16].

There are many factors which may affect these resorption process such as systemic factors, patient habits and general health conditions, local extraction trauma, periodontitis, socket wall conditions, number of extracted adjacent teeth, differences between mouth and dental arches, the biotype of the soft tissues and the type of temporary prosthesis if applied [16]. Besides those factors, the pattern and rate of resorption may be changed if traumatic extraction, pathologic processes or occlusal trauma have damaged one or more bony walls of the socket [17]. There is still insufficient scientific studies about the differences between rates and healing patterns of damaged and intact sockets [16].

Literature suggested guideline for implantation was waiting for alveolar ridge remodeling and healing for 3 months after tooth extraction. And 3–6 months stress free submerged healing without loading was needed for osseointegration [18–20]. At the beginning in 1952, the original Branemark protocol for installation of implants was minimum 6 months waiting-healing period of extraction sockets [21, 22]. Generally the two stage approach was applied; first surgery implant placement and after 3–6 months of submerged healing period, the second surgery applied to open the implant into the mouth. It took approximately 1 year for the final implant supported restoration [12, 23]. This extended treatment time generally necessitate a removable prosthesis enhance cost of the treatment and inconvenience at the patients.

Recently against earlier protocols, need for a faster and more affordable treatment type has gain necessity. There has been increasing interest in immediate implantation [24]. There are several classifications till 1990 to describe the timing of implantation. Mayfield discussed the procedure based on timing after tooth extraction. The terms immediate, delayed and late are used to describe time intervals of 0 weeks, 6–10 weeks and 6 months or more after tooth extraction [25]. Wilson and Weber make a classification based on soft tissue healing but without time intervals [26]. The terms immediate, recent, delayed and mature are used to describe the timing of implantation in relation to soft tissue healing [26]. Hammerle et al. proposed a new one in 2004 that was based on soft and hard tissue healing a classification of four categories (Type1–4). Type I describes immediate implantation after tooth extraction at the same day. Type II describes implantation after complete soft tissue healing typically 4–8 weeks after extraction. Type III was implantation after clinical and/or radiographic bone fill of the extraction socket typically 12–16 weeks after extraction. And Type IV describes the implantation after complete bone fill of the socket means typically more than 16 weeks after extraction [27].

Today well accepted terminology of immediate implantation includes immediate, early and late placement of implants at the post-extraction sockets [28, 29]. Immediate implant placement means implantation at the same time instantly after extraction into the extraction socket. Early placement is 2–4 week delayed implantation after extraction and allowing soft tissue healing. And delayed approach is the conventional method describes implantation after 4–6 months of waiting for complete healing time [27].

There are many advantages of immediate implantation. With this procedure, there is a reduction in the number of surgeries and shorten total treatment time. Also immediate implantation preserves the bone and soft tissues at the extraction socket [30–36]. It decreases the morbidity and rehabilitation time associated with crown replacement and increases patient satisfaction with treatment [32, 37, 38]. However, there is a higher risk for implant failure, unpredictable hard and soft tissue changes and difficulty at primary stabilization [27]. Early placement is also shorten the treatment time but requires an extra surgical procedure and waiting for 2–4 weeks post-extraction allows soft tissue healing. Conventional delayed implantation takes the longest treatment time, requires extra surgical intervention and bone resorption during healing, however, that procedure have less implant failure risk [27, 39]. The short-term survival rate of the methods seems similar between each other. However, there is still little data on the success rates [27].

2. Immediate implantation indications and contraindications

For immediate implantation, it is better to provide ideal clinical conditions. The evaluation of gingival type, facial bone wall, level of smile line, hard and soft tissue levels must be evaluated [40, 41]. When full intact of facial bone with thick phenotype of gingival tissue represents there is a very low risk of gingival recession at the neck of the implant prosthesis. If implant placement is done in patients with a thin biotype, there will be a high risk of thread exposion. Because thin gingival biotype has higher frequency for gingival recession when compared with

thick biotypes. As a result, immediate implantation at the areas with thin tissue biotypes is often not recommended [42, 43]. There must be no an acute or purulent infection at the extraction socket or close to the socket. When chronic infection presents at the extracted tooth area, it can be a concern to place an immediate implant, although not all authors agree for that. Currently, it is agreed that immediate implantation can be performed at the same time with the extraction of periapical lesion sites as long as the infection is removed totally and implant primary stability achieved [27]. Periodontal biotype affects periodontal tissue dimensions and esthetic outcomes [40]. It should be sufficient bony walls at the apical and palatal sites of the socket though implant need to be primarily stabilized and the 3D positioning should be acceptable [44]. For predictable outcome of immediately, replaced single tooth implant success, Kois addresses five diagnostic factors. These are:

1. Tooth position relatively with free gingiva margin,
2. Biotype of the periodontium,
3. Form of the periodontium,
4. Condition of the crestal bone before extraction,
5. Tooth shape.

These factors should be analyzed carefully before immediate implant placement [41]. When there is an option for flapless surgery, it is the ideal circumstance compared with open, flap procedure. With flapless surgery, there will be less recession of the peri-implanter area. Flapless immediate implant placement offers least morbidity for the patients. Although it might seem to be a simple surgery, it is considered as a complex one [44]. It is not easy to prepare a new implant socket at the same extraction socket. Procedure needs a skilled surgeon with experience. New implant socket must be prepared more palatally and avoid any palatal or buccal perforation. To avoid any perforation risks or malposition of implant, guided surgery can be performed or the surgeon should be experienced for the procedure. Corono-apically, the implant should be placed deep inside the extraction socket. The distance between implant shoulder and mid-facial bone crest should be 0.5–1 mm [45]. In some cases, this amount reaches up to 2 mm. This approach avoids worse esthetic outcomes according to the bone resorption. Also distance between implant shoulder and internal surface of the facial bone wall should be at least 2 mm [46]. That gap provides a space for the formation of a blood clot. And from that clot, provisional connective tissue matrix is organized. This change in time to the newly formed woven bone [44]. This gap can be filled with appropriate bone grafts and it is recommended by many researchers and clinicians. Bone grafts reduce the amount of post-surgical buccal bone resorption [47].

To generalize indications, immediate implantation should be performed at systemically healthy patients without acute infection areas and who has adequate hard and soft tissues with intact facial plate and thick tissue biotype. The absolute contraindications are patients with complicated systemic disease, history of iv bisphosphonates usage, uncontrolled periodontal disease, absence of intact labial bone and presence of acute infection. Heavy smokers and maxillary sinus involvements are relative contraindications [27].

3. Surgical procedure

For achieving successful long-term results with immediate implant placement at the fresh extraction sockets, there are some essential rules to obey. In each patient, periapical and panaromic X-rays and computerized tomography scans should be obtained if necessary. If there is no contraindication for the patients administration of local anesthesia, 2% Articaine HCl with 1:100,000 epinephrine was performed. No incisions should be made and no flaps should be reflected unless necessary. At the beginning, an atraumatic tooth extraction is important. Sharp and thin devices like periotomes may be better to use subcrestally when dissecting the fibers. Tooth should be elevated with minimal trauma to the alveolus and rotational movement is better to achieve. Surgeon should avoid to damage the buccal plate and for that it is important to avoid bucco-lingual movement [48]. When the extraction performed at the molar area sometimes endodontically treated roots, multiple roots and curved roots can make the extraction more challenging. Mostly root fracturing can happen. Leaving root tips that can leave the surgeon in medico legal jeopardy to avoid this, it is too important for the surgeon not to leave any root particles in the extraction socket. It is better to use diamond burrs for cutting roots coronally. If there is chronic infection at the socket area, all residual infected remnants must be removed properly. After curettage, the area intrabone marrow penetration with round burrs and curretes can stimulate bleeding and this allows bone fill with maximum amounts [27]. Implant must be placed into enough natural bone with enough primary stability apically or laterally in an ideal three-dimensional position at the extraction socket. Placement of the implant, 3–5 mm apically into the socket or using wide diameter implants increase primary stability. Also placing the implant 2–3 mm below cement-enamel junction of adjacent tooth will provide a better outcome [30, 49, 50].

To prevent buccal plate damage, Yalcin et al. developed an extraction technique in 2009. In this technique in order not to traumatize the surrounding bone during elevation, implant drills were placed in root canals to thin out the root walls giving enough space to extract tooth without applying much more force. It is better to use thin and sharp drills at the beginning. The diameter of the drills should be increased after first sharp drill. Recommended diameter after first drill is 2 mm pilot drill and afterwards it can be increased according to the implant system and the diameter of the tooth. Before final drilling, it is better to extract thin walls of the root from the extraction socket. Preparing the implant site using drills as palatally as possible is recommended. When the socket is ready for implant placement, a periodontal probe should use to explore and estimate the integrity of the alveolar bone. Periapical radiographs can be taken to confirm the total removal of the root remnants. To maintain primary stability, it is better to place long and wide implants as much as possible. After placing the implant, filling the gap between implant and buccal bone with bone graft is recommended [51]. (**Figures 1–13**) There are many different graft types that used in oral and maxillofacial surgery. The gold standard material for grafting procedure is autogenous graft. Preparing the extraction socket for immediate implantation may provide to collect some autogenous bone graft material. Besides this there are many different graft types, for healing process there is no difference between graft types was found that filled the gap around immediately placed implants. Scientific data about this topic assumes the gold standard for grafting was autogenous

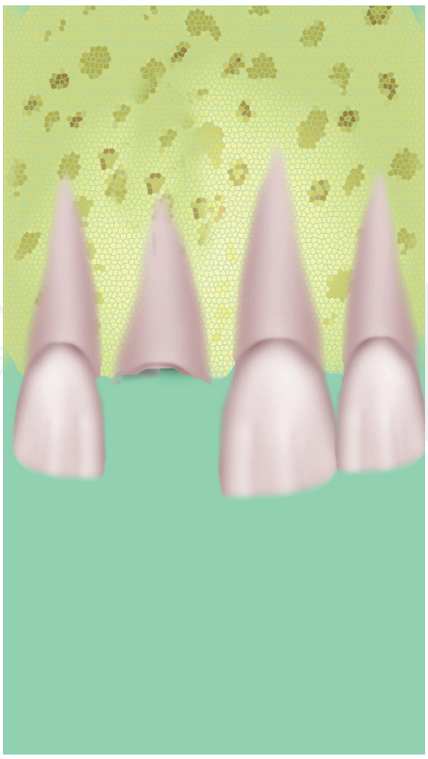


Figure 1. Schematic view of a broken tooth deep in the socket.

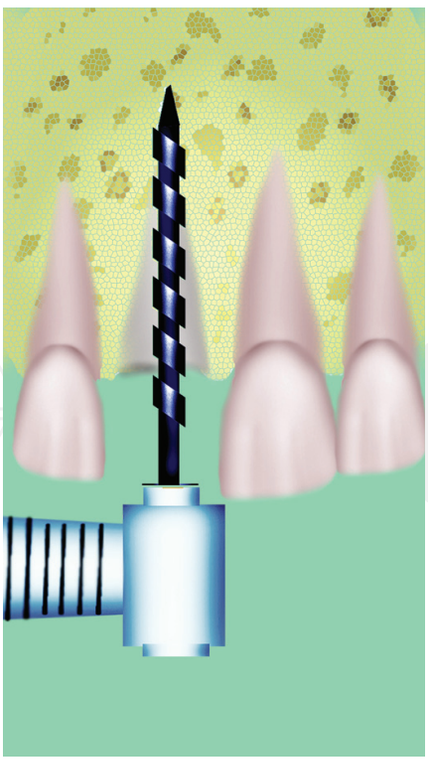


Figure 2. Thinning the walls of the root with a thin and sharp pilot drill. The first drill should move through the root approximately 3–10 mm in depth.

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Figure 3. Drilling the root with a 2 mm sharp first drill.



Figure 4. Drilling starts at the center of the root moves apically to palatally.

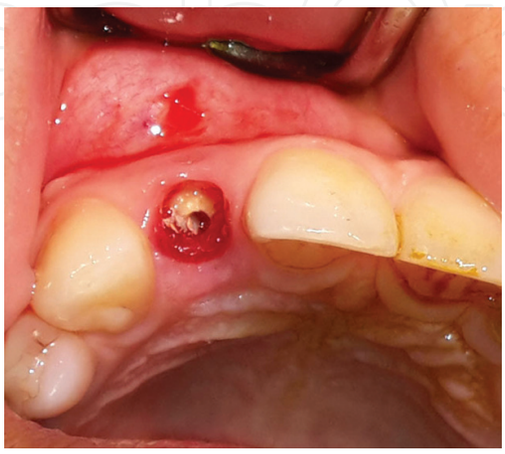


Figure 5. First 2 mm drill compose a cavity at the center of the root.

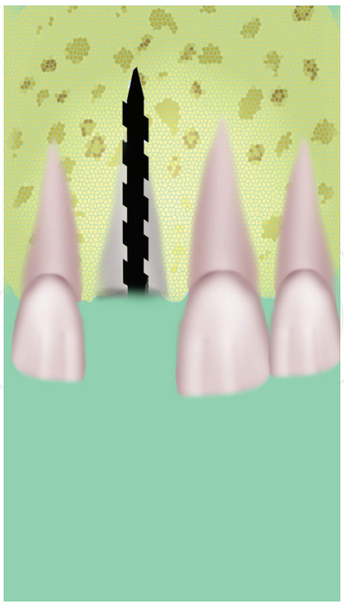


Figure 6. After first drill, a schematic view of the root remnants.



Figure 7. Thinning the walls of the root with thicker 2.2, 3.5 mm drill/drills that depend on the implant system.

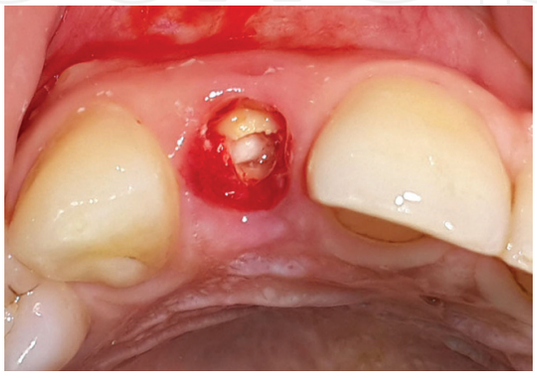


Figure 8. Occlusal view of root remnants after drilling.

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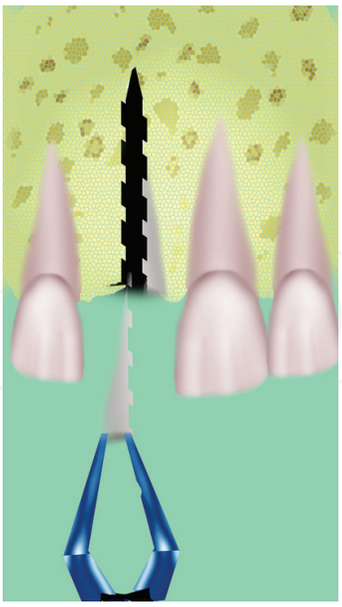


Figure 9. Root remnants should be separated from the alveolar bone with the help of a sharp device like periotome. Later separation of remnants removed from the socket by root forceps. Schematic view of removing root remnants before placing implant from the extraction socket.

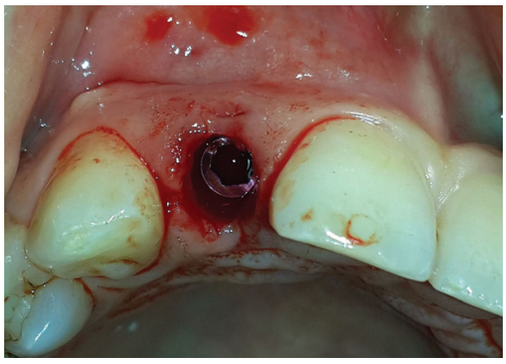


Figure 10. Replacing the implant to the cavity by handpiece or manual device.

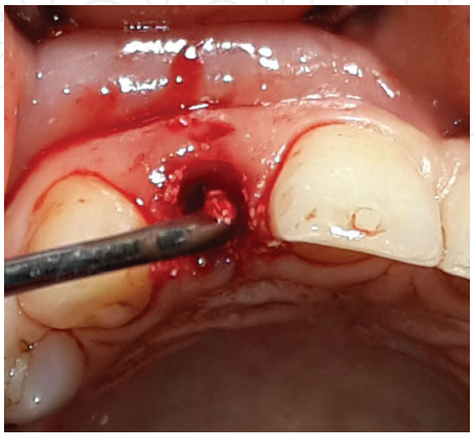


Figure 11. Filling the gap between implant and buccal bone with grafting material. It is important to fill the gap with graft material to prevent soft tissue migration.



Figure 12. Final prosthesis.

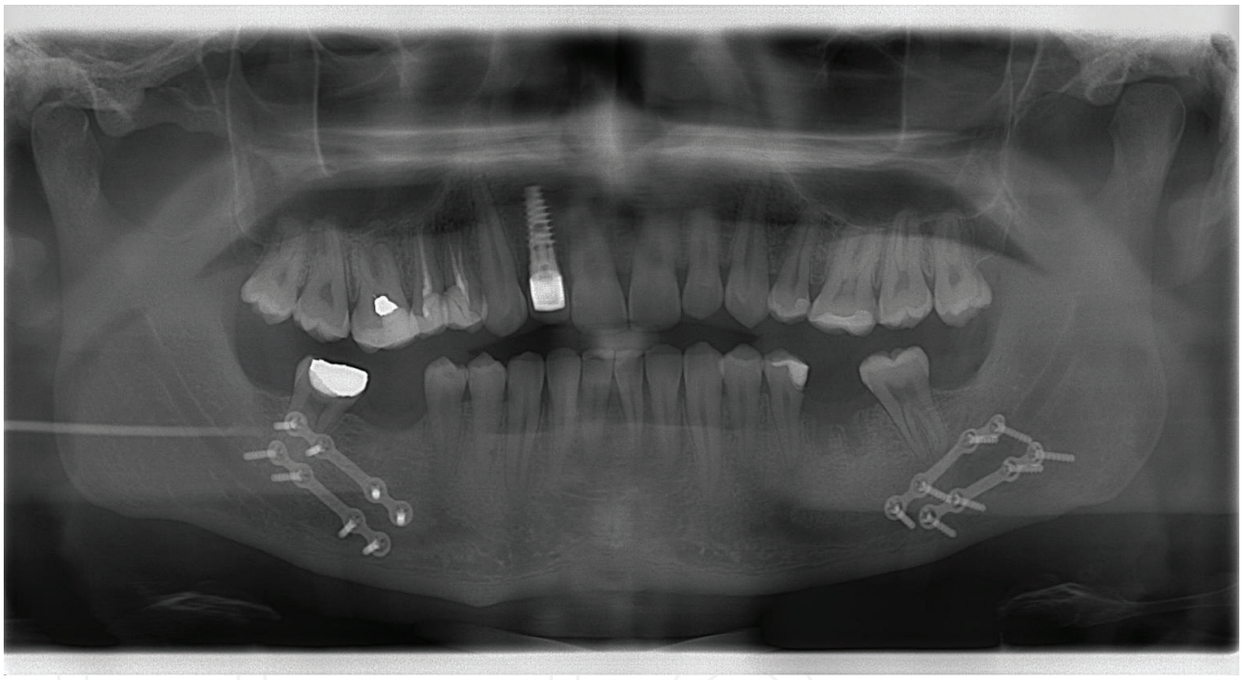


Figure 13. Final X-ray.

grafting. But resorption tendency for autogenous graft material was found high in this kind of graft material. In clinical practice, the need for second surgery area for autogenous graft collection makes the procedure more complicated, although any synthetic graft material can be preferred for grafting procedure.

Surgical area was closed using 4-0 silk, rapid vicryl or 5-0 monofilament resorbable sutures as preferred by the surgeon. Regular medicine included 1 g amoxicillin, non-steroidal analgesics and chlorhexidine gluconate mouth rinse twice a day for 5 days were prescribed to the patients. Penicillin-sensitive patients were prescribed azithromycin or clarithromycin. When using particulated bone grafting materials, antibiotics may prevent possible infection. Systemic antibiotics were used generally in accordance with surgery, whether in conjuction with immediate,

early, delayed or late implantation. However, the effect of antibiotic usage on outcome is still unknown [52–59].

Waiting for healing time for osseointegration of the implants varies between 6 weeks for mandible and 8 weeks for maxilla to 12 weeks post-surgery depending on the system of the implant. Time can be extended 4–6 months post surgically. After the end of the waiting time, a re-entry is necessary for the implant if immediate temporary crown was not applied. Generally, 1 week of waiting for the gingival healing is enough for impression. The final crown can be applied either cemented or screw retained and can be loaded into function.

4. Immediate implant placement at maxillary molars

Most delay reason for implantation at the maxillary molar area is the proximity to the maxillary sinus floor. Amount of bone left on the floor of the maxillary sinus after tooth extraction defined the treatment plan. Distance between the sinus floor and the root apex should be min 3 mm for the best clinical outcome. Also the thickness between roots affects the primary stability at the same area. When tooth has deep decays or crown fractures, separating the roots and moving out them gently is recommended. Best place to prepare implant cavity is the bone center of three roots. If there is enough bone thickness and height for drilling, widest implant in diameter is recommended. After placing the implant, gaps around the implant and the bone border should be filled with bone graft substitutes. With that approach after achieving implant stability, the success rate is approximately 95–97% [60]. When drilling if the height of the bone is not sufficient, bone condensing with internal sinus lift through the maxillary sinus recommended. If there is inadequate bone for stabilizing the implant or the position of the implant does not allow a crown in an ideal position, immediate implantation can be canceled. After 3–4 months, implant can be placed with additional open or internal sinus lift at that time. Perforation of the sinus membrane can be seen but if the bone height is 4 mm or more, implant can be placed normally.

5. Immediate implant placement at mandibular molars

The most avoided procedure for clinicians is immediate implantation at mandibular molar area. This is because of presence of nervus alveolaris inferior and linea obliqua interna. Inter radicular septum bone is highly recommended place for replacing the implant. To avoid traumatizing that area extraction should be done atraumatically. Sometimes it is advisable to separate the crown from the roots and the roots from each other. Using sharp devices like periotomes for losing periodontal sharpey fibers should ease the moving of the roots. The height of the bone can change after the extraction. To avoid mandibular nerve injury, intraoperative X-rays can be done during preparation of the implant gap. After every drill, a depth gauge can be placed at the implant gap and with an X-ray it can measure distance to the mandibular canal. After every drill, consecutive depth gauges in different diameters should be placed at the implant gap to

determine the amount of bone that holds the implant buccolingually and mesiodistally. Also that may provide not to perforate the lingual cortex. After installing the implant, there can be gaps near the mesial and distal implants. These gaps should be filled with bone graft substitutes. There are some complications that would inhibit immediate implantation at the mandibular molar area. Sometimes, there is inability to remove all infected material from the socket area. It is difficult to place implant in a proper position. To gain primary stabilization can be difficult. Mandibular nerve damage can be happen due to much drilling through the mandibular nerve canal. In case of unfavorable conditions, then a two stage procedure should be performed [60].

6. Complication treatments

Like sinus membrane perforation or nervus alveolaris inferior damage, it is better to wait and see. Sinus membrane heals about 4–8 weeks. At same time with implantation, patients prescribed routine antibiotics and non-steroid anti-inflammatory drugs. Additional nasal pump spray of oxymetazoline HCl was given for 5 days, three times a day for twice pump for each nostril. When nerve damage occurs, it takes quite a lot time for healing. Healing depends on the degree of nerve damage. At the beginning after surgery if it happens, implant should be removed or implant not inserted with dexamethasone can be added to their routine prescription. During surgery, when implants cannot be placed in a proper position, it is better to take it out and drill the cavity for an ideal position and install the implant in a proper position if possible. When there is not enough bone for that, delaying implantation and GBR procedure should be performed. After 3–6 months, delayed implantation protocol is recommended. If implant integrates in a poor position, explantation is indicated [60]. Explantation usually performed with trephine drills fit for implant. It is so important that removing the osseointegrated implant with a trephine drill under serum physiologic irrigation must be done properly to avoid heating bone tissue. Explantation should be done under saline irrigation and without too much pressure. After removal, GBR procedures can be performed with or without soft tissue augmentation. Delayed implantation after 3–6 months can be done. To prevent malposition, surgical guide can be used for ideal positioning.

7. Discussion

Immediate implant placement can be challenging due to unpredictable soft and hard tissue healing. Araujo et al. studied the dimensional changes of alveolar bone after immediate implant placement and buccal bone resorption was noted [61]. However, many other studies found the amount of resorption reduced both delayed and immediate approach resulted in statistically significant reduction [61, 62]. Gher ME et al. reported that significantly better bone fill and less crestal bone resorption at immediate implantation sites treated with demineralized freeze-dried bone combination with non-resorbable barrier membrane [42]. For observing

about crestal bone loss for immediately replaced implants, it was very hard to estimate the outcome. In two papers such data showed that after 1 and 5 years, 12 and 18% of the implants has a loss of more than 2 mm of crestal bone loss [42, 63, 64].

For about soft tissue complications, only a prospective study and one retrospective study reported frequency distributions of probing depths around immediately placed implants. After 6 years of immediately placed implants with pockets greater than 4 mm is about 20%. Bianchi et al. reported that pockets greater than 3 mm reached 50% [42, 63, 65]. According to some authors there can be serious gingival recessions that resulted thread exposure with immediate implantation, even though the incidence was not so much [30, 64, 66–69].

Quiryen et al. reflected that total incidence of implant loss after immediate placement was 4–5%. The incidence was greater when immediate placement and immediate loading combined together especially for minimally rough implant surfaces [63].

There is lack of evidence regarding the effect of apical pathology on the success and survival of immediate placed implants. Some studies showed that survival rate of immediately placed implants placed after extraction of tooth with combined endo-perio problems, root fractures and perforations are similar to that of implants placed in healed area [16, 70, 71].

8. Conclusion

Immediate implant placement approach has been known and applied since 1970s and has an increasing attraction. Today the procedure has evident increasing success. Case selection is critical, before like any other surgical approach, a thorough and detailed systemic medical anamnesis and habit history should be obtained. Patient compliance and expectations should determined. Patients who have no systemic problems and healing problems, compliant, thick biotype of soft and bone tissue have the least risk for any complication. Atraumatic extraction of the tooth with preserving the socket bone and papillae means flapless approach has effects outcome success. Also placing the implant in an ideal three-dimensional position is important. When necessary, guided bone regeneration and soft tissue grafting techniques should be well known and applied by the surgeon.

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Conflict of interest

This chapter has no any ‘conflict of interest’.

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