

## Immediate implants in fresh extraction sockets: A Review

Nitin Sethi<sup>1</sup>, Raveen Pal Kour<sup>2</sup>, Gaurav Gupta<sup>3</sup>, Ramandeep Singh<sup>4</sup>, Amrit Pal<sup>5,\*</sup>

<sup>1</sup>Professor, <sup>2,4</sup>PG Student, <sup>3</sup>Prof. & HOD, <sup>5</sup>MDS Post Graduate, <sup>1,2,3,4</sup>Dept. of Prosthodontics, <sup>5</sup>Dept. of Endodontics

**\*Corresponding Author:**

Email: dramrit3@gmail.com

### Abstract

Immediate implants are the implants placed into the fresh extraction socket following tooth extraction. Several human and animal studies have shown that the success rate of these implants is comparable to the implants placed in the healed sites. There are certain advantages of this procedure which include, fewer surgical steps, preservation of the bone height and width, short edentulous time period and reduced overall cost. Immediate implants are advantageous to the patients from both surgical and prosthetic point of view. So this technique is very appealing for the patients who require both extraction and the implant placement. The objective is to provide a general review about immediate implant placement and to summarize uses and applications in which this technique can be indicated.

**Keywords:** Immediate Implantation, Immediate Loading, Periapical Lesions, Extraction Socket, Implant Survival.

### Introduction

The implant therapy is currently considered to be a successful and acceptable means to restore missing teeth.<sup>(1)</sup> The first titanium dental implant to replace a missing tooth in human oral cavity was reported by Branemark et al. in 1969.<sup>(2)</sup> The masticatory functions of partially or completely edentulous patients have been efficiently and successfully restored by dental implants. Earlier guidelines suggested that after extraction, alveolar remodelling should be allowed for 2-3 months before the implant placement and then an additional load free healing period of 3-6 months was required for implant osseointegration. This extended treatment period and need for removable prosthesis during healing period may be inconvenient to certain patients. For success of the implants to be clinically and experimentally meaningful, criteria developed by Albrektson and co-workers should be met, which states that vertical bone loss should not be more than 1.5 mm for the first year of function and 0.2 mm thereafter.<sup>(3)</sup> These criteria were based on implants placed in native bone and restored within 3 -6 months. However, these standards of success still remained in place when studies were carried out by Adell and associates<sup>(4)</sup> Quiryman and colleagues<sup>(5)</sup> etc in immediate implants.

Immediate implants has advantages over the conventional approach such as the preservation of bone and soft tissue esthetics, reduction in overall treatment time, and ideal axial orientation of the implant. The concept of immediate implants was initially described more than 40 years ago by Schulte and Heminke<sup>(6)</sup> in 1976 and confirmed by Krump et al,<sup>(7)</sup> and Barzilay et al.<sup>(8)</sup> Only a slight increase of socket length is required to improve the primary stability, so there is minimum use of surgical drills. The risk of necrosis of the bone is decreased due to the decreased surgical trauma. Moreover, the natural socket is rich in periodontal cells and matrix which makes healing faster and more predictable.<sup>(9)</sup>

### Classification on the basis of the timing of implant placement

1. As per Wilson and Weber,<sup>(10)</sup> the terms used to define the timing of implant placement were, Immediate, Recent, Delayed, and Mature in relation to soft tissue healing and the predictability of guided-bone regeneration procedures. However, no guidelines for the time interval associated with these terms were provided.
2. As per Mayfield et al,<sup>(11)</sup>  
Immediate: Time interval of zero week after extraction  
Delayed: Time interval of 6 to 10 weeks after extraction  
Late: Time interval of 6 months or more extraction
3. As per Hammerle et al,<sup>(12)</sup>  
Type I: implant placement in fresh extraction socket  
Type II: implant placement after soft tissue coverage (4-8 weeks)  
Type III: implant placement after radiographic bone fill (12-16 weeks)  
Type IV – implant placement in healed sockets (>16 weeks)
4. As per Esposito et al,<sup>(12)</sup>  
Immediate: Implant placement in fresh extraction sockets  
Immediate-delayed: Implant placement within 8 weeks post extraction  
Delayed: Implant placement after 8 weeks post extraction.

In the following article, we will be reviewing the implants placed immediately into extraction socket without bone healing.

### Indications for immediate implant placement

1. Patient with good health status.
2. Patient should be of 18 years of age or older

3. Fresh extraction socket without bone healing.
4. Reasons for initial tooth extraction (trauma, caries, root resorption and endodontic failure).
5. Presence of adequate gingival architecture with surrounding dentition.
6. Good oral hygiene.
7. Adequate bone volume.
8. Informed consent of the patient.
9. Deciduous teeth that are retained in the oral cavity.
10. Root fracture either vertical/horizontal
11. Teeth which are periodontally involved
12. Chronic periapical/ periodontal infection
13. Fenestration defects

#### Contraindications for immediate implant placement

1. Poor oral hygiene.
2. Chronic or acute systematic disorders (uncontrolled diabetes, hemorrhagic diathesis, general or autoimmune deficiency).
3. Poor interest or cooperation from the patient.
4. Existence of non treated generalized periodontitis.
5. Insufficient bone volume at the receptor site.
6. Pathological changes at the receptor site (cysts, tumors, osteomyelitis, etc)
7. Patient still growing (child or adolescent).
8. Medically allergic and compromised patients.
9. Presence of dehiscence or fenestrations.
10. Heavy smokers, alcohol or drug abusers.
11. Patients with bruxism.
12. Inability to achieve primary implant stability following immediate implantation.
13. Acute periapical/periodontal infections
14. Proximity to vital anatomic structures
15. Sites requiring guided bone regeneration
16. Patients with high lip line
17. Tissue phenotype
18. Dehiscence defects

#### Clinical requirements for immediate implant placement

1. **Diagnosis and treatment planning:** To start with the immediate implantation, first and foremost requirement is a good initial diagnosis and treatment planning. Thorough medical and dental history should be taken, followed by clinical photographs, study models and panoramic radiographs. The tooth to be extracted is considered for its general dental health, root orientation and anatomy. Generally the tooth indicated for extraction should be unrestorable with non vital pulp and very little or no periodontal disease. Proper diagnosis helps in better prognosis of the treatment outcome. In the aesthetic zone bone morphology, scallop of the periodontium, level of crestal and interproximal bone, smile line, morphology of the gingival tissues must be considered before initiating treatment. A minimum of 4-5 mm of bone width at the crest

and 10 mm or greater from the alveolar crest to a safe distance above the mandibular canal is recommended.<sup>13</sup> Sufficient distance must be available coronal to the maxillary sinus and floor of nose.

2. **Crown to root ratio:** Secondly, the crown to root ratio should be evaluated and the factors like remaining root length, furcation involvement, periodontal health status of teeth adjacent to the proposed implant site should be considered.<sup>14</sup> These factors may influence the dimensional changes of the bone following tooth extraction, appearance, moment of force on the implant and surrounding crestal bone.

3. **Tooth extraction:** Atraumatic tooth extraction should be carried out with the help of luxators, periostomes, vertical root distractors or Peizo surgery. etc. It facilitates maintenance of the maximum amount of bone. Multi rooted teeth should be sectioned into two parts before the removal to avoid trauma to the hard tissues. Teeth that require root amputations, hemisections or advanced periodontal procedures may have a questionable prognosis and patients should be given reasonable options before these procedures are implemented.

By using a bur, a trough should be made around the circumference of the root through the ligament. The roots are to be removed with an elevator using minimum pressure. Care must be exercised not to luxate buccal-lingually. Excessive force in this direction can damage the buccal plate. After tooth removal, a curette should be used to explore the location of the buccal plate and confirm that it is intact. The surgical guide is placed over the surgical site and a sharp precision drill is used to penetrate the palatal wall of the extraction socket. This drill guides the other drills used to create the osteotomy

4. **Incision designs:** While placing an implant in the esthetic zone, conservative flap designs should be employed during the surgery. A full thickness flap should be elevated ideally, however, a flapless technique should only be followed when there is favourable attached gingiva, low esthetic demand, and the site has been assessed radiographically indicating favourable clinical conditions such as intact, and thick facial bony walls. Placing dental implants without the elevation of flap results in probing depth of less than 2mm around dental implants as reported by Al Ansari and Morris,<sup>15</sup> Jemt,<sup>16</sup> Cardaropoli et al<sup>17</sup>, etc. However many authors have contraindicated the advantages of flapless techniques as there are chances of incorrect implant placement or perforation of the buccal plate. So it has been proposed by Campelo and Camara<sup>18</sup> in their study that it is essential to conduct a preoperative CT scan before flapless surgery

5. **Preparation of the site:** After the tooth is extracted, the socket is thoroughly curetted to remove the granulation tissue. This has been documented in various studies of immediate implant placement.<sup>19,45</sup> There should be presence of at least 3-4 osseous walls for the success of immediate implants.<sup>10</sup> Use of an antibacterial irrigant is also necessary before proceeding with the surgery as recommended by Gher et al.<sup>20</sup>
  6. **Initial stability:** Initial stability or primary stability can be defined as the initial strong bond between the bone and implant which leads to the successful osseointegration of implants. In case of immediate implants primary stability can be achieved by drilling at least 3-4 mm beyond the root apex. This was in accordance to various studies by Schwartz-Arad and Chaushu,<sup>21,22</sup> Touti and Guez,<sup>23</sup> Nemcovsky et al.<sup>24</sup> Hammerle et al.<sup>25</sup>
  7. **Implant design:** Tapered, self tapping and threaded implants offer better initial stability in the fresh extraction sockets than the non threaded and cylindrical implants.<sup>26</sup> Similar findings were observed by Toyoshima et al,<sup>28</sup> Yung Soo et al,<sup>29</sup> and Kokovic et al,<sup>30</sup> in their respective studies. Tapered design also allows the implant to be placed in the same position as the extracted tooth and also avoids the perforation of buccal or labial wall which is common in the anterior maxilla when using parallel-walled implants. Also longer and wider diameter implants increase the bone implant interface and hence the primary stability.<sup>27</sup>
  8. **Loading protocol:** If an implant has achieved a good initial stability it is advisable to load the implant immediately. In the studies by various authors, immediate loading of implants in fresh extraction sockets has predictable outcomes and is comparable to the delayed loading. The provisional restoration should have an ovate pontic to support the adjacent tissues and help preserve soft tissue anatomy adjacent to the implant. Provisional restorations not only increase the patient's satisfaction, but also guides the healing of the soft tissue around the implants. Loading of the implant should be done within acceptable limits to stimulate the bone around the implants.
- reduction in the bone defect occurs more in the immediate implants than in the delayed implants as reported by Yournis et al.<sup>(32)</sup> Due to these marked changes, immediate implant placement can be considered as an alternative to reduce the ridge resorption and prevent its atrophy. However some studies have reported that the placement of implants in fresh extraction sockets do not necessarily influence the ridge resorption.<sup>(33)</sup>
2. **Preservation of extraction socket:** The atraumatic tooth extraction preserves the walls of the extraction socket and the drilling in case of immediate implants is done only 2-3 mm beyond the root apex. This leads to less generation of heat and the bone is protected from necrosis. This was confirmed in studies by Garber et al,<sup>(34)</sup> Locante et al,<sup>(35)</sup> Lorenzoni et al.<sup>(36)</sup> The rate and pattern of bone resorption gets altered if any traumatic procedure damages one or more walls of the socket. In these circumstances, fibrous tissue may occupy the part of the socket preventing normal healing and osseous regeneration.
  3. **Bone healing and augmentation procedures:** Bone healing may occur even without the use of barrier membranes. Immediate implants are associated with a critical component of the peri-implant defect that is the size of the horizontal defect. Horizontal defect (HD) is the longest distance in a perpendicular direction from the implant surface to the socket wall.<sup>(37)</sup> It has been demonstrated that the implants which have a HD of 2mm or less do not require any membranes or grafts.<sup>(38-40)</sup> However, prognosis of implants with HD more than 2mm is critical.<sup>(37)</sup> These sites require combination of bone grafts and barrier membrane for osseointegration.<sup>(41,42)</sup> In a study by Schwartz D et al<sup>(22)</sup> implants were placed immediately after tooth extraction into fresh extraction sockets. The defect between the implant and the socket was grafted with small autogenous bone chips (from bone adjacent to implant sites) without the use of any membranes. No implant loss was observed after loading which indicated that implants placed into fresh extraction sites grafted with autogenous bone chips heal predictably.
  4. **Bone fill in immediate implants:** The majority of studies state that there are peri implant defects associated with immediate implants. These defects heal with significant bone fill in both submerged and non submerged implants. Vigonletti et al<sup>(43)</sup> reported that wound healing initiated with a coagulum that was substituted by a provisional matrix at 1 week. Bone formation started concomitant to a marked bone resorption and at 2 weeks woven bone formation was evident and gradually remodelled to lamellar bone at 4 and 8 weeks. Similar results were obtained by Anderson

### Characteristics of immediate implant placement

1. **Effects on alveolar ridge:** Once the tooth is extracted, the alveolar ridge undergoes dimensional changes in the horizontal as well as the vertical direction.<sup>(5)</sup> The buccal plate is however more affected than the lingual plate. Shropp et al<sup>(31)</sup> conducted a study in which he assessed the changes of the alveolar process following extraction. He found that major changes in the dimensions of an extraction socket occurred during the first year after tooth extraction. Similarly

and co-workers,<sup>(44)</sup> who reported a bone gain of 88% in case of immediate implants.

**5. Implantation in infected sites:** Implants can be placed in chronic periapical infected sites. In a study by Jerome A et al<sup>(45)</sup> clinical success of implants placed into periapical infected sites was considered. Fifty patients who were in good health with no chronic disorder or smoking habit were included into this prospective controlled study. Thorough degranulation of the socket was performed after extraction and the implants were loaded after 6 months. It was concluded that placement of immediate implants in chronically infected sites may not be necessarily contraindicated if appropriate clinical procedures like antibiotic administration, meticulous cleaning and alveolar debridement before surgical procedure is done. Similar results were obtained by Villa R et al,<sup>(46)</sup> Horwitz J et al,<sup>(47)</sup> etc in their respective studies. However in some studies, it has been shown that implants placed in sites associated with chronic periodontitis have been associated with slightly elevated failure rates.<sup>(48-50)</sup>

**6. Immediate loading of immediately placed implants:** The concept of immediate loading of immediate implants can also increase the patients acceptance to implant treatment. Initially this approach was applied only in the areas with dense bone, i.e interforamina region,<sup>51</sup> but lately other researchers applied this concept in single tooth restorations as well. Garber et al,<sup>34</sup> in his study found excellent results when the single tooth implants were non functionally loaded after implant placement. Another study by Locante,<sup>(35)</sup> reported a success rate of 98%. Jo et al,<sup>(52)</sup> also loaded the implants immediately after tooth extraction and found a success rate of 98.9%. Similar results were obtained by Saadun et al<sup>(53)</sup> who performed immediate implantation followed by temporisation and reported a success rate of 95.52%. Similarly, Lorenzoni et al<sup>(56)</sup> reported 100% survival rate in immediately placed and immediately loaded implants. Kan et al<sup>(54)</sup> in his study evaluated anterior maxillary hydroxyapatite quoted threaded implants in 35 patients and found that successful aesthetic outcomes can be achieved with immediate temporization. Similar results were obtained in other studies by Norton et al,<sup>(55)</sup> Ribero et al,<sup>(56)</sup> Block et al,<sup>(57)</sup> etc. However there are other studies which contradict this concept. As per Cavacchia and Bravi,<sup>(58)</sup> implants placed immediately should get a load free healing period. Similar results were obtained by Sclar,<sup>(59)</sup> Touati and Guez<sup>(21)</sup> etc. Another study by Chaushu et al,<sup>(60)</sup> reported that immediate loading of immediate implants is not a good treatment of choice as they carried a risk of failure in 20% of the implants placed in his study.

**7. Esthetics:** Although esthetics is the major reason for immediate implant placement, less data is available on esthetic outcomes following implant placement. Judicious planning is necessary for immediate implant placement in the anterior region. The extraction of the tooth extraction in this region can be done with or without elevating the flap. Elevating a flap may cause alveolar bone resorption, particularly if the gingiva has a thin biotype. Chen ST et al<sup>(56)</sup> in 2008 gave a retrospective review on aesthetic outcome of 42 implant restorations completed using an immediate implant placement surgical protocol and concluded that thin tissue biotype showed slightly greater recession than thick tissue biotype. Implants with buccal shoulder positions showed more recession than implant with lingual shoulder position with difference being highly statistically significant and recommended that implants should not be placed buccally to avoid gingival recession. Usually in the maxillary anterior region submerged implants are preferred to achieve esthetics. It is important to engage the palatal wall of the extraction socket and engage the bone 2-3 mm apically. If this guideline is not followed, implant will be placed too close to the labial crest which may result in poor aesthetic outcome due to loss of crestal bone loss and marginal tissue recession. Mesio-distally a minimum of 1.5mm of distance should be maintained from the adjacent teeth.

**8. Immediate implants in the posterior region:** It is recommended to place the implants in the inter radicular bone in the molar region as implant placement in the root socket can lead to a non-ideal restorative position. This may result in mechanical overload of the implant. Furthermore, the resulting shape of the restoration may render oral hygiene more difficult, which enhances the risk for peri-implantitis. The remaining socket should be augmented with graft material and a membrane.

Finally, proper patient/case selection is the primary factor for achieving the success of this technique. The patient has to be in ideal condition and all the systemic health factors that can affect the bone should be considered.

## Conclusion

Following conclusion can be drawn from the above review of literature:

1. Immediate implantation do not completely inhibit the alveolar ridge resorption but it has other advantages like shorter treatment time, decrease in surgical interventions, psychological benefits, etc which causes more benefits to the patients.
2. Immediate implants can also be considered a favourable treatment option in chronically infected sites if complete degranulation of the socket is

done and proper antibiotic treatment is prescribed before and after the surgery.

3. Immediate implantation can be carried out successfully without bone augmentation procedures. However when horizontal defect is greater than 2mm, these augmentation procedures can be implemented.
4. Immediate temporisation of immediate implants can be achieved with predictable results if kept out of contact or in centric contact.
5. Morphology of the alveolar bone, extraction socket, peri-implant tissue, type of bone augmentation procedure used are all important to achieve high success rate. Proper case selection should be done to achieve favourable results.
6. Immediate implantation can be carried out with or without flap reflection.

The purpose of this paper was to review the predictability, rationale and treatment planning steps for implant placement immediately after tooth extraction. Multi-centre studies have validated the predictability of placing implants at the time of extraction provided these procedures are appropriately treatment planned. Additional research can be performed to further investigate the success of immediate implantation and provisionalization.

## References

1. Rouck D, Collys K, Cosyn J. Single-tooth replacement in the anterior maxilla by means of immediate implantation and provisionalization: A review. *Int J Oral Maxillofac Implants* 2008; 23:897-904.
2. Branemark PI, Adell R, Breine U, Hansson BO, Lindstrom J, Ohlsson A. Intra-osseous anchorage of dental prostheses. Experimental studies. *Scand J Plast Reconstr Surg* 1969;3:81-100.
3. Albertson T, Branemark P-I, Hanson HA, Lindstrom J. Osseointegrated titanium implants. Requirements for ensuring a long-lasting, direct bone-to-implant anchorage in man. *Acta Orthop Scand* 1981;52:155-170.
4. Adell R, Lekholm U, Rockler B, Brånemark PI. A 15-year study of osseointegrated implants in the treatment of the edentulous jaw. *Int J Oral Surg*. 1981; 10: 387-416.
5. Quirey M, Van Assche N, Boticelli D, Berglundh T. How does the timing of implant placement to extraction affect outcome. *Int J Oral Maxillofac Implants* 2007;22:(Suppl): 203-23.
6. Schulte W, Heimke G. The tubinger immediate implant. *Quintessenz* 1976;27:17-23.
7. Krump JL, Barnett BG. The immediate implant: a treatment alternative. *Int J Oral maxillofac Implants* 1991;6:277-84.
8. Barzilay L, Graser GN, Iranpour B, Natiella JR. Immediate implantation of a pure titanium implant into an extraction socket: Report of a pilot procedure. *Int J Oral Maxillofac Implants* 1991;6:277-84.
9. Hassan KS, Alagil AS. Immediate Dental Implants And Bone Grafts. *Implant dentistry-the most promising discipline of dentistry, 2011 Prof Ilser Turkyilmaz (Ed), ISBN:978-953-307-481-8.*
10. Wilson TG, Weber HP. Classification of and therapy for areas of deficient bony housing prior to dental implant placement. *Int J Periodontics Restorative Dent*. 1993;13:451-9.
11. Pal US, Dhiman NK, Singh G, Singh RK, Mohammad S, Malkunje LR. Evaluation of implants placed immediately or delayed into extraction sites. *Nat J Maxillofac Surg*. 2011;2(1):54-62.
12. Ortega-Martinez J, Perez-Pacual T, Mareque-Bueno S, Hernandez-Alfaro F, Ferres-Padro E. Immediate Implants following tooth extraction: A Systematic Review. *Med Oral Patol Oral Cir Bucal*. 2012;17(2):251-61.
13. Worthington P. Injury to the inferior alveolar nerve during implant placement: a formula for protection of the patient and clinician. *Int J Oral Maxillofac Implants* 2004; 19: 731-734.
14. Peter Floyd et al. Dental Implants: Treatment planning for implant restorations. *British Dental Journal* 1999;187:297-305.
15. Al-Ansari BH, Morris RR. Placement of dental implants without flap surgery: a clinical report. *Int J Oral Maxillofac Implants*. 1998 Nov-Dec;13(6):861-5.
16. Jemt T. Regeneration of the gingival papillae after single-implant treatment. *Int J Periodont Rest Dent*. 1997 Aug;17(4):326-33.
17. Cardaropoli G, Lekholm U, Wennström JL. Tissue alterations at implantsupported single-tooth replacements: a 1-year prospective clinical study. *Clin Oral Impl Res*. 2006 Apr;17(2):165-71.
18. Campelo LD, Camara JR. Flapless implant surgery: a 10-year clinical retrospective analysis. *Int J Oral Maxillofac Implants*. 2002 Mar-Apr;17(2):271-6.
19. Blus C, Szmukler-Moncler S, Khoury, Khoury P, Orru G. Immediate implant placement in infected and non infected sites after atraumatic tooth extraction and placement with ultrasonic bone surgery. *Clinical Implant Dent And Rel Res*, 2015; 17(1) : e287-e297.
20. Gher ME, Quintero G, Assad D, Monaco E, Richardson AC. Bone grafting and guided bone regeneration for immediate dental implants in humans. *J Periodontol* 1994;65: 881-991.
21. Schwartz-Arad D, Chaushu G. The ways and wherefores of immediate placement of implants into fresh extraction sites: a literature review. *J Periodontol* 1997 Oct;68(10): 915-23. 55.
22. Swardz-Arad D, Chaushu G. Placement of implants into fresh extraction Sites: 4-7 years retrospective evaluation of 95 immediate implants. *J Periodontol* 1997 Nov; 68(11):1110-6.
23. Touati B, Guez G. Immediate implantation with provisionalization: from literature to clinical implications. *Pract Proced Aesthet Dent*. 2002 Nov-Dec;14(9):699-707; quiz 708.
24. Nemcovsky EC, Artzi Z, Moses O. Rotated palatal flap in immediate implant procedures. *Clin Oral Impl Res*. 2000 Feb;11(1):83-90.
25. Hämmerle CH, Lang NP. Single stage surgery combining transmucosal implant placement with guided bone regeneration and bioresorbable materials. *Clin Oral Impl Res*. 2001 Feb;12: 9-18.
26. Malo P, Fridberg B, Polazzi G, Gulani F, Vighagn T, Rangert B. Immediate and early function of Branemark system implants placed in the esthetic zone. A one year prospective clinical study. *Clin Implant Dent Relat Res* 2003;5(suppl1):37-46.
27. Juodzbals G. Instruments for extraction socket measurement in immediate implant installation. *Clin Oral Implants Res*. 2003 Apr;14(2):144-9.
28. Toyoshima T, Wagner W, Klien MO, Stender E, Wieland M, Al Nawas B. Primary stability of hybrid self tapping

- implant compared to non self tapping implant with respect to drilling protocols in an ex vivo model. *ClinImpl Dent Relat Res* 2011 Mar;13(1): 71-78.
29. Kim YS, Lim YJ. Primary stability and self tapping blades: Biomechanical assessment of dental implants in medium-density bone. *Clin Oral Impl Res.* 2011;22:1179-1184.
  30. Kokovic V, Jung R, Felutzis A, Todorovic VS, Jurisic M, Hammerle CHF. Immediate vs early loading of SLA implants in the posterior mandible: 5- year results of randomised controlled clinical trials. *Clin Oral Impl Res*2014;25:114-119.
  31. Schropp L, Kostopoulos L, Wenzel A. Bone healing following immediate versus delayed placement of titanium implants into extraction sockets: A prospective clinical study. *Int J Oral Maxillofac Implants* 2003;18:189-99.
  32. Younis L, Taher A, Abu-Hassan MI, Tin O. Evaluation of bone healing following immediate and delayed dental implant placement. *J Contemp Dent Pract* 2009;10:35-42.
  33. de Sanctis M, Vignoletti F, Discepoli N, Muñoz F, Sanz M. Immediate implants at fresh extraction sockets: An experimental study in the beagle dog comparing four different implant systems. Soft tissue findings. *J Clin Periodontol* 2010;37:769-76.
  34. Garber DA, Salama MA, Salama H. Immediate total tooth replacement. *Compend Contin Educ Dent.* 2001 Mar;22(3):210-6, 218. 35.
  35. Locante WM. The nonfunctional immediate provisional in immediate extraction sites: a technique to maximize esthetics. *Implant Dent.* 2001;10(4):254-8.
  36. Lorenzoni M, Pertl C, Zhang K, Wimmer G, Wegscheider WA. Immediate loading of single-tooth implants in the anterior maxilla. Preliminary results after one year. *Clin Oral Implants Res.* 2003 Apr;14(2):180-7.
  37. Wilson TG Jr, Schenk R, Buser D, Cochran D. Implants placed in immediate extraction sites: A report of histologic and histometric analyses of human biopsies. *Int J Oral Maxillofac Implants* 1998;13:333-41.
  38. Paolantonio M, Dolci M, Scarano A, d'Archivio D, di Placido G, Tumini V, et al. Immediate implantation in fresh extraction sockets. A controlled clinical and histological study in man. *J Periodontol* 2001;72:1560-71.
  39. Celletti R, Davarpanah M, Etienne D, Pecora G, Tecucianu JF, Djukanovic D, et al. Guided tissue regeneration around dental implants in immediate extraction sockets: Comparison of e-PTFE and a new titanium membrane. *Int J Periodontics Restorative Dent* 1994;14:242-53.
  40. Alliot B, Piotrowski B, Marin P, Zahedi S, Brunel G. Regeneration procedures in immediate transmucosal implants: An animal study. *Int J Oral Maxillofac Implants* 1999;14:841-8.
  41. Chen ST, Wilson TG Jr, Hämmerle CH. Immediate or early placement of implants following tooth extraction: Review of biologic basis, clinical procedures, and outcomes. *Int J Oral Maxillofac Implants* 2004;19 Suppl:12-25.
  42. Stentz WC, Mealey BL, Gunsolley JC, Waldrop TC. effects of guided bone regeneration around commercially pure titanium and hydroxyapatite-coated dental implants. II. Histologic analysis. *J Periodontol* 1997;68:933-49.
  43. Vignoletti F, Johansson C, Albrektsson T, De Sanctis M, San Roman F, et al. Early healing of implants placed into fresh extraction sockets: an experimental study in the beagle dog. De novo bone formation. *J ClinPeriodontol*2000;36:265-277.
  44. Anderson E, Haanes HR, Knutsen BM. Immediate loading of single tooth ITI implants in the anterior maxilla: A prospective 5 year pilot study. *Clin Oral implants Res* 2002;13:281-287.
  45. Jerome AH, Lindeboom, Tijook Y. Immediate placement of implants in periapical infected sites: A prospective randomised study in 50 patients. *J Oral surgery* June 2006;101:6:705-710.
  46. Villa R, Rangert B. Immediate and early function of implants placed in extraction sockets of maxillary infected teeth: A pilot study. *J Prosthet Dent* 2007; 97: S96-S108.
  47. Horwitz J, Levin L, Gabay E, Zuabi O, Machtei EE . Immediate restoration of delayed placement of dental implants in patients with treated periodontal disease: 1-year results. *Int J Oral Maxillofac Implants* 2012;27: 1569-1575.
  48. Rosenquist B, Grenthe B. Immediate placement of implants into extraction sockets: Implant survival. *Int J Oral Maxillofac Implants* 1996;112:205-209.
  49. Grunder U, Polizzi G, Goene R, et al. A 3-year prospective multicenter follow-up report on the immediate and delayed immediate placement of implants. *Int J Oral Maxillofac Implants* 1999;142:210-216.
  50. Polizzi G, Grunder U, Goene R, et al. Immediate and delayed implant placement into extraction sockets: A 5-year report. *Clin Implant Dent Relat Res* 2000;22:93-99.
  51. Cooper LF, Rahman A, Moriarty J, Chaffee N, Sacco D. Immediate mandibular rehabilitation with endosseous implants: simultaneous extraction, implant placement, and loading. *Int J Oral Maxillofac Implants.* 2002 Jul-Aug;17(4):517-25.
  52. Jo HY, Hobo PK, Hobo S. Freestanding and multiunit immediate loading of the expandable implant: an up-to-40-month prospective survival study. *J Prosthet Dent.* 2001 Feb;85(2):148-55.
  53. Saadoun AP. Immediate implants placement and temporization in extraction and healed sites. *Compend Contin Educ Dent.* 2002 Apr; 23(4): 309-24.
  54. Kan YK, Rungcharassaeng K, Lozada J. Immediate placement and provisionalization of maxillary anterior single Implants: 1-year prospective study *Pract Periodontics Aesthet Dent* 2000;12(9):817-824.
  55. Norton MR. A short-term clinical evaluation of immediately restored maxillary TiOblast single-tooth implants. *Int J Oral Maxillofac Implants.* 2004 Mar-Apr;19(2):274-81.
  56. Ribeiro FS, Pontes AE, Marcantonio E, Piattelli A, Neto RJ, Marcantonio E Jr. Success rate of immediate non-functional loaded single-tooth implants: Immediate versus delayed implantation. *Implant Dent* 2008;17:109-17.
  57. Block MS, Mercante DE, Lirette D, Mohamed W, Ryser M, Castellon P. Prospective evaluation of immediate and delayed provisional single tooth restorations. *J Oral Maxillofac Surg* 2009;67:89-107.
  58. Cavicchia F, Bravi F. Case reports offer a challenge to treatment strategies for immediate implants. *Int J Periodontics Restorative Dent.* 1999 Feb;19(1):66-81.
  59. Sclar AG. Strategies for management of single-tooth extraction sites in aesthetic implant therapy. *J Oral Maxillofac Surg.* 2004 Sep;62(9 Suppl 2):90-105.
  60. Chaushu G, Chaushu S, Tzohar A, Dayan D. Immediate Loading of single-tooth implants: immediate vs. non-immediate implantation. A clinical report. *Int J Oral Maxillofac Implants.* 2001 Mar-Apr;16(2):267-72.