Immediate Implant Placement in Fresh Extraction Socket

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ABSTRACT

Background: In the traditional protocol, the patient should wait after extraction up to six months to place the dental implant in healed bone, this waiting time accompanied by varying degrees of alveolar bone changes. In order to overcome these problems, immediate implant placement in the fresh extraction socket was introduced. The Aim of this study was to evaluate the outcome of the immediate implant placement utilizing Resonance Frequency Analysis (RFA) to quantify implant stability and osseointegration.

Materials and Methods: A total of (23) patients participated in the study, receiving (44) implants placed in the sockets of teeth indicated for extraction. Clinical and radiographic preoperative assessment was accomplished for each patient, β-TCP (combined with collagen membrane) was used to fill gaps ≥ (2 mm) and to repair bone defects. Implant stability quotient (ISQ) values were measured for the implants at baseline and at 16 weeks. Postoperative clinical and radiographic evaluation was applied for each patient.

Results: A total of (22) patients received (41) implants completed the follow-up period, all these implants survived (100% survival rate) with no signs and symptoms of failure. The mean of ISQ value at baseline was (65.32±9.50), the mean of ISQ value at 16 weeks was (69.78±7.15), paired samples statistic showed high significant increase in the implant stability (P<0.01). Application of guided bone regeneration (GBR) showed no significant difference on ISQ value at baseline and at (16 weeks), but ISQ values increased significantly in GBR cases during the healing period.

Conclusions: Immediate implant placement is a predictable treatment approach; it has the benefit of reducing treatment time and the numbers of surgical procedures when careful preoperative examination and appropriate intraoperative protocol is applied.

Key words: Immediate implant placement, survival rate, RFA. **(J Bagh Coll Dentistry 2016; 28(4):103-110)**

INTRODUCTION

Immediate implant placement is the insertion of dental implant into the extraction socket, at the course of surgical removal of teeth to be replaced. The initial report in the literature was published in 1976 by Schulte [(1)]. The concept was reintroduced in 1989 by Lazzara, who explained this method by three case reports [(2)].

The immediate implant placement protocol was validated later by Gelb, who reported survival rate of 98% in fifty consecutive cases followed over three years.[(3)] since then several animal and human studies, case reports, and randomizes controlled studies furthered the science of this treatment modality and indicated that immediate implant placement can be as successful as delayed implant protocol whenever correct surgical strategies followed [(4)].

This concept have the advantages of preserving alveolar ridge contours, reducing treatment visits and costs, and improve patient psychological insight about treatment, on the other hand immediate implant have a pronounced outcome related to difficulties in obtaining primary implant stability and allocating final implant position [(2,4,5)].

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Papers described different terms to identify timing of implant placement such as: "immediate," "early," "recent," "delayed," "late," and "mature" [(6,7)]. New classification system of implant placement was produced based on the clinical outcome of wound healing rather than on descriptive terms or rigid time frame [(6)]. This classification was slightly modified in 2008 by Chen and Buser and involve classify the timing into four types:- Type 1: placement of implant at the day of extraction within the same surgical procedure i.e. there is no healing of the bone or soft tissue, which is familiarly known as immediate implant placement, Type 2: implant placed after soft tissue healing, but still there is no clinically significant bone fill within the socket, typically 4-8 weeks after extraction, Type3: implant is placed after significant clinical and/or radiographic bone fill of the socket, this occur 12-16 weeks after extraction, Type4: implant is placed into fully healed socket, and this performed more than 6 months after extraction [(7)].

When the implants are initially inserted into the alveolar bone, they become stable depending on the mechanical contact between the implant and the bone, still now there is no actual biological connection at implant bone interface, this initial stability named as primary stability

and it is a prerequisite and a predictor for successful osseointegration [8]. As osseointegration begins, a biological connection will be formed, which in turn leads to biological stability. Resonance frequency analysis is an assured method that gives researchers the ability to quantify implant stability both initially at implant placement and during subsequent follow up periods [9].

MATERIALS AND METHODS

This clinical study conducted at the department of oral and maxillofacial surgery/College of Dentistry/University of Baghdad, during the period from November 2014 to September 2015.

The sample included patients indicated for implant treatment to replace single or multiple hopeless maxillary and mandibular incisors, canines, and premolars teeth, with implant placement into the extraction socket at the same time of extraction, by means of two-stage implant placement protocol.

Inclusion criteria

1. Patients age ≥ 18 years old.
2. Patients with a single or multiple teeth indicated for extraction in the area of maxillary and mandibular incisors, canines, and premolars.
3. Availability of bone > 2 mm apical to the root apex to provide adequate primary implant stability.
4. Patients with a good oral hygiene to be candidate for implant success.

Exclusion criteria

1. Radiotherapy, Uncontrolled diabetics, Heavy smokers (>20 cigarettes/day), immunocompromised patients, and other local and systemic diseases, drugs, and habits that may jeopardize implant success.
2. Patients with medical conditions that preclude any surgical intervention such as patients with bleeding disorders or recent myocardial infarction.
3. Pregnant women.
4. Close proximity of vital structures such as maxillary sinus and mental foramen that make impossible to engage adequate bone apical to the extracted tooth to attain primary implant stability.
5. Sites showing severe bone destruction.
6. Signs of acute infection or pus discharge.
7. Active advanced periodontal disease, and bad oral hygiene.

Clinical and Radiographical assessment

A thorough history was taken from all the patients who were asked about their chief complaint, past treatment of the tooth/teeth under concern such as trauma, failed endodontic treatment, failed prosthesis, and endodontic surgery.

Clinical examination proceeded with thorough general extra-oral and intraoral examination, with special attention to the teeth that were planned to be extracted, these were carefully examined for the presence of any signs of acute infection such as pain, pus discharge, discharging sinus and swelling. All patients obtained preoperative OPG (fig.1), and periapical radiograph of the accused tooth (fig.2).

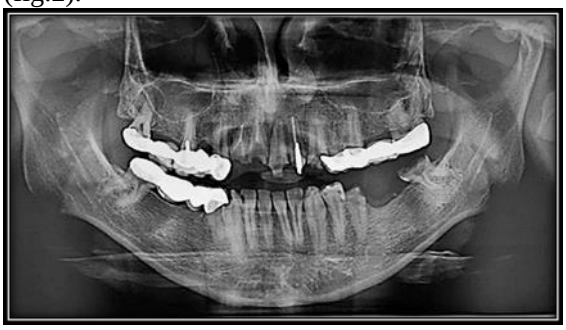

Figure 1: Diagnostic preoperative panoramic radiograph showed multiple destructed teeth at the anterior maxillary area indicated for extraction and to be replaced by dental implants.

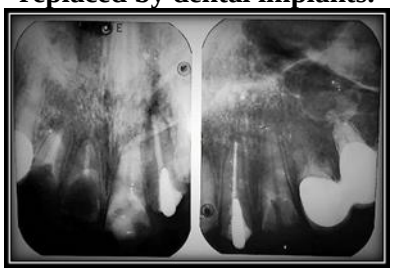

Figure 2: Diagnostic preoperative periapical radiograph for the same patient that showed finer details for teeth No. (7, 8, 9, 10, and 11).

Surgical procedure

Prior to surgery, the patient was instructed to rinse his/her mouth with chlorhexidine 0.12 % mouth-wash for 30 seconds, then the skin around the mouth was disinfected with a sterile gauze swapped by povidone-iodine solution.

Surgery was performed under local anesthesia with (lidocaine 2%, adrenalin 1:100000, 2.2 ml cartridge, Septodent, France), by block and/or infiltration technique on both the facial and palatal/lingual sides.

The accused tooth was extracted carefully utilizing dental forceps using a gradual rotational force in clockwise and counterclockwise movement, elevator (when needed) was used carefully to avoid crushing and damage to the buccal bone. The socket was then curetted by appropriate surgical curette to remove the remnant of granulation tissue, then the extraction site was thoroughly irrigated by normal saline.

Three-sided full thickness mucoperiosteal flap was reflected, the facial bone inspected for the presence of bone defect or periapical lesion.

Utilizing the measurement provided by radiograph and the original length of the root of the extracted tooth (that was measured directly by endodontic file and ruler) (fig.3), then an implant with appropriate length and diameter was selected.

Figure 3: Measurement of extracted root length by endodontic file.

Drilling started by first pilot drill **(Dentium Co., Korea)** with the extracted root direction in mandibular anterior and premolar sites (fig.4 A), or at the conjunction of the middle and apical thirds of the palatal wall of extraction socket in the maxillary anterior sites (fig.5 B).

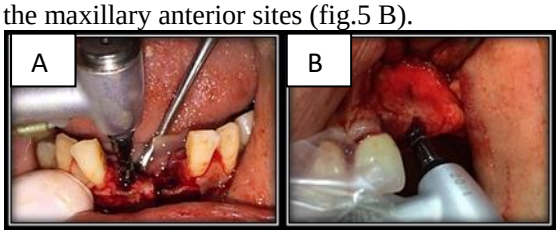

Figure 4: Drilling in: A-anterior mandible, B-anterior maxilla.

Sequential drilling continued until the planned size was reached. The implant fixture **(Dentium Co., Korea)** was inserted at or just below the crestal bone level.

Measurement of the implant stability was performed using Osstell^{TM} ISQ **(Goteborg, Sweden, 4th generation)**. A Smart peg was placed into the implant body. The transducer probe was directed at the top of the Smart peg with a distance of approximately (2 mm) and held stable until the device beeped and displayed the ISQ value. The measurements were taken twice in bucco-lingual and mesio-distal directions (fig.5 A), the mean of the two measurements was represented the ISQ value of the implant at base line record. The cover screw was than inserted over the implant fixture (fig.5 B).

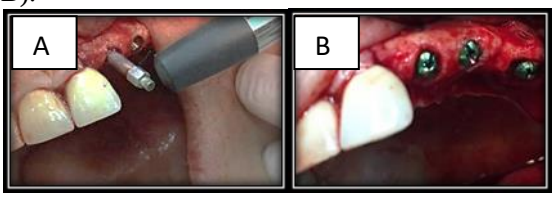

Figure 5: A-ISQ measurement, B-cover screw placement.

In cases with bone defects and/or implant-bone gaps (≥2 mm), β-TCP resorbable bone substitute **(Zizine laboratoire, Freance)**, and autogenous bone (if available) harvested from the implant preparation site were mixed to fill these gaps and defects.

Periosteal slitting at the deepest area of the flap with multiple incisions in the periosteum if required was performed to lengthen the flap and retrieve autogenous blood to the bone grafting material. The absorbable collagen membrane **(Genoss co., Korea)** was trimmed and adapted to cover the defect with at least 2 mm extension toward the palatal side for good fixation and to cover the implant completely. The surgical wound was finally closed by simple interrupted suture using 3/0 non-resorbable black silk suture **(Dynek, Australia)** (fig.6).

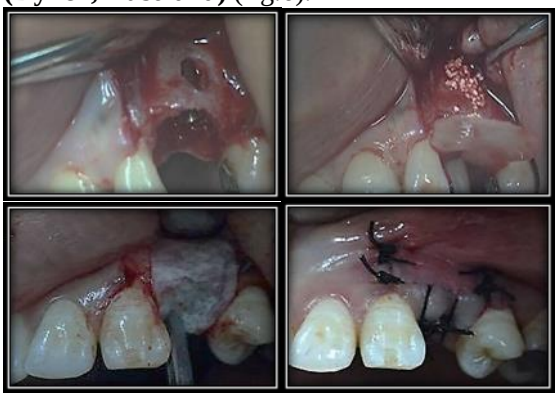

Figure 6: Bone defects repaired by β-TCP and collagen membrane.

Following surgical procedure, the patients were instructed to apply cold pack over the surgical area extra-orally for the rest of the first day, the patients also were instructed to avoid eating at the site of surgery, eating warm diet and rinsing the mouth on the day of surgery.

The patients were medicated by amoxicillin cap. 500 mg t.i.d., and metronidazole tab. 500 mg t.i.d., the treatment continued for 5 days. In

patients allergic to penicillin azithromycin tab. 500 mg was prescribed once daily for 3 days. Paracetamol tab. 500 mg prescribed as analgesic when needed.

The patients were instructed to rinse with 0.12% chlorhexidine mouthwash b.i.d. for two weeks starting from day after surgery, in cases with spontaneously exposed cover screw the mouthwash continued for the rest of the follow up. Sutures were removed 10-14 days after surgery.

Follow up and data collection

The patients were evaluated at 2, 8, 16 weeks for clinical, radiographic assessment and stability measurement.

The implants were evaluated clinically to detect implant mobility and check the presence of signs and symptoms of infection such as pus discharge or draining fistula, pain, and swelling.

Periapical radiograph was taken to the implant site immediately after surgery, at 8 weeks, and at 16 weeks to show any signs of bone resorption and peri-implant radiolucency (fig.7), OPG was taken at the 16 weeks for all cases (fig.8).

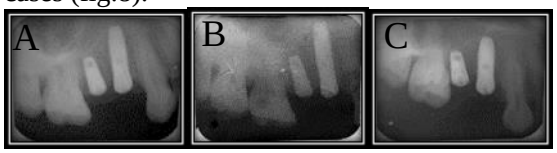

Figure 7: Three postoperative periapical radiograph taken at: A- immediately after surgery, B- at 8 weeks, C- at 16 weeks.

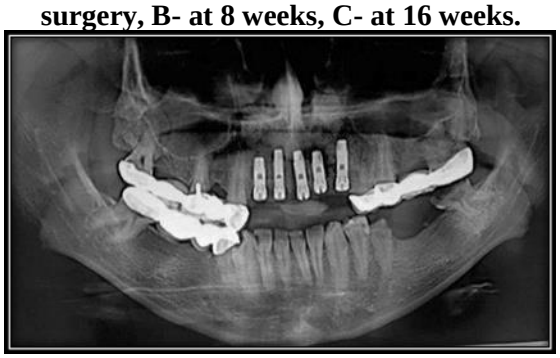

Figure 8: Postoperative OPG of the same patient in figure 1 taken at 16 weeks.

At 16 weeks implants were exposed using soft tissue punch **(Dentium Co., Korea)**, ISQ value measured by Ostell **(Goteborg, Sweden, 4th generation)** in the same way as recorded during surgery, The examiner was blinded to the ISQ value of the previous visit but not blinded about the placement approach.

A suitable healing abutment (gingival former) was placed at the implant top, and then impression taken for final prosthesis construction (fig.9).

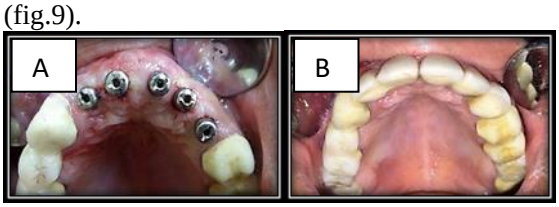

Figure 9: A- gingival formers in place at the top of implants during second stage surgery. B- Final prosthesis.

Statistical analysis

Two independent sample t-test, paired t-test, and Pearson correlation (r) were the statistical methods used to analyse the data. The level of significance tested according to the P-value, were: $P>0.05$ (Not Significant), $P<0.05$ (Significant), $P<0.01$ (Highly significant).

The analyses were accomplished using two computer software programs: Statistical Package for Social Sciences (SPSS version 18) and Microsoft Office Excel 2007.

RESULTS

Twenty two Patients (10 males and 12 females), aged between (32-66 years old), who received (41) implants and completed the follow-up visits, were included in the data record.

The implants distributed according to arches as follow: (87.8%) of implants were placed in the maxillary arch and (12.2%) of implants were placed in the mandibular arch.

Implant diameter (3.8 mm) was used in (65.85%) of cases, implant diameter (3.4 mm) was used in (26.82%) of cases, and implant diameter (4.3 mm) was used in (7.33%) of cases.

Implant length (14) was used in (58.53%) of cases, implant length (12) was used in (39%) of cases, and implant length (10) was used in one case only.

All the implants (41 implants) survived during the follow-up period (100% survival rate). The mean ISQ value and standard deviation at base line was (65.32±9.50 ISQ) range (46.5-81 ISQ), the mean ISQ value and standard deviation at 16 weeks was (69.78±7.15 ISQ) range (46.5-81 ISQ) (fig.10), paired t-test showed a highly significant increase in the ISQ value from the primary stability at baseline to the secondary stability at 16 weeks ($P<0.01$).

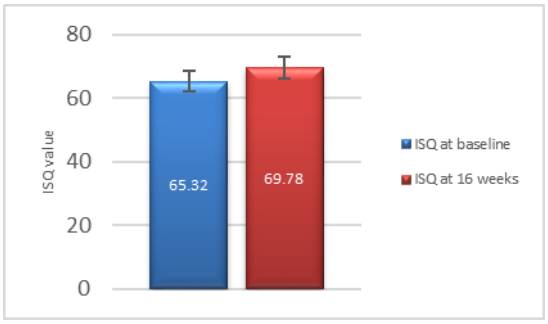

Figure 10: Mean of primary and secondary stability.

The stability at baseline was distributed as follow: low <60 ISQ (29.3%), medium >60 and <70 ISQ (22%), high stability ≥70 (48.7%). At 16 weeks the stability distribution was as follows: low <60 ISQ (7.3%), medium >60 and <70 ISQ (39%), high stability ≥70 ISQ (53.7%).

Twenty six Implants, which represent (63.4%) of implants, were required bone substitute and membrane (GBR) to fill gaps ≥ 2 mm and bone defects. Statistical analysis showed no significant difference between cases (with GBR) vs (without GBR) regarding mean ISQ value neither at baseline nor at 16 weeks (fig.11). Paired t-test showed high significant increase in the ISQ value of GBR cases during the healing period.

Thirteen Implants, (31.7%) of implants were spontaneously exposed during the healing period. Statistical analysis showed no correlation between spontaneous early implant exposure and gender of the patient, using GBR, and presence of bone dehiscence in the extraction socket. Statistical analysis also showed no effect of early implant exposure on the ISQ values

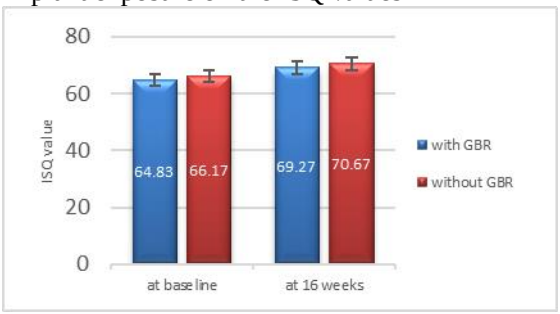

Figure 11: Comparison of ISQ value between cases with GBR and cases without GBR.

DISCUSSION

This clinical study showed that all the implants that were placed immediately in the fresh extraction sockets and followed-up for (16 weeks) had survived (100% survival rate), and met the successful criteria of dental implant presented by Misch et al.[10], with absence of failure signs and symptoms (implant mobility, pain, suppuration, and radiographic bone loss or peri-implant radiolucency).

This result comes in agreement with Gokcen-rohlig et al.[11] the authors in their clinical and radiographic study for two years follow up detected 100% cumulative survival rate, and they concluded that placement of implant in the fresh extraction socket is a reliable treatment alternative.

The results also coincided with previous studies on immediate implant placement.[12,13] This high survival rate may be attributed to careful examination, patient selection, aseptic technique, and appropriate surgical procedure with scientific management of difficulties during intraoperative work.

The mean primary stability recorded in this study was (65.32 ISQ) which is slightly higher than values documented in the previous studies on immediate implant that recorded primary implant stability ranged from (61.2 to 62 ISQ).[14-16] This higher value of mean primary stability may be related to the intraoperative surgeon judgment by under-sized drilling technique or using wider implant diameter than the final drill, especially in sites of soft bone, in order to achieve adequate primary implant stability. The implant stability increased over time with a highly significant statistical difference, and the mean secondary implant stability at 16 weeks was (69.78 ISQ) with (53.7%) of implants achieving high secondary stability (ISQ value ≥70).

The high value of primary implant stability also can explain the high survival rate where (70.7%) of the inserted fixtures had primary stability above 60 ISQ. Many studies have showed that implants with ISQ values of more than 65 ISQ at the time of insertion (baseline) have a 99% survival rate, ISQ values of 60-65 ISQ have been used as a threshold values for implant success.[17,18] If the primary stability is insufficient the healing process will be affected and osseointegration will not happen, good primary implant stability mean less micromotion and reduction in the micromotion of the implants increases the chance of secondary (biological) stability and reduces the chance of fibrous encapsulation and the failure of osseointegration.[15,18]

In a recent study conducted at the college of dentistry/ Baghdad university by Ibraheem and Al-Adili[19], using the same type of implants and loading protocol, where 44 implants placed in native bone had measured primary implant stability during surgery equal to (73.2 ISQ), and (73.5 ISQ) at 16 weeks. the higher ISQ values of

the mentioned study may be related to the difference in the timing of implant placement after extraction, these results coincide with another study comparing stability of implants placed in healed sites vs implants placed in extraction sockets, where the authors found that implants placed in a healed alveolar sites exhibited superior ISQ values at base line, at 90 days, and at 150 days [16].

In this study (63.4%) of cases had gaps (≥ 2 mm) and bone defects required augmentation. Although the autogenous bone is regarded as a gold slandered for bone augmentation, but the retrieved amount from the drilling procedure was inadequate to fill these gaps, so β-TCP represent the main bulk of augmentation material in almost all cases in this study, combined with collagen membrane that was used to cover the surgical area and hinder soft tissue migration to these defects. Various combinations of bone grafting materials combined with resorbable and non-resorbable membrane, have been identified in the previous studies to solve this problem.[20,21,22]

The results showed that there was no statistical significant difference between the cases with GBR and the other cases regarding the mean ISQ value neither at baseline nor at 16 weeks, with significant increase in the mean ISQ value of the cases that used GBR. These results are in keeping with Aloy-Prósper et al.[23] where the authors in their clinical study for three years follow-up comparing implants with and without GBR, found that there was no significant difference between the two groups in success rate and marginal bone loss.

The results also complemented previous studies to confirm β-TCP application with immediate implant, Harel et al.[24] found that using β-TCP resulted in preventing bone loss in 72.1% of cases, the authors concluded that there is no statistical significant difference with other implants placed in sites that do not need augmentation regarding survival rate and bone resorption. In another retrospective study by Daif [25] who utilized CT scan to examine the density of bone around immediately placed implants, and he found that pure-phase multiporous β-TCP enhances bone density around immediately placed implants after 6 months of loading. The author mentioned that the pure-phase multiporous β - TCP may have a positive effect on the bone density when used to fill the bone gaps around immediate dental implants. This idea may explain the significant increase of the implant stability during the healing period.

Results showed that (13) implants top, which represent (31.7%) of implants had been partially or completely exposed during the healing period, the implants top appeared at early postoperative visit during suture removal and continued to the second stage surgery. Statistical analysis found no correlation between this minor complication with (patient's gender, using guided bone regeneration technique, or presence of bone dehiscence in the extraction socket during implant placement). Therefore, other factors related to intra and postoperative environment may have a relation to this complication.

Tal [26] suggested that the possible causes of early implant exposure are: flap tension, mechanical trauma, loosening of the cover screw, and interposition of bone debris. Mendoza et al.[27] failed to establish a relation between early implant top exposure and some implant related factors such as timing of implant placement, tissue thickness, and using guided regeneration technique.

As a prophylactic measure, the patients were instructed to maintain good oral hygiene combined with chlorhexidine mouthwash 0.12 % twice daily, which was continued along the healing period in order to utilize the action of chlorhexidine in reducing plaque accumulation and improve gingival health around implant.[28] because early exposure make an area of plaque accumulation that may lead to inflammation and damage to the peri implant tissue.[26] Rosenquist and Grenthe [29] suggested punch removal of the soft tissue and completely expose the partially exposed cover screw, the authors encouraged this procedure to facilitate cleaning to decrease the possibility of future peri-implantitis.

Statistical analysis showed that early implant exposure had no effect on the ISQ value, this finding coincides with a study comparing submerged with non-submerged implants, which found no statistical significant difference regarding osseointegration and bone implant contact between the two groups [30].

Flap dehiscence was observed in two male patients, in these two flaps Guided Bone Regeneration (GBR) was used. To manage the problem, in one case the wound was re-sutured after debriding and refreshing the flap edges, in the other case the area was left to heal by secondary intention, with reinstruction for oral hygiene measures as some patients neglect regarding oral hygiene was detected during the early postoperative period. The areas were healed and all the implants survived without complications. Kim and Yun [31] found that flap dehiscence occurs mostly in male patients with statistical difference than females, and also in cases where bone graft and membrane are used,

the authors advocated oral hygiene measures rather than flap re-suturing to manage this complication. Sadig and Almas [32] stated that most of risk factors responsible for wound dehiscence are largely related to iatrogenic causes and partly related to patient neglect.

Within the limit of time of this study and the number of the available sample, immediate implant placement in a fresh extraction socket can be regarded as a predictable treatment approach, have the benefit of reducing treatment time, and the numbers of surgical procedures and can be applied even in the presence of bone defect and gaps, recording the same final results when careful preoperative examination and appropriate intraoperative protocol is utilized.

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