Keywords
- Immediate implant placement
- Wound closure
- Crestal bone loss
- Soft tissue healing
- Dental implants
- Primary closure

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Effect Of Two Methods Of Wound Closure On Crestal bone And Soft Tissue Changes Following Immediate Implant Placement. A Clinico-Radiological Study

Abstract
Immediate implant placement has become a predictable treatment modality that helps preserve alveolar bone, reduce treatment time, and improve patient satisfaction following tooth extraction. However, the method of wound closure may influence peri-implant healing, crestal bone stability, and soft tissue outcomes. The present clinico-radiological study aims to evaluate and compare the effect of two methods of wound closure on crestal bone levels and peri-implant soft tissue changes following immediate implant placement.
Patients requiring immediate implant placement after tooth extraction will be allocated into two groups based on the wound closure technique employed. Clinical parameters, including peri-implant soft tissue healing, gingival recession, probing depth, and plaque and bleeding indices, will be assessed at predetermined intervals. Radiographic evaluation will be performed using standardized intraoral radiographs or cone-beam computed tomography (CBCT) to measure changes in crestal bone levels immediately after implant placement and during follow-up. Statistical analysis will be performed to compare the outcomes between the two groups and determine the significance of differences observed.
The findings of this study are expected to provide evidence regarding the influence of different wound closure techniques on peri-implant tissue stability and contribute to optimizing surgical protocols for immediate implant therapy. Improved understanding of wound closure methods may enhance both functional and esthetic outcomes while promoting long-term implant success.

Introduction
The replacement of lost dental structure in the anterior maxilla site has always been a challenge to the dentist due to esthetic, functional, and physiological importance[1-4]. A review of the available human extraction studies have shown an average loss of 3.7mm or 45% of the buccolingual ridge dimensions[5]. The ridge height was found to be less affected post extraction, as an average of only 1.6mm was considered to be lost when extraction was followed by dental implants. The original branemark protocol stated that implants be placed in two stages (branemark et al, 1977). It was believed that after implant placement, it was imperative that they be covered by the mucosa to avoid the epithelial downgrowth between the implant and bone. An extended healing period of three months and six months were postulated as ideal for the mandible and maxilla respectively (adell et al, 1981). Patients were often not allowed to wear a temporary removal prosthesis during the first couple of weeks after the surgery to minimize the risk on implant integration caused due to overloading & micromovement.
Implant exposure were done during a second surgery and further prothesis fabrication was done. The protocol meant a treatment duration of 4-5 months in the mandible and 8-9 months

in the maxilla after the healing of an extraction socket had been completed[6].

To overcome delayed treatment time, lazzara in 1989 proposed an immediate implant concept[7]. This protocol held various advantages over the delayed implant placement protocol which includes reduced number of surgical interventions along with a decreased treatment time, surgical trauma, cost along with satisfactory survival rate. Studies by hansson et al and ericsson supported the above statement when they found that there was a substantial decrease in the risk of bone necrosis due to decreased surgical trauma caused by immediate implant placement, permitting the bone to remodelling around the implant smoothly[8]. The healing process allows the transformation of woven bone into lamellar bone and the presence of periodontal cells and matrix in the natural extraction socket makes the healing more predictable and faster[7-8].

The surgical technique used for site closure after implant placement was also found to have a direct influence on the soft and hard tissue rehabilitation[8]. The traditional surgical approach involved an open flap implant placement to expose the surgical area as it allowed better visualization of the surgical site. However, some authors reported that this technique may cause increased discomfort, edema, and postoperative pain. It also requires a longer surgical time along with compromising the blood supply to the surgical site due to periosteal detachment. This has a direct effect on the preservation of the peri-implant bone. Thus, a flapless surgical technique has been considered as an alternative since it allows surgery with less discomfort to the patient reduces the surgical time, accelerating the healing process. From a biologic point of view, the main advantage of a flapless procedure is preservation of the periosteum and supraperiostal plexus along with maintaining the blood supply to the alveolar bone[9].

Buccal bone dimension is widely considered as a prime factor in determining the soft tissue contour around implants[6]. A loss of the soft tissue change around the implant prosthesis have been found to be more profound in the initial 6 months after the restoration have been placed. A lot of research has been emphasized on alveolar ridge preservation which focuses on minimizing external resorption along with maximized bone formation within the extraction socket[10-13]. On reviewing literature; studies have advocated the use of the “socket plug technique” for the purpose of alveolar ridge preservation[14]. This technique was found to have a profound effect in preventing the collapse of the surrounding soft tissue into the socket during the healing process along with minimizing the initial soft tissue loss post extraction[9,15].

Serino et al used a commercially available bioabsorbable sponge of polylactide–polyglycolide, which served as a support to prevent the collapse of the surrounding soft tissue into the socket during the healing process. The results of this study indicated that alveolar bone resorption following tooth extraction may be prevented or reduced with the use of a bioabsorbable synthetic sponge of polylactide–polyglycolide acid[15]. Collagen plugs have actively been used for this purpose and have shown to provide a favourable artificial environment for bone growth. Colla plug; which is an absorbable collagen sponge, consists of 85 to 95% bovine collagen type I and 5 to 15% bovine collagen type III; has been used with great success for the same. The sponge serves as a support to prevent the collapse of the surrounding soft tissue into the socket during the healing process[15].

There are very limited studies which have been performed to assess which of the technique for site closure after immediate implant placement yields the best result for preventing bundle bone loss and soft tissue loss. This study aims to clinico-radiologically evaluate crestal bone and soft tissue level changes following immediate implant placement with two different methods of wound closure. One technique revolves around closure of the wound socket using figure of eight suture technique, while the other one uses colla plug to assist in wound closure.

Aim

To clinico-radiologically evaluate and compare crestal bone and soft tissue level changesfollowing immediate implant placement with two different methods of wound closure.

Objectives

- To evaluate crestal bone and soft tissue level changes at pre-extraction and after 6 monthspost-immediate implant placement using collagen plug for wound coverage.
- To evaluate crestal bone and soft tissue level changes at pre-extraction and after 6 monthspost-immediate implant placement with primary closure.
- To evaluate and compare crestal bone and soft tissue level changes at pre-extraction and after 6 monthspost-immediate implant placement using two methods of wound closure.

RESEARCH QUESTION

Does four different methods of wound closure have any effect on crestal bone and soft tissue levels following immediate implant placement?

NULL HYPOTHESIS

There is no change in the soft tissue and crestal bone after using poly-tetra-fluro-ethylene membrane, collagen plug and with primary closure after the placement of immediate implant**.**

Materials and methodology

The patients for the study were selected from the outpatient departments of the Department of Prosthodontics, Crown and Bridge, Maxillofacial Prosthodontics and Oral Implantology at multiple participating dental clinics across the Delhi NCR region as part of this multicentric study.This present study was performed to evaluate and compare the crestal bone and soft tissue level changes following immediate implant placement with two different methods of wound closure i.e one using colla plug and other using figure of eight suture.

Instruments for examination
- Mouth mirror
- Periodontal probe
- Tweezer

Instruments for diagnostic impression and model
- PVS impression material
- Stock trays
- Rubber bowl
- Spatula
- Vibrator
- Model trimmer

FIGURE 1: INSTRUMENTS FOR DIAGNOSTIC IMPRESSION AND MODEL

Armamentarium for preoperative radiological assessment
- Disposable sleeves
- Rvg sensor (care stream)

Instruments for immediate implant placement
- Local anaesthesia (2% adrenaline j1:80000)
- Elevators
- Periotome
- Implant hand piece (nsk)
- Physiodispenser (nsk)
- Adin surgical kit (adin implant system ltd, israel)
- Implant hex driver

FIGURE 2 (A) : INSTRUMENTS FOR IMMEDIATE IMPLANT PLACEMENT AND WOUND CLOSURE

FIGURE 2 (B) : PHYSIODISPENSER AND IMPLANT HAND PIECE

Armamentarium for wound closure
- 3-0 Silk sutures
- Bp blade
- Bp handle
- Needle holder
- Scissors
- Colla plug

Instruments for postoperative impression and model after 6 months
- PVS impression material
- Stock trays
- Rubber bowl
- Spatula
- Vibrator
- Model trimmer

Materials to compare soft tissue level changes
- Michigan o probe with **williams markings**
- PVS impression material
- Bp blade
- Bp handle
- Preoperative and postoperative models
- Dental model circular saw cutting machine

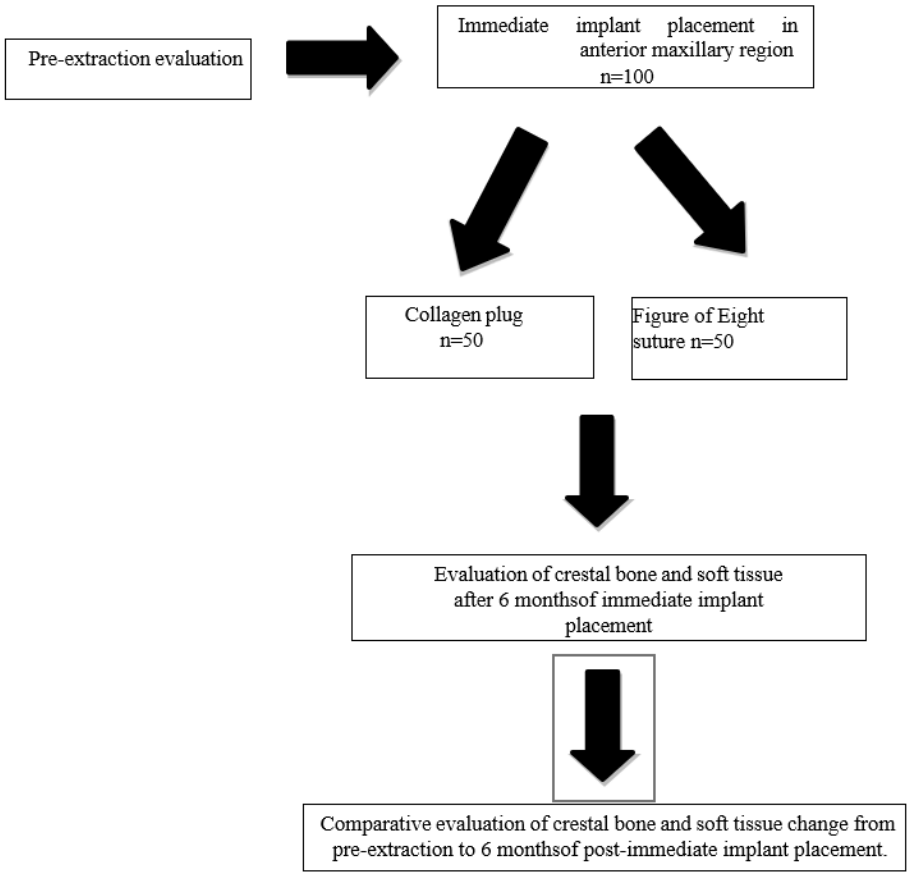
Materials to compare hard tissue level changes
- Preoperative and postoperative radiographic records

Selection criteria

Inclusion criteria
- Healthy subjects aged 25 to 55 years
- Maxillary anteriors
- Tooth indicated for extraction with healthy periapical & peri radicular tissue.
- ASA class 1 and 2 patients will be selected.
- Thick soft tissue biotype
- Sufficient apical bone to allow adequate anchorage/primary stability of the implant.

Exclusion criteria
- Tooth with chronic peri-apical pathology with compromised buccal cortical bone.
- Impossibility of reaching adequate implant primary stability in the native bone
- Patients beyond ASA class 2
- Chronic smokers
- Unwillingness to sign the informed consent
- Patient with chronic systemic diseases

Study flowchart



The patients for the study were selected from the outpatient departments of the Department of multiple participating dental clinics across the Delhi NCR region as part of this multicentric study.

A written informed consent was obtained from all the patients who took part in the study. A detailed medical history was taken from all the participants and a 3 day antibiotic regimen was prescribed to all prior to the surgery.

Sample size

A total of 100 patients were selected with a hopeless tooth present in the anterior maxilla requiring immediate implant placement.

Group I: consisted of 50 patients where wound closure was done using colla plug.
Group II: consisted of 50 patients where wound closure was done using figure of eight suture technique.

TABLE 1: DISTRIBUTION OF SAMPLE (N=20)

Groups	Sample size	Technique
I	50	Site closure with collagen plug
II	50	Figure of eight suture

Step 1: surgical phase
Following the administration of local anesthesia, the hopeless tooth was atraumatically extracted. The extraction socket was debrided using surgical curette and then irrigated with normal saline solution & 0.2% (w/v) chlorhexidine gluconate. Sequential osteotomy preparation was done using ADIN dental implant kit. Dental implant was placed 1.5 – 2 mm subcrestal using a surgical wrench with the appropriate torque (63.26 + 6.8 ncm).[15] Following implant placement, wound closure was performed by colla-plug in 50 patients (group I) and a figure of eight suture in other 50 patients (group II). Postoperative instructions and antibiotic regimen was prescribed to every patient. All patients were advised to follow healthy oral hygiene habits and were recalled after 1 week for suture removal. Both groups were subjected to a comparative evaluation 6 months from implant placement for changes in bone and soft tissue levels. All patients were loaded after 16 weeks of placement.

WOUND CLOSURE WITH COLLA PLUG

Fig 3.(A) : Pre-Op Intraoral Occlusal View

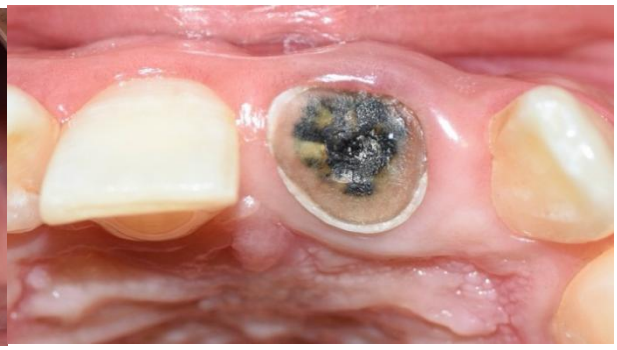


Fig 3.(B) : Pre-Op Intraoral Frontal Profile

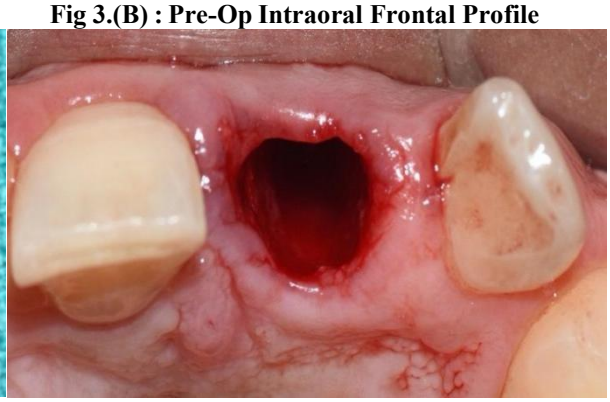


FIG 3.(C) EXTRACTED ROOT STUMPS FIG 3.(D) POST EXTRACTION SOCKET

FIG 3.(E) : CHECKING OSTEOTOMY PARALLALISM USING PILOT DRILL

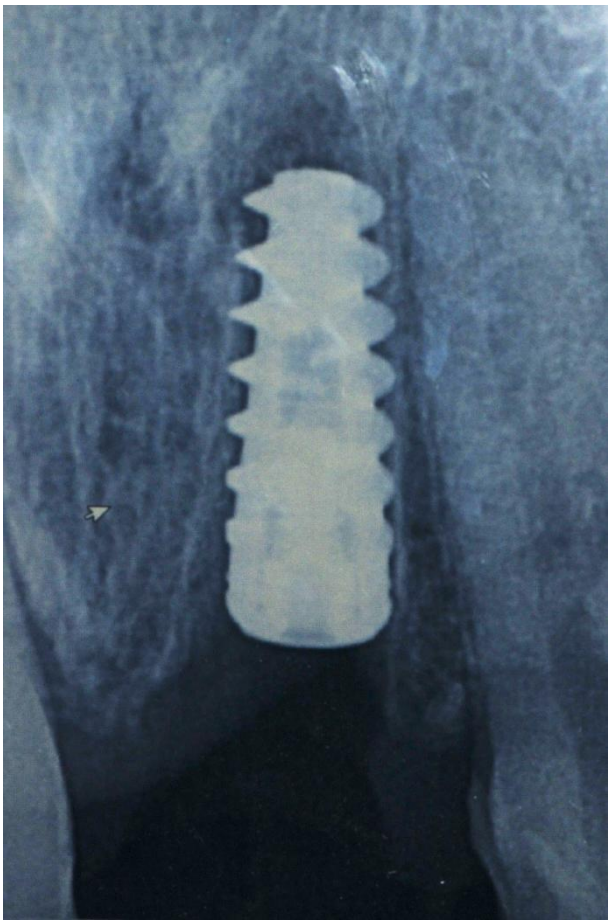


FIG 3.(F) : POST IMPLANT PLACEMENT IOPA

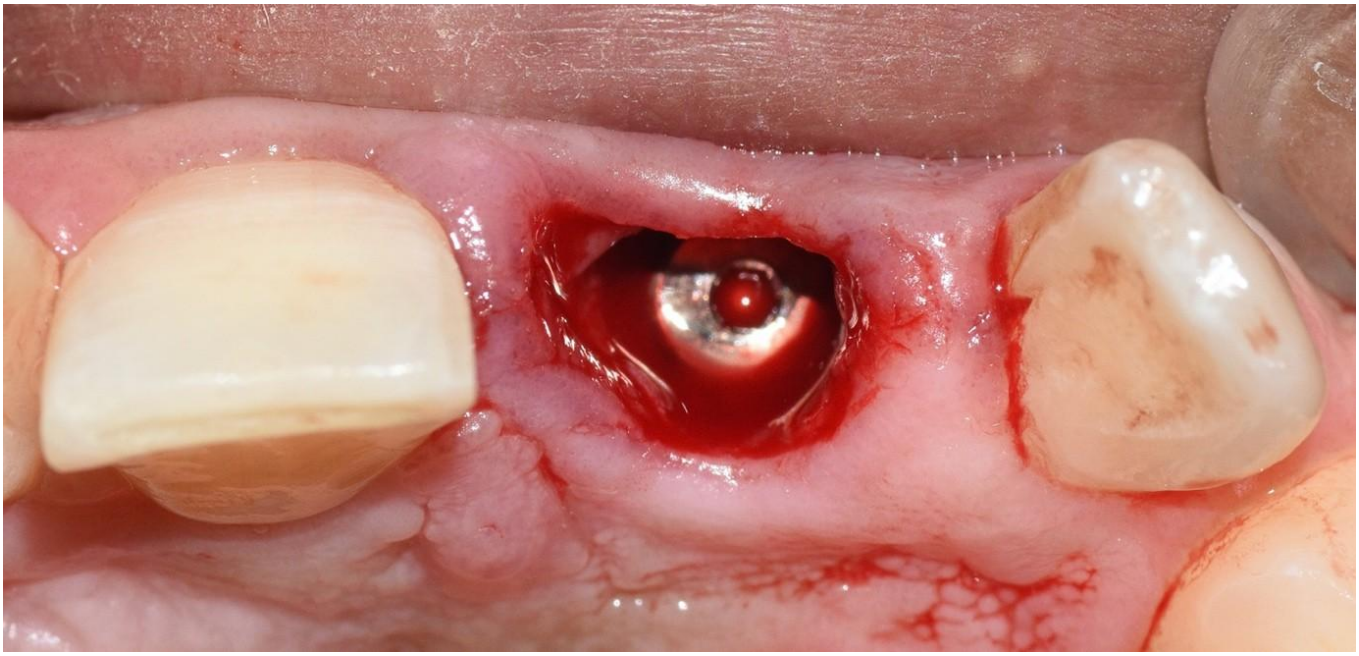


FIG 3.(G) : POST IMPLANT PLACEMENT (OCCLUSAL VIEW)

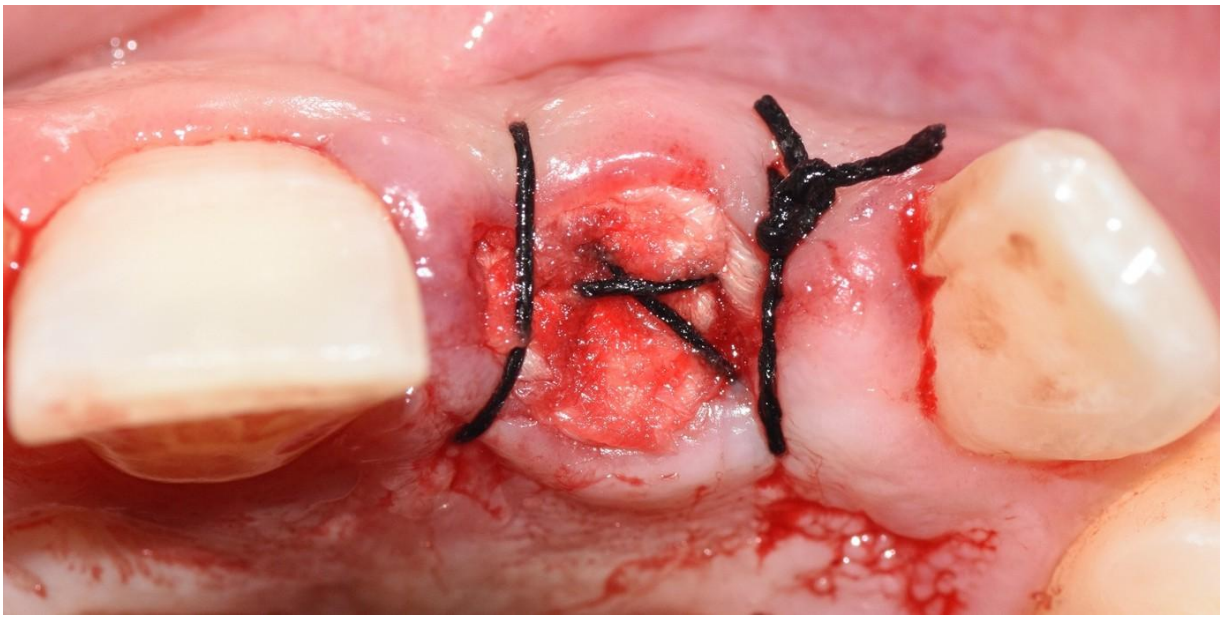


FIG 3.(H) WOUND CLOSURE WITH COLLA PLUG

WOUND CLOSURE WITH USING FIGURE OF 8 SUTURE

FIG 4.(A) PRE-OP INTRAORAL FRONTAL PROFILE

FIG 4.(B) : PRE-OP INTRAORA OCCLUSAL VIEW

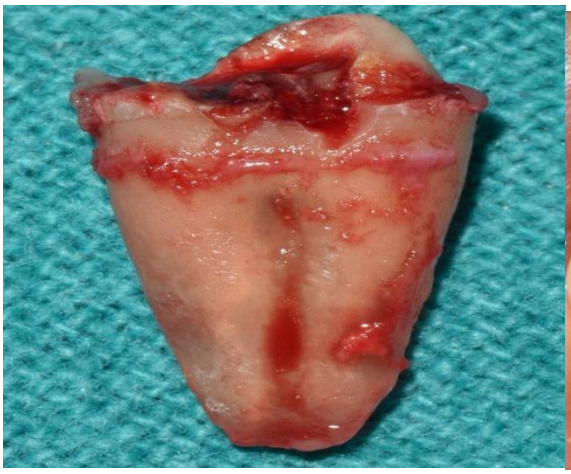


FIG 4.(C) : EXTRACTED ROOT STUMPS

FIG 4.(D) : POST EXTRACTION SOCKET

FIG 4.(E) : CHECKING OSTEOTOMY PARALLALISM USING PILOT DRILL

FIG 4.(F) : WOUND CLOSURE WITH USING FIGURE OF 8 SUTURE

Step 2: Clinical evaluation for soft tissue changes
A preoperative impression was made using putty-light body impression and a die stone model was poured and preserved to compare the soft tissue alterations. Similarly, following 6 months a post-operative putty-light body impression and a second die stone model was made. A divider was used to demarcate the mesio-distal width of the root and then it was measured using a metallic scale. After measuring the width, a straight line was then drawn bisecting it into two equal halves. A silicon putty index was made on the pre-operative stone model to evaluate the soft tissue level changes. The putty index was then sectioned using bp blade in a labio-palatal direction along the bisecting line. The same silicon putty index was then seated onto the die stone model fabricated 6 months post operatively. A periodontal probe was used to compare the alterations that occurred postoperative after 6 months[16].

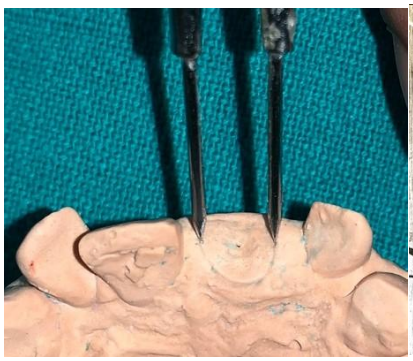


FIG 5 (A) : A divider was used to demarcate the mesio-distal width

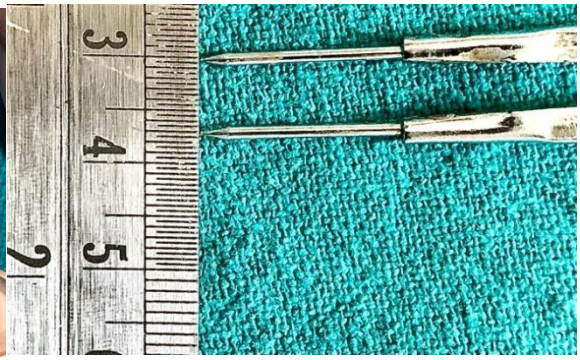


FIG 5(B) : It was then measured

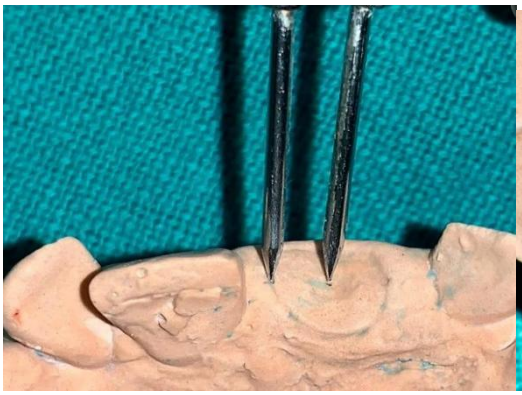


FIG 4(C) After measuring the width, a straight line was then drawn bisecting it into two equal halfes

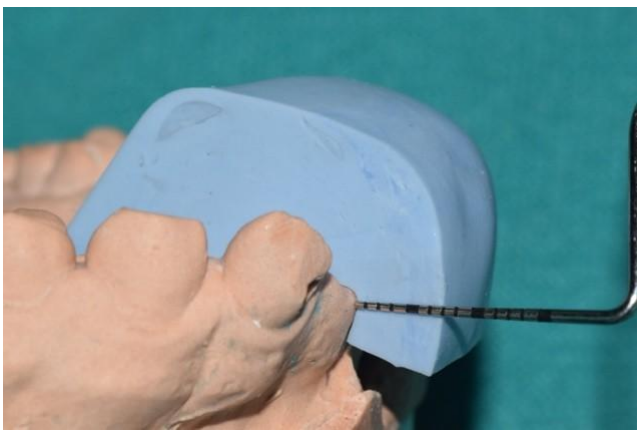


FIG 5 (D) SILICON PUTTY INDEX WAS THEN SEATED ON BOTH THE DIE STONE MODELS AND A PERIODONTAL PROBE WAS USED TO COMPARE THE

Step 3: radiological evaluation for crestal bone changes

- Intraoral peri-apical radiographs were obtained using paralleling technique before the extraction and after the 6 months of implant placement to evaluate bone level changes.

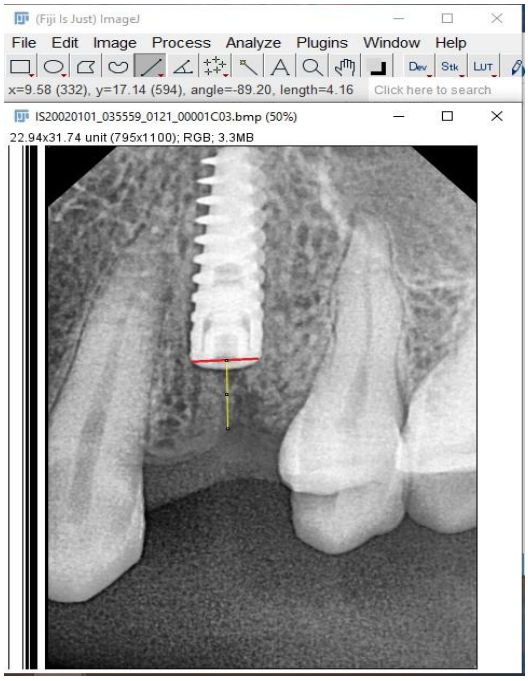


FIGURE 6 (A) : A LINE IS DRAWN AT THE CREST OF THE RIDGE AND THE CENTRE OF IMPLANT COLLAR IS DRAWN.

- Preoperative and 6 months follow-up IOPARs are imported into the Software and scale is set using the known distance (i.e Implant length) to calibrate the IOPAR. A line was drawn from centre of implant collar to crest in order to find out the crestal bone height from implant collar in both a) Baseline radiograph and b) 6 months follow-up radiograph.[17]

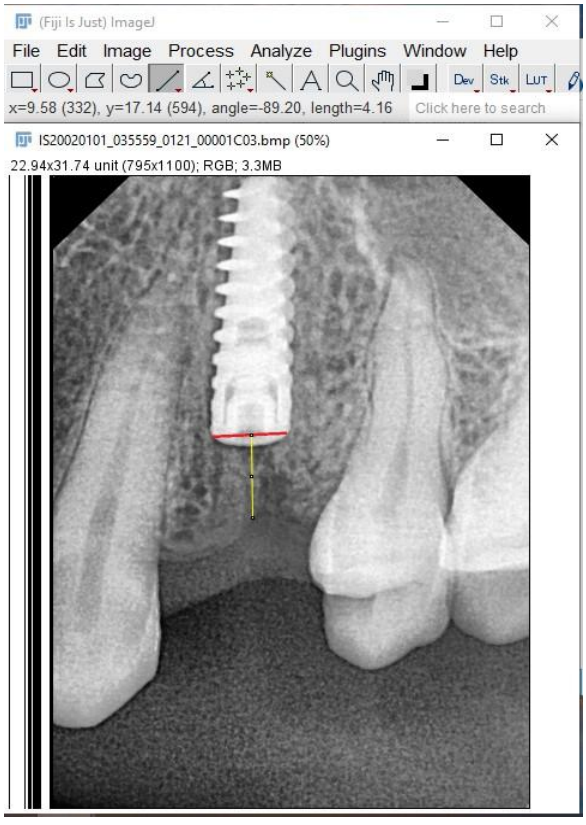
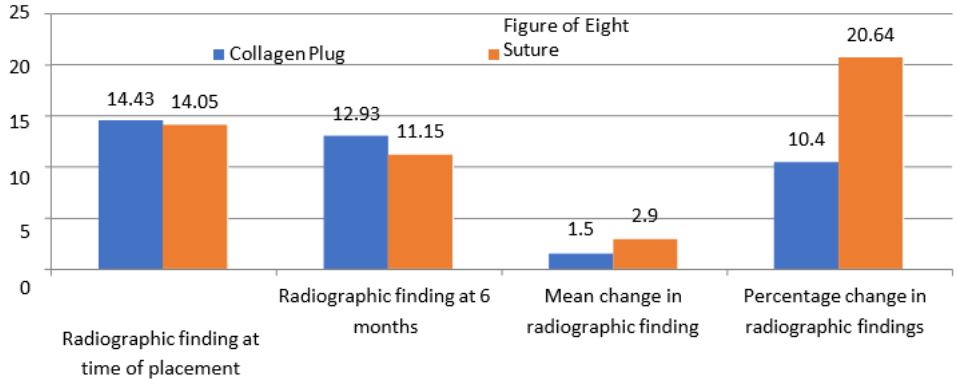


FIGURE 7 (B) : CALIBRATION OF IOPAR USING KNOWN IMPLANT LENGTH AND DISTANCE FROM BONE CREST TO IMPLANT COLLAR IN IMPLANT PLACED WITH CONVENTIONAL TECHNIQUE (6 MONTHS).

Step 4: prosthetic protocol
All implants of both the groups were loaded 16 weeks after implant placement with a cement retained prosthesis

Table 1 : INTERGROUP COMPARISON OF RADIOGRAPHIC CHANGES BETWEEN THE GROUPS

	Radiographic finding at time of placement	Radiographic finding at 6 months	Mean change in radiographic finding	Percentage change in radiographic findings	P value
Collagen Plug	14.43±0.807	12.93±0.873	1.501±0.45	10.408±3.20	0.01 (Significant)
Primary Closure	14.05±1.337	11.15±1.522	2.901±0.71	20.640±5.41	

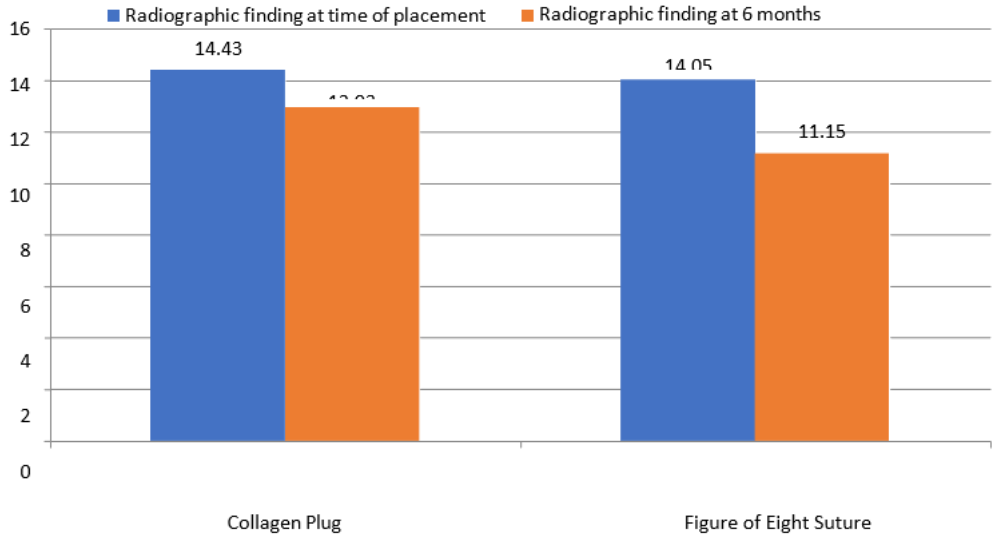


GRAPH 1. INTERGROUP COMPARISON OF RADIOGRAPHIC CHANGES BETWEEN THE COLLAGEN PLUG (GROUP 1) AND FIGURE OF EIGHT SUTURES (GROUP 2)

Description : The intergroup comparison for the difference of mean scores between two independent groups was done using the unpaired/independent t test, then the overall difference was found to be statistically significant.

Table 2. INTRAGROUP COMPARISON OF RADIOGRAPHIC CHANGES BETWEEN THE GROUPS

	Radiographic finding at time of placement	Radiographic finding at 6 months	P value
Collagen Plug	14.43±0.807	12.93±0.873	0.001 (Sig)
Primary Closure	14.05±1.337	11.15±1.522	0.001 (Sig)

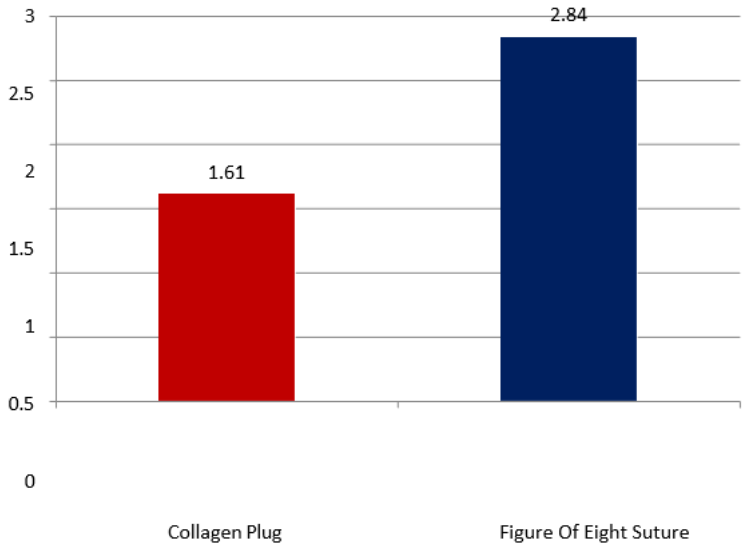


GRAPH 2. INTRAGROUP COMPARISON OF RADIOGRAPHIC CHANGES BETWEEN THE COLLAGEN PLUG (GROUP 1) AND FIGURE OF EIGHT SUTURES (GROUP 2)

Description : The intragroup comparison of radiographic changes between the collagen plug (Group 1) and figure of eight sutures (Group 2) was done using paired t test and Repeated Measures ANOVA to find the difference between the individual time intervals, then the overall difference was found to be statistically significant. The level of the significance for the present study was fixed at 5%.

Table 3. INTERGROUP COMPARISON OF SOFT TISSUE LOSS BETWEEN THE GROUPS

	Mean	Standard Deviation	Standard Error	P value
Collagen Plug	1.61	.25505	.08502	0.001 (Sig)
Primary Closure	2.84	.27915	.09305	



GRAPH 3. INTERGROUP COMPARISON OF SOFT TISSUE CHANGES BETWEEN THE COLLAGEN PLUG (GROUP 1) AND FIGURE OF EIGHT SUTURES (GROUP 2)

Description : The intergroup comparison of soft tissue between the collagen plug (Group 1) and figure of eight sutures (Group 2) was done using paired t test and Repeated Measures ANOVA to find the difference between the individual time intervals, then the overall difference was found to be statistically significant. The level of the significance for the present study was fixed at 5%.

STATISTICAL ANALYSIS

The data for the present study was entered in the Microsoft Excel 2007 and analyzed using the SPSS statistical software 19.0 Version. The descriptive statistics included mean, standard deviation. The intragroup comparison for the different time intervals was done using paired t test and Repeated Measures ANOVA to find the difference between the individual time intervals The level of the significance for the present study was fixed at 5%.

The intergroup comparison for the difference of mean scores between two independent groups was done using the unpaired/independent t test

Mann Whitney U test

In statistics, the Mann–Whitney *U* test (also called the Mann–Whitney–Wilcoxon (MWW), Wilcoxon rank-sum test, or Wilcoxon–Mann–Whitney test) is a nonparametric test of the null hypothesis that it is equally likely that a randomly selected value from one population will be less than or greater than a randomly selected value from a second population. Although Mann and Whitney developed the Mann–Whitney *U* test under the assumption of continuous responses with the alternative hypothesis being that one distribution is stochastically greater than the other, there are many other ways to formulate the null and alternative hypotheses such that the Mann–Whitney *U* test will give a valid test.

A very general formulation is to assume that:

1. All the observations from both groups are independent of each other,
2. The responses are ordinal (i.e., one can at least say, of any two observations, which is the greater),
3. Under the null hypothesis H0, the distributions of both populations are equal.[3]
4. The alternative hypothesis $H1$ is that the distributions are not equal.

This test can be used to investigate whether two *independent* samples were selected from populations having the same distribution.

Formula:

$$U_x = N_x.N_y + \frac{N_x(N_x + 1)}{2} - \Sigma r_x$$

Where, U_x is the Mann Whitney calculation for sample X

N is number in the samples

Σr_x is the sum of ranks for sample X.

Wilcoxon sign Rank test

Wilcoxon signed-rank test is a non-parametric statistical hypothesis test used to compare two related samples, matched samples, or repeated measurements on a single sample to assess whether their population mean ranks differ (i.e., it is a paired difference test). It can be used as an alternative to the paired Student's t-test (also known as "t-test for matched pairs" or "t-test for dependent samples") when the distribution of the difference between two samples' means cannot be assumed to be normally distributed A Wilcoxon signed-rank test is a nonparametric test that can be used to determine whether two dependent samples were selected from populations having the same distribution.

$$z = \frac{W}{\sigma_W}, \text{ where } \sigma_W = \sqrt{\frac{N_r(N_r + 1)(2N_r + 1)}{6}}.$$

Discussion

Teeth are extracted frequently due to varying causes such as chronic periodontitis, gross decay, root caries, periapical pathology, and root fractures. Extractions, even when carried out with great caution and minimum procedural trauma lead to the loss of alveolar bone and the overlying soft tissue. This bone resorption occurs in height as well as width, and is rapid (upto 40-60%) in the first 6–12 months post-extraction followed by soft tissue remodelling[17].

Dental implants have been instrumental in decreasing this bone loss over the past decades. Various techniques have been tried with variable success rates to preserve the alveolar bone. Different alveolar ridge preservation procedures and techniques include the use of autografts, alloplasts, allografts, and xenografts with or without a collagen plug, resorbable/ non-resorbable membranes, PRP and immediate implant placement.

Several factors such as implant shoulder position in a bucco-lingual and apico-coronal plane (Garber 1995; Kois 2001; Buser et al. 2004) as well as tissue biotype (Kois 2001; Kan et al. 2003a) have been proposed as being important in determining the stability of the peri-implant marginal mucosa[18]. De Rouck T, et al. stated that immediate implant placement following tooth extraction has advantages such as saving time, esthetic appearance, and comfort for patients. A systematic review in 2014 emphasized on the better survival of crestal bone in immediate placement of implant when compared to conventional placement. Based on Felice et al. study, soft tissue levels score was significantly better in immediate implants as compared to delayed implants. The collagen plug is an antigenically inert type 1 collagen derived from fish. It is known to not cause any hypersensitivity and is cheaper than other preservation technique materials. This study involved the use of a collagen plug graft material for socket closure & aids in osteoconduction. Moreover, limited literature is present regarding the use of collagen plug in conjunction with immediate implants[19,20].

Various studies have documented that the gingival biotype is an important factor responsible for gingival recession. Lee, Angie et al conducted a study and stated that peri implant tissue biotype is an intrinsic parameter that affects both the aesthetic and functional aspects of implant rehabilitation by influencing the remodelling of hard and soft tissues. Because thick biotype is a desirable feature, conversion of the patient's mucosal phenotype both quantitatively and qualitatively through soft tissue grafting provides more predictable surgical and prosthetic outcomes. There are various studied on how a thin biotype poses a risk of increased mucosal recession, there is also evidence to support that a thin biotype is associated with increased susceptibility to loss of papilla in immediate implants. In a prospective study, Romeo et al placed 48 nonsubmerged immediate implants connected with a transmucosal healing screw. A dichotomous scale was used to identify the presence or absence of papilla. The results show that thick tissue biotype was significantly associated with the presence of papilla when the contact point was 3 to 7 mm from the bone crest (P 0.05), a finding substantiated by previous reports in the literature. So the difference of results between thick and thin gingival biotype, this study standardise the purpose with thick biotype so that this variable would no influence on the crestal bone and soft tissue[21,22].

W. Hafez conducted a study to evaluate the efficacy of

platelet rich fibrin as a membrane for coverage of immediate implants in the maxillary anterior region and after the follow up of 6 months, the bone resorption post 6 months follow up was 1.98 +- 0.59mm. When compared to our study, better results were found for colla plug (1.501 +- 0.45 mm). However, both PRF and colla plug wound closure showed comparatively better results for crestal loss when compared to closures with a figure of 8 sutures. Wallace S et al conducted a study to evaluate the results of socket preservation after extraction using human particulate mineralized cancellous allograft bone (MCAB) and type I porcine collagen membranes (PCM) as a guided bone regeneration barrier. The new bone gain after the 6 months of follow up in the sites with the most bone regeneration compares favourably with results from a similar study by Barone et al in which 2 types of bovine xenografts were compared. Vital bone recorded was 28.5% 6 20% for the test group and 31.4% 6 18% for the control group. Porcine collagen used as a socket graft barrier can generate increased height of keratinized gingival tissue[23].

Recession of the marginal mucosa of 1.61 +- 0.255 mm was found as a mean in wound closure with collagen plug while with the mean loss of marginal mucosa was found to be 2.84 +- 0.279mm in primary closure. In a study by Oh et al, it was demonstrated that the mean PPI values at 6 months for the thick group (3mm) and was 2.29. which was higher than the thin group (2.14,<3mm) , but the difference was not significant (p> .05)[22].

This study negated null hypothesis for both soft and hard tissue factors. Significant results were found which advocated the use of collagen plug over a figure of eight suture. This study proved to have better results when colla plug was compared with results obtained via PRF. On comparison with studies of W. hafez, the hard tissue loss was much lesser than the colla plug. Also, PRF required an invasive technique for drawing blood, collagen plug which is commercially available seems to be a better alternative.

Study limitations

Certain limitations were observed in the study.

1. Regardless of radiographic interpretation of bone loss, the angulation of the IOPA tube & sensor may have an effect on measurement. It could have been better recorded using CBCT. However, owing to the fact that an ethical clearance could not be attained for the same, CBCT could not be used.
2. A larger sample size was also needed for better evaluation of the results.

Future scope

For future studies, CBCT can be planned to evaluate the bone values more accurately and across all walls of the implants.. Future studies may also quantify the width of the buccal bone to adjust its influence on bone remodelling during the healing phase. This may be more clinically significant than the method of site closure us

Conclusion & Summary

The patients for the study were selected from the outpatient departments of the Department of multiple participating dental clinics across the Delhi NCR region as part of this multicentric study.to evaluate the effect of three methods of wound closure on crestal bone and soft tissue changes following immediate implant placement. The following conclusions were drawn

1. The materials colla plug used in this study resulted in favorable outcomes in terms of preservation of bone and soft tissue outcome both.
2. Socket grafting with colla plug is an easy and predictable way of preserving the hard and soft tissue when immediate implants were placed leading to better prosthetic and aesthetic outcomes for the patients.
3. Collagen plug should be considered as an economical and predictable option for socket closure. Further in vivo studies must be conducted using collagen plugs with a larger sample size to make sure of the ridge preservation potential of this material is superior when compared with the conventional suturing.

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