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Nusrat, Aymen

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A comparison of the success of immediate implant placement versus delayed implant placement in the posterior region of the mandible

Dr.Aymen Nusrat

Registrar: Maxillofacial & Oral surgery

School of Oral Health Sciences

Faculty of Health Sciences

University of the Witwatersrand

Johannesburg

Title:

A comparison of the success of immediate implant placement

versus

delayed implant placement in the posterior region of the mandible

Applicant:

Dr. Aymen Nusrat
Registrar: Department of Maxillofacial & Oral surgery
School of Oral Health Sciences
Charlotte Maxeke Johannesburg Academic Hospital

Supervisor:

Dr. Wynand van der Linden
Consultant: Department of Maxillofacial & Oral surgery
School of Oral Health Sciences
Charlotte Maxeke Johannesburg Academic Hospital

I, Aymen Nusrat , declare that this research report is my own work. It is being submitted in partial fulfilment of the requirements for the degree of Master of Dentistry, in the branch of Oral and Maxillofacial surgery, at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any other degree or examination at this or any other university.

Dr A Nusrat

To my parents.

Acknowledgements

I wish to express my sincere thanks to my supervisor **Dr. Wynand van der Linden** for the continuous support of my Master's study and research, for his patience, motivation, enthusiasm, and immense knowledge and for helping and providing me with all the necessary facilities for the research.

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1.Introduction

The objective of using dental implants is to create an artificial titanium root to support restorations that resemble a tooth.

In 1952 the Swedish orthopaedic surgeon, P I Brånemark, was studying bone healing and regeneration. Titanium cylinders were inserted into the bone marrow of rabbits as part of the study design. On completion of his research nine months later he observed that bone had grown into such close proximity with the titanium that it effectively adhered to the metal. This phenomenon was developed into a means whereby screw-form titanium implants were utilised to support teeth following tooth loss experimentally in dogs. A two stage surgical protocol for placement of a dental implant was proposed[1].

Permission to utilise screw form dental implants to support a fixed full lower prosthesis on human subjects was obtained from the Swedish authorities in 1965 and the first patient was treated according to Brånemark's 2-stage protocol. The permission to treat patients in this way was restricted to implants placed into the anterior mandible and a 10 year follow-up was required before blanket approval of the procedure would be contemplated. In 1977 Branemark published a reported 90% success rate for the implants placed in this way with minimal complications[1].

Since that time the predictability of the procedure has been the subject of numerous publications[2, 3,4,6,7]. In 1981 Branemark et al published a study of 1997 dental implants (981 implants in the maxilla and 1016 implants in the

mandible) placed in 410 Edentulous jaws utilizing a conventional Brånemark two-stage protocol which consisted of :

- the procedure being performed under local anaesthetic.
- utilising a buccomucoperiosteal flap as well as lingually or palatally pedicled mucoperiosteal flaps.
- using drills at a speed of about 1500 r.p.m were used to create the implant osteotomy.
- re-adaption of the flap with interrupted sutures
- a load-free healing period of 3-4 months in the mandible and 5-6 months in the maxilla.

A success rate of 89% and 100% was reported for the upper and lower jaw respectively. The mean bone loss was 1.5mm during the nine years of follow up in both the upper and lower jaws[2].

Traditionally, implants are planned to be placed into mature bone in healed edentulous areas of the maxilla and mandible[3].More recently the placement of dental implants immediately after tooth extraction has been widely accepted and good results have been reported[4,5,6,7,8].

Several of these studies suggested that the immediate placement of dental implants may have advantages including:

- preserving bone at the site of implantation[6,9].
- decreasing the number of surgical procedures thus reducing the treatment time by months[5,6].
- in some cases a prosthetic tooth could be attached to the implants simultaneously[4, 8].
- earlier rehabilitation could be considered
- optimal soft tissue aesthetics could be achieved[9,10, 11].

Some disadvantages have been reported with placement of immediate implants such as:

- resorption of the buccal wall of the extraction socket may lead to aesthetic compromise and oral hygiene challenges, especially in the anterior part of the maxilla[5,12].
- if the gap between the implant and alveolar bone is more than 1mm a potential reduction of bone regeneration in the gap may occur[6].
- inability to place the implant due to insufficient implant stability[8].
- inability to place the implant in an infected area[11].

However many factors can play a role in immediate implant placement outcomes.

Several studies have been reported comparing immediate and delayed placement of dental implants [4,5,13,14].

A Systematic Review and Meta-analysis was done by Esposito et al[5]. The authors concluded that there is no statistically significant difference in outcomes between immediate and delayed implant placement.

Penarrocha-Diago et al[4] compared wide-diameter implants placed in mature bone versus implants inserted into extraction sockets. A total of 162 implants were placed. 130 implants were placed into mature bone and 32 were placed immediately after tooth extraction. Autologous bone was grafted around the implants in cases where the bone-implant gap was more than 2 mm. Success rates of 100% and 96.9% were reported after one year of follow-up respectively. Chen et al[6] reviewed thirty one articles to compare the success rates of immediate and delayed placement of dental implants in the anterior and posterior regions of the maxilla and mandible. The authors concluded that the success rates and clinical outcomes are similar and there was no significant difference between them.

Gökçen-Röhlig et al[13] examined the clinical and radiographic results of implants of ten patients who had two immediate dental implants placed in extraction sockets and two delayed implants placed in mature bone. The aim of the study was to evaluate the healing of marginal defects in implants placed into fresh extraction sockets. All surgical procedures were done under local anaesthetic. A crestal incision and mucoperiosteal flap was utilised. The teeth were gently extracted using fine elevators. Implant shoulders were placed at the level of the crestal bone after implant osteotomy preparation with drills.

Autogenous bone was used for augmentation of any alveolar defect. The study reported high survival rates (100%) after two years of follow up without complications.

Schropp L et al[14] reported a prospective study in which 46 patients had dental implants placed. 23 patients had immediate implants and 23 patients had delayed implants at the incisor, canine, or premolar area of the upper and lower jaws. They compared bone healing and crestal bone change for immediate and delayed placement of implants. A full thickness mucoperiosteal flap with two vertical releasing incisions mesial and distal were performed in all of the cases. Success rates of 91% and 96% were reported respectively.

The criteria for evaluating the success of a dental implant have changed over the years. In 1978 the Harvard National Institute[15,16] suggested that the following criteria indicated implant success:

- mobility of less than 1mm in any direction.
- bone loss of less than one third of the vertical height of the implant.
- no symptoms of infection, pain, numbness or any nasal or maxillary sinus symptoms.
- implant functional for 5 years.

However, in 1986 new criteria were suggested by Albrektsson et al[17] which included:

- implant clinically immobile.
- no radiographic evidence of peri-implant radiolucency.

- vertical bone loss less than 0.2mm after the first year.
- no signs or symptoms of pain, infection, paresthesia or any neuropathies.

Very few studies have been made to compare immediate and delayed placement of dental implant in posterior teeth. Fugazzotto[18] studied 341 implants which were placed in the posterior mandible immediately after tooth extraction.

In this study, the following surgical protocol was used:

- all molar teeth were hemisected during extraction to preserve inter-radicular bone.
- the socket was thoroughly debrided.
- the osteotomy was performed in the inter-radicular bone.
- regenerative materials were placed around implants.

A success rate of 99.1% was reported. The authors concluded that an implant may be placed in an ideal restorative position at the time of removal of a multi-rooted mandibular tooth.

Assessment of implant stability is an important factor for immediate and delayed loading of prostheses. Primary implant stability is influenced by various factors, such as local bone quality and quantity, the size of the implant, and cortical bone thickness[19,20]. The secondary stability is influenced by bone healing and remodelling around the implant[21].

Poor primary stability is one of the major causes of implant failure[22]. Other related causes of implant failure include inflammation, bone resorption, and biomechanical overloading[23].

Clinical and radiographic examination of a dental implant prior to placement of the definitive restoration onto the implant is an essential component of the surgical phase. The soft tissue and bone healing around the implants can be evaluated utilising a periodontal probe and an Orthopantomogram. Several methods have been used in clinical practice to determine implant stability. Removal torque strength has been used as a standard biomechanical measure of bone to implant contact, where greater forces required to remove the implants can be interpreted as a measurement of increased osseointegration[24]. Another method is resonance frequency analysis (RFA) which is considered the most accurate method to evaluate stability of a dental implant. Higher resonance frequency values correspond to greater stability of the implant[25]. Numerous studies have considered an implant to be ready for prosthodontic rehabilitation following a healing period of three months[6,24,25].

This study will compare the initial surgical success of immediate versus delayed placement of dental implants placed into posterior region of the mandible.

2.Aims of the study

The aim of this study is to compare the outcome of early osseointegration and implant survival after three months following immediate placement of dental implants in inter-radicular bone and delayed early osseointegration and implant survival of the mandible.

3.Objectives :

To compare the two study groups by evaluating the following parameters :

- soft tissues around the implant.
- alveolar bone resorption.
- stability of the implant.
- clinical success or failure.

4. Materials and Methods

The clinical and radiographic records of forty-six consecutive patients who presented in a private maxillofacial and oral surgery practice between January 2012 and December 2013 were included in this retrospective study. They had been referred for tooth extraction of a mandibular molar(s) due to caries or periodontal disease and who requested replacement of the missing teeth with dental implants. Alternatively the patients were already missing a mandibular molar.

The patients were divided into two groups. The first group received dental implants placed immediately into the inter-radicular bone of a fresh extraction socket in the posterior mandible (1st and 2nd molar regions). The second group received dental implants inserted into healed bone in similar sites.

All the implants were placed by the same oral and maxillofacial surgeon using the same implant system for all the cases (Replace Select Tapered Groovy implants, NobelBiocare implant system, Sweden). A detailed clinical and radiographic examination using orthopantomograph X-rays (Planmeca 2002 CC Proline XC digital X-ray machine) was done preoperatively for implant planning.

The sample size was decided upon after considering previous reports from the literature[4,5,7] and following the recommendations of a statistician regarding significance.

4.1 Inclusion criteria:

- implants placed in the mandibular molar region.
- healthy patients without co-morbidities.

4.2 Exclusion criteria

- Cases subjected to bone grafting
- Presence of active infection
- Medically compromised cases e.g. Diabetes, Bisphosphonate therapy
- Smokers

4.3 Data collection:

Data were collected using a data capture sheet.

The following data were collected:

- age of the patient.
- sex of the patient.
- site of the implant.
- length and diameter of the implant.
- bleeding on probing and nature of the bleed following probing at the follow-up visit 3 months post-implant placement .
- torque evaluation, torque and reverse torque testing of the healed implant.
- radiographic evaluation of bone levels - comparison of crestal bone levels at time of insertion compared with crestal bone levels of the healed implant.
- patient's level of comfort with regards to the presence of the implant.
- overall survival of the implant.

4.4 Assessment of data:

All the implants were evaluated clinically and radiographically: pre-operatively, immediately post-operatively or after 1 week (if immediate radiograph not possible) and a minimum of 3 months post-placement of the implant.

Clinical assessments were divided into soft and hard tissues. For soft tissue assessment at the three months appointment a general impression of the peri-mucosal tissues was recorded, presence or absence of bleeding on

probing per implant site as well as mucosal healing around the implant were evaluated.

For the hard tissues, implant stability and osseointegration assessment by means of percussion and torque and reverse torque testing to approximately 32NCm utilising a calibrated standard Torque wrench (NobelBiocare, Sweden) were performed.

The radiographic assessment of bone healing was done comparing the crestal bone levels around the implant shoulder on the immediate post-operative orthopantomograph with the orthopantomograph taken following a minimum of 3 months healing. Measurements of the crestal bone level were recorded from the implant neck to the crestal bone mesial and distal to each implant with a digital millimetre ruler (Blue Pixel digital ruler) on the orthopantomographic radiograph. The bone level on the immediate post-operative x-ray was considered as the baseline for evaluation of bone changes during the follow- up period.

Success and failure of the implants were determined using criteria advocated by Albrektsson[17] in 1986.

The soft tissue evaluation was performed by recording the presence or absence of bleeding on probing per implant site using the bleeding Index proposed by Mühlemann[27] in 1977:

0 : No bleeding

1: Only one bleeding point appearing

2: Several isolated bleeding points or a small blood area appearing

3: Interdental triangle filled with blood soon after probing

4: Profuse bleeding when probing.

Bleeding suggested mucosal inflammation or was correlated to potential bone loss.

4.5 Statistical analysis

The data was analysed using IBM SPSS Statistics version 22[26]. A Fisher's Exact test was done to determine whether there was a statistical difference in the success rates between the immediate and delayed implant placement groups ($p < 0.05$). The Mann-Whitney test was applied to determine if there was a difference in mesial and distal bone loss for the implant groups.

4.6 Ethical approval

The research was approved by the Ethics committee, Health Sciences, University of the Witwatersrand - ethical approval number: M141014.

5. Surgical Technique

5.1 Immediate placement group:

This group comprised of twenty-six patients who received 27 dental implants immediately after extraction of their mandibular molars.

The patients were prepared for surgery in a surgically clean environment utilising aseptic techniques. A pre-operative antibiotic (500mg amoxicillin or 300mg Clindamycin) was taken orally. Local anaesthesia was obtained using Xylocaine 2% with Adrenaline (Epinephrine) 1:200,000. The extractions were performed as atraumatically as possible utilising a flapless technique whereby the tooth roots were split and the root remnants gently delivered from within the sockets with periotomes to maintain the integrity of the bone. The osteotomy was prepared into the remaining inter-radicular bone. Progressive sequence drills with external irrigation were used according to the preplanned implant diameter and length. The insertion torque ranged from 25 Ncm to 50 Ncm. An healing abutment was then placed onto the implant at finger tightness. The buccal and lingual mucosal tissues were then lightly adapted across the alveolus utilising Plain gut 5’0’ resorbable sutures (Synthecon). No bone grafting was done into the space around the implant irrespective of space dimensions.

5.2 Delayed placement group

Twenty patients who received 26 implants following a “delayed protocol” were included in this group**.** All the implants were placed at least 3 months after extraction of the mandibular molar teeth.

Patients were prepared similarly to the immediate placement group. Once local anaesthesia had been obtained a mid-crestal full thickness mucoperiosteal envelope flap was raised from the alveolar bone. Minimal reflection of the soft tissue sufficient only to expose the surgical site was done. The osteotomy site was determined utilising a prefabricated surgical stent and the osteotomy preparation achieved as for group 1. Insertion torque similarly ranged from 25 Ncm to 50 Ncm. Where practical the implants were positioned slightly subcrestal or at the crest. Where alveolus resorption patterns were irregular a portion of the neck of the implant may have been slightly supra-crestal. An healing abutment was placed finger tight and the mucosa adapted to fit the abutment. The buccal and lingual mucosal tissues were then approximated using a Plain Gut 5”0” resorbable suture.

In both groups post-operative surgical site care (Chlorhexidine containing toothpaste applied digitally to the area) and analgesics were prescribed routinely for all patients. No post-operative antibiotics were prescribed.

Orthopantomograph radiographs were taken immediately after placement of the dental implants for post-operative evaluation. A further orthopantomograph was taken a minimum of 3 months later at the appointment arranged to determine the integration status prior to referring the patient back to the restorative dentist.

6. Results

Fifty five implants were placed in the mandibular molar region in forty six patients who fulfilled the inclusion criteria between January 2012 and December 2013.

26 patients (16 men and 10 women) with a mean age of 54.0 years (range 30 - 75 years) had 29 immediate placed implants. Twenty patients (11 men and 9 women) with a mean age of 49.2 years (range 30 - 66 years) had 26 delayed implants placed (Figs 1 and 2). All the implants were placed in the mandibular molar region (36, 37, 46, 47 sites).

Tables 1 and 2 detail the distribution of implant positions, lengths and diameters of the implants, their insertion torque, and the measured mesial and distal bone loss around the implants after the minimum three month healing period for both groups.

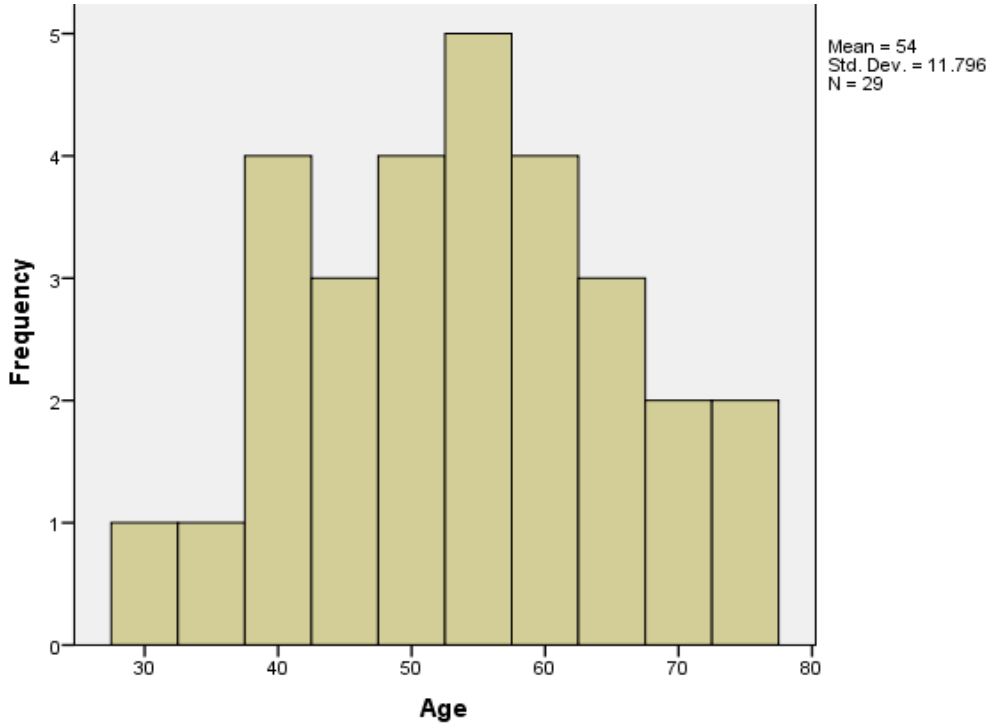


Figure 1. Overview of age distribution in the immediate placement group

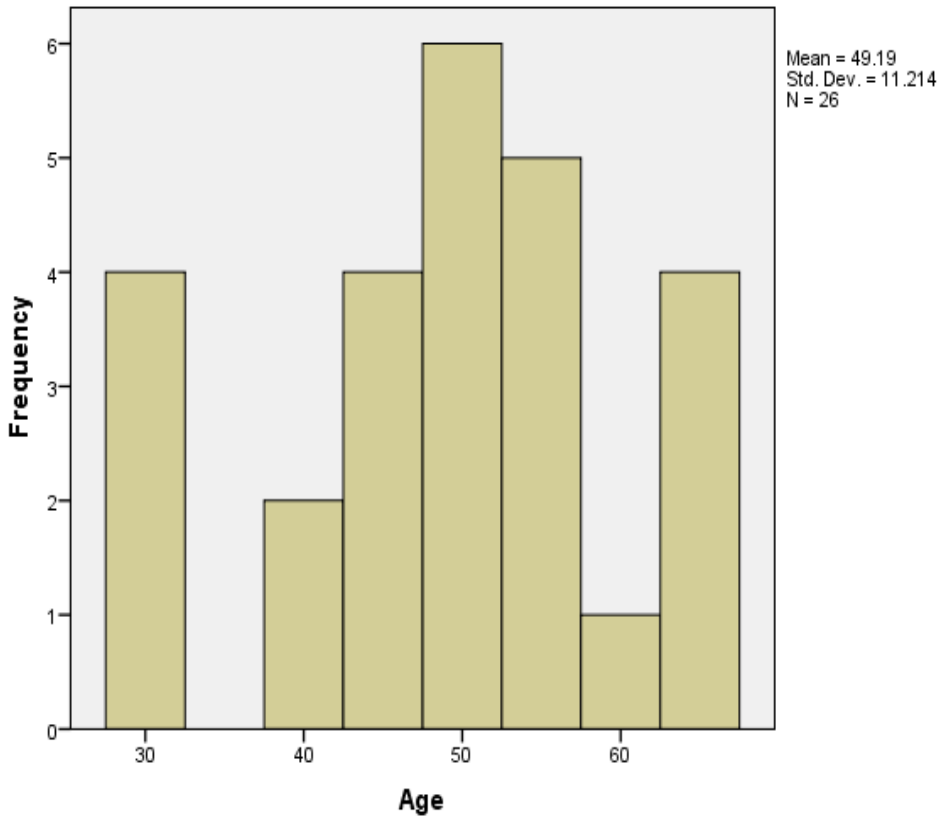


Figure 2. Overview of age distribution in the delayed placement group

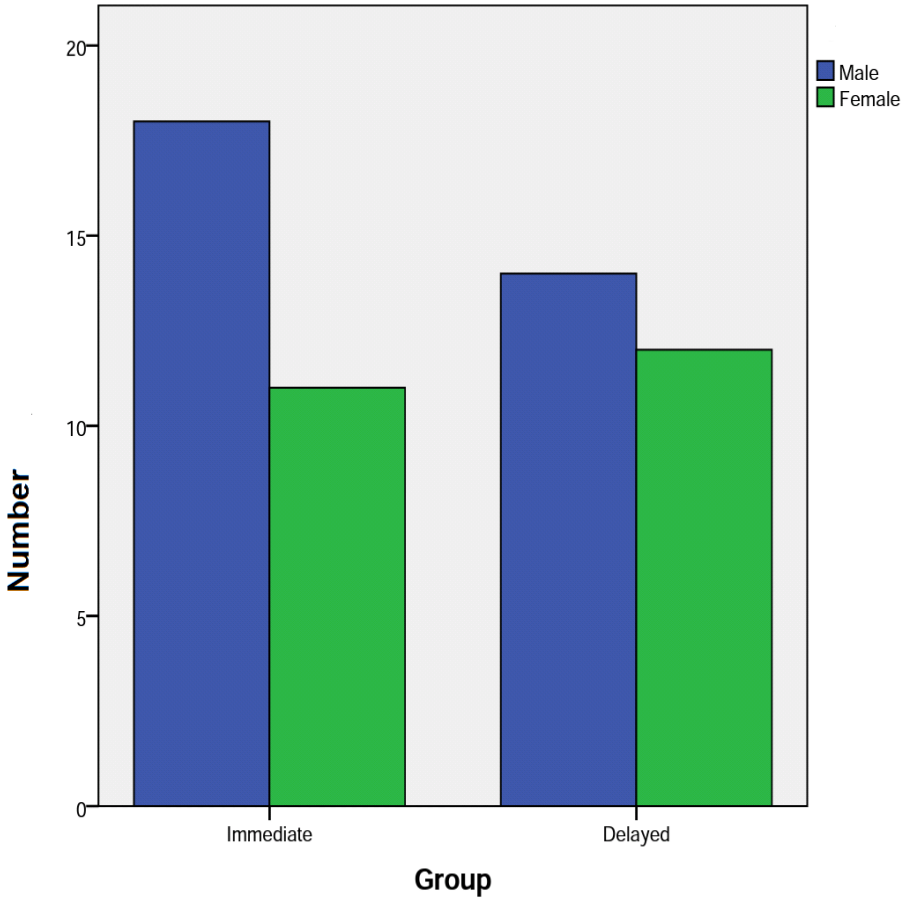


Figure3. Bar chart reflecting the Gender distribution

Table 1. Data collected for immediate group

Implant No	Implant site	Age	Implant length mm	Implant diameter mm	Insertion Torque N/cm	Reverse Torque N/cm	Mesial Bone loss mm	Distal bone loss mm
1	46	64	13	5	40	30	0.3	0
2	46	45	11.5	5	45	35	0	0
3	36	57	10	5	40	25	0	1
4	36	52	13	5	20	30	0.5	0.5
5	46	30	10	5	40	25	0	0.5
6	37	65	10	5	50	25	0	0
7	46	45	13	5	50	25	0	0
8	36	56	11.5	5	45	32	0	0
9	46	70	11.5	5	20	35	0	0
10	36	75	10	5	45	30	0	0
11	46	75	10	5	45	30	0.5	0.5
12	46	36	11.5	5	35	30	0	0
13	46	62	10	5	30	30	0	0
14	47	54	10	5	30	25	0	0
15	46	54	10	5	30	25	0.5	0.5
16	36	64	11.5	5	45	30	0	0.5
17	36	42	11.5	5	50	failure	4	4
18	37	39	10	5	35	35	0	0
19	36	61	11.5	5	50	30	0.5	0
20	36	58	13	5	50	30	0	0
21	37	62	8	5	35	25	0.5	0.5
22	46	40	11.5	5	50	25	0	0
23	47	46	10	5	40	25	0	0.5
24	36	70	10	5	50	25	0.7	0.7
25	47	48	13	5	50	30	0	0
26	37	39	10	6	50	25	0	0.5
27	36	55	10	5	50	30	0	0.5
28	46	51	10	5	40	30	0.5	0.5
29	47	51	10	5	50	30	0.5	0

Table 2. Data collected for delayed group

Implant No	Implant site	Age	Implant length mm	Implant diameter mm	Insertion Torque N/cm	Reverse Torque N/cm	Mesial Bone loss mm	Distal bone loss mm
1	36	56	11.5	5	50	30	0	0
2	36	30	10	5	50	30	0.5	0.5
3	37	30	11.5	5	50	25	0	0
4	36	52	10	5	50	25	0	0
5	46	52	10	5	50	25	0.5	0.5
6	36	57	10	5	50	30	0.5	0.5
7	37	64	10	4.3	40	30	0.5	0.5
8	46	53	10	5	50	25	1	1
9	36	53	10	5	50	25	0.5	0
10	37	66	10	5	40	25	0	0
11	36	43	11.5	4.3	35	25	1	1
12	46	52	10	5	35	25	0	0
13	47	52	10	5	45	25	0	0.5
14	46	61	10	5	50	25	0.5	0.5
15	47	38	10	4.3	50	25	0	0.5
16	46	30	10	5	50	30	0	0
17	36	30	8	5	50	30	0	0.5
18	37	53	10	5	50	25	0	0
19	46	45	8	5	40	25	0.5	0
20	37	48	8	5	50	30	0.5	1
21	47	44	10	5	30	25	0	0
22	36	51	8	4.3	50	Failure	7	7
23	36	42	13	5	40	30	0	0
24	46	45	10	4.3	50	25	0	0.5
25	46	66	10	5	40	25	0	0
26	47	66	10	6	30	25	0	0

6.1 Survival rate:

Only one implant failure was reported in each group with success rates of 96.6% and 96.2 for the immediate and delayed implant groups respectively.

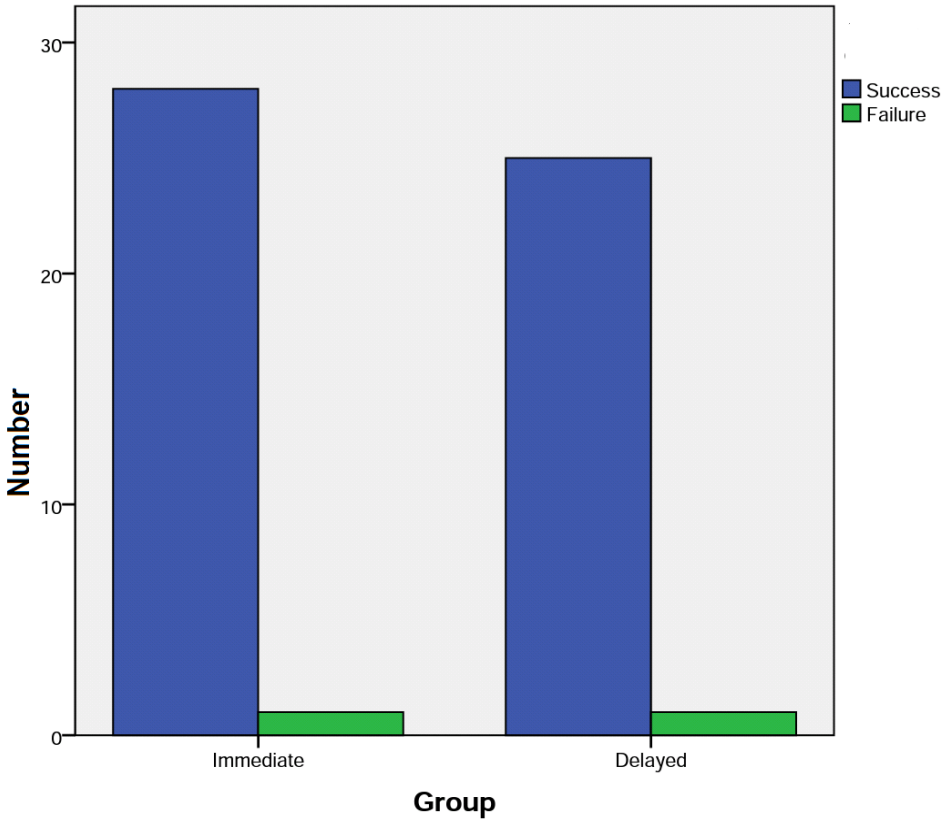


Figure 4. Bar chart showing the reported successful and failed implants

6.2 Rate of bone mesial and distal bone loss :

In this study the mean bone loss in the immediate group was 0.293 mm (range: 0 mm to 4 mm) and 0.369 mm (range : 0 mm to 4 mm) on the mesial and distal surfaces respectively. Mean bone loss in the delayed group was 0.500 mm (range from 0 mm to 7 mm) and 0.558 mm (range from 0 mm to 7 mm) on the mesial and distal surfaces respectively.

There was no statistically significant difference in bone loss between the two groups (mesial bone loss (p = 0.452), distal bone loss (p= 0.607).

Figures 5 and 6 represent the mesial and distal bone loss for the immediately placed implant group respectively.

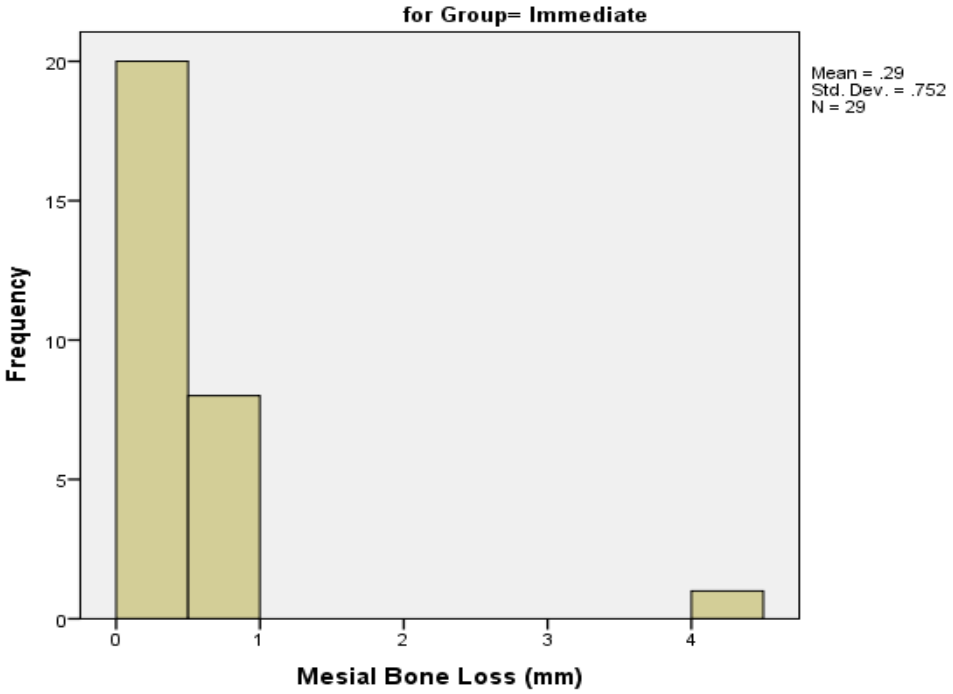
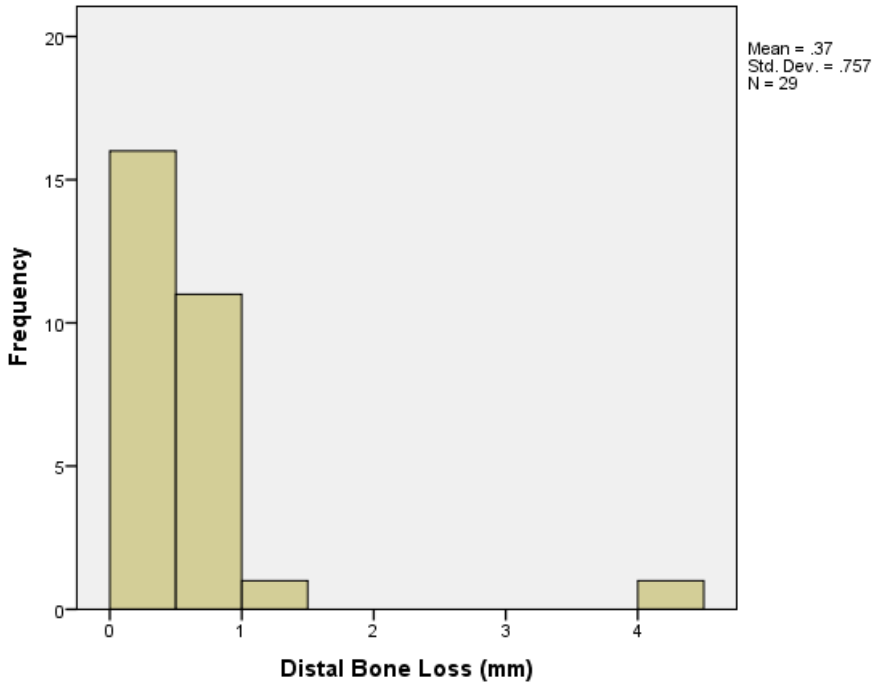


Figure 5. Mesial bone loss for immediate implant group



Figures 7 and 8 represent mesial and distal bone loss for the delayed implant placement group respectively.

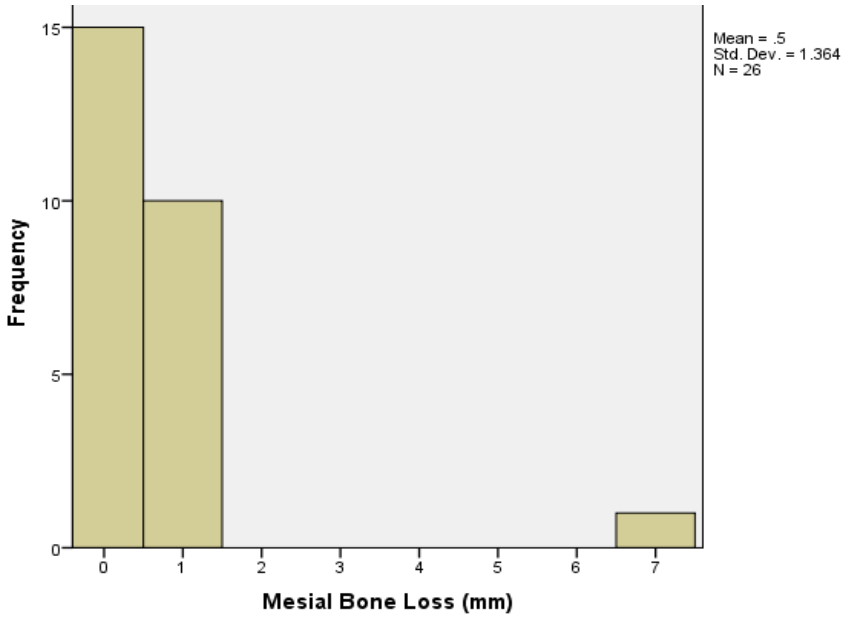


Figure 7. Mesial bone loss for delayed implant group

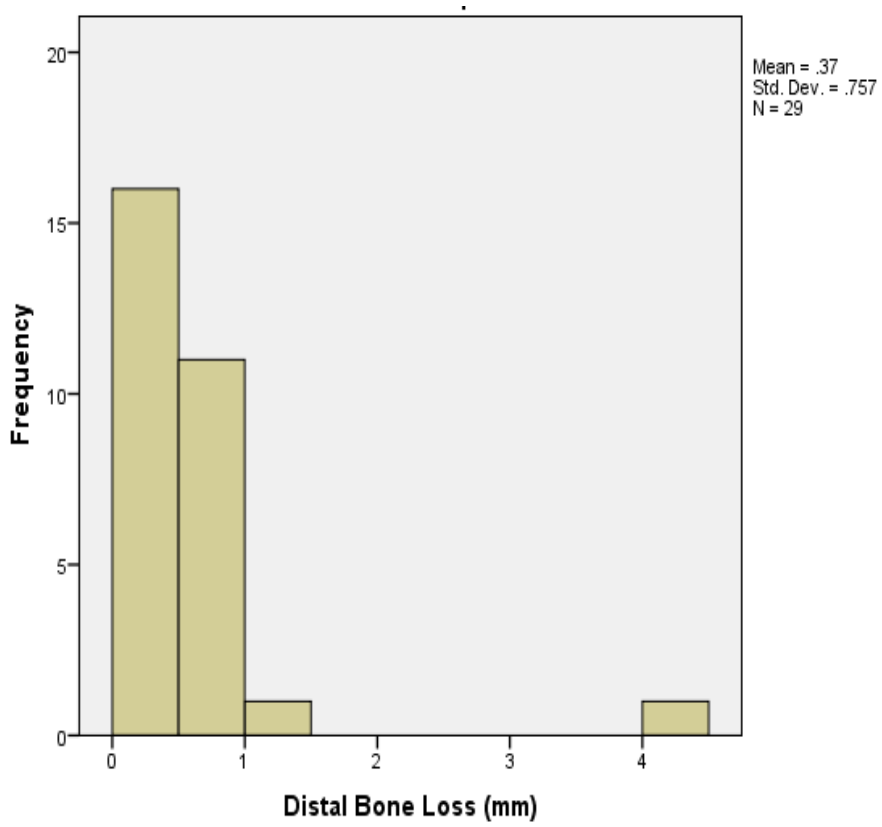


Figure 8. Distal bone loss for delayed implant group

Table 4. Mann-Whitney Test analyzing bone loss

Group		N	Mean	Std. Deviation	Std. Error Mean
Mesial bone loss	Immediate	29	.293	.7521	.1397
	Delayed	26	.500	1.3638	.2675
Distal bone loss	Immediate	29	.369	.7569	.1406
	Delayed	26	.558	1.3589	.2665

6.3 Evaluation of the stability of the implants

The mean insertion torque to assess primary stability in the immediate group was 41.72N/cm (range 20-50N/cm) and 45.19N/cm in the delayed group (range 30-50N/cm). No statistically significant difference was found (p=0.117). Confirmation of osseointegration and stability (secondary stability) of the implant was determined manually after three months with a commercial torque wrench. The healing abutments on the implants were first torqued to a mean of 27.65N/cm (range 25-32N/cm) for the immediate group and to a mean of 25.57N/cm (range25-30N/cm) in the delayed group. A reverse torque loosening the healing abutment was then done to all implants**.** There was no statistically significant difference in secondary stability in both groups (p= 0.127).

Mann-Whitney Test					
Group		N	Mean	Std. Deviation	Std. Error Mean
Age	Immediate	29	54.00	11.796	2.190
	Delayed	26	49.19	11.214	2.199
Implant Length	Immediate	29	10.86	1.274	.237
	Delayed	26	9.98	1.127	.221
Implant Diameter	Immediate	29	5.034	.1857	.0345
	Delayed	26	4.892	.3825	.0750
Insertion Torque	Immediate	29	41.72	9.090	1.688
	Delayed	26	45.19	6.853	1.344
Mesial Bone Loss	Immediate	29	.293	.7521	.1397
	Delayed	26	.500	1.3638	.2675
Distal Bone Loss	Immediate	29	.369	.7569	.1406
	Delayed	26	.558	1.3589	.2665

Table 3: Mann Whitney test representing mean values and standard deviation for mesial and distal bone loss as well as insertion torques.

6.4 Soft tissue evaluation

In the immediate group, 26 (89.7%) implants had no bleeding during probing (score 0) whilst 3 implants (10.3%) exhibited pin-point bleeding (score 1) .

In the delayed group 22 implants (84.6%) had no bleeding (score 0).Probing of 4 implants (11.5%) elicited mucosal bleeding during probing, of which 3 were defined as pin- point bleeding (score 1) and 1 was recorded with profuse bleeding (score 4).

There was no statistically significant difference between the two groups (p= 0.556).

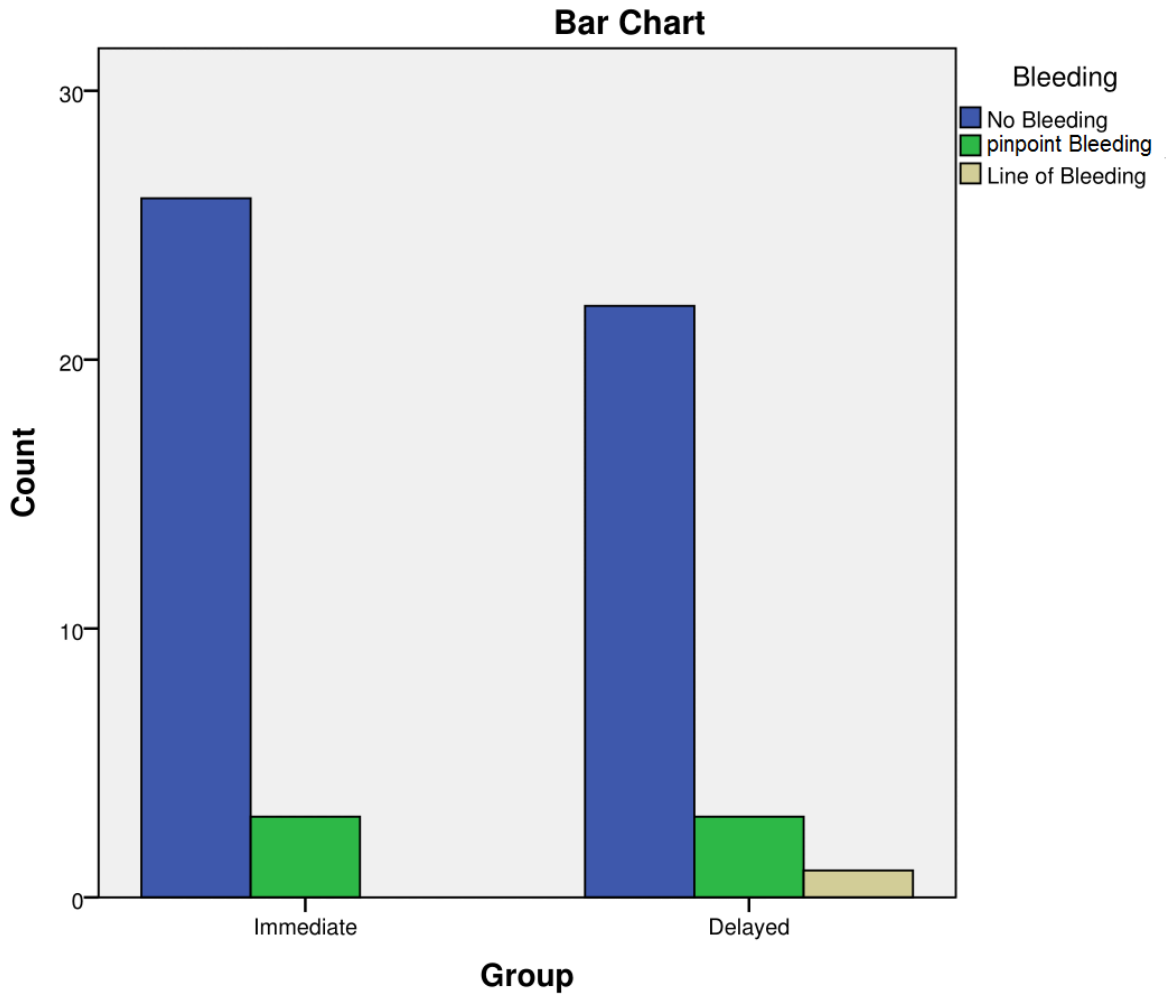
Group * Bleeding

Crosstab

			Bleeding			Total
			No Bleeding	Pin Point Bleeding	Line of Bleeding	
Group	Immediate	Count	26	3	0	29
		% within Group	89.7%	10.3%	0.0%	100.0%
	Delayed	Count	22	3	1	26
		% within Group	84.6%	11.5%	3.8%	100.0%
Total		Count	48	6	1	55
		% within Group	87.3%	10.9%	1.8%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.173[a]	2	.556
Likelihood Ratio	1.556	2	.459
Linear-by-Linear Association	.662	1	.416
N of Valid Cases	55		


Bar Chart
Bleeding
No Bleeding
pinpoint Bleeding
Line of Bleeding
Count
30
20
10
0
Immediate
Delayed
Group

7. Discussion

Placement of dental implants into bone was first reported by Brånemark in 1977 when he described a two-stages surgical treatment protocol[1]. In the late 1970s Schulte et al[28] reported placement of dental implants immediately into fresh extraction sockets. A number of studies have been conducted to compare the outcome of both protocols[4, 5,7,14]. Polizzi et al[29] conducted a 5 year prospective study to compare the outcomes of immediate and delayed placed implants in the mandible and maxilla. They concluded that there was no significant difference in success and failure rates between the two groups.

A randomized controlled study was conducted by Van Kesteren et al[30] to compare soft tissue changes following immediate and delayed placement of dental implants. The conclusion reported no difference in the soft tissue outcomes between the groups.

Many other studies evaluated the outcomes of immediate implant placement in fresh extraction socket of anterior and premolar teeth [6, 8,11,13,31] . Most of the studies showed comparable outcomes compared with delayed implant placement in healed bone.

Placement of implants immediately into freshly extracted sockets of multi-rooted teeth can be very challenging due to socket architecture, anatomical form of that region and the proximity of vital structures. Primary implant stability may possibly be reduced due to the increased proportion of medullary bone reducing the bone to implant contact area and the implant to bone engagement[32].

A few studies were carried out to evaluate the outcome of immediate placement of dental implants into fresh extraction sockets of posterior teeth[7, 18, 32, 33].

Fugazzotto[18] et al studied 341 implants which were placed in the mandible immediately after tooth extraction and a success rate of 99.1% was reported. Another study was conducted by Vandeweghe et al [32] where they evaluated the outcome of Max implants (8mm and 9 mm diameter implants) placed immediately into fresh extraction sockets of molar teeth. 98 implants were included in the study. Only one implant failure was reported resulting in a success rate of 97.9%. They concluded that Max implants can be used to replace molar teeth immediately and that good primary stability can be achieved.
When implants are placed into fresh extraction sockets, a gap is usually present between the socket wall and the implant. It has been suggested that if this gap is greater than 1mm there may be a chance of soft tissue ingrowth between the implant and the socket wall that can lead to lack of adaptation and osseointegration failure at the cervical area of the implant[34]. Some authors advocate using autogenous or allogeneic bone graft to fill the gap in order to preserve crestal bone[35, 36]. Other authors proposed that grafting is only necessary if a mucoperiosteal flap has been raised during tooth removal[37].
In 2011, Dennis Tarnow and Stephen Chu evaluated osseointegration and bone generation around implants placed immediately into a fresh extraction sockets with excessive gap without primary closure of the flap, graft, or membrane. They discovered that placement of implants immediately into fresh extraction sockets with an intact buccal wall and without primary flap closure, a bone graft, or a membrane wall allows bone formation and osseointegration regardless the size of the gap between the implant and the surrounding bone[37]**.** In our study no

grafting or regenerative materials were utilized, supporting the previous study that was done by Tarnow and Chu in 2011.

On the other hand a small gap can successfully regenerate new bone between the implant and socket wall even if a mucoperiosteal flap is raised [38, 39].

Resorbable and non-resorbable barrier membranes have also been utilised with and without bone graft fillers as a means of allowing bone regeneration to promote crestal bone osseointegration[8, 40,41]. Lazzara et al[8] introduced the use of polytetrafluoroethylene membranes to cover implants placed into fresh extraction sockets in 1989 and reported good results. Since then other studies have substantiated these findings [40, 41].

The results of this study are consistent with previously reported studies. One implant failed in each group giving success rates of 96.6% and 96.2% for immediate and delayed implant placement groups respectively. With regard to the mesial and distal bone loss recorded at the cervical shoulder of the implant there was no statistically significant difference in bone loss in either immediate or delayed groups after 3 months of follow up.

The study also shows that there is no difference between the groups in terms of readiness to receive a prosthetic part after 3 months of placement of the implant. Mean values of insertion torque to assess primary stability in the immediate and delayed groups were not statistically significant different (p=0.117).

Confirmation of osseointegration and stability (secondary stability) of the implants by means of reverse torque were performed. There was no statistically significant difference in secondary stability of both groups (p= 0.127).

Using a narrower final drill during preparation of the implant osteotomy can improve the primary stability and increase the insertion torque[42,43]. This may be valuable when placing implants into fresh extraction sites in the molar region where the quality and quantity of bone can make placement of the implant very challenging. However, this technique can cause high compressive forces which may compromise the blood supply of the bone which may lead to necrosis of the osteocytes and bone resorption[43]. Khayat et al[44] conducted a study to evaluate clinical outcomes of implants placed with high insertion torques (up to 176 Ncm), and found no deleterious effects on the bone from using high insertion forces.

The rationale for placing implants immediately is mainly to reduce the morbidity of the procedure to the patient. Additional benefits include having adequate available bone for implant placement, preservation of bone at the site of implantation, being able to judge the emergence position of the implant relative to the proposed new crown based on the original tooth crown and decreasing the number of surgical procedures thus reducing the treatment time by months. In selected cases a prosthetic tooth can be attached to the implants simultaneously[7, 8]. Earlier rehabilitation can be considered and optimal soft tissue aesthetics can be achieved[9,10, 11].

In the present study survival rates, marginal bone loss as well as primary and secondary stability were comparable in both groups. There was no significant difference in the outcomes between both groups. However radiographic assessment was only for evaluation of mesial and distal bone loss. Buccal and lingual bone levels could not be assessed though an indication of an underlying bony defect may be predicted by increased periodontal probing depths and profuse bleeding on periodontal probing. Currently the only technique for evaluating buccal and lingual bone levels is through advanced imaging utilising medical CT scanning or Cone Beam tomography.

Soft tissue evaluation is another important indicator for success or failure of dental implants - colour, shape and consistency of the mucosa, the presence of keratinized mucosa, probing depths and their relationship to bleeding on probing should be carefully evaluated and recorded.

Changes in mucosal colour, profuse bleeding on probing and increased probing depths are possible indicators of a developing peri-implantitis[45,46].

In the current study evaluation of soft tissues around dental implants in both groups was performed by probing around dental implants. Bleeding scores were recorded using bleeding Index as proposed by Miihleman[27].

In the immediate group 3 implants (10.3%) were associated with pin-point mucosal bleeding . Two of these implants recorded successful responses to other tests for osteointegration and did not reveal bone loss on X-ray. However the third implant showed peri-implant bone loss on X-ray, was deemed to have failed the integration test and was removed.

In the delayed group there were 4 implants (11.5%) associated with mucosal bleeding during probing. Three implants exhibited pin-point bleeding (score 1) but

were otherwise recorded as being successfully integrated. Probing the fourth implant was associated with profuse bleeding (score 4) indicating severe inflammation. Bone loss was present on X-ray and the implant was found to be unsuitable for restoration and was removed.

There was no statistically significant difference between the two groups (p= 0.556) with regards the soft tissue evaluation.

The validity of the study was promoted by excluding patients with co-morbidities such as smoking and any medical history that may influence results.eg. Diabetes This greatly reduced the patient cohort resulting in the relatively small numbers of patients and implants investigated.

A limitation of the study is the small sample size and the limited follow-up. In a surgical practice the patients are referred back to the restorative dentists for fabrication of the implant crown. It is very difficult to motivate these patients to return to the surgeon for purely academic reasons thereby increasing the time for post-operative evaluation.

Similarly controlled prospective clinical studies will enhance our understanding of the perceived benefits of placing dental implants immediately at the time of tooth extraction. Improved imaging modalities that are patient friendly and which enable the 3-dimensional evaluation of bone levels around the implants would further validate any findings.

8. Conclusion

The following conclusions can be drawn from this study:

- the immediate placement of implants into fresh extraction sockets in the posterior region of the mandible has similar outcomes to implants placed into healed bone. There is no statistically significant difference in survival rates or marginal bone loss between the groups.
- excellent primary and secondary stability can be achieved in immediately placed implants.
- the main advantages of immediate implant placement at time of tooth extraction are decreasing the patient morbidity, ensuring adequate bone for implant placement, permitting accurate implant positioning and reducing the number of surgical procedures thereby reducing the treatment time by months.

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