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Early loading : comparing delayed and immediate (post extraction) placement protocols

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Early loading: comparing delayed and immediate (post extraction) placement protocols

Beena Navnitlal Harkison

A research report submitted to the Faculty of Health Sciences of the University of Witwatersrand in partial fulfilment of the requirements for the degree of Master of Science in Dentistry, Johannesburg 2005

Declaration

I, Beena Navnitlal Harkison, hereby declare that this research report is my own work and has not been presented for any degree of another university.

_____ 01/06/2005

Beena Navnitlal Harkison

BDS (Witwatersrand)

The work carried out in this research report was performed in the Dental Research Institute, University of Witwatersrand, Johannesburg and the Morningside Medi-Clinic, Sandton, Johannesburg.

Dedication

To my Mum. Wish you were here.

To my Dad, Navnitlal and my brother, Dipesh. Thank you for your support.

To Bhavin. Without you, I could not have accomplished this.

Abstract

Background: It is well documented in the international literature that when implants have been placed with primary stability in the edentulous mandible, immediate or early loading of the implants can be highly successful. Success rates of between 85-98% have been reported.[1] However, no evidence has been published on the success rates of implants placed post-extraction with immediate or early loading in South Africa.

Objectives: The investigation reported in this dissertation was undertaken to compare the success rates of early loaded implants placed in

a) Edentulous mandibles and maxillae (delayed placement),
b) "Fresh" extraction sockets with prior alveolectomies within the mandible/maxilla (immediate placement).

Methods: In a private maxillo-facial surgical practice and a private prosthodontic practice, the number of patients who had received implants, number of implants per patient, type of implant placed (Southern or Nobel Biocare), total number of implants, site of implant placement and type of prosthesis placed were recorded. The success rates were evaluated using the following criteria[3]:

A) Absence of clinically detectable implant mobility
B) Absence of soft tissue infections, persistent pain, paraesthesia, or discomfort

C) Radiographic evaluation of bone loss

D) Period of follow-up, that is loading period

Results: The records of 22 patients who had had 121 implants placed with early loading over a 3 - 45 month period were studied. Of the 121 implants, 107 implants showed no bone loss, and 14 showed bone loss. Furthermore, 4 implants were lost in 2 patients, both patients having had implants placed in edentulous jaws. No clinical complications were seen in any patients.

Conclusions: Implants with early loading placed in edentulous jaws showed a 94.1% survival rate during the study period, while those placed into fresh and immediately post-extraction sockets showed a 100% survival rate. The failure rate was too low for further analysis.

Verbal presentation arising from work described in this research report

Harkison BN, Boyes-Varley JG, Cleaton-Jones PE, Howes DG. Comparison between delayed and immediate post-extraction implant placement – a preliminary study. *International Association for Dental Research: XXXVII Scientific Meeting of the South African Division,* Cape Town 12 September 2003.

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5) To my friends and family, for being there.

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Chapter 1 – Introduction

1.1 General remarks

The traditional way to replace lost or missing teeth in edentulous or partially edentulous patients has been to provide these patients with fixed or removable prostheses by way of conventional crown and bridge work or removable partial dentures.[1] Since the advent of the osseointegrated implant-supported prostheses (ISP) in the 1960's, there are now a number of additional treatment options. The success of osseointegrated implants has been well documented by many researchers and is in the range of 92-98%.[2-7]

The two-stage or conventional surgical protocol established by Brånemark and colleagues[8] required:

1) countersinking the implant below crestal bone
2) obtaining and maintaining a soft tissue covering over the implant for 3-6 months
3) maintaining a non-loaded implant environment for 3-6 months
4) absence of infection in the surrounding bone

The reasons cited for these pre-requisites were to:

1) reduce the risk of bacterial infection
2) prevent apical migration of the oral epithelium along the length of the implant

3) reduce the risk of early implant loading during bone remodelling.[4]

Over the years, however, researchers have reported that endosseous implants that reside in the bone and penetrate through the oral soft tissue do osseointegrate during the period of early bone healing and remodelling, eliminating the need to wait for 3-6 months for bone healing to occur.[4] This surgical approach has been termed a one-stage procedure and eliminates the second surgical phase to expose the implants some 3 months later.

1.2 Implant loading

The literature reports that endosseous implants may be placed into bone using a one or two stage procedure.[5] With the two-stage surgical protocol, also known as delayed loading, implants are exposed into the oral environment and loaded with a prosthesis after the conventional healing period of 3-6 months.[9] In the one-stage surgical procedure, implants are loaded immediately (where a temporary prosthesis is attached to the implant on the same day as the implants are placed) or loaded early (where the prosthesis is attached at a second procedure, within 3-6 months; the time of loading is recorded in days/weeks).[9] The controversy surrounding immediate and early loading has been great, with many documented studies using the term “immediate” loading for implants that were loaded 2-3 days after implant placement. This confusion was rectified at the World Congress Consensus Meeting[9] in Barcelona in 2003 and the definitions are as follows:

- Immediate loading[9] – the prosthesis is attached to the implants on the same day that the implants are placed.
- Early loading[9] – the prosthesis attached at a second procedure, earlier than the conventional healing period of 3 to 6 months; time of loading should be stated in days/weeks
- Delayed loading[9] – the prosthesis is attached at a second surgical procedure after a conventional healing period of 3 to 6 months.

It is important to note that the use of the terms immediate and early loading were synonymous in studies published prior to this Congress, and that both terms will be used in this research report when referring to these studies.

The increasing popularity of immediate and early loading is largely patient driven and immediate placement enhances masticatory function, improves psychological well-being, reduces treatment time and shows a marked reduction in treatment costs.[1,10]

Early functional loading allows patients who are not able to wear conventional dentures the ability to eat and speak without the embarrassment of having to remove the dentures while eating.[11] Petersson and colleagues[5] stated that elimination of one surgical step could be a positive factor. They theorised that most bone level changes occur during the abutment connection procedure. Elimination of this step could result in less marginal bone resorption.[12] Because

the implants are splinted together in the immediate/early loading protocols, it also decreases the risk of overload due to a greater surface area and improved biomechanical distribution.[4,9] Certainly parafunction, low bone volume, low bone density, poor bone vitality and infection are risk factors of immediate/early loading.[9]

The following guidelines for immediate/early loading have been proposed by Horiuchi and colleagues[12]:

1) use multiple implants (at least 8)
2) use long implants (at least 10mm for regular diameter implants)
3) maintain an insertion torque between 32 - 40Ncm
4) if an insertion torque of less than 40Ncm and a length of less than 10mm is present then the implants should be submerged
5) a screw-retained, passively fitting provisional prosthesis with a rigid metal casting should be used
6) avoid cantilevers in the provisional prosthesis
7) do not remove the provisional prosthesis during the healing period of 4-6 months

These were reiterated at the World Congress Consensus Meeting in Barcelona[9] where the following were also mentioned:

- controlled occlusal loads for full-arch cases
- non-occlusal loads for short span bridges and single-teeth replacements

- site evaluation for bone density and volume
- controlled infection and inflammation

1.3 Reported success rates

The success rates for immediate/early loaded endosseous implants are as follows:

- Mandible - 93-100% over a 1-5 year period[6,7,10-17]
- Maxilla - 92-97% over a 1-2 year period[12,16,18-19] and
- Cumulative success rate between 95-100% over a 5 year period.[2,4,20-21]
- The cumulative success rate evaluating immediate/early loading over a 10 year period has been shown to be 85%.[22] These success rates are very similar to those shown using the delayed loading protocol.[2-7]

1.4 Bone healing

An important factor in considering immediate or early loading as a treatment option for a patient is the bone reaction to early loading. Rocci and colleagues[23] histologically studied oxidised implants that were subjected to immediate and early loading. The results showed an undisturbed healing of the soft tissue and bone with no difference in response between immediately and early loaded implants. Lamellar bone, bone remodelling and the presence of a lamina dura-like structure were also presented in the study resulting in the compaction of

bone and increased stiffness of the bone-implant system. The bone-to-implant contact value and bone area values were 84.3% and 79.1% respectively. These results are comparable to the results described by Albrektsson and colleagues[24] using the two-stage protocol. More bone was also found at the bone-implant interface in an immediately loaded implant (64.2%) than at a submerged one (38.9%).[23] It has also been speculated that early loading within physiologic limits imparts a functional load to the bone around the implant, stimulating bone formation, thus making this a safe and effective treatment option.[23,25] Taking into account the advantages of immediate/early loading, the high success rates documented and the histological comparisons between delayed and immediate/early loading, it can be seen why the one stage surgical procedure has become increasingly popular in the treatment of patients with endosseous implants.

1.5 Immediate (post-extraction) placement

A further step, the next obvious step in the implantology field, has been the placement of implants into tooth sockets immediately after tooth extraction. This is known as immediate implantation. Following tooth extraction, a period of 8 weeks to 4 months has been recommended to allow for alveolar bone healing before implant placement (delayed placement).[35] However, if there is adequate bone below the apices of the teeth in the extraction sites, and peri-apical pathology and active infection are not present, implant placement can occur

immediately following tooth extraction.[28] The advantages of immediate implantation include the prevention of vital bone loss, placement of wider and longer implants, bone preservation improving crown-implant ratio, shorter treatment time, fewer surgical sessions and better acceptance of the overall treatment plan.[26-29] Grunder and colleagues[26] suggested that immediate implantation may provide better opportunities for osseointegration because of the healing potential of the “fresh” extraction site. It has also been mentioned that immediate implantation followed by immediate/early loading does not result in the loss of the existing dental papillae, which normally occurs when a complete denture is prescribed after tooth extraction.[16] The neck of the implant supports the mucosal papillae and no loss occurs in immediate implantation cases.

The disadvantages of immediate implantation are the greater risks of infection in the case of periodontally involved teeth and the difficult management of the interim prosthesis due to the inadequate alveolar ridge.[28] The common reasons for the tooth extractions are periodontitis, non-restorable carious lesions and endodontic complications.[16,27,29]

For patients who still have their own teeth but will lose them eventually due to periodontic, restorative or endodontic complications, and plan to have a fixed implant-supported prosthesis, a fixed temporary restoration on implants immediately after tooth extraction would be an even greater advantage.[16] Although a higher failure rate for the immediate placement of implants has been

shown,[28] it can be as successful as implants placed into healed bone sites (delayed placement).[16] Success rates of more than 92% for immediate implants has been documented,[16,26-28] a figure comparable to the success rates for implants placed in healed bone. It is also a treatment option that has been highly recommended but with the advice that more clinical trials be undertaken to establish the long-term predictability of the treament.[16,26-28]

From the literature review presented, it is clear that

- the success rates of immediate (post-extraction) implants are comparable to that of delayed (edentulous) implants[16,26-28]
- the success rates of implants placed with immediate and early loading are also comparable to those placed with delayed loading.[2-7,20-22] In South Africa, no published evidence exists comparing the delayed and immediate placement of implants using the early loading technique.

1.6 Aim of the present study

The purpose of this retrospective study was to compare the success rates of early loaded implants placed in

- edentulous mandibles and maxillae (delayed placement), and
- “fresh”, uninfected extraction sockets with concomitant alveolectomies within the mandible and maxilla (immediate placement) where uninfected sockets showed no signs of residual infection

Chapter 2 - Materials and Methodology

Before commencing the study, ethical clearance was obtained from the Human Research Ethics Committee (Medical) at the University of Witwatersrand, Johannesburg (Clearance M03-06-14).

Patient files for the period 1999-2003 were the data source. Twenty two (22) patient files were selected from a private practice situated in the northern suburbs of Johannesburg. All the implants were placed by a single experienced Maxillofacial and Oral Surgeon to eliminate operator bias. The restorative work was shared amongst a prosthodontist (treated 18 patients) and a general dental practitioner (treated 4 patients). These practices were chosen because both the surgical and restorative specialities lent a multi-disciplinary approach to the treatment. The oral surgeon and the prosthodontist worked in the same hospital and the primary impression of the implant head could be recorded at the time of implant placement. There was also no need for the patients to travel to a second location for the restorative work, and the practices were thus able to speed up the early loading process. A study of this nature is also not possible in an academic setting due to little or no funding for implant placement.

2.1 Criteria for early loading

The treating practitioners used the following criteria for early loading:[9,14,19,36]

- All patients were pathology free at the time of implant placement
- Optimized implant placement using a surgical stent
- Primary clinical stability of the implant with an insertion torque of not less than 45Ncm for all implants, which was the acceptable value at the time that these implants were placed.[12]
- Adequate implant splinting for the provisional prosthesis, reducing the influence of cantilevers
- Use of provisional restorations that promote splinting and reduce mechanical load
- Avoidance of provisional restoration removal during the recommended period of implant healing
- Incorporation of the team approach

If primary clinical stability and a insertion torque of not less than 45Ncm was not obtained at implant placement, the implants were submerged and not early loaded.

2.2 Study groups

All patient files were examined by one observer (BNH). The patient files were

divided into two groups:

- early loaded implants placed into edentulous mandibles and maxillae (delayed placement)
- early loaded implants placed into “fresh” extraction sockets with concomitant alveolectomies (immediate placement) whereby all extraction sockets showed no residual infection

2.3 Assessment

The observer (BNH) made note of the following:

- Total number of implants placed
- Number of implants placed in edentulous jaws
- Number of implants placed into extraction sockets
- Number of implants per patient
- Type of implants placed – Southern/Nobel Biocare – surface enhanced
- Site of implant placement – anterior/posterior, maxilla/mandible
- Type of prosthesis placed – fixed/removable
- Follow-up period (in months)

2.4 Success criteria

The success rates were evaluated using the criteria advocated by Roos and colleagues[3]

1) Absence of clinically detectable mobility
2) Absence of clinical criteria: soft tissue infections, persistent pain, paraesthesia, discomfort
3) Radiographic evaluation of bone loss

The first two criteria that is the absence of implant mobility, and absence of clinical criteria, were obtained from the patient records. Implants were assessed clinically by the attending practitioner at the time of taking the secondary impression approximately three months after placement. Each implant was counter-torqued at 20Ncm to test for implant integration. Those implants that did not counter-torque were removed immediately to prevent any infection in the affected implant site.

The radiographic evaluation of bone loss was measured on a panoramic or a periapical radiograph. Each implant on the radiograph was divided into three parts: apical, middle and coronal third extending from the apex of the implant to the head of the implant (Figure 1). Bone loss was measured on the mesial and distal aspects of each implant. The bone loss was measured using a 'Peak Scale Lupe or Vernia' (7x with an eyepiece 19mm, objective lens 19mm and scale diameter 26mm of unknown manufacturer) with a set of digital calipers of unknown manufacturer (Figure 2). All the panoramic radiographs were taken on one machine (Asahi Panoramic/Ceph, Toshiba, Japan) with magnification set at 25%.

The bone loss was calculated according to following equation:

Total bone loss = bone loss measured on radiograph × 25% magnification

Means of the total bone loss were calculated.



Figure 1 – Photograph showing how each implant was split into thirds

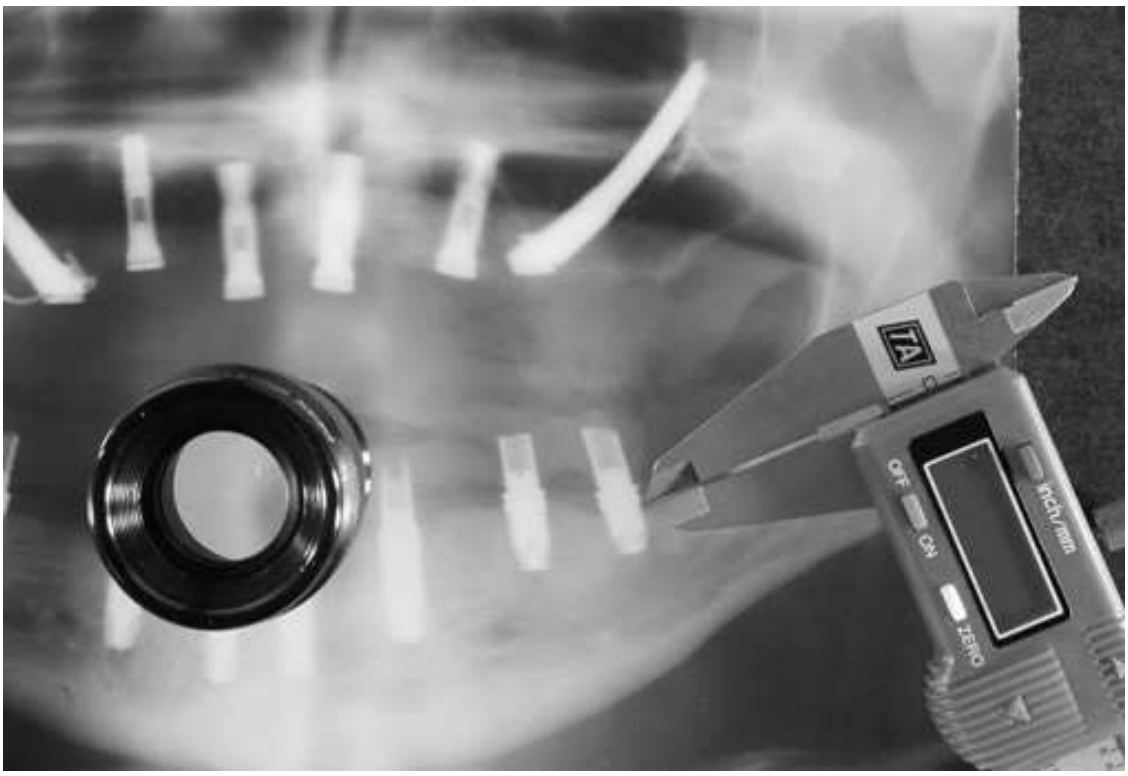


Figure 2 – Photograph illustrating the use of the ‘Peak Lupe Vernia’ and digital calipers

Chapter 3 – Results

3.1 General Remarks

Because bone loss was only seen in 14/121 implants and due to the high success rate of the implant placement, only descriptive statistics were performed.

3.2 Distribution of implants

In total, 121 implants were placed: 92 in the mandible and 29 in the maxilla. All implants were surface enhanced. Southern implants are acid etched and coated with SLA, while Nobel Biocare implants are coated with a Ti-Unite surface
The distribution of the implants between the 2 groups is shown in Figures 3 and 4.

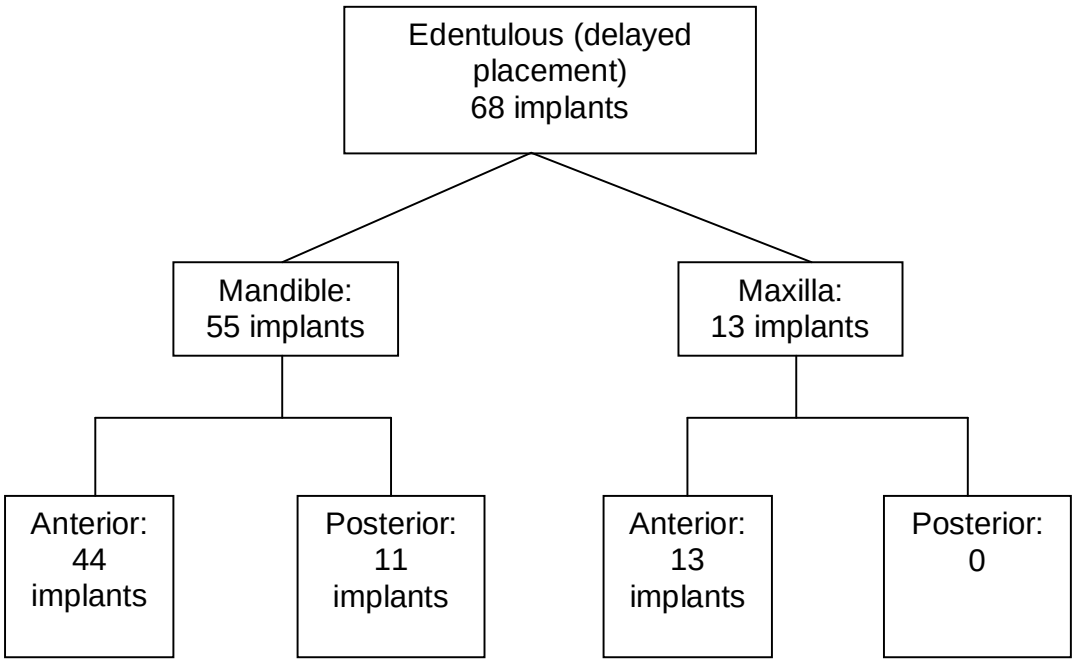


Figure 3 – Distribution of implants in the edentulous group

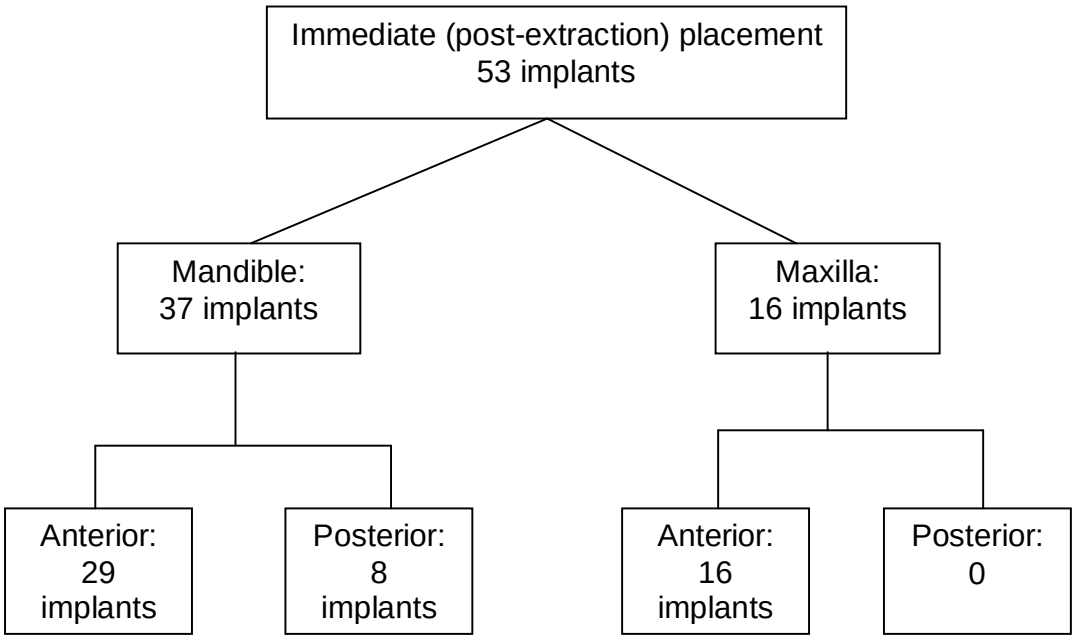


Figure 4 – Distribution of implants in the extraction socket group

3.3 Success assessment

3.3.1 Absence of mobility

121 implants were placed in this study. The edentulous group showed a 94.1% survival rate. No implants placed into extraction sockets were lost (100% survival rate in the extraction group).

Four implants were lost in two patients: three implants in the mandible in the first patient were lost. These implants were believed to have failed due to prosthodontic complications. They were replaced with delayed loading and successfully integrated. One implant was lost in the second patient in the paranasal area as a result of infection (following the perforation of the nose by the implant). *Methicillin Resistant Staphylococcus aureus* (MRSA) was identified from a purulent exudate. The role of Diabetes Mellitus in controlling the infection and allowing for osseointegration of the implant in this patient is uncertain. It is important to note that both these patients had implants placed in the edentulous jaw.

3.3.2 Clinical complications

No severe clinical complications were noted in any of the cases. The most common post-operative complaints reported were pain and discomfort related to

the post-operative swelling. No implants were lost in the extraction socket group. In the edentulous group, the design of the over-denture created unfavourable loading on the implants with resultant loss of 3 implants. The one implant lost due to MRSA was due to an infection that originated in the nasal cavity and not the oral cavity.

3.3.3 Radiographic evaluation of bone loss

Fourteen implants showed bone loss, eight implants showed bone loss in the edentulous group (Figure 5), six implants in the extraction socket group (Figure 6). For both groups, bone loss in the maxilla was in the anterior region (no implants having been placed in the posterior maxilla). In the mandible, bone loss was seen in the posterior mandible. The mean bone loss (n=number with bone loss) in the edentulous group was 0.27mm (n = 0.71) over a 52-month period while the average bone loss in the extraction socket group was 0.16mm (n = 0.34) over a 30-month period (Table I). The bone loss seen in the fourteen implants were all in patients restored with fixed prostheses. No bone loss was seen in patients restored with removable prostheses. Five of the implants showed an initial bone loss usually observed in the radiograph taken within 1 week of implant placement but showed no bone loss in later radiographs. In addition, 4 of these 14 implants showed bone gain (increase in bone height) in later radiographs.

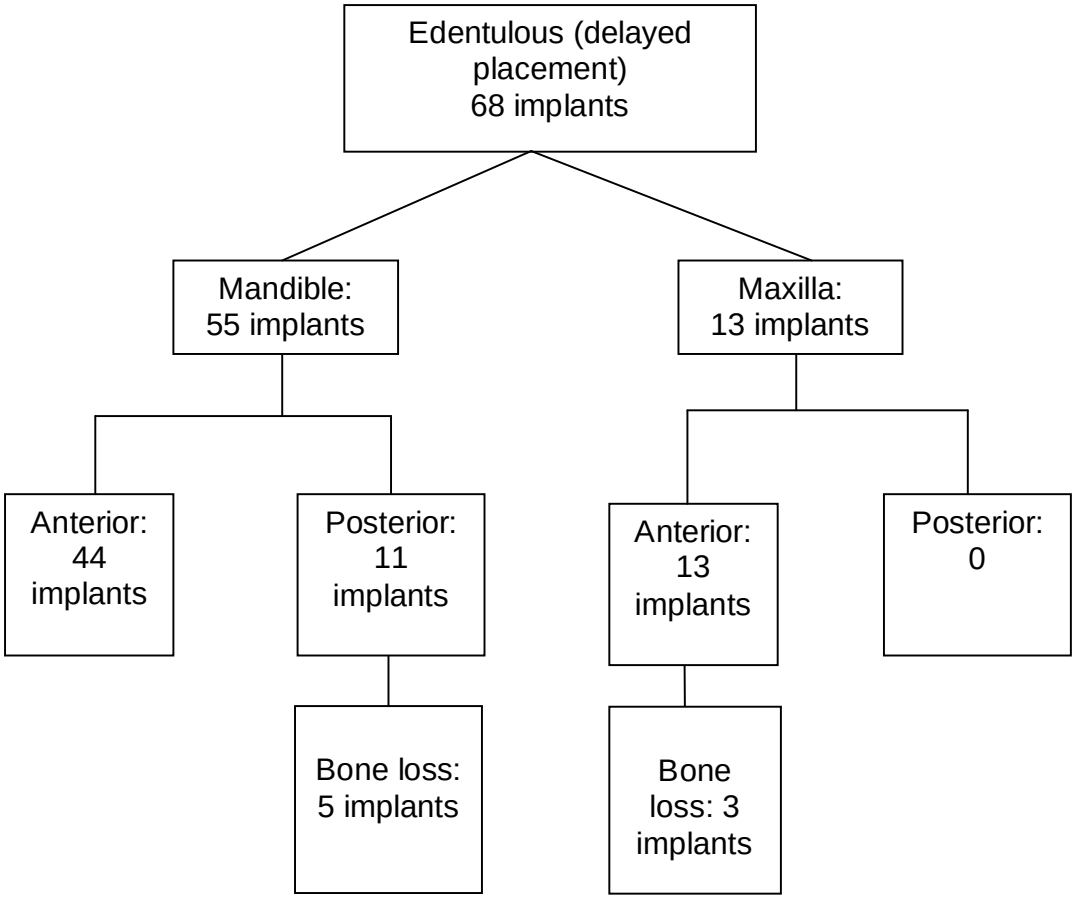


Figure 5 – Distribution of implants that showed bone loss in the edentulous group

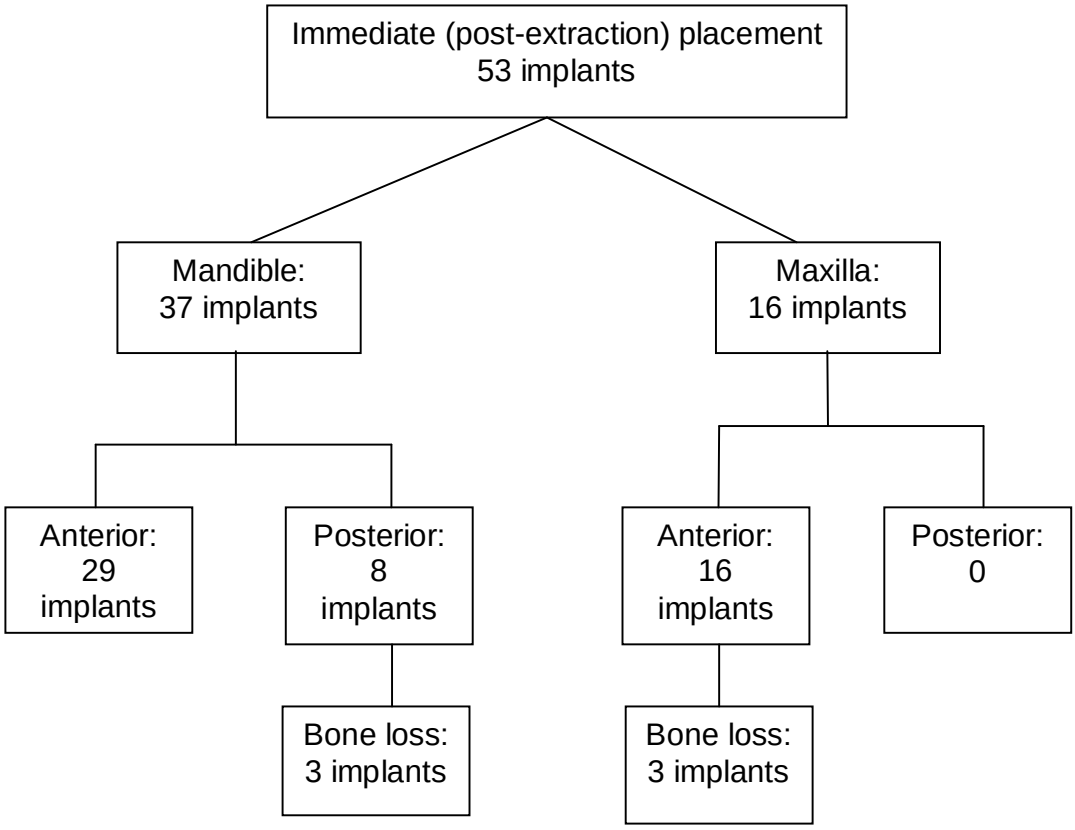


Figure 6 – Distribution of implants that showed bone loss in the extraction group

Table I – Length of follow-up for each patient

Placement	Patient	No. of implants	No. of implants lost	No. of implants that showed bone loss	Length of follow-up (months)
Delayed	1	3	0	0	3
	2	7	0	2	5
	3	4	0	0	6
	4	6	0	0	6
	5	6	0	0	9
	6	5	0	0	10
	7	5	3	0	16
	8	2	0	0	26
	9	14	0	2	27
	10	7	0	2	27
	11	5	0	0	28
Immediate	12	6	0	0	1 week
	13	4	0	0	1 week
	14	7	0	2	4
	15	5	0	0	4
	16	3	0	0	5
	17	4	0	3	8
	18	4	0	0	9
	19	4	0	0	12
	20	5	0	0	17
	21	4	0	1	45
Delayed and immediate combined	22	11	1	1	8

4. Discussion

4.1 Principal findings

The edentulous group (delayed placement) showed a 94.1% survival rate with the early loading technique over a 52 month period while the extraction socket group (immediate placement) showed a 100% survival rate with early loading over a 30 month period.

4.2 Strengths and weaknesses of the study

This clinical audit is the first of its kind known to be undertaken in South Africa. It revealed problems typical of retrospective record reviews. Obtaining all the radiographs for measuring bone loss was problematic due to the following:

- Two patient files had to be excluded because the radiographs were requested by the Medical Aid companies responsible for the payment of clinical fees.
- Although baseline radiographs were taken on the day of implant placement as recommended[5], radiographs following placement were not standardised. Radiographs for each patient were taken at different stages following implant placement with no or few radiographs after 12 months. This is most probably due to the inconsistent periods that patients return for post operative follow-up after implant placement, patients moving

away from the treatment centre and the additional cost of regular follow-up radiographs by the patient. No standardisation of timing for measuring bone loss could be determined as outlined in Table I.

- The follow-up or recall for each patient was also not standardised. Many patients did not keep their recall appointments once treatment was completed and follow-up radiographs were not taken once every year as recommended.
- A number of patients were foreigners who flew into South Africa for implant treatment. It was difficult to get the patients to return for their follow-up appointments.
- Another criticism could be that the statistical analysis was descriptive and performed manually, however the measurements for bone loss were evenly distributed (Figures 4 and 5) and due to the high success rates in both groups, large numbers would be needed for analytical statistics.

4.3 Strengths and weaknesses of the study compared to other studies

When compared to other studies researching implant success rates, this study lacks the data on the peri-implant tissues. Payne and colleagues[6] described the following peri-implant parameters: peri-implant probing depth, mucosal height and attachment level, plaque presence, bleeding upon probing and width of keratinized mucosa as a measure of success of implant placement. Although clinical criteria were recorded in the patient files, peri-implant details were not

measured and recorded. However, due to this study's retrospective nature, measuring these peri-implant parameters was not possible.

Resonance frequency analysis (RFA) has also been quoted in the literature as a test of implant stability.[6] RFA values were not calculated for the implants in this study. To ensure patient compliance in order for these measurements to be taken would have been too problematic and costly in a private practice. Stability testing is also an invasive procedure and removal of the connected prosthesis must be clinically and scientifically justified.[3] Roos and colleagues[3] stated that radiography, rather than stability testing be used for success rating in the long-term follow-up of routine treatment, provided that an already well-documented implant system is used. In addition, there is insufficient data at the present time to provide definitive values of what are safe initial stability measurements.[9]

Jawbone classification, that is, bone quantity and bone quality have been described in many studies with regard to implant success rates.[6,30] These records were not available in the patient files. While this may be seen as a drawback of the study, Misch and colleagues[4] found no significant differences in bone loss among the four types of bone densities.

Although the patient sample in this study is small, it has its strength as a preliminary study with excellent survival rates. While De Bruyn and colleagues[15] recommended early loading for implants placed in edentulous or healed bone,

they advised against early loading for implants placed in extraction sites (failure rate of 39%). Malo and colleagues[20] and Chaushu and colleagues[31] showed similar failure rates for implants placed in extraction sites followed by early/immediate loading. This study shows a higher survival rate in implants placed in extraction sites (100%) than in implants placed in edentulous bone (94.1%).

Ericsson and colleagues[13] advised against the placement of implants in the posterior mandible. According to their study, implants should be limited to the interforamina area of the mandible. This study showed encouraging survival rates in the posterior mandible. While this study lacks the data from the placement of implants in the posterior maxilla (no implants having been placed in the posterior maxilla), the treating practitioners believe that higher success rates can be attained using zygomatic implants in the posterior maxilla (with a 97% success rate[37]). These zygomatic implants were excluded from the study because they were not early loaded.

It has been suggested that more implants than usual be inserted, so that immediately/early loaded implants are not used in the final restoration or to increase the surface area of the implant support and decrease the impact and risk of implant failure.[4] More than the usual implants were not inserted here in an attempt to keep treatment costs to a minimum. The treating practitioners also do not believe that placing more implants than usual is entirely necessary.

The bone loss levels mentioned above are also comparable to other studies.[15,32] In this study, bone loss measurements were small and measured in only 11.6% (14) of the implants indicating the steady-state bone situation in both groups. Like other studies, this study showed that the bone resorption around early loaded implants were in a similar range as the bone resorption measured around conventionally loaded implants.[4,5,13]

Long term data comparing the delayed and immediate implant placement protocols with early loading are missing. This study has successfully bridged the gap presently found in the literature.

4.4 Comments on survival rates

This study showed excellent survival rates in both groups. Although the purpose of the study was to determine the success rates of delayed placement early loaded implants and immediate placement early loaded implants, certain problems were encountered during evaluation of the patient records. The follow-up radiographs were not available for all the patients at the end of the study period. It was decided that survival rates would be more appropriate as this rate defines an implant *in situ*, neither meeting the success criteria, nor being a dropout. A survival rate is a quantitative measurement while a success rating is both a quantitative and qualitative evaluation (the qualitative evaluation being the

success criteria mentioned in the methodology).[3]

The 100% survival rate in this study is attributed to 2 factors:

1) No pre-existing peri-apical infection was present in the cases where implants were placed into “fresh” extraction sockets.
2) All implants for immediate placement were torqued to at least 45Ncm[12].

The following guidelines outlined by Horiuchi and colleagues[12]; long implants, multiple implants, controlled occlusal loads, controlled infection and inflammation were also adhered to; contributing factors to the excellent rates seen in the study.

The failures occurred in the edentulous group. The 3 implants lost in one patient were due to the design of the prosthesis leading to unfavourable load on the implants with resultant failure of the implants. Prosthetic design and prosthodontic complications are not uncommon and reiterate the importance of proper planning. The one implant lost in the paranasal area in another patient was due to MRSA. In this patient, the floor of the nose was the contaminant and not the implant intraorally. In addition, the same patient had a history of Diabetes mellitus. Although the patient was a controlled diabetic, MRSA can be extremely difficult to treat. As a result, one implant was lost in that patient.

It has been shown that early loading preserved the most crestal bone, while delayed loading has shown significantly more crestal bone loss.[5] In fact, delayed loading resulted in twice the amount of bone loss as early loading.[33] The

averages of bone loss, 0.27mm over a 52-month period and 0.16mm over a 30-month period found in this study are within the range of average bone loss quoted in similar studies using the early loading technique.[4,10-11,15,17-18,21,26,33] These bone loss averages are also comparable with findings in similar studies that have been reported with the conventional two-stage approach.[4,33] This study also showed increases in bone height in four implants. It is not unusual that some implants show slight increases in bone height after the first year, even though further increases may not be seen at a later date.[4]

This study found bone loss around implants restored with fixed prostheses, while no bone loss occurred around implants restored with removable prostheses. We believe this is an incidental finding and can offer no explanation for this.

An important contributing factor to the survival rates seen in this study is the surface enhancement of the implants. Implants may be oxidized, acid-etched, sand-blasted, titanium plasma-sprayed or any combination of the above. Nobel Biocare implants are surface enhanced by means of a TiUnite surface whereas Southern implants have a surface enhancing layer that consists of a sand blasted acid-etched layer. These surface enhancements have been proven to be more advantageous when placing implants which are going to be early/immediate loaded.[15,18,21,23] Experimental studies have shown better bone integration, higher bone-to-implant contact and higher removal torque values with surface-enhanced titanium implants than with machined titanium implants.[23,34] Olsson and

colleagues[18] hypothesized that bone grows into the irregularities of the oxidized surface on the implant and allows for a stronger fixation with bone compared to a machined surface. Olsson[18] demonstrated a 93.4% success rate using oxidized implants in the posterior maxilla combined with the early loading technique. When using machined implants De Bruyn and colleagues[15] recommended immediate or early loading of the implants if placed into healed mandibular bone but not placement of implants in “fresh” extraction sockets. In their study, 0.7% of machined implants placed in healed bone failed versus 39% of implants placed into extraction sockets. Similarly, Schnitman and colleagues[22] showed a 1% failure rate in immediately loaded surface enhanced implants, while immediately loaded machined implants showed a 17% failure rate. All the implants in this study were treated and surface enhanced. To conclude, the surface enhancement contributed to the high survival rates shown here.

The results in this study correspond well with other published results. Nevertheless, within the limits of this study, it was not possible to obtain all the data necessary to determine the success rates of the implants placed in the two groups. The survival rates, however are very acceptable and the positive results in this study of the early loading technique make this treatment option highly recommendable.

4.5 Conclusion

This study has showed excellent survival rates when using surface-enhanced implants in healed bone (94.1%) and “fresh” extraction sockets (100%) combined with an early loading technique. The treatment protocols are highly recommended in the absence of infection, inflammation, and overloading, however long-term results are outstanding and future reappraisals are certainly warranted.

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