Original Article - Comparative Study

Implant Survival between Endo-osseous Dental Implants in Immediate Loading, Delayed Loading, and Basal Immediate Loading Dental Implants a 3-Year Follow-up

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Abstract

Introduction: With introduction of the term "ossteointegration of dental implant" by Branemark, advancement in implantology from 1957 to 2017 has come a long way with modification in implant type and in loading time. This study aims to evaluate the survival of endo-osseous immediate loading (IL) implant and basal IL implants in atrophic jaws with objective to compare implant survival in atrophic jaws for full mouth rehabilitation between endo-osseous IL versus endo-osseous delayed loading (DL) versus basal IL during 3-year follow-up. **Materials and Methods:** Fifty-two (34 endo-osseous and 18 basal) implants were placed in 4 patients requiring full mouth rehabilitation in atrophic jaws. Case 1: Endo-osseous DL implants in upper and lower arch, Case 2: Endo-osseous IL implants in upper and lower arch, Case 3: Basal IL implant in upper and lower arch, and Case 4: Endo-osseous DL in upper arch and basal IL implant in the lower arch. Intraoperative evaluation was done on the basis of pain (visual analog scale [VAS]), operative time, and initial primary implant stability. Postoperative evaluation was done on pain (VAS), infection, radiographically successful implant (orthopantomogram), and patient satisfaction (Grade 0–10). **Results:** All cases showed satisfactory results but more amount of intra- and post-operative pain was felt with immediate basal implants. **Conclusion:** We believe that clinicians should comply with patient requests, and for this reason, we agree with some authors to use minimally invasive techniques and to avoid when possible esthetic or functional problems associated with the use of removable prosthesis after teeth extractions.

Keywords: Atrophic jaws, basal dental implants, full mouth rehabilitation, immediate loading dental implants

Introduction

The ability to rehabilitate an amputated limb or tooth by means of a bone-anchored substitute or prosthesis is a traditional endeavor. The success and predictability of an osseointegrated dental implant have forever changed the philosophy and practice of dentistry.

Originally, dental implants were considered as "last resort" for treatment of the edentulous patients. As implant dentistry progressed, the original Brånemark protocol required long healing periods of several months for osseointegration to take place before beginning fabrication of the definitive prosthesis.[1] Dentists consequently became profoundly aware of time-dependent relationship between form and functional changes in the masticatory system. Such knowledge helped nurture the development of new materials and knowledge about the relationships between esthetics, occlusion, and patient's personalities. Although a favorable treatment outcome often was achieved, few patients were not able to tolerate removable complete dentures. This failure is neither an indictment of one's professional skills nor necessarily a condemnation of the patient's response to the clinician's efforts.[2] There is a growing need of patients to be rehabilitated with a fixed, implant-supported prosthesis immediately after surgery, not only to minimize patient discomfort but also to restore functionality and esthetics

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Quick Response Code:

Website: www.amsjournal.com

DOI: 10.4103/ams.ams_87_17

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How to cite this article: Garg R, Mishra N, Alexander M, Gupta SK. Implant survival between endo-osseous dental implants in immediate loading, delayed loading, and basal immediate loading dental implants a 3-year follow-up. Ann Maxillofac Surg 2017;7:237-44.

quickly so that patients can return to their normal routine within a short period of time.

Consequently, many researchers have attempted to analyze implant insertion in fresh extraction sockets with immediate loading (IL) even in the chronically infected alveolar bone.[3] The need of sufficient bone around the endo-osseous implant is critical for the success of the implant. In the maxillary sinus region, the reduction of the bone height due to postextraction pneumatization and resorption poses a challenge for implant placement. In the mandibular region if the height of bone is compromised, the placement of endo-osseous implant may lead to injury to the neurovascular bundle. When adequate number of implants is present in an arch, a traditional fixed bridge is the prosthetic modality of choice. Often, this is not an option in the maxilla due to combined vertical and horizontal resorption of bone and tilted positions of the implants. In this instance, a traditional fixed bridge would not meet the patient's requirements for hygiene maintenance, esthetics, phonetics, and comfort.[4]

Implant placement in severely atrophic jaws is especially challenging because of the poor quality and quantity of the future implant bed.[5] Restoring the oral functions and esthetics in these patients becomes a challenge and requires major bone grafting or artificial gingival tissue. Bone grafting is usually required before placing dental implants.[6,7] However, horizontal bone augmentation procedures are often difficult and offer an unpredictable result.[8] Furthermore, in patients with chronic periodontitis with multiple endo-periodontal lesions, the remaining infection often prevents simultaneous tooth extractions and bone grafting or immediate placement of implants.[9]

Basal implantology also known as bicortical implantology or just cortical implantology is a modern implantology system which utilizes the basal cortical portion of the jaw bones for retention of the dental implants which are uniquely designed to be accommodated in the basal cortical bone areas. The basal bone provides excellent quality cortical bone for retention of these unique and highly advanced implants. Because basal implantology includes the application of the rules of orthopedic surgery, the basal implants are also called as "orthopedic implants" to mark a clear distinction between them and the well-known term "dental implants." These implants when placed in this bone can also be loaded with teeth immediately. This science behind them has already been proved in orthopedic implants (Hip/Knee replacements). Once the patient is fitted with the artificial joint, he/she is asked to start using immediately.[10]

Hence, we decided to conduct a comparative study which describes results after 3 years of endo-osseous dental implants with immediate and delayed loading (DL) and success of IL basal implants in edentulous jaws and extraction sockets for patients in need of a full-arch implant-supported prosthesis.

Materials and Methods

Fifty-two implants (34 endo-osseous and 18 basal) dental implants were placed in patient requiring full mouth rehabilitation in atrophic jaws.

Case 1 [Figures 1-3]

- Endo-osseous delayed implant in maxilla – 08
- Endo-osseous delayed implant in mandible – 08.

Case 2 [Figures 4-6]

- Endo-osseous immediate implant in maxilla – 05
- Endo-osseous immediate implant in mandible – 05.

Case 3 [Figures 7-9]

- Basal immediate implant in maxilla – 04
- Basal immediate implant in mandible – 06.

Case 4 [Figures 10-12]

- Endo-osseous delayed implant in maxilla – 08
- Basal immediate implant in mandible – 08.

Patients were allocated according to their preference of rehabilitation, i.e., 3 days (immediate) or 3 months (delayed). Informed consent was taken prior by all patients.

Inclusion criteria

1. Patient above 16 years of age
2. Both sex
3. Patient requiring full mouth rehabilitation.

Exclusion criteria

1. Medical compromised
2. Chronic smoker
3. Refuse to give informed consent.

Under aseptic condition, all remaining decayed natural or artificial teeth were removed and implants were placed in immediate sockets and normal crestal bone (depending on implant site needed) using implant drills in both upper and lower jaw. Crestal incision was given (where needed) and alveolar bone was exposed raising full thickness flap and implants were placed after achieving primary stability in all implants. Closure was done using 3-0 silk in all patients.

Delayed dental implants were loaded after 3 months of healing period. IL was done within 72 h (3 days) with temporary fixed prosthesis followed by permanent prosthesis after 4 weeks.

Intraoperative evaluation

1. Pain
2. Operative time
3. Primary implant stability – reverse torque achieved/not (Y/N).

Postoperative evaluation was done on the following parameters

1. Pain – visual analog scale
2. Infection – present/absent

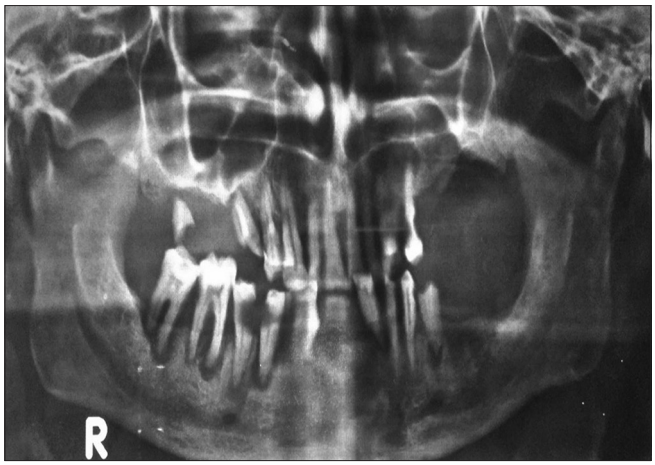


Figure 1: Case 1 preoperative orthopantomogram

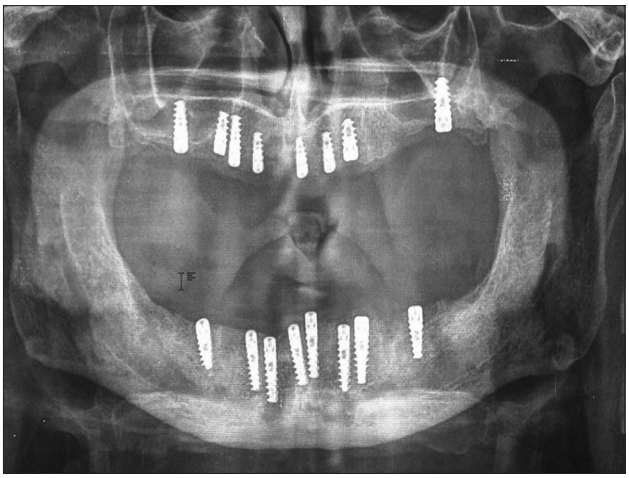


Figure 2: Case 1 postoperative orthopantomogram

Figure 3: Case 1 clinical picture - Intraoral, extraoral and occlusion

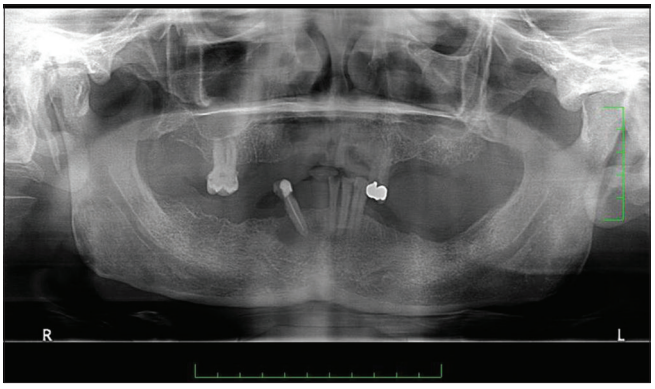


Figure 4: Case 2 preoperative orthopantomogram

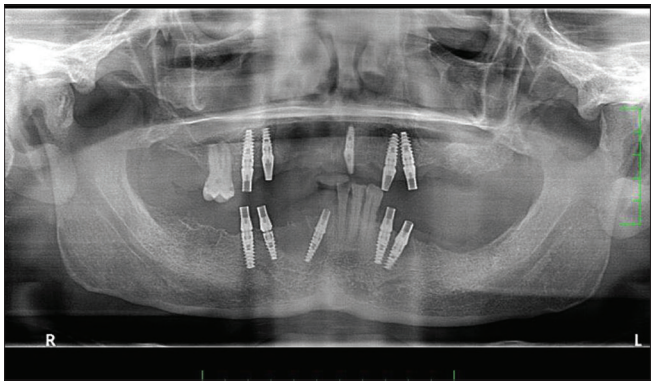


Figure 5: Case 2 postoperative orthopantomogram

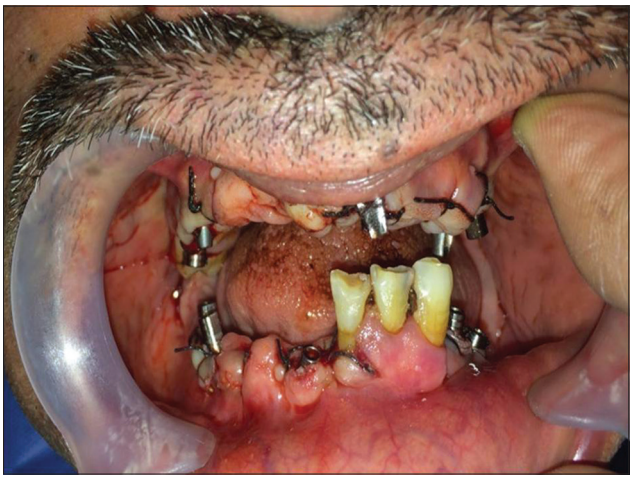


Figure 6: Case 2 Intraoral picture

3. Radiographic successful implant – orthopantogram
4. Patient satisfaction – Grade 0–10.

Postoperative follow-up was done at 1 week, 1, 3, 12, and 36 months.

Result

Result has been described in Graphs 1-3 and Table 1-7.

Discussion

This study aims to evaluate the survival of endo-osseous IL implant and basal IL implants in atrophic jaws with objective to compare implant survival in atrophic jaws for full mouth rehabilitation between endo-osseous IL versus endo-osseous DL versus basal IL during 3-year follow-up.

Figure 7: Case 3 preoperative orthopantomogram

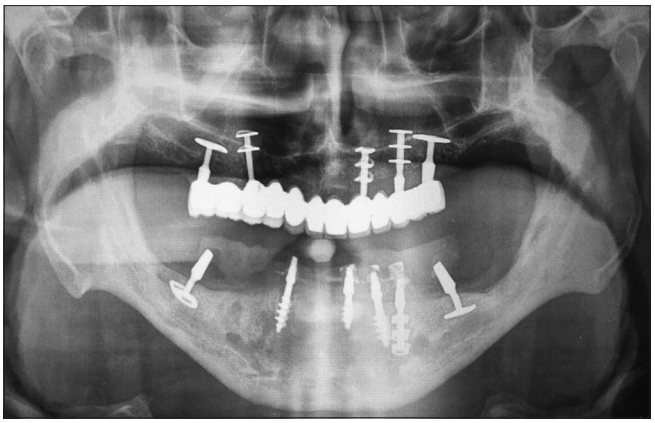


Figure 8: Case 3 postoperative orthopantomogram

Figure 9: Case 3 clinical and orthopantomogram

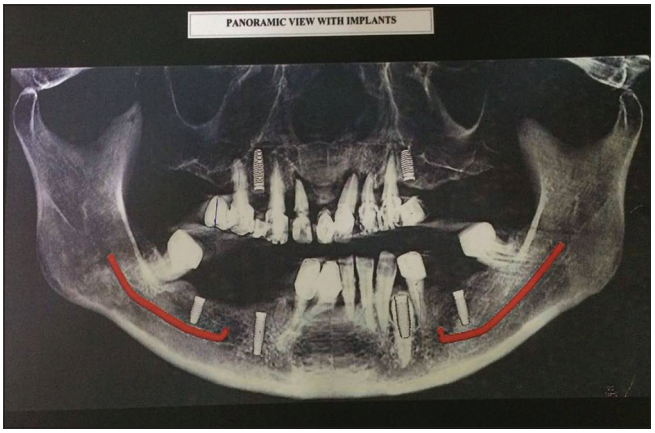


Figure 10: Case 4 preoperative orthopantomogram

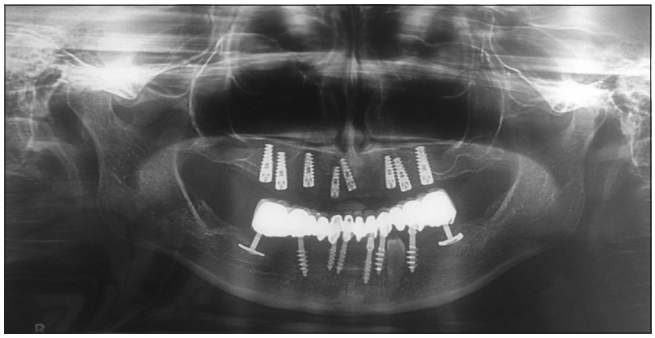


Figure 11: Case 4 postoperative-orthopantomogram

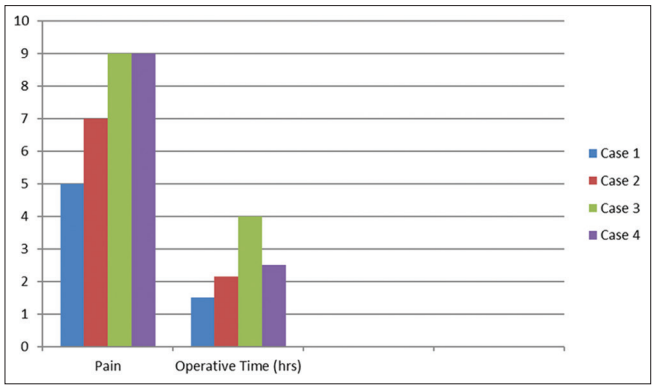
Figure 12: Case 4 Intraoral clinical - Pre and postoperative

There is a growing need for patients to be rehabilitated with a fixed, implant-supported prosthesis immediately after extraction, not only to minimize patient discomfort but also to restore functionality and esthetics quickly so that patients can return to their normal routine within a short period of time. Moreover, patients often request such prostheses to avoid wearing removable prostheses for a few months.

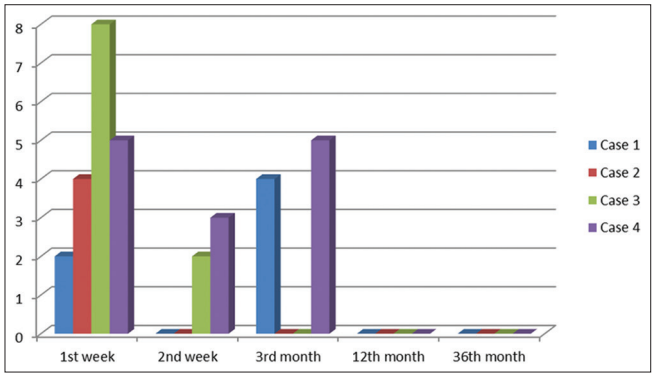
Predictor of dental implant success

1. Bone quality and type
2. Immediate or delayed
3. Primary stability.

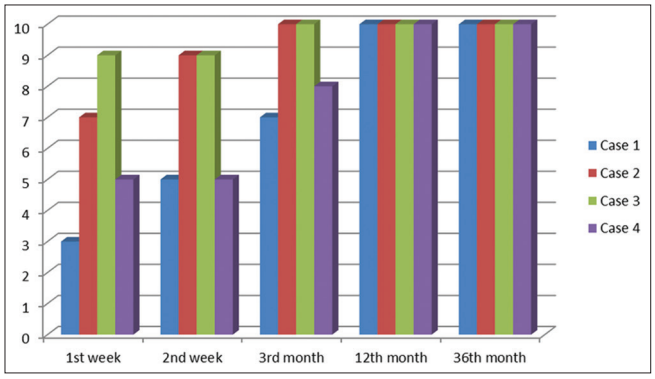
The term bone quality is commonly used in implant treatment and in reports on implant success and failure. It has been shown that the quality and quantity of bone available at the implant



Graph 1: Graph showing pain on VAS scale & operative time (Intraoperative)



Graph 2: Pain as measured by VAS by time in the study population



Graph 3: Postoperative patient satisfaction with time

site are very important local patient factors in determining the success of dental implants.[11,12] The success rate obtained with dental implants depends to a great extent on the volume and quality of the surrounding bone. Therefore, it is important to know the bone quantity and quality of the jaws when planning implant treatment.

Lekholm and Zarb explain the classification system of bone as follows: based on its radiographic appearance and the resistance at drilling, bone quality has been classified in four categories: Type 1 bone in which almost the entire bone is composed of homogeneous compact bone; Type 2 bone in which a thick layer of compact bone surrounds a core of dense trabecular bone; Type 3 bone in which a thin layer of cortical bone surrounds a core of dense trabecular bone; and Type 4 bone characterized as a thin layer of cortical bone surrounding a core of low-density trabecular bone of poor strength.[13] These differences in bone quality can be associated with different areas of anatomy in the upper and lower jaw. Mandibles generally are more densely corticated than maxilla,

Table 1: Intraoperative evaluation

Parameter	Case 1	Case 2	Case 3	Case 4
Pain	5	7	9	9
Operative time (h)	1.5	2.15	4	2.5
Primary implant stability	Y	Y	Y	Y

Table 2: Postoperative follow-up: Case 1

Parameters	1st week	1st month	3rd month	12th month	36th month
Pain	2	0	4	0	0
Infection	0	0	0	0	0
Radiographic successful implant	Y	Y	Y	Y	Y
Patient satisfaction	3	5	7	10	10

Table 3: Postoperative follow-up: Case 2

Parameters	1st week	1st month	3rd month	12th month	36th month
Pain	4	0	0	0	0
Infection	0	0	0	0	0
Radiographic successful implant	Y	Y	Y	Y	Y
Patient satisfaction	7	9	10	10	10

Y=Radiographic osteointegration seen in 1st week

Table 4: Postoperative follow-up: Case 3

Parameters	1st week	1st month	3rd month	12th month	36th month
Pain	8	2	0	0	0
Infection	0	0	0	0	0
Radiographic successful implant	Y	Y	Y	Y	Y
Patient satisfaction	9	9	10	10	10

Y=Radiographic osteointegration seen in 1st week

Table 5: Postoperative follow-up: Case 4

Parameters	1st week	1st month	3rd month	12th month	36th month
Pain	5	3	5	0	0
Infection	0	0	0	0	0
Radiographic successful implant	Y	Y	Y	Y	Y
Patient satisfaction	5	5	8	10	10

Y=Radiographic osteointegration seen in 1st week

Table 6: Intragroup postoperative pain comparison

Parameters	Case 1	Case 2	Case 3	Case 4
1st week	2	4	8	5
2nd week	0	0	2	3
3rd month	4	0	0	5
12th month	0	0	0	0
36th month	0	0	0	0

Table 7: Intragroup patient satisfaction comparison

Parameters	Case 1	Case 2	Case 3	Case 4
1st week	3	7	9	5
2nd week	5	9	9	5
3rd month	7	10	10	8
12th month	10	10	10	10
36th month	10	10	10	10

and both jaws tend to decrease in their cortical thickness and increase in their trabecular porosity as they move posterior. Complete atrophy of the alveolar bone is often found in the distal maxilla and is rarely observed in the mandible. Both the expansion of the maxillary sinus and the resorption of the alveolar bone contribute to the overall maxillary atrophy, while in the mandible, the development of the atrophy progresses caudally. Some studies disagree that there is a decrease in success rates as the bone type increases. There has been a range of statistics that have been reported 2% difference from type 1 (98% in 36 months) to type 4 (96% in 36 months) and 14% difference in another group (90% type 1 vs. 76% type 4 in 36 months). These are important statistics as it indicates, first, that the bone quality is of significance when considering an implant placement site, and second, that there appears to be other factors in the success rates of implants as one considers the vast discrepancy between the results.[14] Some studies have found implant stability quotient values higher in type 1 bone than those in type 2 bone.[15] In the jaws, an implant placed in poor-quality bone with thin cortex and low-density trabeculae (Type IV bone) has a higher chance of failure compared with the other types of bones. This low-density bone is often found in the posterior maxilla and several studies report higher implant failure rates in this region.[14,16,17] When compared to the maxilla, clinical reports have indicated a higher survival rate for dental implants in the mandible, particularly in the anterior region of the mandible, which has been associated with better volume and density of the bone.[18] Surveys have shown that implant therapy in the maxilla has a significantly higher clinical failure rate than that in the mandible.[19]

Immediate implant loading can be briefly defined as the loading of a dental implant immediately or few hours after being placed. Scortecci *et al.* have defined it as immediate occlusal loading within 2 weeks of implant insertion. With the introduction of one-stage implants, improvement in implant design and development of roughened implant surfaces and better force understanding, the concept of immediate implant loading has been made possible. The paradigm has thus shifted from "No load on implants during healing" to "No micro movements of implants." The placement of an immediate restoration on the day of implant surgery may offer esthetic, second surgery, psychological, and functional advantages. The advantages of IL of dental implants include reduced time of treatment, greater acceptance on the part of patients and better function and esthetics. IL of oral implants has been defined as a situation where the superstructure is attached to the implants no later than 72 h postsurgery.[20]

Endo-osseous implants are always a preferred choice; as it gives functional ankylosis (i.e., osseintegration), and a good number of clinical studies have indicated that IL of oral implants yield acceptable-to-excellent results in full-arch prosthetic restorations. Some have reported high survival rates in both the maxilla (between 93% and 99.2% with 15 years of follow-up) and mandible (between 93.2% and 100% with 15 years of follow-up).[21,22] A growing number of retrospective studies have also reported a high success rate for patients restored using the All-on-four and All-on-six treatment protocols combined with computer-guided flapless implant surgery.[23] There is no doubt that the concept of DL has been used successfully for many years, and therefore, the number of placed implants in different studies is higher that the number of immediately loaded implants.

Recently, in a systematic review of survival rates for immediately loaded dental implants, Del Fabbro *et al*.[24] reported that 55% of the articles on IL were published in the last 4 years, and the average overall ISR was 96.39%. Balshi *et al*.[25] showed a cumulative survival rate of 98.6% for full-arch maxillary immediately loaded implants in 55 patients over an average of 3 years. The cumulative result showed 97.1% of success after 4 years of prosthetic loading. It was concluded that the applied IL protocol, in combination with a slightly tapered implant design and a modified implant surface texture, was shown to be a successful treatment alternative in regions exhibiting bone of poor quality. Other authors emphasized the importance of a progressive thread implant design to achieve good primary stability in areas of bone of poor quality. When comparing immediately loaded implants versus delayed loaded implants using a split-mouth design protocol, 100% implant success rate (no bone loss) in 2 years was reported.[14] The parameter most often associated with the success of immediately loaded implants as reported in the literature was adequate primary stability of the implants.[14]

Successful osseointegration from the clinical standpoint is a measure of implant stability, which occurs after implant integration.[26] Two terms, the primary and the secondary implant stability, are related to implant therapy. Primary stability is associated with the mechanical engagement of an implant with the surrounding bone, whereas bone regeneration and remodeling phenomena determine the secondary (biological) stability to the implant. A secure primary stability is positively

associated with a secondary stability. Extent of implant stability may also depend on the situation of surrounding tissues. Bone quantity and quality, implant geometry, and surgical technique adopted are also among the predominant clinical factors that affect primary stability. Therefore, it is essential to assess the implant stability at different time points to ensure a successful osseointegration.[27]

As previously mentioned achievement of primary implant stability in type 3 or type 4 bone is difficult in some areas. To overcome this, Ihde introduced basal implants.[27,28] The philosophy of placement of basal implant differs from conventional implantological thinking since the possibility of mounting prostheses does not depend on the presence of vertical bone, alveolar bone, or the presence of bone in the area of the desired tooth. However, sometimes, esthetical and phonetic problems have to be addressed in a different manner. Patients are eagerly requesting early results in implant treatments. The mainstream in dental industry today seeks to improve the implant surfaces to allow immediate load procedures. The successes of this approach is limited if the vertical bone supply is limited. Implants inserted offers significantly more mechanical retention than conventional screw designs. Other advantageous features are the thin vertical implant part, which reduces the risks of infection significantly. The penetration area of basal implants does not necessarily coincide with the area of the clinical crown as it usually does in crestal implants having diameters of more than approximately 2 mm. This way, the available bone may be used instead of bone grafting. This significantly lowers treatment costs and the necessary treatment time und chair time. We estimate that in average cases, the savings will be 50%.[28,29] Herrera-briones indicated that outcomes tend to be more favorable for implants that are loaded after a period of osseointegration although the difference in success rates between the immediate and DL of implants does not reach statistical significance.[30] Results have revealed that DL is a favorable method of loading. Furthermore, some authors confirmed that mean bone loss in dental implants was less in early loading compared with conventional loading.[31,32]

The literature appears to be undecided in specifying the criteria for success or failure with type of implant used in different types of bone.

In our study, all patients requiring full mouth rehabilitation represented with atrophic jaws (mostly D-3 and D-4). Placement of endo-osseous and basal implants in maxilla (anterior and posterior) is difficult for both immediate and DL whereas placement of endo-osseous IL implant in posterior mandible region is difficult. To achieve primary stability in maxilla, using basal implant in IL is difficult as compared to endo-osseous. Intraoperative pain and time are more with basal implants. Patients with IL basal implant exhibit severe pain during intraoperative and 1st postoperated week whereas patient with DL felt minimal pain. Patients with DL have to bear pain at 3rd month postoperatively whereas others don't. Mild bone loss and gingival recession are seen in all type of IL implants whereas delayed showed less. Patients with IL endo-osseous and basal implant showed result satisfactory as compared to delayed.

Authors believe that implant success depended on the planning of implant site and number of implant placed to support masticatory load irrespective of delayed or immediate type. The main factor is to achieve primary stability with either implant type used. The other two important factors might be the amount of trauma patient can bear (more in BOI), number of visits and implantologist preference and satisfaction.

Advantage of basal implants compared over endo-osseous implants

1. Achieving primary stability is easy in basal implant compared to endo-osseous implant as basal implant is cortical engagement implant, but only in mandible whereas in maxilla, both exhibit similar results
2. Basal implant placement is less technique sensitive
3. No minimal bone width or length required.

Drawback of basal implants over endo-osseous implants

1. As basal implant is a single unit prosthesis in the entire arch, it is difficult to replace a basal implant, whereas in delayed implants, it can be done
2. Basal implant placement requires more time than endo-osseous implant placement.

Limitation of study

1. Patients with only atrophic jaws and poor bone quality have been selected, normal/health bone (d1 and d2) might have shown better study
2. Indirect sinus lift was only done in endo-osseous DL implants
3. Implant site were decided by surgeon preference or availability of good bone after exposure, no prehigher diagnostics or prefabricated splints used
4. More number of cases should have been done in each respective case.

Advantage of study

1. All surgery are performed by one surgeon with same team
2. Patient psychological need was met along with good rehabilitation
3. At minimal cost (no graft), fewer surgical procedures, and in minimal time frame, full-arch rehabilitation was achieved.

Conclusion

We believe that clinicians should comply with patient's requests, and for this reason, we agree with some authors about the need to use minimally invasive techniques and to avoid when possible esthetic or functional problems associated with the use of removable prosthesis after teeth extractions.

Declaration of patient consent

The authors certify that they have obtained all appropriate

patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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