Journal Homepage: -www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI:10.21474/IJAR01/16909
DOI URL: http://dx.doi.org/10.21474/IJAR01/16909

RESEARCH ARTICLE

PROSTHETIC CONSIDERATIONS IN IMMEDIATE LOADING OF IMPLANTS- A NARRATIVE REVIEW

Sanath Kumar Shetty[1], Murtaza Shabbir Hussain[2], Rajesh Shetty[3] and Kevin Fernandes[4]

1. BDS.MDS.PhD Department of Prosthodontics Yenepoya Dental College and Hospital.
2. BDS Department of Prosthodontics Yenepoya Dental College and Hospital.
3. BDS.MDSDepartment of ProsthodonticsYenepoya Dental College and Hospital.
4. BDS.MDS Department of Prosthodontics Yenepoya Dental College and Hospital.

Manuscript Info

Manuscript History
Received: 15 March 2023
Final Accepted: 18 April 2023
Published: May 2023

Key words:-
Implant, Immediate loading, Interim Prosthesis, Micromotion, Maintenance

Abstract

Immediate loading of implant is the placement of a definitive or a temporary prothesis within the first week of implant placement. The prosthesis connected to an immediately loaded implant may or may not be function depending upon the existing condition of the patient's oral health. It has become a widely reported practice with a success rate comparable to a conventionally loaded implant. The success of an immediately loaded implant not only depends upon the survival of the implant but also the hard and soft tissue stability underneath the prosthesis. This paper narratively discusses about different factors affecting immediate loading and the guidelines of immediately loaded implants in partially or completely edentulous arches.

Introduction:-

A predictable, dependable, and generally recognised choice for prosthetic rehabilitation of partly or fully edentulous arches is Implant dentistry. The foundation of implant dentistry is based on the principle of "osseointegration," which was first prescribed by "Dr.Branemark" in 1969. It is thought that the most conclusive, secure, and plausibly efficacious course of therapy for implant dentistry is to wait until the healing period of osseointegration had completed for three to six months before placing any restorations.

The time period between the placement of the implant and the connection of the prosthesis is known as an implant loading protocol. Different loading protocols have been established over the years as a result of numerous various therapy modalities and the desire to shorten treatment time. The clinician will choose the ideal time to load the implants after implant placement. Often, dental implants are put to function using a temporary prosthesis that will remain in position until the final rehabilitation is delivered. The choice of the most suitable loading protocol is an important step in the process of treatment planning. The loading protocol varies even with the time of implant placement.

The preservation of peri-implant bone, particularly the bone crest, is a crucial region to assess the effectiveness of implant treatment because it can experience physiological bone loss during its response to occlusal forces (or due to overloading). Planning the surgery procedure, healing period, and loading period all depend on the density of the accessible bone.

Corresponding Author:- Dr. Murtaza Shabbir Hussain
Address:- Department of Prosthodontics,Yenepoya Dental College, Deralakatte, Mangalore 575018, Karnataka, India.

Numerous authors have agreed that the chance of failure rises as soon as the implant is loaded and begins to function, so various loading protocols have been developed and studied.

The concept of immediate loading has led to many advantages such as :-
1. The advantage of one stage surgery
2. Reduced treatment time
3. Elimination of the removable phase of treatment until the definitive treatment
4. Improving the speech, function and the psychological factors

The principal objective for the success of immediate implant is the amount of bone to implant contact. Different researches have concluded the success rate of immediate loading of implant to have similar clinical outcome when compared with the conventional loading of implant. So, this article discusses about the factors affecting and the different prosthetic considerations for immediate implant loading.

Implant Placement
Surgical steps involved in the drilling of the osteotomy and delivery of the implant into the bone either as a two-stage procedure where the implant will be covered with gingival tissues and allowed to integrate, or as a one-stage procedure with a transmucosal healing collar, with or without a soft tissue flap[1].

Protocols For Timing Of Implant Placement
Late implant placement: Dental implants are placed after complete bone healing, more than 6 months after tooth extraction[2].

Early implant placement: Dental implants are placed with soft tissue healing or with partial bone healing, 4–8 weeks or 12–16 weeks after tooth extraction[2].

Immediate implant placement: Dental implants are placed in the fresh socket on the same day of tooth extraction[2].

Implant Loading Protocols
Conventional Loading / Delayed loading:
Dental implants are allowed a healing period more than 2 months after implant placement with no connection to the prosthesis[3].

Immediate Loading: -
Dental implants are connected to the prosthesis within 1 week subsequent to implant placement. Immediately loaded implants can be of two types:

Immediate functional loading[1]
A clinical protocol for the placement and applying force on dental implants, with a fixed or removable restoration in occlusal contact with the opposing dentition, at the same clinical visit.

Immediate non-functional loading[1]
A clinical protocol for the placement of a dental implant(s) in a partially edentulous arch, with a fixed or removable restoration not in occlusal contact with the opposing dentition, at the same clinical visit.

Early Loading:
Dental implants are connected to the prosthesis between 1 week and 2 months after implant placement and can be divided into
(a) Functional early loading where the temporary prosthesis is in occlusal contact
(b) Non-functional early loading if it is kept out of occlusion.

Progressive Loading:
In 1983 Misch introduced this concept and indicated that bone could mature when tension during the prosthetic phase increases gradually without overloading the implant. There is a gradual loading taking place after the implant healing phase where the transitional prothesis is brought into occlusion gradually. This concept supports the

empirical idea that gradual loading causes bone maturation, improves density and bone quality. The time span of this type of loading is about 6 months to 8 months[4]

Treatment Modifiers For Loading Protocol

The choice of loading procedure is influenced by treatment modifiers, which are clinical variables identified during the diagnostic, planning, surgical, prosthodontic, and maintenance stages of treatment.

1. Patient medical condition and local risk factors
2. Implant primary stability and insertion torque- >25 Ncm, & an ISQ of >60.
3. Implant dimensions and characteristics
4. Quality and quantity of soft tissue and bone
5. Substantial bone augmentation at the time of placement
6. Treatment planning related to patient's requirement

Selection Of A Loading Protocol (Conventional vs Immediate loading)

1. Conventional loading: - Conventional loading is the chosen protocol if the patient has a medical condition or a risk factor, if implant stability was not achieved or a low insertion torque was measured, if significant grafting is required at the time of placement, or if the volume of the bone only permits the placement of implants with a smaller diameter. In all clinical circumstances, conventional implant loading is foreseeable and is especially advised when one or more treatment modifiers are present.
2. Immediate loading: - Early or immediate loading can be chosen if the patient is in good health and there are no risk factors present, if implant stability was achieved or a high insertion torque was measured, if no or little grafting is required at the time of placement, or if the bone volume allows for the placement of standard diameter implants. To choose early or immediate loading, all of these treatment-modifier traits must be present. Additionally, precise instructions for loading procedures are provided based on various clinical circumstances.

Indications For Immediate Implant Loading Protocol

It can be difficult to establish which loading protocol is better, and the choice for implant loading varies with each patient. Research has shown that immediate implant loading may be successful in the following clinical situations:

• Edentulous maxilla—when fixed prostheses are used.
• Edentulous mandible—treatment is successful with both removable and fixed prosthesis.
• Single-tooth replacement in esthetically critical zones.
• Short-span fixed partial dentures.

Factors Affecting Immediate Loading

Prosthetic considerations that might affect the success of immediate loading have been classified into six sections:

(1) Cross-arch stability and micromovements.
(2) Interim prostheses.
(3) Definitive restorations inserted immediately after implant placement
(4) Screwed or cemented prostheses.
(5) Occlusion in immediate functional loading (IFL) and in immediate non-functional loading (INFL).
(6) Implant design, Number and distribution of implants

Cross – Arch Stability and micromovements

1. In a stiff bilaterally splinted interim prosthetic, cross-arch stability is a crucial requirement .
2. Splinting assists in decreasing unfavourable stresses and spreading the masticatory forces equally over a greater area by counteracting the bending impact of lateral forces.
3. Additionally, a passive fit that is sufficient for a cross-arch restoration protects against excessive micromotion and provides the stability needed for osseointegration to take place.
4. Stem cells in the osseous wound differentiate and form scar tissue around the implant, thus inhibiting osseointegration when excess micromovement occurs.
5. In this respect, micromotion <150 μm is well tolerated by the bone, as this controlled mechanical stimulation can increase bone growth and BIC.
6. According to studies, the immediate loading protocol resulted in a BIC percentage of 71.1 ±11.8% compared to conventional loading's BIC percentage of 45.1 ±16.1%, suggesting that the short exposure to extremely low amplitude mechanical stresses may hasten bone formation[5].

Interim prosthesis

1. Delivering an interim prosthesis is what immediate loading most frequently entails.
2. Later, after all soft tissue and hard tissue have healed, this prosthetic is changed in for a permanent prosthesis.
3. The materials used in interim prostheses are typically gentler, reducing the stresses placed on the bone while it heals. However, with the drawback of fractures, particularly in full arch restoration.
4. However, there is a chance that a permanent prosthesis will be available right away and be completely useful in such cases[5].

Definitive restoration for immediate loading.

1. The Branemark Novum introduced in 1999. The system consisted of immediately loading three implants in the interforamina region of the edentulous mandible.
2. The Speed Master technique (Conexao, Brazil), introduced in 2006. It enabled the placement of four implants in the edentulous mandible using surgical guides.
3. The Trefoil system by Nobel Biocare (Zurich, Switzerland) is an evolution of the Branemark Novum concept, & was introduced in 2017. Three particularly designed fixtures are placed in the anterior part of the mandible using drilling templates and then immediately splinted with a prefabricated titanium bar.
4. It features adaptable joints that adjust to compensate for horizontal, and vertical and angular deviations from the ideal implant position and allow passive fit of the final prosthesis[5].
5. Intra oral welding for immediate loading with definitve prosthesis[5]

- Intraoral welding can join and support the Implants by the use of a titanium wire or bar (grade 2) that is permanently connected to the implants. An Electric current for 2-5 milliseconds is used to fuse the titanium wire to the abutments with temperature rising upto 1660°C.
- The welded wire is removed and retentive wire are added extraorally, excess metal parts are removed and the framework is opaqued checked for fit in the premanufactured hollow restoration and intraorally attached on to the abutments
- The hollow restoration is relined intraorally on the framework and after final packing, finishing and polishing the restoration is inserted in the patient.

Disadvantages of restoring immediately placed implants with definitive prostheses are:

1. Due to the anatomical differences in the patient's jaw, it may be challenging to use the pre-manufactured Titanium bar in every circumstance.
2. Even when surgical guidelines are used, passive fit may not always be feasible.
3. Poor soft tissue contour management could jeopardise the final soft tissue design result.
4. The surgically delivered definitive prosthesis will be changed with a new prosthesis if an implant fails later during the osseointegration phase.

Screw and cement retained prosthesis

The interim prosthesis would require to be retrieved every 2 weeks for clinical procedures like suture removal, implant stability assessment, soft tissue healing evaluation, and modification of embrasure. These steps are critical for moulding, contouring, and healing of soft tissues to have ideal esthetic outcome. In general, a screw-retained temporary prosthesis should be chosen over a cement-retained one for the following reasons:

1. A temporary cemented prosthesis should not be removed during the healing phase of 3-4 months, as the removal force could jeopardise the osseointegration process.
2. Cement residue could obstruct the successful healing of both soft and hard tissues.
3. Contouring of soft tissues is not possible due to inability to frequently remove the cemented prosthesis[5].

Occlusion

There are basically two types of occlusion in immediate implants:

1. In completely edentulous individuals, **immediate functional loading** is used when the interim prostheses are entirely occluded.
2. The benefits of a single-stage process and immediate loading are combined in **immediate non-functional loading**. The interim restorations here aren't in occlusion They are used in partly edentulous patients and mainly for aesthetic purposes as well as to direct the soft tissues during the healing process. This has the benefit of lowering the risk of biomechanical overloading when parafunctional behaviours are present.

Irrespective of the type of occlusal concept chosen, there are basic rules to follow in immediate loading:

1. Reduction in size of occlusal table and Reduction in cuspal inclination (Figure 1A and 1B).
2. Occlusal anatomy should be modified to provide a true horizontal fossa. (Figure 2)
3. The occlusal line angles & grooves should be reshaped to contain a 1.5mm horizontal fossa. (Figure 3)

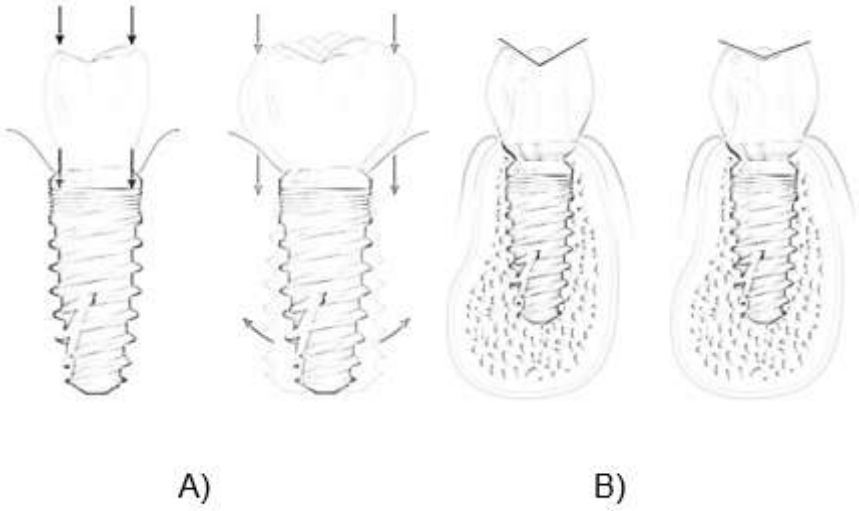


Figure 1:-

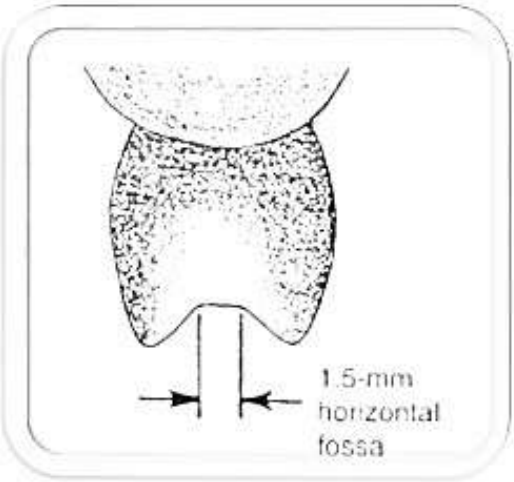


Figure 2:-

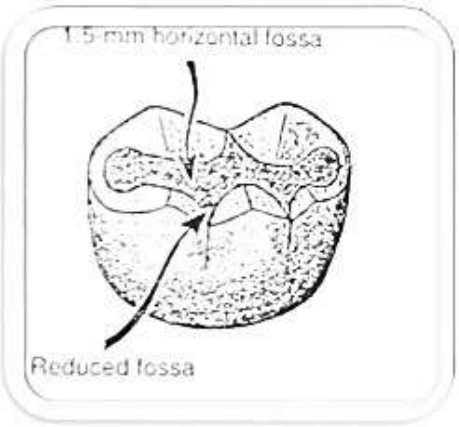


Figure 3:-

4. Reduction in the number of Occlusal contacts

- Number of occlusal contacts in implant restorations should not be more than 2.
- Primary- right over the head of the implant (central fossa). Secondary- within 1mm of the periphery of implant (Figure 4)

Figure 4:-

5. To avoid non-axial pressures, there shouldn't be any cantilever projections.
6. During the first few weeks of healing, patients should alter their diets by eliminating hard foods (about 4 weeks)[6].

Implant design characteristics, surface and number

1. The active thread screw implant design has a higher mechanical retention rate and is better able to transmit compressive forces. Along with enhancing primary stability, the screw implant design also reduces dental implant micromotion, which is a crucial component of successful immediate loading[5].
2. The main stability is greater with longer implants. If the bone quality is weak, try to accomplish bicortical fixation to increase primary stability.
3. Implant surface roughness improves bone-implant interaction (BIC). An implant with a surface roughness will have a faster total stability avoiding the dip of stability during healing phase than a non-surface treated implant[7]. (Figure 5A and 5B)

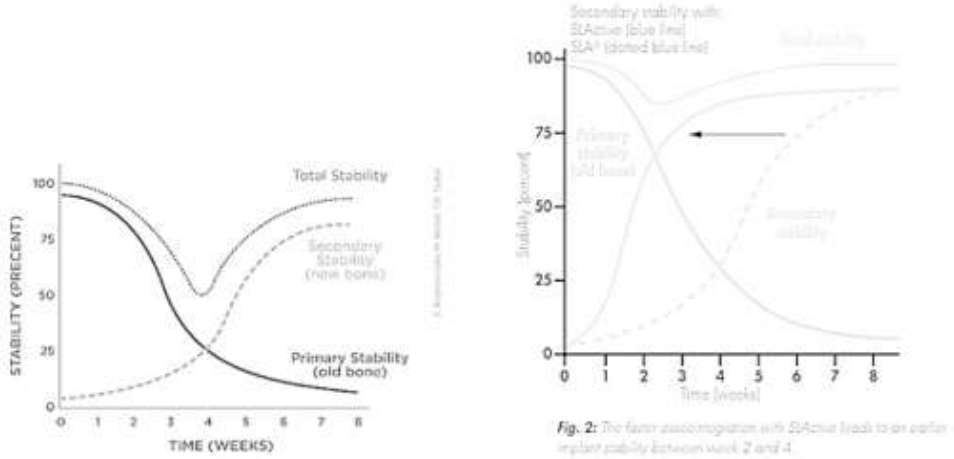


Figure 5:- a) Stability without surface treated implant b) Stability with surface treated implant

- In cases requiring the restoration of fixed prostheses in the maxilla, more implants are required than in cases requiring the restoration of fixed prostheses in the mandible.
- Antero-posterior spread is essential for immediate loading in cases of complete arch reconstruction[7].

Guidelines For Immediate Loading In Partially Edentulous Arches

1) In healed extended edentulous locations, immediate loading of posterior implants appears to be foreseeable. However, in these circumstances, the clinical advantage of immediate implant loading is minimal[3].
2) Immediate implant loading in partially edentulous patients with extended edentulous sites should be done with caution and by experienced clinicians because there is not enough evidence to back up this course of action[3].
3) When immediate implant loading is planned, the following factors should be taken into account: primary implant stability, prerequisite for significant bone augmentation, implant design and size, occlusal considerations, patient behaviours, general health, and practitioner experience[3].

Immediate restorations are advised in partly edentulous arches rather than complete occlusal loading. Because the patient usually has enough healthy residual teeth in contact for the patient to function, the interim restoration serves primarily as a cosmetic enhancement, and the implant prosthesis is completely out of occlusion. The concept of a nonfunctional immediate tooth (N-FIT) is therefore suggested. Splinting several nearby implants is advised[7].

Advantages of nonfunctional immediate loading

1. Patient has a fixed aesthetic tooth replacement soon after stage I surgery. No stage II surgery is necessary
2. Psychological advantage for the patient.
3. Because the prosthesis is kept out of occlusion, the implants are not subjected to excessive occlusal pressures while they are healing.
4. It is possible to create soft tissue emergence with transitional prostheses and enable tissue to grow throughout the bone-healing process[8]

Disadvantages of nonfunctional immediate loading

1. Implant failure or crestal bone loss may result from implant micromovement more frequently than with a two-stage method.
2. Trauma, crestal bone loss, or implant failure may result from tongue or foreign behaviours (pen chewing).
3. Acrylic or impression material may get wedged between the implant and the crestal bone or under tissue.
4. Greater crestal tension may result in bone loss or implant failure due to too-soft bone, small implant diameters, or implant shapes with a small surface area[8].

Indications:

1. Patients with esthetic need & who are not willing to use removable type prosthesis.
2. Partially edentulous patients with centric occlusal contacts and excursions on natural teeth .
3. Division D1, D2, and D3 bone in regions of implants.
4. Screw-shaped implant bodies, 4 mm or more in diameter, with increased surface area designs to decrease crestal stresses.
5. Primary stability of atleast 30Ncm during implant[8].

Immediate loading of implant in the esthetic zone

Treatment of a single tooth replacement in the aesthetic zone is regarded as a complicated operation necessitating a team strategy because, once an aesthetic complication develops, it is very challenging to restore the lost hard and soft tissues to their presurgical levels[8].

Factors to be considered for immediate placement & restoration in esthetic zone

1. Esthetic risk assessment (ERA).
2. Tomographic Planning
3. Minimally traumatic tooth extraction.
4. Implant placement in good available bone both apically and palatally along the palatal wall.
5. Use of a narrower (3.3 mm to 4.3 mm) implant versus a widerdiameter (4.5 mm or greater) implant.
6. Buccal gap bone graft.
7. Facial gingival grafting.
8. Immediate contour management of the emergence profile from the implant.
9. Custom impression coping technique.
10. Final restoration with a screw-retained crown[9]

Guidelines For Immediate Loading In Fully Edentulous Arches

1. Inclusion criteria, such as insertion torque ≥ 30 ncm, ISQ ≥ 60, and minimal implant length ≥ 10 mm, have been used in the majority of the included studies[3].
2. The number of implants used to support a fixed prosthesis varied from 2 to 10 in the mandible and 4 to 12 in the maxilla[3]

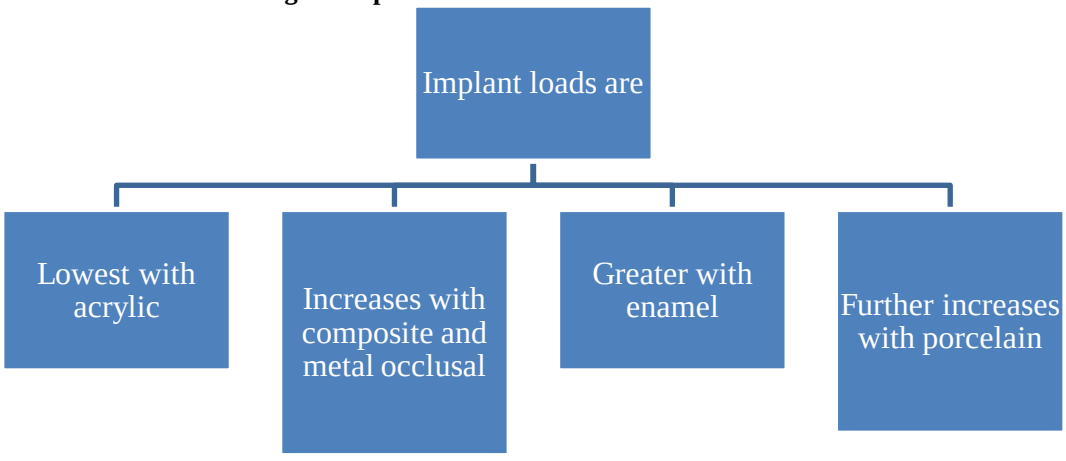
Prosthodontic indications for edentulous Maxillary and Mandibular Overdenture prosthesis[10] (Table 1)

FACTORS	MAXILLARY		MANDIBULAR	
	SPLINTED	FREE STANDING	SPLINTED	FREE STANDING
Retention and implant number	Bar design over four or six splinted implants	Four or six Free standing implants with locator or telescopic crown attachment	Bar design over two or four	Two or four standing implant with ball or locator attachment
Prosthesis	With Palate Overdenture for four implants and Palate-less overdenture for 6 implants.	Palateless overdenture for 6 implants		
Inter-arch Space	More than 18mm	15mm	More than 18 mm	15-18mm

Prosthodontic indications for Edentulous Maxillary and Mandibular Fixed prosthesis[10] (Table 2)

FACTORS	MAXILLARY		MANDIBULAR	
Implant number	Four to six implants	Six to eight implants	Four to six implants	Six implants in the anterior and posterior region
Prosthesis	Full arch with distal cantilevers, one unit for six implants and two units for four implants	Full arch with no cantilever for six implants , segmented in four to three –unit FPD for eight implants.	Full arch with one unit bilateral distal cantilevers for four implants and two unit bilateral for six implants	Full arch with one piece or segmented into three FPD's
Inter-arch Space	10-18mm of space with adequate bone in the anterior maxilla	10-18mm of space with adequate bone in the anterior and posterior maxilla	10-18mm of space with adequate bone in the anterior mandible	10-18mm of space with adequate bone in the anterior and posterior mandible

Materials Used In Loading Of Implants



When immediate loading is planned, the clinician should always go for softer materials for provisional, to reduce the load on implants[11].

Materials used for immediate loading

1. Acrylic/resin.
2. Peek
3. Composite resin

When conventional loading is planned, the following materials are used[11]

- FRAMEWORK
  - Casted
  - Milled :- Titanium , PEEK, Zirconia , Cobalt chromium
- LAYERING MATERIAL
  - Acrylic
  - Composite resin
  - Ceramic

Post Operative Prosthetic Complications Of Immediate Loading In Various Phases Of Treatment And Maintenance

Diagnostic Phase And Surgical Phase

-Occlusal vertical dimension

As most of the times the provisional prosthesis material of choice during immediate loading is acrylic resin, each arch needs a minimum of 12 to 15 millimetres of restorative space. Lesser space could reduce the strength of the prosthesis and result in frequent fracture[10].

-Smile Line Related to Transition Zone

Smile line assessment is critical to hide the pink acrylic visibility around the transition zone. To prevent this, need for vertical alveolar excess reduction is needed during the surgical phase to take the transition zone under the lips during smile[12].

-Complications due to insufficient planning

Implant placement must follow an exact plan that is prosthetically driven and determined by the design of the potential prosthetic framework[12].

-Lip Support

When a patient has worn a removable prosthesis for an extended amount of time, they frequently need a buccal flange to provide sufficient lip support and aesthetically appealing appearance[12].

-Failure of Grafting procedure

Failure of grafts placed for horizontal and vertical bone gain, could be a serious complication if immediate loading is planned in such cases[12].

-Soft tissue complications

Lack of keratinized tissue may cause peri-implant pain, and also a poor peri-implant seal resulting in periimplantitis[12].

The Transitional Prosthodontic Phase

This phase compromises of the time period when the temporary prosthesis is fastened to the implant, till the definitive prosthesis is delivered. As the temporary prosthesis are mostly made up of soft acrylic material, precautionary steps should be taken to lower the likelihood of fracture due to :

1. Implant overloading.
2. An incorrect occlusal concept
3. Bruxism
4. Inadequate passive fit.[12]

The Definitive Prosthodontic Phase

1. Definitive prosthesis should have even occlusal contacts bilaterally to reduce tooth wear, T-scan can also be used to check for even occlusal contacts and pressure bilaterally.
2. The intaglio surface must be made smooth to convex, not festooned, and tightly abutted to the tissues for the prosthesis contours. Smoothness in the buccolingual profile is necessary for phonation[12].

Maintenance Phase And Its Related Issues

1. Soft tissue hypertrophy is commonly seen under overdenture prosthesis, this might be due to poor oral hygiene leading to plaque accumulation or poor adaptation of the prosthesis to the underlying soft tissue. The primary focus of a comprehensive therapy strategy is plaque management.
2. A superstructure for a fixed implant prosthesis must be built with appropriate dental hygiene in mind, to make it easy to use the common oral hygiene instruments. The pontic should always be designed to keep the area self-cleansing. Wherever possible the pontic regions must be built on the ovate pontic design idea. Wherever feasible, a ridge-lap pattern must be avoided[10].

Conclusion:-

In carefully chosen situations, immediate loading seems to be an efficient and safe form of treatment for the partially or completely edentulous maxilla or mandible. The methods employed possesses strong clinical and radiological success rates comparable to those reported in the conventional delayed two-stage technique, when applied to a fixed prosthesis or an overdenture. However, the success totally relies on the factors affecting it which was overlooked in this article. Apart from different factors , patient compliance and effective oral hygiene measures are a must for the success of the treatment as a whole.

References:-

1) Jalbout Ziad et al. Glossary of Implant Dentistry. ICOI 2004.
2) Chen, S.T. and Buser, D. (2009) Clinical and esthetic outcomes of implants placed in postextraction sites. International Journal of Oral & Maxillofacial Implants, 24, 186-217.
3) Wismeijer D, Chen ST. Proceedings of the 6th ITI Consensus Conference. Clin Oral Implants Res. 2018 Oct;29 Suppl 16:5-7.
4) Misch, C.E. (2007) Contemporary Implant Dentistry. 3rd Edition, Mosby, St. Louis.
5) Ghoul WE, Chidiac JJ. Prosthetic requirements for immediate implant loading: a review. J Prosthodont. 2012 Feb;21:141-54.
6) Y Chen, C L Kuan, Y B Wang, Implant occlusion: biomechanical considerations for implant supported prostheses, J Dent Sci, 2008, 65 -74.
7) Lum LB, Beirne OR, Curtis DA. Histologic evaluation of Hydroxylapatite coated versus uncoated titanium blade implants in delayed and immediately loaded applications. Int J Oral Maxillofac Implants. 1991; 6:456-462.
8) Pawar, Dr &Karkar, Dr. (2020). Loading protocol in implant dentistry: A review. International Journal of Applied Dental Sciences. 6. 578-587.
9) Levine RA, Ganeles J, Gonzaga L, et al. 10 keys for successful esthetic-zone single immediate implants. Compend Contin Educ Dent. 2017; 38:248-260.
10) Behl, N. ITI treatment guide. Volume 4: loading protocols in implant dentistry. Edentulous patients. Br Dent J 210, 390 (2011).
11) Soliman TA, Tamam RA, Yousief SA, El-Anwar MI. Assessment of stress distribution around implant fixture with three different crown materials. Tanta Dental Journal. 2015 Dec 1; 12:249-58.
12) Balwani TR, Godbole SD, Sathe S, et al. Prosthodontic complications associated with immediately loaded fixed implant-supported prostheses - a review. J Evolution Med Dent Sci 2020; 9:3394-3398.