

Review Article

Title: Prerequisite for successful implant placement with a comparative study on novel bone ring technique: A Review.

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Abstract:

Implant placement is getting space day by day. However, in every case, we never get the ideal condition of alveolar bone for implant placement. Alveolar bone loss is seen due to periodontitis, tooth loss, tooth extraction, and periapical infection, etc.

Resorption of alveolar bone varies from person to person and side to side. It has been noted that the size of the residual ridge shrinks more quickly within the first six months.

There is new demand for reconstruction of the alveolar ridge for implant placement. Various techniques are available for increasing the ridge height and width by using bone graft, membrane, etc., one of these is the vertical ring procedure.

Bone ring technique (BRT) has been described as a one-stage approach to restore vertical ridge height defects, in which an autogenous or allogeneic bone block graft is used and the implant is placed simultaneously.

This review aims to focus on the importance of the implant placement, consequences of complete edentulism, the problem with removable partial denture (RPD) placement, as a result of bone loss in fully edentulism patients, and the use of vertical ring technique for the implant placement.

KEYWORDS- vertical ring, implant, periodontitis, allograft, implantology, bone grafts.

Introduction-

A dental implant is a material made up of alloplastic, implanted into the oral tissues under the mucosal or/and periosteal layer, and on/or within the bony envelope to aid in retention and support to a fixed or removable dental prosthesis.¹

Types of Implant

Endosseous Implants

- 1)Bladelike
- 2)Pins
- 3)Cylindrical hollow and Cylindrical full
- 4)Dislike
- 5)Screw shaped
- 6)Tapered shaped

2) Subperiosteal frame like implants

3) Trans-mandibular implants²

Why Implant Placement Is Important?^{3,4,5,6}

The implant placement is important to preserve the alveolar bone, maintain the vertical dimension, occlusion, improve mastication. However, if early tooth loss occurs, partially or complete edentulism can lead to the consequences that are:

1. Continue loss of bone of jaws
2. Undesirable changes in the soft tissues of the jaws
3. Undesirable facial feature changes
4. Reduced masticatory process
5. Issues related to psychology
6. Decreased width and height of the supportive bone
7. Protruding mylohyoid as well as internal oblique ridges and amplified sore spots
8. Advanced loss of keratinized mucosa area
9. Protruding superior genial tubercles with sore spots and augmented denture movement
10. Muscle attachment neighboring crest near the ridge

11. Raise of the prosthesis as well as the reduction of mylohyoid as well as buccinator helping in the latter provision
12. Frontward elevation of the prosthesis from normal inclination
13. Thinning of mucosa which leads to the sensitivity from abrasion
14. Paraesthesia in mandibular neurovascular part
15. Increased role of the tongue in the mouth
16. Changes in the esthetics of the last third of the face due to loss of bone
17. Maximum risk of mandible fracture of the body from accelerated bone loss.
18. Increased changes of a denture and sore spots due to the reduction of the anterior ridge as well as nasal spine
19. Labiomenal angle is loss
20. Skin of the lips and face are deepened.
21. Chin moves forward and then face have a prognathic view
22. Horizontal angle of the lip is decreased changing the rest expression of patient
23. Loss of tonicity in muscles responsible for facial expression
24. Advance columella-philtrum angle
25. Thinning of the vermillion border as a result of loss of muscle tone
26. Nasolabial groove appears deep
27. Dimension of the maxillary lip is increased,

However, if some teeth are retained by doing the periodontal therapy or conservatively therapy and had a partial edentulism. For these, we generally use removable partial denture (RPD) in those conditions where fixed partial denture (FPD) cannot be given. However, there are several problems related to RPD, they are as followed: ⁶

1. Low rate of survival of more than 60% in 4 years.
2. 35% rate of survival in 10 years
3. Rate of restoration of abutment of at least 60% in 5 years as well as 80% in 10 years
4. Advance mobility as well as plaque accumulation, bleeding on probing, and caries in underlying supporting abutment teeth
5. 44% loss of underlying supporting abutment teeth in 10 years
6. Faster loss of bones in the edentulous area if the patient wears RPD

Advantages of Single Tooth Implant ⁷

1. Increased success rate (above 97% in the 10 years)
2. Reduced chances of caries to the next teeth
3. Increased capability to clean the proximal areas of the adjacent tooth
4. Increased esthetics of next tooth
5. Increased lifespan of alveolar bone in the area where teeth are absent
6. Decreased cold as well as contact sensitivity to the adjacent tooth
7. Psychologically healthy patient
8. Decreased risk of loss of next tooth

Alveolar Bone Height

The height available is calculated by evaluating the radiograph in an ideal edentulous area where the placement of the implant is intended. When one or a couple of teeth is missing then a periapical radiograph is of sufficient use to estimate the available alveolar bone height.

Generally, the anterior part of the mandible has the highest bone height. The bone is dense in the mandible anterior area. Even when the resorption of the bone takes place after the loss of a tooth there is enough bone to have the implant. The areas with greater forces and where naturally wider teeth were present with 2 or 3 roots, also some shorter size implants, are generally used and are usually lesser in number because of the limited anatomy.

Oikarinen et al. had said that if there is more than 6mm of the height of bone is seen in as less as 50% of the posterior mandible and 40% in the posterior maxilla in partial edentulism patients. The available bone height is the most critical criterion for implant placement because it has an impact on both implant length and also the height of the crown.⁸

TYPES OF BONE DENSITY IN MAXILLA AND MANDIBLE

A) Misch's Bone Density Classification Scheme⁹

| The density of the bone | Description | Physical Equivalent | Standard Anatomical Site |
|--------------------------------|---------------------------------------|-----------------------------------|---|
| D1 | Densely corticated | Oak, Maple wood | Anterior area of mandible |
| D2 | Porous cortical and coarse trabecular | White pine as well as spruce wood | Anterior area of mandible Posterior area of the mandible Anterior maxilla |
| D3 | Porous cortical and fine trabecular | Balsa wood | Anterior area of maxilla area of |
| D4 | Finely trabecular | Styrofoam | Posterior area of the maxilla |

B) GENERALIZED BONE DENSITY LOCATION¹⁰

| | |
|----------------------------|----|
| Anterior area of Mandible | D2 |
| Posterior area of Mandible | D3 |
| Anterior area of Maxilla | D3 |
| Posterior area of Maxilla | D4 |

C) COMPUTED TOMOGRAPHY DETERMINATION OF BONE DENSITY ¹¹

| | |
|----|---------------------------|
| D1 | >1250 Hounsfield units |
| D2 | 850-1250 Hounsfield units |
| D3 | 350-850 Hounsfield units |
| D4 | 150-350 Hounsfield units |
| D5 | <150 Hounsfield units |

D) Initial Bone-in Relation to Implant Contact Percent (BIC%) ^{12,13}

| DENSITY | BIC % |
|---------|--------|
| D1 | 85% |
| D2 | 65-75% |
| D3 | 40-50% |
| D4 | 30% |

*: Bone To Implant Contact

BONE GRAFT-

a) Types of bone graft ¹⁴

Various Graft Material

| | |
|---------------------------------------|---------------------------|
| 1) Autogenous Bone Grafts | |
| a) Bone - Intraoral Sites. | b) Bone - Extraoral Sites |
| 1) Osseous coagulum | 1) Iliac Autografts |
| 2) Bone Blend | |
| 3) Cancellous Bone Marrow Transplants | |
| 4) Bone Swagging | |

| | |
|---|----------------------|
| 2) Allografts | 3) Xenografts |
| Freeze-Dried Bone Allograft (FDBA) | Calf bone |
| Demineralized Freeze-Dried bone Allograft (DFDBA) | Bio-Oss |
| | Bio-Guide |

| |
|--|
| Nonbone Graft Materials |
| Sclera from the eye |
| Cartilages |
| Plaster of Paris (pop) |
| Plastic Materials |
| Calcium Phosphate Biomaterials- Hydroxyapatite (HA) and Tricalcium phosphate (TCP) |
| Bioactive Glass |

| |
|--------------------------|
| Coral- Derived Materials |
|--------------------------|

b) Biologic requirement for bone regeneration ¹⁵

| Requirement | Surgical Procedures |
|-------------------|--|
| Blood supply | Cortical perforations |
| Wound coverage | Flap management, tension-free suturing |
| Stabilization | Fixation screws membrane tacks |
| Osteoblasts | Autogenous |
| Space maintenance | bone graft materials |
| Confined space | Barrier membrane |

c) Biologic Properties of Various Bone Graft Materials ¹⁶

| Sources | Osteoinductive | Osteoconductive | Osteogenic |
|-----------|----------------|-----------------|------------|
| Alloplast | No | Yes | No |
| Xenograft | No | Yes | No |
| Autograft | Yes | Yes | Yes |
| Allograft | Yes/No | Yes | No |

Bone Regeneration:

With the increasing pace of development in dentistry, there is increased demand for the reconstruction of bone before or during implant therapy in partially or fully edentulous patients with deficient jawbone, especially when the main concern is aesthetics.

Advanced loss of alveolar bone prevents the proper placement of the implant in a prosthetic position can be due to tooth extraction, periodontal bone loss, tooth, and also long term use of removable and fixed appliances.

Recent advances in implantology sometimes contradict the original standard procedures by the placement of implants in such areas where the adequate volume of bone is absent, simultaneously augmentation of bone and placing and loading the implants after the short healing period.

Restoration of periodontal osseous defects can be done by various therapeutic grafting modalities. Materials that can be used for grafting can be obtained from the same individual that is called an autograft, materials that are derived from a different individual of the same class are known as allografts and the ones derived from a different class are called xenografts.

Bone graft materials are usually graded according to their osteogenic, osteoconductive, or osteoinductive properties.

Osteogenesis- development of new bone with the help of cells in the graft.

Osteoinduction- the chemical procedure by which the molecules present inside graft also known as bone morphogenetic proteins change the surrounding cells in osteoblasts which leads to the form of the bone.

Osteoconduction- It is a physical effect in which the matrix molecules of the graft lead to the formation of a scaffold that aids the outside cells to enter the graft and form new bone.¹⁷

Bone Ring Technique.

Various treatment modalities are available to increase the vertical height and horizontal width for the alveolar ridge defect. Successful implant placement has been seen in the ridge defect having

the vertical height and horizontal width defect by using ridge augmentation methods. One of the recent techniques which are used to increase the vertical height is the Bone ring technique (BRT).

BRT has been described as a one-stage approach to restore vertical ridge height defects, in which an autogenous or allogeneic bone block graft is used and the implant is placed simultaneously. Various studies about the vertical bone ring technique have been performed.

| Sr. no | Author (Year) | Title of study | Conclusion |
|--------|--|---|--|
| 1 | Kerri Thomas Simpson et. al (2020) ¹⁸ | Computer -Guided Surgery using the Allograft Ring Technique” with Simultaneous Implant Placement: a case report | The method of computer-guided technology for planning and placing of an allograft bone block and simultaneous insertion of implant aides for a prosthetically headed group approach to conciliated grafting at the site in addition to improving precision |

| | | | |
|----|--|---|---|
| | | | as well as accuracy as a comparison with no guided techniques. |
| 2. | Robert J Miller et.al (2020) ¹⁹ | Indications for Simultaneous Implantation and Bone Augmentation Using the Allograft Bone Ring Technique | The Allograft Ring Technique is utilized successfully to regenerate both the vertical and horizontal defects in the ridge following placement of the implant. Many clinical situations occur that can get the benefit from this technique; however, case assessment is the key factor. The optimal three-dimensional placing of the implant is the ultimate guide to surgical success and |

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| | | | <p>must be prior analyzed. The defect in the bone should be considered as the placement of the implant within the bone increases the chances of surgical success. An alternative that has a two-stage procedure should be considered when there is no possibility for restoratively driven placement. The standard factors that influence surgical success, including a selection of the patient and the surgical judgment of the dentist should not</p> |
|--|--|--|--|

| | | | |
|----|---|--|---|
| | | | be overlooked. ¹⁹ |
| 3. | El Chaar E et al. (2021) ²⁰ | Bone Ring Allograft: Digitally Guided Placement in the Anterior Esthetic Area. A Retrospective Case Series | This case study shows a one-stage process in which a bone ring allograft, as well as implant, are placed for treating a severe damage ridge in the anterior region of the maxilla. The technique is reliable to use in the esthetic zone, with minimal first-year loss of peri-implant bone |

CONCLUSION

Reconstruction of deficiencies in the alveolar bone, preservation of dimensions of alveolar bone, and replacement of lost teeth with dental implants in an aesthetic position with a natural appearance, the form can be achieved by bone augmentation and simultaneous implant surgery procedures. The desired outcome of this procedure also depends on various biologic principles that should be taken into consideration. Diagnosis, treatment planning, clinical approach and

treatment and also postoperative follow-up, and appropriate implant loading are all deciding factors in achieving success.

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