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Implants in orthodontics: A brief review

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ABSTRACT

Orthodontic implants used to provide an anchorage that is useful for the straightening of teeth. These implants are called orthodontic mini-implants/micro-screws and serve as temporary implants. Here in this discussion, we are going to study about indications, contraindications, risk factors associated with the implants.

1. Introduction

In the last two three decades of years, dental implants have been used successfully in combined management of orthodontic-restorative patients, particularly in partially edentulous adults. Osseointegrated dental implants are used for orthodontic anchorage and then later serve as abutments for tooth replacement. This type of anchorage is very effective in treating patients with hypodontia, congenially missing teeth, or periodontal disease, who lack sufficient teeth for conventional anchorage. Additionally, implants have been used for presurgical tooth movement, space opening/closing, and generally as a means to achieve better functional, biologic, and esthetic results in multidisciplinary treatment.

1.1. Orthodontic anchorage & classification in implants

Orthodontic anchorage can be defined as resistance to unwanted tooth movement by the different techniques used. During orthodontic treatments, different techniques can be used to reinforce the anchorage. Traditional biomechanical methods include – The use of extraoral anchorage by headgear or intraoral, One by bars, Palatal/lingual arches or Intermaxillary elastics.

But these techniques cannot effectively control anchorage, either due to lack of patient compliance or due to inaccuracies in the support structures.[1] And, in order to enhance the anchorage in orthodontics the concept of implant came into existence. The implant anchorage is typically made of stainless steel, commercially available titanium, or titanium alloy and the diameter of them is from 1 to 2mm with the length of 8 to 20mm generally. There are multiple types of implant anchorages are available, mostly including palatal plates, onplants, miniplates, and miniscrews.[2]

1.2. Palatal plates

The implant is primarily placed on the maxillary hard palate with a location in the median palatine suture or on either side of the median palatine suture behind the incisive foramen. Most palatal implants are made of titanium alloy and are screw-like with a cylindrical surface.

1.3. Onplants

These are also known as disc implants. The onplant has the similar role to the palatal plate and is inserted in the median palatine suture. Onplants are button shaped and implanted

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between the periosteum and jaw. Such implants require secondary surgeries, whereas palatal plates require a single surgery.

1.4. Miniplates

These are placed on the apical buccal area of the upper and lower jaw, and are implanted following periosteum flap surgery. Titanium plates are fixed in dense buccal bone by miniscrews. Most of the implant is located under the periosteum. Miniplates can also withstand large orthopedic forces, including front traction of the maxilla, or retraction of the overall dentition.

1.5. Miniscrews

Miniscrews are made of pure titanium or titanium alloy, with a diameter of 1 to 2mm and a length of 10mm. The shape of the implant below the bone surface is screw-like, and is not generally used for surface treatment. The advantage of the miniscrew is its simple operation. The use of miniscrew implants (MIs) controls the movement of teeth in the mesial, distal, and vertical directions, without the need for additional anchorage.[3]

Also depending upon the are of insertion implants can be defined as –

1.6. Endosteal

The subperiosteal implant is placed under the periosteum and rests on the bone surface without penetrating it.

1.7. Subperiosteal

The endosteal implant is partially submerged and anchored within the bone.

1.8. Transosseous

The transosseous implant penetrates the bone completely.

1.9. Based on the type of design

1. Cylinder
2. Screw form

1.10. According to the nature of material

1. Satinless steel
2. Titanium
3. Maxilla

1.11. Sites for the placement of implants –

1. In maxilla
2. Infrazygomatic crest area
3. Tuberosity area
4. Between 1st and 2nd molars buccally
5. Between 1st molar and 2nd premolar buccally
6. Between canine and premolar buccally
7. Between incisors facially
8. Midpalatal area

1.12. In mandible

1. Retromolar area
2. Between 1st and 2nd molars buccally
3. Between 1st molar and 2nd premolar buccally
4. Between canine and premolar buccally
5. Symphysis facially
6. Edentulous area
7. Mandibular tori

1.12.1. Factors that influence the stability of orthodontic mini-implants are –

1. **Host factors –** As bone is a dynamic tissue in which the modeling and remodeling processes are continuous throughout. Therefore, the general condition of the bone is one of the to stability of implants. The condition of the hard tissue depends on the age and sex and anatomical location of the implant placement site; the quantity and quality of the host bone also a major factor, as the stability in case of dense trabecular bone is more favorable than low density trabecular bone. Extremely dense cortical bone may also increase stress during placement, which results in degradation of bone tissue at the implant-bone interface[4,5] Also, the host's soft tissue also important in deciding the stability of the implant as an implant placed in the attached gingiva has a more stable soft tissue-implant interface in comparison to the implants in the mucosa or movable soft tissue, and thus low stable soft tissue-implant interface; are likely to cause soft tissue problems, such as infections.[6] Also, the excessive local forces may occur during mastication in the area between the mandibular first and second molars may compromise the stability of the orthodontic implants.
2. **Operator/dentist's factor –** the primary stability of any procedure is also dependent upon the fine skills of the operator either it may be root canals or implant placement or any other procedure. Proper surgical protocols are very important in preventing unnecessary surgical trauma.
3. **Implant factors –** One of the implant factors that decides its stability is its biocompatible nature and implant design. The physical properties of the implant materials, particularly those on the surface in direct contact with tissue, determine the adsorption of biomolecules or foreign materials and cell adhesion patterns, and these materials may be considered bioactive, bioinert, or biotolerant and it has been reported that, when used in implants, bioactive materials such as hydroxyapatite or aluminum oxide

can form chemical bonds with bone.[7,8] The implant design influences the distribution of stress to the adjacent bone tissues. The length of the mini-implant was shown to have little effect on the distribution of stress but the designing of implant threads and its diameter had a significant effect on the distribution forces and so this indicates role of thread design & diameter of the implants. The orthodontic mini-implant made up of titanium alloy grade V (Ti - 6AL - 4V) is designed to be used transmucosally for osseous orthodontic anchorage and orthodontic mini screw has four components –

Head – Has a slot for placement of orthodontic arch wire.

Neck –It is an isthmus between head and platform for attachment of an elastic, NiTi coil spring or other accessories.

Platform – It is of three different sizes (1mm, 2mm, 3mm) for an accommodation of different soft tissue thickness at different implant site.

Body – It is parallel in shape and is self- drilling with the wide diameter and deep thread pitches. It provides better mechanical retention, less loosening breakage, and stronger anchorage.[9]

4. **Oral hygiene –** The oral hygiene is also playing an important role in the success of implants, as the poor oral health may lead to chronic inflammation and thereby may lead to failure to the procedures.

1.12.2. Procedure of implant surgery in orthodontics include 5 stages

1. Preoperative examination stage – This stage involves the selection of the site, administration of anesthetics and performing preoperative examinations like the cortical bone surface examination with a periodontal probe.
2. Marking stage – The site of insertion should be cleaned with povidone-iodine solution and thereafter a periodontal probe is used to mark the horizontal and vertical reference lines on the gingiva and gingiva should be perforated with a periodontal probe at the correct insertion point according to the treatment plan.
3. Perforating stage – This stage is important in the whole procedure as cortical bone is the component that is the most resistant to implant insertion and the most critical to primary stability and so the main goals in the perforating stage are to allow implantation to proceed easily and to protect cortical bone against unnecessary surgical trauma by cortical bone punching.[10]
4. Guiding stage – In the 4^{th} stage, the screw is engaged with the bone and inserted at a planned angle. With any type of insertion method, an implant should be inserted through rotation of the screw with minimal vertical force but enough to maintain the insertional angle. A pin or a nail is inserted by vertical force, or pushing, while a screw is inserted by means of rotation. The most important point to be noted in giving stress or applying forces is that excessive vertical forces should never be applied as they can increase the chances of vibration and root injuries.
5. Finishing stage – This is the last phase of this surgery in which finishing can be done only by rotation and this made it possible by the engagement of the screw threads with the bone during the guiding stage, and this is the stage for obtaining of the mechanical stabilization from cortical bone.

1.13. Indications & contraindications of implants

Table 1: Indication & advantages of implants in orthodontics[7,11]

Indications	Advantages
Intrusion/extrusion of teeth	Mini-implants more feasible than conventional methods
Close edentulous spaces	Avoid need for prosthesis, reduce endodontic complications
Repositioning of malposed tooth	Enhance oral hygiene
	Improve anchorage
	Reconstruction of the edentulous area
Reinforce anchorage	Maximize anchorage, e.g. palatal implant improve patient compliance (no headgear, class II elastics)
Partial edentulism	Future restorative abutments
	Reduce dental complications
Correct undesired occlusion	Provide solid anchorage to retract entire arch, Facilitate localized bonding and treatment
Orthopedic movement	Accelerate sutural distraction (palatal expansion) and bone movement

1.14. Contraindications

1.14.1. Absolute contraindication[11]

1. Severe systemic disorder, e.g. osteoporosis
2. Psychiatric diseases, e.g. psychoses dysmorphobia
3. Alcoholic drug abusers
4. Patients with circulatory disturbances or latent infections
5. Patients with hypersensitivity to specific materials, i.e. who react to foreign bodies
6. Acute infection

1.14.2. Relative contraindications[11]

1. Insufficient volume of bone
2. Poor bone quality
3. Patients undergoing radiation therapy

4. Insulin-dependent diabetes
5. Heavy smokers
6. Patient suffering from recurring diseases of the oral mucosa and poor oral hygiene.

1.15. Complications

1. Failure of implant either early or delayed
2. Pain that can be associated with Peri-implantitis, Oroantral fistula or Breakage of implants
3. Implants breakage while insertion and use
4. Trauma to the periodontal ligament or the dental root
5. Implant breakage during removal
6. Material hypersensitivity of the patient due to the foreign bodies in the form of allergic reactions.
7. Nerve involvement
8. Emphysema
9. Oral ulcers

2. Conclusions

The implants in orthodontics can provide the promising results for anchorage than to the conventional methods. Also, pre-surgical proper examination for the treatment plan is necessary with an informed consent from the patient, as there are some associated risk factors with implants. Otherwise implants have good and promising results in orthodontics with good biocompatibility in most of the patients.

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4. Conflict of Interest

None.

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