Implants in Orthodontics : Mini Screw Orthodontic Implants -A Systematic View

Dr. Sagar Mapare
Professor
Department Of Orthodontics and Dentofacial Orthopedics
Hedgewar Dental College, Hingoli(Maharashtra)

Dr. Anand A Tripathi
Associate Professor
Department Of Orthodontics and Dentofacial Orthopedics
V.Y.W.S. Dental College,Amravati (Maharashtra)

Dr. Amol A. Verulkar
Associate Professor
Department Of Orthodontics and Dentofacial Orthopedics
V.Y.W.S. Dental College, Amravati (Maharashtra)

Dr. Pratik Chandra
Reader
Department Of Orthodontics and Dentofacial Orthopedics
Saraswati Dental College and Hospital, Lucknow (Uttar Pradesh)

Introduction

Conventional means of supporting anchorage have been using either intra-oral sites or relying on extraoral means. Both of these have their limitations – The extra-oral forces cannot be used on a 24x7 basis to resist the continuous tooth moving forces and are also taxing on the patient's compliance. On the other hand strict reliance on intra-oral areas - usually dental units does not offer any significant advantages, except the fact that the patient's co-operation is less critical. Due to these constraints therefore, at times, either the treatment options start getting limited or the end result compromised.

The advent of osseo-integrated implants, due to the pioneering studies of Prof. Branemark has changed this scenario. The implants made of titanium have been widely used by several orthodontists as they offer Absolute Anchorage'.[1]

Key Words: Anchorage, Temporary Anchorage Device, Micro Implant, Osseo-integration

Terminology Used

Implant: As defined by Boucher Implants are alloplastic devices which are surgically inserted into or onto jaw bone.

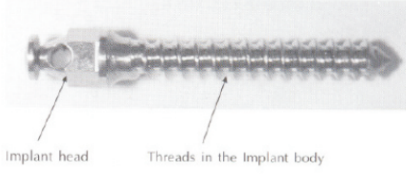
Osseointegration: An intimate structural contact at the implant surface and adjacent vital bone, devoid of any intervening fibrous tissue - Brane-mark(1983)[3].

Parts

The commonly used implant screw/plate has two parts:

a) Implant head, which serves as the abutment and in the case of an Orthodontic implant, could be the source of attachment for elastics/ coil-springs

b) Implant body, which is the part embedded inside bone. This may be a screw type or a plate type -which is flatter and can be used in resorbed and knife edged ridges . The plate design that has been used in Orthodontics as the skeletal anchorage system varies from these conventional plate implants.(Fig. 1)



History Of Implants (brief)

Since the introduction of fixed appliance the question of anchorage has attracted considerable interest and created many problems.

Endosseous implant became a major influence within the oral implant surgery due to the work of Brane mark (1969) who achieved constant long term success with oral endosseous implants.[4]

The concept of metal components being screw into the maxilla and mandible to enhance orthodontic anchorage was first published in 1945 with the use of Vitallium Screws to effect tooth movement in dogs .Despite some success the resultant tooth movement was limited due to the screw in 1 month. Two decades later Linkow (1970) described the endosseous blade implant for orthodontic anchorage, but did not report long term stability.[2]

BRANEMARK ET AL (1977) have defined osseointergration as a direct structural and functional connection between living bone and the surface ofa load carrying implant.

ROBERTS(1989) used conventional two stage implant in the retromolar region to help reinforce anchorage whilst successfully closing first molar extraction site in the mandible . After completion of the orthodontic treatment the implant were removed using a trephine and histologically analysed . They found a high level of osseo integration had been maintained despite the orthodontic loading.[3]

DAHL (1945) first published the use of subperiostel vitallium implant to effect tooth movement in dogs. LINKOW (1966) described endosseous blade implants with perforation for orthodontic anchorage. KAWAHARA(1975) developed Bioglass coated ceramic implant for orthodontic anchorage.[8]

Various bioactive ceramics such as glass ceramic (BROMER ET AL 1977,HENCH ET AL 1973) , tricalcium hosphate ceramic (LUHR AND RIESS 1984) and hydroxyapatite ceramic, BRANE MARK (1969, 1977) THE MENTOR OF MODERN IMPLANT SURGERY described the high compatibility and strong anchorage of titanium in human tissue and coined the term

osseointergration.[14]

CREEKMORE(1983) reported the possibility of skeletal anchorage in orthodontics .

HIGUCHI and JAMES (1991) used titanium fixtures for intraoral anchorage to facilitate orthodontics tooth movement.[16]

COSTA ET AL (1998) used miniscrew for orthodontic anchorage [8]

UMEMORI ET ET AL (1999) used SAS for open bite correction [9]

GIULIANO MAINO (2003) spider screw[11]

1966	Pure titanium	Cylinder with screw threads	Late implantation; several months of covered healing; precut threads	Branemark e al (1977)
1966	Titanium, Vitallium	Blade implant with large perforations	Groovelike bone preparation made with a turbine drill or oscillation saw	Linkow (1966, 1968, 1970)
1971	Aluminium oxide ceramic (CBS)	Screw	Late implantation; step by step preparation of bony host site	Sandhaus (1971)
	Tantalum	Pins	Impaction of a	Pruin (1971)
1974	Tantalum	Screw (Helicoidal shape)	One stage ; immediate loading; self tapping thread	Heinrich (In Pruin, 1974)
	Tantalum	Double blade	Groove like bone preparation	Herskovits (Schroedr et al, 1974)
1975	Bioceram	Screw	Immediate and late implantation	Kawahara et al (1975)
	Steel	Endosseous screws and	Requires extraoral	Small (1975)
1976	Aluminium oxide ceramic	Conical root shaped	Immediate implantation, several months of unloaded transgingival healing	Schulte and Heimke (1976)
	Plasma coated titanium	Cylinder with intramobile element	Internal cooling; covered unloaded healing	Koch (1976) Kirsch and Mentag (1986)
	Plasma coated titanium	Hollow cylinder, hollow screw	Immediate functional loading	Schroeder et al (1976
1979	Titanium	Screw	Immediate functional loading; self - tapping thread	Ledermann (1979)
1982	Titanium	Cylinder	Several possibilities of prosthodontic treatment	Niznick (1982)

Classification Of Orthodontic Implant

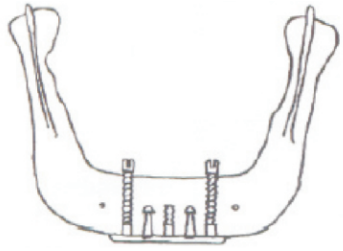
Implants can be broadly classified under the following: [16]

Based on the location

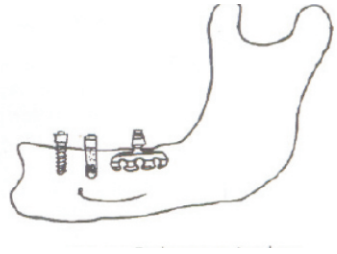
Subperiosteal: In this design, the implant body lies over the bony ridge. This type has had the longest history of clinical trials but a decreased long-term success rate; probably due to the fact that the chances of getting it dislodged are high.Also, the complexity of their designs requires a precise casting procedure. The subperiosteal design currently in use for orthodontic purposes is the 'Onplant'.(Fig.2)

Transosseous: In this particular variety, the implant body penetrates the mandible completely. These have enjoyed good success rate in the past. However they are not widely used because of the possible damage to the

intrabony soft tissue structures like the nerves and vessels . Even in the field of Orthodontics, transosseous implants have not been used.(Fig.3)



Endosseous: These are partially submerged and anchored within bone. These have been the most popular and the widely used ones. Various designs and composition are available for usage in specific conditions. The endosseous implants are also the most commonly employed types for orthodontic purposes.(Fig.4)



Based on the configuration design .

Root form implants: These are the screw type endosseous implants and the name has been derived due to their cylindrical structure

Blade / Plate implants:

According to the composition

- Stainless steel
- Cobalt-Chromium-Molybdenum (Co-Cr-Mo)
- Titanium
- Ceramic Implants
- Miscellaneous such as Vitreous carbon and composites

According to the surface structure.

Threaded or Non-threaded.

The root form implants are generally threaded as this provides for a greater surface area and stability of the implant.

Porous or Non Porous.

The screw type implants are usually non porous, whereas the plate or blade implants (non-threaded) have vents in the implant body to aid in growth of bone and thus a better interlocking between the metal structure and the surrounding bone.

Since 1995 over 10 new systems of orthodontic implant have been introduced

Based on the implant morphology:

a) Implant discs
i.Onplant
b) Screw designs - These include:
i. Mini-Implant
ii. Orthosystem implant system
iii. Aarhus implant
iv. Micro-implant
v. Newer systems such as the Spiderscrew, the OMAS system, the Leone mini implant,the Imtec screw etc.
c) Plate designs - These include:
i. Skeletal Anchorage system (SAS)
ii. Graz implant supported system
i i i. Zygoma anchorage system

They can also be classified depending on the area of placement as:

a) Subperiosteal Implants
b) Osseous implants and
c) Inter-dental implants

Indications And Contraindications of Implants

Indications for implant in orthodontics

To retract and align anterior teeth with no posterior support

To close edentulous spaces in first molar extraction sites

To intrude or extrude teeth

To protract or retract teeth of one arch

To stabilize teeth with reduced bone support

For orthopedic traction

Implant for osteogenic distraction

Contraindication for orthodontic implant therapy

Absolute contraindication[9]

Severe systemic disorder eg. osteoporosis

Psychiatric diseases eg. psychoses dysmorphobia

Alcoholics drug abusers

Relative contraindications

Insufficient volume of bone

Poor bone quality

Patients undergoing radiation therapy

Insulin dependent diabetes

Heavy smokers

Treatment Planning

Problem List and Patient Desires

Initial Evaluation

Chief compliant

Medical/ Dental History Review

Intra /Extraoral Examination

Diagnostic Impression /Articulated Casts

Radiographs (Panoramic and Periapical , CT Scan or Tomography

Photographs

Miniscrew Anchorage System(m.a.s)

Developed by Incorvati , Carano and et al [13]

Appliance Design: The screws used in the M.A.S. system are made of medical grade 5 titanium, they have a conical profile and are available in three diameters. Type A has a 1.3

mm diameter at the height of the neck of the implant, and 1.1 mm at the tip. Type B has a 1.5 mm diameter at the neck and 1.3 mm at the tip. The overall length for both Type A and Type B is 11.0 mm. Type C has a 1.5 mm at the neck and 1.3 mm at the tip with 9 mm of total length.

The head has a shape of two spheres (2.0 mm the lower sphere and 2.2mm the upper) that are fused together, with an internal hexagon for the insertion of the screw driver. There is a 0.6 mm aperture placed perpendicular to the length of the screw where a ligature wire or auxiliary monkey hook can be attached. In the junction point between the two circles, a slot is present for the attachment of elastics, chains or coil springs.((Fig. 5)

Surgical Sites

1) Interradicular spaces, both buccal and palatal, of maxillary canine and laterals. Interradicular spaces, both buccal and palatal, of maxillary first molar and second premolars (from 2 to maximum 8 mm from the crest).
2) Interradicular spaces, both buccal and lingual, of maxillary second and first molars (from 2 to maximum 8 mm from the crest).

The sites that should not be used are in order:

1) In the maxillary tuber especially with the unerupted third molars.
2) Interradicular spaces upon 8mm from the bone crest in the molar and premolar area.

Advantage of Miniscrew Anchorage System:

- Independency from the number or position of the
- present teeth
- Optimal use of the pulling forces
- Independency from patient cooperation
- Patient comfort
- Shorter treatment time (not need to prepare dental anchorage)
- Easy and fast screw insertion
- Possible application even in interceptive therapy

Advantages when compared with other osteo-integrated systems:

- VersatiIity in the insertion sites
- Easy insertion and removal
- Immediate loading
- Application in growing patients
- Low cost

Some potential complications common to other implant procedure are:

- Lesions of some anatomic structures like nerves, vessels, dental roots.
- Loss of the screw during the placement or during loading were lost during loading)
- Inflammation around the implant site
- Breakage of the screw within the bone duringinsertion or removal. This complication has probably be due to the use of screws with a small diameter.

Clinical Application:

Orthodontic Space Closure

For posterior space closure the anterior-posterior location of the miniscrew is between roots of the first molars and the second bicuspids roots. Vertically the miniscrew should be located at or above the mucogingival line depending on the desired line of action.

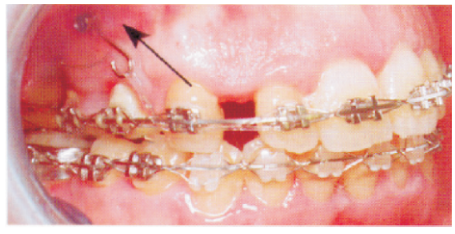
For intrusion and distalization –above the mucogingival line

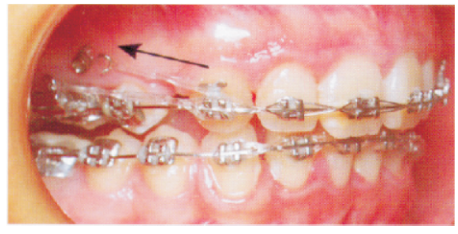
For distal movement –at level of the mucogingival line

Higher the screw in the maxilla the more perpendicular it is in order to avoid damage to the maxillary sinus .Ideally it is 30- 40 degrees .

In case the alveolar process is to prominent an auxiliary attachment (monkey hook) is used it avoids discomfort and possible ulceration of the gums.

In the mandibular arch care should be done to avoid the mental foramen.[5]
(Fig.6 & 7)





Symmetric intrusion of the incisors

To intrude the upper incisors the screw is placed between the upper lateral incisors and the canines. The placement of the mini-screws should be done after leveling and alignment, in order to maximize the interadicular space at the placement site.

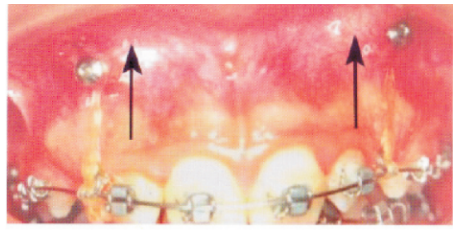
In order to avoid tipping the upper incisors buccally during the intrusion, the end of the archwire should be cinched back.

Correction of the cant of the plane of occlusion and of the dental midline

The miniscrew is used as anchorage to intrude the extruded canines and the laterals on the side of the cant, and to center the dental midline . During the intrusive movements, it is very important to center the mini-screws in between the roots of the teeth that need to be intruded in order to avoid the interferences between the teeth and the
screw.

Molar intrusion[10]

It is very hard to place the micro-screws precisely between the roots of first and second molars without interfering with the roots of the teeth either during implantation or during the intrusive movements.
(Fig. 8)



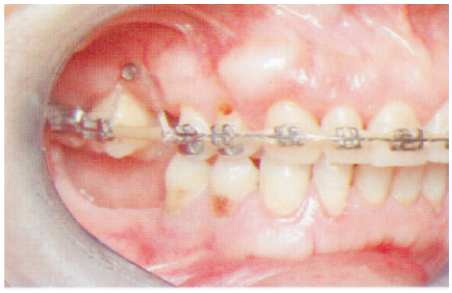
Moreover, sometimes the intrusion force need to be relatively high and more than one screw might be necessary in places where there is insufficient space available for the screw placement. For the above reasons it is suggested to limit the use of the miniscrews to cases where simple molar intrusion of one or two teeth.[10]

Molar mesialization[12]

MAS is placed mesial to the space to be closed, at a height that facilitates a vector of force approximating the center or resistance of the molar, dental tipping can be avoided. The MAS can be placed after the initial leveling and aligning phase has been completed, so to use a full size arch wire that will prevent the mesial crown tipping of the molar during the space closure. The mesial movements are usually very slow especially in the lower arch so not more than 2-3 mm of mesial molar movement should be attempted. (Fig. 9 & 10)

Intermaxillary anchorage

Class II correctionis done by elastics or anterior repositioning appliances (i.e. Jasper



Jumper, Bite Fixer, etc. There are numerous unwanted side effects of those kinds of mechanics, such as excessive anterior movement (proclination and protrusion) of the lower incisors and opening of the bite, to name a few. To address the above problems one alternative may be to place MAS between the roots of the first and second lower molars or between the root of the second bicuspids and lower first molars, in this way the upper arch can be retracted without any unwanted dental effects on the lower teeth. The placement of the MAS mesial to the lower molar may also prevent the mesial movement of the entire lower arch because the MAS, when in contact with the lower molar, may not allow it to move anteriorly. More research is needed to verify the clinical results.

Further View Of Ortho-dontic Implant

The ideal implant design would be one that would be simple to place as well as remove, causing minimum discomfort to the patient. At the same time, they should be optimum in resisting the conventional Orthodontic forces. One would be looking at newer designs, which could be placed by an Orthodontist himself. Also, since the implants need not last for a very long time, biodegradable implants may be a lucrative option. Biodegradable screws made of L-polylactide have been introduced by Glatzmaier et al and are currently undergoing clinical trials. The system, termed as the BIOS (Bioresorbabale implant for Orthodontic systems)consists of resorbable polylactide with a metal abutment.[16]

Conclusion

Implants for the purpose of conserving anchorage are welcome additions to the armamentarium of a clinical Orthodontist. They help the Orthodontist to overcome the challenge of unwanted reciprocal tooth movement. The presently available implant systems are bound to change and evolve into more patient friendly and operator convenient designs. Long-term clinical trials are awaited to establish clinical guidelines in using implants for both orthodontic and orthopedic anchorage.

Reference:

References are available on request at anand.tripathi86@gmail.com