



International Journal of Applied Dental Sciences

ISSN Print: 2394-7489
ISSN Online: 2394-7497
IJADS 2016; 2(2): 35-41
© 2016 IJADS
www.oraljournal.com
Received: 06-02-2016
Accepted: 07-03-2016

Dr. Unjum Bashir

Senior Resident, Department of
Prosthodontics, Government
Dental College Srinagar, Jammu
and Kashmir, India.

Dr. Manas Gupta

Assistant professor Department
of Oral Medicine and Radiology,
Rishiraj College of Dental
Sciences, Bhopal, Madhya
Pradesh, India.

Dr. Ravish Ahuja

Senior Lecturer, Department of
Pedodontics & Preventive
Dentistry, Rama Dental College,
Hospital & Research Centre
Kanpur, Uttar Pradesh, India.

Correspondence:

Dr. Unjum Bashir

Senior Resident, Department of
Prosthodontics, Government
Dental College Srinagar, Jammu
and Kashmir, India.

Implant systems

Dr. Unjum Bashir, Dr. Manas Gupta, Dr. Ravish Ahuja

Abstract

We may think of implants as being an invention of modern times. But history shows evidences of ancient civilization trying to replace missing teeth by banding artificial tooth replacements to remaining teeth or by using gold ligature wires to stabilize periodontally weak teeth. The first clear evidence of tooth replacement is from the early Egyptians in 2500 BC where attempts were made to stabilize periodontally compromised teeth with the use of gold ligature wires. Some of the implant system should be discussed although research for comparing all the systems simultaneously is limited. The implants systems discussed here has had direct case study and application either in clinical / laboratory or laboratory only.

Keywords: Osseointegration, Implant system, Abutment.

1. Introduction

More than 220 implant brands have been identified, produced by about 80 manufacturers. The implants are made from different materials, undergo different surface treatments and come in different shapes, lengths, widths and forms. The dentist can in theory choose among more than 2,000 implants in a given patient treatment situation. Implants made from titanium and titanium alloys appear to perform well clinically in properly surgically prepared bone, regardless of small variations of shapes and forms. Various surface treatments are currently being developed to improve the capacity of a more rapid anchorage of the implant in to bone. A substantial number of claims made by different manufacturers on alleged superiority due to design characteristics are not based on sound and long term clinical scientific research. Implants are, in some parts of world, manufactured and sold with no demonstration of adherence to any international standards^[1].

Asbjorn^[1] identified all implants and implant systems that have been evaluated in the clinical trials. On the basis of number of clinical trials and scientific methodology quality of the reports he defined four levels of clinical documentation.

- A. Extension clinical documentation
- B. Some documentation identified of acceptable quality
- C. Some documentation identified, but of poor quality
- D. No clinical documentation

According to the ADA report 1996 the following products have been classified by the Council (if the product has been accepted only for a certain type of prosthesis and anatomical location that is indicated in brackets).

Acceptable

- Branemark System (fully edentulous arches and partially edentulous [two or more units]), Nobelpharma USA, Inc.
- IMZ (4.0 mm) Implant System (fully edentulous arches and partially edentulous [two or more units]), InterPore International
- One Stage Oratronics Weiss Standard Blade Implant System (partially edentulous patients), Oratronics, Inc.
- Integral Endosseous Implant System, Calcitek, Inc.
- Integral Omniloc Endosseous Implant System, Calcitek, Inc.
- Omniloc Dental Implant System with Interface Ring, Calcitek, Inc.
- Spline Hydroxylapatite (HA)-Coated Cylinder Dental Implant System, Calcitek, Inc.

Provisionally Acceptable

- Astra Tech Implant System, Astra Tech, Inc.
- Branemark System (single tooth replacement), Nobelpharma USA, Inc.
- Core-Vent Implant System, Dentsply/Core-Vent Corp.
- IMZ (4.0 mm) Implant System (single tooth replacement), Interpore International
- ITI Dental Implant System, Straumann USA
- STERI-OSS Titanium Screw Type Endosseous Dental Implant, STERI-OSS, Inc.
- Hydroxylapatite-Coated Threaded Titanium Alloy Endosseous Dental Implant, STERI-OSS Inc.

The ADA Council in 2004 ³provides a list of products available to the profession that have received the ADA seal of acceptance.

All ADA-Accepted endosseous implants have demonstrated safety and efficacy when used as indicated in fully and/or

partially edentulous patients and/or as single tooth implants. The type of prosthesis and anatomical location used in evaluating Accepted Implants is identified in the Seal Statement

The implant manufacturers listed above submitted evidence demonstrating that their implants met the criteria for Acceptance According to the ADA Acceptance Program Guidelines for Endosseous Implants (July 1993). Evidence was provided demonstrating that the physical properties (such as modulus of elasticity, strength and surface characteristics) of the implant material are acceptable and biocompatible. Demonstrating biocompatibility requires animal and tissue culture studies on the implant material and any implant coatings (such as hydroxylapatite). In addition, manufacturers must demonstrate that the implant can be sterilized. Clinical studies must demonstrate safety and efficacy of the implant over a three-year period (for provisional Acceptance) and a five-year period (for full Acceptance).

BOX

ADA-ACCEPTED DENTAL IMPLANT SYSTEMS.

The ADA Council on Scientific Affairs has granted the Seal of Acceptance to the following dental implants that are voluntarily participating in the Council's Seal Program:

- Astra Tech Implants system, Astra Tech (Lexington, Mass.)
- Brånemark System Dental Implants, Nobel Biocare USA (Yorba Linda, Calif.)
- Steri-Oss Titanium Screw Type Dental Implant, Nobel Biocare USA
- Steri-Oss Hydroxyapatite-Coated Titanium Screw Type Dental Implant, Nobel Biocare USA
- Oratronics Osteo-Loc Standard One-Stage Osseopreservation Implant System (partially edentulous only), Oratronics (New York)
- ITI Dental Implant System (fully and partially edentulous only), Straumann (Waltham, Mass.)
- Spline Hydroxylapatite (HA)-Coated Cylinder Dental Implant System, Centerpulse Dental (Carlsbad, Calif.)

The Branemark implant system

The history of Branemark System can be categorized in to three stages^[4]

- The early stage (1965-1968)
- The developmental stage (1968-1971)
- The production stage (1971-present)

The implant consists of six components^[5]

- 1) The fixture
- 2) Cover screw
- 3) Abutment
- 4) Abutment screw
- 5) Gold cylinder and
- 6) Gold screw

The fixture is the component which is surgically placed in to the jawbone and the cover screw is screwed in to the top of the fixture to prevent down growth of soft and hard tissue in to the internal, threaded area. The abutment is the Trans mucosal component which is connected using an abutment screw in to the fixture. The gold cylinder, an integral part of the final prosthesis, is connected to the abutment with the gold screw. The various components become a single unit using the screws to connect them together.

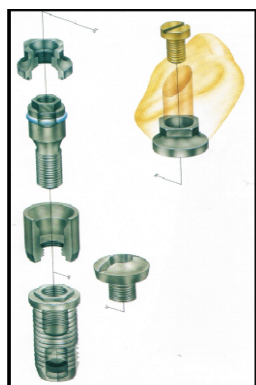
The cover screw acts as a seal on the coronal portion of the fixture and fits into threads of the internal channel over the

hexagonal shape. This is used during the interim period after the first surgical procedure and before the second surgery. The cover screw has a groove for screwdriver access and is rounded on the top to help prevent damage to soft tissue. In the center of cover screw, there is a depression within the groove to accommodate the punch blade. The punch blade is spring loaded and the post fits into the depression of the cover screw; the blade is used for cutting soft tissue located around the circumference of the cover screw.

The abutment is made of titanium in a cylinder shape. The apical portion has a recessed hexagonal shape designed to fit the coronal portion of the fixture, precisely. The abutment screw inserts through the abutment and threads into the fixture to connect the two components. The abutment screw has a silicone ring that provides a seal to prevent microorganisms from passing through the abutment to the fixture. The head of the abutment screw has a smaller hexagonal shape with threads machined inside a smaller channel.

The gold cylinder is made of gold, palladium and platinum; it is machined to fit the coronal portion of the abutment. The gold cylinder becomes an integral part of the final prosthesis by incorporating it into the laboratory wax-up and investing procedures. The gold screw inserts through the gold cylinder and threads into abutment screw to connect the gold cylinder and abutment.

The Frialit- 2 System



Branemark System components

From lower to upper components; fixture, cover screw, abutment screw, gold cylinder, gold screw

Developed by Prof. W. Schulte in 1974 at the University of Tuebingen. It was the Frialit-1 or the Tuebingen implant. The basic concept of this was the immediate replacement of a tooth after extraction with an implant. Dr. Schulte believed this would prevent atrophy of the alveolar ridge.

This system represents a further development of the Tuebingen immediate implant which was originally designed to be used as a single tooth replacement. However, Frialit -2 is made of pure titanium and is a two -stage system in that it remains covered by the mucosal integument during the healing in phase [6].

Frialit -2 system is available as a press-fit-cylinder or as a self-tapping step-screw with diameters of 3.8, 4.5, 5.5 and 6.5 mm, and in five different lengths (8, 11, 13 and 15 mm). The surface of Frialit -2 implant is sandblasted and etched. The shape is different from the original Tuebingen implant, in that the threads provide enhanced primary stability. Frialit -2 implants are first placed in to the prepared bed to about two-thirds of their length and then seated definitively using a special screwdriver and a ratchet, with three full turns.

The cylinder implants (press-fit) are either plasma flame-sprayed or HA-coated. These implants are placed definitively by means of a special instruments and light blows with a mallet. For single-tooth replacement, straight or 15° angled prosthetic posts are available: these posts can be modified by grinding and are available in lengths of 1, 2 and 3 mm. Rotational stability is guaranteed by an internal hexagon: definitive fixation of prosthetic post is via a central, axial screw. The porcelain crown can be cemented or screwed in to place. All of the components of this system are made of titanium. The broad variety of abutments makes this system virtually universal as an implant with as an implant with a wide range of indications.

Implant Design

Material used

The original material used was aluminum oxide. This was later changed to Complete Pure titanium. Titanium has proved to be biocompatible with improved mechanical properties. It can accommodate an internal hex. The surface can be roughened or coated to increase the surface area for Osseointegration.

Design

Exterior Design

It consists of 2 types of implants:

1. Stepped cylinder.
2. Stepped screw.

Stepped Cylinder

The implant body is shaped as a stepped cylinder. This shape allows force transfer to be spread at various levels of the bone-implant interface in horizontal as well as vertical direction.

According to a 12 year study by d' Hoedt, the stepped cylinder supplied in various lengths and diameters are selected according to the amount of anatomic substrate and amount of available bone is suitable for both immediate and delayed implantation. Axial loads acting on the implant are distributed to the step plateaus whereas lateral forces are dissipated to the enveloping surfaces.

Stepped screw

This was developed primarily for situation where greater demands are placed on the initial stability due to poor bone quality or insufficient congruency between the implant sites and the implant as in immediate extraction cases. This is designed to be inserted to the lower edge of the non-threaded section with finger pressure. Only 3 full turns are then required to screw the full length of the implant into the bone.

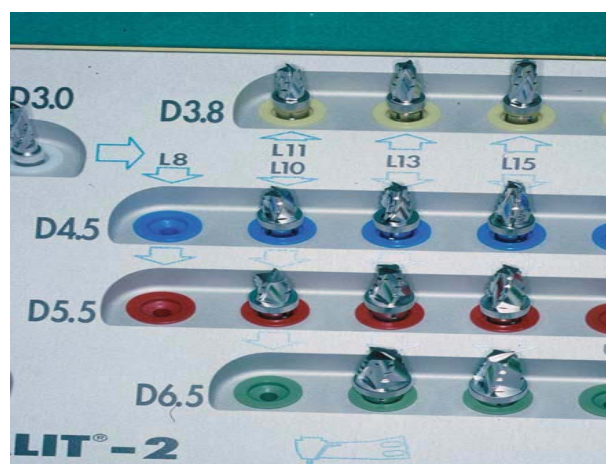
Various lengths and diameter of implants				
D	3.8mm	4.5mm	5.5mm	6.5mm
L		8mm	8mm	
	11mm	10mm	10mm	10mm
	13mm	13mm	13mm	13mm
	15mm	15mm	15mm	15mm

It is available in four diameter and five lengths. The implant length should exceed the length of natural tooth and draw on trabecular bone for amplification of Osseointegrated surface area.

Interior Design

An internal hex in the implant is designed to prevent rotation of the abutments and also to prevent gap formation at the implant - abutment interface.

- Blue : D 4.5
- Red : D 5.5
- Green : D 6.5.



The matched drills for the stepped Frialit 2 implants, with lengths of 8, 10, 11, 13 and 15 mm and diameters of 3.8, 4.5, 5.5 and 6.5 mm.

The IMZ System

The intramobile cylinder implant (IMZ) has been used clinically since 1974. The major difference between the IMZ system and all other relevant implant systems is that an elastic compensating component is inserted between the Osseointegrated implant and the prosthetic superstructure [5, 9].

The IMZ implant consists of two parts

- The implant body and
- Intramobile connector (IMC).
- The latter consists of titanium inserts and the intramobile element.

The elastic intramobile element is intended to assume the role of periodontal ligament of a natural tooth and provide shock absorption as well as force distribution, in order to prevent exceeding and adaptive tissue tolerance when chewing forces are applied. The slight mobility of the superstructure upon the intramobile element is also intended to prevent local overloading of the osseous bed during function and parafunction. The overall aim is a certain mobility of the superstructure, which is intended to dissipate and distribute forces. The purpose of titanium insert is to lengthen the implant beyond the gingiva after uncovering. Titanium inserts of 2 and 4 mm length are available for use with mucosa of varying thickness. Thus, the position of the intramobile element is always supragingival.

Once the titanium insert is anchored onto the implant body, only a tiny gap (3 micrometer) exists between the insert and the coronal border of the implant body. Because the insert is highly polished, good peri-implant hygiene is enhanced. A practical clinical advantage of the intramobile element is the minor imprecision of the metal prosthesis framework can be compensated by the elastic buffer component. The insert and the implant body consist of highly pure titanium. The implant is a cylinder with a half-spherical apex, rounded shape is intended to avoid stress peaks and overloading of the osseous bed in the apical region. Perforations through the base of the implant permit the in growth of bone in the apical region. Immediate stable anchorage of the implant in bone is achieved during surgery by means of the so called "press-fit" concept.

IMZ implants are available in two different diameters (3.3 and 4.0mm) and four different lengths (8, 10, 13,15mm). Furthermore, IMZ implants are available with two different surface coatings: Frios titanium plasma flame sprayed coating and Frios apatite coating (HA). The elastic intramobile elements consist of a titanium core coated with polyoxymethylene. The latter is characterized by favorable mechanical properties e.g. it is reported to maintain its dimensional stability in the oral milieu. The elastic component of the IMC is positioned in the conical orifice of the titanium insert. The cone angle of the IMC is 15° and permits up to 30° of correction for implant that is not perfectly parallel. The centre of rotation

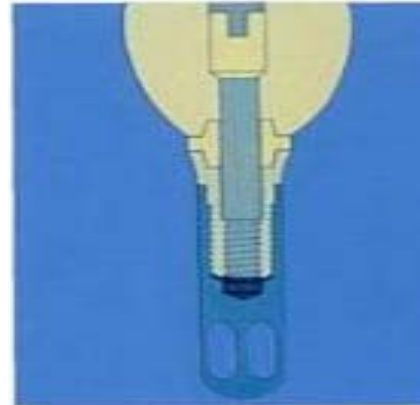
The proper concept for implant longevity was already in earlier days, thought to be related to Osseointegrated root form alloplastic elements. Dr. Kirsch ^[6] theorized that in order to restore lost natural tooth units, the bone, tooth and periodontal ligaments with ankylosed implant units required duplication in some capacity of the natural tooth unit. It was considered that if an ankylosed implant unit was splinted or fastened to a rigid fixed prostheses and attached to other natural movable, tooth units, one if not all of the following factors could be initiated.

1. Because of the high modulus of elasticity of the cement that helps to, secure the FPD to the natural tooth, cement bond could fail when stressed by the rigid, flexible combination; eventually micro movement of the retainer on the natural tooth could create micro trauma, resulting in complications to the natural tooth.
2. If the prostheses were exceptionally long, flexure of the metal substructure might result in the fracture of the ceramic veneer, if present.

3. Bone might resorb either around the implant, natural tooth or both.

Therefore the positioning of a shock absorbing, shock distributing mechanism between the ankylosed implant unit and the prosthesis was done. The material that was used was polyoxymethylene, commercially known as Delrin. The design of this component, the intra-mobile element (IME), is placed into the implant cylinder and is positioned between it and the final prosthesis.

The 2nd important factor for Osseointegration success is directly related to a 2 stage procedure. The basic atraumatic, congruent, precision, osseous, receptor site preparation as well as the initial primary stability constitutes the first stage. A 90 day stress free, non-functional healing phase is then initiated.



Schematic depiction of an IMZ implant with a single tooth crown screwed in place

The TPS Implant System

The greatest quality and quantity of residual bone is in the mandibular symphyseal region where it is devoid of vital structures. This fact was the basis for the development of TPS screw implant system by institute Straumann, Waldenberg, a Swiss International team for Implantology ^[7].

The TPS screws are indicated solely for placement in the mandibular symphysis, anterior to the region of mental foramina. The maximal bone space required to house the TPS implant is 6.0mm horizontally and 9-10 mm vertically. It is not indicated in cases where there are insufficient bone dimensions and where concomitant vestibuloplasty procedure is performed. In these cases two stage Osseointegrated implants would be indicated. Because this is a one-stage Osseointegrated procedure, vestibuloplasty is either extremely difficult or cannot be carried out at all. The use of 4 screws is indicated in this system so that distribution of the functional load is performed in a physiological manner. The guidelines for this system indicate that the screws should engage the inferior mandibular cortex without perforation of the inferior border. The 4 TPS screws are splinted together by means of a mesostructure. This is composed of 4 prefabricated gold telescopes soldered together with sections of a prefabricated Hader or Dolder type bar. This design creates a solid bar that is secured into position on the 4 abutment heads with four of the occlusal fastening screws of the system.

The final restoration is a complete lower removable prosthesis with internal clip fixation which provides the patient with a retentive element that has increased security and function.

The screw implant corresponds to the basic design of the Association of Osteosynthesis (AO) cortical traction screw. The material used is commercially pure Ti. The screw is coated with TPS layer. Plasma spray coatings promote direct

bone Osseointegration or bony ankylosis. This coating increases the surface area six- fold with a resultant increase of implant bone contact [8].

ITI Dental Implant System

The international team of implantologists (ITI) was established to develop endosseous implant systems to satisfy a variety of needs and application for the partially or totally edentulous patient.

The doctors of North Iowa Oral Surgery Associates P.C. utilize Straumann ITI dental implants. The ITI@DENTAL IMPLANT SYSTEM, developed and scientifically documented by the ITI and Straumann since 1974, is based on artificial roots which are firmly anchored in the jawbone to assume the function of natural roots for the fixing of crowns, bridges, or dental prostheses.

The ITI (International Team for Oral Implantology) Dental Implant System (Bone fit) employs titanium plasma-sprayed implants to permanently Osseointegrated into the human mandible and maxilla. These permanent implants are intended to support dental prostheses in fully and partially edentulous patients [9].

The ITI Hollow cylinder system is founded upon the following criteria for endosteal implants.

1. The use of high strength biocompatible material (pure Ti) with an optimal micromorphologic surface structure (sprayed Ti) features that guarantee direct bonding with the bone (i.e. ankylotic bond, osseointegration).
2. An implant design that 3-dimensionally transmits physiological loads with the smallest possible loss of bone.
3. Good primary stability achieved through precise fit of the implant in a congruent bone site produced with the aid of instruments designed for the purpose.
4. An operative technique that can be performed by any dentist qualified in oral surgery.
5. The possibility of building an uncomplicated suprastructure that can be maintained plaque-free by the patient.

The first hollow cylinder implants in 1974, already features fenestrations in deliberately chosen patterns. Bone grows through these perforations in the cylinder wall and within a short time bridges the gap between the bone stub in the cylinder lumen and the surrounding bone.

The Hollow cylinder as the basic construction unit [10]

There are several advantages to using the hollow cylinder implant technique.

1. **Large anchorage surface of the implant:** Hollow cylinder implants have much larger contact areas between implant and bone than do corresponding solid bodies therefore the specific area loading of bone by the implant is reduced.
2. **Minimal bone trauma in preparing the implant bed:** The bone defect created in preparing the implant bed is much smaller than that required for corresponding solid-body type for all types of implants, whether single or multiple cylinder.
3. **The smallest possible volume of the implant anchoring element:** The implant i.e., the foreign body volume is extremely modest. The implant is therefore better accepted and is better able to conform to elastic deformation of the jaw than a solid body.

4. **Implant stiffness approaching that of bone:** The functional loading of the jaw generates compressional and tensile forces that lead to a corresponding directionality of the trabeculae. Furthermore, it is known that the loads in the mandible generated by mastication require a considerable degree of flexible response from the bone. The open-cage-like shape of ITI hollow cylinder implants along with advantageous material and design properties ensures that these functional criteria are met exactly and that contact between bone tissue and implant surface is maintained or continually renewed under functional loading.

5. **Promotion of biologic integration:** The open implant form allows a favourable blood supply to develop promoting the regeneration of bony tissue, which quickly leads to bony lesion through the fenestrations between the bone stumps in the implant lumen and surrounding bone.

6. **Reduction of stresses between bone and implant:** Bone growth into and through the perforations with their systematic pattern acts as what can best be described as a shock absorber during physiologic loading of the implant; interfacial stresses between bone and implant surface are minimized. The danger of pressure- induced bone resorption after the initial healing phase is thus greatly reduced or even completely eliminated.

The Various ITI implant types

Type HC (Hollow Cylinder)

The basic form of the type HC implant is very similar to the first single hollow cylinder implant (Type C). The outer diameter of the Type HC implant is 3.5 mm. The anchorage surface is coated according to ITI principles with plasma-sprayed Ti. The perforations in the cylinder stop about 4mm below the bone surface when the cylinder is implanted. Primary stability, achieved by a slight positive press fit, promotes bony incorporation, which leads to an excellence and permanent secondary stability. The implant has a cylindrical post, which is highly polished in order to reduce the danger of plaque accumulation and to provide the most advantageous conditions for epithelial attachment. The edges of the Type HC implant are rounded to prevent local peak load induced bone resorption.

Type HS (Hollow Screw)

This is a variant of the Type HC implant. It has the same form with the addition of a spiral screws thread. Head and shoulder, size and pattern of the perforations and TPS coating of the anchorage region are all analogous to the type HC implants.



The complete system of seven types of ITI implants.

The Integral System

The integral System is a cylinder endosseous dental implant. The implant is made of titanium and is coated with a 75 micron layer of hydroxyapatite. It is this hydroxyapatite surface which differentiates the integral implant system from other commercially available systems^[11].

The integral implant system offers a series of hydroxyapatite-coated Ti root form dental implants. These cylindrical implants are available in diameters of 4mm or 3.25mm and lengths of 8, 10, 13 and 15 mm. A two-stage surgical technique is used to achieve bio-integration. Recently, a new type of implant was introduced called the integral Omniloc implant. The Omniloc implant is designed for the replacement of single missing teeth.

The integral implant system offers versatile prosthodontic options. As restoration can be made which is either cement retained or screw retained. The integral prosthetic line also features stud overdenture abutments. All integral abutments are offered with gingival cuff height of 2, 3, 4 or 8 mm^[9].

STERI-OSS System

The Steri-Oss dental implant system features a series of screw and cylindrical root form dental implants. Both series are available with the occlusal end either cylindrically shaped or externally hexed. The prosthetic abutments are either screwed to place or locked to the hex if anti rotational capabilities are necessary. Steri-Oss also offers a series of 2 stage submergible blade implants.

PME (Precision Margin Esthetics) Abutment^[12]

This is used on non-hexed implants. It is used to elevate the abutment/prosthesis interface from extremely subgingival to minimally subgingival or even supragingival, depending on the heights of the abutments used. PME abutments are available in 4 heights: 3, 4, 5, and 6 mm. The heights to be used are usually determined after the stage II surgery has healed and before the final impression is made. The abutment is screwed directly into the implant body. The fit of the abutment to the implant is checked with a periapical radiograph. The PME abutment is internally threaded to receive an implant coping, a temporary healing cap, or a coping series used to secure the prosthesis to the abutment.

Impressions are made using either an implant post or a screw retained implant coping with the impression pin technique. The impression is removed from the mouth and the impression pin is assembled to the PME analog and inserted into the impression prior to pouring the cast.

Screw retained implant copings require the use of an open-top impression tray so that the coping screw can be completely loosened before removing the impression from the mouth. The PME abutment analog is then secured to the coping prior to pouring the cast.

The prosthesis is fabricated using either a Pre-fabricated plastic coping or a Pd-Au alloy coping. The plastic coping is incorporated into the wax pattern, invested, burn out and cast in a noble or semi noble alloy. The Pd-Au alloy coping is incorporated into wax-pattern. However, the coping becomes a part of the final casting. This provides the clinician a mechanical fit to the PME abutment rather than a cast fit. The prosthesis fit is secured to the PME abutment with either a 1 mm, 10mm or 16mm coping screw.

The PME abutment is designed to be used for full arch restorations, screw-retained fixed bridgework and the tissue borne for overdenture retention. This abutment accommodates up to 40 degrees of nonparallelism.



PME abutments available in 3, 4, 5, and 6 mm heights. PME abutment healing caps are same height because depth is controlled by PME transmucosalabutments.

Conclusion

Patients who are totally edentulous and who have been doomed to discomfort, pain and dysfunction because of the inability to use complete dentures and preventing natural teeth preparation in fixed partial denture as a biologic consideration and maxillofacial defects have been rehabilitated using various implant systems. Implants should only be considered after exhaustive medical history taking and diagnostic wax-ups. A variety of prosthetic techniques can be employed to restore various forms of edentulism. The implant systems mentioned in this literature have been proved to be highly successful foundation to restore the patient to optimum function, comfort, esthetics and elevated patient's self-image.

The results, long-term follow up and survival rates are the only way in which one may evaluate an implant system. The tried and tested various implant systems have revolutionized the treatment options open to the prosthodontist. For the edentulous patient, particularly the maladaptive one, the prospects for a life time of restored oral comfort, function and appearance have now become predictable and reliable. For the prosthodontist, osseointegrated dental implants appear to provide scope for diversifying and enhancing treatment planning for partial/ completely edentulous and maxillofacial patients. The biological anchorage of tooth root analogues to replace missing teeth is finally tenable and the predicament of edentulism is bound to become a thing of the past.

Reference

1. Jokstad A, Braegger U, Brunski JB, Carr AB, Naert I, Wennerberg A. Quality of dental implants. *Int J Prosthodont.* 2004; 17:607-41.
2. Association report. Dental endosseous implants: an update. ADACouncil on Scientific Affairs. *J Am Dent Assoc.* 1996; 127:1238-39.
3. Association report. Dental endosseous implants: an update. ADACouncil on Scientific Affairs. *J Am Dent Assoc.* 2004; 135:92-97.
4. Adell R, Lekholm U, Rocker B, Branemark PI. A 15 year study of osseointegrated implants in the treatment of edentulous jaw. *Int J Oral Surg.* 1981; 10:387-416.
5. Osseointegration implant systems. In, Hobo S, Ichida E, Garcia LT (ed). *Osseointegration and occlusal rehabilitation.* Tokyo, Ikko Sasaki Publishers, 1996; 21-32.
6. Implant Systems. In, Spiekermann H, Donath K, Hassel T, Jovanovic S, Richter J (ed). *Color Atlas of Dental Medicine Implantology.* New York, Thieme medical

Publishers, 1995; 25-58.

7. Babbush CA. Titanium plasma spray screw implant system for reconstruction of the edentulous mandible. *Dent Clin North Am* 1986; 30:117-31.
8. Small IA. Survey of experiences with the mandibular staple bone plate. *J Oral Surg.* 1978; 36:604-605.
9. Sutter F, Schroeder A, Straumann F. Engineering and design aspects of ITI hollow basket implants. *J Oral Implantol.* 1983; 10(4):535-51.
10. Sutter F. The concept of ITI Implants. In, Schroeder, Sutter, Buser, Krekeler (ed). *Oral Implantology*, 2nd edition. New York, Thieme Medical Publishers, 1996; 114-44.
11. Clive Boner. Integral implant system. *J can Dent Assoc.* 1989; 55:475-76.
12. Rungcharassaeng K, Kan J. Substituting precision margin esthetics transmucosal abutments for healing abutments. *J Prosthet Dent.* 1999; 81:245-46.