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Exploring the latest advances in Dental Implant Technology: A Focus on India's growing market – A literature review

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Abstract

In order to support replacement teeth, dental implants are artificial tooth roots that are surgically inserted into the mandible. Because they offer a dependable method of replacing lost teeth, they have completely changed dentistry. Different implant designs, materials, and surface treatments are available to enhance bone integration and success rates. Titanium and its alloys find widespread application. A number of variables, including bone amount and quality, implant design, and surgical location, affect the outcome of implants. Certain implant kinds are needed for softer, less dense bone. The bonding of an implant to bone, or osseointegration, is essential for implant stability. It depends on the chemical makeup, surface characteristics, and bone healing. In India, there are numerous implant systems to choose from, including Nobel Biocare, Dentsply, Alpha Bio, Zimmer, Bicon,

BioHorizon, Osstem, Alfagate, Quickdent brands. There isn't enough proof to say that one brand is better than another. Because of their high quality, extensive product line, and osseointegration characteristics, Nobel Biocare implants are regarded as the gold standard. They are typically more expensive, though. The primary factors influencing the choice of implant brand are the patient's needs, physician experience, and cost. The most crucial system is the one that gives the particular patient the best results.

Keywords: Dental implant system, Osseointegration, Bone density.

Introduction

A dental implant is an artificial tooth root replacement that is placed surgically into the jaw bone to support a prosthetic device that replaces a missing tooth. Implants have revolutionized the field of dentistry by providing a reliable and successful way to replace missing teeth.[1-4] The success of an implant depends on its ability to integrate and bond with the surrounding jaw bone tissue. There are several factors that influence this integration, including the implant material, bone quality and quantity, and implant loading conditions.[3,4]

Implants have undergone various modifications to their design to improve safety, ease of surgical placement, functionality, resistance, esthetics, and overall success rate. Terminology used in implant dentistry includes osseointegration which refers to the bonding of implant material to living bone. A dental implant is also known as a fixture. The implant abutment connects the implant to the prosthetic tooth and can be temporary or permanent. An abutment screw is used to attach the abutment to the implant. Implant surgery can be single-stage or two-stage, depending on if the implant is left exposed or initially buried under gum tissue.[5]

History of implant

Over time, dental implantology has evolved from primitive attempts to replace missing teeth using materials like shells and animal teeth, to using various metal alloys and ceramics, and finally to today's highly reliable and predictable options.[6]

Some key milestones in the history of dental implants include:

• In 1913, Dr. Greenfield placed an iridio-platinum cylinder as an artificial root.[7]

• In the 1930s, brothers Drs. Alvin and Moses Strock experimented with Vitallium screw fixtures.[8]

• In the 1940s, Dr. Formiggini developed a spiral stainless steel implant design that allowed bone to grow into the metal.[9]

• In the 1970s, Dr. Brånemark presented a two-stage threaded titanium implant system and coined the term "osseointegration" to describe the bond between implant and bone.[10]

• In the 1980s, a variety of new implant designs and materials were developed, including hydroxyapatite coatings and titanium alloy implants.[11]

Overall, the evolution of dental implants has progressed from simple metal designs to advanced materials and surface treatments that allow for secure attachment and integration with bone.

Types of implants

The various ways in which dental implants can be classified. The main classifications are:[12]

1. Based on penetration into the tissues:

- Mucosal implants
- Subperiosteal implants
- Transosseous implants
- Endosseous root form implants
- Blade implants, pins, disk implants
- Endodontic implants.

2. Based on the macroscopic body design: This includes

- Cylindrical
- Screw-shaped
- Blade form
- Pin implants.

3. Based on the number of surgeries:

- Submerged/two-stage implants non-submerged/one-stage implants.

4. Based on the implant surface:

- Texture
- Roughness
- Chemical composition
- Energy/charge. Various processes like additive, subtraction, etching, and anodization are used to modify the surface.

5. Based on the implant-abutment interface:

- External hex
- Internal hex
- Cone screw, cone hex, cylinder hex, spline, cam
- Pin/slot.

6. Based on implant materials:

- Alloys
- Tantalum
- Ceramics like zirconia, polymers, and newer biomaterials.

7. Based on biologic response:

- Biotolerant
- Bioinert
- Bioactive.

8. Based on implant length: Short implants less than 10mm and conventional/wide diameter implants.

Bone classification and density

There are various classifications of bone resorption in edentulous jaws. Atwood classified the mandible into 6 classes based on the shape and height of the alveolar process after resorption.[13]Lekholm and Zarb further classified the degree of resorption into 5 classes (A to E) for both maxilla and mandible based on the condition of the alveolar ridge and base.[14] Another classification by Fallschussel described 5 classes of maxillary resorption based on the shape of the anterior segment.

The text also discusses the different types of bone quality according to Misch and Lekholm and Zarb. Misch classified bone into 4 types (D1 to D4) based on density,[15] while Lekholm and Zarb classified bone into 4 classes (I to IV) based on compactness. Softer and less dense bone requires longer implants, wider diameter, specialized implant design, and progressive loading for better results.

In summary, the classifications highlight the important role of bone resorption, density and quality in determining the appropriate implant therapy and prosthetic outcomes for edentulous patients. The softer and less dense the bone, the more considerations are needed in implant planning.

Osseointegration

Theosseointegration, A "direct structural and functional connection between the surface of a load-carrying implant and ordered, living bone."[16]The process by which dental implants bond with the bone. Upon implant placement, the bone healing response begins similar to a bone fracture. Osteoprogenitor cells are drawn to the implant site and begin differentiating into osteoblasts that produce new bone. If the implant surface is nontoxic, bone apposition will occur.[17]

Several factors influence osseointegration. Surface micro-roughness and free energy impact how cells attach to the implant. Chemical composition and rigidity also play a role. Initially, woven bone forms rapidly around the implant and is then gradually replaced by lamellar bone over months.[18]

Soft tissues also interface with the implant. The epithelium attaches to the implant through hemidesmosomes. The biologic width of connective tissue around implants is similar to that of natural teeth. However, differences exist as well. Implants lack a periodontal ligament and the connective tissue fibers do not embed in the implant surface. The vascular supply is also reduced due to the absence of periodontal ligament vessels.[19]

Dental implant system in India

There is various implant systems and their features.

- Many implant systems use titanium or titanium alloy as the main material due to its biocompatibility and strength. Some use a TiUnite or SLA surface coating to enhance osseointegration.Implants come in different shapes like tapered, cylindrical, conical, etc. Some have a threaded body while others are threadless.
- Implants can be self-tapping or require separate drilling. They are available in one-stage or two-stage options.Implant diameters typically range from 2.5 mm to 6 mm while lengths range from 6 mm to 20 mm or more. Wider and longer implants provide more stability but may require bone grafting.
- Implant systems offer a variety of abutments for different restorative needs like cement-retained, screw-retained, angled, etc. Some come with a pre-mounted abutment.Implant surfaces like Laser-Lok microchannels, bioactive coatings and SLA surfaces can enhance soft tissue integration and osseointegration.Short implants, narrow diameter implants and platform switching designs can provide esthetic results and work for narrow ridges.
- All major implant brands like Nobel Biocare, Dentsply, Zimmer, Biohorizons etc. are considered acceptable options.

Nobel Biocare dental implant system

- Nobel Biocare is credited as the company that started it all by commercializing Dr. Brånemark's work. It offers a complete implant solution. However, it may be more expensive.

Various implant systems offered by Nobel Biocare, including NobelActive implants, Replace Select implants, Nobel Replace implants, Nobel Perfect implants, NobelDirect implants, Brånemark MKIV implants, and Nobel Speedy implants.

Some of the key features shared across many of the implant systems are:

They are made of TiUnite material, a titanium dioxide surface that enhances osseointegration.They are offered in various shapes, including tapered, threaded, and straight. They offer both one and two-stage implant options.They provide a wide range of abutments and restorative options for single tooth implants to full arch implant restorations.

The benefits, indications for use, and key features of each individual implant system. The NobelActive implants, for example, aim to more closely resemble the natural tooth root shape to provide better esthetics. The Nobel Speedy implants are designed for increased initial stability in soft bone.

Nobel Active implants

Dentsply implant system

- Dentsply implants like Ankyloses, Friadent and XiVE provide good functional and esthetic results for different indications. The DENTSPLY IMPLANT SYSTEM, including the Friadent, ANKYLOS and XiVE implant systems. Some key points:
- The Friadent implant system uses a micro-retentive grit blasted and acid etched titanium surface. It has a root-analog stepped design to preserve the interproximal space and papilla. The implants come in various lengths from 8 to 15mm and widths from 3.4 to 6.5mm. They have a stepped cylindrical design for poor bone quality.
- The system includes a variety of abutments and prosthetic components to provide different prosthetic solutions.The ANKYLOS implants are made of pure titanium and have a tapered shape. They come in lengths from 8 to 17mm and widths from 3.5 to 5.5mm.
- The ANKYLOS system design focuses on the implant threads, load, conical connection and biological width. It also offers various types of abutments. The XiVE implant system focuses on surgical flexibility, prosthetic variety and high primary stability in all bone classes. It offers innovative prosthetics like CERCON abutments for esthetics.

ANKYLOS Implant FRIALIT Implant XiVE Implant

Bicon implant system

Bicon implants are simple to use but have limited prosthetic components. The key details about the Bicon Short Implant System are:

Bicon implants have a unique pleatue design that allows for the use of short implants. Their locking taper connection provides 360 degrees of universal abutment positioning, offering restorative flexibility.Short implants between 4.5mm to 6mm in width and 5.7mm to 8mm in length are available. These shorter implants help avoid vital structures, minimize bone grafting, and increase patient acceptance.

The 4.5mm by 6mm implant offers an option for situations where a wider implant is not possible. The 6mm length avoids the need for grafts.The implants come in Integra-Ti, a grit-blasted and passivated titanium surface, or with hydroxyapatite coating for poorer bone quality.

Transitional, o-ring, and orthodontic implants are also available.A variety of abutments are offered including non-shouldered, stealth shouldered, stealth transitional, temporary, healing, Brevis, Locator, bar, and fixed-detachable abutments.

That covers the key details about the Bicon Short Implant System, including its design features, implant sizes and options, surface treatments, and abutment choices.

Bicon Implant

Alpha-bio implant system

Alpha-Bio implants come in different designs to suit different bone types and indications. The Alpha Bio Implant System, which consists of several implant systems. The main advantages of the implant system include early bone to implant contact, increased primary stability, shortened healing period, higher predictability, and reduced risk for immediate loading.

There are 5 implant systems within the Alpha Bio Implant System:

- SFB implants are internal hex implants with 2.5mm diameter. They have a conical design for more bone and soft tissue around the implant head. They are self-tapping and available in various diameters and lengths.
- SPI implants are also internal hex implants with 2.5mm diameter and are designed for immediate loading. They have a tapered design and double threads.
- DFI implants are also internal hex implants with 2.5mm diameter and are designed for conventional implantation. They have variable threads and are available in various diameters and lengths.
- ATDI implants are straight walled implants with double threads. They are self-tapping and self-drilling and available in various diameters and lengths.
- The Arrow Press implant systems, including ARRP, ARPB, ARRC, ARR and ARB implants. They have features like tapered designs, one-stage implantation, and self-tapping. They are available in various diameters and lengths.

Alpha Bio Implant

Zimmer implant system

- Zimmer implants like Tapered Screw-Vent and Advent offer versatility for any indication but may be expensive. It has several types of implants, including TSV family implants, Tapered Swiss Plus implants, Spline implants, and Swiss Plus implants.

The TSV family implants feature an internal hex platform to reduce stress on the bone and resist abutment screw loosening. They come in one-piece and screw vent designs. Prosthetic options for TSV implants include contour abutments, ceramic abutments, angled abutments, gold abutments, ceramic components, and overdenture attachments. TSV implants come in one and two stage versions with tapered bodies and multi-lead threads. They can be used for immediate and conventional loading in both jaws for different prosthetic applications.

The Zimmer one-piece implant which combines the design of TSV implants with the prepared margins of the Hex-Lock Contour Abutment. It offers benefits like fast restoration, minimal abutment preparation, and snap-on impression caps. Healing caps and contour components are available in various sizes and angled versions. The one-piece implant comes in 3.0mm and 3.7mm/4.7mm sizes for different tooth locations.

The Zimmer Dental Implant System offers different types of implants with various prosthetic options and features to provide flexible solutions for dental implant restorations.

Zimmer Implant

Bio Horizons implant system

BioHorizons implants are based on Dr. Misch's philosophy but lack proven superiority.

The tapered internal implants feature laser micro channels and patented reverse buttress threads on a tapered body. The internal hex connection allows for a wide range of restorative products. The laser micro channels of 8 to 12 microns have been shown in studies to improve soft tissue integration, control cell growth, increase bone and tissue attachment, and reduce bone loss.

The single-stage implants combine the features of their two-stage implants into one designed for one-stage surgical procedures. They feature snap impression restorative options that allow for cement-retained restorations in minimal visits.

The internal implants come with a pre-mounted 3inOne abutment at no extra cost. This abutment can be used as a surgical drive, impression component, and final abutment, saving time and money.

The external implants also come with the 3inOne abutment, which similarly saves time and money. A variety of abutment options are available. The one-piece 3.0 implant is designed for placing implants in tight spaces, for treating lateral and incisor teeth. It has a one-piece construction with no extra components needed.

The overdenture implants are packaged with all required attachments, providing maximum simplicity for restoring dentures.

Osstem implant system

The Osstem implant system which has the following features:

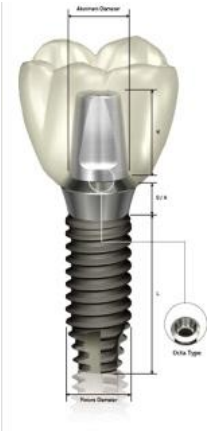
The implant surface is called RBM which uses HA powder for outstanding biocompatibility. The surface roughness ranges from 1.2 to 1.8 microns, allowing for optimal surface roughness. The system maintains cleanliness.

The different types of Osstem implants:

SS System - for non-submerged implants using internal octa and morse taper methods. It has stable connection and can be used for various bone qualities.

GS System - for submerged implants. It uses oxidized cell nest material and has dual thread design for minimizing bone resorption and optimal stress distribution.

The MS System comes in 3 types for narrow ridges, provisional use and dentures.

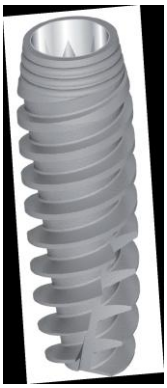


Osstem Implant

Adin dental implant system

Adin Dental. Here are the key details:

- The Adin Dental Implant System (TOUAREG) is made of TiUnite, a highly crystalline and phosphate-enriched titanium dioxide. It has a tip and thread design and can be inserted manually.
- The Touareg-S implant is designed for close sinus lifts. It has a round apex shape that pushes bone grafts with minimal harm.
- The Swell implant is straight, parallel-walled and slightly tapered with V-shape threads. Its design allows for accurate positioning for improved esthetics.
- The One implant system is a tapered core spiral implant that is intended to be as easy to use as regular crown and bridge dentistry. It offers a straightforward drill protocol and is suitable for narrow places.



Adin Implant

Alfa gate implant system

Alfa gate is an implant system that offers various implant types made from titanium alloy. The implant types include bioactive implants, trio implants, max implants, porous implants, S-line implants, M+ implants, and Patro implants. The implants have features like internal hex for anti-rotation, tip and thread design, self-tapping, and one or two-stage protocols. They provide high initial stability and can be used for both single and multiple restorations.

The bioactive implants have a calcium phosphate coating that promotes faster healing. The trio implants have micro rings that enhance bone formation. The max implants have a combined conical and cylindrical shape. The porous implants have a domed apex for safer placement. The S-line implants come in a narrow diameter for thin ridges. The M+ implants have a conical connection and are suitable for soft bone. The Patro implants have a flexible neck design for angled placement.

In summary, Alfa gate offers a wide range of titanium implants with different shapes, coatings, and features to suit various clinical needs and indications. The implants aim to provide high initial stability, promote bone healing, and enable both immediate and delayed loading protocols.

Alfa gate Trio implant

Quick dent implant system

Quickdent implants come in various types for different needs and provide good stability.

Quickdent implant system has various implant designs for different clinical indications. The key features are:

The implants are made of titanium alloy and have conical body shapes. They are self-tapping implants available in one and two stage options. They provide high initial stability due to the threads and tapered design.

The implants come in various lengths and widths depending on the design. Internal cooling is provided

during drilling to prevent heat necrosis of bone. Abutments with tri-channel connection are available for healing, esthetic and temporary restorations.

The threads and tapered design help the implants to cut through cortical bone and compress the cancellous bone, providing stability. The implants are indicated for sinus lift procedures, single tooth replacement and immediate loading cases.

In summary, Quickdent implant system offers a wide range of implant designs with features to provide initial stability, suitable for various clinical situations. The system aims to make the implant placement and restorative procedures faster and easier for the clinician.

In summary, there is no definitive evidence that any particular brand of implant is superior. Selection depends on factors like cost, physician experience and patient requirements.

Quickdent OSSI classic (IH)

Conclusion

There is different dental implant brands in India. It mentions that currently, there is no evidence that any implant brand offers significant advantages in terms of patient outcomes. However, the preference for Nobel Bio care implants due to their high quality, wide range of products, osseointegration properties, tissue tolerance and esthetics.

The text discusses and compares various dental implant systems and their features. Here are the key points:

Many implant systems use titanium as the main material due to its biocompatibility and strength. Implants come in different shapes and sizes to suit different needs. They offer options for one-stage or two-stage implantation.

Implant systems provide a variety of abutments and restorative options. Some implants have surface coatings or microchannels to enhance osseointegration and soft tissue integration. Short implants and platform switching designs provide esthetic results.

Popular implant brands like Nobel Biocare, Dentsply, Zimmer and BioHorizons offer different implant systems with features aiming to provide initial stability, promote bone healing and enable immediate and delayed loading.

Each implant system has its own advantages and disadvantages. There is no definitive evidence that any particular brand is superior. Selection depends on factors like cost, physician experience and patient requirements.

In summary, the key considerations when choosing an implant system include the material, design features, prosthetic options, surface treatments, cost and physician experience with the system. The goal is to select an implant that meets the clinical needs and indications for each patient.

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