

Dental Implants

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Abstract:

Dental implants are becoming a common practice in the field of dentistry. There has been extensive research in this field, and efforts are being made to improve quality while minimizing costs. A comprehensive study was conducted on diverse dental implants, their design procedures, manufacturing methods using additive manufacturing, and materials as well as future developments. The following types of dental implants were discussed: Single Tooth Dental Implant, Implant-Supported Bridge, Implant-Retained Denture. For the design and force analysis, Mastication and occlusion processes were the focus of the study. The materials that are used for manufacturing these implants were also discussed. Since additive manufacturing is currently a leading manufacturing technology, various methods of manufacturing these implants using additive manufacturing have been studied and discussed. Furthermore, future research and development efforts within the dental implant industry were discussed.

Keywords: Dental Implants, Wisdom Teeth Removal, Dental Hygienist.

Introduction:

A dental implant is one of the treatments to replace missing teeth. Their use in the treatment of complete and partial edentulism has become an integral treatment modality in dentistry. Dental implants have a number of advantages over conventional fixed partial denture.

1. A high success rate (above 97% for 10 years)
2. A decreased risk of caries and endodontic problems of adjacent teeth
3. Improved maintenance of bone in edentulous site
4. Decreased sensitivity of adjacent teeth

A dental implant is a structure made of alloplastic materials implanted into the oral tissues beneath the mucosa and/or periosteum and/or within or through the bone to provide retention and support for a fixed or removable dental prosthesis.

Implant dentistry the second oldest dental profession; exodontia (oral surgery) is the oldest. Around 600 AD, the Mayan population used pieces of shells as implants to replace mandibular teeth. In 1809, J. Maggiolo inserted a gold implant tube into a fresh extraction site. In 1930, the Strock brothers used Vitallium screws to replace missing teeth. A post-type endosseous implant was developed by Formiggini (the father of modern implantology) and Zepponi in the 1940s. The subperiosteal implant was developed in the 1940s by Dahl in Sweden. In 1946 Strock designed a two-stage screw implant that was inserted without a permucosal post. The abutment post and individual crown were added after this implant

completely healed. The desired implant interface at this time was described as ankylosis. In 1967, Dr. Linkow introduced blade implants, now recognized as endosseous implants. Dental implants became a scientific cornerstone after the serendipitous invention of Dr. Branemark who helped in the evolution of the concept of osseointegration (direct, rigid attachment of the implant to the bone without any intervening tissue in between two implants) [1][2][3].

Dental implants are a structure used to replace missing teeth. They have been used in the dental industry for over 50 years now [1]. Over the years, there have been several modifications to the design of a dental implant to make it safe to use, make the surgical procedure to install the implant easier, and make the implant aesthetically and functionally apt. A dental implant must comply with certain characteristics before it can be used: [1].

- **Functionality:** The implant must help in chewing food particles just like a tooth would do.
- **Resistance:** The implant must have enough structural strength to withstand the biting load, and the liquids present in the mouth.
- **Safety:** The implant must use materials that are biocompatible and do not harm the oral environment in any way. The implant should not have sharp edges which may be harmful.
- **Aesthetics:** The implant should closely resemble the natural tooth, and should not disturb the facial profile of the patient.

Over time, a lot of innovation and research has taken place in the area of dental prosthetics. There has been an evolution in the materials that have been used, initially starting with metals and gradually advancing to advanced ceramics, resins, and other heterogeneous materials [1]. Similar to the advancement in the materials used for dental prosthetics, manufacturing methods have also been developed to become more accurate, safe, and efficient. Traditional methods like wax casting have been made for additive manufacturing techniques [1]. These methods rely on optical scanners and other scanning technologies which capture the topology of the required tooth to be printed [2]. Some of the more common additive manufacturing techniques include stereolithography, digital light processing, and material jetting [2]. This paper reviews the types of dental implants, the materials required to manufacture dental implants, additive manufacturing techniques, and the future scope in this area.

Anatomy and Physiology:

A proper knowledge of anatomical landmarks and its variations prior to implant placement is indispensable to ensure a precise surgical procedure and safeguard the patient against iatrogenic complications. The precise evaluation of distinct anatomical factors such as the position of the mandibular canal, maxillary sinus, the width of the cortical plates, the existing bone density, etc. is very important in appropriate implant selection and planning the most appropriate implant position in the existing clinical condition. Important anatomical structures in the maxilla are a nasal floor, nasopalatine canal anteriorly and maxillary sinus posteriorly. Iatrogenic sinus perforation is commonly encountered complication. This problem can be taken care of by selection of short implants and Sinus lift and bone augmentation procedure.

The most important anatomical consideration while placing an implant in the mandibular arch is the location of the inferior alveolar canal which contains inferior alveolar nerve and artery. Injury to these

vital structures during implant placement can cause pain, altered sensation, excessive bleeding, etc. Hence it is important to determine the location as well as the configuration of the mandibular canal prior to implant placement[4][5].

Dental Implant Surgery for Beginners



Dental Implants have revolutionized the fields of prosthodontic and cosmetic dentistry since they were first introduced. Prior to this technology, people relied entirely on complete dentures, partial dentures and bridges to replace missing teeth in their oral cavity. While these treatments may have restored function and aesthetics to some degree, Dental Implants opened up a whole different world of possibilities.

An implant is made up of two or three components depending upon the system/manufacturing company. However, the main parts include the Crown, which replaces the once visible portion of the natural tooth, and the Implant, which takes the place of the root. Prior to the surgery, the patient is given anaesthesia to eliminate any chances of discomfort and pain. An incision is made on the ridge, and through this incision, the Implant is drilled deep below the gum. Underneath the gum, this Implant undergoes a process known as Osseo-Integration, whereby it fuses with the surrounding jaw bone. This fusion gives a strong anchor, or foundation to the whole Implant. A Crown is then fabricated using Porcelain, which matches the colour and contour of the natural teeth in the oral cavity. It is then placed atop the Implant. This procedure may take up to two or three appointments to complete.

While the surgery may seem invasive, new systems and instruments have considerably reduced chair-time for patients, and the procedure relatively simple for dental surgeons. Bone grafting procedures have made it possible for patients with inadequate bone to also get implants for the replacement of a single tooth, or multiple missing teeth. Additionally, all leading dental surgeons offer consultation sessions to patients in order to address any concerns or queries they may have prior to the procedure.

Dental Implants, typically fabricated using Porcelain and Titanium, offer countless advantages in dental

restorative as well as cosmetic aspects. They are 100% biocompatible, non-toxic, non-allergenic, and non-irritant to the oral mucosa. They are much easier to maintain and clean, as compared to dentures and bridges. They restore a patient's ability to bite, chew, speak and smile properly without ever having to worry about adhesives, displacement issues, or secondary infections as long as they maintain good oral hygiene.

At DentSpa, we offer single implants, as well as multiple implants designed to support complete dentures. If you have been experiencing problems because of missing teeth and wish to have them restored in the best possible way, give us a call to book an appointment with the leading implant specialists in Turkey today!

Types of Dental Implants:

Dental implants are small posts that are attached to your jaw and stand in for the root of a tooth. They fuse to new replacement teeth with a connector, or abutment. Most dental implants are made of titanium. There are different types of dental implants and procedures. Your doctor will help you choose which may be best for you.

Single Implants vs. Multiple Implants:

Dental implants can replace one tooth or many teeth. Here are your options.

Single-tooth implant: If you have one tooth that needs to be replaced, your doctor will do a single-tooth implant, then put in a single replacement tooth or crown.

Multiple-tooth implant: If you have a few teeth missing, your doctor may do a multiple-tooth implant with custom-made replacement teeth.

Full-mouth implant. If you don't have any teeth, your doctor may do a full-mouth dental implant.

Basic Types of Implants:

The most common types of dental implants are endosteal and subperiosteal implants. The main difference is how they're attached to your jawbone.

1. Endosteal implants



This is the most common type of dental implant. It's shaped like a small screw, cylinder, or blade. It goes in your jawbone and holds one or more replacement teeth, which are also called prosthetic teeth.

Your doctor may recommend an endosteal implant if you already have dentures or bridges.

2. Subperiosteal implants



This type of implant is placed on or above your jawbone. It's a metal post that's put under your gum and sticks through your gum to hold it in place.

You may get a subperiosteal implant if you can't wear regular dentures, you don't have enough natural jawbone to hold an endosteal implant, or you don't want to do a bone augmentation procedure to build up the bone.

3. All-on-4 Dental Implants



All-on-4 dental implants are often a viable option for adults who want to avoid dentures. A small titanium screw is placed into your jaw which replaces the root of the missing tooth. This requires a small surgery. Once that is done, a crown is connected, with the end result being a very real looking and functional tooth. They're known as all-on-4 as implants as 4 implants are used per jaw.

4. Implant Overdentures

As long as you're healthy enough for tooth extraction, implant overdentures are a great alternative to traditional dentures. Overdentures are placed on top of implants which can add stability when compared to traditional dentures. The benefits of overdentures often include an easier time chewing foods, improved speech, minimized discomfort, no more denture adhesives and often existing dentures can be used.

Implant Supported Bridges:

Implant supported bridges are a good option when one or more teeth are missing, if you don't have enough jawbone to support an implant, or if a nerve is nearby. Implant supported bridges have three pieces.

- The implant
- The abutment
- The restoration

The good news is that this dental implant can reduce pressure on your individual implant caused by grinding your teeth.

As for a timeline for implant supported bridges, your experience will begin with an initial consultation which will include x-rays, dental history, taking impressions, and possible CT scan if multiple teeth are missing. This will be followed by the first surgery. Once the implant is healed, a second surgery will follow where a small incision is made and is a simpler surgery than the first. The fourth step is the restoration stage and at the final visit a permanent bridge will be attached.

Indications

1. Partial edentulous patients who have intermediate gaps or free-end edentulism (Kennedy class 1).
2. When a patient is not satisfied with the existing unstable and nonretentive conventional complete dental prosthesis.
3. To preserve existing removable partial prostheses.[6][7].

Contraindications

Absolute Contraindication

Acute illness, the magnitude of defect or anomaly, uncontrolled metabolic disease, bone or soft tissue pathology/infection

Relative Contraindications

Diabetes, osteoporosis, parafunctional habits, HIV, AIDS, bisphosphonate usage, chemotherapy, irradiation of head and neck, behavioral, neurogenic, psychosocial, psychiatric disorders[6][8][9]

Preparation:

The implant placement should be restoration driven to fulfill the patient's goals. The prosthesis should be designed first, similar to the architect designing a building before making the foundation. Only after the prosthesis is created can the abutments, implant bodies, and available bone requirements be determined to support the specifically predetermined restoration.

The patient is medically evaluated for cardiovascular diseases (hypertension, congestive heart failure, subacute bacterial endocarditis, etc.), endocrine disorders (diabetes mellitus, thyroid disorders, etc.), pregnancy, blood disorders, and bone diseases, etc.[8][6]

Comprehensive and accurate radiographic assessment provides all necessary surgical and prosthetic information required for the success of the venture. Various types of imaging modalities are used for dental implant imaging:

- Periapical radiography
- Panoramic radiography
- Occlusal radiography
- Cephalometric radiography
- Computed tomography (medical CT and cone beam CT)
- Interactive CT
- CBCT has a great role in dental applications.

Surgical preparation in a standard sterile fashion is recommended for all implant procedures. The goal is to minimize mechanical and thermal injuries to the bone. Osteotomies should be completed under copious cool saline using sharp and new osteotomy drills at high torque and slow speed. Incremental drill sequence should be followed. During an osteotomy, the bone temperature should not exceed 47 degrees to avoid irreversible changes. Bone necrosis and failure of integration can occur when the temperature exceeds 47 degrees C. D1 bone presents the highest risk of overheating.[12][13][14]

Technique or Treatment :

Surgical protocols: There are three surgical approaches which are in use over the years: (1) two-stage (2) one-stage, and (3) immediate-loading. The two-stage surgical procedure first places the implant body below the soft tissue until the bone begins to heal (usually 2 to 3 months for mandible and 3 to 6 for maxilla). During the second stage of surgery, soft tissues are reflected to attach a perimucosal element or abutment. In one-stage surgical approach, the implant body in the bone and the perimucosal element above the soft tissue are both placed simultaneously until initial bone maturation has occurred. The abutment of the implant then replaces the perimucosal element without the need for a secondary soft tissue surgery. The immediate-restoration approach places the implant body and the prosthetic abutment at the initial surgery, and restoration (mostly transitional) is then attached to the abutment.

Complications:

Various complications and problems can be encountered during surgery and postoperatively. Perforated buccal or lingual plates can be seen during the procedure. In case of an elliptical /eccentric preparation, a wider implant can be used if possible. If not, pack the osteotomy with autogenous graft, compress it, and place implant again. Bleeding in the floor of the mouth can occur from the lingual artery or facial artery injury. So absolute care has to be taken during osteotomy preparation. Nerve injury can lead to altered nerve sensation in the form of anesthesia, paresthesia or hyperesthesia. Consequently, the surgical landmark is often set conservatively 2mm above the mandibular canal.

The most common postoperative complication is incision line opening. The design of the removable interim prosthesis is involved, it is corrected. The patient is instructed to rinse 2-3 times daily with chlorhexidine. If granulation process extends for more than two weeks, epithelial margin trimming can be done. If implants become exposed during the healing period, no attempt should be made to cover them with tissue. Rather denture is relieved aggressively over the area with implant exposure. The mobility of the implant during healing is unusual but may occur, mostly accompanied by a radiolucent zone around the implant. Whatever may be the cause, the implant should be removed. Signs and symptoms of failure for an implant are horizontal mobility greater than 0.5 mm, rapid progressive bone loss, pain during

percussion, uncontrolled exudate, generalized radiolucency around the implant, more than one half of the bone is lost around the implant and last the implants inserted in poor position, making them useless for prosthetic support. A success rate of 85% at the end of 5 year period and 80% at the end of 10 year period are minimum criteria for success.

Clinical Significance:

The goal of modern dentistry is to restore the patient to normal profile, function, comfort, esthetics, speech, and health regardless of the atrophy, disease, or injury of the stomatognathic system.

People are living longer on average. This fact, combined with an existing population of patients with minor and major dental problems, guarantees the future of implant dentistry for several generations of dentists. Dental implants are increasingly used to replace single teeth, especially in the posterior regions of the mouth. Rather than removing sound tooth structure and crowning two or more teeth, increasing the risk of decay, endodontic therapy, and splinting teeth together with pontics, which may have the potential to decrease oral hygiene ability and increase plaque retention, a dental implant may replace the single tooth. Organized dentistry has finally accepted implant dentistry. The current trend to expand the use of implant dentistry will continue until every restorative practice uses this modality for abutment support of both fixed and removable prostheses on a regular basis as the primary option for all tooth replacements.

Conclusion:

The review presented in this paper provides a holistic view of the development of dental implants. It classifies the types of dental implants and their application in different situations. It gives an insight on the different aspects that determine the quality, efficiency, and strength of a dental implant like material and manufacturing processes.

There are numerous efforts being made to make the materials for dental implants stronger while maintaining their biocompatibility. While the newer

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