# ORTHOPEDIC BODY IMPLANTS: A REVIEW

**Ravinder Pal Singh[a*], Vaidehi Katoch[b]**

[a]School of Mechanical Engineering, Lovely Professional University, Punjab, India

[a]School of Biosciences and Bioengineering, Lovely Professional University, Punjab, India

**Abstract**

The interest in sports, defense services, self-operating machines, racing motorcycles and cars has been increased over the past couple of decades. This resulted in the amplification of road traffic and also in the occurrence of accidents which, in turn, resulted in damage / loss of limbs or loss of countless lives. It inevitably caused people to opt for orthopedic implants. This review presents the introduction, applications and various factors detrimental to contemporary orthopedic implants.

**Keywords: Implants, Orthopedics, Bone, *In-vitro*,**

## 1. Introduction

The human body is a biomechanical system made up of various bonds that produce relative movements. In the event of body damage, metals / alloys can therefore serve as replacements and can help individuals to do their routine work effectively.

Metals / alloys for orthopedic applications in the human body are called orthopedic body implants. Once implanted into the body, these devices are considered implants and are significant length and prothesized when permanently attached to a short-term use for the person until the end of life. In particular, the skeletal structure of human body consists of orthopedic implant devices which help to healed, correct anomalies and remove the functions of the current component. It contains bone blocks support, pins, minimal oblique muscles, knees and hips, knee joint, arm joints, and tendon or ligament modifications.

**(a) Knee and hip implant components**

**(b) Orthopedic hip replacement implant**

**(c) Hip and knee joint implants** **(d) Bone fixing plates**

**Figure 1 (e). Stainless steel bone fracture fixation plate and screw**

Orthopedic body implants comprise biomaterials used to produce applications that intermingle with limited losses over speedy operating cycles and communicate with biological processes. Williams (1981) describes the' unviable components' of these materials to be used in medicinal products intended to interfere in biological processes. The components of skeletonal muscles such as cartilage, muscles, tendons and zinc have to be reconstructed, removed or raised.

## 2. Detrimental factors affecting performance implant materials

In microbial complex, human body condition is continuously introduced and leads to wear, tear and degradation, thus premature degradation from the body. The efficiency of implant products subjected to a set dynamic environment, according to the procedure of the user, depends on a number of adverse factors.

### 2.1. Physical stresses exerted on the implant

Implants have both static and dynamic loads depending on the procedure of the patient. The broken bone is placed into a patient's body, powerful enough to endure and ease the pressure as the joint and muscle motions.

### 2.2. Mechanical damages on implants' surface

#### 2.2.1. Biological climate

For chemicals and metals with a salt content of around 0.9% at 7.4 Acids and a level of 37 Celsius in an oxygenated solution for saline, the body is a hard world. At some finite rate, the chemical or electromagnetic dissolution of all the metal implant components, including some of the most corrosion-proof material.

#### 2.2.2. Tissue- implant corrosion

Contact with the material and tissues is of primary importance in contrast with dangerous conditions. Such interactions allow the embedded instrument to be corrosive / ionized. The impacts are two-fold. A sudden and unexpected decrease in weakening of implant. Other is the cell reaction that contributes to corrosive compounds that contribute to local and systemic infections in implants. In natural conditions, the magnetic foil is completely immune to corrosion / ionization.

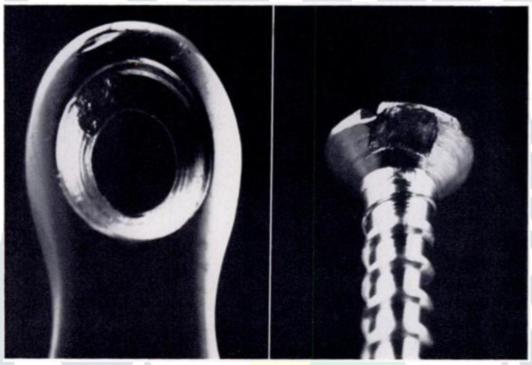

**Figure 2. Head of screw and corresponding hole in plate to show face corrosion**

#### 2.2.3. Wear

Wear is mechanical displacement during the relative transfer phase of products between two or more contact surfaces.

#### 2.2.4. Biocompatibility

The basic requirement of the biomaterial of an orthopedic implant is that the substance or tissue Structure of the body that coexist without any unintentional or adverse result, called biocompatibility of the implant. The biocompatibility factors for implants are,

#### 2.2.4.1 Materials for Orthopedic Application

Over the last quarter of a century, orthopedic innovations boost the standard of living of millions of people. The medical goal is to relieve and strengthen the function of the joint. The engineering goal is to reduce the physiological stress on the remaining bone structure so that the bone and prosthetics stay long-lasting and durable. When transplanting materials are embraced by the organism and capable of dealing with tensile stress in the body's hostile world.

- **Ceramics**- Inorganic compounds are in oil, alumina, zirconia and the phosphate in calcium. Such materials ' limitations are their low tensile strength and crack fracture tolerance.
- **Polymers**- Implants in various forms are recognised for their resemblance to components of polymer cells, such as fibres, textiles, rods and viscous liquids. However, this was degraded by biochemical and mechanical influences in the body.
- **Composites**- These are products produced in every part from the incorporation of materials with the direction to advance the functionality. Composites widely used for biomedical uses of fiber-reinforced polymers (FRP). Their weak mechanical abilities restrict their requirements and their uncertain life / decay under dynamic stress conditions.
- **Metals and alloys**- Wide range covers fracturing fixation systems, selective and absolute joint replacement, exterior flaps, braces. Metals susceptible to chemical and electrochemical degradation considering their high strength and toughness. They can corrode, cause waste generation to pierce, ultimately exacerbate life and cause local and systemically biological responses.
- **Metallic implant materials commonly used**- Metals and alloys are commonly used in different forms as they facilitate the necessary biocompatibility, toughness and corrosion resistance. This includes typically of products such as austenitic quartz, cobalt chrome alloys, titanium and its alloys.

### 2.3. Surface alteration of the orthopedic implants

The best way to achieve biocompatibility is to change the surface through protective bio-ceramic coatings. They are dense, with similar constituents and morphology as inorganic bone compounds, based on calcium phosphate. The essential component of different ceramic calcium phosphate ceramics is Hydroxyapatite Ca10 (PO4)6(OH)2(HAP). It is the versatile implantation material because it has bone mineral resemblances and is able to bond with bones. These products are characterized by their solubility that allows the bone around them to be tightly connected to the implant. Such products are mainly limited by their small weights, meaning that they can only be used as bulk parts for low charge applications.

### 2.4. Ionic device

Include the study in the surface material with a neutron high-speed ion beam without altering the mass properties of a specific component that are independent of thermodynamic restrictions. Properties such as strength, tolerance to rust, wear; increased biocompatibility without changing the material's bulk properties. Implanting of nitrogen ions is a suitable method of biomedicine between the different implanted ions.

### 2.5. Emerging areas of research in implant development

In the medical and engineering environment, the creation of biocompatible implants is the main concern. Different work areas have been established in the production of biocompatible implants:

#### 2.5.1. Tough coatings for orthopedic implants

The technical drawback of the surface alteration is its small penetration range (0.1 to 0.3 microns). Techniques of recent development, the development of alloy surface design, the application of diamonds-like carbon layers (DLC) on Ti alloy substrates on the purest Ti side, accompanied by HAP layer and the HAP implantation on the pure Ti surface.

#### 2.5.2. Organic ceramics

The nature, crystalline bars and chemical composition of the surfaces of various types of bioceramics will be modified to satisfy the biological and practical requirements of cells, organs and various parts of body for the next few years. It is only beginning to realize its full potential.

## 3. Conclusion

The orthopedic body implants have become hope for many people who have damaged their body parts in the accidents. The work is be equivalent artificial devices with their human equivalents. It's not too far when the human body becomes a computer with natural and artificial defense systems that always function.

## References

1] Grabarczyk, J., Batory, D., Louda, P., Couvrat P., Kotela, I., Bakowicz-Mitura, K. (2007). Carbon coatings for medical implants, *Journal of achievements in Materials and Manufacturing Engineering*, 20(1-2), 107-110.

2] Hansen D. C. (2008). Metal Corrosion in the Human Body: The Ultimate Bio-Corrosion Scenario, The Electrochemical Society Interface.

3] Hench, L. L, Ethridge E. C, (1982). Biomaterials: An interfacial approach, NewYork: Academic Press.

4] Kiel, M., Krauze, A., Marciniak, J. (2008).Corrosion resistance of metallic implants used in bone surgery, *Archives of Materials Science and Engineering*, 30 (2), 77-80.

5] Mudali, U. K., Sridhar, T. M., and Raj, B. (2003). Corrosion of bio implants, *Sadhana*, 28(3, 4), 601–637.

6] Raj, B., Mudali, U. K., Jayakumar, T., Kasiviswanathan, K.V. and Natarajan, R. (2000).Meeting the challenges related to material issues in chemical industries, *Sadhana*, 25(6), 519–559.

7] Scales, J .T., Winter, G. D. (1959). Corrosion of orthopedic implants screws, plates and femoral nail-plates**,** *The Journal of Bone and Joint Surgery*, 41B (4).

**8]** Sharan, D. (1999). The problem of corrosion in orthopaedic implant materials, *Orthopaedic Update India*, 9(1), 1-5.

**9]** Von Recum, A. F. (1999). Handbook of *biomaterials evaluation – Scientific, technical and clinical testing of implant materials*, 2nd Ed., Philadelphia: Taylor & Francis.