Evaluation of narrow diameter implants in compromised sites.

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بسم الله الرحمن الرحيم

إقرأ باسم ربك الذي خلق (1) خلق الإنسان من علق (2) إقرأ و ربك الأكرم (3) الذي علم بالقلم (4) علم الإنسان ما لم يعلم (5)

صدق الله العظيم

العلق من آيه 1-5

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Dedication

I dedicate this work to my everlasting mentors my father, my mother for bearing me throughout my life.

To my wife, the secret pillar of my success, to my two angels ***Zaina*** and ***Ghalia.***

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Introduction
And
Review of literature

Introduction and Review of literature

The history of implant dentistry is best viewed in terms of critical periods and landmark events. The earliest dental implants were of stone and ivory, cited in archaeological records of Chinese and Egyptian civilizations before the common era. Implanted animal and carved ivory teeth cited in ancient Egyptian writings are the oldest examples of primitive Implantology **(*Block a 1997*)**. In **1809, Maggiolo** reported the placement of gold in the shape of a tooth root. However, this led to uneventful results including intense pain and gingival inflammation ***(Driskell 1987).*** This was followed by **Harris in 1887** who reported the use of porcelain teeth into which lead-coated posts were fitted. Many materials followed and were tested in the early 1900s. This included a series of attempts made by **Lambotte** using aluminum, silver, brass, red copper, magnesium, gold and soft steel plated with gold and nickel. He discovered the corrosion of several of these metals in body tissues due to electrolytic action **(*Mische 1999).***

Dental Implantology has been evolved over the last 40 years to become one of the most predictable forms of treatment currently available to surgeons. Missing teeth and supporting oral tissues have traditionally been replaced with dentures or partial prostheses to restore the ability of patients to eat, speak and to improve appearance. However, patients are not always satisfied with the function of removable dentures, and it is not always possible to place a fixed prosthesis if the number of remaining abutment teeth is insufficient. Dental implants have offered dramatic changes in the treatment plan of completely edentulous patients with atrophic ridges. ***(Branemark et al. 1977).***

In **1952 Branemark** was interested in studying bone healing and regeneration, and adopted the Cambridge designed ‘rabbit ear chamber’ for use in the rabbit femur. By time and after several months of study, he attempted to retrieve these expensive chambers from the rabbits and found that he was unable to remove them. **Branemark** observed that bone had grown into such close proximity with the titanium that is effectively adhered to the metal. He carried out many further studies into this phenomenon, using both animal and human subjects, which all confirmed this unique property of titanium. Finally he decided that the mouth was more accessible for continued clinical observations and the high rate of edentulism in the general population offered more subjects for widespread study. He termed the clinically observed adherence of bone with titanium as ‘osseointegration’ ***(Stevens et al. 1971).***

A dental implant can be defined as a prosthetic device or alloplastic material that is implanted into the oral tissues within the bone to provide retention and support to a removable as well as fixed prosthesis ***(The glossary of Prosthodontic term 1999).***

The variations in the shapes of the mandibles and amount of remaining bone following extraction resulted in the versatility in the types, shapes and designs of the dental implants. This includes the subperiosteal implants, , transosteal implants, ramus frame implants one-stage endosteal pins and endosseous implants **(** ***Block b 1997).***

1) Subperiosteal implants :

The first type of dental implants to be used. They were designed to fit over the bones of extremely atrophic jaws. This was constructed by direct impression of the jaw bones. This was first made by **Goldberg** and **Gershkoff**. The implant was constructed as a frame work of narrow cobalt-chrome-molybdenum with four abutments. After that, computerized tomography generated CAD-CAM models of the mandible on which the frame work is made ***(Small 1984)***.

2) Transosteal implants :

It was first introduced by **Small** in **1975** in the form of a mandibular stable bone plate. It was placed by a sub-mental incision and fixed to the mandible by multiple fixation and two transosteal screws ***(Small 1984).***

3) Ramus frame implants :

They receive stabilization from their bilateral anchorage in the ramus and in the mandibular symphysis area ***(Linkow and Roberts 1967).***

4) One- stage endosteal pins :

They were screw shaped implants introduced in the 1960s. They were one piece and were not submerged, they generally did not osseointegrate ***(Linkow and Roberts 1967)***.

5) **Blade implants :**

In **1967** two variations of the blade implant were introduced by ***Linkow and Roberts***. They designed a series of configurations for the blade to make it suitable for the maxilla and mandible, especially for narrow ridges.

6) **Endosseous implants**

An endosseous implant is the most common form of implant in use ***(The glossary of prosthodontic terms 1994).*** In many circumstances, implants are an alternative to fixed or removable prosthetic appliances and it has been estimated that 300,000 to 428,000 endosseous dental implants are placed annually ***(Seckinger et al. 1996)***.

Endosseous implants are classified according to their shape into:

a. Blade form implants

They are buccolingually narrow wedge shaped implant which incorporate vents in their design to allow tissue ingrowth ***(The glossary of prosthodontic terms 1994).***

b. Root form implants

Endosseous root form implants are the most used in dentistry today. They are the easiest to be placed since they simulate the general size of a normal tooth root, they can be placed in locations previously occupied by natural roots making them very versatile for replacing one or more teeth ***(Buser et al. 1999)***.

Implant materials

Synthetic materials for surgical implant devices have evolved from the early metallic system to a variety of materials combinations and composites. Current biomaterials and their biomechanical properties provide relatively optimal stable bone/soft tissue interface. In this way, the implant surface bonded to the appropriate cells of the bone rather than becoming encapsulated and separated from the tissue by poorly differentiated fibrous connective tissue ***(Hanker and Giammara 1988 and Lemons 1990).***

A. Titanium

Since **Branemark** and co-workers introduced the use of screw shaped commercially pure (cp-Ti) titanium implants for oral rehabilitation, an increasing number of dental and orthopedic implants are placed in patients every year. Titanium and its alloys are among the most commonly used implant materials, particularly for dental, orthopedic and osteosynthesis applications ***(Branemark et al. 1969 and Adell et al. 1981)***. These materials are known to have a combination of good properties making them particularly relevant and suited for biomedical applications. Titanium shows a favorable combination of intrinsic properties for the fabrication of dental implants such as low specific weight, high strength to weight ratio, low modulus of elasticity, very high corrosion resistance and excellent general biocompatibility ***(Massaro et al. 2002).*** The range of metallic materials used for implants has become limited to commercially pure titanium and its major biochemical alloy (Titanium-Aluminium-Vanadium) (Ti_6Al_4V) ***(Keller 1999 and Gorustovich et al. 2002).***

Titanium forms and maintains an oxide layer without apparent breakdown or corrosion under physiologic conditions. It is that relatively thick titanium oxide layer that determines the implant tissue interaction rather than the metal itself ***(Lindhe et al. 2003).***

B. **Carbons**:

The very high compatibility of carbon with blood leads to its use in a variety of prosthetic devices by controlling its strength. It was possible to fabricate carbon material of high strength and low stiffness, and with the ability to sustain load without loss of strength, but it was found that carbon compounds were responsible for a significant number of clinical failures and subsequently were withdrawn from clinical use ***(Kent and Bokros 1980 and Meffert et al. 1992).***

C. Ceramics:

To enhance tissue responses at the dental implant interface, ceramic like calcium phosphate materials were introduced as implant device. The use of calcium phosphate in bulk or as a surface coating material is now widely known ***(Keller 1999).***

D. Zirconium:

Zirconia was used for its excellent biocompatibility, improved esthetic results, compressive strength, bending forces, fracture toughness and high electrical resistance. Another advantage of zirconia is the significantly reduced plaque affinity, which reduces the risk of inflammatory changes in the adjacent soft tissue ***(Akagawa et al. 1998).***

Recently, the evolution of the science of dental Implantology yielded technological breakthroughs in the macro and micro-design of dental implants, including improved implant shape, thread patterns and surface treatments, which have demonstrably fostered greater primary stability and faster osseointegration ***(O'Sullivan et al. 2000, Stanford 2002, Sakoh et al. 2006, Jones and Cochran 2006)***. Dentists also prefer implants with surface treatments that accelerate osseointegration mechanisms, and with geometries that provide good primary stability, good load distribution and maintenance of osseointegration ***(Buser et al. 2004).***

According to ***(Sul 2002)***, healing around the machined titanium implant occurs through a gradual mineralization process from the bone towards the implant. The cells in contact with the turned surface allow the bone mineralization, but titanium does not act as an inductor. Besides this, the healing process occurs over several days, and the remodeling process takes months or years. The healing time for dental implants without surface treatment is higher than that for implants with treated surfaces. With smooth surfaces, the biological processes at the bone–implant interface are slower, and the properties of the native titanium oxidized layer take a longer time to be affected.

To minimize the mineralization time, titanium surface treatment is carried out. This procedure accelerates the adhesion micro mechanisms between the implant and the bone. With surface treatment, it is possible to change the surface features of the titanium dental implant, such as chemical composition, energy level, morphology, topography and roughness. Surface chemical changes include hydroxyapatite deposition and the incorporation of calcium ions, phosphorous and fluorite ***(Ellingsen et al. 2004).*** Sandblasting and acid etching treatment can change the surface topography and energy. The morphology and roughness can be controlled by treatment with acid solution or oxidation. The data in the literature showed that these modifications have their advantages and disadvantages ***(Brunette 1988, Martin et al. 1995 and Chehroudi et al. 1997).*** In most cases, they improve the success rate of the surgical procedure, but in others, they cause inflammatory complications in the tissue close to the implant ***(Rosenberg et al. 2000).***

Surface roughness of dental implants

There are numerous reports demonstrated that the surface roughness of titanium implants affects the rate of osseointegration and biomechanical fixation ***(Cochran et al. 1998 and Hallgren et al. 1998)*****.** Surface roughness can be divided into three levels depending on the scale of the features: macro-, micro- and nano-sized topologies. The macro level is defined for topographical features as being in the range of millimeters to tens of microns. This scale is directly related to implant geometry, with threaded screw and macroporous surface treatments giving surface roughness of more than 10µ. Numerous reports have shown that both the early fixation and long-term mechanical stability of the prosthesis can be improved by a high