

**EFFECT OF BONE MORPHOGENETIC PROTEINS (BMP) ON
IMMEDIATELY PLACED AND LOADED ONE-PIECE
DENTAL IMPLANTS IN FRESH EXTRACTION SOCKETS**

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Dedication

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The idea of replacing missing teeth with an implant has a very long and ancient history, beginning with the ancient Egyptians who implanted teeth in corpses according to their religious belief in the afterlife. Also, in what is known now as modern Italy, underground burial chambers were found with evidences suggesting that missing teeth were replaced by artificial teeth carved from bones of oxen in the early Etruscan civilization. The earliest man made endosteal implant in fact was found in a Mayan mandible fragment dating from about A.D. 600, into which three tooth-shaped pieces of shell were found implanted in the sockets of the lower incisors. The radiographic examination showed compact bone formation around the implanted shells similar to that bone found surrounding a modern blade implant. Later in the mid 1880's, a trial was conducted by **Dr. Younger** using a natural tooth with its pulp chamber filled with gutta-percha, and the apical opening filled with gold as an implant in an artificial socket. He claimed that a tooth of any source was acceptable. His work was unsuccessful; however, it gave the spark for many later attempts at implantation. ^(1, 2)

The middle of the twentieth century was the beginning of a new era for implants in dentistry. It all started by coincidence when **Per-Ingvar Brånemark** of Sweden conducted an experiment to study the blood flow in the bones of rabbits using titanium implant chamber, when the time came to remove the chamber, he couldn't remove it, and discovered that the bone had completely integrated with the titanium chamber. He called this discovery osseointegration and started seeing a promising potential for human applications. The concept of osseointegration was implemented in dental medicine in the mid-1960s. ^(3, 4)

Brånemark placed his first implants in a human patient in the mid 60's whose name was Gosta Larsson. The implants placed were to support a palatal obturator, as she had a cleft palate defect. She died in the year of 2005, with the original implants still in place after about 40 years of functionality. **Brånemark**

spent almost 30 years fighting the scientific community for acceptance of osseointegration as a viable treatment. Eventually, an emerging breed of young academics started to notice the work being performed in Sweden. Toronto's Professor **Zarb**, a Maltese dentist working in Canada, played an important role in bringing the concept of osseointegration to the wider world. The year of 1983 is considered a turning point for osseointegration, when, finally, the worldwide scientific community accepted the Brånemark's concept of osseointegration. Brånemark's team followed by Schreoder's team independently showed that titanium dental implants could be integrated into jawbone forming a reliable attachment. ^(5, 6)

Brånemark and co-workers originally defined Osseointegration as a direct structural and functional connection between ordered living bone and the surface of a load carrying implant at the light microscopic level of magnification. Later on a more practical and pragmatic concept was developed, stating that in osseointegration there is an anchorage mechanism whereby non-vital components can be reliably and predictably incorporated into living bone, and this anchorage can persist under all normal conditions of loading. ^(7, 8)

The main clinical technique to evaluate the Success of dental implant is through the evaluation of its stability, which is composed of two different stages: the primary and the secondary stability. The primary stability comes mainly from the engagement of the dental implant with the cortical bone mechanically and it is a requirement for a successful secondary stability, while secondary stability comes later through bone regeneration and remodeling around the dental implant dictating the time of functional loading. ⁽⁹⁻¹³⁾

Criteria for implant success include: absence of persistent signs and/or symptoms such as: pain, infection, neuropathies and parathesias. No violation of vital structures, no implant mobility, absence of continuous peri-implant radiolucency. None or negligible progressive bone loss (less than 0.2 mm annually) after physiologic remodeling during the first year of function and patient/dentist satisfaction with the implant supported restoration.⁽¹⁴⁾

Brånemark defined dental implants as prosthetic devices of alloplastic material(s) implanted into the oral tissues beneath the mucosa and/or within the bone to provide retention and support for a fixed or a removable prosthesis. **Brånemark et al. 1977**⁽¹⁵⁾ classified dental implants into 5 main categories, which are: endodontic implant, endosseous implant, trans-osseous implant, intra-mucosal implant and sub-periosteal implants. This classification was based on their anchorage component as it relates to the bony housing that provides support and stability of the prosthetic appliance.

The endosseous root-form implant is the most widely used category of dental implants nowadays with a very high and predictable success rate. Based on the relation between fixture and the abutment used, the two main basic types of root form implant are the two-piece and the one-piece dental implants. The two-piece implant consists of a fixture and a separate abutment. It is mainly used for the two stages or the submerged surgical protocol for implant placement, in which a healing period usually of three to six months was needed for osseointegration before connecting the prosthetic abutment. A second healing period is also allowed for the gingival tissues before restorative procedures are continued. On the other hand, the one-piece implant is made from one piece of titanium, in which the fixture and the abutment are integrated in one implant body. **Tramonte** introduced one-piece implants in the 1950's with the intention to be used in the immediate loading protocol. However, most clinicians have continued to utilize

two-piece implant systems for one-stage procedures, even though those designs were never intended to be used in that manner, as the implant-abutment junction constitutes a structural weakness, while the need to remove a healing abutment and replace it with a final abutment adds complexity to the procedure and insult to the healed or healing gingiva. The utilization of the one-piece implant avoids both drawbacks.^(6, 16, 17)

Root-form dental implant was further classified based on the design and surface characteristics of the fixture part. The classification was divided into two main categories, which are the macro and the micro design features. The macro design features include: implant shape, threads (number, geometry, pitch, shape, and depth), crest module considerations and apical considerations.⁽¹⁸⁾ The original Threaded screw form implant by Brånemark had a V-shaped thread pattern; with the scientific advance of the implant design, variation of thread's number, thickness, depth, face angle and helix angle were thoroughly studied and all these geometric parameters were found to have an eminent influence on the biomechanics of the implant and load distribution.⁽¹⁹⁾ On the other hand non-threaded implants are press-fit cylinders and they may have vents, grooves or internal hollow recess. They are inserted through a slightly smaller osteotomy than their diameter and then tapped in. Although this design was proven to be successful, it was not suitable for all applications. One of the most obvious limitations of its use is an increased risk of perforation in the labial bone, when used in narrow ridges and ridges with concavities. Nowadays, threaded implants are the most commonly used design in dentistry.^(20, 21) According to the geometric shape, the implant could be further classified into: a parallel wall, tapered, hybrid or conical implant, with the conical implants being recently introduced into the market. They can be inserted through undersized osteotomy preparations that allows for more bone compression than normal tapered implants, giving higher initial stability. The conical design is considered more convenient as it fits better