Immediate Implants In Infected Sockets: A Systematic Review

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FPD Fixed Partial Denture

RPD Removable Partial Denture

BIC Bone Implant Contact

RFA Reasonance Frequency Analysis

ISQ Implant Stability Quotient

SLA Sandblasted with Large grit particles and Acid Etched

PAL Probing Attachment Level

PRGF Platelet Rich Growth Factor

FMBS Full Mouth Bleeding Score

FMPS Full Mouth Plaque Score

F Flap

FLS Flapless

IDP InterDental Papilla

PRP Platelet Rich Plasma

PD Probing Depth

ERCRYSGG Erbium Chromium Yttrium Scandium Gallium Garnet

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Introduction:

The loss of human dentition comprises a critical dilemma for most of the people nowadays. Since long time ago, either removable or fixed partial dentures (FPD) were the treatment of choice. With the introduction of dental implants, they became the treatment of choice by most of the dentists and the patients because it does not only offer functional and esthetic quality, but also it offers long term results up to ten years in function.[1]

Until the mid-1980`s, only the basic surgical technique for dental implant therapy was established based on avoiding surgical trauma and overheating of the bone. Two eminent teams lead the research at that time[2]. First, the Branemark team using Titanium screw-type machined rough dental implants, second, the

Schroeder team using Titanium plasma sprayed implants with various shapes offering more porous surface with greater surface area. The Branemark team favored a submerged healing phase while the Schroeder team used a transmucosal healing because they were using one-piece implants where the abutment was a part of the implant. Both teams contributed in the development of the Nobel Biocare and Strauman dental implant systems (one of the leading dental implant companies). During this era, the main focus was on restoring fully edentulous mandibles with fixed prosthesis.

Starting the second era of dental implants by the year 1985, a shift in the treatment options appeared. Researchers started restoring partially edentulous arches as well. Partially edentulous cases represents more than 90% of implant patients[3]. A greater demand for more prosthetic options showed which led the implants companies offer angled abutments and cementable abutments.

The increased demand of restoring missing single teeth with dental implants led to the appearance of bone grafting materials to augment localized bone defects. The most predictable method was the guided bone regeneration utilizing a grafting material and a barrier membrane[4]. Also the loss of maxillary posterior teeth led to appearance of sinus augmentation surgeries. In the 1990s, the utilization of fixation pins and screw appeared aiming at stabilizing the barrier membrane and offering a more stable environment for bone regeneration with less rate of infection[5].

The implant surface macro and micro topography is a key factor in the success of osseointegration. The implants which were sandblasted with large grit particles and acid etched offered a higher surface area and greater bone implant contact area. Those implants showed higher torque on removal than the smooth implants[6].

The improvement of the surface topography of the implants led to a shift in the loading protocol. Researchers found out that loading could be applied six to eight weeks after insertion of a micro rough dental implant with five years followup period[7] which was shorter than the healing period suggested by Branemark (four to six months). The reduction of the healing period increased the popularity of dental implants and challenged the dentists to furthermore decrease the healing period. This led to the appearance of immediate loading protocol which was tested first with mandibular retained overdentures[8]. The success rate of immediate loading with a fixed prosthesis is comparable with that of delayed loading. De Bruyn et al reported a failure rate of 0 – 0.3% for mandible and 7.2% for maxilla[9].

In an attempt to ease and decrease the period of implant therapy, the period between the tooth extraction and implant insertion was decreased. Immediate dental implants first appeared in Germany[10]. During 1990`s, many researches were concerned with the immediate implant placement but they had poor esthetic outcomes due to labial hard and soft tissue recessions[11]. This mandates that before immediate implantation, a proper case selection and treatment planning should be done especially in the esthetic area.

The primary stability of the immediately inserted dental implants is a keyfactor of success. The primary stability depends several factors such as the bone density, implant design and osteotomy preparation protocol. A primary stability of 35 Ncm or an implant stability quotient of 60 – 70 is considered sufficient for immediate loading[12].

Immediate implant placement after extraction of an infected tooth is a controversial treatment. What is its prognosis? Does the type of infection affect the success rate? What is the proper protocol for this procedure to achieve best results? All these questions will be discussed in this review after critically review the literature available.

Review of Literature:

Osseointegration:

Branemark was the first who discovered the concept of Osseointegration in the early of 1950`s during studying the blood flow in rabbit`s bones[13]. The aim for Branemark`s study was to evaluate the response of bone with the bone marrow to various types of trauma including mechanical or thermal trauma. He used special intravital microscope with high magnification and resolution and special transillumination devices fixed to rabbits` fibula after careful surgical preparation of bone, removing most of the cortical layer with minimum microvascular damage to the marrow and leaving only a small shell of cortical bone (10 – 20 μm) enclosing the bone marrow and allowing visual examination of bone marrow. He discovered later after sacrificing the animals that these optical chambers were fused with the bone and that there were very thin shells of new bone entrapped in between minute parts of the optical chambers.

Branemark performed separate studies on the healing of bone after placing titanium implants with different shapes and allowing them to heal for an adequate period. He found out that a thin layer of newly formed cortical bone was formed on the surface of the implants with no soft tissue incorporation between the new bone and the surface of the implants.

Branemark also placed subperiosteal and transosseous titanium implants in dog`s jaws. Those implants had an immobilization healing period of 3 – 4 months without loading. Histological assessment was done after sacrificing the animals.

He concluded that the integration of Titanium implants could remain for 10 years provided that no active inflammatory reaction was available. After sacrificing the dogs, the fixtures could not be removed from the bone unless the bone was cut, the anchorage capacity of those implants were determined as 100 kg for the mandible and as 30 – 50 kg for the maxilla. Branemark suggested that only one size of implant should fit all bone and provide adequate anchorage regardless the volume of available bone. That implant was screw – shaped made from pure Titanium with an outer diameter of 3.7 mm and length of 10 mm. He suggested an immobilization healing period of 3 – 6 months and he mentioned that even with careful osteotomy preparation, there was a microgap between the surface of the implant and the bone. This microgap was filled with new bone during the 3 – 6 months healing period.

Osseointegration and dental implants:

Branemark started his first human experiment in the mid of 1960`s[14]. He and his coworkers placed 2768 fixtures in 371 patients utilizing 191 maxillary and 219 mandibular edentulous jaws. A total of 405 jaws were counted in that. All patients were continuously followed up for one year.

They aimed at was placing six implants between the mental foramina in the mandible and the anterior wall of the maxillary sinus in the maxilla and trying to maintain parallelism between the fixtures to facilitate the prosthetic part. Healing period was 3 – 4 months for mandible and 5 – 6 months for maxilla. The prosthetic part started 2 weeks after the implant uncovery surgery. The prosthesis delivered to the patient was like a screw retained hybrid prosthesis with a gold framework at the Pontic side and lingual side and acrylic facing on the labial side. The prosthesis allowed a distal cantilever of 2 teeth in the mandible and 1 tooth in the maxilla. All restorations were fabricated with sufficient space around the abutment for easier oral hygiene measures.

The survival rate of the implants was 81 – 88 % for maxillary fixtures and of 91 – 97 % for mandibular implants. Branemark found out an increase in bone density around the fixtures on radiographs which he claimed that it was a biological response of the bone according the direction of the mechanical load applied to the fixtures. It was not possible to remove implants from the bone after successful osseointegration even when there was bone loss up to two third of fixture height. Marginal bone loss was mostly in the first year after fixture installation with a mean value of 1.2 mm.

Obsolete dental implants:

Dental implants were also used by many researchers before Branemark discovered Osseointegration but they didn`t have high success rates. In 1949 Goldberg and Gershkoff[15] reported the use of subperiosteal implants with a success rate of 50% after 15 years.

Linkow et al in 1966,[16] reported the use of Blade Implants. They performed a randomized control trial comparing between removable partial denture and fixed partial dentures with blade vent implants. 114 patients were placed in the fixed partial denture group (FPD) and 118 in the removable partial denture group (RPD).

Linkow and his coworkers had a success rate of 83.7% for the 60 months follow-up of the FPD group. A total failure of 12 implants was reported, 4 implants couldn’t been placed during the surgery due to insufficient bone, 3 implants were removed due to infection or severe pain at the first 8 weeks after surgery and 5 implants due to excessive mobility.

Root form endosseous Implants are used nowadays with different surface treatments and different thread designs, with a primary objective to increase the Bone Implant Contact (BIC) and increase the primary stability of the implant at time of placement.

Implant surgery protocols:

Several protocols are suggested for implant placement timing which are: a)immediate placement at the time of extraction, b) immediate delayed placement which is within 8 weeks from the extraction after complete soft tissue coverage, c)delayed placement with clinical and radiographic bone fill of the extraction socket which typically ranges from 12 - 16 weeks from the extraction.[17]

In some instances, immediate implant placement is not the treatment of choice because of bone and/or soft tissue condition at the time of extraction. The clinical decision for the placement of the fixture can be postponed from 2 to 6 months till improvement of both soft and hard tissues condition which can warrant successful Osseointegration[17].

Many authors proposed that 2 months were enough for complete soft tissue healing. However, bone had a different healing process. At 2 months, woven bone is available and lamellar bone is gradually increasing until 6 months.[18][19] [20].

Bone and soft tissue healing after extraction:

Pietrokovski et al[18] performed an animal study aiming at studying the clinical and histological stages of bone and soft tissue healing after extraction. A total of 86 teeth were extracted from Rhesus monkeys. The animals were sacrificed at different timings after the extraction in order to assess different stages of healing on the histological level. They found that the extraction of a single tooth or multiple teeth had almost a negligible effect on the rate of healing.