Dental Implants

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Dental implants are widely used for oral prosthetic rehabilitation in case of partially (single or more missing teeth), as well as fully edentulous patients. It was demonstrated that osseointegrated implants have a high survival rate (cumulative mean of 94.6%, SD 5.97%) with a follow-up period of up to 20 years.

dental implant | prosthetic abutment | microgap | implant-abutment interface | osseointegration | peri-implantitis

1. Introduction

Among the absolute contraindications for dental implants are poor oral hygiene, drug abuse, psychiatric illness, and patients' unrealistic expectations. Whereas, circulatory system diseases, diabetes, xerostomia, endocrine, and metabolic disorders (with an adequate treatment) are generally considered as relative contraindications. In addition, relative contraindications include aged patients, as well as patients with a low quality and density of bone, with bruxism, periodontal diseases, oral carcinomas, and generally immunocompromised patients [1][2]. An individual approach to the patient allows considering the negative influence of systemic diseases on the dental implant treatment outcome [3]. The overall implant loss limited by implant region and bone quality varied from 0.3 to 3.3% [4]. In medically compromised patients, the implant failure was 0.0–22.5% [5][6][7]. Most of the implant failure was observed in patients with smoking history (37%), hypertension (20.8%), and diabetes (20.3%) [8].

2. Causes of Bone Loss around the Dental Implant and Types of Implants

2.1. Causes of Bone Loss around the Dental Implant

Factors that have an impact on bone loss around implants can be divided into local, systemic, and social. The local factors include the implant body, occlusal loading, size of implant, and biological aspects. Structure-related factors of bone loss involve the type of connection between the implant and abutment (internal hex, external hex, conical, and their modifications), as well as the size of a microgap between the implant and abutment. Moreover, the type of an implant (one-piece, two-piece, and multi-part implant), its shape (tapered, non-tapered), diameter, length, stiffness and surface topography (created by mechanical machining, etching, oxidizing, sandblasting, laser patterning) or thread of the implant (e.g., V-thread, buttress, reverse buttress) play a key role in the process [9].

Occlusal overload applied on implant-supported prostheses may contribute to peri-implantitis and can result in implant loss [10][11]. Susceptible to overloading, cortical peri-implant areas are mostly affected by implant diameter, irrespective of bone-implant interface length [12]. However, the length as well as the implant diameter can affect bone loss around implants. Researchers examined implants with a diameter of 3.0–5.0 mm and a length of 7.0–16.0 mm. Bone loss increased with shorter and wider implants, however there were no significant differences in crestal bone loss for the tested implants regarding different diameters and lengths of implants [13][14][15]. On the other hand, another retrospective study mentioned the highest failure of implants with a diameter lower than 3.75 mm and longer than 11.5 mm [4]. Implants with a lower diameter placed in the posterior region may cause an excessive bone loss due to the reduced contact area between the implant and bone and subsequent poorer osseointegration. The higher the implant diameter, the higher the contact surface area that reduces stress due to overload around the implant neck. Stress values were decreased when the implant diameter increased. Moreover, when the implant length increased, better stress distribution was observed [12][16].

Biological factors that influence bone loss are peri-implantitis, poor bone quality, surgical procedure of implant placement, early loading of the implant, and poor osseointegration. Peri-implantitis manifests clinically with bleeding on probing and in radiograph as bone loss around the implant [17]. The adopted types of bone quality (according to Lekholm and Zarb [18]) assume as type 1—homogeneous, non-vascularized bone, type 2—combination of cortical bone with bone marrow cavity, type 3—mainly trabecular bone, type 4—thin cortical part and low-density trabeculae. Poor bone quality—soft and providing improper initial stabilization—leads to complications in the implant treatment. This is manifested by a frequent high loss of bone and implant [19]. It is characterized with a low density of trabecula and thin cortical bone [20]. The surgical procedure of implant placement can cause bone loss in case of placing implants in a very soft bone using methods, such as bone regeneration or condensation, improperly performed with regards to the bone condition [21]. Bone loss can be observed with the early loading of the implant due to the improper initial stabilization [22]. The prevention of biological factors causing bone loss relies on regular control of infection, maintaining good oral health, implant surface decontamination, correctly performed surgical procedure, and obtaining osseointegration [23]. For control of infection and maintaining good oral health, the patient is instructed to mouth rinse with 0.2% or 0.12% chlorhexidine. This procedure reduces infection by 4.6%. Implant surface decontamination should be performed to remove biofilm from the peri-implant tissue, from the pocket and implant surface [24]. To prevent an incorrectly performed surgical procedure, precise examination, X-rays, detailed planning including assessment of bone quality and quantity, should be performed. Moreover, placing the implant at a correct inclination angle, as recommended by the manufacturer’s torque value and performing the treatment in aseptic conditions can prevent complications. Treatment of peri-implant disease includes non-surgical, surgical, antibiotics delivery, and tissue regeneration antimicrobial membranes around implants [25][26]. The antibiotic application significantly affects the implant treatment by reducing the early failure to 1.55% from 4.61% of patients with no antibiotics or placebo. No significant difference was observed in the decreasing failure rate applied by the pre- or postoperative antibiotics regimen [27]. The lack of osseointegration should be treated with removal of loose implant, debridement of the bone, and replacement with a new implant after healing [28].

Within other factors that can lead to bone loss, systemic factors (patient's age, general condition, and genetic predispositions), as well as social factors (patient's socioeconomic status, oral hygiene, and stimulants consumption) play an important role [21].

2.2. Types of Implants

The implant systems can be categorized according to the number of parts of mechanical design to one-piece and two-piece implants. The one-piece and two-piece implants can be used in one-stage, as well as in two-stage treatment procedure [29]. In a one-piece implant, the endosseous and the abutment part are one unit, with prosthetic restoration placed on top of the implant. Whereas, two-piece dental implants consist of a part placed in the bone (implant) and a separate supragingival part (prosthetic abutment). Abutment (in two-piece implants) can comprise several parts (e.g., multi-unit constructions) used depending on the clinical situation. Such multi-unit abutments are indicated when the angulation correction of inadequately/disadvantageously positioned implants is needed, e.g., in case of implant-borne multi-unit or full-arch prosthetic restorations. Then, several multi-unit abutments are used to maintain the aesthetics and emergence profile in compromised cases of edentulous spaces [30].

One-piece implants are placed in one-stage surgery with immediate implant loading. The over 2-mm bone loss was observed in 6% of cases of one-piece implants, while in 16% of cases of two-pieces implants in 1-year follow-up [31]. Such advantageous results can be attributed to the absence of a microgap between the abutment and implant in one-piece implants [29]. On the contrary, over 2-mm bone loss was reported in 49% of one-piece implants in contrast to 7.7% of two-piece implants [32]. However, the higher apical migration of soft tissues was observed for one-piece implants. The apical migration of soft tissues can adversely affect the contour and the aesthetics of soft tissues around the implant due to the lack of suitable shape and surface of a prosthetic abutment [33].

3. Summary

On the market, there are more and more manufacturers offering advanced solutions, which allow decreasing the number of failures and providing longer lasting prosthetic implant-supported restorations. With adequate procedures and correct selection of the system and tools, bone loss can be reduced and soft tissues without pathological changes can be retained. Finding the balance between function and aesthetic in implant rehabilitation is crucial.

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