AESTHETICS OF DENTAL IMPLANTS - PERIODONTAL AND SURGICAL ASPECTS

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Abstract: Aesthetic effect of definitive restorations on dental implants is the most important aspect of oral rehabilitation. To ensure satisfactory aesthetic when performing implant treatment, different biological, periodontal and surgical concepts should be taken into account. The most common reasons for implant placement in the aesthetic region are considered to be extraction of the front teeth due to unsuccessful endodontic treatment or as a consequence of advanced periodontal disease. Taking into account the aforementioned factors, as well as the growing importance of aesthetics in modern society, the main goal of this research was set - to make an analysis of the relevant periodontal and surgical factors that affect the aesthetics of superstructures worn by dental implants. Adequate literature research was performed to fulfill the main goal. Sources of information used in this study were obtained from the most used of all scientific databases- Pub Med. All of the used literature data was previously published in peer-reviewed publications and journals. Most of the articles used for this literature review have been published in English and cover the period from the last two decades 2001 to 2021. Numerous factors have been identified as influencing on the satisfactory aesthetics of definitive work and long-term success in oral implantology. First ones are periodontal and are related to: gingival morphological aspects and positioning, periodontal biotype, position of the lower lips in a relaxed state and while smiling and interocclusal space. The second group is connected to the surgical interventions such as: regeneration ability of soft tissues and alveolar bone, placing the implants in the correct position and absence of the need to lift the flap. The third group of factors is those related to prosthetic rehabilitation such as morphology and relationships of superstructures, the relationship of prosthetic devices with the surrounding soft tissues and proper planning of prosthetic devices. The thickness of the buccal side of the alveolar processus after implant placement, after few or longer time, is the most important prognostic factor in the aesthetic aspect. Surgical adherence to the buccal wall of the alveoli is the most important factor in obtaining a satisfactory aesthetic result. Except the resorption of the alveolar bone, another aspect is the fact that the final aesthetic result correlates with the morphology and width and biotype of the gingiva. This refers primarily to the possibility of recession of the gingiva on the buccal side after the definitive placement of the suprastructure. Adequate handling of soft and bone tissues during implant therapy has extremely importance. Proper planning and management of oral tissues can suppress the occurrence of numerous intra and postoperative complications and thus affect the patient's quality of life in the postoperative period. During the planning of implant placement regardless of whether it is immediate or delayed-loading implants it is necessary to have adequate manipulation of the surrounding soft tissue and bone structures. Minimally invasive procedures have become a new paradigm in dental medicine. The main idea and concept of this approach is preservation of tissues, with at least damage to the surrounding tissue structures on the one hand and the most precise on the other. At the end of the surgical procedure, all the bony parts of the alveoli that protrude above the edges should be removed or covered with movable sutures on the mucous membrane, which should then be sutured. Also, crushed, traumatized and thermally unprotected bone should be removed. In conclusion we can note that the establishment of proper aesthetics of superstructures worn by dental implants largely depends on the knowledge of biological, periodontal and surgical aspects.
Keywords: periodontium, dental implants, aesthetic, suprastructures

1. INTRODUCTION

Except the term and concept of osteointegration, Branemark also established a number of principles for proper placement of dental implants without taking into account the aesthetic aspects. However, in modern clinical practice, many patients consider the aesthetic effect of definitive restorations to be the most important aspect of oral rehabilitation. To ensure satisfactory aesthetics when performing implant treatment there is need for rigorous adherence to many biological and biomechanical concepts. (Forna & Agop-Forna, 2019).

The most important activity before implant placing is adequate clinical evaluation of the patient. This procedure can help to surgeon consideration about the various surgical options that can ensure adequate preservation and regeneration of the natural alveolar ridges. (Mittal et al, 2016) Adequate analysis of the clinical parameters should

and can affect the pre-surgical implant treatment plan and special attention should be paid to the possibilities for predictability of healing of the surrounding bone structures and soft tissues.

The most common reasons for implant placement in the aesthetic region are considered to be extraction of the front teeth due to unsuccessful endodontic treatment or as a consequence of advanced periodontal disease. (Da Silva et al, 2014).

Taking into account the aforementioned factors, as well as the growing importance of aesthetics in modern society, the main goal of this research was set - to make an analysis of the relevant periodontal and surgical factors that affect the aesthetics of superstructures worn by dental implants in the aesthetic areas. Adequate literature research was performed to fulfill the main goal. Sources of information used in this study were obtained from the most used of all scientific databases- Pub Med. All of the used literature data was previously published in peer-reviewed publications and journals. Most of the articles used for this literature review have been published in English and cover the period from the last two decades 2002 to 2022.

Factors influencing on aesthetic aspects of dental implants

Numerous factors have been identified as influencing on the satisfactory aesthetics of definitive work and long-term success in oral implantology. First ones are periodontal and related to: gingival morphological aspects and positioning, periodontal biotype, position of the lower lips in a relaxed state and while smiling and interocclusal space. The second group is connected to the surgical interventions such as: regeneration ability of soft tissues and alveolar bone, placing the implants in the correct position and absence of the need to lift the flap. The third groups of factors are those related to prosthetic rehabilitation such as morphology and relationships of superstructures, the relationship of prosthetic devices with the surrounding soft tissues and proper planning of prosthetic devices. (Dhir, 2011; Balasubramaniam et al, 2013)

2. PERIODONTAL ASPECTS

After extraction of the tooth, resorption of the alveolar bone occurs. This resorption of the alveolar bone can not only cause difficulty in adequate placement of endosseous implants or even impossible, but also cause an aesthetic problem for the production of conventional or superstructures over implants.

The optimal aesthetic result from dental implants primarily is in correlation with the quality and dimensions of the alveolar bone on the buccal- side bone wall. (Heimes et al, 2021) Resorption of this cortical part of the alveolar bone usually results in a compromised aesthetic situation caused by the presence of buccal concavity on the alveolar processus. (Mijiritsky et al, 2021)

The thickness of the buccal side of the alveolar processus after implant placement, after fewer or longer time, is the most important prognostic factor in the aesthetic aspect. Surgical adherence to the buccal wall of the alveoli is the most important factor in obtaining a satisfactory aesthetic result. (Qahash et al, 2008)

Some authors has noted that resorption of the buccal wall of the alveoli after tooth extraction can lead to a number of disadvantages for dental implants, especially in the frontal region of the maxilla. (Hansson & Halldin, 2012) Poor aesthetic from dental implants is mostly caused by very buccal concavity in the alveolar processus or when the implant is placed more lingually in relation to the adjacent teeth. (Ribas et al, 2020)

Immediate implantation (implant placement immediately after the extraction of the teeth) can preserve the alveolar ridge and this is the way to place the dental implant in an ideal position from a prosthetic and surgical aspect. Therefore, this implantation procedure is considered to be successful with predictable reparative and regenerative success. (Ebenezer et al, 2015). In these cases, the success rate is over 95%, especially due to the fact that the placement of the implants is in the same position and inclination as the natural tooth, which is significant from a prosthetic-aesthetic point of view. (Kadkhodazadeh et al, 2019) This avoids alveolar bone resorption after extraction. The main advantages of immediate implantation are - reduction of the morbidity, reduction of the treatment time, preservation of the remaining width and height of the alveolar ridge and what is most important, the optimal aesthetic effect is achieved. (Muhamad et al, 2016).

Numerous scientific and studies have reported high success rates of superstructures over immediate- loaded implants, i.e. implants placed after tooth extraction in the frontal region of the maxilla. (Chen & Buser, 2014; Weigl & Strangio, 2016; Groenendijket al, 2021).

Except the resorption of the alveolar bone, another aspect is the fact that the final aesthetic result correlates with the morphology and width and biotype of the gingiva. This refers primarily to the possibility of recession of the gingiva on the buccal side after the definitive placement of the suprastructure. Preoperative periodontal clinical examination of the anatomy and architecture of the gingiva, for the presence of inflammation and edema or for pre-existing recession is extremely important for the placement of the dental implants. These factors can influence on the possibility of predictable aesthetic results. A very thin and gracy gingival tissue biotype is not considered to be a good prognostic element for implant placement in the front of the maxilla. (Lin et al, 2013)

Setting temporary restoration as valid technique for preserving the gingival and alveolar architecture is extremely important. The use of temporary rehabilitation reduces the "dead space" between the soft tissues and the alveolar bone, reduces the chances of infection and improves the healing process and modeling of the soft tissue. Temporary prosthetic superstructures must not put pressure on the soft tissues. The use of fixed temporary restoration can help control the occlusal forces occurring at the bone-implant interface within the physiological range. This is also quite important from an aesthetic point of view for the patient and on the other hand prevents excessive stress on the body of the implant. (Lorenzoni et al, 2003)

3. SURGICAL ASPECTS

In modern implantology, various surgical and prosthetic options are available, which together with biological factors can provide the best aesthetic result and long-term stability of the peri-implant tissues. In the preoperative evaluation of the patients, special attention should be paid to the patient's smile, where in many cases anatomical limitations may occur and of course to the knowledge needed to choose the ideal intervention. Each implant should take into account the biological limitations of each patient, as well as the technical limitations that may arise when conducting the treatment. Soft tissues can be affected during the various stages of implant treatment. (Hong, & Oh, 2017)

Adequate handling of soft and bone tissues during implant therapy has extremely importance. Knowledge of the biological, histological and surgical characteristics of peri-implant tissues can be a great predictor of proper implant prosthetic rehabilitation. (Kligman et al, 2021) Proper planning and management of oral tissues can suppress the occurrence of numerous intra- and postoperative complications and thus affect the patient's quality of life in the postoperative period. (Yoon et al, 2017)

Serious analysis of the dental and medical history taking into account every possible general and local factors that may influence the osteointegration has most significant role during the preoperative planning and during the intervention, as well as in the possibility of assessment and prevention of possible complications. (Minovska et al, 2020)

This is the reason why entire surgical procedure should be planned in every detail before starting the intervention, such as: flap type, location and type of incision(s), bone management and final flap closure and suturing. Although some details may be modified during the procedure, detailed planning provides a better clinical outcome. (Summers, 1994)

During the planning of implant placement regardless of whether it is immediate or delayed-loading implants it is necessary to have adequate manipulation of the surrounding soft tissue and bone structures. Therefore especially attention in the preoperative period needs to be directed to the following steps: (1) planning of mucoperiosteal and mucosal flap, (2) adequate bone manipulation, (3) control of hemorrhage and (4) adequate wound healing.

When forming the mucosal or mucoperiosteal flap, special attention should be paid to the initial incision. The initial incision must be done with a sharp scalpel and firm pressure in one stroke at right angles to the bone. If this move is uneven, the edges of the incision will be irregular or cut and if the angle is blunt and improper suturing as well as improper healing will appear. The length and shape of the incision depend on the type of intervention and of course the number of planned implants to be placed. When incisions for the formation of a mucoperiosteal flap are done, special attention should be paid not to injure the surrounding neurovascular structures. It is therefore best to make such an incision on the outside of the maxilla and the entire periosteum of the palate as well as the buccal and lingual side of the mandible. When planning the size of the flap, the incision in the antero-posterior direction must be away from the future osseous defect to allow proper healing. And perhaps most importantly, the flap should be of adequate size to ensure good visualization of the operating field and adequate surgical accessibility to the intervention area. (Miloro, 2004).

The design of the flap predominantly depends on the surgical assessment of the operator and the goals of the operation. When designing the cut, the degree of accessibility required to access the bone as well as the final position of the cut must be taken into account. It is also very important to consider preserving a good blood supply.

There is conflicting data about how much it is advisable to expose the bone when it is not really needed. When the periosteum separates from the bone, there is resorption at the edge of the alveolar process and a loss of a certain amount of bone tissue. (Florencio-Silva et al, 2015) This loss is prevented in situations when the periosteum is left on the bone. However, recent scientific research suggests that the differences are usually not clinically significant. (Saxena et al, 2015)The periosteum left on the bone can also be used to suture the incision when it is placed apically.

Regarding the preservation of the interdental papilla and its inclusion in the surgical flaps, two basic slicing designs are used. Depending on how the interdental papilla is treated, the flap can either split the papilla (conventional) or preserve it (papilla preservation flap). In the conventional flap, the interdental papilla divides below the point of contact between two adjacent teeth to allow elevation of the vestibular and lingual flaps. The incision usually follows the contour of the marginal part of the gingiva to preserve the gingival morphology with as many papillae as

possible. Conventional flap is used when 1) the interdental spaces are too narrow, which prevents the preservation of the papillae, and 2) when the incision needs to be elevated. The papilla flap includes the entire interdental papilla in one of the incisions with the help of cervical interdental incisions to separate the connective tissue attachment, and a horizontal incision at the base of the papilla, leaving the papilla attached to one of the incisions. Newman et al, 2012).

When performing the surgical intervention, it is necessary to pay attention to these aspects while manipulation of the soft and bone tissues: (1) Not to use vertical incisions in the aesthetic zone because of possibility to create tissue defects due to lack of elastic fibers and never heal like the surrounding structures; (2) choice of grafting techniques that are minimally invasive and require fewer surgical sessions and consciously give the best aesthetic effect; (3) using of atraumatic suturing which results in a better healing process of the surgical wound. (Kois, 2004).

The work in alveolar bone is quite complex and requires knowledge of its morphological and histological characteristics. When working on the bone, especially when placing dental implants, it should be noted that it is necessary to allow continuous cooling. Namely, due to the use of rotary movements during the creation of the bearing of the dental implant, there is an increase in the temperature of the bone structures. Cooling is necessary to prevent side effects that may occur on the bone due to increased temperature. (Mishra, & Chowdhary, 2014)

Of particular importance is the proper manipulation of the soft and bone tissues during immediate implantation and placement of dental implants is largely determined by the integrity of existing hard and soft tissues. Adequate assessment of soft and bone tissue loss during extraction is crucial to the success of aesthetic implant procedures.

Minimally invasive procedures have become a new paradigm in dental medicine. The main idea and concept of this approach is preservation of tissues, with at least damage to the surrounding tissue structures on the one hand and the most precise on the other (Mm et al, 2014). The improvement of old techniques and the development of new technologies have revolutionized oral implantology and now a therapist now has a number of treatment options that can be incorporated into everyday practice to facilitate the surgical approach.

Hard and soft dental lasers nowadays are becoming part of everyday dental practice and also show significant advantages compared to conventional instruments and techniques when placing dental implants. Therefore, over time, they will become an invaluable and indispensable tool in modern dental implantology. (Martin, 2004).

Although wound healing has long been considered a fundamental aspect of medical practice and involves a series of complex biological processes. There is a fundamental difference between surgical wound healing and regeneration, and although all tissues are capable of regeneration, but in some aspect of healing phase does not have the same functionality or morphology as the lost tissue (Takeo et al, 2015). In particular, the oral cavity is an excellent environment in which wound healing takes place in a warm oral fluid containing millions of microorganisms.

The normal healing of a post-extraction wound goes through five different stages, which often overlap: coagulation, replacement of the coagulum with healthy granulation tissue, replacement of the granulation tissue with connective or other tissue, and filling of two-thirds of the alveoli up to 45 days after extraction in parallel with oral epithelial regeneration. (Politis et al, 2016)

A specific form of wound healing occurs around dental implants. When biphasic dental implant procedures are done, the implant is placed directly below or at the same level as the bone surface and the abutment is usually covered with soft tissues that heal without significant granulation tissue. The healing of the implant in the bone occurs between the working surface of the implant and the edges of the osteotomy. Blood coagulation is infiltrated by granulocytes and macrophages. Fibroblastic progenitor cells migrate into the matrix, allowing granulation tissue formation. Finally, cells in the granulation tissue transform in the osteoblasts, creating bone. This bone formation begins 4 days after the placement of dental implants, achieving maximum effect after 3 months. Depending on the mechanical stress caused by occlusal forces, bone reconstruction around the dental implant takes about 1 year. (Davies, 1998, 2003).

Soft tissue healing around implants has become the focus of attention in modern dental implantology because if its central role in aesthetic outcomes. Soft tissue healing of the peri-implant region occurs similarly to what occurs after any oral surgery procedure. Thus, a fibrin clot serves as a temporary matrix that allows epithelial and fibroblastic migration to the implant surface. Contact with epithelial or connective tissue to the implant or abutment surface is established within 1 to 2 weeks, with further maturation continuing for at least 12 weeks. In this inter phase, the epithelium present in the peri-implant region is similar, but longer than the junctional epithelium of the tooth itself. The orientation of complex collagen fibers also differs from that of a natural tooth. Instead of attaching to the neck of the implant, the collagen fibers are directed parallel and circularly around the implant. Additional studies are needed to develop better implant designs and their surfaces that would improve soft tissue healing and give more accurate aesthetic results. (Khoury et al, 2008; Villar et al, 2011)

At the end of the surgical procedure, all the bony parts of the alveoli that protrude above the edges should be removed or covered with movable sutures on the mucous membrane, which should then be sutured. Also, crushed,

traumatized and thermally unprotected bone should be removed. (Annibali et al, 2008) Suturing of surgical wounds is the last procedure of all surgical interventions, as well as the placement of dental implants. According to the basics, suturing is always done in the direction - from motile to immobile tissue. Binding of the suture is two to three times and should not be localized on the incision line. In most cases, the care is performed by suturing all layers of the wound, which enables the establishment of continuity of the mucosa and the elimination of "dead" spaces. There are resorbable and non-resorbable sutures. Resorbable sutures are used to bind the inner layers of tissue and to ligate blood vessels. They can be catgut sutures, chromed catgut sutures, or they are made of synthetic materials. The non-resorbable suturing materials are made of silk, linen, cotton, metal. Non- resorbable suture types are used to suture intraoral tissues and skin. (Koyuncuoglu et al, 2019)

4. CONCLUSSION

In conclusion we can note that the establishment of proper aesthetics of superstructures worn by dental implants largely depends on the knowledge of biological, periodontal and surgical aspects.

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