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Tricking the Gap and Width-Platform Switching: A Literature Review

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Abstract

A dental implant prosthesis enables natural muscle function and promotes bone stimulation, maintaining its shape and size similarly to a healthy, natural tooth. An important criterion for the success of dental implants is the presence of good amount and quality of bone around the implants. Bone preservation should always be considered while planning for implant placement. However, bone loss around the implant can lead to an accumulation of bacteria, causing secondary peri-implant disease, which can result in a decline in bone support. This, in turn, can cause an excessive occlusal load, ultimately leading to implant failure. To mitigate this issue, a technique known as platform switching is employed in implant dentistry to conserve the alveolar bone surrounding dental implants. This approach involves using a narrower restorative abutment on a wider implant, rather than using abutments of matching diameters. By adopting this method, the lifespan of dental implants can be significantly extended. This article highlights the significance of platform switching in enhancing the longevity and overall success of dental implant procedures.

Keywords: Implant; Abutment; Platform Switching, Platform Matching; Crestal Bone Loss; Esthetics

Introduction

Dental implants are considered to be one of the most preferred treatment modalities of replacement missing teeth. Osseointegration is direct structural and functional relationship between implant and bone. A successful implant should encompass a restoration that is not only esthetically appealing but also functional, surrounded by healthy peri-implant tissues that harmonize with the natural dentition.

Crestal bone loss plays a crucial role in stability of dental implant. According to Albrektsson (1986) for successful dental implant is bone loss of less than 1.6 mm during first year and bone loss less than 0.2 mm per year after the first year of loading. Crestal bone loss during first year after placement could be due to violation of biologic width and inflammatory infiltrate that forms around the implant. Other possible factors that associated with crestal bone loss are trauma during Surgical procedure, Microgap, Crest module, excessive occlusal load [1,2].

Platform switching concept was introduced in order to preserve the crestal bone levels by using a narrow diameter abutment over the wide diameter implant collar. This concept has the ability to deal with various factors associated with crestal bone loss [3].

Concept

After osseointegration, abutment will be placed over the implant fixtures in order to place the restoration. When abutment diameter is matched with implant fixture collar it is called as platform matching. When narrow diameter abutment used over the wider implant fixture collar it is called platform switching.

History

The concept of platform switching, as introduced by Lazzara, Porter, and Gardner, involves using abutment with a diameter smaller than the implant platform in order to minimize crestal bone loss around dental implants. This technique creates a distinct angle or step between the abutment and the implant. The origins of this concept date back to the 1980s, when wide-diameter implants (5.0mm and 6.0mm) were introduced to enhance primary stability in poor-quality bone. However, the standard diameter abutments available at the time (4.1mm) were not compatible with these wider implants, resulting in a noticeable discrepancy of 0.45mm and 0.95mm in the horizontal dimensions. Interestingly, despite this mismatch, these implants exhibited less initial crestal bone loss than anticipated.

This serendipitous discovery led to the development of a technique that could mitigate one of the most common issues associated with osseointegrated implants. Subsequent clinical and radiographic examinations revealed that crestal bone levels were preserved, and the soft tissue profile was maintained, highlighting the effectiveness of this approach [4,5].

Rationale

The inflammatory cell infiltrate at the implant-abutment junction may be the cause of bone resorption, therefore, implant abutment junction is displaced horizontally inwards from the perimeter of the implant platform & further away from bone which leads to the creation of an angle or step, thereby containing the inflammatory cell infiltrate within the width of platform switch. The magnitude of implant abutment mismatch is important as a difference of 0.8mm will create a circumferential 0.4mm platform around the implant abutment junction [4,5].

Mechanism of Action

The possible mechanisms that platform switching can prevent crestal bone loss are

1. Shifting the inflammatory cells infiltrate inwards and away from the adjacent crestal bone
2. Reduces the stress levels on peri implant bone
3. Reduces possible influences of microgap
4. Maintenance of supracrestal tissue attachment and increased distance of implant abutment junction from the crestal bone level in the horizontal way.

Indications

1. If the residual bone height is limited by the anatomic structures present.
2. In the atrophic area where there is a need for the placement of shorter implants.
3. When the distance between the two implants is less than 3 mm i.e. in the narrow edentulous ridge.
4. When aesthetics is a primary consideration [6].

Advantages

1. The abutment has a smaller diameter than the implant neck, which aids in creating a more effective soft tissue seal.
2. It allows for an even distribution of stress.
3. It helps prevent or reduce crestal bone resorption as the inflammatory infiltrate shifts away from the crestal bone.
4. This leads to a horizontal extension of the biological width.
5. It offers bone support for shorter implants.
6. Platform switching implants can be utilized in areas where aesthetics are particularly important.
7. This results in improved implant stability and greater longevity [6].

Disadvantages

1. Proper functioning of platform-switched implants requires components with a similar design.
2. Mechanical complications due to stress concentration in the implant- abutment junction.
3. Aesthetic outcomes may be compromised if there is inadequate space [6].

Limitations

- To establish this technique, if a normal sized abutment is used, a larger implant is needed and at the same time, if normal implants are placed, a narrow diameter abutment will be necessary.
- Alteration of emergence profile in the anterior region.
- A soft tissue seal of 3 - 4 mm is critical for platform-switched implants to help prevent bone resorption.
- A decreased abutment diameter can lead to an increased risk of abutment fracture, as smaller abutments concentrate stress more near their base [6].

Discussion

Several studies have investigated the effects of platform switching on dental implants. Luongo et al. examined biopsy specimens and found that an inflammatory connective tissue infiltrate was localized around the implant platform, which may contribute to the preservation of crestal bone [7]. Maeda et al. conducted a 3D finite element analysis and discovered that platform switching reduces stress concentration at the bone-implant interface, but increases stress on the abutment or screw [8].

Other studies have explored the effects of platform switching on bone-implant interactions. Schrotenboer et al. created a 2D model and found that reducing the abutment diameter had a minimal effect on von Mises stresses in the crestal region of cortical bone [9]. Canay, et al. concluded that stresses are confined to the cortical bone region around the implant neck, and that increasing the horizontal offset can increase stress on the abutment [10]. Hsu, et al. reported that bone strains were reduced by less than 10% when platform switching was used compared to no platform switching [11].

Degidi et al. evaluated the histology and histomorphology of three Morse cone connection implants and found that platform switching showed no resorption when there was zero microgap and no micromovement [12]. Cappiello, et al. highlighted that the microgap is a critical factor influencing the remodeling of peri-implant crestal bone. They found that platform switching implants help to reduce this microgap, which in turn helps to prevent crestal bone resorption [13]. Overall, these studies suggest that platform switching can be an effective strategy for preserving crestal bone and reducing the risk of implant failure, but further research is needed to fully understand its effects and optimize its implementation.

Baumgarten et al. described the platform switching technique as advantageous in scenarios where shorter implants need to be utilized, implants are placed in the esthetic zone, or when prosthetic space is limited despite the desire for larger implants. They emphasized that a sufficient tissue depth of approximately 3 mm or more is crucial for accommodating an adequate biologic width. Platform switching implants play a significant role in preventing crestal bone loss, thereby preserving the surrounding bone [3].

In non-platform-switched (NPS) implants, peri-implant bone resorption typically ranges from 1.5 to 2 mm on the vertical axis and approximately 1.5 mm on the horizontal axis. In contrast, platform-switched (PS) implants generally demonstrate early peri-implant bone resorption of only about 0.6 mm on both axes. This significantly lower bone resorption observed around PS implants compared to NPS implants suggests that the use of narrower abutments can help reestablish the soft tissue barrier, thereby reducing bone resorption [14]. Additionally, Matrix Metalloproteinase-8 (MMP-8), a sensitive biomarker of the inflammatory response associated with periodontal and peri-implant health or disease, indicates that the presence of horizontal implant/abutment mismatching is compatible with peri-implant health even three years after implant loading. This suggests that PS implants may provide more favourable conditions for long-term bone and soft tissue stability around dental implants [15].

The preservation of crestal bone levels is crucial for the successful functioning of dental implants. Traditional implants are associated with a certain degree of bone loss, which can compromise their longevity and health. In contrast, platform-switched implants present a more favourable option for minimizing crestal bone loss. This technique effectively shifts the inflammatory cell infiltrate away from the crestal bone, thereby mitigating potential damage. Moreover, platform switching helps maintain the biologic width and reduces the microgap between the implant and the abutment. These factors collectively contribute to enhanced stability of the crestal bone and promote long-term success of the implant [16]. Therefore, platform-switched implants are often considered superior in maintaining peri-implant bone health compared to traditional implant designs. However, in a study conducted by Salama et al, they concluded that there was no significant difference in the survival rates of platform switched and matched implants. Hence more randomised controlled clinical trials with bigger samples are needed to confirm the results [17].

Conclusion

The ability to achieve equal distribution of mechanical stress at the center of the implant is one of the advantages of platform switching implants. This design promotes both horizontal and vertical expansion of the biologic width and helps to relocate inflammatory cell infiltrate away from the crestal bone, thereby preventing or minimizing crestal bone loss. In recent years, platform switching implants have demonstrated significant effectiveness, making them a superior option as they address all essential factors necessary for successful implant function.

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