Masterclass in Clinical Practice

Dental Implants

with

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Platform Switching

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Introduction

When two components are connected and the connection is with a cone-in-cone connection, it implies that one component will be of a smaller diameter at the point of connection. Over the past 15 years, cone-in-cone connection (Morse-taper) implants have become the norm for abutment attachment to implants. This off-set in size difference of the implant abutment versus the implant diameter, is called platform switching (Fig. 1).

Before Morse-taper implant connections became the norm, it was most often platform matched abutment connections where the abutment was the same diameter as the implant (Fig. 2).

It was however known that reducing the abutment diameter in relation to the implant diameter, had benefits for the maintenance of bone levels. The idea was that the implant-abutment connection which allowed for bacterial ingrowth, was moved further away from contact with the coronal bone around the implant neck by this horizontal off-set.

Although this original platform switching was used with success, it was still possible for contamination of the implant-abutment to harm the bone due to the presence of a micro-gap allowing bacterial ingrowth. Figure 3 shows the Xive implant system (Dentsply Sirona, Charlotte, USA) which has one abutment connection for the 3.8, 4.5 and 5.5mm diameter implants. Using the 3.8mm abutment (yellow line) on the 4.5 or 5.5mm implant, will increase the platform switching with the increase in implant diameter. Figure 4 shows a clinical case restored with the 3.8mm abutment on the 3.8mm implant with a slight platform switching, and the 3.8mm abutment on the 4.5mm implant with a more pronounced platform switching. This preserved bone more than a platform matched configuration.

It is today accepted that a secure connection in the form of a Morse-taper, which does not allow bacterial ingrowth, is an essential part of the platform switching concept to protect the coronal bone and support the soft tissue around the implant neck.

One should also take care when platform switching a butt-joint implant, that the stability of the abutment connection is reduced further by narrowing the abutment, allowing for a more pronounced "rocking" motion during function. This may lead to more damage to surrounding bone from increased leaking of endotoxins during this movement. In addition, if such a butt-joint platform switched connection is then placed sub-crestal in bone as Morse-taper

Figure 1: A 3D CT image on the left showing a cone-in-cone connection with the horizontal off-set of platform switching and on the right a cross section of the same implant. The abutment will always be of a smaller diameter in such a connection.

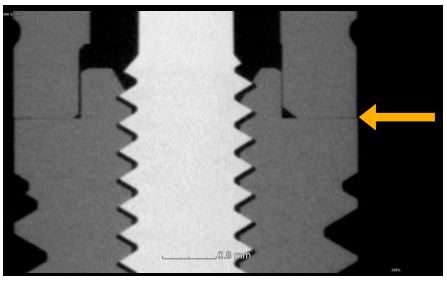

Figure 2: A platform matched abutment connection, with the arrow indicating the abutment-implant connection (abutment is the upper part).

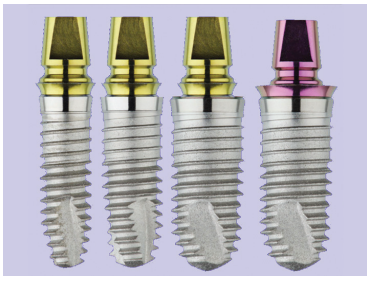

Figure 3: The Xive® System (Dentsply Sirona, Charlotte, USA) demonstrating the platform concept by using the 3.8mm abutment (yellow) on the 3.8, 4.5 and 5.5mm implants, while on the extreme right the 5.5mm diameter implant has the 5.5mm abutment (purple).

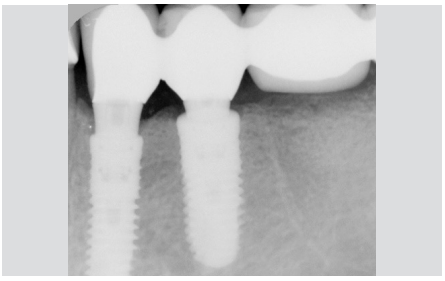

Figure 4: The 34 and 35 implants have identical abutments, with a more pronounced platform switching on the 35 implant due to the wider diameter. Note the subcrestal placement and bone stability at 2 years post placement of bridge. This can only be done with a system where the abutment connection dimension is identical between different diameters.

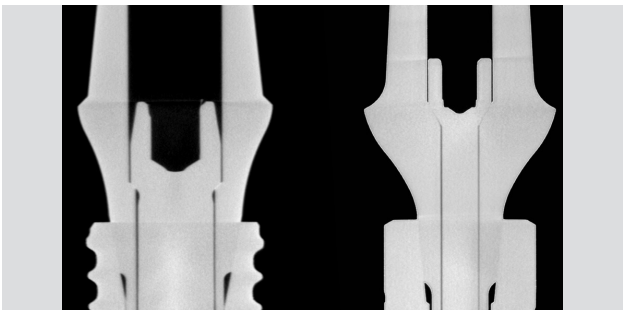

Figure 5: Comparison of two regular platform implant systems, with the implant on the left showing a wider abutment diameter, with slightly less platform switching than the implant on the right, which has a smaller diameter abutment. One could argue that the wider abutment diameter will be stronger and more suitable where occlusal forces are expected to be higher but that would be anecdotal without controlled studies.

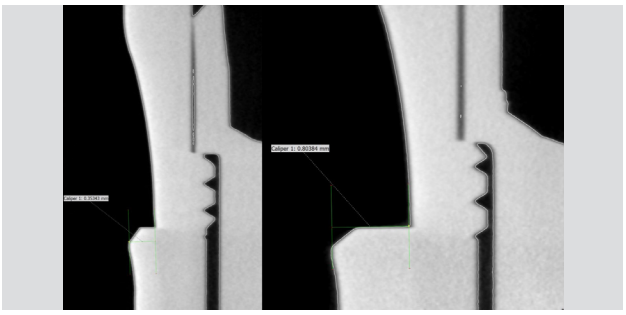

Figure 6: Implant on the left is a narrow diameter with identical abutment dimensions as the regular diameter implant on the right (same system), but with thinner wall thickness and less platform switching.

implants are recommended to be placed, it may cause extensive bone loss as the abutment-implant interface is still contaminated.

Another aspect of platform switching which should be considered, is the extent of the platform switching. The bigger this dimension, the thinner the abutment diameter will be and the thicker the wall of the implant. This will provide more strength to the implant long term as a small platform switch (thin wall implant) may fracture if overloaded. The diameter of the abutment is however of importance to prevent abutment fracture under load, so one should keep this in mind when deciding on the extent of platform switching (Fig. 5). This is of course even more import when a single implant is used to support a cantilever 2 unit bridge which will increase the loading on the abutment.

The golden principle would be to place the strongest implant for the specific site, while still leaving a 2mm bone margin around the implant for long-term stability. Figure 6 shows regular and narrow diameter implants from the same system. The regular diameter implant has the same diameter abutment as the narrow diameter implant, but more platform switching (0.80mm versus 0.35mm) and a stronger wall thickness. It would therefore be better to place the regular diameter implant if the bone volume and 3D spacing allows for it, to ensure long-term stability and prevent fractures in high occlusal forces.

Benefits of platform switching

The presence, stability, and maintenance of crestal bone levels at the level of the implant shoulder is of critical importance to ensure long-term implant success and survival. Platform switching is a concept, based on the use of an abutment having a smaller diameter than the implant platform which creates a horizontal step, shifting the implant-abutment connection towards the central axis of the implant and providing space for biological width formation. It is an innovative feature for preserving the peri-implant bone. Platform switching was introduced by Gardner. [1, 2]

Previous studies on platform switching reported that implants with this concept did not minimize crestal bone loss compared with non-platform switched implants.[3] However, more recent systematic reviews with meta-analysis indicate positive peri-implant bone preservation for implants restored with platform switching.[4] Although platform switching is an important concept to ensure the stability of tissue around an

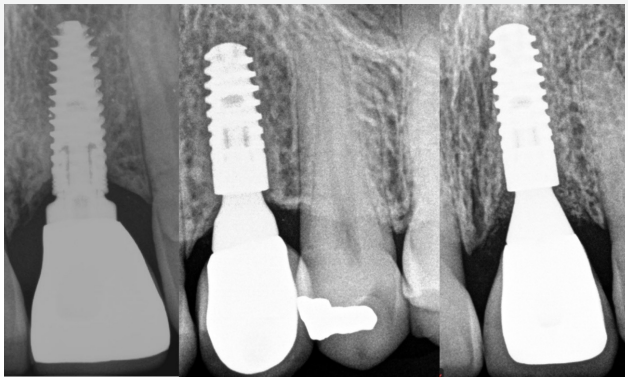

Figure 7: Implant on the left shows an abutment emergence that is too aggressive, with resultant bone loss. In the middle and right identical implants are shown with middle implant showing a wider abutment emergence than on the right which has a straight, almost concave emergence. The more space that is created for soft tissue and bone, the more stable the long-term situation will be. Platform switching is identical for the middle and right implants, but the emergence profile on the right allows for more soft tissue and bone fill.

implant, three-dimensional implant positioning, the width of the alveolar ridge and control of micromotion at the implant-abutment interface are additional factors that influence crestal bone levels.[3]

Studies which evaluated crestal bone resorption around implants with platform-matched and platform switched interfaces demonstrated that the platform switch concept reduces tribo-corrosion products released from dental implants, which may minimize adverse tissue reactions leading to peri-implant bone loss.[5]

The design of the transmucosal component, even on platform switched implants, can lead to crestal bone loss. Flat and wide emergence profiles (≥ 45° angulation with implant long axis) should be avoided and the aim should be to create a narrow emergence profile (Fig. 7).[6]

In addition to this, implants with a concave abutment and narrow emergence profile will allow for thicker soft tissue around the implant and therefore more of a protective barrier against bacteria.[7]

Further studies confirmed that the crestal bone loss around implants with platform switching was significantly less (five- to six-fold) compared to bone-level implants without platform switching (butt-joint connections).[8]

Discussion

Bone and soft tissue stability around implants has been considered as one of the most crucial factors that influence long-term success in implant therapy. However, an inevitable non-infectious bone remodelling process occurs within the first year of implant functional loading. This process has a multifactorial aetiology and may be affected by various iatrogenic factors.

Platform switching concept represents an engineering achievement in implant dentistry, designed particularly to have a beneficial impact on peri-implant tissues, mainly the preservation of crestal bone around implants. However, due to a heterogeneity in the available studies designs the evidence supporting this should be evaluated with caution.[9, 10] It is well known that peri-implant diseases are triggered by bacterial plaque accumulation at the level of implant-abutment connection. We also know from the literature that two-piece implants present a micro-gap of 1 to 49 µm at this level. After an early colonisation of these spaces, a bacterial reservoir may be formed and contaminate the implant surroundings and interfere with peri-implant tissue health.[11] The risk is even higher in patients with a history of periodontitis, as the same bacterial species have a role in per-implantitis.

The cone-in-cone connection with platform switching dominates in contemporary implant-abutment connection designs. The internal taper design creates a high propensity for parallelism between the two structures within the joint space, providing a significant amount of frictional lock on the implant-abutment system.[12] This seal between implant and abutment is important especially during mastication, as the loading forces on the prosthetic components may induce a micro-movement or bending of implant-abutment connection. This can result in micro-gap enlargement and a well-known ``pump effect`` leading to the leaking of endotoxins between implant/abutment connection and surrounding tissues. The platform switching approach may shift the micromotion between the implant and abutment away from the bone, reducing its negative effect. Additionally, it was observed that the level of mismatch between implant platform and abutment correlates with marginal bone loss. In other words, by increasing the horizontal distance between implant-abutment connection and the bone, the anti-bone-resorptive effect of the platform switching may be increased.

The role of the connective tissue zone in protecting the peri-implant bone is well documented. Platform switching implants facilitate the formation of a connective tissue ring over the implant shoulder, providing better protection of the surrounding bone, reducing the bone modelling in an apical direction.

In recent years, a subcrestal implant position has become

the dominant clinical strategy. Depending on conditions, the implant shoulder is usually buried 1 to 2 mm bellow the bone margin. One meta-analysis confirmed that platform-switched implants placed sub-crestal exhibit less marginal bone change than implants placed equicrestal.[13] It is however important to note that placing implants subcrestal requires a conical connection with platform switching that is stable and can be trusted to seal against bacterial contamination.

Conclusion

The concept of platform switching has shifted the paradigm in implant dentistry. More and more implant manufacturers are accepting this principle and introducing it in their production lines. Also, many research papers confirm the potential benefits of platform switch toward peri-implant tissue health. It should be clear from the above that platform switching by itself is not the only factor in ensuring peri-implant tissue stability. It has been shown that the stability and tightness of the connection is of paramount importance.[14] Each clinician should be aware of all the factors influencing tissue stability and choose a system that will fulfil the requirements for long-term tissue stability.

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