

Advanced Esthetic and Functional Solutions in Implantology: The Revolution of ASC / TPA Inclined Screw Channels

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Abstract:

The evolution of implantology has led to the introduction of inclined screw channels, known as ASCs (Angled Screw Channels) or TPAs (Tilted Placement Abutments), which offer innovative solutions to improve the aesthetics and functionality of screw-retained prostheses. Traditionally, placement of the screw hole in visible areas compromised the aesthetics of the restoration, especially in patients with a high smile.

ASC/TPA screws allow the channel to be tilted up to 30 degrees with respect to the axis of the implant, improving the aesthetic result. This article analyzes the functional and mechanical benefits of this technology, such as flexibility in implant placement and optimal management of masticatory forces, reducing the risk of mechanical complications. In addition, the effectiveness of ASC screws in combination with angled multi-unit abutments (MUAs) to optimize the stability and aesthetics of the restoration is discussed. Although ASC screws have greater technical complexities and costs, their impact on improving prosthetic treatments is significant.



Figure 1: Example of screw-retained bridge on IPD Dental Group Custom Interface and TPA screws

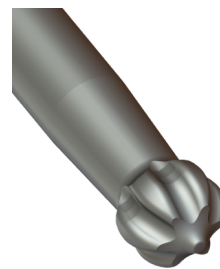
Introduction

Implant dentistry has undergone considerable development, with innovations that continuously improve the quality of

treatments. One of the technologies that has gained popularity is the screw-retained prosthesis, which offers periodontal advantages over cemented prostheses, reducing the risk of peri-implantitis due to the elimination of subgingival cementation. However, one of the main limitations of screw-retained dentures is aesthetics: the screw hole can be visible in frontal areas, compromising the aesthetic result, especially in patients with a high smile. To solve this challenge, inclined screw channels (ASCs) have been developed, which allow the screw path to be tilted by up to 30 degrees. This flexibility not only improves the aesthetics of the restoration, but also offers mechanical advantages, allowing for optimal placement of implants in complex anatomical conditions. In this article, we will examine in detail the aesthetic and functional benefits of ASC screws, along with their possible disadvantages, such as increased engineering complexity and cost.

What is the Angled Screw Channel

The angled screw channel is an innovative design element that allows the fixing screw to be inserted at an angle to the longitudinal axis of the implant.



This feature offers considerable flexibility, allowing greater adaptation in clinical situations where direct access to the screw canal may be limited or where aesthetics require that the exit of the screw canals is not visible. Imagine having a patient with an implant placed in an aesthetic area, such as the anterior upper jaw.

In these situations, aesthetics play a crucial role in the success of the treatment. A traditional screw channel, perpendicular to the axis of the implant, could compromise the aesthetics by exposing the screw or creating a suboptimal angle for the restoration.

With an angled screw channel, we can tilt the screw path up to 30 degrees, moving the access point to a more favorable position both aesthetically and functionally. Even limited access in molar areas could be solved with the inclination of the screw channel, allowing the operator to access the prosthetic fixation screws more easily.

The innovation of the angled screw channel is not limited only to aesthetics. This technology allows for greater flexibility in implant placement. In cases of bone resorption or other anatomical complications, implants can be positioned in a way that makes the most of the amount of bone available, knowing that the screw canal can be angled to achieve the best possible prosthetic result. This is especially useful in rear areas where room to maneuver is limited and direct access can be tricky.

How Can You Make a Screw Driver/Angle Screw Connection

To make an efficient connection between the screw driver and the angle screw, specific engineering solutions must be adopted. The ASC screw driver is designed with a rounded shape that allows it to be adjusted to the angle of the screw channel. This mechanism is similar to a gimbal connection, which allows the driver to transmit the tightening torque to the screw even if the screw channel is inclined with respect to the axis of the implant. Making this connection requires very high engineering precision, which increases the complexity of design and manufacturing, leading to higher costs than traditional systems.



Figure 2: Example of a T-drill on "Direct to Implant" files from IPD Dental Group libraries

An ASC connection can be made with different technologies and materials. One of the most common solutions is the use of TiBase, titanium bases that offer excellent biocompatibility and strength.

Another option is the use of CoCr (cobalt-chromium) bases, made by overcasting or sintered laser, which guarantee excellent mechanical strength and stability. In addition, the bases can be milled from solid using advanced CNC milling technologies, ensuring high precision and a perfect fit. The T-Drills represent an additional solution, allowing you to create angled screw channels with a high degree of customization.

Clinical Benefits

The possibility of angulating the screw channel offers extraordinary flexibility. This is particularly useful in aesthetic areas where direct access can compromise the final result.

ASC screws improve the retention and stability of dentures, reducing the risk of misalignment and improving long-term stability. In addition, they can significantly reduce the risk of ceramic fractures and other mechanical damage caused by suboptimal insertion angles.

Let's consider a practical example: imagine that you have an implant placed in the anterior region, between 1.4 and 2.4, where aesthetics are crucial. By using an ASC screw, we can tilt the screw channel so as to avoid unsightly metal exposure. This not only improves the final appearance of the restoration, but also offers greater flexibility in the placement of the prosthesis, allowing for a more natural and harmonious fit. Compared to an angled multi-unit abutment (MUA), which can be expensive and complex to manage, the use of an ASC screw with an angled canal offers a more cost-effective and versatile solution. While an angled MUA corrects the tilt of the implant, an ASC screw allows the implant to be kept in its original position, by angling only the screw channel. This reduces costs without compromising the quality of the treatment.

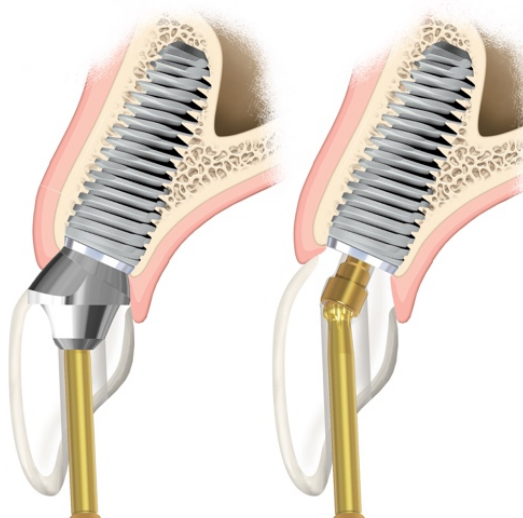


Figure 3: Comparison of screw channel correction with MultiUnit and with ASC/TPA

However, true clinical excellence is achieved by combining the two technologies: angled MUA and ASC screws. As demonstrated in Dr. Toia's thesis, the combined use of angled MUA and ASC screws creates an exceptional prosthetic system. The angled MUA works on an ideal angle of insertion of the prosthesis and on the discharge of forces, while the angled screw channel allows the exit of the screw channel to be positioned in a precise, aesthetic and perfect way.

Separately, both systems are good, but together they become invincible, offering the ultimate in flexibility, adaptability and aesthetic results.

Mechanical disadvantages

Like any innovation, ASC screws present challenges. Making screws and angled drivers requires greater engineering precision and the use of advanced technologies, increasing production costs.

The tilt of the screw channel can affect the distribution of mechanical stress, potentially reducing fatigue strength in some situations.

If the design is not optimized, it can lead to an increased risk of screw loosening under chewing cyclic loads. In addition, the driver must be kept in the correct position during operation to avoid stripping the driver and screw, compromising the integrity of the system.

A recent study, *"The effect of screwdriver angle variation on the off-axis implant abutment system and hexalobular screw"*, showed that the maximum angle of the screw channel can affect the tightening torque and final preload.

In particular, angles greater than 15 degrees can reduce tightening efficiency and increase the risk of premature screw loosening, especially in areas with high occlusal loads.

This study showed that angulation significantly affects the output torque of the screw, with a reduction in tightening torque to 25 and 28 degrees compared to 0 and 15 degrees. It is therefore essential to carefully evaluate the angle necessary for each individual clinical case and to follow strict operational protocols to minimize these risks.

Another important aspect is the TiN (titanium nitride) coating. This coating improves the wear and corrosion resistance of ASC screws, increasing their durability and reliability. Without proper coating, screws can be subject to faster degradation under mechanical stress and aggressive oral conditions.



Figure 4: Example of Pentalobulated Driver for ASC/TPA Screws by IPD Dental Group

The shape of the driver is another crucial factor. A five-lobed geometry or a 5-point Torx seems to be the best to ensure optimal transmission of tightening torque and minimize the risk of slippage or damage.

These shapes offer a large contact surface, better distributing forces and reducing the risk of deformation.

Practical Tips

To get the most benefit from ASC screws, it is crucial to receive proper training in the use of these screws and angled drivers. Participating in refresher courses and workshops can improve skills and reduce the risk of complications.

Before opting for an ASC system, we carefully evaluate each clinical case to determine if this technology is the best solution for the patient.

In addition, it is recommended that you try and familiarize yourself with using the driver in a controlled environment

before performing the procedure on a patient.



A further practical tip concerns the maintenance and replacement of screws and drivers. It is important to regularly monitor the wear and tear of the components and replace them when necessary to avoid long-term complications.

The use of high-quality compatible components ensures the quality and durability of the system, reducing the risk of malfunctions and complications.

Case Studies and Practical Applications of ASC Screws

ASC screws have already demonstrated a significant impact in various clinical settings, not only aesthetic but also functional, thanks to their flexibility in handling screw hole exits. Let's consider some practical examples that highlight their use in real clinical situations:

Case 1: Patient with a high smile and implant in the anterior arch.

A 35-year-old patient presents with a high smile, with the need for an implant in the anterior upper arch (region 1.1). The implant is placed with a screw hole which, with a traditional screw-retained prosthesis, would be visible in the vestibular face of the tooth.

Using an ASC screw allows the screw channel to be tilted by about 20 degrees, moving the access point on the palatal face. This greatly improves the aesthetics of the restoration, avoiding the need to cover the hole with composite, which could discolor over time. The end result is an aesthetically natural and functionally stable restoration.

In this case, we chose to use a direct-connect library, milled in CoCr and ceramizing.

Case 2: Bone resorption in the molar region.

A 50-year-old patient with bone resorption in the lower molar region requires a screw-retained prosthesis on an implant. The space available for implant placement is limited, making direct

access to the screw channel complex. In this case, an ASC screw inclined by 25 degrees allows the operator to position the restoration optimally, without compromising prosthetic stability and ensuring easier access during the prosthetic phase. The canal tilt solves access difficulties, improving the clinical result without complications by bringing the screw hole into the lingual position leaving the occlusion untouched.

The choice fell on a TiBase with low transmucosal to leave the bonding stem as long as possible, the aesthetic part was made of monolithic zirconia.

Case 3: Use of ASC screws in combination with MUA (Multi-Unit Abutment).

In a complex case, a patient with two implants strongly inclined in the 1.4/1.5 region requires a fixed prosthesis. In this context, the prosthodontist decides to use two 30-degree angled MUAs to correct the tilt of the implant, but combines the use of an ASC screw to further angle the screw channel.

This combined approach makes it possible to obtain a stable and well-positioned prosthesis both from an aesthetic and mechanical point of view, with a perfect discharge of occlusal forces.

The MultiUnits with long transmucosal are chosen to reduce interference with bone and tissue peaks, the latest generation TiBases with a height of 4mm.

Conclusions

In the field of implant dentistry, innovations such as ASC screws represent a significant step forward, giving us tools to improve the esthetics and functionality of our restorations. However, it's important to remember that every new technology brings with it new challenges and requires proper training and attention to detail. ASC screws allow us to overcome the limitations of traditional screw channels, but they require careful evaluation and conscious use to exploit their full potential.

Looking to the future, we can imagine further improvements in implant prosthetic techniques, thanks to continuous innovation and research. It is crucial to stay up-to-date on the latest technologies and practices, participate in trainings, and share our experiences with the dental community. Only in this way will we be able to continue to offer our patients the best and safest solutions.

We are in an exciting era for implant dentistry, where innovation is at the heart of our progress. ASC screws are an example of how technology can improve clinical practice, but it is our experience and commitment that make the difference.

We continue to explore, learn and innovate, with the belief that every challenge we overcome brings us closer to ever better outcomes for our patients. The dentistry of the future is in our hands, and with tools like ASC screws, we can look forward with confidence and optimism.