Advancing levels of precision in dental implants through computer navigated surgeries

By Dr Shyam Bhat, India & Dr Shankar Iyer, USA

Advances in technology have enhanced clinicians’ comfort and accuracy by minimizing the margin of error. We have seen a paradigm shift from using only a radiograph to using cone beam CT scans for diagnosis. A cone beam CT scan now has become the standard of care in treatment planning for dental implants.

Traditionally, implants have been placed free hand or aided by the use of static guides derived from a CT scan. Although using well-planned surgical guides have all the same advantages, they are usually bulky and do not provide adequate information regarding angulation of the drill, degree of deviation from the planned position, implant delivery in a three-dimensional perspective and often precludes irrigation to the osteotomy sites. A possibility of error always exists, no matter how thoroughly the guide is planned.

Using a static surgical guide along with a specific guided implant surgery instrumentation can result in less than 2 mm of cranial and apical deviation and an angulation error of less than 15 percent.

However, implant placement without any guide results in significantly more error than either guiding modality. This article is an attempt to explain the instrumentation and procedure involved in placing implants under dynamic computer navigation.
The position of the implant is repro-duced from the surgical guide via the virtual implant placement per-former with a cone beam CT scan and hence does not allow intra-opera-tive modification of the implant posi-tion.30 With the static systems, the planned implant location is usually transferred to the surgical guide template by a specially designed drilling ma-chine.30 Another static option, called the Stereolithography method, uses a specially designed software to de-sign the surgical guide template which is fabricated from a liquid polymer using two cameras which are part of a precision tracking system.30 It is designed to work in the oral cavity after positioning on the guide manufacturer and wait for the software to complete the design of the surgical guide.30

Discussion
Guided implant surgery can be performed in two ways. Static and Dy-namic. The static approach refers to the use of a static surgical template.

In the static approach, the surgical guide or splint is custom made to fit the patient’s anatomy. The guide is placed in the mouth and the surgeon follows the guide or the splint to perform the surgical placement. The guide provides a framework for the surgeon to follow and ensures that the implants are placed in the correct position and orientation. Static guides are typically made using computerized tomography (CT) scans or three-dimensional (3D) models of the patient’s mouth. The CT scans are used to create digital images of the patient’s mouth, which are then used to design the guide. The guide is then fabricated using materials such as thermoplastic resin or titanium. Static guides are relatively inexpensive and are commonly used in practice. However, they have some limitations. The fit of the guide to the patient’s mouth is critical, and any deviation can affect the accuracy of the implant placement. The guide can also be bulky and may introduce additional forces that can affect the healing of the bone. Additionally, the patient may experience discomfort wearing the guide during the surgery.

In the dynamic approach, the surgical guide is designed and fabricated using computer-aided design (CAD) software. The guide is then transferred to the patient’s mouth, and the surgical placement is guided using real-time tracking of the guide. This approach allows for modifications to the guide as the surgery progresses, ensuring more accurate and precise implant placement. Dynamic guides are typically used in computer-guided surgery systems, where the guide is updated in real-time based on the position of the guide markers and the impact of the surgical forces on the guide. This approach is more accurate and precise than static guides, but it is also more expensive and requires specialized equipment.

Guided implant surgery has several advantages over freehand implant placement. It is more accurate and precise, which can lead to better functional and aesthetic outcomes. It also reduces the risk of complications such as nerve damage and infection. Additionally, guided implant surgery can reduce the time required for surgery, which is particularly important in cases where the patient has limited time availability. However, guided implant surgery also has some limitations. It requires specialized equipment and training, which can be costly. It also requires a longer time for surgery compared to freehand placement.

Conclusion
The results of this study support the use of computer-aided design (CAD) and computer-aided manufacturing (CAM) techniques for guided implant surgery. The use of computer-aided design and computer-aided manufacturing in implant dentistry has been shown to improve the accuracy of implant placement, reduce surgical time, and minimize complications. The use of CAD/CAM technology in implant dentistry is expected to continue to grow in the future, as it offers significant advantages over traditional methods.

References
Morbidity after harvesting of autologous pelvic bone

Bimaxillary implant restoration by all-ceramic bridges

A nuanced perspective on periimplantitis
The synthesis of aesthetics, health and structural stability

The advantages of using the Angulated Screw Channel (ASC) abutment system

By Dr Chandur Wadhwani, USA

There are many reasons why cement retained implant restorations gained popularity over the last few years, which can be attributed to aesthetics, ease of use and familiarity with cementation techniques. However, Pauletto, Gapski and others reported that cement excess was problematic; then Wilson’s study established a positive relationship between excess residual cement and peri-implantitis. Surveys on cements used for implant restorations indicated a diversity in material selection, application technique and volume. This suggested a lack of conformity and understating of cement usage within the dental profession. To overcome the cement problem, it became evident that improved understanding was required for cement material selection, abutment design and the determination of cement margin depths. Even with the best intentions, however, residual excess cement can lead to disease, affecting the health of the implant/tissue interface and remains a dominant risk factor. The association of residual excess cement and peri-implantitis has resulted in the need to re-examine alternatives such as the screw retained implant crown. For many implant systems, the ability to use a screw retained implant restoration is limited to regions where the screw access channel emerges in an aesthetically ‘safe’ site. Usually the anterior maxilla and mandible present the greatest challenges, as the long axis of the implant often projects through the proposed incisal edge or even facial to the final restoration (Fig. 2a). Occasionally, when the surgeon places the implant in a compromised site—or the implant is inappropriately placed—the traditional screw-retained implant restorations may seem to provide more of a challenge than a solution (Fig. 2b).

With the ability to alter the screw channel up to 25 degrees, it eliminates the need for cementation in the vast majority of cases like these. The ASC provides for an active synthesis of health, aesthetics, and excellent structural and mechanical abutment joint stability.

Health

With use of the ASC abutment system, cement extrusion into the fragile peri-implant soft tissues is eliminated. The ASC puts an end to the onslaught of cement fluid pressure and unset chemicals from the cement material. It also gets rid of the potential for foreign bodies being pushed around the implant site, which can jeopardise implant health (Fig. 4a). In addition, the use of zirconia abutment superstructures in combination with titanium bases provides optimised materials for biocompatibility and health.

Aesthetics

With the ASC, the screw access channel can be projected away from high-aesthetic-risk areas and placed appropriately at a variety of different angulations. CAD/CAM design enables the restorations to be efficiently designed and quickly manufactured at Nobel Biocare’s production facilities (Fig. 5). Milled zirconia is highly aesthetic, thus especially useful at the soft tissue emergence site.

Angulated Screw Channel saves the day

An innovative solution to the off-axial implant is the Angulated Screw Channel (ASC) abutment system developed by Nobel Biocare (Fig. 9). Діалогічна комунікація

Mentioned in this article please visit: Nobel Biocare’s production facilities.

Mechanical stability

CAD/CAM utilisation (Fig. 6a-c) allows for optimised screw access site planning and the machining of components provides a precise, dedicated connection, optimised for the implant-abutment joint. As with all implant-to-abutment connections, the optimised passive fit results when these surfaces are in intimate contact and forces are distributed universally. Casting abutments cannot always provide an even connection with joint contact, as they are often inadvertently damaged through cleaning and polishing, which alters the consequent fit (Fig. 7). When this occurs, the joint connection may fail with screw loosening or even failure of the implant as a result.

Structural components

Titanium alloy abutment bases provide the most accurate fit with machining tolerances readily controlled. Attractive wear, i.e. the release of titanium metal into the peri-implant tissues from the inside of the implant, is not an issue. The zirconia abutment, with its well-designed circumferential wall strength, is held through the abutment screw, optimising the ceramic’s ability to withstand forces that have been seen to fracture non-titanium base abutments.

Conclusion

The benefits of the ASC abutment system are numerous, reflecting a multiple symbiosis of engineering ingenuity and biocompatible materials, and allowing for the combination of good aesthetics and excellent health.

References


Fig. 1: Failed, removed implant restoration may seem to provide a ‘safe’ site.

Fig. 2a & b: The anterior teeth present a challenge to the screw-retained restoration unless an Angulated Screw Channel (ASC) abutment is used (a). In cases where the surgical placement is less than ideal, the ASC may help lend further compromise to the site (b).

Fig. 3: The ASC allows the ideal screw access site to be planned, then machine fabricated.

Fig. 4a & b: Even with shallow margins and minimal cement (a), the elimination of cement extrusion still presents a clinical challenge (b).

Fig. 5: The Nobel Biocare CAD/CAM software allows ideal screw access site to be planned, then machine fabricated.

Fig. 6a–c: The screw access from Figure 2a has been redirected using the ASC abutment and crown (a & b), producing a pleasing natural appearance thanks to a screw-retained axi-axial implant is the Angulated Screw Channel (ASC) abutment system.

Dr Chandur Wadhwani is a prosthodontist in private practice in Bellevue, Washington, USA. An adjunct assistant professor at Loma Linda University’s School of Dentistry, he is also affiliated with the University of Washington School of Dentistry in Seattle. He has written the first evidence-based textbook dedicated solely to implant cementation. Here, he describes some of the advantages of working with the Nobel Biocare ASC (Angulated Screw Channel) abutment system.