Background
With the success of dental implants, the profession of dentistry has moved into applying innovative ideas that have deemed treatment time and amplified the quality of patient’s lives. While integrating into modern dentistry, implant treatment has shifted direction from being surgically driven to prosthetically driven. Among other developments in improving all aspect of implant dentistry, angled implants were first introduced in the early 1990’s and since then there has been ample research performed to study their success. (Figure 1)

Implants were originally tilted in a bodily fashion to bypass certain anatomic structures that otherwise hindered clinicians from placing them in areas such as the maxillary sinus, inferior alveolar nerve canal, the mental foramen, mandibular lingual concavities and maxillary buccal concavities. Procedures such as nerve repositioning, various grafting procedures, distraction osteogenesis, ridge splitting and many more not only lengthened treatment time, but also increased patient morbidity during implant rehabilitation cases. In addition to bypassing the anatomical structures, the tilting of posterior implants in a distal manner results in an increase in the length of the prosthetic table thereby allowing better load distribution, and reducing the cantilever length. With time, tilted implants became an effective and safe alternative to major augmentation procedures such as maxillary sinus grafting procedures andridge augmentation procedures.

Initially there were negative speculations regarding the hard and soft tissue response around tilted implants as opposed to axially straight implants. However various in vitro and in vivo studies have proven no apparent long-term clinical advantages between angled and straight implants. Kreekamanos et al in 2000 followed up forty-seven consecutive patients with tilted implants for forty months and showed no significant difference between tilted and non-tilted implants. A comparative 3D finite element stress analysis conducted by Cases et al in 2008 showed no indication that angled implants create stress-induced problems compared to straight implants. A meta-analysis preformed by Maffei et al in 2012 evaluated the outcomes of upright and tilted implants supporting full-arch bridges over a four-year period of immediate rehabilitation of edentulous maxillae, after at least 1 year of implantation. No significant mean difference between tilted and upright implants was found with regards to bone loss. Rosén et al in 2013 retrospectively evaluated the surgical effect of tilted implants in the severely resorbed edentulous maxilla as opposed to bone grafting and conventional prostheses to restore the posterior maxilla. In a ten-year study patients with tilted implants reported a clinically satisfactory alternative to the more demanding grafting techniques.

Angled abutments
Furthermore while angled implants improved load distribution, reduced augmentation procedures, lessened cost, treatment time and eliminated cantilevers in many cases they did necessitate the use of angled abutments to achieve a parallel path for the draw of the final prosthesis. Custom or prefabricated abutments were necessary to redirect the screw access holes in a common path of insertion to aid in the fabrication and installation of the final prosthesis. In addition these abutments were also used to redirect the screw access hole in the lingual direction to aid with esthetics of the final restoration. In cases of severe angulations the prosthodontist is limited to the use of cemented restorations with the use of custom made abutments. (Figure 2)

Although these abutments are widely used today, they do present certain disadvantages that warrant mention. Firstly the connecting surfaces of custom made abutments may have casting imperfections that will attract bacteria and biofilm accumulation. Secondly if used in cemented restorations, they promote the use of cement that can cause untreated peri-implantitis and peri implant mucositis. Thirdly, thinning of the custom abutment decreases the abutment’s ability and hence allowing for a minimal inclination of the implants. The use of angulated abutments is effective in bypassing the anatomic structures that would otherwise lead to implant thread exposure after initial healing, not to mention the inevitable use of custom made abutments and cemented restoration to correct the severe facial angulations. Consequently by avoiding the use of angled or customized abutments there is minimal inflammatory response due the micro gap / cement that may ultimately lead to crestal bone loss over time is eliminated. Lastly, facial inclination of an implant makes the facial surface of the connecting abutments thinner than usual and hence allowing for a minimunm of 2mm of buccal bone that will ensure the stability and firmness of the gingival position in the esthetic area. (Figure 3)

Anterior Maxilla
Implants in the esthetic area has been a popular topic in recent years due to the catastrophic failures associated with implants in the esthetic region. The difficulty that arises with implants in the esthetic area is related to anatomic limitations and the higher resorative properties of the bicuspid plate. The anatomic limitation is the common buccal concavity associated with the pre maxillary region. The anatomic limitations of the anterior maxilla often require either an angled implant or adjunctive grafting procedures. The use of Co-Axis implants allows the operator to place an implant in the extraction socket of an anterior maxillary tooth without pressure on the buccal plate and simultaneously avoiding buccal plate perforations. The placement of an implant close to the buccal plate will lead to implant thread exposure after initial healing, not to mention the inevitable use of custom made abutments and cemented restoration to correct the severe facial angulations. Consequently by avoiding the use of angled or customized abutments there is minimal inflammatory response due the micro gap / cement that may ultimately lead to crestal bone loss over time is eliminated. Lastly, facial inclination of an implant makes the facial surface of the connecting abutments thinner than usual and hence allowing for a minimum of 2mm of buccal bone that will ensure the stability and firmness of the gingival position in the esthetic area. (Figure 4)

Posterior area
As mentioned earlier the use of angled implants not only aids with the bypassing of anatomic constraints that would otherwise require grafting procedures, but also aids with load distribution and the elimination of long cantilevers(Figure 5). The mental foramen, maxillary sinus and severe concavities can be avoided with the use of angled implants. However this necessitates the use of angled abutments to correct the severe distal inclination of the implants. The use of the Co-Axis Implants facilitates the avoidance of anatomic limitations, shortening of cantilevers, and enables the use of screw retained restoration without the need of angled abutments. The use of angled abutments is hence not necessary since Co-Axis Implants correct the angulation within the body of the implant.

Deciding on the Angle
This tapered body implant is available in 12°, 24° and 36° degree built in angle, ranging in 4, 5, 6 mm diameter and 8.5mm to 14mm in length. It is currently available in the external hex, Tri-nex and internal octagon connections. In extreme cases for even higher angle correction, the Co-Axis implant can be combined with a 17° or even the 50° angled abutment. With various angulations available one can make a decision of the angle needed by the use of angled direction indicators that may be used to orientate and assess the 3-D position of the desired access hole within the surgical guide(Figure 6). The angled direction indicator is inserted into the osteotomy and the prosthetic axis is checked regarding the access hole position for screw retention as well as for parallelism with other implant fixtures. When the orientation is con-
firmed, then the site is enlarged to appropriate implant diameter & length and the implant with the appropriate built in angulation is inserted (Figure 7). The angle correction of the implant is therefore at a sub-crestal level and prosthetic space is not utilized by angulated abutments.

Conclusion

Today more clinicians are advocating the use of angled implants. This leads to less grafting procedures that not only minimizes the overall treatment time, but also reduces the cost and diminishes the patient's morbidity associated with grafting procedures. Co-Axis implants also allow early or immediate loading protocols that would otherwise not be possible with conventional implants. Therefore, the use of native bone, the avoidance of expensive angulated abutments, decreased patient morbidity, reduced cost, benefits of immediate loading, likelihood of screw retained restorations, and elimination of long cantilevers are all advantages of using Co-Axis implants.

References


Figure 6. 12° direction indicator within a surgical guide

Figure 7. Direction indicators left to right (0°, 12°, 24° and 36°)

Figure 8. The use of 12°, 24° and 36° implants in a fixed maxillary immediate loading rehabilitation

Costa Nicolopoulos BDS, MFDS Oral & Maxillofacial Surgeon Dr. Costa BDS qualified as a dentist in 1984 receiving his dental degree cum laude from the University of Witwatersrand, Johannesburg, South Africa. He graduated top of this class with rank order No.1 and received numerous awards including the Gold Medal of the Dental Association of South Africa for the most outstanding graduate. In 1990 he completed his 4 year full time postgraduate Maxillo-Facial & Oral Surgery training at University of Witwatersrand, South Africa and was awarded FFD (SA) MFDS.Since 1999 he is in full time specialist Maxillo-Facial & Oral Surgery private practice concentrating on immediate loading rehabilitation of dental implants. To date he has placed over 50,000 dental implants. He has also presented as a key lecturer at numerous international implant congresses.

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Dr. Safa Tafmasebi Completed his Bachelors degree in Biology and a minor in Biochemistry at Saint John’s University Queens New York in 2004 with a full scholarship based on academic performance. In 2005 he joined State University of New York at Buffalo School of Dental Medicine where he attained his Doctor of Dental Surgery and qualified as a Dentist in 2006. He joined the Albert Einstein Medical hospital of Montefiore in Bronx New York where he completed one-year hospital dentistry fellowship. In 2015 he completed three and half year full time training in prosthodontics and surgical training with a masters degree in prosthodontics at the West Virginia University School of dentistry. During this time He was an adjunct clinical instructor to the undergraduate programs at the WVU University. In 2015 he joined the SameDay Dental implants Bränemark Osseointegration Center (BOC) Dubai as a full time prosthodontist specializing in full mouth rehabilitation, immediate loading and Smile reconstruction.

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