INTRODUCTION
Long-term esthetic outcomes with dental implants have become the expected goal for both, the dentist and the patient. Factors that influence our success are multi-factorial and include a stable, mechanically sound bone architecture, which allows the proper placement of an implant with adequate primary stability. Sufficient initial stability allows the clinician to incorporate immediate loading where appropriate. The correct three-dimensional placement of the implant is of paramount importance, the mid pivot of the implant-abutment interface must lie within the prosthetic epicenter of the proposed restoration. An adequate quantity and quality of soft tissue volume is essential to create a biologic width especially at the gingival restorative interface. Ideally, early or one time placement of the abutment with minimal disruption is considered advantageous. Development of soft tissue contours with provisional restorations is considered to play a significant role. The transmucosal form, contours and material of construction of the abutments contribute to the formation of the biologic seal. And finally, maintenance of the final restoration is probably the most important aspect.

TREATMENT PLANNING
Treatment planning and diagnosis involve an interdisciplinary approach to optimize treatment outcomes. The initial diagnosis of primary disease cannot be overemphasized. Failing to plan usually means planning to fail.

EVIDENCE-BASED DENTISTRY
Evidence-based dentistry first and foremost, is a process of systematically finding, apprising and using the best available external clinical research and data for our clinical practice, incorporating our clinical expertise and experience and finally respecting the patients’ wishes. The strongest evidence we have are systematic reviews with a meta-analysis of the raw data, these would include randomized controlled clinical trials (RCTs). In an ideal world every clinical decision would be backed by such overwhelming evidence but the reality is different. The following presents the

CASE 1: Immediate implant placement after removal of a fractured lateral incisor (a to b); restoration of the Ankylos implant by utilizing a Cercon-abutment (c). Excellent esthetic long-term result with stable hard and soft tissues after eight years; note the natural appearance of the gingival contour achieved by following the described guidelines (d).
key factors for successful implant treatment and the related clinical data, which is a useful tool to choose both, the right implant and the ideal treatment protocol.

Preferably the implant system used in the daily routine supports the practitioner in the best way to achieve the treatment goal either from the dentists’ and the patients’ perspective. The following overview is visualizing how the Anyklos implant fits into these evidence based concepts.

The surface topography seems to play an important role in terms of successful osseointegration, particularly in challenging situations, such as insufficient bone quality or accelerated loading concepts. Published data is showing strong evidence, that rough surface types are superior to smooth surfaces with regard to overall success rates. However, doubts arose that the rougher surface types may trigger the establishment of periimplantitis, especially by utilizing an implant type with a somewhat rough collar, which is close to the soft tissue seal.

However, a systematic review by Esposito et al. entitled “Interventions for replacing missing teeth: different types of dental implants” found on the available results of RCTs, “that there is only limited evidence showing that implants with relatively smooth (turned) surfaces are less prone to lose bone due to chronic infection (periimplantitis) than implants with rougher surfaces”. On the other hand, the working group concluded that there is no evidence showing that any particular type of dental implant has superior long-term success. Since these findings are based on a few RCTs, with a high risk of bias, with only a few participants and relatively short observation periods, there is a need for more RCTs with follow-up of at least five years including a sufficient number of patients to detect a true difference.

**CURRENT KNOWLEDGE ON THE SUPPORT OF TISSUES**

The mystery of the so-called biologic width was disenchanted over the past years, whereas in 1997 Hermann et al. found that in all two part implant systems, placed in submerged and non-submerged protocols, the most coronal bone-to-implant contact was consistently located two millimeter below the microgap of the implant abutment interface.

Nevins and Stein in 1998 concluded, that the most important factor to consider when placing implants in the maxillary anterior segment is the vertical height of the alveolar process, and its relation to the proposed position of the final restoration.

Further studies carried out by Jemt and Lekholm in 2003 observed, that the papillae continue to improve over time whilst the mid facial aspect continues to recede caudally.

In 2011, Tsuda and co-workers studied the behavior of the facial gingival level around single immediately placed implants. They were able to show that the position could be maintained following the placement of connective tissue grafts, when proper three-dimensional placement of the implant has been achieved.

In the same year, studies carried out by Degidi revealed that “by placing an implant with a rigid offset conical connection in a submerged position of the implants resulted in bone being located above the implant shoulder”.

Atieh and his team performed in 2010 a systematic review and meta-analysis to observe the marginal bone preservation around platform-switched dental implants. They stated that platform-switching for maintaining crestal implant bone levels has gained popularity among implant manufacturers over the last few years. However, they are correctly summarizing the development of this concept as an incident, and the

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*Radiographic controls with stable crestal bone level on top of the implant shoulder: during the provisionalization phase (e), after delivery of the final restoration (f), after two years (g), four years (h), six years (i) and eight years (j and k) in function.*
assumption that the inward shifting of the implant-abutment junction may preserve crestal bone was primarily based on a chance finding rather than scientific evidence. The objectives of their study were to systematically review radiographic marginal bone-level changes and the survival of platform-switched implants compared to conventional platform-matched implants. Ten randomized-controlled studies with a total of 1,239 implants were included. Indeed, the marginal bone loss around platform-switched implants was significantly less than around platform-matched implants (mean differences/MD: -0.37; 95 percent; confidence intervals/CI: -0.55 to -0.20; <0.0001). There was no statistically significant difference for implant failures between the two groups. They concluded that the review and meta-analysis show, that platform-switching may preserve inter-implant bone height and soft tissue levels. The degree of marginal bone resorption seems to be inversely related to the extent of the implant-abutment mismatch.

CHECKLIST FOR IDEAL ESTHETIC RESULTS
An esthetic checklist has been established for natural teeth by Magne and Belser, which includes:
- gingival health
- interdental closure
- tooth axis
- zenith of gingival contour
- balance of gingival levels
- level of interdental contact
- relative tooth dimensions
- basic features of tooth form, tooth characterization, surface texture, color, incisal edge configuration
- upper and lower lip line and smile symmetry
Photographs comprehensively record all of the above (Figs. 1a to 1k)

IMPLANT PLACEMENT CRITERIA
The most significant predictors of a successful outcome are the criteria we adopt for the timing and accuracy of placement, and the ideal time for loading. Accurate three dimensional placement of the implant is critical. The harmony that exists between the surrounding bony housing and the supporting soft tissue must be maintained. The principles of biological harmony must be observed.

IMMEDIATELY PLACED IMPLANTS
In 2003, Schropp et al. published their observation that the preservation of the alveolar bone following tooth extraction facilitates the subsequent placement of dental implants and can
lead to an improved esthetic and functional prosthetic result. The results also demonstrated that major changes occurred during the first twelve months after tooth removal. These findings are confirmed by Araujo's group in 2005 and 2006. The early bone-to-implant contact achieved subsequently to implant placement is partially lost when placing the implant into the fresh alveolar socket, since during the socket-healing the buccal bone wall undergoes continued resorption. In contrast to the legacy opinion, the placement of an implant into the fresh extraction site fails to prevent the remodeling. The resulting height of the buccal and lingual walls after three months was similar at implants and edentulous sites. Moreover, the vertical bone loss was more pronounced at the buccal than the lingual aspect. This resulted in a marginal loss of osseointegration. It is suggested that the resorption of the socket walls that occurs following tooth removal must be considered in conjunction with implant placement in the fresh extraction sockets (Figs. 2a to 2h).

**EARLY PLACEMENT WITH GUIDED BONE REGENERATION (GBR) – SIX TO TWELVE WEEKS**

Studies by Buser et al. in 2002 and Donos et al. in 2004 observed up to five years follow-up on implants placed with simultaneous grafting procedures. Both groups were able to demonstrate that there was no difference in the outcome, when compared to groups without GBR procedures. Moreover, the results with GBR demonstrated no significant loss of crestal bone. In addition, a systematic review was carried out by Hämmerle et al. in 2002 “on the survival of implants in bone sites augmented with barrier membranes (guided bone regeneration) in partially edentulous patients”. The outcome measures were implant survival, described as presence of implant, implant success, absence of clinical implant mobility, absence of implant fracture, absence of progressive peri-implant crestal bone loss as assessed on radiographs without clinical signs of peri-implant infection, absence of peri-implant infection with suppuration. A total of eleven studies could be identified fulfilling the inclusion criteria. Cumulative success or survival rates, respectively, for implants in regenerated bone ranged from 100 to 79.4 percent after five years of function. Regarding survival data, no significant differences were found in the controlled clinical trials between implants in regenerated compared to implants in non-regenerated bone. Within the limits of this systematic review characterized by second and third levels of evidence, the following conclusions can be drawn: “The survival rate of implants placed into sites with regenerated/augmented bone using barrier membranes varied between 79 and 100 percent, with the majority of

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In this case an immediate implant placement was contra-indicated, due to the apical process. After removal of the severely decayed central incisor (a and b) the Ankylos implant was placed six weeks later (c). The buccal defects were grafted by the use of bone substitution material, which was covered by a resorbable membrane (d and e). After implant uncovery, the soft tissue contour was shaped by utilizing the provisional restorations (f to j). Final restoration in situ and radiographs after six years in function (k to m).
studies indicating more than 90 percent after at least one year of function. The survival rates obtained in the present systematic review are similar to those generally reported for implants placed conventionally into sites without the need for bone augmentation.” (Figs. 3a to 3m)

**DELAYED PLACEMENT AT A MINIMUM OF THREE MONTHS AFTER TOOTH EXTRACTION WITH A STAGED APPROACH**

In 2003 and 2005, Jemt and co-workers carried out measurements over a three and six year period of buccal tissue volume at single dental implant restorations after localized block bone grafting in the anterior maxilla.\(^{13,14}\)

They draw the conclusion that local bone grafting seems to be a valuable protocol to create sufficient bone volume for implant placement: “However, significant resorption of the graft occurs, which reduces the impact of grafting on the esthetic outcome. Instead, placement of the abutment cylinder and the crown seems to play a more important role for re-establishing the tissue volume at the implant-supported single crowns.”

A systematic review by Esposito in 2009 on the efficacy of horizontal and vertical bone augmentation procedures for dental implants concluded, that the findings are based on few trials including few patients, sometimes having a short follow-up, and often being judged to be at high risk of bias. Various techniques can augment bone horizontally and vertically, but it remains unclear which the most efficient ones are. Short implants appear to be a better alternative to vertical bone grafting of resorbed mandibles. Complications, especially for vertical augmentation, are common. Interestingly, some bone substitute materials could be a preferable alternative to autologous bone. Distraction osteogenesis allows for more vertical bone augmentation than other techniques, which, on the other hand, can allow for horizontal augmentation at the same time. Titanium screws may be preferable to resorbable screws to fixate onlay bone grafts.\(^{8}\) (Figs. 4a to 4i)

**ADJACENT IMPLANTS**

Various authors, such as Tarnow 1992 and 2000, or Schwartz-Arad and her group in 2007, have warned of the pitfalls associated with adjacent implants and the proximity limitations of three to four millimeter.\(^{15,20,21}\) Vela and Rodriguez in 2009 were able to show different results in conjunction with the use of platform-switching and adjacent implants. They concluded that the proximity of implants could be reduced and the amount of bone loss reduced as well.\(^{18}\) In 2010, a study by Novaes et al. demonstrated no loss of bone, where the proximity limitation of implants with a rigid conical platform offset implant was around one millimeter (Figs. 5a and 5b).\(^{4}\)

**SUMMARY OF KEY STEPS TO OPTIMIZE SOFT TISSUE WITH IMPLANTS IN THE ESTHETIC ZONE**

For long-term esthetic results the following guidelines should be followed:

1. Orthodontic extrusion prior to tooth extraction, where possible
3. Align the implant-abutment connection three millimeter apical and two millimeter palatal to final gingival margin
4. Thicken labial tissues (connective tissue graft or roll flap) only in case of inadequate attached keratinized mucosa

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4a to 4i. In this situation a staged-approach was indicated due to the enormous bone defect with loss of the complete buccal wall (a and b). The defect was grafted by utilizing an autogenous bone block subsequently to the tooth removal (c). After three months the Ankylos implant was placed and the buccal bone plate was stabilized with bone substitution material (d and e). The implant was uncovered another six months later, the maturation of the soft tissue was awaited and the final restoration inserted (f to g). The clinical and radiographical inspection revealed stable tissue levels after six years with an adequate esthetic appearance (h and i).
5. Utilize under-contoured or concave transmucosal components
6. Use of more biocompatible materials for the transmucosal components or abutment, for example zirconia, alumina or titanium, rather than gold, feldspathic porcelain, acrylic or composite material
7. Avoid repeated disconnection and reconnection of components, early or immediate placement of final abutment.
8. Develop soft tissue contours with provisionals.
9. Control and removal of cement excess at final cementation

CONCLUSION
Adopting and integrating a new implant system into a dental office can be a daunting task. A conceptual paradigm shift challenges that we consider to be state-of-the-art treatments. During the past ten years, I have examined the critical factors in long-term success and evaluated the esthetic outcomes. Utilizing contemporary restorative principles, I offer the reader a guide to a simplified treatment approach that produces the highest level of consistency. Passed in review the presented status quo in implantology and the related factors that decide on success or even failure of the treatment, it becomes obvious that the Ankylos implant perfectly meets the aforementioned requirements. This implant-system enables the user to achieve the desired results in all the described concepts. Interestingly enough, Ankylos was not designed due to scientific data and clinical findings. Moreover it was vice versa: it is owed to the smart inventors who were able to transfer the knowledge from technology to implantology combined with profound clinical understanding; but only now we are getting an almost complete picture why it works so well. The unique Ankylosophy – a reason for celebrating the 25th anniversary of the system.

References available on www.dentsply-friadent.com/identity
References

Ankylosophy: Decades of clinical excellence

Literaturverzeichnis
Ankylosophy: Jahrzehnte klinischer Kompetenz

I Nigel Saynor


