Primary stability vs. viable constraint: A need to redefine

By Michael R. Norton, BDS, FDS, RCS(Ed)

Any regular reader of the journal of Oral & Maxillofacial Implants or in-teresting stories emphasizing the need to establish mechanical stability to ensure uninterrupted healing of the bone. This was most evident in the orthopedic literature as it pertains to hip prostheses. By the 1990s, numerous reports were being published on immediate loading of dental implants, and the groundbreaking work by Neil Meredith on the application of resonance frequency analysis (RFA) came to the fore with statements that achievement of implant stability was a prerequisite for long-term positive outcomes. At the same time, Meredith recognized it was possible for clinically firm implants with poor axial stability to still be prone to failure. Of course, Brånemark recognized this in his early work, proposing as he did a period of submerged healing because of his concerns for any destabilization of the bone-to-implant interface during the early healing phase. However, today, we all recognize that such protective protocols are frequently unnecessary, with widespread acceptance of not only transmucosal healing but also immediate temporization and/or loading. So how do we define primary stability? The most simple definition is one of mechanical friction between the implant and bone. Certainly, we can all appreciate that this contrasts with secondary stability where secondary stability is achieved by biological integration, i.e., osseointegration. The gradual shift from primary stability to secondary stability is critically poised at around three weeks. This is seen to be the least stable time point where viscoelastic stress relaxation of the bone along with remodeling results in a loss of primary mechanical stability but with an as yet poorly established degree of secondary stability or osseointegration. This is also apparent in RFA curves, which, like a heartbeat, always register a certain pattern in healthy bone that reflects this loss of stability at the third or fourth week, regardless of bone density. That said, we still need to define what constitutes primary stability, i.e., that which sets it apart from biological integration. As stated above, mechanical stability is one where a friction occurs between the implant and the surrounding bone, giving rise to a resisting torque at time of insertion. This resisting torque is proportional to the effort required to seat the implant or peak insertion torque, they are in essence one and the same and depend largely on the characteristics of the implant, the density of the bone and the differential size of the osteotomy as it pertains to the diameter of the implant.

AAID: Digital implant dentistry isn’t the future

By AAID Staff

Digital implant dentistry is not the future. No, far from it. Digital implant dentistry is the here and now for dental implant practitioners. From digital treatment planning and delivery to patient communication, new technologies are changing the way dentists practice implant dentistry. The American Academy of Implant Dentistry will present a course titled “Implant Dentistry in the Digital World” in Baltimore from April 24-25.

In addition to offering 12 hours of C.E., the AAID is honoring Dr. Leonard Linkow, one of the pioneers of the field of dental implants, with a dinner on Friday, April 24.

The conference, which is co-hosted by the AAID’s Northeast and Southern Districts, will be held at the Marriott Inner Harbor at Camden Yards in Baltimore. More information and registration is available online at www.aaid.com.

The following programs are among those to be included:

• “CBCT Implant Planning: Digital Solutions from a Laboratory Perspective” (Joe “Ambrose” D’Ambrosia, CDT)
• “Reverse Engineering in Digital Smile Design” (Alain Méthot, DMD)
• “Innovations in Digital Implantology” (Gilbert Tremblay, DMD, FAAD, DABOI/ID)
• “Technology to Enhance Your Practice” (Marty Jablow, DMD)
• “Fixed Implant Prosthetic Considerations” (Shankar Iyer, DDS, MDS, FAAD, DABOI/ID)
• “Planning the Rehabilitation of an Edentulous Arch” (Lou Dipede, DMD)
• “Soft-Tissue Management in Implant Therapy” (Scott Ganz, DMD, DABOI/ID)
• “Protocols to Avoid Complications and Failures with the New Digital Workflow” (Scott Ganz, DMD)

Established in 1951, the AAID is the only dental implant organization that offers credentials recognized by federal and state courts as bona fide. Its membership, which exceeds 5,000, includes general dentists, oral surgeons, periodontists and prosthodontists from across the United States and in 40 other countries. For more information, contact AAID at aaid@aaid.com or at (312) 335-1550 or (877) 335-AAID (2245).
Mechanical fixation to full osseointegration in the shortest possible time. The most fascinating aspect of this debate is the lack of correlation between initial torque, implant stability quotient (ISQ) as measured by RFA, which appears to be counterintuitive. How is it possible for an implant that is driven in at 30 Ncm to have the same ISQ as one that required 100 Ncm of torque? None- theless, the weight of literature would seem to suggest this to be the case.

Because ISQ is measuring axial stiffness, it must be clear that frictional rota- tional resistance is a completely differ- ent parameter. After all, I don’t doubt we all have experienced the “spinner” (an implant that exhibits little or no rotato- rional stability) that went on to osseoin- tegrate, and there are a number of stud- ies published that report high success rates for immediately loaded implants that were inserted with low insertion torque.

By contrast, implants with an ISQ of less than 50 rarely go on to integrate suc- cessfully, and ISQ has been described as a good predictor of success. 2 It is this dichotomy that has got me thinking and has led me to write this editorial piece.

Could it be that axial stiffness is far more pertinent than rotational friction in en- suring an implant integrates? We already know from the literature that an implant can tolerate a degree of micro-motion, thought to be circa 200 μm, 3 and this is in essence what ISQ measures.

Studies have also demonstrated that insertion torque correlates closely to the degree of micro-motion. 4 However, it is not the aim to seek complete elimina- tion of micro-motion, a valuable lesson learned in orthopedics. 5 If it is possible to place an implant with lower insertion torque and still achieve axial stiffness with an ISQ >60, surely this provides us with a more optimal evaluation of pri- mary stability.

Our goal must be the rapid onset of secondary stability, with minimal criti- cal pressure to the poorly vascularised cortical bone so unfavorable reparative responses and delayed healing are avoid- ed. At the same time, we need to ensure an objective measure of constraint that reliably ensures the implant can tolerate early or immediate loading. 6

Bone is not wood. It is not inanimate. It would behoove us all to remember this, and avoid the dentist’s approach to implantology.

So I would take this opportunity to ask that we think in terms of viable con- straint. It will, of course, take controlled prospective studies to determine the optimal conditions for VS, but if we were a gambling man (which I most certainly am), I would guess for a 4 mm implant in bone with a cortex of 0.50 mm thickness that a maximum torque of 20 Ncm and an ISQ of 60 represent the optimal measures we are looking for to ensure safe immediate loading.

In the past, we used to think length was important with implants, whereas today there is increasing focus on short im- plants. However, I would point out that a strong correlation has been shown to ex- ist between ISQ and implant length,64 65 and, as such, for immediate loading, I also believe a longer implant with a higher ISQ, inserted at a lower insertion torque, will yield a more favorable out- come.

References available upon request from the publisher.

Note This content originally appeared as an editorial in The International Journal of Oral & Maxillofacial Implants, published by Quintessence Publishing.

About the author

DR. MICHAEL R. NORTON, BDS, MDS, RCS, Graduated from the University of Wales, School of Dental Medicine, in 1988. He runs a world-renowned prac- tice dedicated to implant and reconstructive den- tistry in Harley Street, London. He is a specialist oral surgeon and, in 2007, was awarded a presti- gious fellowship of the Royal College of Surgeons, Edinburgh, without examination, for his contribu- tion to the field of implant dentistry. In 2013, Nor- ton was appointed clinical professor at the Depar- tment of Periodontology at the Ivy League Dental School at the University of Pennsylvania.

For more than 20 years, Norton has led the way for implant dentistry in the United Kingdom, becom- ing one of the world’s most respected and re- named implant surgeons. His considerable port- folio of research has been groundbreaking, and he has become one of the most sought-after lecturers in his field. Since 1989, Norton has dedicated all his time to academic dentistry. In 2013, Norton was awarded a prestigious fellowship of the Royal College of Surgeons, Edinburgh, without examination, for his contri- bution to the field of implant dentistry. In 2013, Nor- ton was appointed clinical professor at the Depart- ment of Periodontology at the Ivy League Dental School at the University of Pennsylvania.

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D2

FROM PAGE 1


<STABILITY, Page D1>

Mathematically, it can be defined as fol- lows:

**Resisting torque** = μ · P · H · A · D

Where: **H =** height of the implant cylinder and an ISQ of 60 represents the optimal measures we are looking for to ensure safe immediate loading.

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