So, what do we know about implant dentistry?

This April saw the Association of Dental Implantology UK Team Congress held in Manchester. With the theme of ‘What we know, what we think we know and what we think we don’t know about implant dentistry’, the event saw more than 650 delegates come together to hear world-class speakers discuss the latest topics within implant dentistry.

It was interesting to see the sector breakdown of delegates – whilst more than 50 per cent of the attendees were clinicians, there was an even spread across other registered and non-registered groups. The one exception being dental nurses, which seems to show the changing views of the importance of teamworking in dental practice, especially in the more complicated areas of dentistry. This of course was complimented by the extensive dental implant team programme which ran alongside the plenary session. The attendee breakdown is as follows:

- 556 clinicians – 55.5%
- 45 technicians – 6.5%
- 167 nurses – 25%
- 48 practice managers – 7%
- 8 students – 1%

The speaker line-up itself was a global who’s who of implantology, with figures such as Tomas Albrektsson and Michel Magne taking to the podium. The team programme played host to names such as Ashley Latter, Louise Fletcher and Simon Wright, discussing topics ranging from team approaches in implant dentistry to medical emergencies, HTM01-05 to sinus lifts.

Plenary speakers included:

- Prof Tomas Albrektsson MD PhD OIhsc: How learning from past errors can guide the future of dental implants
- Mr Michel Magne MDT BS: Aesthetic dentistry today - a distinctive approach to nature
- Prof Mauricio Araújo DDS MS: PhD: Management of the alveolar socket
- Prof Clark M Stanford DDS PhD: Integrating the process predictable aesthetics into clinical practice
- Dr Stephen L Wheeler DDS: Immediate implant placement: is it safe and predictable?
- Prof Joseph Kan DDS MS: Implant papilla management in the aesthetic zone
- Mr Oliver Brix MDT: Oral Harmony: a systematic way to success
- Dr Stephen S Wallace DDS: Latest strategies and techniques for maxillary sinus augmentation
- Assoc Prof Tara Aghaloo DDS MD PhD: Bone grafts for site development - the past, the present and the future
- Prof Torsten Jemt DDS Odont Dr/PhD: Long-term experience of dental implants – clinical development and biological response

Dental implant team programme speakers included:

- Ms Anita H Daniels RDH: The team approach to implant dentistry: a blueprint for success and The role of the dental hygienist in implant treatment
- Mr Ashley Latter: Ringing the changes: turn every patient enquiry into an appointment
- Miss Helen McVicker: Asepsis for dental implants: the theory and Asepsis for dental implants: the practical
- Miss Louise Fletcher: Effective communication with patients
- Miss Helen Batty and Dr David Spreechley BDS DMI RCS Edinburgh: Advanced surgical techniques, instruments and preparation
- Miss Helen Frost, Miss Amy Miller and Dr Simon Wright BDS PGCTLEP FHEA PGDip Implant Dentistry: Medical emergencies in implant dentistry
- Miss Helen Batty: HTM01-05 and implant dentistry
- Miss Kara Moody: Sinus lifts

Sitting alongside the congress was an extensive exhibitor’s area, where delegates could discover the latest technologies on offer to make their
implant dentistry easier and more predictable. With more than 500 implant systems available worldwide and with this number growing, delegates were finding it helpful to speak to the teams behind some of the systems available in the UK. Representatives of the largest implant companies in the UK were there, including Astra Tech, Biohorizons, Nobel Biocare and Straumann. Other emerging systems were also on show, including Bicon, d2d Implants, DIO Implants, Implantium and Southern Implants.

ADI’s stand was prominent in both size and busyness, with many of the organisation’s staff and officers on hand to help with queries and showcase the many services and benefits ADI can offer its members. The main highlight of the stand was the launch of the association’s new online education resource Ark.

Ark comprises 15 individual courses, each covering a core topic within implant dentistry and is designed to meet the complex educational needs of today’s learners. It has been designed to incorporate a flexible approach so that learners can access individual modules or the whole course, and can access the learning at their own time and preference of learning opportunities: online, directed reading, study days and experience-based learning through mentoring.

Speaking at the congress, ADI President Dr Stephen Jacobs was delighted at the success of the event: “This is turning out to be a fantastic event. The speakers have really kept to the remit of reflection within the subject of implant dentistry.”

“There really isn’t a lot that’s new in implantology. Of course, with the advances in technology the accessibility for patients has improved as well as the predictability of the implant components.

“This year’s congress has been two years in the planning and I was delighted that every speaker we invited to take part was able to accept except one who could not make it.”

Dr Jacobs was keen to stress the importance of mentoring when developing the skills needed as an implant clinician, both in terms of patient safety and the clinician’s own needs. “Mentoring can often be more stressful for the mentor! The relationship between mentor and mentee is extremely important; it needs to be right.

“In a field such as implant dentistry mentoring is a fundamental facet to becoming competent, a patient’s well-being is paramount when performing this kind of treatment and the clinician needs to have confidence in their skills. Mentoring helps give that confidence.”

The congress was a vibrant and exciting event which delegates seem to thoroughly enjoy. Comments from attendees included: The congress exceeded my expectations - wonderful accessible venue, superb audio visuals, world class speakers, friendly sociable delegates, excellent standard of catering. All in all, the best dental convention I have attended.

Outstanding - best ever in all respects.

A very professional and organised congress - excellent overall and excellent speakers.

Very good event! The best ever done by ADI.

ADI President Elect, Professor Cemal Ucer will host the next ADI Team Congress in 2013 with the theme How long do implants last? Complications, risk management and prognosis. Save the date!

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Bone Harvesting—nice and easy
Dr Hohl and Dr Petersen discuss bone harvesting

The desire to use bone from your own body to build new bone in another place is almost as old as humanity itself. We call this procedure autologous bone grafting.

In the case of autologous bone grafting the bone is removed from the same organism that the graft is to be incorporated in. The body’s own bone cells have the greatest potency for rebuilding of bones and are the gold standard in oral augmentation surgery.

rated in. The body’s own bone cells have the greatest potency for rebuilding of bones and are the gold standard in oral augmentation surgery. Donor areas are: the tuber maxillae, the retromolar space, the chin region or the iliac crest, the ribs or the shin. Gaining the required quantity is sometimes elaborate (large surgical interventions, in patient stay) and afflicted with particular problems, especially when it comes from regions far away from the oral cavity (eg the iliac crest).

The extraction of autologous bone grafts from the retromolar space find the best acceptance with patients.

Particularly in implantology lateral augmentations are necessary in more than 75 per cent of cases. These augmentative measures mostly require low bone volumes of less than 0.5mg. If the decision is made intraoperatively, that the patient’s own bone must be used, this situation the question is raised of whether implantation and necessary augmentation of the crestal jaw line can occur synchronously.

It was planned for the patient to have autologous bone adhered in the region of the 051 vestibular. Hereby the right retromolar space and the right tuber area were considered as donor areas. The patient could be assured preoperatively that an extraction defect of bone extraction would only involve few complaint symptoms. Interoperatively the crestal incision was begun in the areas 031 and 041. After forming a minimally invasive mucoperiosteal flap, in particular region 051 showed strong vestibular atrophies. Initially implant drilling was carried out and the bore shaft was extended using bone condenser, ie the peri-implantational bone was condensed. Subsequently, the transplant bodies were inserted. Here it became obvious that the implant was 2/5 exposed on its vestibular side in region 051. Both implants were primarily stable. After measuring the missing bone volume, a stab incision was made in the right retromolar. Then a conventional implant drill was driven through the gap in his teeth in the regions 051, 041 to be filled with implants due to his otherwise intact dentition. However, in

'The body's own bone cells have the greatest potency for rebuilding of bones and are the gold standard in oral augmentation surgery.'

Case description
The 36-year old patient wants the gaps in his teeth in the regions 031, 041 to be filled with implants due to his otherwise intact dentition. However, in
the gums and drilled precisely 9mm deep. When withdrawing the drill the bone meal was already able to be retained. Additionally further spongiose bone was extracted with a mini-excavator.

The transplant bone was able to be absorbed into the implant body in an ideal manner. Finally a thin collagen membrane was applied for complete coverage. The soft tissue defects were closed with absorbable materials. The stab incision in the retromolar was glued with cyanoacrylate. In regions 031/041 the wound closure was carried out using absorbable suture material and horizontal mattress stitches.

Finally, as a provisional restoration, a Maryland temporary prosthesis was affixed, which additionally ensured a good soft tissue stabilisation. A digital volume tomography (DVT) was produced in order to evaluate the removal defect and document the augmentative result.

Summary

Autologous bone grafting represents the gold standard in augmentation surgery. Particularly with implant operations it is often only shown intraoperatively that a small quantity of autologous bone is needed for augmentation. In this situation quick reaction is often indicated. The retromolar space is frequented most often for this purpose. As the patient should have the least possible discomfort due to the bone extraction, minimally invasive procedures are the means of choice.

The technique presented above is a new method which is impressive due to its minimally invasive and simple characteristics. The shown procedure is especially ideal for augmentation planning with volumes up to 0.5mg. Of course larger bone volumes can also be extracted using this minimally invasive method. Soft tissues can be closed discreetly and so that they are hardly noticeable to the patient using adhesive techniques. Minimally invasive procedures in implantology can be perfectly planned and executed by including modern 3-D-diagnostics (DVT).

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Fig 14 - A. Initial situation in region 031,041. State 3 months after the removal of the teeth 31, 41. In region 041 the vestibular lamella has completely collapsed.
Fig 3. Noticeably visible three wall bone defect in region 041 vestibular.
Fig 2. After drilling the implant shafts, region 031 showed to be significantly atrophied.
Fig 4. The implant shafts are dilated using condensers and the perimplantational bone is condensed.
Fig 5. Stab incision in the regions 031, 041. In region 031 it is visible that a vestibular augmentation must take place.
Fig 6. The implant body in region 031 must be vestibularly covered with autologous bone over approx. 2/3 of its surface.
Fig 7. Stab incision in the region 041, 041. In region 041 it is visible that a vestibular augmentation must take place.
Fig 8. After drilling the implant shafts, region 041 showed to be significantly atrophied.
Fig 9. The implant shafts are dilated using condensers and the perimplantational bone is condensed.
Fig 10. Bone excavation via simple shaft drilling with the conventional “two spade drill”.
Fig 11. Additional bone excavation by hollowing out the shaft drill hole in the linea obliqua with the excavator.
Fig 12. Implants and autologous bone augmentation in situ. In order to achieve this result it was only necessary to drill into the Retromolar space.
Fig 13. Covering the implants and augmentations with a simple collagen membrane.
Fig 14 - A. The stab incision of the retromolar extraction region is glued with cyanoacrylate. Hereby the patient only incurs a microscopic extraction defect.
Fig 15. The soft tissue in the implant region is closed with absorbable suture material. The neighbouring teeth 32,33 are lingually cauterised.
Fig 16. Insertion of a Maryland provisional prosthesis, directly after the augmentative-implantological intervention.
Fig 17. DVT of excavation defect.
The concept of “platform switching” in implant dentistry: A literature review—Part I

Virgil Koszegi Stoianov, Romania reviews the latest literature

Over the last decades, osseointegrated dental implants have proven to be highly predictable and largely accepted as treatment modality for the rehabilitation of partially and completely edentulous jaws.

Being considered the most aesthetic and functional alternative to missing teeth, dental implants are used as prosthetic supports and expected to withstand complex occlusal load. However, they also have to confront the effects of additional factors such as oral microflora or elevated parafunctional forces.

Several factors such as implant design and surface, implant abutment interface or connection, bone architecture, prosthodontic restoration type and loading conditions may have effect on bone modelling and remodelling around the implants.

The generally accepted criterion for implant success is that less than 0.2 mm of alveolar bone loss per year should occur after the first year in function. What is overlooked, however, is that the implant therapy success is determined after the first year of service because most of the bone loss occurs during the first 12 months following abutment connection.

Therefore, the 2 mm loss of crestal bone over the first year might be considered a normal characteristic of a healthily functioning implant and this change in bone height is merely due to remodelling in response to loading.

The questions that need to be redressed are whether this small amount of bone loss exerts any clinical significance and whether it can be considered acceptable.

Dental implants have two goals to fulfil: an aesthetic one and functional one. The loss of crestal bone and soft tissue may have important implications for aesthetic implant restorations, which are reliant on healthy and constant soft tissue dimensions over time. The aesthetic replacement of teeth has become an important standard for implant dentistry, leading to further research regarding the factors contributing to crestal bone loss around two stage implants (Fig. 1).

Bone adaptation under loading conditions

Bone is a tissue that changes its mass and internal architecture adapting itself to the loading conditions. According to Wolff’s law, every change in the form and function of bone is followed by modifications in its internal architecture and external configuration. The dimensions and orientation of trabeculae are adaptable in accordance with changes in loading-trajectory vectors and, when equilibrium is found, trabecular patterning represents the average regime experienced by the bone.

Mechanical stimuli affect bone response and exert influence on the replication and differentiation of mesenchymal cells toward the osteoblast lineage.

Frost’s theory

Frost stated that bone mass changes when absolute peak strains induced inside the bone fall either below or above the physiological window estimated between 200 and 1,500 microstrains.

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The application of this theory (Fig. 2) to dental implant rehabilitation explains bone resorption at the crestal level of loaded implants, a condition that may occur because of the stress shielding effect, due to both the solid metal structure of the implant and the implant design. These features can play a role on load transfer to the bone, reducing strain magnitude under the lower physiologic threshold and, thus, promoting osteoclast resorption at the crestal level.

Implants with a slim design at the crestal level, for example, demonstrate a wide bone formation, corroborating Frost’s theory.

Effect of implant geometry

Implant design consists of the combination of the implant body three-dimensional geometry, presence of threads, thread design, surface topography and surface treatments that may affect strain stimulation of peri-implant bone.20

Finite element analysis is reported that tapered implants present a better mechanical performance than cylindrical implants to avoid punching stresses.21, 22 It has been demonstrated that threads and their location on the implant body have a role in the load transferring pressure patterns to the bone.23

The outcome of comparative clinical research on different implant systems have reported analogous marginal bone loss per year (1–3), even if smooth surfaced implants with a conical collar have demonstrated higher bone loss than self-tapping and standard implants.29, 30

In this respect, marginal bone loss might be primarily related to the smoothness of the implant surface, leading to stress protection, and thus, to bone resorption (bone shielding).31

Effect of the implant surface on the peri-implant bone

Surface microgeography plays a primary role in facilitating biological interactions between bone precursor cells and implant. Rough implant surfaces facilitate high osteoblast adhesion levels24, and since osteoblasts are spread on implant surfaces, the roughness seems to induce osteoblasts toward synthesis and the release of biological factors affecting the tissue response at the interface. Surface roughness is a crucial factor affecting bone apposition at the interface and improving the interface resistance because of better mechanical interlocking.

However, increased bone mass around rough surfaces may also be attributed to a lower bone remodelling level during the early stages of implantation, as reported in a comparative research study between plasma sprayed and smooth surfaced implants.25, 26

A poor implant design like smooth machined coronal part could be related to a reduction in mechanical interlocking between implant and crestal bone, acting like a stress shield and inducing crestal bone loss.27, 28

The stability of the peri-implant cervical bone around the neck of the implant and the absence of resorption are the key to maintaining gingival papillae and bone in the anterior region.

According to reference literature, several changes should occur after abutment connection. Bone resorption of approximately...
31, 41. In region 041 the vestibular lamella has completely collapsed.

Figs. 1 & 2_Initial situation in region 031, 041. State 3 months after the removal of the teeth and abutments on larger platforms.4, 5

Restored with smaller-diameter implants, following loading, or elimination when implants are surgical stage two, may be reduced or eliminated when implants are restored with smaller-diameter abutments on larger platforms.4, 5

The interface between abutment implant and the microgap, is subject to micro movements and bacterial seeding, and, if it lies at or below the crest of the bone, prompts osseous resorption for these reasons. Bone preserving techniques such as platform switching have been utilised for more than ten years (Fig. 5).

The answer to these questions may be of an important support in choosing the implantsystem, ableto switch the platform, which can face high implant–aesthetic demands.

Is the concept of platform switching a bone preserving technique, and, if so, it is reproducible?

Is this concept alone able to preserve bone?

Is the platform switching concept evidence based?

Materials and methods

The aim and objectives of this review have been to examine the scientific validity of claims that platform switching concept improves implant performance, being a bone preserving technique.

These claims have been analysed against historic back-ground, findings and conclusions of published implant studies.

A literature search of paper published in reference journals in the English language was performed by computer using the National Library of Health.

PubMed search for the key words “implant platform switching concept” ended in 10 and Google Scholar in 5,110 results for the same key words in 0.07 seconds.

These results show an ever-growing interest in this subject which is very challenging for the peer reviewed literature to keep up with.


The finding that some of the implants have demonstrated bone above the level of the microgap cast doubt on the theory of bio-logic width, with regard to the influence of the location of the implant-abutment microgap which requires re-evaluation.

J Periodontol. 2001 Oct

Hermann JS, Schoofield JD, Schenk RK, Buser D, Cochran DL. Influence of the size of the microgap on crestal bone changes around titanium implants. A histometric evaluation of unloaded non-submerged implants in canine mandible.

Results: All implants in the non-welded group had significantly increased amounts of crestal bone loss compared to the welded group. These findings demonstrate that crestal bone changes around 2-piece non-submerged titanium implants are significantly influenced by possible movements between implants and abutments, but not by the size of the microgap. Significant crestal bone loss occurs in 2-piece implant configurations even with the smallest sized microgaps (<30 micron) in combination with possible movements between implant components.

Tables have been drawn up using data and findings extracted from relevant studies, further compared and analysed in view of establishing a final conclusion.

Results

Table 1

| Table 1 | Jomi 2009; 24:105–109 | Paolo Vigole, Andrea Givani |

Platform Switched Restorations on Wide-Diameter Implants: A five-year Clinical Prospective Study

Result: Statistically significant differences in marginal bone loss have been observed between implants with platform switching (0.6 mm; SD 0.2 mm) and implants with the same abutment platform (0.9 mm; SD 0.5 mm)

Table 2


Peri-implant bone level around implants with platform switched abutments: Preliminary data from a prospective study

Result: The concept of platform switching appears to limit crestal resorption and seems to preserve peri-implant bone levels. Significant differences concerning the peri-implant bone height in PS compared to non PS implants are still evident one year after final restorations.

Table 5

| Table 5 | Jomi 2007;22:995–1000 | Luigi Camillo, Giulio Rasperini |

Preservation of Peri-implant Soft and Hard Tissues Using Platform Switching of Implants Placed in Immediate Extraction Sockets: A Proof-of-Concept Study with 12—36 months follow-up

Result: Post-extractive immediate implants with platform switching can preserve hard and soft tissues and, therefore, may provide better aesthetic outcomes.

Table 6

| Table 6 | JOMI 2006; 21:777–784 | Michael R. Norton |

Multiple Single-Tooth Restorations in the Posterior Jaws: Maintenance of Marginal Bone Levels with Reference to the Implant—Abutment Microgap

Result: The way in which bone responds around an implant may be due to multiple factors. It is also plausible that the tight conical joint, with its high resistance to bending moments and a microgap of only 2—3 microns, contribute significantly to the maintenance of marginal bone.

With an overall mean marginal bone loss of only 0.05 mm from the microgap the data of this study is in close agreement with numerous studies on the Astrotile System.

The finding that some of the implants have demonstrated bone above the level of the microgap cast doubt on the theory of bio-logic width, with regard to the influence of the location of the implant-abutment microgap which requires re-evaluation.

Table 7

| Table 7 | Int. J Periodontics/Restorative Dent. 2008 Ang | Cappiochi M, Luongo R, Di Iorio D, Bugaæ C, Cocchetto R, Calleri R. |

Evaluation of Peri-Implant Bone Loss around Platform-switched implants

Result: This data confirm the important role of the microgap between the implant and abutment in the remodeling of the peri-implant crestal bone.

Platform switching seems to reduce peri-implant crestal bone resorption and increase long-term predictability of implant therapy.

Table 8

| Table 8 | J Periodontol. 2001 Oct | Hermann JS, Schoofield JD, Schenk RK, Buser D, Cochran DL |

Influence of the size of the microgap on crestal bone changes around titanium implants. A histometric evaluation of unloaded non-submerged implants in canine mandible.
There is an association between bone and soft tissue preservation around implants with direct influence on aesthetics. Some authors have proposed different methods to maintain supporting bone: improved implant micro-geometry and implant surface treatment, improved implant abutment connection (elimination of bacterial reservoir, absence of movements under bending forces) as well as the use of wide implants with smaller-sized abutments (platform switching concept).

An alternative in preserving marginal bone levels around implants is the platform switching concept that refers to the use of a smaller diameter abutment on a larger diameter implant platform. This connection shifts the perimeter of the implant-abutment junction (IAJ) inward towards the central implant axis. Lazzara and Porter demonstrated that the inward movement of IAJ also shifts the inflammatory cell infiltrate inward and away from the bone implant interface, creating a horizontal biological width that will limit bone resorption around the coronal aspect of the implant.

From a biomechanical perspective, stress in the bone is concentrated around the crestal region because of the difference in modulus of elasticity between bone and implant, as demonstrated in photoelastic and finite element analysis studies.

Peak bone stresses occurring in marginal bone have been hypothesised to cause bone micro-fracture and may be responsible, at least partially, for peri-implant bone loss with saucerisation patterns after prosthetic loading.

The issue of whether platform switching may affect the biomechanical stable connection and a more retentive surface on the implant collar has not been demonstrated yet.

The original criteria established for assessing implant success and survival identified marginal bone levels as an important indicator for measuring the response of the peri-implant tissues to functional loading.

More recent studies have considered the effect of stresses established in bone by the direct influence of non-passive prosthetic work to be a causative factor in marginal bone loss.

Another more recent explanation of marginal bone loss is the theory of establishing the biologic width directly related to the position of the implant-abutment microgap and its associated microbial flora.

In addition, some studies have shown that certain designs in the geometry of implant coronal part may contribute to bone loss, while other studies have indicated that such bone loss can be prevented by incorporating a bio-

Prevention of horizontal and vertical marginal peri-implant bone resorption during the post-loading period is fundamental in maintaining stable gingival levels around implant-supported restorations. It has been demonstrated that peri-implant marginal bone loss is time-related with significantly more acute bone loss during the preloading period than in the following loading phases (two years after surgery) and also during the first year after loading (six months to one year after surgery) than in the second one (one year to two years after surgery).

Aesthetic outcomes cannot be attributed to a single parameter. They are the result of a number of important factors, especially in the aesthetic area.

Both biologic width and the integration of platform switching concept are of utmost significance in preserving a stable marginal bone level around implant neck. It is important to understand mainly the meaning of biologic width. Hence, the stable bone serves as a support for the soft tissue determining the long-term aesthetic and functional treatment, the outcome stability being ensured in this manner.
The following points should be noted:

- The use of a single post for temporary and final prosthetic work
- As long as the frequent replacement of parts is not avoided, repeated destruction of the connective tissue attachment of the biologic width occurs increasing the risk of bone resorption

A special implant and abutment design (a ledge and integration of the biologic width/tapered shape of the post) facilitates nonsurgical lengthening and thickening of the peri-implant soft tissue.

This leads to the establishment of a wider and more resistant zone of connective tissue. A micro-rough and nano-rough titanium surface extending to the implant shoulder in conjunction with the platform switching concept provides osseous integration along the entire length of the implant.

A fine thread optimally distributes the masticatory forces in the region of the implant neck, avoiding further bone loss in this region.

Possible interactions amongst factors contributing to peri-implant bone loss

These factors include:
- Surgical and anatomical considerations such as mucoperiosteal flap design, thickness of buccal and lingual cortical plates of bone remaining after osteotomy preparation, bone quality, healing technique submerged or nonsubmerged, early unintentional cover screw exposure by mucosal dehiscence and amount of keratinized Gingiva
- Patient risk factors such as medical and pharmacological status, habits including cigarette smoking, poor oral hygiene, excessive alcohol consumption, mucosal erosive pathology like lichen planus, previous or present periodontitis (chronic or aggressive);
- Biologic width related factors such as level of the micro-gap, platform switching and implant-tooth or implant-implant distance
- Implant design including geometry, surface, length and diameter
- Biomechanical factors including time of loading, type of loading, type of prosthesis, habits like bruxism

Flap design

It was reported in the literature long time ago that, whenever a mucoperiosteal flap is reflected about a tooth, some crestal bone resorption will occur. Similarly elevating a flap to place a dental implant will lead to crestal bone loss and there is evidence suggesting a direct relationship between size of full thickness flap and the resulting post-op bone loss.

Other studies reported no statistically significant differences using more traditional histological evaluation of retrieved specimens after 12 weeks of site healing. Becker reported the same magnitude of difference in buccal vertical implants bone loss as Jeong, one millimeter less for flapless approach.

Alveolar bone thickness

The main blood supply for buccal alveolar bone is supplied by vessels in the overlying mucoperiosteum and is greatly affected by elevating a full thickness flap to facilitate placement of a dental implant. Studies suggest that if residual faci al bone thickness is less than 2mm and/or if dehiscences or fenestrations of facial bone occurred during osteoto-
my preparation, consideration should be given to augmenting facial bone thickness with GBR procedures. 53, 54

Premature exposure of an implant cover screw through the overlying mucosa may result where mucosal tissues fail to achieve primary closure, or are too thin to avoid dehiscence, or have been traumatised with the transitional prosthesis. It was reported in the literature that patients with prematurely exposed cover screws suffered 5.9 times greater bone loss than nonexposed ones. 37

Quantity of keratinised tissue

Adequate keratinised tissue may be more important around implants than natural teeth for several reasons: supracrestal collagen fibers are oriented in a parallel rather than in a perpendicular configuration adjacent to transmucosal surfaces of implants, providing less resistance to local trauma and microbial penetration. Periimplant mucosa may have a reduced capacity to regenerate itself due to compromised number of cells and poor vascular supply. 39

Oral hygiene, smoking, alcohol abuse

Patients with poor oral hygiene and/or existing periodontal disease experience greater periimplant crestal bone loss than patients with good oral hygiene and stable periodontal status. Both current and lifetime cigarette are associated with deterioration in bone quality and impaired wound heal-

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Smoking has been shown to be one of the most significant factors predisposing to implant failure. Individuals who use alcohol in excess may have inadequate nutrition including vitamin deficits which may compromise initial site healing.

Diabetes
It is well known that diabetic patients are at higher risk for developing periodontitis and are also more prone to infection. It is very likely that performance of dental implant will be affected as well. Poor metabolic control in diabetic patients increases the risk of peri-implantitis.

**Biologic width**
Crestal bone remodeling to establish “biologic width” or soft tissue seal in peri-implant mucosal tissues is considered to be an important factor contributing to early crestal bone loss with all types of endosseous dental implants (Fig. 4). Factors known to affect this crestal bone loss include the level of micro-gap in relation to the bone crest, platform switching achieved either by implant body design and/or by using an abutment smaller in diameter than the implant body and tooth-implant or inter-implant horizontal distance. Another factor with deleterious effect on crestal bone resorption is considered to be the repeated removal and re-placement of abutments because of disruption of the soft tissue seal.

**Level of the micro-gap**
The connection between implant body and prosthetic abutment is termed “micro-gap” and, in most cases, it is susceptible to microbial seeding and micro-movements between the parts during clinical function. Both micro-gap and micro-movements may lead to localized inflammation and associated crestal bone loss if the micro-gap is within a minimum distance from the alveolar crest. Biologic width around the neck of a dental implant constitutes a mucosal seal intended to protect the underlying bone. It is formed apically to the micro-gap and requires a minimum of about 1.5mm of fibrous connective tissue between bone and epithelial attachment of the gingival sulcus of the implant (Fig. 5).

**Platform switching**
This design feature can be created in an implant body or achieved by the clinician using a compatible abutment of a narrower diameter than the implant platform. It can be acquired even with the healing abutment or inter-implant horizontal distance.

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the stress concentration away from the cervical bone-implant interface. 50

Generally, the horizontal component created by platform switching is around 0.5mm (Fig. 6), sufficient to result in significantly less radiologically detectable crestal bone loss in humans. 51, 52 Not only does this concept reduce the risk of peri-implantitis in the future but also has the benefit in the aesthetic zone of providing better soft tissue support. 53

**Implant-tooth or inter-implant distance**

For single tooth dental implants, a minimum horizontal distance of 1.5mm must be left between the implant and the two approximating tooth root surfaces in order to avoid crestal bone loss after biologic width accommodation. When two implants are placed side by side, the crestal bone loss that occurs between them has a more complicated etiology. A clear tendency for increased inter-implant vertical bone loss occurs as the distance between two implants decreases below 5mm. 54, 55

Histological data from animal experiments using 2-piece, moderately rough surface, submerged implants, showed that vertical inter-implant bone loss decreased from 1.98mm for a 2mm inter-implant distance to 0.23mm for 5mm inter-implant distance. 56

**Conclusion**

Significant differences in marginal bone loss have been identified between implants with platform switching and implants without platform switching only in the first year after loading. It may be concluded that the platform switching concept represents a bone preserving technique. Preservation of crestal bone around dental implants cannot be attributed to a single parameter. That is the result of a number of important factors, especially in the challenging aesthetic zone.

It is important to understand the mechanism that permits the implant-abutment connection to maintain a seal against the bacterial ingress before and after loading due to absence of micromovements. An appropriate understanding of the importance of biologic width and the use of platform switching concept in the routine treatment is of real support in maintaining a more stable marginal bone level around implants.

This stable marginal bone as a support of the soft tissue is determinant for the long-term aesthetic stability. Further neutral clinical studies are required to demonstrate the importance of micro-gap, biologic width and platform-switching in crestal bone preservation around dental implants.

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Editorial note: The literature list can be requested from the author.

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