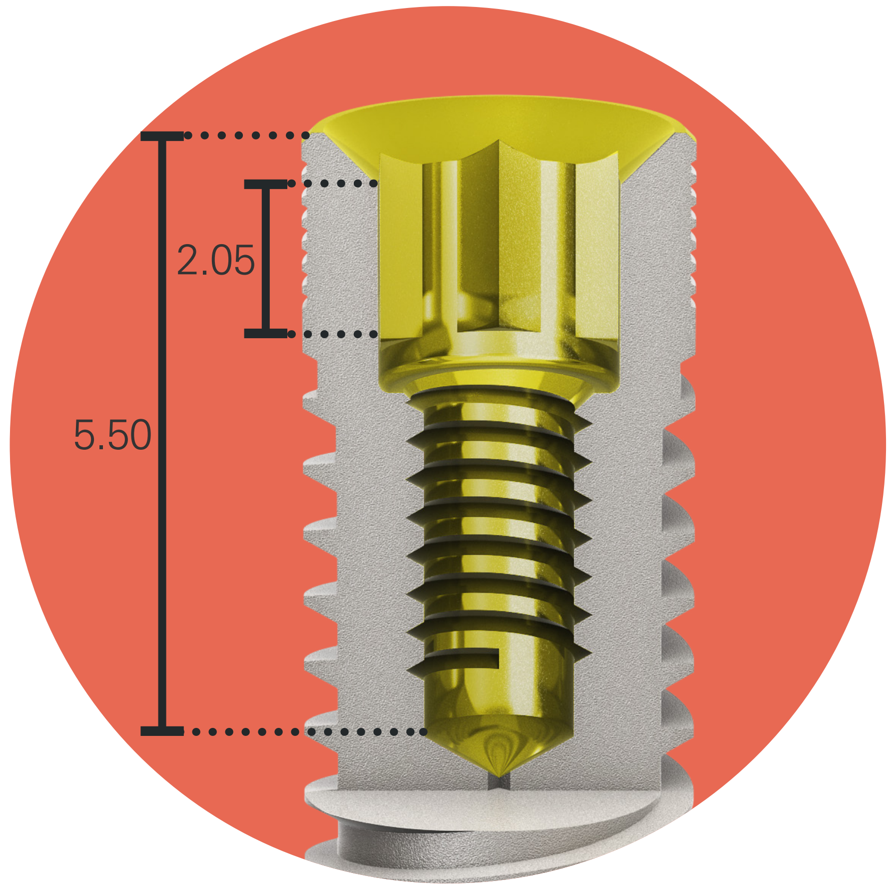
InternalFIT™ Mini Review

Simplicity made accessible.

DISCOVER

Internal Hexagon Connection (IF)

The first internal implant-abutment connection had a deep hexagonal mechanism inside the implant body [1] (Figure 1), developed to resist to high torques when placing the implant. **NUVO™ Internal**FIT™ was developed to resist high insertion and torsion forces (Table 1) maintaining the system's mechanical stability, resulting in surgical safety. Also, internal hexagon implants decrease the rotational freedom between the implant and the abutment [2]. The large implant-abutment contact area dissipates peak stress, consequently reducing screw loosening incidences [3,4]. To screw the abutment into the implant, **NUVO™** system offers a single screw driver for all the prosthetic components, which makes the work simple, fast and versatile.



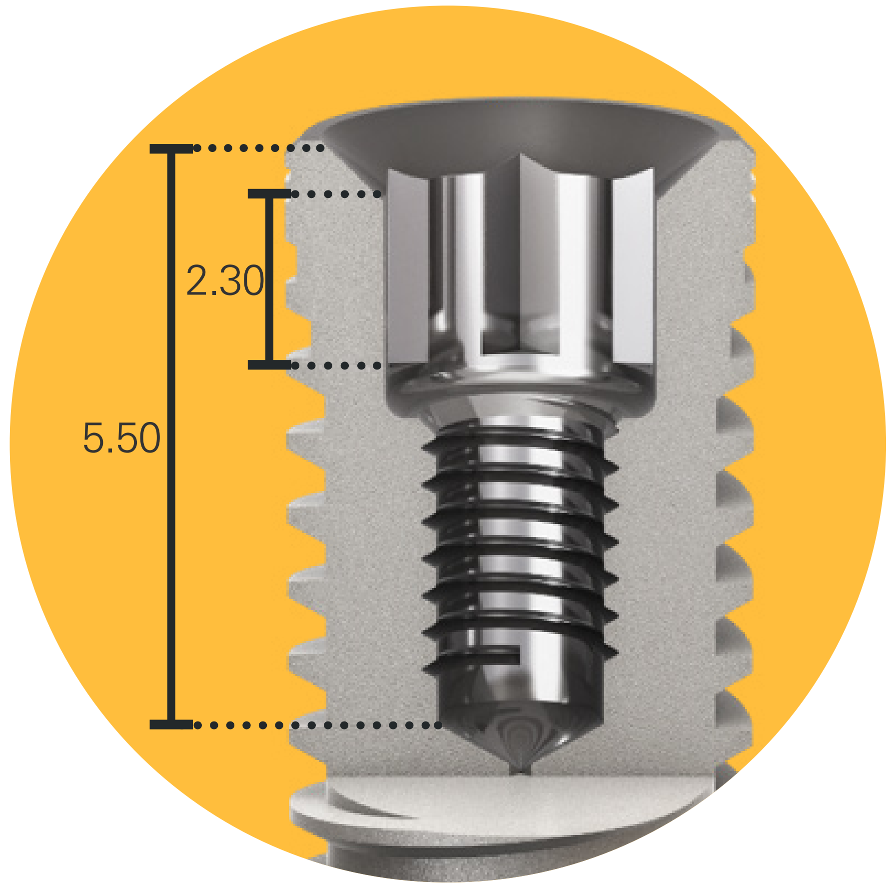


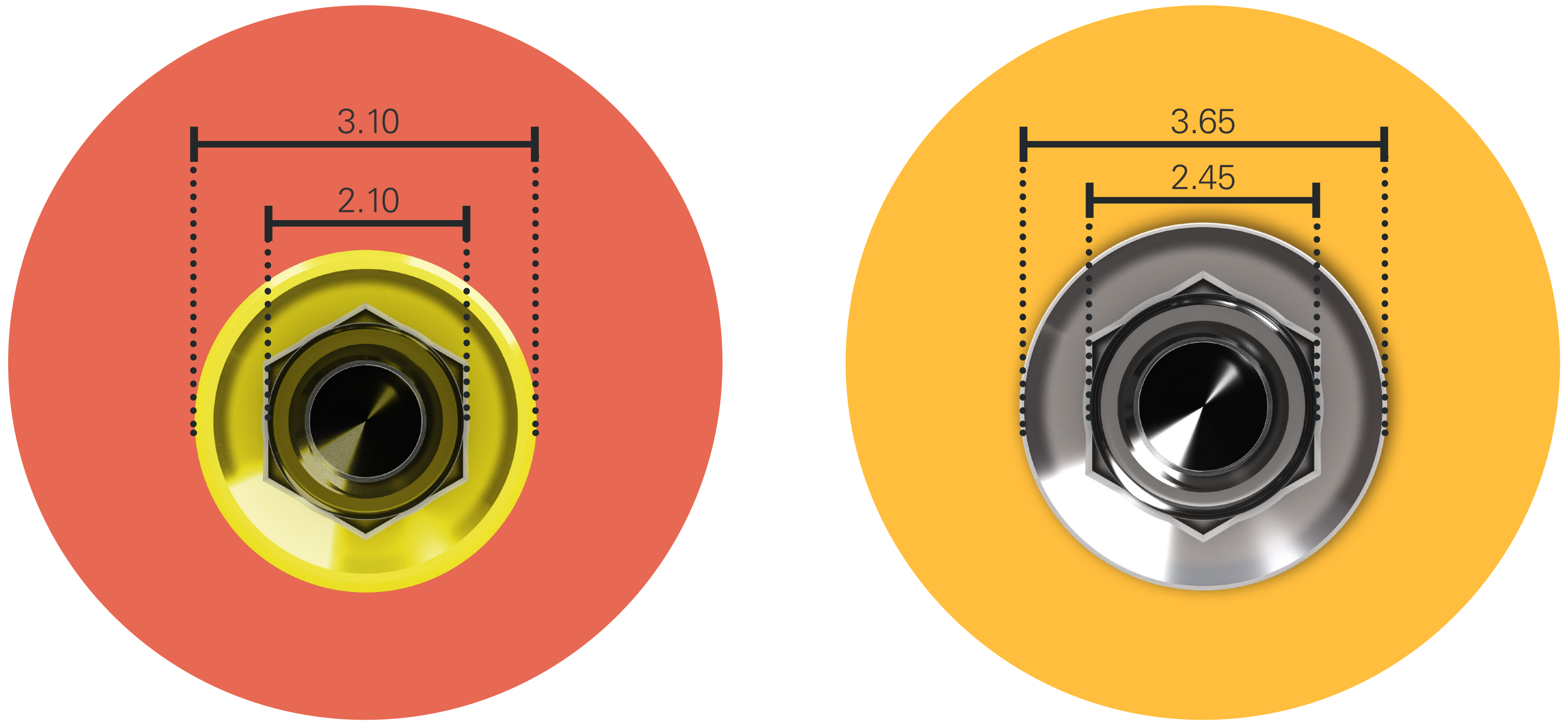
Figure 1: NUVO™ InternalFit™ NP and SP Implant body.

InternalFIT™ was designed according to the concept of platform switching [5,6], when an abutment is narrower than the implant platform, potentially avoiding periimplant bone loss (Figure 2). Authors suggest this happens because the biological width can be established horizontally, since there is more horizontal space for the soft tissue to attach [5]. It also contributes to decreasing abutment micromovements during functional loading [7] and finally, due to the the possibility of an abutment with a smaller prosthetic platform diameter [8], the clinician will have additional treatment options to use in instances where large diameter implants are indicated for use.

Figure 2: Platform Switching – NUVO™ InternalFit™ SP Ø5.0. Abutment with smaller diameter than the implant platform.

Another **NUVO™** implant characteristic that simplifies the treatment is the color-coded narrow platform (NP). The implants have two prosthetic platform diameters, NP - 3.1 mm (for implant diameter 3.5 mm) which has a yellow color (Figure 3), and standard platform (SP) – 3.65 mm platform (for implant diameters 3.75, 4.3 and 5.0 mm) (Figure 3). The yellow color identifies all the NP platforms, on the implant and abutments, making the clinical procedures easier and faster.

Gathering all the internal hexagon benefits and **NUVO™ Internal**FIT™ implant advantages, it is an excellent and versatile system for clinicians to use.



NP SP

Figure 3: NUVO™ InternalFit™ Internal hexagon.

Implant Design

The interaction between bone and an implant is a crucial point for implant treatment success. A prerequisite for osseointegration is primary stability [9]. It could be explained by the mechanical interaction between bone and implant during the surgical insertion [10]. Some implant characteristics are directly related to this mechanical interaction, such as the macro-geometry of the implant (shape, thread, diameter and length) [11].

The **NUVO™** system has a double threaded, apically tapered implant body (Figure 4), developed to achieve high insertion torque with fast insertion, consequently providing primary stability, resulting in an improved implant success rate [7,12,13]. Tapered implants have a design similar to tooth roots [14], making it easier to be placed between two teeth. Also, conical implants result in a faster implant placement than cylindrical due to the relation between the osteotomy and the implant shape (Figure 5).

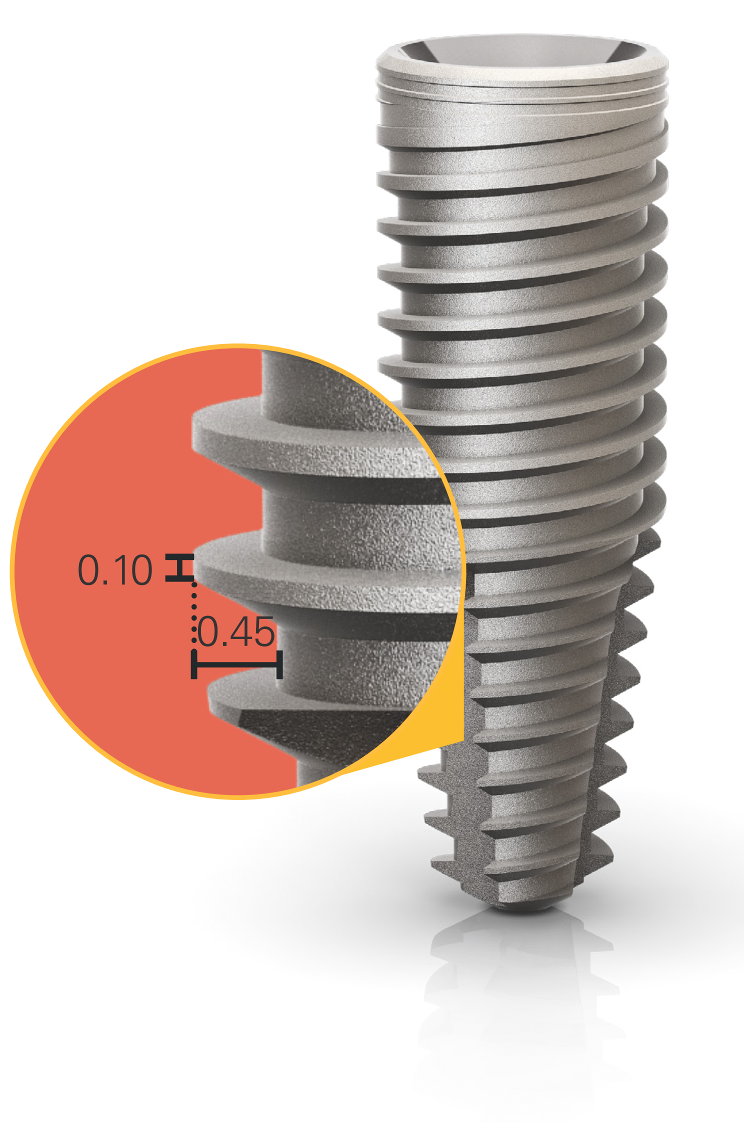


Figure 4: NUVO™'s thread characteristics.

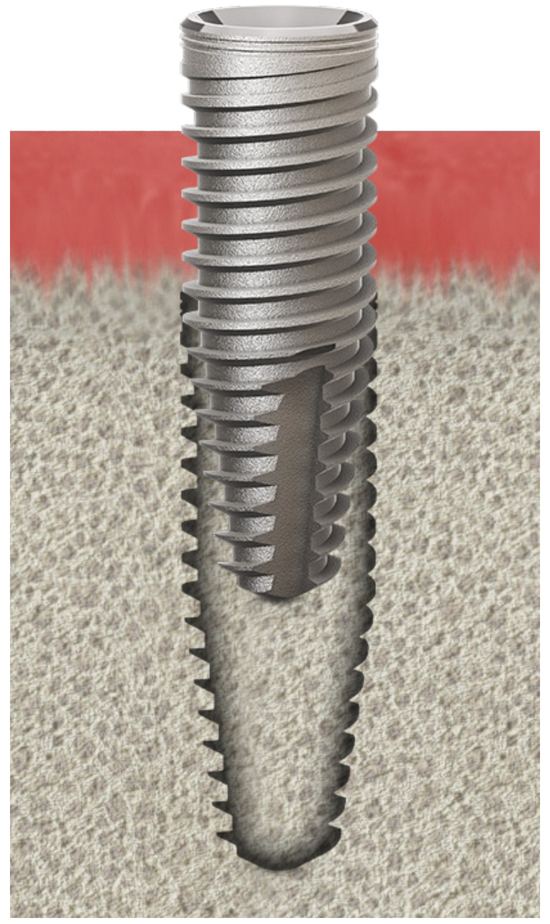


Figure 5: Tapered and conical implant design versus osteotomy.

A straightforward color coded surgical cassette with a reduced number of drills was developed for ease of use when placing **NUVO** implants.

The high insertion torque can be related to the screw thread geometry, which can provide larger contact area with the host tissue [15], improving load distribution. The threads will also facilitate dissipation of loads at the bone by converting the occlusal loads into more favorable compressive force at the bone interface [16,17,18]. The design of the screw thread geometry provides a larger contact area with the host tissue, creating high insertion torque for the implant when placed.

Matching the macro-geometry of **NUVO™** implants with the correct abutment choice, can result in a functional, asthetic and comfortable restoration for the patient.

Figure 6-A: Surgical Kit – NUVO™ InternalFit™.

Figure 6-B: Narrow (yellow) and standard implant driver for ratchet – NUVO™ InternalFit™.

Surface

Restoring missing teeth with dental implants has proven to be an effective way of rehabilitation. When trying to achieve a successful treatment, osseointegration is vital [19] and can be described by the connection between the newly formed bone and the implant surface. Osseointegration occurs by the formation of new bone or osteogenesis, specifically contact and distance osteogenesis. When the bone generation starts from osteogenic cells that grow on the implant surface, this is called contact osteogenesis [20].

The first important thing to evaluate, is the raw material. Currently, the majority of implant manufacturers use commercially pure titanium (Ti G1 to G4) or Ti-6Al-4V (Ti G5) with surface treatment to optimize the contact between bone and implant [21]. The composition of the different titanium alloys is described in Table 2.

	N	C	H	Fe	O	V	Al	Ti
Ti G1	0,03	0,08	0,010-0,015	0,20	0,18	-	-	Balanced
Ti G2	0,03	0,08	0,010-0,015	0,30	0,25	-	-	Balanced
Ti G3	0,05	0,08	0,010-0,015	0,30	0,50	-	-	Balanced
Ti G4	0,05	0,08	0,010-0,015	0,50	0,40	-	-	Balanced
Ti-6Al-4V	0,02	0,01	0,003	0,22	0,17	3,8	6,2	Balanced

Table 2. *Maximum value. Mass %.

Ti G5 has some challenges when compared to Ti G4, since it has a smoother surface even after acid etching, making it less appealing for osseointegration, also the value of bone-implant contact can be affected due to possible toxic effects resulting from the releasing of aluminum and vanadium, [22] chemical components not present in Ti G4 composition. Furthermore, in cases of peri-implant inflammatory conditions, Ti G5 has a high level of corrosion, resulting in a strong attack of the passive film formed on the implant surface [23].

Because of its benefits, Ti G4 was chosen for the **NUVO™** implant's raw material. Ti G4 has greater mechanical characteristics and important benefits, like increased roughness after acid etching, high corrosion resistance and biocompatibility [22], designed to provide improved osseointegration [24].

Besides the raw material, another important feature is the way the surface treatment is achieved. Different surface treatment methods have been developed trying to speed up the osseointegration period and fortify the interface between implant and bone [25].

NUVO™ implants have a surface that combines sandblasting and acid etching as presented in Figure 7, which increases the roughness of the implant surface [26,27,28]. The roughness extends the implant area providing great space for cell attachment and proliferation [29]. In addition, when a roughened implant is placed, there is an initial increase in the absorption of blood protein on the implant surface [30,31,32]. These enhance the chances of a positive contact osteogenesis.

A B

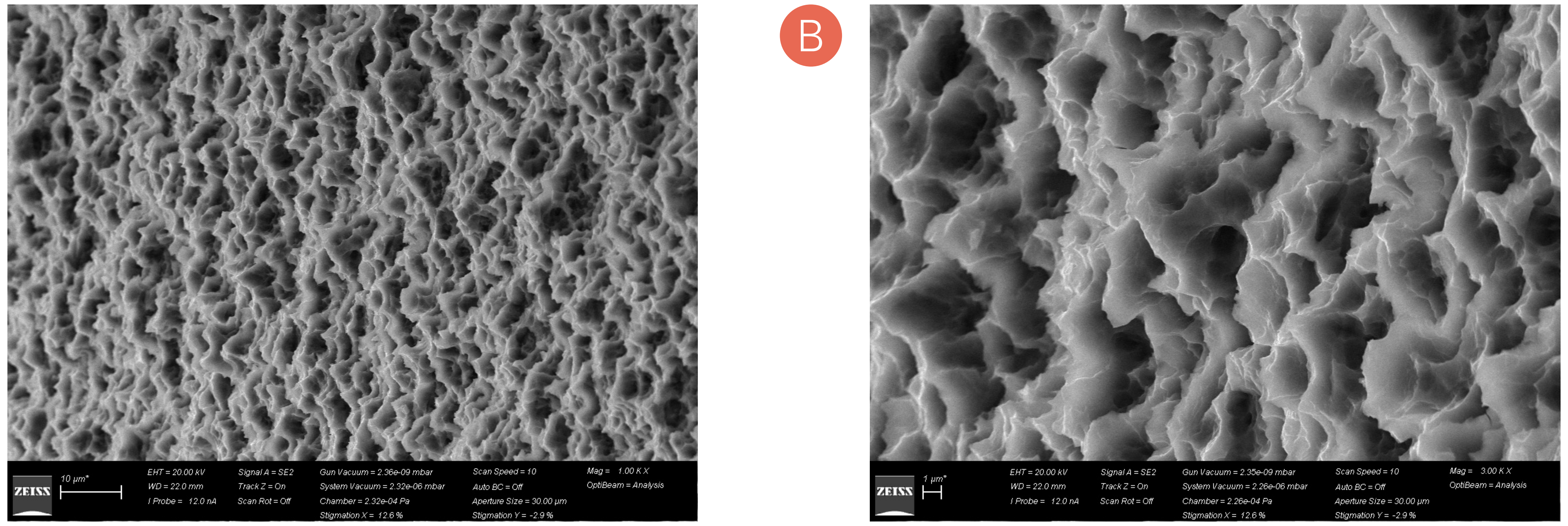


Figure 7: NUVO™'s Sandblasted and Acid Etched Surface. A-Macro topography (600x). B- Micro topography (300x).

Finally, a Sandblasted and Acid Etched surface promotes implant anchorage [28] and less bone loss [27]. Gathering all these surface characteristics, a higher rate of bone-implant contact and osseointegration properties are shown [26,27,28,29,33].

Combining all this information, the Pure Titanium G4 and the Sandblasted and Acid Etched surface used for **NUVO™** implants are excellent and proven choices for implant material and surface treatment, designed for favorable treatment results.

1. Niznick G.A. The Core-Vent™ implant system. The evolution of the osseointegration implant. Oral Health 1983; 73:13-317.
2. Prithviraj, D., Muley, N., & Gupta, V. The Evolution of External and Internal Implant–Abutment Connections: A Review. International Dental Research 2012; 2(2): 37-42.
3. Lemos C.A.A. et al. Comparison of external and internal implant-abutment connections for implant supported prostheses. A systematic review and meta-analysis Journal of Dentistry. 2018; 70; 14–22.
4. Bergamim, M. et al. Análise comparativa do grau de liberdade rotacional e da integridade física das conexões protéticas de diferentes implantes com hexágono interno. Revista Implant news. 2009; 6(3); 251-8.
5. Lazzara RJ, Porter SS. Platform switching: A new concept in implant dentistry for controlling post restorative crestal bone levels. Int J Periodontics Restorative Dent. 2006; 26:9–17.
6. M. Di Girolamo, et al. Bone level changes around platform switching and platform matching implants: a systematic review with meta-analysis. ORAL & implantology. 2016; (9)1; 1-10.
7. Valente M.L.C. et al. Analysis of the influence of implant shape on primary stability using the correlation of multiple methods. Clin Oral Investigation. 2015;19(8):1861-6.
8. Vijayalakshmi R, Ramakrishnan T. Platform switch dental implants – Search for evidence: An overview. SRM J Res Dent Sci 2016; 7:101-5.
9. Kim D.S. et al. Comparison of dental implant stabilities by impact response and resonance frequencies using artificial bone. Med Eng Phys. 2014; 36: 715–720.
10. Mazzo C.R. et al. In vitro analysis of the influence of surface treatment of dental implants on primary stability. Braz Oral Res. 2012; 26: 313–317.
11. Rabel A, Köhler SG, Schmidt-Westhausen A.M. Clinical study on the primary stability of two dental implant systems with resonance frequency analysis. Clin Oral Investig. 2007; 11: 257–265.
12. George A., Khalil A., Hassan N. et al. Comparison between cylinder and tapered implants in delayed immediate placement. Alexandria Dental Journal. 2015; 40: 221-228.
13. Torroella-Saura G. et al. Effect of implant design in immediate loading. A randomized, controlled, split-mouth, prospective clinical trial. Clin. Oral Impl. Res. 2015; 26: 240–244.
14. Babbush C.A., Hahn J.A. Chapter 20-Extraction Immediate Implant Reconstruction: single tooth to full mouth. In: Dental Implant. The art and science. 2010. 2nd ed. P. 315
15. Javed F, Romanos G.E. The role of primary stability for successful immediate loading of dental implants. A literature review. J Dent. 2010; 38: 612-20.
16. Dos Santos M.V., Elias C.N., Cavalcanti Lima J.H. The effects of superficial roughness and design on the primary stability of dental implants. Clin Implant Dent Relat Res. 2011; 13: 215–223.
17. Chowdhary R. et al. Biomechanical evaluation of macro and micro designed screw-type implants: an insertion torque and removal torque study in rabbits. Clin Oral Implants Res. 2013; 24: 342–346.
18. Misch C.E., Strong T., Bidez M.W. Scientific rationale for dental implant design. In: Misch CE, ed. Contemporary Implant Dentisry. 2008; (3): 200-229.
19. Lai H.C. et al. Bone apposition around two different sandblasted large-grit and acid-etched implant surfaces at sites with coronal circumferential defects: an experimental study in dogs. Clin. Oral Impl. Res. 2009; 20;247–253.
20. Junker R. et al. Effects of implant surface coatings and composition on bone integration: a systematic review. Clinical Oral Implants Research. 2009; 20(4); 185–206.
21. Elías C.N. et al. Biomedical applications of titanium and its alloys. JOM; 2008; 60: 46
22. Elias C.N. et al. Mechanical and Clinical Properties of titanium-based alloys. J Mater Res Technol. 2019;8(1):1060–1069.
23. Berbel L.O. et al. Determinants of corrosion resistance of Ti-6Al-4V alloy dental implants in an In Vitro model of peri-implant inflammation. PLoS ONE. 2019; 14(1).
24. Bosshardt D.D., Chappuis V., Buser D. Osseointegration of titanium, titanium alloy and zirconia dental implants: current knowledge and open questions. Periodontol2000. 2017; 73(1):22-40.
25. Gerzon A.S. et al. Surfaces in Implantology: Characteristics of the main Brazilian implants. Dental Press Implantol. 2013; 7(4): 46-51.
26. Buser D. et al. Influence of surface characteristics on bone integration of titanium implants. A histomorphometry study in miniature pigs. J Biomed Mater Res. 1991; 25(7); 889-902.
27. Cochran et al. Bone response to unloaded and loaded titanium implants with a sandblasted and acid-etched surface: A histometric study in the canine mandible. J Biomed Mater Res. 1998; 40(1): 1-11.
28. Jemat A. et al. Surface modifications and their effects on titanium dental implants. Bio Med Research International. 2015; Article ID 791725.
29. Kim H. et al. The biocompatibility of SLA-treated titanium implants. Biomedical Materials. 2008; 3(2); 25011.
30. Moreo P., García-Aznar J.M., Doblaré M. Bone ingrowth on the surface of endosseous implants. Mathematical model. J Theor Biol. 2009; 260: 1-12.
31. Sela M.N. et al. Adsorption of human plasma proteins to modified titanium surfaces. Clin Oral Implants Res 2007; 18: 630-8.
32. Terheyden H. et al. Osseointegration–communication of cells. Clin Oral Implants Res 2012; 23: 1127-35.
33. Xue W. et al. In vivo evaluation of plasma-sprayed titanium coating after alkali modification. Biomaterials. 2005; 26(16); 3029–3037.

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InternalFit™ Design Surface References

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