NSK

Wright MILLNERS

Get Your Hands On The *HOTTEST DEAL THIS SUMMER*

ORDER NOW TO AVOID DISAPPOINTMENT
Limited Number Of Deals Only

NLX nano
Electric Micromotor

R14 999

SAVE R10 000

S-Max M M95L

R8 999

SAVE R1 800

NLX nano
Electric Micromotor

SAVE R11 800
OFF REGULAR PRICE

S-Max M M95L

R22 799

SAVE** an additional **R1 199** with this **COMBO DEAL!

Offer valid 14 October - 23 December 2020.Prices include VAT. Delivery of goods December 2020. Deal does not include installation. Terms & Conditions Apply. Pictures used may be for representation only. E&OE. While Stocks Last. Discount cannot be used in conjunction with another special.

0860 100 200 | @wrightmillners | Wright Millners Dental Suppliers | www.wright-millners.co.za

The cardinal role of chemical composition in abutment screw loosening - A literature review and analysis

Jose' Alexandre da Silva Nunes[1]

Introduction

The replacement of missing teeth in modern dentistry by using dental implants is satisfying for patients and clinicians. Everybody desires the best possible outcome at all times.

Implant restorations comprise of an implant and the abutment-prosthesis complex. This is joined together utilizing an abutment screw, which creates and maintains a joint compression. In the natural dentition, the maximal vertical (axial) biting forces approximate 800 N and lateral forces circa 20 N (Brunski, 1999), consequently implant systems are required to withstand similar forces.

The performance of the abutment screw in maintaining joint compression is dependent on the implant system connection (internal hex, external hex, Morse taper)

In external hexed connections, the abutment screw is the weakest link in the implant-abutment-prosthesis complex. A common problem is loosening and fracturing of abutment screws.

Regardless of the implant attachment system the common complication of abutment screw loosening and fracture, reported extensively in the literature, plagues both clinicians and patients. Despite decades of engineering improvements to abutment screws this author continues to encounter patients with this complication in daily implant practice.

Abutment screws differ in their shape; size, physiognomy, roughness, and chemical composition yet are primarily manufactured from titanium and gold alloys. Chemical composition determines a material's Brinell hardness (indentation hardness) and tensile strength.

Gold alloy (GA) abutment screws dominated early years, however, titanium alloy screws have become the standard in recent years.

This review scrutinizes:

1 - frequency of abutment screw loosening and fracture

2 - root causes of this complication.

3 - clinical suggestions to reduce screw loosening and

4 - the superior alloy in the Implant-abutment-screw prosthesis complex (IAPC)

Background

One of the most significant challenges in the literature is to determine how common is abutment screw loosening (Taylor, 1998)

Some authors state this is not a complication but rather an annoyance. Common sense dictates it results in a disruption to workflow, has financial consequences and more importantly may be a sign of imminent fracture of the IAPC.

Goodacre et al., 2003 reported that the average loosening with single implant crowns using original screw designs was 25% but contrasted that when the data

[1] Dr. Jose' Alexandre da Silva Nunes
BDS PDD MSc. FICOI
Private Practice: Dental Implant Placements, Perth, Australia
Dental Implant Training: Mindarie, Perth, Australia

Email: dentalimplants@outlook.com.au

from 6 recent studies were combined, the mean incidence was 8%, indicating substantial improvement with new screw designs.

Varying frequency in abutment screw loosening has been reported: (Jung et al., 2012) 8.8%; (Naert, Quirynen, Van Steenberghe, et al., 1992) 5% and (Becker & Becker, 1995) 38%.

Early abutment screws were made of gold (the 'premium standard') to secure abutments to the implant fixture as they offered a superior engineering outcome with more favourable preload, Young's modulus, and coefficient of friction.

Coefficient of friction is a value used to quantify frictional force between the abutment screw and implant body whereas Young's modulus is the value of a substance's resistance to being deformed elastically when stressed. Preload is defined as an internal application of stress to an implant system.

Recently it has become common to fasten implant crowns with titanium alloy (TA) abutment screws. The principal reason for this being cost. Tsuge & Hagiwara, 2009 found that TA abutment screws were less likely to loosen than GA.

An extensive PubMed review could not identify any prospective or retrospective in vivo studies comparing the performance of GA versus TA screws regarding loosening and fracture.

To understand intricacies of abutment screw loosening/tightness, an audit of screw mechanics requires reviewing. An understanding of the underlying technical anatomy of the implant abutment screw is also needed. The descriptive terms used are at times confusing for clinicians, and therefore reviewed articles were scoured for information and compiled into one diagram for ease of reference and understanding [Figure 1]

Abutment screw engineering

Dziedzic et al., 2012 reported the success of a screw joint is related to the preservation of the preload, properties in the material such as elasticity modulus, composition, clamping of the parts, screw head design, strain, finishing of the interfaces, and presence of a lubricant.

An interface is defined as the point where two systems meet such as implant/abutment (IA). A lubricant is a substance used to reduce friction between abutment screw and implant body.

IA interface is what determines the lateral and rotational stability of the IA joint, and that is decisive in prosthetic stability of an implant-supported restoration (Prithviraj et al., 2012).

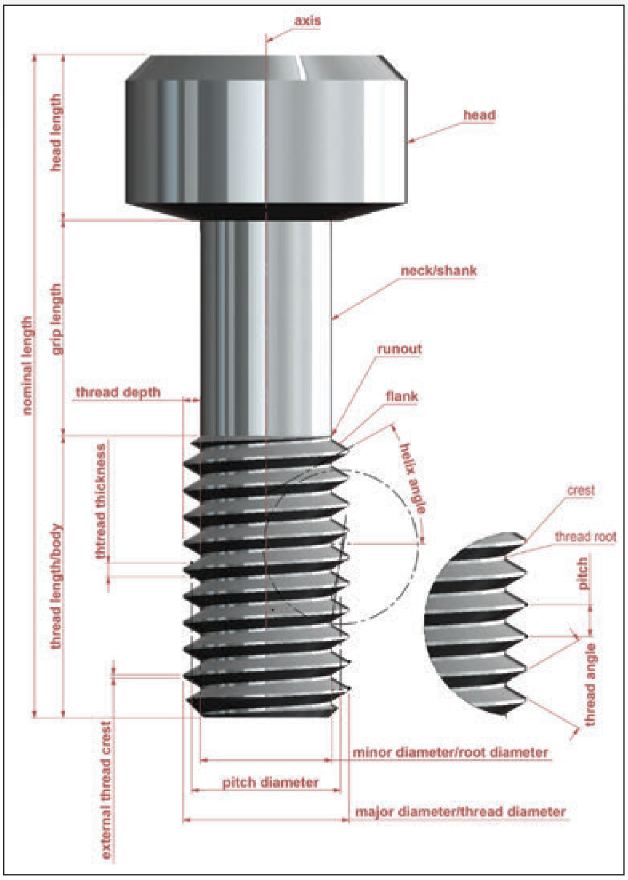


Figure 1: Technical anatomy of a classic implant abutment screw.

Burguete et al., 1994 found lubrification of the screws lowered friction resulting in higher preload for the same torque value compared with non-lubricated screws.

This literature review identified 20 factors affecting the loosening of screws (this article elaborates on some of these factors):

- Clamping force
- Torque
- Preload
- Excessive bending
- Settling effect/embedment relaxation
- Wet lubricants
- Abutment screw coating/dry lubricants
- Metal fatigue
- Clockwise and counterclockwise moments
- Consecutive loosening and retightening
- External & internal hexagon (butt connection) types and micro-gap formation
- Conical connection types and micro-gap formation

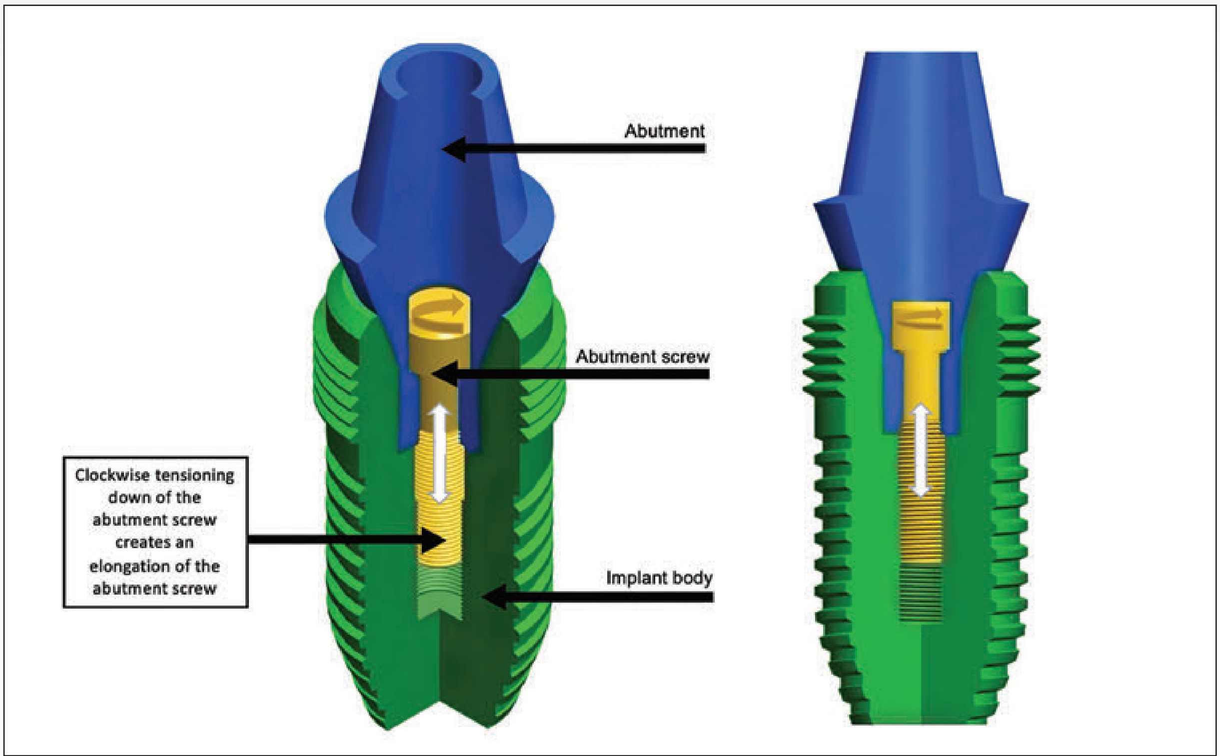


Figure 2: Graphical (conical connection) representation of how the abutment screw in the centre joins the upper abutment to the lower implant. Torqueing the abutment screw develops a tensile (elastic) force called the preload which is illustrated by the white arrow with opposite pointing arrowheads. This preload produces a compressive force clamping the abutment and the implant together.

- Abutment screw alloy composition and tensile strength
- Galling (cold welding due to excessive friction)
- Number of screw threads
- Number of implants and diameter
- Prosthetic design and occlusal table
- Abutment and screw head interface
- Screw head and body design
- Abutment screw flanks connection with the implant internal thread flanks

A review by Siamos et al., 2002, highlighted the following influences:

When two parts are tightened together by a screw, the unit is called a screw joint.

The screw loosens only if outside forces trying to separate the parts are higher than the forces keeping them together. Forces attempting to disengage the parts are called joint separating forces while the clamping force keeps the parts together, such as the abutment to the dental implant.

To prevent screw loosening these separating forces must remain below the threshold of the clamping force.

If the joint does not separate when a force is applied, the screw does not loosen. The two primary factors involved in keeping screws tight are:

1- maximising the clamping force and

2 - minimising joint separating forces.

To achieve secure an IA connection, screws should be tensioned to produce a clamping force more significant than the external separation forces. In the design of a rigid screw joint, the most important consideration from a functional standpoint is the initial clamping force developed by tightening the screw, more than the tensile strength of the screws. Clamp load is usually proportional to tightening torque. Tensile strength is the resistance of a material to break under tension.

Torque is a convenient, measurable means of developing desired tension. Too small a torque may allow separation of the joint and result in screw fatigue, failure, or loosening. Too large a torque (above the tensile strength of the material) may cause the failure of the screw or stripping of the screw threads.

A specific torque is recommended for each screw for different implant systems from different manufacturers. Administered torque develops a force within the screw

HENRY SCHEIN®
DENTAL WAREHOUSE

Rely on Us™

SOLARE from GC

GC

SOLARE Universal Bond

One bonding agent for
all etching modes

Self-etch Selective-etch Total-etch

5ml
0101600820

Superior Bond Strength

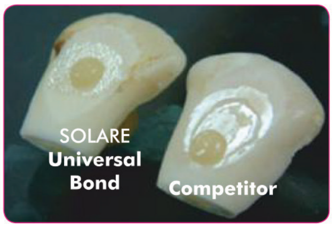
The superior bond strength of SOLARE **Universal Bond** to enamel and dentine is attributable to its unique formulation. The dimethacrylate monomer in SOLARE **Universal Bond** increases its permeability into enamel and dentine compared to other adhesives, while the increased level of phosphate ester monomer optimises etching.

See and Feel the Difference

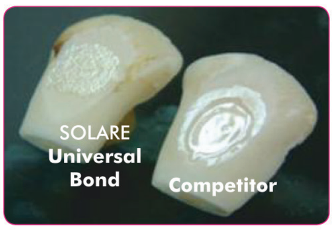
After preparation of SOLARE **Universal Bond** you can see a frosty, matte-like surface effect. The first layer of composite sticks nicely to SOLARE **Universal Bond**.

HEMA Free for a Durable Bond over Time

SOLARE **Universal Bond** does not contain HEMA. This improves bond strength as water is not attracted to the area, which means there is no degradation of the collagen fibres.



SOLARE **Universal Bond** creates a sticky, frosty, matte-like surface to aid in composite adhesion and manipulation.



Traditional adhesives leave a wet, glossy surface after light activation. Composites do not adhere well to the adhesive, making it hard to manipulate.

Taking care of everything dental TOLLFREE 0800 111 796 admin@henryschein.co.za

Contact your local Henry Schein Representative or your GC Representative, Terry Greyling: 082 457 3200 • terry.greyling@gc.dental

LIKE US ON HenrySchein SA FIND US ON @HenryScheinSA Henry Schein South Africa

T's & C's apply. E's & O's exempt.

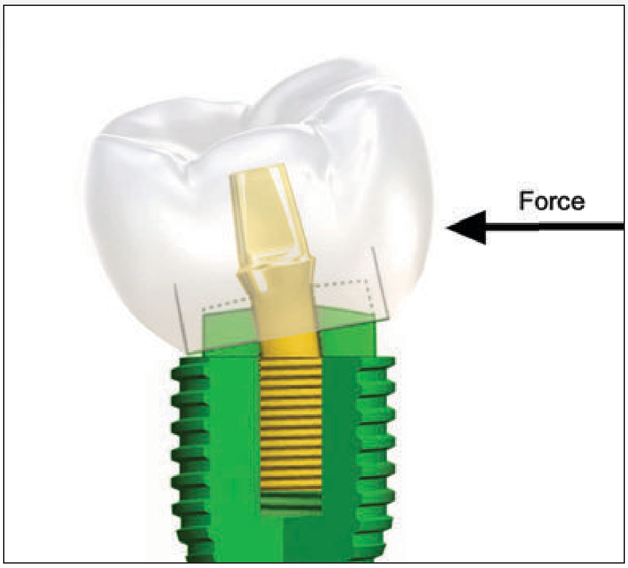


Figure 3: Graphical representation of excessive bending of an abutment screw.

called preload, and that preload is the initial load on the screw.

Tan & Nicholls, 2001 described the efficiency of a material in converting torque to preload and Haack et al., 1995 reported higher preload values with gold alloy screws. Preload is induced in a screw when torque is applied during tightening and this preload keeps the screw thread tightly secured to the screw's mating counterpart and holds the parts together by generating a clamping force between the screw head and its seat. The screw elongates, positioning tension in the shank and threads.

The elastic recovery of the screw generates the clamping force that pulls the prosthesis and the implant together. [Figure 2]

Preload must be maintained and fluctuate as little as possible to prevent joints from separating.

Several factors play critical roles in screw joint stability, including settling effects, preload, and screw geometry.

IA interface geometric design and precision fit of mating components serve to resist mastication forces.

Two main mechanisms of screw loosening for implant-supported restorations are excessive bending on the screw joint and settling effects.

Excessive bending is defined as a force that can cause material failure of the abutment screw.

Tan & Nicholls, 2001 reported screw joint preload as the "clamping" force necessary to maintain screw joint integrity. Torque dispatched to the fastening screw is transformed into tensile stress in the screw shank and into an equal and counter compressive force holding the two implant components together. Opening of the screw joint, or its loosening, has been incriminated as the primary cause of gold screw breakage.

For certain prosthetic implant connections, two screw joints are of concern: the prosthetic gold cylinder/abutment screw joint and the abutment/implant screw joint.

The overall stress in the screw joint in clinical function can be viewed as the summation of screw joint preload, stress from distortion of the prosthesis, and stress from functional loading.

Metallurgical properties of titanium screws permit for the generation of a more consistent albeit lower preload than gold abutment screws (Doolabh, 2014).

Martin et al., 2001 concluded that, as friction decreased the preload of the screw joint increases.

Zipprich, Rathe, et al., 2018 stated that the preload force of an abutment screw depends on the amount of friction, the thread pitch, and the tightening torque.

Krishnan et al., 2014 found the optimum preload of a screw is when it is elongated to capacity but does not surpass its yield strength. In a perfect scenario, the preload should be 75% of the yield strength or 65% of the screws fracture strength. Preload is primarily dependent on the enforced torque and secondarily on the component material, screw head and thread design and surface roughness.

Screw strength is related to the modulus of elasticity of the material from which the screw is manufactured. The torque values of 32-35 Ncm were established based upon gold screws made from materials with low moduli and yield strengths. With more progressive technologies available today, perhaps it is time to reconsider these torque values (Piermatti et al., 2006)

Occlusal forces seem to play an essential role in screw loosening of implants with hex connections, with screw preload the only force that resists it to prevent abutment separation. If the occlusal force exceeds preload, the screw will loosen (Schwarz, 2000)

If a bending force on a single-tooth restoration causes a load larger than the yield strength of the screw, permanent plastic deformation of the screw results, with a loss of tensile force in the screw stem. Plastic deformation is defined as the ability of metal to undergo permanent deformation. Excessive bending (Figure 3) results in reduced contact forces between the abutment and the implant, and consequently, the screw joint loosens easier.

Another mechanism resulting in screw loosening is due to

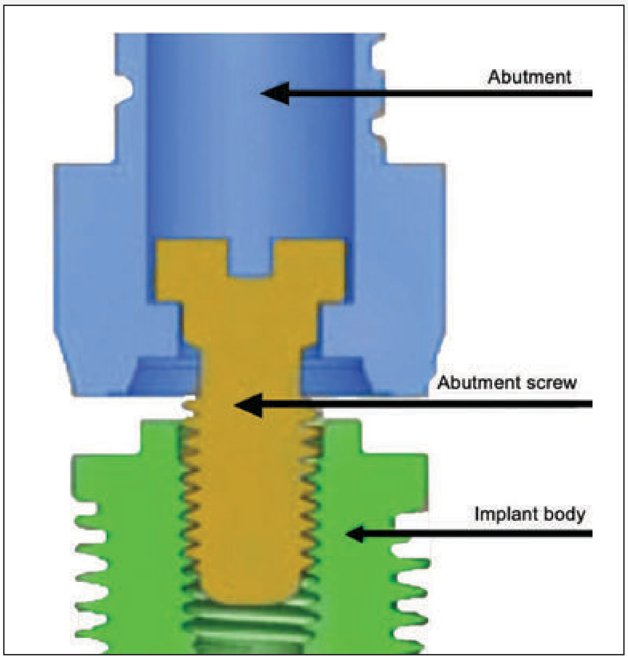


Figure 4: Graphical representation of an external implant abutment connection.

no surface being completely smooth.

Even a machined implant surface is slightly rough when viewed microscopically. As a result of this micro-roughness, no two surfaces are entirely in contact with one another. When the screw interface is subjected to external loads, micromovements occur between the surfaces.

Wear of the contact areas might be a result of these motions, thereby bringing the two surfaces closer to each other. This is referred to as the settling effect or embedment relaxation. The magnitude of settling depends on the initial surface roughness and surface hardness as well as the extent of the loading forces.

Rough surfaces and large external loads increase the settling effect. When the total settling impact is more than the elastic elongation of the screw, the screw works loose as there are no longer any contact forces holding the screw.

It has been hypothesised that up to 10% of initial preload is lost due to the settling effect.

Thread friction is highest for the first tightening and loosening of a screw, after repeated tightening and loosening cycles, friction decreases. Settling effect results in less torque necessary to remove a screw than that used to place the screw initially.

It has therefore been suggested that the implant-abutment joint be tightened periodically after the initial placement.

Seddigh & Mostafavi, 2019 highlighted the following influences:

There is no consensus whether saliva and chlorhexidine, that act as wet lubricants in the implant cavity affects torque and preload. However, blood contamination of the abutment screw implant interface could result in greater loosening. This is due to the high protein content in blood and the presence of platelets or fibrinogen, leading to the formation of a thin film on screws.

A higher preload can be achieved by altering the chemical composition of an alloy in an abutment screw and utilising dry lubricant coated screws

A metal with low strength, like pure gold, may play the same role as a dry lubricant.

Byrne et al., 2006 demonstrated that gold-coated abutment screws showed increased preload compared to non- coated screws. All abutment screws demonstrate less preload with repeated tightening cycles, yet gold-coated abutment screws still present higher preload in comparison to non-coated screws.

Stüker et al., 2008 found preload in gold-coated screws to be three times higher than titanium-coated screws.

Martin et al., 2001 established that screws with a 0.76 µm pure gold coating had a greater tightening rotation angle and significantly higher value of preload than titanium alloy screws. They also concluded that coated titanium alloy screws with solid lubricants act better than non-coated titanium screws in preserving the stability of the IA joints.

External and internal hexagons are referred to as flat connections.

Distinctive characteristics among screws with the same design and geometry can be attributed to manufacturing processes and contrasting intrinsic material properties. Screws made by the same manufacturer but from different lots, show disparate tensile stability.

The ideal connection system should act as a one-piece implant without micro-gap formation at IA interface. Micro-gap formation in IA connections is paramount to their biomechanical deterioration such as screw loosening. External and internal hexagon systems have shown larger micro-gaps allowing passage of bacteria (Zipprich, Weigl, et al., 2018).

Seddigh & Mostafavi, 2019 reported external hexagon (Figure 4) systems to be more prone to screw loosening, especially when exposed to tension forces different from the axial. This causes a micro-gap at the IA connection and mechanical instability in the IA complex with screw loosening. Micro-gap production is linked to the force applied to an abutment. External hexagon connection systems may therefore be a risk in bruxism or clenching.

Pardal-Peláez & Montero, 2017 described micromovements in the IA interface causing both mechanical problems (increased loosening, breakages of screw, abutment and implant body) as well as biological complications.

Micro-gaps permit the colonisation of bacteria resulting in mucositis, peri-implantitis, and finally implant loss due to cyclic loads worsening the effect.

Internal connection systems (Figure 5) were seen as an improvement of the external hexagon system, to decrease or eliminate the micro-movement at the abutment connection level and increasing load absorption, especially under a lateral force. Theoretically, internal hexagons have reduced biomechanical complications such as screw loosening.

Pardal-Peláez & Montero, 2017 found no qualitative data comparing loosening between external and internal connections.

Tsuge & Hagiwara, 2009 reported internal hex did not necessarily offer advantages over external hex concerning abutment screw loosening.

Most of the fixation of conical IA connection systems is not performed by the screw, but rather by the frictional resistance derived from the contact between the tapered mating sections (Schwarz, 2000)

Zipprich, Weigl, et al., 2018 highlighted the following influences: Dynamic loading (non-static load) of 100 N or more on IA connections led to a cyclical opening and closing of gaps between the implant and the abutment. Such gaps, albeit exceedingly small, may allow a direct connection between the internal cavities of the implant and the peri-implant tissues, leading to damage of these tissues.

Zipprich, Weigl, et al., 2018 demonstrated that conical connections displayed no or reduced formation of micro-gaps during dynamic loading of 200 N compared with flat connections.

Additionally, conical IA connections act not only as an anti-rotational device but also to ensure positional stability and reduce screw loosening.

Abutment screws comprise of a flat head seat, a long stem length, and six screw threads and originally the stem stretched elastically, evoking a preload.

A lesser number of screw threads lowers friction and additional threads are superfluous, considering the first three threads carry most of the load (Piermatti et al., 2006). Zipprich et al., 2018 found the preload force of the IA screws were independent of the number of screw threads and only tightening torque and screw head angle affected the resulting preload force of the IA connection.

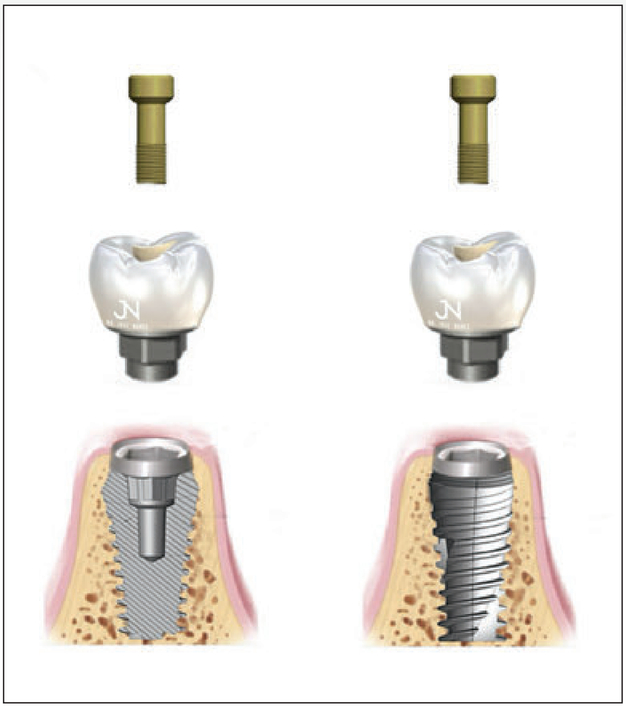


Figure 5: Graphical representation of an internal implant abutment connection.

Zipprich, Rathe, et al., 2018 found that only the screw head angle affected the preload force when comparing different screw head angles with varying numbers of thread.

Abutment screw loosening is reduced when two conventional diameter implants are used instead of one wide implant to replace a missing molar. (Bakaeen et al., 2001)

Maximum biting forces are three times greater in molar areas as compared to anterior regions. Posterior implants carry the heaviest loads (Schwarz, 2000)

Wide diameter (WD) implants have wider IA platforms resulting in increased abutment stability by reducing the occlusal-table to loading-platform-cantilever (OT/LPC) and the collateral stress to the abutment screw.

When a WD implant is subjected to a masticatory/off-axis bending force, that force is dispersed over a wider IA area with a reduction in the plastic deformation at the IA interface (Krishnan et al., 2014)

Narrowing the occlusal table of restorations can reduce the degree of screw loosening when using one implant to support a missing molar.

Moving the occlusal contact area further in line with the


Create your own dental magic
DWX-4
The Original
DWX-42W
Wet Mill Solution
DWX-4W
Wet Mill Master
DWP-80S
Dental 3D Printer
DWX-52D
Efficiency Expert
DWX-52DCi
Factory in a Box
From chair-side milling to a dental lab,
we have the best solution for you
FAB
Imagine.dental
Warrior's, We never give up!
www.rolanddg.co.za sales@rolanddg.co.za
0800ROLAND (765263) +2711 875 9300
Roland

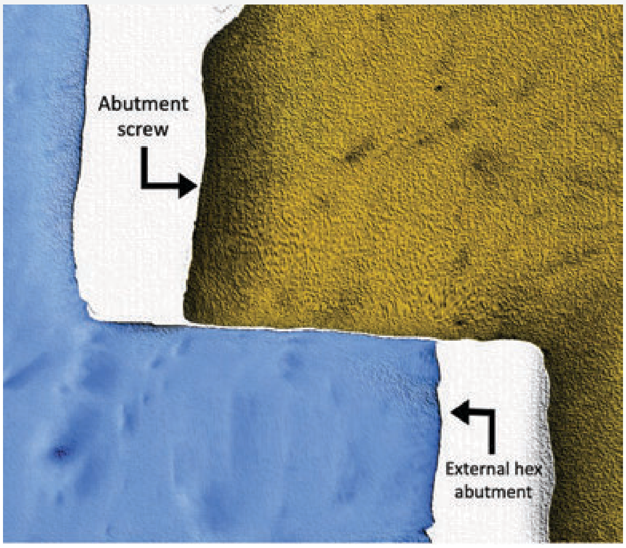


Figure 6: Graphical representation of the interface between an abutment screw and an external hex abutment.

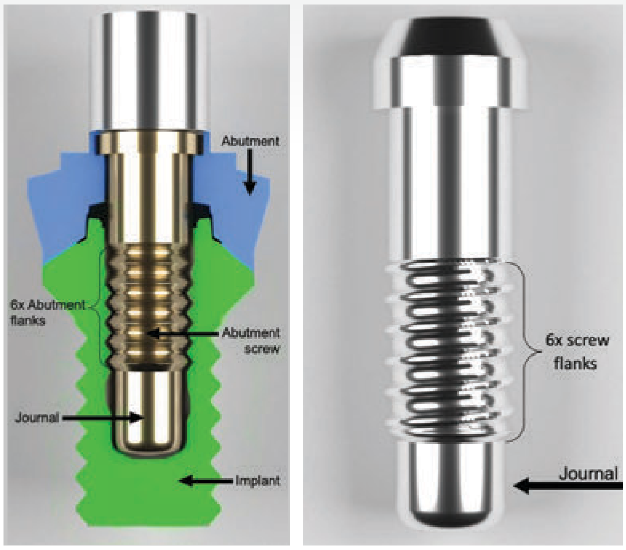


Figure 7: Graphical representation of a journal on the inferior end of an abutment screw. Classical abutment screws have six screw flanks.

implant location reduces the shearing stress on the abutment screws. Flattening the cusp inclination of the crown furthermore reduces the stress on the abutment screw.

Reducing the buccolingual prosthetic design width may require selecting a different occlusal scheme such as a cross-bite relationship or lingualized occlusion to lessen the bending moments on the implant and associated structures. (Krishnan et al., 2014).

As a result of preload achieved in the components which are dependent on the finish of the interfaces (Martin et al., 2001) clinicians should always use original components to ensure the best possible clinical outcome. Figure 6 shows a graphical representation of the interface between an abutment screw and an external hex abutment

Flat-head screws, by virtue of a reduced surface contact, cause less frictional resistance when tightened, than screws with bevels or tapers. When torque is lost to heat and friction, further torque is transferred into usable preload. Subsequently, flat-head screws always offer a higher preload at any given torque range than tapered or bevelled screws (Figure 8) and are, therefore, more stable (Piermatti et al., 2006).

Zipprich, Rathe, et al., 2018 showed persistently greater preload force of flat-head screws which they concluded could arise from lower friction between the screw head and its counterbore, because of the passive fit.

Piermatti et al., 2006 further reported that long and conventional flat-head screws with a machined journal were better and highlighted the importance of screw design in preload maintenance.

The journal is a smooth diameter machined on the end of the screw fitting in an intimate aspect within the walls of the implant, resisting lateral movement and bending of the joint.

The combined use of a screw with a thick stem and a journal (Figure 7) contributed to the least loss of torque and, thus, highest joint stability.

Clinically, if a patient bruxes or has less than favourable implant placement, the use of a thick stem abutment screw with a journal is useful. Furthermore, with some current screw designs, torque values of 40 and perhaps 50 Ncm may be possible without plastic deformation. Therefore, the use of higher torque values would increase the preload and provide increased resistance to joint separation and better abutment screw stability.

As torque is applied, the preload keeps the screw flanks tightly secured to the internal aspect of the implant threads and the screw elongates. Screw flanks are the side of threaded part of screw which connects the crest with the root.

The elongated screw places the screw shank and screw flanks in tension. (Siamos et al., 2002) The elastic recovery of the screw enables the clamping force that brings the prosthesis and implant together. (Piermatti et al., 2006). Thus, screw flanks are important for this action.

The relationship between torque and screw preload is affected by many variables, such as shank thread hardness

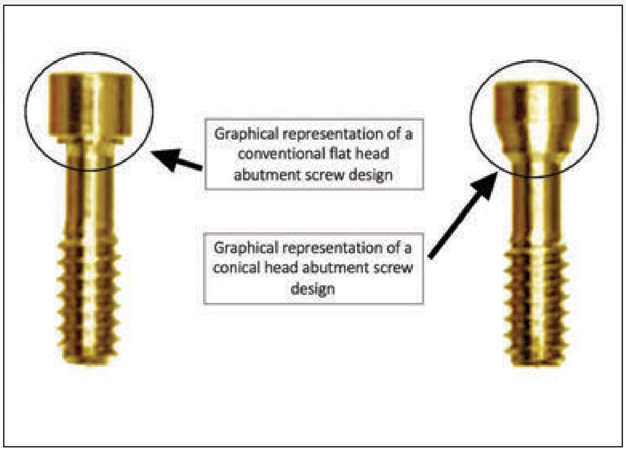


Figure 8: Graphical representation of conical head abutment screw design and conventional flat head abutment screw design.

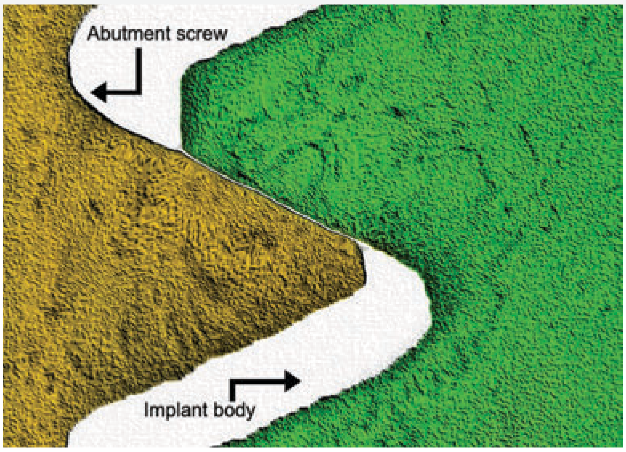


Figure 9: Graphical representation of abutment screw flanks connecting with the implant body internal thread flanks.

and shank surface finish which affects the coefficient of friction of the screw shanks (Tan & Nicholls, 2001)

No machined surface is entirely smooth, always having some high spots.

After the initial torque and unscrew process there is a "flattening out" phenomena of the high spots on the machined surfaces to a more even contact at the flanks to implant thread-contacting surfaces (Tan & Nicholls, 2001)

Martin et al., 2001 investigated the performance of GA versus TA screws. He identified that in both the screw flanks connecting to the implant threads were localized between the superior edge of the screw flanks contacting the middle portion of the implant mating threads [Figure 9]. This phenomenon was also identified by Dziedzic et al.,2012.

Martin et al., 2001 also compared GA abutment screws which had a 0.76 μm pure gold coating lubricant over the screw flanks to other abutment screws (regular GA, regular TA and TA with carbon surface treatment) and showed a greater number of mating thread contacts in the gold screws that had gold coating lubricant. This finding was explained by either an increase in gold screw elongation and or the higher preload value of gold abutment screws.

Discussion

A basic implant system comprises of an implant crown, abutment screw, abutment, and implant. [Figure 10]

An abutment screw (AS) does not function as a stand-alone entity but rather as an integral part of an implant system. It follows that performance of an AS is affected in a greater or lesser extent by other components of an implant system.

In implant abutment connections (IAC) that are flat (external hexagon and internal hexagon), the abutment screw plays a more important role in securing the IAC. A review by Zipprich, Weigl, et al., 2018 showed that during dynamic loading, conical connections produce fewer micro-gaps at the IAC and the abutment screw plays a less important role compared to flat connections.

Flat connection type implant systems continue to be used for a variety of historical and technical reason by clinicians. Conical implant systems are less reliant on the abutment screw in terms of their maintenance of preload at the IA interface. Using the best possible abutment screw design made from the best possible materials will ultimately improve both patient and clinician satisfaction.

Manufacturing an abutment screw from the best possible alloy combination that produces the most favourable preload is one of the factors affecting the long-term prognosis of the IAC, as favourable preload prevents abutment screw loosening. (Schwarz, 2000) (Pardal-Peláez & Montero, 2017)

This may seem like a quite simple and attainable objective, yet one of the most challenging problems to discern from the literature is the frequency of screw loosening. (Taylor, 1998)

The chemical composition of an abutment screw alloy stands paramount to its performance. Surprisingly, small changes in the chemical composition on an alloy can change its modulus of elasticity and tensile strength. (Piermatti et al., 2006)

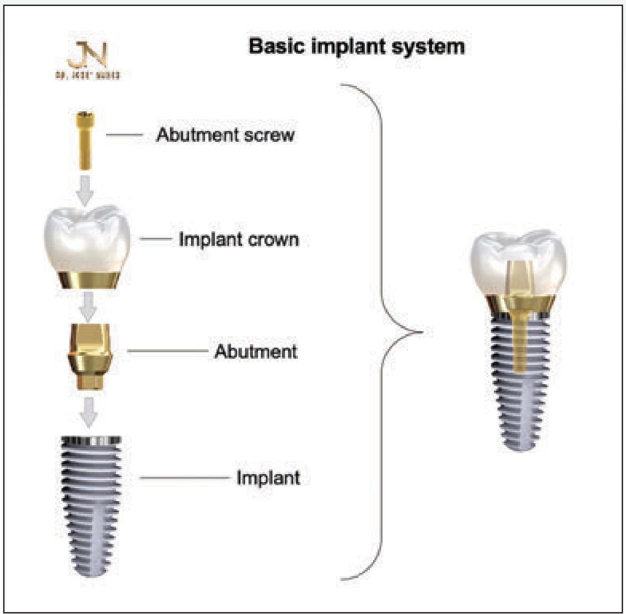


Figure 10: Graphical representation of a Basic Implant System comprising of implant crown, abutment screw, abutment, and implant.

The majority of studies demonstrate that gold abutment screws provide superior performance in comparison to titanium abutment screws.

Conclusion and clinical hints

Screw loosening and screw fracture continues to be a common complication and is not improving. Over a lifespan abutment screw loosening and fracture increase by 0.61% per year.

To reduce the complication of screw loosening and fracture, manufacturers should use the best alloys and the clinician should select an abutment screw manufactured from a strategically chosen alloy that warrants a more favourable preload.

Gold alloy abutment screws are the material of choice to secure the implant-abutment connection in that they have a higher modulus of elasticity, greater preload values, lower coefficient of friction and result in more stable implant-abutment connections. The highest possible preload is paramount but too high a preload will result in fracture of the abutment screw

Clinicians looking for cheaper options should use a titanium abutment screw with surface dry lubricant to achieve optimal preload values but manufacturers should make these available.

To neutralize the certain initial loss of preload, clinicians should retighten (a second time) freshly placed abutment screws either after a few seconds, a few minutes, or the following day- whichever is practical.

Clinicians must be vigilant of pirate components which may result in less than desirable preload and screw loosening due to poorly finished interfaces.

External hexagon connection systems should be used guardedly in cases of functional overloads, such as bruxism or clenching.

Narrowing the occlusal table, flattening cuspal inclination and moving the occlusal contact in line with implant location will reduce lateral forces and decrease abutment screw loosening.

Conical IA connection mechanisms act not only as an anti-rotational device during functional loading but also to ensure positional stability and reduce abutment screw loosening.

The benefit of gold abutment screws is their capacity in securing a preload of more than twice that of a titanium alloy screw, thus minimizing risk of abutment screw loosening and fracture.

Clinicians require their implant manufacturer to provide essential information such as the chemical composition, tensile strength, coefficient of friction and more importantly the preload that can be achieved at a particular torque (e.g. 500N at 30 Ncm torque) from the abutment screw they are inserting into their patients as this has vital biological and performance effects.

Acknowledgement

The author would like to thank the following colleagues for their co-operation wirth this article: Prof. Andre Van Zyl, Dr. Colin Lesar, Dr. Andrew Thomas, Dr. Jaejoon Lee, Dr. Hugo Hagen, Dr. Christoph Ratka

References

Bakaeen, L. G., Winkler, S., & Neff, P. A. (2001). The effect of implant diameter, restoration design, and occlusal table variations on screw loosening on posterior single-tooth implant restorations. Journal Oral Implantology, 27, 63–72.

Becker, W., & Becker, B. E. (1995). Replacement of maxillary and mandibular molars with single endosseous implant restorations: A retrospective study. The Journal of Prosthetic Dentistry, 74(1), 51–55. https://doi.org/10.1016/S0022-3913(05)80229-X

Brunski, J. B. (1999). In vivo bone response to biomechanical loading at the bone/dental-implant interface. Advances in Dental Research, 13(June), 99–119. https://doi.org/10.1177/08959374990130012301

Burguete, R. L., Johns, R. B., King, T., & Patterson, E. A. (1994).

Now offering affordable alternatives to meet your daily small equipment needs

Wright MILLNERS

Hurry! Limited Stock Available!

DTE iLED
Light curing lamp

Features:

- Lightweight, ergonomic design
- 360° Rotating Head
- Automatic power off, low battery alert
- Wave length matches top notable Curing Lights
- 1 second curing time (2mm solidification depth)

**Please note, no pre-ordering of colours is permitted, you will either receive purple or silver.*

LAUNCH OFFER R2,999

GWP-ILED

LAUNCH OFFER R2,499* EACH

***IF YOU BUY 2**

DTE D5
LED Ultrasonic Scaler

Features:

- Multi-Function: scalling, perio and endo
- Detachable autoclavable handpiece with LED light and is compatible with Satelec type scalers
- 6 scaler tips included

LAUNCH OFFER R4,330

GWP-D5LED

DTE®

DTE D7 Piezo Scaler

Features:

- Multi-Function fully self-contained scaler
- Detachable autoclavable handpiece
- Compatible with NSK and Satelec
- 8 scaler tips included

LAUNCH OFFER R7,900

GWP-D7LED

DTE DPEX
V APEX Locator

LAUNCH OFFER R3,900

GWP-DPEX-V

PLEASE CONTACT YOUR WRIGHT MILLNERS SALES REPRESENTATIVE FOR MORE INFORMATION.

T's & C's apply. Due to the attractive price point, these items will be treated as plug and play and will be uneconomical to repair. Offer Valid Until December 2020

Prices include VAT. Pictures used may be for representation only. E&OE. While Stocks Last. Discount cannot be used in conjunction with another special.

0860 100 200 | @wrightmillners | Wright Millners Dental Suppliers | www.wright-millners.co.za

Tightening characteristics for screwed joints in osseointegrated dental implants. The Journal of Prosthetic Dentistry, 71(6), 592–599. https://doi.org/10.1016/0022-3913(94)90443-X

Byrne, D., Jacobs, S., O'Connell, B., Houston, F., & Claffey, N. (2006). Preloads generated with repeated tightening in three types of screws used in dental implant assemblies. Journal of Prosthodontics, 15(3), 164–171. https://doi.org/10.1111/j.1532-849X.2006.00096.x

Doolabh, R. (2014). Dental Implant Retaining Screws:The effect of using gold or titanium on preload. South African Dental Journal (SADJ), 69(7), 316–320. https://doi.org/10.1558/jsrnc.v4il.24

Dziedzic, D., Nhata, J., Jamcoski, V., & Dziedzic, M. (2012). Assessment of preload in carbon coated prosthetic screws. Rsbo- South Brazilian Dental Journal, 9(2), 137–142.

Goodacre, C. J., Bernal, G., Rungcharassaeng, K., & Kan, J. Y. K. (2003). Clinical complications with implants and implant prostheses. Journal of Prosthetic Dentistry, 90(2), 121–132. https://doi.org/10.1016/S0022-3913(03)00212-9

Haack, J. E., Sakaguchi, R. L., Sun, T., & Coffey, J. (1995). Elongation and Preload Stress in Dental Implant Abutment Screws. International J Oral Maxillofac Implants , 10 (5), 529-36, 10(5), 529–536.

Jung, R. E., Zembic, A., Pjetursson, B. E., Zwahlen, M., & Thoma, D. S. (2012). Systematic review of the survival rate and the incidence of biological, technical, and aesthetic complications of single crowns on implants reported in longitudinal studies with a mean follow-up of 5 years. Clinical Oral Implants Research, 23(SUPPL.6), 2–21. https://doi.org/10.1111/j.1600-0501.2012.02547.x

Krishnan, V., Thomas, C. T., & Sabu, I. (2014). Management of abutment screw loosening: Review of literature and report of a case. Journal of Indian Prosthodontist Society, 14(3), 208–214. https://doi.org/10.1007/s13191-013-0330-2

Martin, W. C., Woody, R. D., Miller, B. H., & Miller, A. W. (2001). Implant abutment screw rotations and preloads for four different screw materials and surfaces. Journal of Prosthetic Dentistry, 86(1), 24–32. https://doi.org/10.1067/mpr.2001.116230

Naert, I., Quirynen, M., Van Steenberghe, D., & Darius, P. (1992). A six-year prosthodontic study of 509 consecutively inserted implants for the treatment of partial edentulism. The Journal of Prosthetic Dentistry, 67(2), 236–245. https://doi.org/10.1016/0022-3913(92)90461-I

Pardal-Peláez, B., & Montero, J. (2017). Preload loss of abutment screws after dynamic fatigue in single implant-supported restorations. A systematic review. Journal of Clinical and Experimental Dentistry, 9(11), e1355–e1361. https://doi.org/10.4317/jced.54374

Piermatti, J., Yousef, H., Luke, A., Mahevich, R., & Weiner, S. (2006). An in vitro analysis of implant screw torque loss with external hex and internal connection implant systems. Implant Dentistry, 15(4), 427–435. https://doi.org/10.1097/01.id.0000245440.09464.48

Prithviraj, D. R., Muley, N., & Gupta, V. (2012). The Evolution of External and Internal Implant–Abutment Connections: A Review. International Dental Research, 2(2), 37. https://doi.org/10.5577/intdentres.2012.vol2.no2.3

Schwarz, M. S. (2000). Mechanical complications of dental implants. Clinical Oral Implants Research, 11 Suppl 1, 156–158. https://doi.org/10.1034/j.1600-0501.2000.011S1156.x

Seddigh, M. A., & Mostafavi, A. S. (2019). Implant Abutment Screw Loosening: A Review of Effective Factors. Journal of Clinical and Diagnostic Research, 13(8), 6–9. https://doi.org/10.7860/jcdr/2019/41751.13088

Siamos, G., Winkler, S., & Boberick, K. (2002). The relationship between implant preload and screw loosening on implant-supported prostheses. Journal Oral Implantology, 28(2), 67–73.

Stüker, R. A., Teixeira, E. R., Beck, J. C. P., & Da Costa, N. P. (2008). Preload and torque removal evaluation of three different abutment screws for single standing implant restorations. Journal of Applied Oral Science, 16(1), 55–58. https://doi.org/10.1590/S1678-77572008000100011

Tan, K. B., & Nicholls, J. I. (2001). Implant-abutment screw joint preload of 7 hex-top abutment systems. The International Journal of Oral & Maxillofacial Implants, 16(3), 367–377.

Taylor, T. D. (1998). Prosthodontic problems and limitations associated with osseointegration. Journal of Prosthetic Dentistry, 79(1), 74–78. https://doi.org/10.1016/S0022-3913(98)70197-0

Tsuge, T., & Hagiwara, Y. (2009). Influence of lateral-oblique cyclic loading on abutment screw loosening of internal and external hexagon implants. Dental Materials Journal, 28(4), 373–381. https://doi.org/10.4012/dmj.28.373

Zipprich, H., Rathe, F., Pinz, S., Schlotmann, L., Lauer, H.-C., & Ratka, C. (2018). Effects of Screw Configuration on the Preload Force of Implant-Abutment Screws. The International Journal of Oral & Maxillofacial Implants, 33(2), e25–e32. https://doi.org/10.11607/jomi.5837

Zipprich, H., Weigl, P., Ratka, C., Lange, B., & Lauer, H. C. (2018). The micromechanical behavior of implant-abutment connections under a dynamic load protocol. Clinical Implant Dentistry and Related Research, 20(5), 814–823. https://doi.org/10.1111/cid.12651