



ORIGINAL RESEARCH PAPER

Medical Science

ALL ON FOUR IMPLANTS, SCREW LOOSENING AND THEIR EFFECT ON TREATMENT OUTCOMES - A REVIEW

KEY WORDS:

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INTRODUCTION

The all on four treatment concept is a procedure to rehabilitate the completely edentulous patients by maximizing the use of available bone in atrophic jaws allowing immediate function. This technique was innovated by Paulo Malo and his co-workers in the year 2003.

The function and retention of conventional dentures for completely edentulous patients is limited since it only adheres to mucosa for retention.¹ However the implant supported restoration are almost similar to natural dentition since its fixed and there is no movement of denture which increases its function and capability in mastication and phonetics etc.²

The all on four treatment concept is a treatment procedure that leaves behind the routine treatment of conventional dentures to provide completely edentulous patients with immediately loaded full arch restoration on only four dental implants. In this procedure two implants are placed vertically in the anterior arch and two implants placed distally at an angle of upto 45 degree in the posterior region to minimize the cantilever length.^{1,2}

Although highly successful in terms of both short- and long-term survival rates, all on four treatment is a multi-process procedure with many potential complications. There are numerous studies documenting the success of all on four dental implants concept however the literature is relatively short of information regarding the pitfalls and complications that comes along with the all on four dental implants concept.³ One of the most prevalent complications of dental implants is screw loosening. Screw loosening in literature is defined as one of the most frequent complications associated with dental implants and main causes of failure of implant supported prostheses. The long term success of implant restorations depends on it. Goodacre et al. in his study indicated that "screw loosening occurs in 7% of cases and can reach up to 45% in single crowns.⁴ Another study by Gunne J et al., reported that over a 3-year follow-up of patients, loosening of gold prosthetic screws was the most common mechanical failure, along with fracture of occlusal material. In addition, a systematic review of the literature reported that incidence of screw loosening to be 12.7% over 5 years.⁵ Ricciardi Coppede A et al., also reported that 5.4% of abutment screws became unstable over the first year of function. Over all screw loosening can also cause other complications such as screw fracture, marginal gap, peri implantitis, microbial leakage, crown loosening, and patient discomfort."^{6,7} This review article aims to highlight and present the insight into the causative factors in screw loosening.⁸

Causative Factors For Screw Loosening.

The All on four dental treatment is not without complications and pitfalls and the procedure has high success rate but there can be problems both in long term and short term. One of the main complication being the screw loosening which further leads to complications such as fracture, peri-implantitis, prosthesis loosening, loss of prosthetic function and finally patient discomfort.^{1,2,6,7}

Implant Treatment Process

Implant abutment complex is an assembly joined together by a screw. Contamination by blood and saliva can affect implant abutment screw joint stability.

Gumus et al in their study concluded that blood contamination of abutment screw holes was shown to significantly decrease RTVs (Reverse Torque Value) and that blood contamination may result in greater loosening of implant screws in clinical practice.⁸ Another study by Koosha et al concluded that RTVs were more significantly reduced by saliva contamination in comparison with chlorhexidine, blood and fluoride and highest RTVs were detected in chlorhexidine contamination.⁹

Jorn et al in their study concluded that reduced friction due to the presence of saliva during the assembly of the implant-abutment is likely to have a detrimental effect or stresses in the implant components and therefore should be avoided.¹⁰

Microleakage

Sahin and Ayyildiz did a study to evaluate the correlation between microleakage and screw loosening at different types of implant abutment connections and/or geometrics measuring the torque values before and after the leakage test and concluded that there was significant correlation between microleakage and screw loosening.¹¹

Successive Loosening And Retightening.

In some cases, it maybe necessary to remove the prosthetic components multiple times to adjust the prosthesis, make impressions or to do the required adjustments. In such cases repeated loosening and tightening of the abutment screw leads to creation of smooth micro-irregularities of the contact surfaces thereby decreasing the friction-coefficient.^{6,7} Several studies have confirmed this theory. Guzaitis et al conducted a study on effect of repeated screw joint closing and opening cycles on implant prosthetic screw reverse torque and implant and screw thread morphology where they concluded that after 10 screw insertion cycles, a new prosthetic screw should be used with the implant system to maximize screw reverse torque and maintain preload when an abutment is definitely placed.¹² Tzenakis et al conducted a study to see the effect of repeated torque and salivary contamination on the preload of slotted gold implant prosthetic screws and concluded that higher preload was achieved after the repeated use of a saliva lubricated gold prosthetic retaining screws.¹³ Byrne et al did a study to compare three screws (titanium alloy, gold alloy and gold coated) with similar geometry by recording the preload induced when torque of 10, 20 and 35 Ncm were used for fixation concluded that all screws types displayed some decay in preload with repeated tightening irrespective of abutment type and insertion torque.¹⁴ Another study by Arshad et al where they evaluated the effect of repeated screw joint closing and opening cycles and cyclic loading on abutment screw removal torque and screw thread morphology using SEM and they concluded that using a new screw could not significantly increase the value pf removal torque and that restricting the amount of screw tightening is more important than replacing the screw with new one when an abutment is definitely placed.¹⁵

Abutment Collar Length.

Siadat et al conducted a study to see if abutment collar length affect abutment screw loosening after cyclic loading and concluded that increase in height of the abutment collar could adversely affect the torque loss of the abutment screw.¹⁶

Fit Of The Prosthesis

When ill-fitting prosthesis are screwed into place, static stresses are created and can have significant effect on screw loosening. A Bacchi et al conducted a study to evaluate the effect of the prosthesis material on loosening torque of the prosthetic screws under 2 levels of vertical misfit and concluded that prosthesis material and misfit factors showed a statistically significant influence on the loosening torque.¹⁷

Different Prosthetic Screws

An in-vitro study conducted by Farina et al to determine implant supported fixed prosthetic suprastructure retained with different prosthetic screws and levels of fit under masticatory simulation conditions concluded that stability of titanium screws was higher than that of gold screws after six months of simulation because of their lower plastic deformation but when the cycling time was analyzed , titanium screws were less stable after 1 year of simulation because of loss of torque in the presence of misfit.¹⁸

Angulation Of Abutment.

Methods to correct angulation of implant to enable a screw retained prosthesis include angled abutments, angulated screw channels or angulated prosthetic platforms incorporated into the implant. Hotinski and Dudley conducted an in-vitro study to assess abutment screw loosening in angulation correcting implants and straight implants subjected to simulated non-axial occlusal loading and concluded that a significant loss of abutment screw torque was found in both implant groups with increased cycles of occlusal loading. The angulation correcting implants resisted screw loosening significantly more than the straight implants because of reduced angle of abutment screw loading.¹⁹

Lateral Cycle Loading

Khraisat et al conducted a study to investigate the effect of lateral cyclic loading with different load positions on abutment screw loosening of an external hexagon implant system where they concluded that within the limitation of their study, reverse torque values of the screw joint were preserved under eccentric lateral loading as compared with centric loading.²⁰

Torque Value

Lee et al in his to investigate the effects of simulated mastication on implant components by using wave analysis to document the basic mechanisms of screw loosening in a simulated oral environment concluded that tightening torque had a significant effect on screw loosening and that more than 10 Ncm of tightening torque should be recommended.²¹ Another study by Georgios Siamos et al to determine whether varying preload on the implant abutment complex would affect the screw loosening under simulated loading conditions of 25, 30, 35 and 40 Ncm concluded that increasing the torque value for abutment screws above 30Ncm can be beneficial for implant abutment stability and to decrease screw loosening.²²

Implant Diameter And Width Of Occlusal Table

The placement of prosthesis that extends beyond the diameter of the implant both mesiodistally and buccolingually maybe potential biomechanical problems leading to screw loosening. Lara G Bakaee et al in their study of the effect of implant diameter, restoration design and occlusal table variations on screw loosening concluded that restoring with wide diameter implant can cause a higher degree of screw loosening as compared with use of 2

conventional diameter implants and that narrowing the occlusal table of restoration can reduce the degree of screw loosening.²³ Another cross sectional study by Londhe SM et al where they evaluated the factors associated with abutment screw loosening in single implant support crowns concluded that wider diameter implants have less prevalence of screw loosening than standard diameter implants.²⁴

CONCLUSION

In spite of the successful rate of implant restoration to rehabilitate patients with missing teeth or non -restorable teeth, biological and mechanical complications do exist one of the most common complications being the screw loosening and which is the most common cause of failure of an implant supported prosthesis. There are several factors that could increase or decrease the occurrence of this complication. This article has reviewed the most common causative factors for screw loosening and how it can be decreased in order for the prosthesis to be functional and treatment successful.

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