**Impact of implant number, distribution and prosthesis material on loading on implants supporting fixed prostheses.**

Ogawa T, Dhaliwal S, Naert I, Mine A, Kronstrom M, Sasaki K, Duyck J.


**Abstract**

The purpose of this study is to evaluate axial forces and bending moments (BMs) on implants supporting a complete arch fixed implant supported prosthesis with respect to number and distribution of the implants and type of prosthesis material. Seven oral Brånemark implants with a diameter of 3.75 mm and a length of 13 and 7 mm (short distal implant) were placed in an edentulous composite mandible used as the experimental model. One all-acrylic, one fibre-reinforced acrylic, and one milled titanium framework prosthesis were made. A 50 N vertical load was applied on the extension 10 mm distal from the most posterior implant. Axial forces and BMs were measured by calculating signals from three strain gauges attached to each of the abutments. The load was measured using three different models with varying numbers of supporting implants (3, 4 and 5), three models with different implant distribution conditions (small, medium and large) and three models with different prosthesis materials (titanium, acrylic and fibre-reinforced acrylic). Maximum BMs were highest when prostheses were supported by three implants compared to four and five implants (P < 0.001). The BMs were significantly influenced by the implant distribution, in that the smallest distribution induced the highest BMs (P < 0.001). Maximum BMs were lowest with the titanium prosthesis (P < 0.01). The resultant forces on implants were significantly associated with the implant number and distribution and the prosthesis material.

**Rationale for choices of occlusal schemes for complete dentures supported by implants.**

Nikolopoulou F, Ktena-Agapitou P.


**Abstract**

This review of occlusal considerations for implant-supported complete dentures reflects the majority opinion of authors according to clinical observations and research-documented evidence. Occlusal concepts are presented for the implant-supported complete dentures regarding analysis of loads applied to dental implants, location and number of implants, occlusal materials, and occlusal scheme.
**Influence of forces on peri-implant bone.**

Isidor F.


**Abstract**

Occlusal forces affect an oral implant and the surrounding bone. According to bone physiology theories, bones carrying mechanical loads adapt their strength to the load applied on it by bone modeling/remodeling. This also applies to bone surrounding an oral implant. The response to an increased mechanical stress below a certain threshold will be a strengthening of the bone by increasing the bone density or apposition of bone. On the other hand, fatigue micro-damage resulting in bone resorption may be the result of mechanical stress beyond this threshold. In the present paper literature dealing with the relationship between forces on oral implants and the surrounding bone is reviewed. Randomized controlled as well as prospective cohorts studies were not found. Although the results are conflicting, animal experimental studies have shown that occlusal load might result in marginal bone loss around oral implants or complete loss of osseointegration. In clinical studies an association between the loading conditions and marginal bone loss around oral implants or complete loss of osseointegration has been stated, but a causative relationship has not been shown.

**Mechanical complications of dental implants.**

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**Abstract**

Adverse occlusal forces can result in mechanical complications of implant components. While unacceptably high incidences of mechanical failures have been reported for the two-stage external hex screw-type implant systems, the standard-diameter ITI solid-screw implant does not seem to be vulnerable to these problems. The 8 degrees Morse taper has eliminated abutment screw loosening and fracture. The incidence of prosthetic screw loosening has been minimized by the 45 degrees bevel on the implant shoulder and by the 1.5 mm vertical abutment walls. The design of the standard-diameter solid-screw ITI implant and the material used in its fabrication (cold worked type IV cp titanium) have eliminated fixture fracture. However, because there have been some reported instances of fractures involving reduced-diameter and hollow implants, these designs should be used with caution.
The impact of loads on standard diameter, small diameter and mini implants: a comparative laboratory study.

Allum SR, Tomlinson RA, Joshi R.


Abstract

OBJECTIVES:

While caution in the use of small-diameter (< or = 3.5 mm) implants has been advocated in view of an increased risk of fatigue fracture under clinical loading conditions, a variety of implant designs with diameters < 3 mm are currently offered in the market for reconstructions including fixed restorations. There is an absence of reported laboratory studies and randomized-controlled clinical trials to demonstrate clinical efficacy for implant designs with small diameters. This laboratory study aimed to provide comparative data on the mechanical performance of a number of narrow commercially marketed implants.

MATERIALS AND METHODS:

Implants of varying designs were investigated under a standardized test set-up similar to that recommended for standardized ISO laboratory testing. Implant assemblies were mounted in acrylic blocks supporting laboratory cast crowns and subjected to 30 degrees off-axis loading on an LRX Tensometer. Continuous output data were collected using Nexygen software.

RESULTS:

Load/displacement curves demonstrated good grouping of samples for each design with elastic deformation up to a point of failure approximating the maximum load value for each sample. The maximum loads for Straumann (control) implants were 989 N (+/-107 N) for the 4.1 mm RN design, and 619 N (+/-50 N) for the 3.3 mm RN implant (an implant known to have a risk of fracture in clinical use). Values for mini implants were recorded as 261 N (+/-31 N) for the HiTec 2.4 mm implant, 237 N (+/-37 N) for the Osteocare 2.8 mm mini and 147 N (+/-25 N) for the Osteocare mini design. Other implant designs were also tested.

CONCLUSIONS:

The diameters of the commercially available implants tested demonstrated a major impact on their ability to withstand load, with those below 3 mm diameter yielding results significantly below a value representing a risk of fracture in clinical practice. The results therefore advocate caution when considering the applicability of implants < or = 3 mm diameter. Standardized fatigue testing is recommended for all commercially available implants.
Mechanical and technical risks in implant therapy.

Salvi GE, Brägger U.


Abstract

PURPOSE:

To systematically appraise the impact of mechanical/technical risk factors on implant-supported reconstructions.

MATERIAL AND METHODS:

A MEDLINE (PubMed) database search from 1966 to April 2008 was conducted. The search strategy was a combination of MeSH terms and the key words: design, dental implant(s), risk, prosthodontics, fixed prosthodontics, fixed partial denture(s), fixed dental prosthesis (FDP), fixed reconstruction(s), oral rehabilitation, bridge(s), removable partial denture(s), overdenture(s). Randomized controlled trials, controlled trials, and prospective and retrospective cohort studies with a mean follow-up of at least 4 years were included. The material evaluated in each study had to include cases with/without exposure to the risk factor.

RESULTS:

From 3,568 articles, 111 were selected for full text analysis. Of the 111 articles, 33 were included for data extraction after grouping the outcomes into 10 risk factors: type of retentive elements supporting overdentures, presence of cantilever extension(s), cemented versus screw-retained FDPs, angled/angulated abutments, bruxism, crown/implant ratio, length of the suprastructure, prosthetic materials, number of implants supporting an FDP, and history of mechanical/technical complications.

CONCLUSIONS:

The absence of a metal framework in overdentures, the presence of cantilever extension(s) > 15 mm and of bruxism, the length of the reconstruction, and a history of repeated complications were associated with increased mechanical/technical complications. The type of retention, the presence of angled abutments, the crown-implant ratio, and the number of implants supporting an FDP were not associated with increased mechanical/technical complications. None of the mechanical/technical risk factors had an impact on implant survival and success rates.

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→ Proceedings of the 4th consensus conference

→ Risk factors: