Does the type of implant prosthesis affect outcomes in the partially edentulous patient?

Weber HP, Sukotjo C.


Erratum in:


Abstract

PURPOSE: Implant restoration of the partially edentulous patient has become highly predictable. The scientific information on the specifics of restorative designs and their influence on the long-term outcome is sparse. The main objective of this systematic review was to determine what scientific evidence exists regarding the influence of prosthodontic design features on the long-term outcomes of implant therapy (implant success and survival, prosthesis success and survival) in the partially edentulous patient.

MATERIALS AND METHODS: Four questions of primary interest regarding implant prosthodontic design options were selected by the 2 reviewers: abutment type, retention type (cemented, screw-retained), support type (implant support alone versus combined implant-tooth support), and the type of restorative material. Inclusion and exclusion criteria were formulated and applied to a total of 1,720 titles. The list of titles was primarily based on a PubMed-type search provided by the State of the Science of Implant Dentistry workshop leadership. It was supplemented by a hand search of relevant journals at the Countway Library of the Harvard Medical School and of a personal collection of relevant publications of the 2 reviewers. Information on the survival and success of implants and prostheses as defined by the respective authors was retrieved from the included articles, entered into data extraction tables, and submitted for statistical analysis.

RESULTS: Seventy-four articles were selected for data extraction and analysis after critical appraisal and application of the exclusion criteria. The kappa value for reviewer agreement was 100% between the 2 reviewers. The majority of studies were in the "average" range and were published between 1995 and 2003. Only 2 "best" trials, ie, randomized controlled clinical trials, were identified. For the method of retention (screw-retained versus cemented), no differences were found in implant success or survival rates between screw-retained and cemented restorations. Prosthesis success rates showed greater variations between cemented and screw-retained restorations at the various evaluation times; however, the differences never reached statistical significance. The prosthesis success rate at the last reported examination (> 72 mo) was 93.2% for cemented and 83.4% for screw-retained restorations (P > .05). Regarding the type of support, implant success rates at the last reported evaluation were 97.1% for implant-supported fixed partial dentures (FPDs), 94.3% for single-implant restorations, and 89.2% for implant-tooth-supported FPDs. None of the differences reached statistical significance. Implant survival at the last examination (> 72 mo)
was highest for implant-supported FPDs (97.7%), followed by single-implant restorations (95.6%) and implant-tooth-supported FPDs (91.1%). Differences were not statistically significant. Prosthesis success at the last examination (> 72 mo) resulted in overall lower percentage rates than implant success or survival (89.7% for implant-supported FPDs, 87.5% for implant-tooth-supported FPDs, and 85.4% for single-implant restorations; differences not statistically significant). Insufficient extractable information was available regarding the influence of abutment type or restorative material.

CONCLUSION: The scientific evidence obtained from this review is insufficient to establish unequivocal clinical guidelines for the design of implant-supported fixed prostheses in the partially edentulous patient.

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**Strains recorded in a combined tooth-implant restoration: an in vivo study.**

Ormaner Z, Brosh T, Laufer BZ, Shifman A.


**Abstract**

Implant-supported fixed prosthesis is a treatment option to restore missing teeth. Occasionally, it is necessary to connect teeth and implants as abutments for these restorations. Whether such restorations can be recommended is a matter of debate. This in vivo study measured strains involved in connecting implants to a natural tooth and compared rigid and nonrigid tooth/implant connections. A patient was treated with mandibular unilateral fixed prosthesis supported by two implants and one proximal tooth. Strain gauges were cemented to the experimental framework restoration. Recordings were obtained from the restorations while the patient bit on a wooden stick on the day of placement and after 2 weeks in function, using both rigid and nonrigid attachment connections. A significant difference was found in horizontal deformation of the tooth/crown between day 1 and 2 weeks later. Vertical deformations were smaller than horizontal ones. After applying biting forces, horizontal and vertical deformations were maintained. Strain recorded in a clinical setting revealed mostly horizontal strains generated in a combined tooth/implant device. These strains were maintained after a 2-week recording. Within the limitation of this study, combined tooth/implant restorations could be a potential complication and could cause an intrusion of a natural abutment regardless of the type of connection (rigid or nonrigid).
Tooth-to-implant connection: a systematic review of the literature and a case report utilizing a new connection design.

Chee WW, Mordohai N.


Abstract

BACKGROUND: In the treatment of partially edentulous patients, implants have often been connected to natural teeth. Numerous studies have reported significant complications and problems, while others have demonstrated favorable outcomes.

PURPOSE: The purpose of this article was to systematically review the literature regarding the splinting of implants and teeth. The difference in the biomechanical behavior between osseointegrated implants and teeth and the efficacy of the different modes of connection that have been employed are explored.

MATERIALS AND METHODS: A MEDLINE search between 1966 and October 2006 was performed to retrieve relevant articles. A further manual search from the bibliographies of the former articles was performed to include as many references as possible. Prospective and retrospective clinical studies, as well as laboratory and computer-generated research, were included.

RESULTS: A pronounced difference in the biomechanics of teeth and implants has been revealed in theoretical models. This disparity has also been supported by the majority of the experimental work published. As a result, principal complications, such as intrusion of teeth and higher risk of overload and greater marginal bone loss around the implants have been reported. Among the several types of connections utilized, the rigid connection showed fewer complications but unfortunately did not eliminate them.

CONCLUSION: Totally implant-supported prostheses should be the treatment of choice. However, there are cases where combining teeth and implants is inevitable. The authors propose a rationale design of connecting implants and teeth. This design minimizes the biologic and technical complications.

A systematic review of the survival and complication rates of fixed partial dentures (FPDs) after an observation period of at least 5 years. II. Combined tooth--implant-supported FPDs.

Lang NP, Pjetursson BE, Tan K, Brägger U, Egger M, Zwahlen M.


Comment in:
- Evid Based Dent. 2005;6(4):98.
OBJECTIVES: The objective of this systematic review was to assess the 5- and 10-year survival of combined tooth-implant-supported fixed partial dentures (FPDs) and the incidence of biological and technical complications.

METHODS: An electronic MEDLINE search supplemented by manual searching was conducted to identify prospective and retrospective cohort studies on FPDs with a mean follow-up time of at least 5 years. Patients had to have been examined clinically at the follow-up visit. Assessment of the identified studies and data abstraction was performed independently by two reviewers. Failure and complication rates were analyzed using random-effects Poisson regression models to obtain summary estimates of 5- and 10-year survival proportions.

RESULTS: From a total of 3844 titles and 560 abstracts, 176 articles were selected for full-text analysis, and 13 studies met the inclusion criteria. Meta-analysis of these studies indicated an estimated survival of implants in combined tooth-implant-supported FPDs of 90.1% (95% confidence interval (95% CI): 82.4-94.5%) after 5 and 82.1% (95% CI: 55.8-93.6%) after 10 years. The survival rate of FPDs was 94.1% (95% CI: 90.2-96.5%) after 5 and 77.8% (95% CI: 66.4-85.7%) after 10 years of function. There was no significant difference in survival of tooth and implant abutments in combined tooth-implant FPDs. After an observation period of 5 years, 3.2% (95% CI: 1.5-7.2%) of the abutment teeth and 3.4% (95% CI: 2.2-5.3%) of the functionally loaded implants were lost. After 10 years, the corresponding proportions were 10.6% (95% CI: 3.5-23.1%) for the abutment teeth and 15.6% (95% CI: 6.5-29.5%) for the implants. After a 5 year observation period, intrusion was detected in 5.2% (95% CI: 2.1-13.3%) of the abutment teeth. Intrusion of abutment teeth were almost exclusively detected among non-rigid connections.

CONCLUSION: Survival rates of both implants and reconstructions in combined tooth-implant-supported FPDs were lower than those reported for solely implant-supported FPDs (Pjetursson et al. 2004). Hence, planning of prosthetic rehabilitation may preferentially include solely implant-supported FPDs. However, anatomical aspects, patient centered issues and risk assessments of the residual dentition may still justify combined tooth-implant-supported reconstructions. It was evident from the present search that tooth-implant-supported FPDs have not been studied to any great extent and hence, there is a definitive need for more longitudinal studies examining these reconstructions.

Survival and complication rates of fixed partial dentures supported by a combination of teeth and implants.

Weber HP, Zimering Y.


Abstract

Selection Criteria: The authors searched for all English-language articles in MEDLINE through 2004. The electronic search yielded 3844 titles, from which 151 studies were ultimately selected. The authors also conducted a manual search that included searching 8 specialty dental journals that published articles on implant-related research during 2001 to 2004. The manual search yielded 25 additional studies. Overall, no randomized controlled
trials (RCTs) were found. Inclusion criteria required studies to have patients clinically examined at follow-up and to have reported on the characteristics of the fixed partial dentures (FPD) structure. The meta-analysis included 13 of 176 studies in which patients with 5 or 10 years of follow-up in a prospective or retrospective study design were evaluated clinically at the end of the follow-up period. KEY STUDY FACTOR: The primary exposure was tooth-implant-supported fixed partial dentures compared with implant-only supported FPDs.

MAIN OUTCOME MEASURE: The main outcome measure was the failure rate of implants in tooth-implant-supported FPDs after 5 or 10 years of follow-up. Secondary outcome measures included the failure rate of the FPD itself or biological or technical complications.

MAIN RESULTS: The meta-analysis included 555 patients ranging in age from 17 to 83 years who received 1002 implants that supported 538 FPDs. Survival of implants in combined tooth-implant-supported FPDs was 90.1% (95% confidence interval [CI]: 82.4%-94.5%) after 5 years and 82.1% (95% CI: 55.8%-93.6%) after 10 years. Survival of FPDs was 94.1% after 5 years and 77.8% after 10 years. There was no difference in the failure rates of implant abutments (3.4%) or tooth abutments (3.2%) for the FPDs after 5 years. Biological complications were reported in only 2 of 13 studies after 5 years, and the cumulative rate was 11.7%.

CONCLUSIONS: The authors concluded that survival rates for implants and FPDs in combined tooth-implant-supported FPDs were lower than found in a similar meta-analysis of implant-only-supported FPDs. The worse survival data for FPDs after 10 years for combined tooth-implant support (77.8%) compared with implant-only support (86.7%) is based on data in only 60 FPDs.

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**Survival and complication rates of combined tooth-implant-supported fixed partial dentures.**

Nickenig HJ, Schäfer C, Spiekermann H.


**Abstract**

OBJECTIVES: The objective of this study has been to review the incidence of biological and technical complications in case of tooth-implant-supported fixed partial denture (FPD) treatments on the basis of survival data regarding clinical cases.

MATERIAL AND METHODS: Based on the treatment documentations of a Bundeswehr dental clinic (Cologne-Wahn German Air Force Garrison), the medical charts of 83 patients with tooth-implant-supported FPDs were completely recorded. The median follow-up time was 4.73 (time range: 2.2-8.3) years. In the process, survival curves according to Kaplan and Meier were applied in addition to frequency counts.

RESULTS: A total of 84 tooth-implant (83 patients) connected prostheses were followed (132 abutment teeth, 142 implant abutments (Branemark, Straumann). FPDs: the time-dependent illustration reveals that after 5 years, as many as 10% of the tooth-implant-supported FPDs already had to be subjected to a technical modification (renewal (n=2), reintegration (n=4),
veneer fracture (n=5), fracture of frame (n=2)). In contrast to non-rigid connection of teeth and implants, technical modification measures were rarely required in case of tooth-implant-supported FPDs with a rigid connection. There was no statistical difference between technical complications and the used implant system. Abutment teeth and implants: during the observation period, none of the functionally loaded implants (n=142) had to be removed. Three of the overall 132 abutment teeth were lost because of periodontal inflammation. The time-dependent illustration reveals, that after 5 years as many as 8% of the abutment teeth already required corresponding therapeutic measures (periodontal treatment (5%), filling therapy (2.5%), endodontic treatment (0.5%)). After as few as 3 years, the connection related complications of implant abutments (abutment or occlusal screw loosening, loss of cementation) already had to be corrected in approximately 8% of the cases. In the utilization period there was no screw or abutment fracture.

CONCLUSION: Technical complications of implant-supported FPDs are dependent on the different bridge configurations. When using rigid functional connections, similarly favourable values will be achieved as in case of solely implant-supported FPDs. In this study other characteristics like different fixation systems (screwed vs. cemented) or various implant systems had no significant effect to the rate of technical complications.

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**Survival and complication rates of combined tooth-implant-supported fixed and removable partial dentures.**

Nickenig HJ, Spiekermann H, Wichmann M, Andreas SK, Eitner S.


Abstract

PURPOSE:

The aim of this study was to assess and compare clinical outcome results of tooth-implant-supported fixed and removable partial dentures in a selected population group of partially edentulous patients. Biological and technical complications were recorded and reviewed.

MATERIALS AND METHODS:

A retrospective analysis of the dental charts of 224 patients (174 men, 50 women) with a mean age of 51.3 years was carried out. The evaluation included details regarding the survival and technical complications of the prescribed prostheses, as well as the biological and technical complications associated with both types of abutments used, ie, teeth and implants.

RESULTS:

A total of 229 prostheses were supported by 459 implants and 449 teeth. They were monitored for a period of 2 to 10 years (median follow-up time: 6.7 years). At the end of the different observation periods, 14% of the tooth-implant-supported prostheses had undergone technical modifications, with no statistical difference in the occurrence of technical complications between the 2 types of prosthesis. Three of the functionally loaded implants were removed, while 23 abutment teeth were lost (15 had undergone endodontic treatment).
Abutment teeth with a reduced attachment level after prosthesis insertion were significantly affected by biological complications ($P = .04$).

CONCLUSIONS:

The survival data for both types of prosthesis were comparable to prostheses supported solely by implants. There was no difference in the complication rate between primary splinting (fixed) and secondary splinting with telescopic systems (removable). A greater risk of biological complications was recorded for endodontically treated abutments or teeth with a reduced attachment level.

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**Retrospective evaluation of complete-arch fixed partial dentures connecting teeth and implant abutments in patients with normal and reduced periodontal support.**

Cordaro L, Ercoli C, Rossini C, Torsello F, Feng C.


**Abstract**

**STATEMENT OF PROBLEM:** The clinical outcome of complete-arch fixed prostheses supported by implants and natural tooth abutments in patients with normal or reduced periodontal support has been reported by few studies, with controversial results.

**PURPOSE:** The purpose of this study was to report on the implant success rate, prosthetic complications, and the occurrence of tooth intrusion, when complete-arch fixed prostheses, supported by a combination of implants and teeth, were fabricated for patients with normal and reduced periodontal support.

**MATERIAL AND METHODS:** Nineteen patients with residual teeth that served as abutments were consecutively treated with combined tooth- and implant-supported complete-arch fixed prostheses and were retrospectively evaluated after a period varying from 24 to 94 months. Nine patients showed reduced periodontal support as a result of periodontal disease and treatment (RPS group), and 10 patients had normal periodontal support of the abutment teeth (more than 2/3 of periodontal support [NPS group]). Ninety implants and 72 tooth abutments were used to support 19 fixed partial dentures. Screw- and cement-retained metal-ceramic and metal-resin prostheses were fabricated with rigid and nonrigid connectors. Implant survival and success rates, occurrence of caries and tooth intrusion, and prosthetic complications were recorded. The number of teeth, implants, prosthetic units, fixed partial dentures, and nonrigid connectors were compared with a t test to assess differences between the 2 groups, while data for the occurrence of intrusions and prosthetic complications were compared with the Fisher exact test (alpha=.05).

**RESULTS:** One of the 90 implants was lost (99% survival rate) over 24 to 94 months, while 3 implants showed more than 2 mm of crestal bone loss (96% success rate) over the same period. No caries were detected, but 5.6% (4/72) of the abutment teeth exhibited intrusion. Intrusion of abutment teeth was noted in 3 patients who had normal periodontal support (13% of teeth in NPS group) of the abutment teeth and was associated with nonrigid connectors. No intrusion of teeth was noted in the patients exhibiting reduced periodontal
support regardless of the type of connector or when a rigid connector was used for either group. The number of intruded teeth was significantly greater in patients with intact periodontal support (P=.03).

CONCLUSIONS: Complete-arch fixed prosthesis supported by implant and tooth abutments may be associated with intrusion of teeth with intact periodontal support when nonrigid connectors are used to join the implant- and tooth-supported sections of the prostheses. However, fixed partial dentures supported by implants and teeth with reduced periodontal support were not associated with tooth intrusion, regardless of the type of connectors used.

**Biomechanical interactions in tooth-implant-supported fixed partial dentures with variations in the number of splinted teeth and connector type: a finite element analysis.**

Lin CL, Wang JC, Chang WJ.


Abstract

OBJECTIVE: The aim of this study was to investigate the biomechanical interactions in tooth-implant-supported fixed partial dentures (FPDs) under several loading conditions with different numbers of splinted teeth and connector types (rigid and non-rigid) by adopting the three-dimensional (3D) non-linear finite element (FE) approach.

MATERIAL AND METHODS: A 3D FE FPD model was constructed containing one Frialit-2 implant in the mandibular second-molar region splinted to the first and second premolars. Frictional contact elements were used to simulate realistic interface conditions within the implant system and the non-rigid connector function. The main effects for each level of the three investigated factors (loading condition, number of splinted teeth and connector type) in terms of the stress values and dissimilar mobility of the natural teeth and implant were computed for all models.

RESULTS: The results indicated that load condition was the main factor affecting the stress developed in the implant, bone and prosthesis when comparing the type of connector and the number of splinted teeth. The stress values were significantly reduced in centric or lateral contact situations once the occlusal forces on the pontic were decreased. However, the prosthesis stress for the non-rigid connections was increased more than 3.4-fold relative to the rigid connections. Moreover, the average tooth-to-implant displacement ratios (R(TID)) with a non-rigid connection were obviously larger than those for rigid connections under axial loading forces. Adding an extra tooth to support a three-unit tooth-implant FPD only exploited its function when the prosthesis withstood lateral occlusal forces.

CONCLUSIONS: The load condition is the main factor affecting stress distribution in different components (bone, prosthesis and implant) of tooth-implant-supported FPDs. Minimizing the occlusal loading force on the pontic area through selective grinding procedures could reduce the stress values obviously. A non-rigid connector may more efficiently compensate for the dissimilar mobility between the implant and natural teeth under axial loading forces but with the risk of increasing unfavorable stresses in the prosthesis.
Intrusion phenomenon in combination tooth-implant restorations: a review of the literature.

Schlumberger TL, Bowley JF, Maze GI.


Abstract

STATEMENT OF PROBLEM: Controversy regarding the connection of implants to natural teeth in fixed partial dentures has emerged in response to clinical reports of intrusion of the natural teeth. Although theories have been proposed to explain this phenomenon, the cause of the intrusion remains unknown. Numerous longitudinal studies have demonstrated that teeth can be successfully connected to implants. The use of rigid connectors, or nonrigid connectors with the keyway on the implant, are described as mechanisms to prevent intrusion of the natural tooth.

PURPOSE: This article reviews the literature that pertains to this subject and includes treatment modalities that may be helpful in preventing intrusion.

Prosthetic treatment planning on the basis of scientific evidence.

Pjetursson BE, Lang NP.


Abstract

The objective of this report is to summarize the results on survival and complication rates of different designs of fixed dental prostheses (FDP) published in a series of systematic reviews. Moreover, the various parameters for survival and risk assessment are to be used in attempt to perform treatment planning on the basis of scientific evidence. Three electronic searches complemented by manual searching were conducted to identify prospective and retrospective cohort studies on FDP and implant-supported single crowns (SC) with a mean follow-up time of at least 5 years. Patients had to have been examined clinically at the follow-up visit. Failure and complication rates were analyzed using random-effects Poisson regression models to obtain summary estimates of 5- and 10-year survival proportions. Meta-analysis of the studies included indicated an estimated 5-year survival of conventional tooth-supported FDP of 93.8%, cantilever FDP of 91.4%, solely implant-supported FDP of 95.2%, combined tooth-implant-supported FDP of 95.5% and implant-supported SC of 94.5% as well as resin-bonded bridges 87.7%. Moreover, after 10 years of function the estimated survival decreased to 89.2% for conventional FDP, to 80.3% for cantilever FDP, to 86.7% for implant-supported FDP, to 77.8% for combined tooth-implant-supported FDP, to 89.4% for implant-supported SC and to 65% for resin-bonded bridges. When planning prosthetic rehabilitations, conventional end-abutment tooth-supported FDP, solely implant-supported FDP or implant-supported SC should be the first treatment option. Only as a second option, because of reasons such as financial aspects patient-centered preferences or anatomical structures
cantilever tooth-supported FDP, combined tooth-implant-supported FDP or resin-bonded bridges should be chosen.

Comparison of survival and complication rates of tooth-supported fixed dental prostheses (FDPs) and implant-supported FDPs and single crowns (SCs).

Pjetursson BE, Brägger U, Lang NP, Zwahlen M.


Erratum in:

Comment in:

Abstract

OBJECTIVES: The objective of this systematic review was to assess and compare the 5- and 10-year survival of different types of tooth-supported and implant-supported fixed dental prosthesis (FDPs) and single crowns (SCs) and to describe the incidence of biological and technical complications.

METHODS: Three electronic searches complemented by manual searching were conducted to identify prospective and retrospective cohort studies on FDPs and SCs with a mean follow-up time of at least 5 years. Patients had to have been examined clinically at the follow-up visit. Failure and complication rates were analyzed using random-effects Poisson's regression models to obtain summary estimates of 5- and 10-year survival proportions.

RESULTS: Meta-analysis of the included studies indicated an estimated 5-year survival of conventional tooth-supported FDPs of 93.8%, cantilever FDPs of 91.4%, solely implant-supported FDPs of 95.2%, combined tooth-implant-supported FDPs of 95.5% and implant-supported SCs of 94.5%. Moreover, after 10 years of function the estimated survival decreased to 89.2% for conventional FDPs, to 80.3% for cantilever FDPs, to 86.7% for implant-supported FDPs, to 77.8% for combined tooth-implant-supported FDPs and to 89.4% for implant-supported SCs. Despite high survival rates, 38.7% the patients with implant-supported FDPs had some complications after the 5-year observation period. This is compared with 15.7% for conventional FDPs and 20.6% for cantilever FDPs, respectively. For conventional tooth-supported FDPs, the most frequent complications were biological complications like caries and loss of pulp vitality. Compared with tooth-supported FDPs, the incidence of technical complications was significantly higher for the implant-supported reconstructions. The most frequent technical complications were fractures of the veneer material (ceramic fractures or chipping), abutment or screw loosen and loss of retention.

CONCLUSION: On the basis of the results of the present systematic review, planning of prosthetic rehabilitations should preferentially include conventional end abutment tooth-supported FDPs, solely implant-supported FDPs or implant-supported SCs. Only for reasons of anatomical structures or patient-centered preferences and as a second option should
cantilever tooth-supported FDPs or FDPs supported by combination of implants and teeth be chosen.

**Long-term survival and success of oral implants in the treatment of full and partial arches: a 7-year prospective study with the ITI dental implant system.**

Romeo E, Lops D, Margutti E, Ghisolfi M, Chiapasco M, Vogel G.


**Abstract**

PURPOSE: This study evaluated the long-term survival and success of different implant-supported prostheses supported by ITI implants.

MATERIALS AND METHODS: Two hundred fifty consecutive patients were rehabilitated using implant-supported prostheses. Seven hundred fifty-nine implants were loaded. Single-tooth prostheses (n = 106), cantilever fixed partial prostheses (n = 42), fixed partial prostheses (n = 137), fixed complete prostheses (n = 5), implant/tooth-supported prostheses (n = 13), and overdentures (n = 37) were used. The mean follow-up period was 3.85 years. Life table analyses were performed. Implant survival rates were calculated by means of standard life table principles. Statistical analysis was performed to compare the implant survival and success by implant placement site for each type of prosthesis.

RESULTS: The cumulative implant survival rates were calculated for implants supporting single-tooth prostheses (95.6%), cantilever fixed partial prostheses (94.4%), fixed partial prostheses (96.1%), fixed complete prostheses (100%), implant/tooth-connected prostheses (90.6%), and overdentures (95.7%). Similar survival and success rates were documented for implants placed in maxillae and mandibles. Implant size did not influence survival.

DISCUSSION: Seven-year survival rates were similar for implants supporting single-tooth prostheses, cantilever fixed partial prostheses, fixed partial prostheses, and implant/tooth-supported prostheses. Medium-long term implant survival and success were not influenced by the site (maxilla or mandible). Implant and prosthetic survival rates for overdentures supported by 2 implants were comparable to those for overdentures supported by 3 or more implants.

CONCLUSION: Prostheses supported by ITI implants represent a reliable medium-term treatment. (More than 50 references.)
Tooth-implant connection: a bibliographic review.
Hita-Carrillo C, Hernández-Aliaga M, Calvo-Guirado JL.

Abstract
The aim of this study was to carry out a bibliographic review of all available literature addressing the issue of whether or not the connection of teeth to implants by means of a prosthesis is a viable treatment alternative. Twenty articles from a variety of sources were analyzed and classified in order to draw conclusions. Articles were classified by type and an analysis was made of the different variables considered in each study, obtaining percentages of implant survival ranging from 84.4% to 100%, prosthetic complications ranging from 80% to 90%, and the incidence of dental intrusion ranging from 0 to 5.6%. Biomechanical studies: Some articles studied models in order to assess different connections subjected to force, in which varying results were obtained. Rigid connections appeared to produce the most stress to the natural tooth, periodontal ligament and peri-implant bone; non-rigid connections reduced the stress to the bone, but increased stress to the prosthesis. Clinical studies: The results obtained were disparate. Studies in the medium or short-term show this as a viable treatment alternative, whereas some studies point to a greater risk of complications, although the use of rigid connection decreases the percentage of intrusion. Other bibliographic reviews have concluded that there is a need for more longitudinal studies on the viability of tooth-implant connection, also concluding that complications are greater when this is the chosen treatment. As a viable alternative with an acceptable success rate, this course of treatment is always associated with rigid connection rather than non-rigid connection. Although intrusion is avoided with rigid connection, this nevertheless remains inadvisable as the primary treatment choice.

 Artikel frei einsehbar unter:
http://www.medicinaoral.com/pubmed/medoralv15_i2_p387.pdf

Evaluation of stress induced by implant type, number of splinted teeth, and variations in periodontal support in tooth-implant-supported fixed partial dentures: a non-linear finite element analysis.
Lin CL, Wang JC, Chang SH, Chen ST.

Abstract
BACKGROUND: This study investigated the biomechanical interactions in tooth-implant-supported fixed partial dentures (FPDs) with variations in periodontal support, implant system, number of splinted teeth, and load type using the non-linear finite element (FE) approach.

METHODS: The section contours of the alveolar bone, abutment teeth, and prosthesis were acquired using computed tomography (CT) and micro-CT to construct the FE models with normal periodontal support (NPS) and compromised periodontal support (CPS) containing
one- and two-piece implants splinted to the first and second premolars. Realistic interface conditions within the implant system were simulated using frictional contact elements. The main effects for each level of investigated factors in terms of stress values and dissimilar mobility of natural teeth and the implant were computed for all models.

RESULTS: Analytic results indicated that the load condition was the predominant factor affecting stress developed in the implant, bone, and prosthesis. Additionally, the oblique occlusal forces increased the stress values relative to that of axial analogs. A splinted system with a two-piece implant increased stress on the bone and decreased stress on the prosthesis compared to that of the one-piece implant. The splinted system with a CPS only slightly increased implant stress on the bone compared to that of the splint system with NPS. Splinting an additional tooth did not significantly impact stress values for the tooth-implant-supported FPD.

CONCLUSIONS: A one-piece structure implant may be better than that of a two-piece structure implant in decreasing bone stress when a natural tooth is planned to connect with an implant. The factors of periodontal support and number of splinted teeth only slightly influenced stress in tooth-implant-supported FPDs.

**Freestanding and tooth-implant connected prostheses in the treatment of partially edentulous patients. Part I: An up to 15-years clinical evaluation.**

Naert IE, Duyck JA, Hosny MM, Van Steenberghe D.


**Abstract**

In 123 patients, 339 implants were connected to 313 teeth by means of fixed partial prostheses (test) and followed up for 1.5-15 years (mean: 6.5). In another ad random selected 123 patients, 329 implants were connected to each other by means of 123 freestanding fixed partial prostheses (control) and were followed up for 1.3-14.5 years (mean: 6.2). The aim of this study was to compare both treatment modalities with each other based on implant, tooth and prosthesis complications. The cumulative implant success, based on implant immobility and/or lack of implant fractures after loading, in the test and control groups amounted to 95% and 98.5%, respectively. Although in the test group 10 implants versus only 1 in the control group failed, a regression analysis of the survival data, based on the cox proportional hazards model, revealed no significant difference. In the test group periapical lesions (3.5%), tooth fracture (0.6%) and tooth extraction due to fatal decay or periodontitis (1%) were observed, besides tooth intrusion (3.4%) and crown cement failure (8%). Framework fracture occurred in 3 patients. In the control group, only 2 abutment screws fractured. The treatment of partial edentulism by means of oral implants was beneficial for our patients. Because of a clear tendency of more implant failures (mobility or fractures) and tooth complications in the tooth-implant connected prostheses, the freestanding solution is the primary option to be considered. To avoid intrusion of abutment teeth, the connection, if made, should be completely rigid.
Freestanding and tooth-implant connected prostheses in the treatment of partially edentulous patients Part II: An up to 15-years radiographic evaluation.

Naert IE, Duyck JA, Hosny MM, Quirynen M, van Steenberghe D.


Abstract

A total of 123 patients were followed between January 1983 and July 1998 with 140 tooth-implant connected prostheses. The age of the patients at prosthesis installation ranged from 20 to 79 years (mean 51.8). 339 (Brånemark(R) system) implants were connected to 313 teeth. The loading time ranged from 1.5 to 15 years (mean: 6.5). 123 patients were randomly selected as a control group with freestanding implant-supported prostheses only. The age of the patients at prosthesis installation ranged from 22 to 78 years (mean 52.3). The loading time for the 329 freestanding (Brånemark(R) system) implants ranged from 1.3 to 14.5 years (mean: 6.2). Evolution of the marginal bone stability around the implant in the tooth-implant connected as well as the freestanding group was studied with respect to the prognosis of the implants. Over the period from 0 to 15 years, there was significantly more marginal bone loss (0.7 mm) in tooth-implant connected versus freestanding prostheses. No significant difference in marginal bone loss was found between the non-rigid tooth-implant connected prostheses versus freestanding prostheses. However, there was a significant difference in marginal bone loss for rigid and multi-connected tooth-implant connected prostheses versus freestanding ones. The results of this study indicate that more bone is lost around implants which are rigidly connected to teeth. This suggests that bending load, which is increased in tooth-implant connected prostheses, might be responsible for this phenomenon. These observations favor the use of freestanding prostheses whenever possible. However, the clinical significance of greater bone loss in rigid versus non-rigid connections might outweigh the annoying phenomenon of tooth intrusion in the case of non-rigid tooth connection, when connection is considered.

A survey of natural tooth abutment intrusion with implant-connected fixed partial dentures.

Rieder CE, Parel SM.


Abstract

To elicit information about the phenomenon of intrusion of natural tooth abutments in implant-connected prostheses, a survey was distributed to clinicians with varied experience. Although practitioners with more experience in fabricating implant-supported dentures connected to natural teeth reported fewer instances of intrusion, it cannot be concluded that this observation is significant. The cause of intrusion is probably multifactorial, and respondents suggested several possible causative factors: disuse atrophy, debris impaction, impaired rebound memory, and mechanical binding. Because apical migration of abutment teeth affects occlusion and oral hygiene, the authors make several recommendations for treatment planning for patients who have natural dentition adjacent to proposed implant sites.
**Tooth-implant connection: some biomechanical aspects based on finite element analyses.**

Menicucci G, Mossolov A, Mozzati M, Lorenzetti M, Preti G.


**Abstract**

This study investigated, with the use of two- and three-dimensional finite element analysis, the peri-implant stress that occurred during loading of a tooth that was rigidly connected to a distally placed implant. A fixed bond between the bone and the implant was assumed, while the periodontal ligament was represented by means of three-dimensional nonlinear visco-elastic spring elements. Two different loading conditions were compared in the study: i) an axially directed static load of 50 kg that was applied to the tooth for 10 s, and ii) a transitional load of 50 kg that was applied for 5 milliseconds. Load duration appeared to have a greater influence than load intensity on the stress distribution in the bone around an implant and a rigidly connected tooth. Static load is, therefore, potentially more harmful for peri-implant bone than transitional load. The periodontal ligament seems to play a key role in the stress distribution between a tooth and a rigidly connected implant.

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**Fixed partial dentures supported by natural teeth and Brånemark system implants: a 3-year report.**

Tangerud T, Grønningsaeter AG, Taylor A.


**Abstract**

**PURPOSE:** To evaluate fixed partial dentures (FPDs) supported by a combination of natural teeth and implants in a variety of clinical situations.

**MATERIALS AND METHODS:** In 30 patients, 86 teeth and 85 implants were used as supports for 30 FPDs of varying extension (mean = 8.6 units); 23 in the maxilla and 7 in the mandible. The prostheses had a removable section fastened with screws to both the implants and to a section cemented on the supporting teeth, and were thus functioning as rigid, fixed partial dentures.

**RESULTS:** Five implants were lost prior to the placement of prostheses, 2 were lost after loading, giving survival rates of 91.0% in the maxilla and 95.5% in the mandible. Complications were predominantly soft tissue-related and were all amenable to treatments. One patient was lost to follow-up. The remaining 29 FPDs remained stable throughout the 3-year observation period.
DISCUSSION: Changes in plaque accumulated, bleeding on probing, pocket depths, and marginal bone level were acceptable. The survival rate of implants was comparable to that of similar studies. Further investigations are needed with regard to design for such FPDs.

CONCLUSION: These findings, together with the patient satisfaction experienced, indicated that the combined support of implants and teeth for fixed prostheses may be appropriate treatment for patients.

Literaturstudie:
Kombinationsversorgung von Zähnen und Implantaten
Moll D
E-Dissertation 2006

» Dissertation online frei einsehbar unter:
http://deposit.ddb.de/cgi-bin/dokserv?idn=979244196&dok_var=d1&dok_ext=pdf&filename=979244196.pdf

» Interessant sind S. 87 – 102:
4.3 FESTSITZENDER ZAHNERSATZ – ZAHN-IMPLANTATGETRAGEN

Biological and technical complications and failures with fixed partial dentures (FPD) on implants and teeth after four to five years of function.

Brägger U, Aeschlimann S, Bürgin W, Hämmerle CH, Lang NP.

Abstract

The aim of this study was to compare the frequency of biological and technical complications with fixed partial dentures (FPDs) on implants, teeth and as mixed tooth-implant supported FPDs over 4 to 5 years of function. All implants belonged to the ITI Dental Implant System. Group I-I (implant FPD) included 33 patients with 40 FPDs, group T-T (tooth FPDs) 40 patients with 58 FPDs, group I-T (mixed tooth-implant FPDs) 15 with 18 FPD. Of the bridge abutments 144 were teeth and 105 were implants. The median number of units replaced by the FPDs was 3 (range 2-14). The mean age of the patients was 55.7 years (range 23-83). Complete failures resulted in the loss of one FPD in each group. Two implants were lost due to fracture secondarily to development of a bone defect. One tooth had a vertical fracture and 1 tooth was lost due to periodontitis. Biological complications (peri-implantitis, PPD > or = 5 mm and BOP+) occurred at 9.6% (10) of the implants. This number was, however, reduced to 5% if the threshold for definition of peri-implantitis was set at PPD > or = 6 mm and BOP+. Biological complications occurred in 11.8% (17) of the abutment teeth (NS compared to implants); 2.8% (4) had secondary caries, 4.9% (7) endodontic problems and 4.1% (6) had periodontitis (PPD > or = 5 mm, BOP+). Ten out of 32 patients with a general health problem
indicated a biological complication, whereas 9 out of 53 patients with no general health problem had a biological complication (chi 2: NS). Statistically significantly more technical complications were found in FPDs on implants (chi 2, P < or = 0.05). The technical complications were associated with bruxism. Out of 10 bruxers 6 had a technical complication whereas 13 out of 75 non-bruxers had such a complication (chi 2 < or = 0.01). Extensions were associated with more technical complications (13 out of 35 with extensions versus 9 out of 81 without). In conclusion, favourable clinical conditions were found at tooth and implant abutments after 4-5 years of function. Loss of FPD over 4-5 years occurred at a similar rate with mixed, implant or tooth supported reconstructions. Significantly more porcelain fractures were found in FPDs on implants. Impaired general health status was not significantly associated with more biological failures but bruxism as well as extensions were associated with more technical failures.

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**Prospective evaluation of implants connected to teeth.**


**Abstract**

**PURPOSE:**

This prospective clinical trial examined the effect on teeth and implants when rigidly or non-rigidly connected in a cross-arch model.

**MATERIALS AND METHODS:**

Thirty patients received 2 implants, 1 on each side of the mandible, and were restored with 3-unit fixed partial dentures connected either rigidly or non-rigidly to an abutment tooth. Patients were followed for at least 5 years post-restoration.

**RESULTS:**

Repeated-measures analysis revealed no significant difference in crestal bone loss at implants (rigid versus non-rigid methods). An overall significant difference (P < .001) was found comparing methods for teeth. Paired t tests revealed no significant differences in crestal bone levels for implants or teeth at the 5-year recall. Kaplan-Meier methods and the Cox proportional hazards model showed no differences between attachment methods with regard to success based on survival and bone loss criteria. During the 5-year recall period, 1 implant (rigid side) was removed. Four implants developed bone loss greater than 2 mm during the course of this trial. One tooth on the rigid side and 2 teeth on the non-rigid side had greater than 2 mm of crestal bone loss and were removed secondary to fractures. In all, 5 abutment teeth were removed, all of which had been treated with root canal therapy and fractured at the interface of the post within the tooth. There was no clear relationship of tooth fracture to attachment. Repeated-measures analysis of mobility values revealed no significant changes over the time course of this study, and paired t tests revealed no statistically significant differences between implants for mobility. Repeated-measures analysis and paired t tests for probing depth revealed no significant changes over the time
course of this study. There were no significant differences in soft tissue indices for either attachment method. The percentage of patients who had measurable intrusion was 66% for the non-rigid group, and 44% for the rigid group; 25% of the non-rigid teeth had greater than 0.5 mm intrusion, compared with 12.5% for the rigid group. For the 2 time periods evaluated, there was no significant increase in intrusion over time. The non-rigid-side implant required more nonscheduled visits to treat problems than the rigid implant and the teeth. Discussion: Most patients were treated successfully with rigid or non-rigid attachment of implants to teeth.

CONCLUSION:

The high incidence of intrusion and non-scheduled patient visits suggest that alternative treatments without connecting implants to teeth may be indicated.

Tooth- and implant-supported prostheses: a retrospective clinical follow-up up to 8 years.

Kindberg H, Gunne J, Kronström M.


Abstract

PURPOSE:

The purpose of this study was to evaluate clinical treatment outcome of fixed prostheses in different sizes and with combinations of different numbers of teeth and implants as abutments.

MATERIALS AND METHODS:

A total of 115 implants were placed in 36 patients, 75 (65%) in the maxilla and 40 (35%) in the mandible. The implants were connected to 85 abutment teeth, 50 in the maxilla and 35 in the mandible. Of the prosthetic restorations, 19 were gold ceramic, 17 were gold acrylic, three were titanium acrylic, one was titanium ceramic, and one was titanium composite. The observation period ranged from 14 months to 8.9 years. The treatments comprised both fixed partial dentures supported by one tooth and one implant as well as complete-arch fixed prostheses supported by a number of teeth and implants.

RESULTS:

A total of nine implants were lost, three during healing and six after loading. The postloading cumulative implant survival rate was 89.8% after 5 years. Five abutment teeth were lost, and of the 41 prostheses included in the study, only two (5%) were lost during the observation period. Marginal bone loss was registered around 46 implants at the 1-year follow-up examination. During the following observation period, only slight changes in the marginal bone level adjacent to the implants and teeth were registered. The magnitude of technical complications was low.

CONCLUSION:
This investigation confirms the findings in similar studies that treatments with periodontally healthy teeth and implants splinted together in rigid one-piece superstructures show excellent long-term follow-up results.

**Intrusion of teeth in the combination implant-to-natural-tooth fixed partial denture: a review of the theories.**

Pesun IJ.


**Abstract**

This article reviews the literature dealing with the combination implant-to-natural-tooth-supported fixed partial denture. The restoration of masticatory function with a combination implant-to-natural-tooth fixed partial denture is associated with a variety of undesirable clinical sequelae, including the breakage of implant components, damage to the abutment teeth, or intrusion of the abutment teeth. Theories regarding intrusion of abutment teeth combined with implants for fixed partial dentures are only speculative. Several theories are presented to explain the intrusion of natural teeth in association with implant-to-natural-tooth fixed partial dentures. One of the first theories was based on the idea that a lack of normal stimulation of the periodontal ligament produces atrophy of the periodontal ligament and intrusion of the tooth. The remaining theories relate to excessive forces being placed on the natural tooth, resulting in movement of the tooth to a less stressful position. These forces are placed on the tooth by differential energy dissipation, mandibular flexion and torsion, flexion of the fixed partial denture framework, impaired rebound memory, debris impaction or microjamming, or ratchet effect related to the use of precision attachments. Based a review of the literature, a philosophy for treating combination implant-to-natural-tooth restorations is presented.