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# Patient Related Outcomes for Dental Implant Therapy with Fixed Prosthesis: A Systematic Review

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# Patient Related Outcomes for Dental Implant Therapy with Fixed Prosthesis: A Systematic Review

## **Abstract**

**Aim:** To explore the available literature compiling studies that discuss patient related outcomes in terms of function and comfort for dental implants with fixed restorations. **Materials and Methods:** To identify studies relevant to the field of patient related outcomes in terms of function and comfort for treatment with dental implants in fixed restorations, literature review search was done via PubMed, Scopus, Ovid and Cochrane. Review articles were searched for any related studies that could be included in this systematic review. **Results:** 107 studies were initially identified from the search; 13 studies met the inclusion criteria and were selected for this systematic review. The analysis of the data related to comfort shows that the patients' satisfaction ranged between 75.3% to 99.5% with an average of 90.8% and a standard error (SE) of  $\pm 2.6$ . Data analysis of the perception of function's improvement showed that patients' satisfaction ranged between 69.9% to 100% with an average of 92.1% and a standard error (SE) of  $\pm 2.4$ . **Conclusion:** The results indicate that the patient's satisfaction in terms of function and comfort for treatment with dental implants and fixed restorations is relatively high and this is an acceptable modality of treatment. Further standardized studies with larger sample sizes and standardized evaluation scales are recommended.

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## **Primary Advisor**

Dr. Joseph P. Fiorellini

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Patient outcome, Satisfaction, Dental implant, Fixed prosthesis, Comfort, Function, Dentistry, Systematic review

## **Subject Categories**

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**“Patient Related Outcomes for Dental Implant Therapy with  
Fixed Prosthesis: A systematic Review”**

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## **Introduction:**

Improving the quality of life of a patient is the primary goal of every dental professional. The advent of dental implants has made this more realistic in the partially and fully edentulous patient, who may have had issues with mastication, speech, and overall quality of life. Simply knowing that a missing tooth has been replaced with a fixed appliance can give a patient added confidence in his or her daily activities, regardless of the patient's age, gender, or occupation.

Replacing a missing tooth with a fixed appliance is a true benefit provided by modern dentistry. Removable appliances have their own inherent issues. Patients usually complain about the fit and retention. Some patients forget to take them out and clean the dentures properly. An ill-fitting partial denture can lead to bone resorption, which in turn makes the retention even worse. Therefore, when appropriate and affordable, some patients will opt for a fixed option. Fixed partial dentures, while permanently seated, can be difficult to maintain for some patients. Trying to thread a dental floss or pick under the internal contacts of a bridge is sometimes too difficult for some patients. This can contribute to recurrent caries or periodontal disease around the bridge. This brings us to the advent of the modern dental implant. Some dental implants, when done appropriately, can mimic a natural tooth in terms of feel, function, and cleaning ability. In an ideal situation, a dental implant with a fixed prosthesis can make a patient forget that he has a dental restoration in his or her mouth. Implants are of course susceptible to peri-implant diseases and fractures. None of these options are risk free, but some may be more advantageous for certain patients and certain situations.

How a patient perceives a treatment is an important indicator of its success. A patient may not always understand the biological components of the success or failure of a dental implant. Patients can, however, tell a practitioner whether or not they are happy with the treatment. Patients can usually tell the dentist whether or not the implant has satisfied their needs and expectations. Is the restored implant comfortable? Can they use the implant to chew without reservations? Can they properly clean the implant in an easy way? It is very important for a practitioner to consider how a patient might answer these questions. If the answers to these questions are a resounding "no," then a new modality of treatment may need to be suggested.

Questionnaires can be used to assess how a person feels following a procedure. They can be given at any time: before, during, and/or after a procedure. In the case of dental implants, objective questions and answers offer dentists something that a radiograph may not offer: how a patient feels about the implant-supported restoration. A radiograph may show a perfectly integrated implant. This implant, however, may be causing the patient extreme discomfort for some other reasons, regardless of appropriate osseointegration. A probing depth around an implant may show no signs of bleeding on probing, however, the patient may say that he feels that it is a very difficult area for him to clean. Patient feedback is paramount for the adequate treatment outcome, adding it to the professional clinical perspective.

The purpose of this systematic review is to explore the available literature compiling studies that discuss patient-perceived outcomes to dental implants with fixed restorations. Implants have become so mainstream that in many cases general dentists, oral surgeons, periodontists, endodontists, and prosthodontists are all treatment planning and placing implants. Due to this increasing usage of dental implants, it is important to discuss the patient satisfaction for this treatment. What are the patient related outcomes in terms of function and comfort for treatment with dental implants in fixed restorations? This manuscript will list and discuss articles in which the authors pose these very questions to their patients. To get a clear understanding of whether or not our patients approve of this vastly used treatment modality in the field of dentistry.

## **Materials and Methods:**

### **Search strategy**

To identify studies relevant to the field of patient related outcomes in terms of function and comfort for treatment with dental implants in fixed restorations, a search of the MEDLINE database was carried out. A broad search was employed to capture as many relevant publications as possible (Table1).

Literature review search was done via PubMed, Scopus, Ovid and Cochrane. Gray literatures were searched via Web of Science.

### **Study selection**

All included studies were based on personal evaluation from adult male or female patients who received dental implant(s), restored with fixed restorations. The evaluation from the selected papers was done through face-to-face interviews, telephone interviews, mailed or self administrated questionnaire evaluations. Also, electronic mail or Web data collection that had addressed the patient's comfort or function. Studies included were limited to English language and comprising human subjects only. Review articles were searched for any related studies that can be included in this systematic review.

The excluded articles consisted of case reports, non-dental implant studies, studies evaluating the dental prosthesis only, studies relating to implant supported overdentures, studies that are not evaluating patient's comfort or function, and studies written in a different language other than English.

### **Compilation of relevant scientific papers**

The abstracts of all studies that resulted from the searches were assessed and full text copies of all relevant and potentially relevant studies were obtained. For all studies appearing to meet the

inclusion criteria, or if the title and abstract were unclear as to whether it met the inclusion criteria or not, a full text copy was reviewed. All eligible studies that were quoted in the studies reviewed, were searched manually and were added to the list of potential studies to be included in this review. After assessment, any duplicate publications or remaining studies that did not match the inclusion criteria were excluded from further review and the reasons for their exclusion noted in table 2.

All the selected studies were reviewed by two independent readers. Screening and selection process is outlined in a PRISMA flow chart in Figure 1.

## **Results:**

The initial screening resulted in 107 records. 90 studies were found on PubMed, 4 were found on Scopus, 7 were found on Ovid, and 6 on Cochrane databases. After the removal of duplicated studies (6 total), and after excluding all of the studies that did not meet the inclusion and exclusion criteria, 54 studies were obtained for full text assessment (Fig. 1). 41 studies were then excluded by not meeting the inclusion criteria listed in the method's section, resulting in the final 13 articles for this systematic review.

Details of studies concerning patient related outcomes in terms of function and comfort for treatment with dental implants in fixed restorations used in this study are presented in Table 3. All studies included in this review have used questionnaires to assess their patients' outcomes.

The type of questionnaire and the scales used to express the patient's evaluation varied between all the studies. Some studies evaluated either function or comfort as part of the questionnaire. The specific aim of some studies was to evaluate these patient related outcomes, while others incorporated these outcomes as part of a broader study. Length of assessment period varied considerably between studies.

The shortest follow up period was 6 months after implant placement and the longest was 15 years after placement.

For the purposes of this study, depending on a patient's answers to the questionnaire used in each study, the percentage of patient responses was calculated using only the answers that indicate comfort or absence of pain and the ability to chew or function. The answers that were considered satisfactory were: "excellent and good" (Hammerle et al. 2011, Cochran et al. 2011), "satisfied" (den Hartog et al. 2011, Preciado et.al 2013), "no and once" for pain experience and "yes and enough" for chewing comfort (Adler et al. 2016), "definitely and enough" (Pjetursson et al. 2005), "never, yes but rarely, greatly improved and somewhat improved" (Derks et al. 2015), "5 and 4" rating (Bruyn et al. 1997) and "preferred implants and no difference" (Tey et al. 2016).

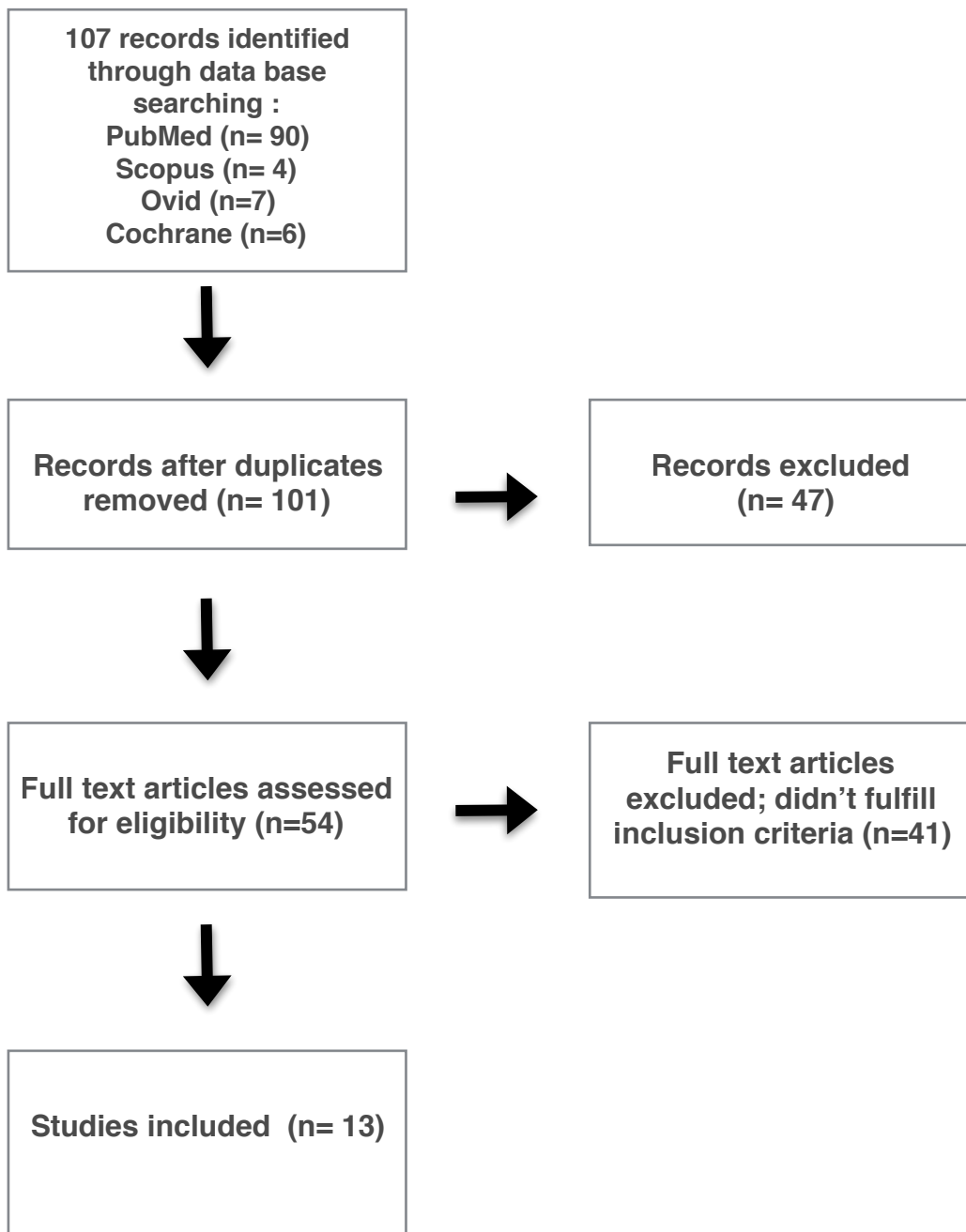
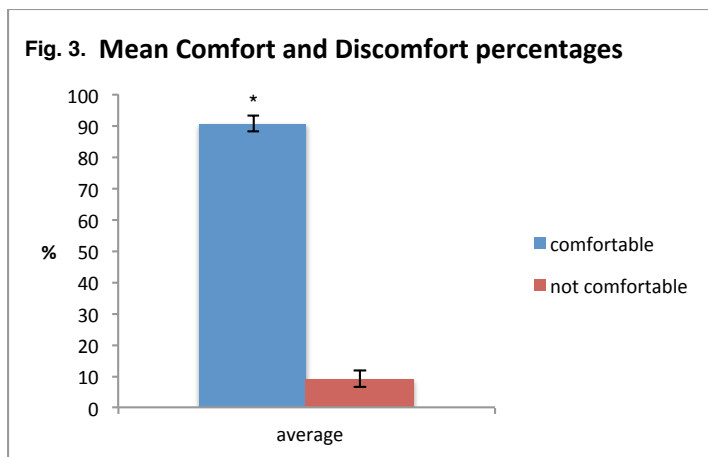
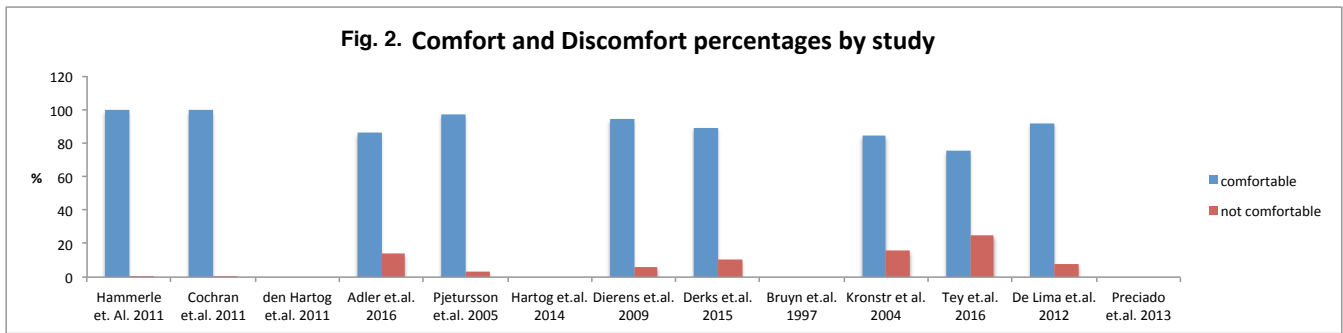


Figure 1. Study flow diagram

The analysis of the data related to comfort shows that the patients' satisfaction ranged between 75.3% to 99.5% (Fig.2) with an average of 90.8% and a standard error (SE) of  $\pm 2.6$  (Fig.3). Data analysis has showed that comfort was statistically higher than discomfort by T-test ( $p < 0.05$ ).

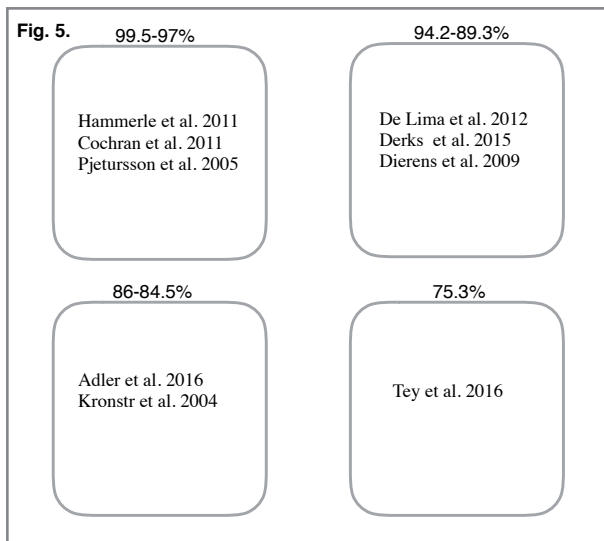
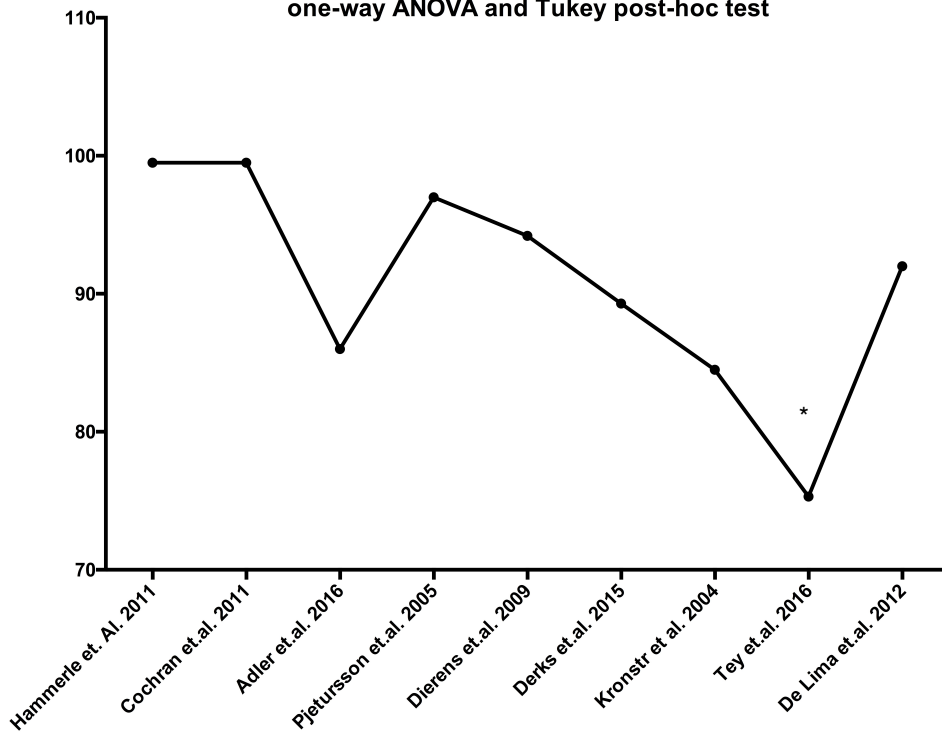
Although all papers have a high range of comfort, this does not guarantee that they are the same. Further analysis of the studies with One-way ANOVA test showed that there are significant differences between comfort percentages among the analyzed studies ( $P < 0.0001$ ). Tukey's post-hoc test showed a paper that differs from all other papers analysis: Tey et al. 2016. By further looking at the post-hoc test and each papers' comfort percentages, clusters of papers with similar percentages of comfort were identified (Fig.4,5). In the stand-out study (Tey et al. 2016), the question was created differently from all of the other studies. It was not directed toward the comfort perception of the implant supported prosthesis treatment only. Rather, it was asking patients to compare their comfort level between the natural teeth and implant supported prosthesis.



\* statistically significant ( $p < 0.05$ )



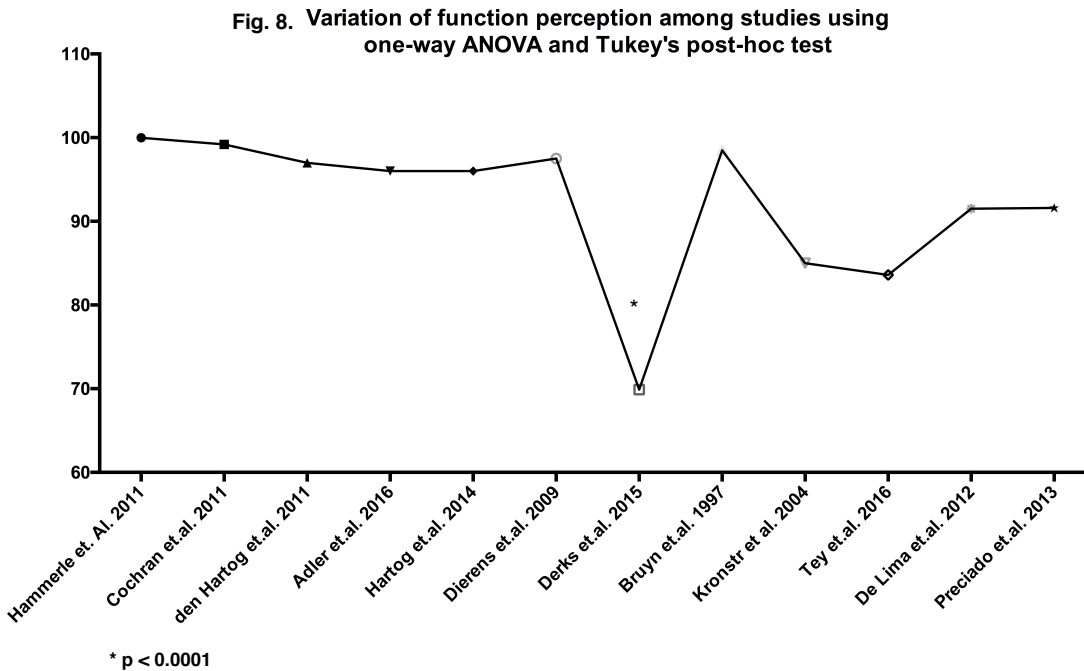
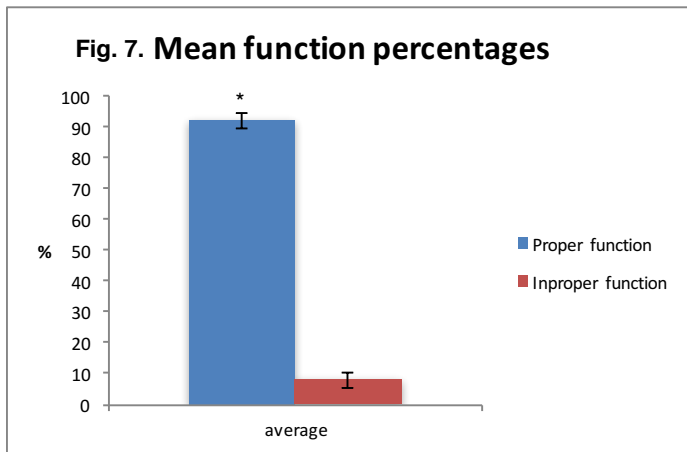
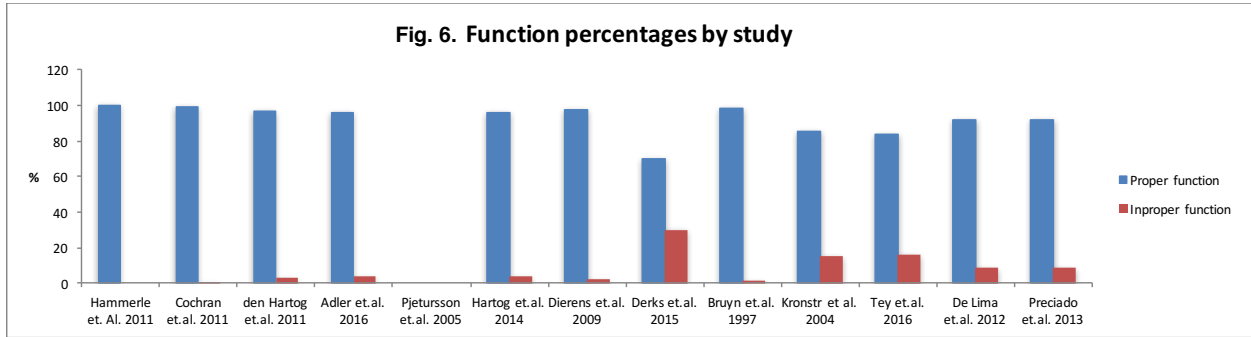
**Fig. 4. Variation of comfort perception among studies using one-way ANOVA and Tukey post-hoc test**

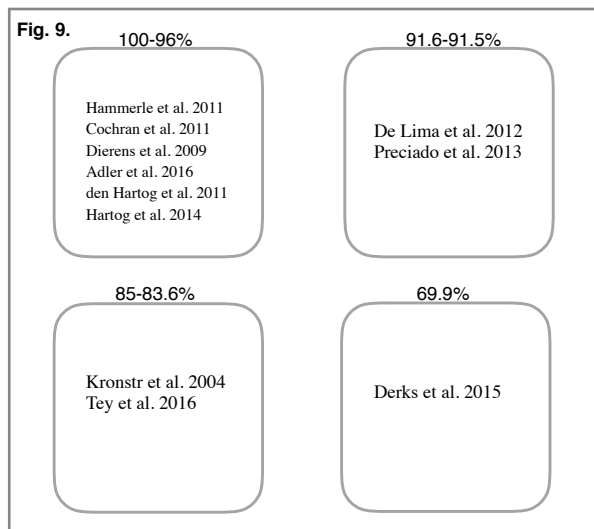


**Fig. 5. Clusters of papers with similar range in comfort**

Data analysis of the perception of function's improvement showed that patients' satisfaction ranged between 69.9% to 100% (Fig.6) with an average of 92.1% and a standard error (SE) of  $\pm 2.4$  (Fig.7). One-way ANOVA test showed that there are significant differences in function perception among the analyzed studies ( $P < 0.0001$ ). Tukey's post-hoc test showed a stand-out paper: Derks et al. 2015. In the same way as for comfort, clusters of papers with similar range were identified (Fig.8,9). In the stand-out study (Derks et al. 2015), the question that evaluated the function was directed to compare function before and after treatment with an implant

supported prosthesis. At the same time, they mentioned in their results that the patients who reported less improvement were those who have been treated by general practitioners, received reconstructions only in anterior locations or in the maxilla, and had tooth extractions performed less than 6 months prior to therapy.





Clusters of papers with similar range in function

## Discussion:

This systematic review includes studies that used dental implants with fixed prostheses as the final restorations. The studies presented several limitations such as: no specification of which implant systems were used in the studies or how the surgical procedures were performed. Moreover, the location of the implants was not always specified.

Implant systems and final prostheses were not standardized in all of the studies as the dental implant field has presented intense progress in a short period of time and there are always new systems and new technology. Standardization of the surgical approaches can also be difficult, because each case has its own individual circumstances and it may not be possible to treat them all with the same surgical approach. Some patients already lost their teeth and are ready for implant placement, some need an extraction and then implant placement, some of them are suitable for immediate implants, and some of them may have to go through grafting and implant site development.

The calculated results indicate that a patient's comfort with implant therapy, utilizing a fixed prosthesis, is generally high. The same can be said about their ability to chew and function.

In terms of comfort, it showed that the satisfaction in one of the studies (Tey et al. 2016) was not within the same range of the others, although the results indicate high satisfaction. The question concerning comfort compared the patients' feelings between natural teeth and implants restored by fixed prostheses. With little argument, natural teeth, if healthy, are superior to implants. Therefore, comparing implants to natural teeth can lead to a biased result and lower patient satisfaction. Furthermore, the patient is used to his natural teeth and used them throughout his life, while implants may be new to him. This could generate a slightly different feeling. On the other hand, teeth could have been compromised by many factors, such as pulpitis and caries, all of which may have affected the patient's evaluation.

In other studies (Derks et al. 2015, Adler et al. 2016), the questions were formulated to evaluate the negative outcomes such as pain and discomfort. These are opposite to the questions in the majority of the studies that evaluated the positive outcomes such as comfort and satisfaction. However, the differences between the results of positive and negative questions were statistically insignificant.

In terms of function, the analysis revealed that one study (Derks et al. 2015) had a reduced number of patient satisfaction compared to the others. This study evaluated the improvement in the function with implant therapy, but also stated that those who responded with no improvement have been treated by general practitioners, have received reconstruction in anterior locations or in the maxilla, and have had tooth extraction performed less than 6 months prior to therapy. Reconstruction in the anterior area greatly affects esthetics and phonetics. For patients with posterior teeth, who can chew properly, replacing only anterior teeth with implants could not greatly affect or change their ability to chew and function. Therefore, their answers will be may lean more toward no improvement in function. Also, when having an implant only 6 months after extraction, the patient may compare the perception of the previous existing tooth with the implant, and that may affect the response to the question. This could lead to a certain level of bias.

Clinicians should be aware of the limitations of this systematic review that focused on patient related outcomes in terms of only comfort and function and did not evaluate other factors such as esthetics and phonetics. The lack of standardized evaluation periods and scales was also a challenge presented in this review

In future studies, patient satisfaction guidelines could be proposed for dental practitioners and used in order to make it easier and more practical to compare different studies. Also, it could be beneficial to look at comfort and function as a group of different sensations that can be combined together for the evaluation of patient related outcomes. It may help us to develop an index that can address each aspect in detail and give us a better understanding of what the patient feels. For example, comfort can be expressed by the absence of multiple factors like pain, bleeding, bad odor and/or the difficulty of cleaning teeth. The ability to chew food that previously was not possible or hard to chew, the ability to bite, or the ability to slide and move the jaw without restrictions are all factors that may be considered together to evaluate the patient's function perception. A standardized scale for evaluating patient related outcomes would be ideal and would help in the future studies. A universal system in the evaluation of patient related outcomes would only help the dental community in assuring that the best possible care is being given to the patient population for this modality of treatment.

## Conclusion:

In conclusion, we understand that few studies met the criteria of this systematic review. However, the results indicate that the patient's satisfaction in terms of function and comfort for treatment with dental implants and fixed restorations is relatively high and it is an acceptable therapeutic approach. Further standardized studies with larger sample sizes are recommended.

Table 1: Search methods

Search No.1	(outcome assessment) OR (patient satisfaction) OR (quality of life) AND (dental implant) OR (dental implantation)
Search No.2	(patient outcome) OR (patient satisfaction) OR (quality of life) AND (dental implant)
Search No.3	(dental implant) AND (quality of life) OR (patient satisfaction) AND (patient outcome)

Table 2: Excluded studies

Author	Reason for exclusion
(Cortellini et al. 2011). Periodontal regeneration versus extraction and prosthetic replacement of teeth severely compromised by attachment loss to the apex: 5-year results of an ongoing randomized clinical trial	Needed data were not available
(Schropp & Isidor 2008). Clinical Outcome and Patient Satisfaction Following Full-Flap Elevation for Early and Delayed Placement of Single-Tooth Implants: A 5-year Randomized Study	Only have the median of the results
(Chang et al. 1999). Esthetic Outcome of Implant supported single-Tooth Replacements Assessed by the Patient and by Prosthodontists	Patients evaluated the esthetic outcome
(Tymstra et al. 2010). Treatment Outcome and Patient Satisfaction with Two Adjacent Implant-Supported Restorations in the Esthetic Zone	Has overall patient satisfaction only
(Locker et al. 1998) Patient-Based Assessment of the Outcomes of Implant Therapy: A Review of the Literature	Doesn't meet inclusion criteria
(Alfadda et al. 2009). Five-Year Clinical Results of Immediately Loaded Dental Implants Using Mandibular Overdentures	Doesn't meet inclusion criteria

Author	Reason for exclusion
(Schropp et al. 2004). Patient experience of, and satisfaction with, delayed-immediate vs. delayed single-tooth implant placement	Only have the median of the results
(Boerrigter et al. 1995). Patient satisfaction with implant-retained mandibular overdentures. A comparison with new complete dentures not retained by implants- a multicentre randomized clinical trial	Doesn't meet inclusion criteria
(Gatten et al. 2011). Quality of Life of Endodontically Treated versus Implant Treated Patients: A University-based Qualitative Research Study	Results for endodontically treated teeth and implant-supported fixed prostheses were combined
(Zembic et al. 2014). Patient-reported outcomes of maxillary implant-supported overdentures compared with conventional dentures	Doesn't meet inclusion criteria
(Wismeijer et al. 1997). Patient satisfaction with implant-supported mandibular overdentures. A comparison of three treatment strategies with ITI-dental implants	Doesn't meet inclusion criteria
(Hartlev et al. 2014). Patient satisfaction and esthetic outcome after immediate placement and provisionalization of single-tooth implants involving a definitive individual abutment	Patients evaluated the esthetic outcome
(McGrath et al. 2012). An evidence-based review of patient-reported outcome measures in dental implant research among dentate subjects	Doesn't meet inclusion criteria
(Levi et al. 2003). Patient Self-reported Satisfaction with Maxillary Anterior Dental Implant Treatment	It has only Odd ratio and confidence intervals
(Kuoppala et al. 2013). Quality of Life of Patients Treated With Implant-Supported Mandibular Overdentures Evaluated With the Oral Health Impact Profile (OHIP-14): a Survey of 58 Patients	Doesn't meet inclusion criteria
(Harris et al. 2013). A comparison of implant-retained mandibular overdentures and conventional dentures on quality of life in edentulous patients: a randomized, prospective, within-subject controlled clinical trial	Doesn't meet inclusion criteria
(Goiato et al. 2015). Quality of life and satisfaction of patients wearing implant-supported fixed partial denture: a cross-sectional survey of patients from Aracatuba city, Brazil	The scale is not consistent with the other studies

Author	Reason for exclusion
(Kapur et al. 1991). Veterans Administration Cooperative Dental Implant Study-Comparisons between fixed partial dentures supported by blade-vent implants and removable partial dentures. Part IV: Comparisons of patient satisfaction between two treatment modalities	Doesn't meet inclusion criteria
(Yi et al. 2001). Patient evaluation of treatment with fixed implant- supported partial dentures	Missing standard of deviation
(Raghoobar et al. 2009). Comparison of procedures for immediate reconstruction of large osseous defects resulting from removal of a single tooth to prepare for insertion of an endosseous implant after healing	Doesn't evaluate Implants supported prosthesis
(Abu-Ta'a et al. 2008). Asepsis during periodontal surgery involving oral implants and the usefulness of peri-operative antibiotics: a prospective, randomized, controlled clinical trial	Doesn't evaluate Implants supported prosthesis
(Bianchi et al. 2004). Single-tooth replacement by immediate implant and connective tissue graft: a 1–9-year clinical evaluation	Doesn't report patients evaluation
(Gallucci et al. 2011). Esthetic outcomes with porcelain-fused- to-ceramic and all-ceramic single-implant crowns: a randomized clinical trial	Patients evaluated the esthetic outcome
(Harrison et al. 2009). Patient satisfaction relating to implant treatment by undergraduate and postgraduate dental students – a pilot study	Doesn't evaluate function or comfort
(Hui et al. 2001). Immediate Provisional for Single-Tooth Implant Replacement with Branemark System: Preliminary Report	Doesn't meet inclusion criteria
(Karabuda et al. 2007). Comparison of Analgesic and Anti-Inflammatory Efficacy of Selective and Non-Selective Cyclooxygenase-2 Inhibitors in Dental Implant Surgery	Doesn't meet inclusion criteria
(Velez et al. 2010). Cryopreserved Amniotic Membrane for Modulation of Periodontal Soft Tissue Healing: A Pilot Study	Doesn't meet inclusion criteria
(Lang et al. 2007). Immediate implant placement with transmucosal healing in areas of aesthetic priority A multicentre randomized-controlled clinical trial I. Surgical outcomes	Doesn't have patients evaluation

Author	Reason for exclusion
(Meijndert et al. 2007). Evaluation of aesthetics of implant-supported single-tooth replacements using different bone augmentation procedures: a prospective randomized clinical study	Patients evaluated the crown and the peri-implant mucosa
(NISSAN et al. 2011). The influence of partial implant-supported restorations on chewing side preference	Doesn't report patients evaluation
(Dolz et. al 2014). Changes in General and Oral Health-Related Quality of Life in Immediate or Conventionally Loaded Dental Implants: A Nonrandomized Clinical Trial	The scale is not consistent with the other studies
(Tymstra et al. 2011). Treatment outcome of two adjacent implant crowns with different implant platform designs in the aesthetic zone: a 1-year randomized clinical trial	Patients evaluated the crown and the peri-implant mucosa
(Urban et al. 2010). Discomfort experienced after immediate implant placement associated with three different regenerative techniques	Doesn't evaluate function or comfort
(Wiesner et al. 2010). Connective tissue grafts for thickening peri-implant tissues at implant placement. One-year results from an explanatory split-mouth randomised controlled clinical trial	Patients evaluated the esthetic outcome
(Felice et al. 2009). Bone augmentation versus 5-mm dental implants in posterior atrophic jaws. Four-month post-loading results from a randomised controlled clinical trial	Doesn't evaluate function or comfort
(Suzuki et al. 2008). Effect of Implant Support on Distal-Extension Removable Partial Dentures: In Vivo Assessment	Doesn't meet inclusion criteria
(Felice et al. 2008). Vertical ridge augmentation of the atrophic posterior mandible with interpositional block grafts: bone from the iliac crest versus bovine anorganic bone. Results up to delivery of the final prostheses from a split-mouth, randomised controlled clinical trial	Doesn't meet inclusion criteria
(Cannizzaro et al. 2008). Immediate versus early loading of 7-mm-long flapless-placed single implants: a split-mouth randomised controlled clinical trial	Doesn't evaluate function or comfort



Author	Reason for exclusion
(Andersson et al. 1999). Ceramic Implant Abutments Used for Short-Span Fixed Partial Dentures: A Prospective 2-Year Multicenter Study	Patients evaluated the esthetic outcome
(Andersson et al.2001). Alumina Ceramic Implant Abutments Used for Single-Tooth Replacement: A Prospective 1- to 3-Year Multicenter Study	Patients evaluated the esthetic outcome
(Felice et al. 2009). A comparison of two techniques to augment maxillary sinuses using the lateral window approach: rigid synthetic resorbable barriers versus anorganic bovine bone. Five-month post-loading clinical and histological results of a pilot randomised controlled clinical trial	Assessed patient's preference

Table 3: Included studies

Author	sample size	intervention	comfort outcome	function outcome	number of participants
(Hammerle et al. 2011)	127	Single implants; submerged versus transmucosal healing	submerged:75% excellent, 24% good, 0% fair, 1% poor transmucosal: 80% excellent, 20% good, 0% fair, 0% poor	submerged:72% excellent, 28% good, 0% fair, 0% poor transmucosal: 76% excellent, 24% good, 0% fair, 0% poor	127
(Cochran et al. 2011)	200	Single or multiple implants for fixed partial arch restoration	submerged: 92.1% excellent, 7.4% good	submerged: 92.4% excellent, 6.8% good	200
(den Hartog et al. 2011)	62	Single implants; Immediate non-occlusal loading versus conventional loading	N/A	18 months: 97% satisfied	31 (conventional load)

Author	sample size	intervention	comfort outcome	function outcome	number of participants
(Adler et al. 2016)	400	Single or multiple implants for screw or cement retained crowns	“I have experienced felt problems with my implants”: yes: 10% yes once: 22% I dont know: 4%, No: 64%	“I am comfortable chewing with my implants”: yes: 81%, enough: 15%, I dont know: 2%, No: 2%	400
(Pjetursson et al. 2005)	104	Single or multiple implants for crowns or fixed partial dentures	"Chewing comfort": definitely: 90% enough: 7% I dont know: 1% not so: 0% definitely not: 1% no answer: 1%	N/A	104
(Hartog et al. 2014)	153	Single implants in the maxillary esthetic zone	N/A	18 months: 4.8	153
(Dierens et al. 2009)	50	immediate loading of dental implants with a provisional bridge and then a fixed prosthesis	one year (mean): 94.2	one year (mean): 97.5	36 (at one year)
(Derks et al. 2015)	3827	Single or multiple implants for implant-supported restorative therapy	Have you experienced any complications?: Never: 64.6% Yes, but rarely: 24.7% Yes, frequently: 6.0% No answer: 4.7%	Greatly improved: 53.9% Somewhat improved: 16.0% No improvement: 28.1% No answer: 2.0%	3827

Author	sample size	intervention	comfort outcome	function outcome	number of participants
(Bruyn et al. 1997)	61	Single or multiple implants for implant-supported restorative therapy	N/A	“Eating comfort” after 3 years: 5: A&B 92%, C 85% 4: A&B 5%, C 15% 3: A&B 0%, C 0% 2: A&B 0%, C 0% 1: A&B 3%, C 0% 0: A&B 0%, C 0%	61
(Kronstr et al. 2004)	42	21 with tooth and implant supported fixed prosthesis and 21 with implant supported fixed prosthesis	TISP: 8.5 ISP: 8.4	TISP: 8.2 ISP: 8.8	36 (TISP&ISP)
(Tey et al. 2016)	206	Single or multiple implants for implant-supported single crown	23.8% felt more secure with teeth, 50.5% perceived no difference, and 24.8% preferred implants	83.6	206
(De Lima et al. 2012)	52	Single or multiple implants for implant-supported fixed partial treatment or single crowns	Mean: FPDs: 9 Implant-Supported Single Crowns: 9.4	Mean: FPDs: 9 Implant-Supported Single Crowns: 9.3	52
(Preciado et.al 2013)	131	patients wearing screw-retained implant restorations	N/A	91.6%	131

(A): Full-arch bridges in mandible supported by 4-6 fixtures, (B): Full-arch bridges in maxilla supported by 4-6 fixtures supported by 4-7 fixtures, (C): 1-2 restorations on 1-3 implants, (TISP): tooth and implant support fixed prosthesis, (ISP): maxillary complete implant supported prosthesis.

## References of the included studies:

- 1-Adler, L., Liedholm, E., Silvegren, M., Modin, C., Buhlin, K., & Jansson, L. (2016). Patient satisfaction 8-14 years after dental implant therapy - a questionnaire study. *Acta Odontologica Scandinavica*, 74(5), 423-429. doi:10.1080/00016357.2016.1177661 [doi]
- 2-Cochran, D. L., Jackson, J. M., Jones, A. A., Jones, J. D., Kaiser, D. A., Taylor, T. D., . . . Oates, T. (2011). A 5-year prospective multicenter clinical trial of non-submerged dental implants with a titanium plasma-sprayed surface in 200 patients. *Journal of Periodontology*, 82(7), 990-999. doi:10.1902/jop.2011.100464 [doi]
- 3-de Bruyn, H., Collaert, B., Linden, U., & Bjorn, A. L. (1997). Patient's opinion and treatment outcome of fixed rehabilitation on branemark implants. A 3-year follow-up study in private dental practices. *Clinical Oral Implants Research*, 8(4), 265-271.
- 4-de Lima, E. A., dos Santos, M. B., & Marchini, L. (2012). Patients' expectations of and satisfaction with implant-supported fixed partial dentures and single crowns. *The International Journal of Prosthodontics*, 25(5), 484-490.
- 5-den Hartog, L., Raghoobar, G. M., Stellingsma, K., Vissink, A., & Meijer, H. J. (2011). Immediate non-occlusal loading of single implants in the aesthetic zone: A randomized clinical trial. *Journal of Clinical Periodontology*, 38(2), 186-194. doi:10.1111/j.1600-051X.2010.01650.x [doi]
- 6-Derks, J., Hakansson, J., Wennstrom, J. L., Klinge, B., & Berglundh, T. (2015). Patient-reported outcomes of dental implant therapy in a large randomly selected sample. *Clinical Oral Implants Research*, 26(5), 586-591. doi:10.1111/clr.12464 [doi]
- 7-Dierens, M., Collaert, B., Deschepper, E., Browaeys, H., Klinge, B., & De Bruyn, H. (2009). Patient-centered outcome of immediately loaded implants in the rehabilitation of fully edentulous jaws. *Clinical Oral Implants Research*, 20(10), 1070-1077. doi:10.1111/j.1600-0501.2009.01741.x [doi]
- 8-Hammerle, C. H., Jung, R. E., Sanz, M., Chen, S., Martin, W. C., Jackowski, J., & Multicenter study group. (2012). Submerged and transmucosal healing yield the same clinical outcomes with two-piece implants in the anterior maxilla and mandible: Interim 1-year results of a randomized, controlled clinical trial. *Clinical Oral Implants Research*, 23(2), 211-219. doi:10.1111/j.1600-0501.2011.02210.x [doi]
- 9-Hartog, L., Meijer, H. J., Santing, H. J., Vissink, A., & Raghoobar, G. M. (2014). Patient satisfaction with single-tooth implant therapy in the esthetic zone. *The International Journal of Prosthodontics*, 27(3), 226-228. doi:10.11607/ijp.3672 [doi]
- 10-Kronstrom, M., Trulsson, M., & Soderfeldt, B. (2004). Patient evaluation of treatment with fixed prostheses supported by implants or a combination of teeth and implants. *Journal of Prosthodontics : Official Journal of the American College of Prosthodontists*, 13(3), 160-165. doi:10.1111/j.1532-849X.2004.04027.x [doi]

11-Pjetursson, B. E., Karoussis, I., Burgin, W., Bragger, U., & Lang, N. P. (2005). Patients' satisfaction following implant therapy. A 10-year prospective cohort study. *Clinical Oral Implants Research*, *16*(2), 185-193. doi:CLR1094 [pii]

12-Preciado, A., Del Rio, J., Lynch, C. D., & Castillo-Oyague, R. (2013). Impact of various screwed implant prostheses on oral health-related quality of life as measured with the QoLIP-10 and OHIP-14 scales: A cross-sectional study. *Journal of Dentistry*, *41*(12), 1196-1207. doi:10.1016/j.jdent.2013.08.026 [doi]

13-Tey, V. H., Phillips, R., & Tan, K. (2016). Patient-related outcome measures with implant therapy after 5 years. *Clinical Oral Implants Research*, doi:10.1111/clr.12862 [doi]

Yi, S. W., Carlsson, G. E., Ericsson, I., & Kim, C. K. (2001). Patient evaluation of treatment with fixed implant-supported partial dentures. *Journal of Oral Rehabilitation*, *28*(11), 998-1002. doi:819 [pii]

## References of the excluded studies:

1-Abu-Ta'a, M., Quirynen, M., Teughels, W., & van Steenberghe, D. (2008). Asepsis during periodontal surgery involving oral implants and the usefulness of peri-operative antibiotics: A prospective, randomized, controlled clinical trial. *Journal of Clinical Periodontology*, *35*(1), 58-63. doi:CPE1162 [pii]

2-Alfadda, S. A., Attard, N. J., & David, L. A. (2009). Five-year clinical results of immediately loaded dental implants using mandibular overdentures. *The International Journal of Prosthodontics*, *22*(4), 368-373.

3-Andersson, B., Scharer, P., Simion, M., & Bergstrom, C. (1999). Ceramic implant abutments used for short-span fixed partial dentures: A prospective 2-year multicenter study. *The International Journal of Prosthodontics*, *12*(4), 318-324.

4-Andersson, B., Taylor, A., Lang, B. R., Scheller, H., Scharer, P., Sorensen, J. A., & Tarnow, D. (2001). Alumina ceramic implant abutments used for single-tooth replacement: A prospective 1- to 3-year multicenter study. *The International Journal of Prosthodontics*, *14*(5), 432-438.

5-Bianchi, A. E., & Sanfilippo, F. (2004). Single-tooth replacement by immediate implant and connective tissue graft: A 1-9-year clinical evaluation. *Clinical Oral Implants Research*, *15*(3), 269-277. doi:10.1111/j.1600-0501.2004.01020.x [doi]

6-Boerrigter, E. M., Geertman, M. E., Van Oort, R. P., Bouma, J., Raghoobar, G. M., van Waas, M. A., . . . Kalk, W. (1995). Patient satisfaction with implant-retained mandibular overdentures. A comparison with new complete dentures not retained by implants--a multicentre randomized clinical trial. *The British Journal of Oral & Maxillofacial Surgery*, *33*(5), 282-288.

7-Cannizzaro, G., Leone, M., Torchio, C., Viola, P., & Esposito, M. (2008). Immediate versus early loading of 7-mm-long flapless-placed single implants: A split-mouth randomised controlled clinical trial. *European Journal of Oral Implantology*, *1*(4), 277-292. doi:14263 [pii]

- 8-Chang, M., Odman, P. A., Wennstrom, J. L., & Andersson, B. (1999). Esthetic outcome of implant-supported single-tooth replacements assessed by the patient and by prosthodontists. *The International Journal of Prosthodontics*, 12(4), 335-341.
- 9-Dolz, J., Silvestre, F. J., & Montero, J. (2014). Changes in general and oral health-related quality of life in immediate or conventionally loaded dental implants: A nonrandomized clinical trial. *The International Journal of Oral & Maxillofacial Implants*, 29(2), 391-401. doi:10.11607/jomi.3479 [doi]
- 10-Felice, P., Checchi, V., Pistilli, R., Scarano, A., Pellegrino, G., & Esposito, M. (2009). Bone augmentation versus 5-mm dental implants in posterior atrophic jaws. four-month post-loading results from a randomised controlled clinical trial. *European Journal of Oral Implantology*, 2(4), 267-281. doi:18118 [pii]
- 11-Felice, P., Marchetti, C., Piattelli, A., Pellegrino, G., Checchi, V., Worthington, H., & Esposito, M. (2008). Vertical ridge augmentation of the atrophic posterior mandible with interpositional block grafts: Bone from the iliac crest versus bovine anorganic bone. *European Journal of Oral Implantology*, 1(3), 183-198. doi:13931 [pii]
- 12-Felice, P., Scarano, A., Pistilli, R., Checchi, L., Piattelli, M., Pellegrino, G., & Esposito, M. (2009). A comparison of two techniques to augment maxillary sinuses using the lateral window approach: Rigid synthetic resorbable barriers versus anorganic bovine bone. five-month post-loading clinical and histological results of a pilot randomised controlled clinical trial. *European Journal of Oral Implantology*, 2(4), 293-306. doi:18120 [pii]
- 13-Gallucci, G. O., Grutter, L., Nedir, R., Bischof, M., & Belser, U. C. (2011). Esthetic outcomes with porcelain-fused-to-ceramic and all-ceramic single-implant crowns: A randomized clinical trial. *Clinical Oral Implants Research*, 22(1), 62-69. doi:10.1111/j.1600-0501.2010.01997.x [doi]
- 14-Goiato, M. C., Torcato, L. B., Dos Santos, D. M., Moreno, A., Antenucci, R. M., & de Carvalho Dekon, S. F. (2015). Quality of life and satisfaction of patients wearing implant-supported fixed partial denture: A cross-sectional survey of patients from aracatuba city, brazil. *Clinical Oral Implants Research*, 26(6), 701-708. doi:10.1111/clr.12372 [doi]
- 15-Harris, D., Hofer, S., O'Boyle, C. A., Sheridan, S., Marley, J., Benington, I. C., . . . O'Connell, B. (2013). A comparison of implant-retained mandibular overdentures and conventional dentures on quality of life in edentulous patients: A randomized, prospective, within-subject controlled clinical trial. *Clinical Oral Implants Research*, 24(1), 96-103. doi:10.1111/j.1600-0501.2011.02368.x [doi]
- 16-Harrison, P., Polyzois, I., Houston, F., & Claffey, N. (2009). Patient satisfaction relating to implant treatment by undergraduate and postgraduate dental students--a pilot study. *European Journal of Dental Education : Official Journal of the Association for Dental Education in Europe*, 13(3), 184-188. doi:10.1111/j.1600-0579.2009.00573.x [doi]
- 17-Hartlev, J., Kohberg, P., Ahlmann, S., Andersen, N. T., Schou, S., & Isidor, F. (2014). Patient satisfaction and esthetic outcome after immediate placement and provisionalization of single-tooth implants involving a definitive individual abutment. *Clinical Oral Implants Research*, 25(11), 1245-1250. doi:10.1111/clr.12260 [doi]

- 18-Hui, E., Chow, J., Li, D., Liu, J., Wat, P., & Law, H. (2001). Immediate provisional for single-tooth implant replacement with branemark system: Preliminary report. *Clinical Implant Dentistry and Related Research*, 3(2), 79-86.
- 19-Kapur, K. K. (1991). Veterans administration cooperative dental implant study--comparisons between fixed partial dentures supported by blade-vent implants and removable partial dentures. part IV: Comparisons of patient satisfaction between two treatment modalities. *The Journal of Prosthetic Dentistry*, 66(4), 517-530. doi:0022-3913(91)90516-Y [pii]
- 20-Karabuda, Z. C., Bolukbasi, N., Aral, A., Basegmez-Zeren, C., & Ozdemir, T. (2007). Comparison of analgesic and anti-inflammatory efficacy of selective and non-selective cyclooxygenase-2 inhibitors in dental implant surgery. *Journal of Periodontology*, 78(12), 2284-2288. doi:10.1902/jop.2007.070192 [doi]
- 21-Kuoppala, R., Napankangas, R., & Raustia, A. (2013). Quality of life of patients treated with implant-supported mandibular overdentures evaluated with the oral health impact profile (OHIP-14): A survey of 58 patients. *Journal of Oral & Maxillofacial Research*, 4(2), e4. doi:10.5037/jomr.2013.4204 [doi]
- 22-Lang, N. P., Tonetti, M. S., Suvan, J. E., Pierre Bernard, J., Botticelli, D., Fourmouis, I., . . . European Research Group on Periodontology. (2007). Immediate implant placement with transmucosal healing in areas of aesthetic priority. A multicentre randomized-controlled clinical trial I. surgical outcomes. *Clinical Oral Implants Research*, 18(2), 188-196. doi:CLR1371 [pii]
- 23-Locker, D. (1998). Patient-based assessment of the outcomes of implant therapy: A review of the literature. *The International Journal of Prosthodontics*, 11(5), 453-461.
- McGrath, C., Lam, O., & Lang, N. (2012). An evidence-based review of patient-reported outcome measures in dental implant research among dentate subjects. *Journal of Clinical Periodontology*, 39 Suppl 12, 193-201. doi:10.1111/j.1600-051X.2011.01841.x [doi]
- 24-Meijndert, L., Meijer, H. J., Stellingsma, K., Stegenga, B., & Raghoobar, G. M. (2007). Evaluation of aesthetics of implant-supported single-tooth replacements using different bone augmentation procedures: A prospective randomized clinical study. *Clinical Oral Implants Research*, 18(6), 715-719. doi:CLR1415 [pii]
- 25-Nissan, J., Berman, O., Gross, O., Haim, B., & Chaushu, G. (2011). The influence of partial implant-supported restorations on chewing side preference. *Journal of Oral Rehabilitation*, 38(3), 165-169. doi:10.1111/j.1365-2842.2010.02142.x [doi]
- 26-Ohkubo, C., Kobayashi, M., Suzuki, Y., & Hosoi, T. (2008). Effect of implant support on distal-extension removable partial dentures: In vivo assessment. *The International Journal of Oral & Maxillofacial Implants*, 23(6), 1095-1101.
- 27-Raghoobar, G. M., Slater, J. J., Hartog, L., Meijer, H. J., & Vissink, A. (2009). Comparison of procedures for immediate reconstruction of large osseous defects resulting from removal of a single tooth to prepare for insertion of an endosseous implant after healing. *International Journal of Oral and Maxillofacial Surgery*, 38(7), 736-743. doi:10.1016/j.ijom.2009.03.002 [doi]

- 28-Tymstra, N., Meijer, H. J., Stellingsma, K., Raghoobar, G. M., & Vissink, A. (2010). Treatment outcome and patient satisfaction with two adjacent implant-supported restorations in the esthetic zone. *The International Journal of Periodontics & Restorative Dentistry*, 30(3), 307-316.
- 29-Tymstra, N., Raghoobar, G. M., Vissink, A., Den Hartog, L., Stellingsma, K., & Meijer, H. J. (2011). Treatment outcome of two adjacent implant crowns with different implant platform designs in the esthetic zone: A 1-year randomized clinical trial. *Journal of Clinical Periodontology*, 38(1), 74-85. doi: 10.1111/j.1600-051X.2010.01638.x [doi]
- 30-Urban, T., & Wenzel, A. (2010). Discomfort experienced after immediate implant placement associated with three different regenerative techniques. *Clinical Oral Implants Research*, 21(11), 1271-1277. doi:10.1111/j.1600-0501.2010.01943.x [doi]
- 31-Velez, I., Parker, W. B., Siegel, M. A., & Hernandez, M. (2010). Cryopreserved amniotic membrane for modulation of periodontal soft tissue healing: A pilot study. *Journal of Periodontology*, 81(12), 1797-1804. doi:10.1902/jop.2010.100060 [doi]
- 32-Wiesner, G., Esposito, M., Worthington, H., & Schlee, M. (2010). Connective tissue grafts for thickening peri-implant tissues at implant placement. one-year results from an explanatory split-mouth randomised controlled clinical trial. *European Journal of Oral Implantology*, 3(1), 27-35. doi:18885 [pii]
- 33-Wismeijer, D., Van Waas, M. A., Vermeeren, J. I., Mulder, J., & Kalk, W. (1997). Patient satisfaction with implant-supported mandibular overdentures. A comparison of three treatment strategies with ITI-dental implants. *International Journal of Oral and Maxillofacial Surgery*, 26(4), 263-267.
- 34-Zembic, A., & Wismeijer, D. (2014). Patient-reported outcomes of maxillary implant-supported overdentures compared with conventional dentures. *Clinical Oral Implants Research*, 25(4), 441-450. doi: 10.1111/clr.12169 [doi]
- 35-Schropp, L., & Isidor, F. (2008). Clinical outcome and patient satisfaction following full-flap elevation for early and delayed placement of single-tooth implants: A 5-year randomized study. *The International Journal of Oral & Maxillofacial Implants*, 23(4), 733-743.
- 36-Schropp, L., Isidor, F., Kostopoulos, L., & Wenzel, A. (2004). Patient experience of, and satisfaction with, delayed-immediate vs. delayed single-tooth implant placement. *Clinical Oral Implants Research*, 15(4), 498-503. doi:10.1111/j.1600-0501.2004.01033.x [doi]
- 37-Levi, A., Psoter, W. J., Agar, J. R., Reisine, S. T., & Taylor, T. D. (2003). Patient self-reported satisfaction with maxillary anterior dental implant treatment. *The International Journal of Oral & Maxillofacial Implants*, 18(1), 113-120.
- 38-Gatten, D. L., Riedy, C. A., Hong, S. K., Johnson, J. D., & Cohenca, N. (2011). Quality of life of endodontically treated versus implant treated patients: A university-based qualitative research study. *Journal of Endodontics*, 37(7), 903-909. doi:10.1016/j.joen.2011.03.026 [doi]
- 39-Cortellini, P., Stalpers, G., Mollo, A., & Tonetti, M. S. (2011). Periodontal regeneration versus extraction and prosthetic replacement of teeth severely compromised by attachment loss to the apex: 5-year results of an ongoing randomized clinical trial. *Journal of Clinical Periodontology*, 38(10), 915-924. doi:10.1111/j.1600-051X.2011.01768.x [doi]