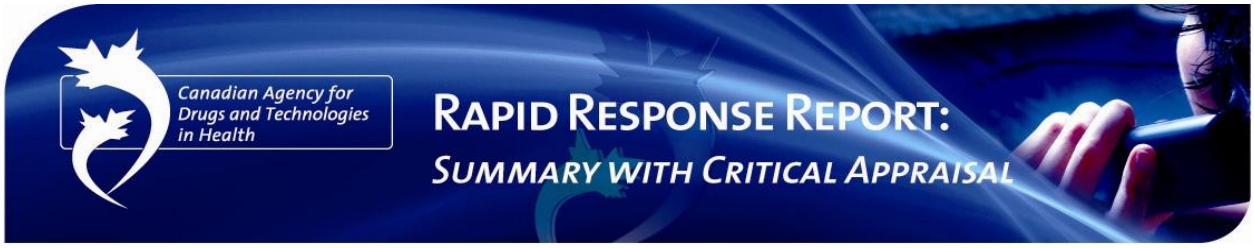

TITLE: Dental Implants and Conventional Prosthetics: Comparative Clinical Effectiveness and Safety

DATE: 16 October 2012

CONTEXT AND POLICY ISSUES

The use of osseo-integrated oral implants has increased recently to replace missing teeth.[1] Dental implants can be used alone or in combination with natural teeth to support fixed or removable dental prostheses. They are of particular interest in the replacement of missing teeth in the distal part of the alveolar arches because the conventional prosthetics produce a cantilever effect on the remaining teeth and compromise their integrity. Another common use of these implants is to support the mandibular complete denture because conventional complete dentures cannot be stabilized easily and is a cause of frustration with patients.

To facilitate the decision of introducing dental implant systems in health care facilities, a comprehensive evaluation of the advantages and limits of each system is essential. This report will examine the evidence regarding the comparative clinical effectiveness and safety, in concept, of dental implant therapy and conventional prosthetic therapies.

RESEARCH QUESTIONS

1. What is the evidence regarding the comparative clinical effectiveness and safety, in concept, of dental implant therapy and the conventional prosthetic therapies?

2. What is the evidence regarding the comparative clinical effectiveness and safety of the different dental implant systems available in Canada?

KEY MESSAGE

Dental implants may improve chewing functions and patients' satisfaction when used to support mandibular overdentures. No conclusions can be made on safety because of the study limitations.

METHODS

Literature Search Strategy

A limited literature search was conducted on key resources including Medline, PubMed, The Cochrane Library (2012, Issue 8 of 12), University of York Centre for Reviews and Dissemination (CRD) databases, Canadian and major international health technology agencies, as well as a focused Internet search. Methodological filters were applied to limit retrieval to health technology assessments, systematic reviews, meta-analyses and randomized controlled trials. Non-randomized trials were limited to safety trials only. Where possible, retrieval was limited to the human population. The search was also limited to English language documents published between January 1, 2009 and August 28, 2012.

Selection Criteria and Methods

One reviewer screened citations and selected studies. The first level of screening was based on the titles and abstracts of the identified citations. Full texts of any relevant titles/abstracts were retrieved, and the final article selection was based on the inclusion criteria presented in Table 1.

Table 1: Selection Criteria

Population	Adults who are missing teeth
Intervention	Dental implants
Comparator	Conventional prosthetics, different dental implant systems, or no comparator (for safety studies only)
Outcomes	Benefits (for example treatment success/ survival, patients' satisfaction), harms (for example infection, peri-implantitis, bone loss)
Study Designs	health technology assessment, systematic review, meta-analysis, randomized controlled trials, non-randomized trials (for safety only)

Exclusion Criteria

Studies were excluded if they did not meet the selection criteria. Duplicate reports of the same outcomes from the same trials were also excluded. Additionally, primary studies were excluded if they were discussed in one of the included systematic reviews.

The current review evaluated the safety and effectiveness of dental implants as concept. Several themes related to dental implants that can potentially affect the effectiveness of the implants were not evaluated within the review. The full list of these excluded themes is provided in APPENDIX 1: Themes Excluded from the Review.

Critical Appraisal of Individual Studies

The methodological quality of the included systematic reviews was evaluated using the Assessment of Multiple Systematic Reviews (AMSTAR) checklist.[2] The randomized controlled trials were evaluated using the SIGN50 checklist for controlled studies.[3]

For the included studies, a numeric score was not calculated. Instead, the strengths and limitations of the study were described.

SUMMARY OF EVIDENCE

Quantity of Research Available

A total of 1035 potential citations were identified by searching the bibliographic database, with 1007 citations being excluded during the title and abstract screening based on their irrelevance to the questions of interest. The full text documents of the remaining 28 articles were retrieved. Three additional articles were identified in the grey literature search. Of the 31 articles, 13 did not meet the inclusion criteria and were excluded, leaving 18 articles[1,17-33] that reported 10 systematic reviews,[1,17-20,22-25,29] and eight randomized controlled trials.[21,26-28,30-33]

A PRISMA diagram demonstrating the study selection process is presented in APPENDIX 2: Selection of Included Studies.

Summary of Study Characteristics

Eighteen studies that addressed at least one of the research questions were included in this review, including four systematic reviews[1,17-19] and one RCT[26] evaluating safety issues of dental implants and conventional prosthetic therapies. The efficacy of these therapies was evaluated in four systematic reviews[20,22-25] and three RCTs.[21,27,28] The comparative clinical effectiveness between different dental implant systems was assessed in two systematic reviews[8,29] and four RCTs.[30-33] Details regarding characteristics of the included studies are tabulated in APPENDIX 3: Characteristics of the Included Studies.

Studies on the Safety of Dental Implants and Conventional Prosthetic Therapies:

One systematic review by Emami et al.[17] evaluated the prevalence of denture stomatitis associated with partial removable dentures. The review included information from four clinical trials and four observational studies with a total number of 2813 patients included in these studies.

Three systematic reviews[1,18,19] and one RCT[26] evaluated safety concerns related to the use of dental implants. Jané-Salas et al.[1] evaluated the association of dental implant placement with the development of oral cancer. In their systematic review,[1] the authors included 13 case-studies on 19 patients. Another systematic review by Javed et al.[18] assessed the relationship between the use of titanium dental implants and the occurrence of titanium sensitivity; this review included two clinical trials, two observational studies and three case-studies. Esposito et al.[19] compared the effect of using prophylactic antibiotic (1 to 2 grams of amoxicillin prior to implant placement) with placebo on implant failure; the review included four RCTs of 1007 patients. One RCT by Pineiro et al.[26] investigated the post-surgery prevalence of systematic bacteremia among 50 patients who received dental implants. The trial compared the prevalence of bacteremia between a group of 30 patients who received antiseptic mouth wash prior to the procedure and a group of 20 patients who received placebo.[26] The results of this trial[26] and the last systematic review above[19] can provide insight into the question of whether dental implant placement causes systematic bacteremia or infection.

Studies on the Efficacy of Dental Implants and Conventional Prosthetic Therapies:

The systematic reviews compared a wide range of prosthetic options. Of interest, Abt et al.[20] compared fixed dental prosthesis (FDP) supported by implants only with FDP supported by an

implant and a natural tooth. In this systematic review, 21 RCTs of 1501 patients were included, and treatments were compared in terms of success and failure of the prosthesis. The systematic review by Thomson et al.[22] evaluated the evidence of using overdentures supported by implants as compared to the conventional dentures. The review considered outcomes such as patient satisfaction and quality of life from two systematic reviews and three observational studies. Pjetursson et al.[34] compared the failure and complication rates between FDP supported by teeth only, by implants only, and by a combination of dental implant and natural tooth. The review included results from six previous systematic reviews that had information on 115 patients.[34] Koller et al.[24] estimated the survival rates of removable dental prosthesis supported by dental implants, natural teeth and the combination of both. Data were collected from 11 observational studies that included 1126 patients.[24] Kim et al.[25] conducted a review of three meta-analyses in order to calculate the cost of the treatment modalities for failed root canal treatment. The review compared the survival/ success rates between non-surgical endodontic retreatment, endodontic microsurgery, extraction and replacement with FDP, and extraction and replacement with implant-supported crown.[25]

Implant-supported overdentures were compared with conventional dentures in two RCT. The RCT by Awad et al.[21] evaluated the effect of these treatments on blood serum concentration of homocysteine and other nutritional indicators in 255 patients. The trial compared the chewing function between the two treatments. The RCT by Harris et al.[28] compared the quality of life (QoL) between 122 patients who received either treatment. The QoL was measured using the denture satisfaction questionnaire (DSQ) and the oral health impact profile (OHIP). In another RCT by Sagirkaya et al.,[27] the survival probability of implant-supported crowns were compared with tooth-supported crowns in a sample of 59 patients.[27]

Studies on the comparative Clinical Effectiveness and Safety of the Different Dental Implant Systems:

In the systematic review by Laurell et al.[29] the marginal bone loss around implants was compared between three dental implant systems; AstraTech, Branemark, and Straumann. The review included 12 clinical trials and 18 cases-studies with a total of 2073 patients.

Akoglu et al.[30] compared in an RCT the marginal bone loss, chewing function and retention of overdentures supported by implants from Straumann, Zimmer Dental, and AstraTech. The sample size included 36 patients and 72 implants, and the trial patients were followed-up for 5 years. Ho et al.[31] compared the short-term clinical efficacy of implants from Nobel Biocare and Branemark in terms of survival rates and marginal bone loss. The RCT included 32 patients who received 64 implants.[31] In their RCT, Meijer et al.[32] reported the 10-year follow-up results of the functional complaints of 90 patients who received dental implants from IMZ, Branemark and Straumann systems. Finally, Park et al.[33] compared the primary stability and the marginal bone loss one year after the placement of standard Straumann implants and Ossten SSII implants. The trial included 53 patients who received 71 implants.[33]

Summary of Critical Appraisal

The strength and limitations of included studies are summarized in APPENDIX 4: Critical Appraisal of the Included Studies

Studies on the Safety of Dental Implants and Conventional Prosthetic Therapies:

The systematic reviews on the safety of the evaluated treatments were based mainly on descriptive case-study publications and observational studies.[1,17,18] This type of literature is useful in collecting epidemiological information rather than establishing causal effect between the treatment and the harm outcomes. Comparative observational studies are appropriate source of evidence for safety outcomes.

The quality of the included studies was not evaluated or considered in the interpretation of results in two reviews.[1,18] The systematic review by Esposito et al.[19] evaluated the failure rates at three to five months after implant placement. The short-term follow-up allow for the assessment of early implant failure, and this type of failure can be caused by several factors related to the patient, the surgeon, and the implant system used; these factors were not considered in this review. Therefore, differences in implant failure rates between the amoxicillin and placebo groups might have been due to other factors than infection or bacteremia caused by the implant placement. The RCT by Pineiro et al.[26] was not powered sufficiently to detect the difference in bacteremia between the chlorhexidine and placebo groups. Furthermore, the trial did not adjust for the number of implants each patient had; this adjustment was necessary to account for the increased risk of infection/ contamination with higher number of implants received by the same patient.

Studies on the Efficacy of Dental Implants and Conventional Prosthetic Therapies:

Considering the systematic reviews, the quality of the included studies was not evaluated in three reviews,[22,24,25] and the definition of survival/ success of the prosthetic treatment was inadequate[23,24] or not provided at all.[25] The systematic review by Abt et al.[20] followed a systematic process for literature search bias assessment; however, only one included trial was of interest to this review.

With regard to the RCTs, the follow-up period used in Awad et al.[21] and by Sagirkaya et al.[27] were inadequate to allow for the detection of clinically important differences in systemic nutritional indicators[21] or the long-term clinical outcomes of zirconia restorations. Nevertheless, chewing functions evaluated by Awad et al. could be reliably assessed with the 12-month trial period.[21] In the RCT by Harris et al.[28], patient satisfaction and health were evaluated using the DSQ and OHIP scales; however, the report did not provide indicators of the clinical significance of score changes or differences seen on these scales.

Studies on the comparative Clinical Effectiveness and Safety of the Different Dental Implant Systems:

The systematic review by Laurell et al.[29] did not evaluate or consider the quality of the included studies. Furthermore, the review did not consider potential confounders for the marginal bone loss outcome such as the type of alveolar bone, prosthetic restoration, and the periodontal health of the patients. These factors might have biased the comparison between the implant systems.

The power of the included RCTs was the main limitation in three trials.[30,31,33] In the RCT by Akoglu et al.[30] the sample size was selected for convenience rather than for the achievement of a desired power for the test of the trial hypothesis. On the other hand, Ho et al.[31] and Park et al.[33] conducted sample size calculation to achieve sufficient power for the statistical tests.

However, Ho et al.[31] based this calculation on an expected survival time difference between Branemark and Nobel Biocare dental implants of 3 months; this difference was not justified, and the trial reported the results in terms of survival rates rather than survival time. Park et al.[33] based their sample size calculation on results obtained from *in vitro* trial; it was not clear in the report which outcomes were used from that trial to calculate the sample size, and how the results of *in vitro* trial could be used to estimate the sample size.

Summary of Findings

A summary of study findings and authors' conclusions are provided in APPENDIX 5: Main Study Findings and Authors' Conclusions.

Studies on the Safety of Dental Implants and Conventional Prosthetic Therapies:

Emami et al.[17] reported that the prevalence of denture stomatitis ranged from 1.1% to 36.7% among patients in the included studies. This prevalence was higher in complete denture wearers than partial denture.[17]

Jané et al.[1] reported that 19 cases of oral cancer were detected in patients who had received dental implants; it was reported that 10 of these cases had a prior history of cancer. Javed et al.[18] showed that the number of patients who had titanium sensitivity was 21/56 (37.5%) of patients included in the clinical trials and 9/35 (25%) of patients included in the observational studies. The authors concluded that whether or not dental implants caused titanium sensitivity remained unproven.[18]

The risk of post-operative infection or bacteremia was evaluated in the meta-analysis by Esposito et al.[19] and an RCT by Pineiro et al.[26] Esposito et al.[19] reported that the risk ratio of implant failure (pre-surgery antibiotic versus placebo) was 0.4 (95% CI: 0.19, 0.84); however, the meta-analysis did not adjust for confounding factors that might have affected the failure rate of the implants. The meta-analysis also reported that there were no statistically significant differences between the amoxicillin and placebo groups in terms of post-operative infection. The RCT by Pineiro et al.[26] concluded that the placement of dental implants using mucoperiosteal flap did not carry a significant risk of developing bacteremia.

Studies on the Efficacy of Dental Implants and Conventional Prosthetic Therapies:

A. Implant-supported Fixed Dental Prostheses:

Two systematic reviews[20,23] compared the clinical effectiveness of implant-supported FDP with FDP supported by an implant and a natural tooth. The first review included one RCT that reported the 10-year follow-up results of 23 patients who received both types of prostheses in a split mouth manner.[20] The RCT concluded that there was insufficient evidence to determine the relative advantages of either treatment over the other.[20] On the other hand, the meta-analysis by Pjetursson et al.[23] reported that relative failure rate of implant-supported FDPs was numerically lower than that for FDPs supported by implant and a tooth; the respective relative failure rates were 0.72 (95% CI: 0.49, 1.06) and 1.33 (95% CI: 0.37, 4.80). However, the analysis did not allow for statistical comparison between the two treatments. One RCT by Sagirkaya et al.[27] compared the survival probability of implant-supported crowns with tooth-supported crowns; the reported survival probabilities were 1.00 and 0.936 respectively, and the difference between the two treatments was not statistically significant.

B. Implant-supported Overdentures:

The results of the systematic review by Thomson et al.[22] were based on a systematic review evaluating patient satisfaction and quality of life and another review evaluating the masticatory function. The Thomson review concluded that there was overwhelming evidence to support the treatment with overdentures supported by dental implants.[22] The RCT by Awad et al.[21] did not find statistically significant differences in systemic nutritional indicators between patients who received implant-supported overdentures or conventional complete dentures. However, it was reported that wearers of implant-supported overdentures had a significant improvement in the ability to chew.[21] In concordance with this result, Harris et al.[28] reported that wearers of implant-supported overdentures, compared with conventional denture wearers, had statistically significant difference in change from baseline in the Denture Satisfaction Scores and Oral Health Impact Profile. However, the clinical significance of these changes and differences in scores were not defined.

C. Implant-supported Removable Partial Dentures (RPD):

The systematic review by Koller et al.[24] reported that the survival rate of RPDs supported by natural teeth was 90% to 95.1%, that for RPDs supported by implants the survival rate ranged from 95% to 100%, and that the survival rate of RPDs supported by a combination of implants and natural teeth was 100%. The review concluded that the included literature did not provide sufficient data to evaluate the long-term outcomes of these treatments.

D. Treatment of Failed Root-Canal:

Kim et al.[25] estimated a survival rate of non-surgical endodontic retreatment of 87%, and a survival rate of fixed partial denture (after extraction of the failed tooth) of 89.1%. The implant-supported crowns had the highest survival rate of 94.5%. These survival rates suggest relative differences between the treatment options; however, the statistical and clinical significance of these differences were not tested.

Studies on the comparative Clinical Effectiveness and Safety of the Different Dental Implant Systems:

A. Implant failure/ survival:

Ho et al.[31] compared the 6-month survival rate between Nobel Biocare implants and Branemark implants; the respective rates were 87.5% and 96.9%, and the difference between treatments was not statistically significant.

B. Marginal Bone Loss:

The systematic review by Laurell et al.[29] reported the marginal bone loss at 5 years of the implant life for three implant systems: AstraTech, Straumann, and Branemark. The three systems had statistically significant reduction of the marginal bone height compared to baseline; the respective bone loss was 0.27 mm, 0.56 mm, and 0.72 mm respectively. The changes were not compared between the different implant systems, and it was concluded in the review that the bone reduction of the three systems is within the clinically accepted ranges.

Akoglu et al.[30] compared the marginal bone loss at the five-year follow-up for implants from Straumann, SwissPlus, and AstraTech; the reported bone loss were 0.2 mm, 0.24 mm and 0.34 mm respectively, and the difference between treatments was statistically significant (implant systems with smaller bone loss are better). However, the clinical significance of these changes and differences were not defined. Ho et al.[31] reported the marginal bone loss associated with Nobel Biocare implants and Branemark implants; the respective bone loss at six month was 1.2 mm and 1.39 mm; the difference between groups was not statistically significant. Park et al.[33] showed that Straumann implants were associated with more marginal bone loss in the distal side of the implant when compared with Osstem SSII implants; the mean bone loss was 0.93 mm and 0.65 respectively, and the difference was statistically significant.

C. Function

The Stramann implants, SwissPlus implants and AstraTech implant where compared in terms of chewing function and retention;[30] and between implants from IMZ, Branemark and Straumann systems in terms of patients' complaints from the prostheses function.[32] Both trials showed that there were not statistically significant differences between the different systems with regards to function.

Limitations

This review examined the clinical efficacy of dental implants and conventional prosthetic therapies. Because of the large quantity of available dental literature, the literature search was limited to the last three years. Therefore, older publications would not have been identified. However, the literature of the last three years likely reflects current clinical practice, and older publications may be less relevant. A limitation related to generalizability is that the included studies were conducted in academic facilities or specialized dental clinics; therefore, the technology used and skills of the specialized dentists might not be generalizable to private general dental services.

The included trials did not provide the minimal clinically important difference for the numerical measures used in the trials. The results, therefore, need to be interpreted with caution. Furthermore, the definitions of survival, success and failure were not clearly provided in the included studies. Another limitation related to the included safety studies is that most of the included reports used data from observational studies or case studies. These types of reports do not allow for conclusive findings about cause-effect relation between interventions and harms because they either don't have comparative groups or they don't provide a clear relation between exposure and the occurrence of harm.

CONCLUSIONS AND IMPLICATIONS FOR DECISION OR POLICY MAKING

This report compared dental implants to conventional prosthetic therapies including implant supported fixed dental prostheses, implant supported overdentures and implant supported removable partial dentures. The comparative effectiveness of the different marketed implant systems was also reviewed. A total of eighteen trials or systematic reviews were retrieved.

With respect to the safety of dental implants and conventional prosthetic therapies, the data was limited to those obtained mainly from non-randomized trials. It was shown that the use of dental implants did not cause post-operative infection or bacteremia, titanium sensitivity, or oral cancer. These findings must be considered in light of the fact that the trials did not account for

possible confounders. Other important harms outcomes such as pain or peri-implantitis were not considered by any of the studies reviewed.

With regards to the clinical effectiveness of dental implants as compared with the conventional prosthetic therapies, the available evidence does not show statistical differences in the effectiveness of fixed and partial dentures supported by implants or those supported by implant and natural tooth. There is evidence to suggest that implant-supported overdentures may improve chewing functions and patients' satisfaction.

When comparing the different implant systems available for purchase, the available information did not show significant differences between treatments in terms of implant failure or function. The evidence on bone loss was mixed, with some studies but not all, showing a statistically significant difference between types of systems. The clinical significance was not confirmed.

These results have significant implications on tooth extraction decision making, research on tooth preservation, and governmental health care policies.

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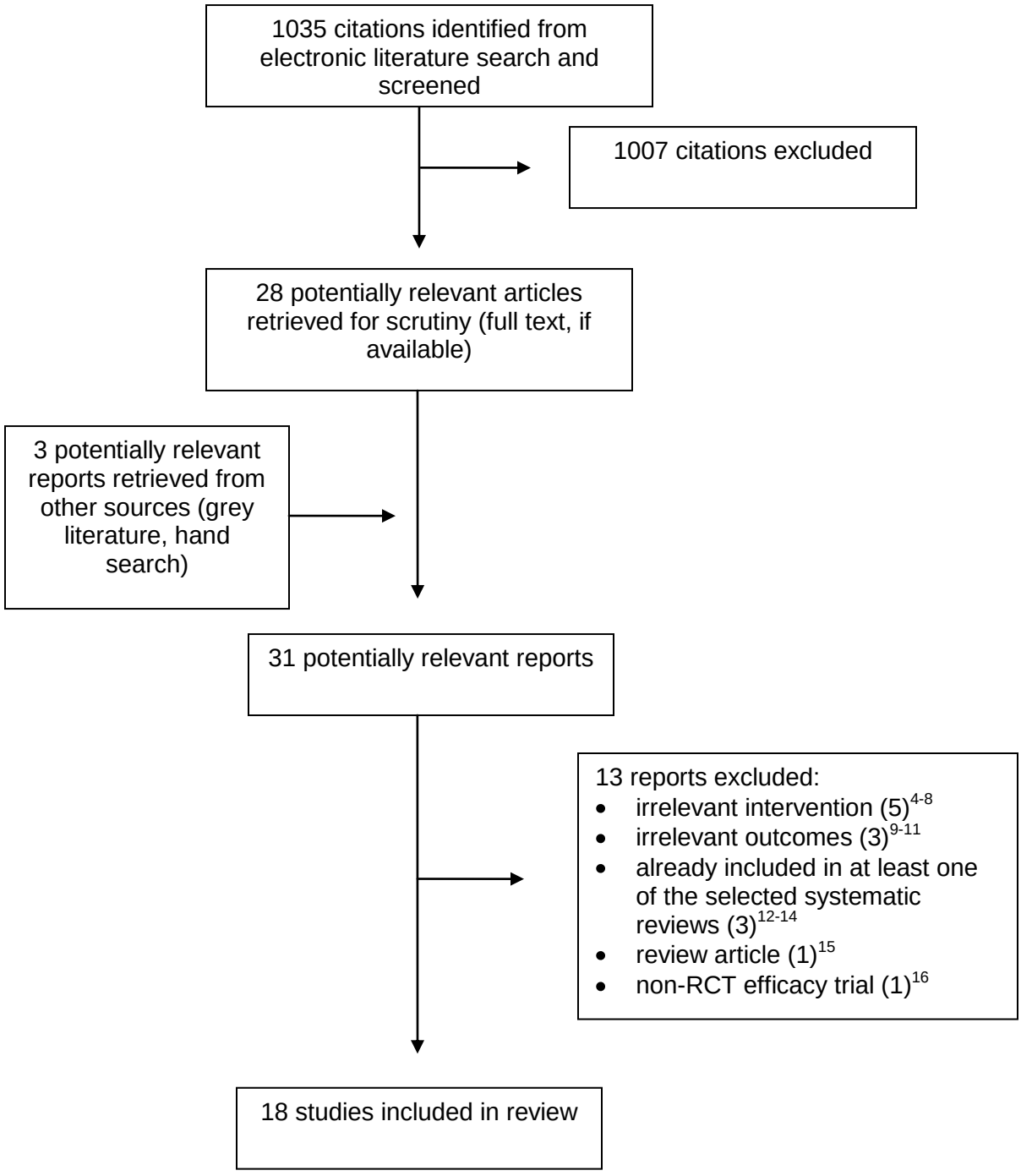
APPENDIX 1: Themes Excluded from the Review

- Orthodontic implants; mini-implants used for orthodontic anchorage or for overdenture support
- Zygomatic and pterygoid implants – only alveolar implants
- Experimental implants not available for clinical use.
- Transitional or temporary implants
- Comparisons of implant surgical protocols, this can include the following:
    - Bone-level versus tissue-level implants
    - Submerged versus non-submerged implants or one-step versus two-step implant surgery
    - Flap versus flapless implant surgery
    - Bone graft material
    - Periodontal membranes and platelet-rich plasma
    - Bone augmentation techniques and their effects on implants outcomes
    - Navigation systems and implant guided surgeries
    - Periodontal surgeries to prepare the implant site, e.g., keratinized tissue augmentation, osteotomy and osteoplasty
- Comparisons of prosthetic protocols, and this can include the following:
    - Comparisons between cemented and screwed prosthetics
    - Comparisons between prosthetic materials, e.g, all-ceramic versus porcelain fused to metal.
    - Impression materials and techniques
    - Number of implants for multiple teeth replacement and over-denture support
    - The use of definitive versus multiple transitional abutment
    - Comparisons between implant-overdenture attachments
    - Comparisons between prostheses placed at the implant level and the abutment level
- Comparisons of between different concepts of implant and abutment designs, this can include the following:
    - Implant-abutment interface design and plat-form switching attachment between implants and abutments
    - Comparisons between implant shapes; scalloped, flat implants, tapered, or cylindrical
    - Comparisons between different abutment designs
    - Nick design
    - Fully etched versus hybrid implants
    - Micro-thread location
    - Laser welded implants versus machined or chemically treated implants (included SLA implants)
    - Cylindrical versus tapered implants
    - Materials of implants and abutments; zirconium versus titanium implants
    - Comparisons between different implant dimension
- Comparisons between loading protocols:
    - Any comparison between immediate, early and delayed esthetic or occlusal loading
    - Immediate versus early or delayed implant placement after tooth extraction

APPENDIX 2: Selection of Included Studies



APPENDIX 3: Characteristics of the Included Studies

Table 2. Characteristics of the Systematic Reviews on the Comparative Clinical Effectiveness and Safety of Dental Implant Therapy and the Conventional Prosthetic Therapies

First Author, Publication Year, Setting - Country	Study Objectives and Design	Literature search limits Type of included studies Number of included studies Total number of patients	Intervention Comparator	Clinical Outcomes
Systematic Reviews on the Safety of Dental Implant Therapy and the Conventional Prosthetic Therapies				
Emami et al.[17] 2012 Canada	To analyze the evidence on the occurrence of denture stomatitis and potential risk factors in patients wearing partial removable dental prostheses	1980 to 2010/ Clinical trials (n=4) observational studies (n=4) Number of patients = 2813	Partial removable dental prosthesis – No comparator	Prevalence of denture stomatitis and risk factors
Jané-Salas et al.[1] 2012 Spain	To review the literature of the association of implant placement with the development of oral cancer.	1996 to 2009 Case studies (n=13) Number of patients = 19	Dental implants – No comparator	Occurrence of oral cancer
Javed et al.[18], 2011 Academic facility – Saudi Arabia	To assess whether or not titanium sensitivity is associated with allergic reactions in patients with dental implants.	1977 to 2010 Clinical trials (n=2), observational studies (n=2), case-studies (n=3) Number of patients > 108	Titanium dental implants	The Occurrence of titanium sensitivity
Esposito et al.[19], 2010	To assess the beneficial and harmful effects of systemic prophylactic antibiotics at dental implant placement	To 2010 RCTs (n=4) Number of patients = 1007	Amoxicillin 1-2 g 1 hour prior implant placement – compared with placebo	Implant failure
Systematic Reviews on the Efficacy of Dental Implant Therapy and the Conventional Prosthetic Therapies				
Abt et al.[20] 2012 USA	To assess the effects of different prostheses for the treatment of partially absent dentition	To 2011 RCTs (n=21 studies) Number of patients = 1501	**RPDs comparing different:** • Designs (n=3) • Materials (n=1) • Fabrication techniques (n=1) **FPD comparing different:** • Designs (n=2) • Materials (n=11) **Treatment of shortened dental arch:** • FDP versus RPD	Prosthetic complication – success/ failure Physiological and psychological impact Cost of prosthesis

Table 2. Characteristics of the Systematic Reviews on the Comparative Clinical Effectiveness and Safety of Dental Implant Therapy and the Conventional Prosthetic Therapies

First Author, Publication Year, Setting - Country	Study Objectives and Design	Literature search limits Type of included studies Number of included studies Total number of patients	Intervention Comparator	Clinical Outcomes
			Implant supported FDP versus tooth plus implant-supported	
Thomson et al.[22] 2012 Academic facility, UK	To present the current evidence and rationale to support the McGill and York consensus statements*.	Search dates were not reported Systematic review (n=2), observation studies (n=3) Number of patients - NR	Implant-supported overdenture versus conventional denture	Patient assessed satisfaction and quality of life Masticatory function
Pjetursson et al.[23] 2011, Academic facility – Iceland	To assess and compare the survival of different type of tooth-supported and implant – supported fixed dental prostheses	Search dates were not reported Systematic reviews (n=6) Number of patients = 115	Implant-supported FDPs Tooth-implant-supported FDP Conventional FDPs Implant-supported crowns Resin-bonded prostheses	Failure and complication rates
Koller et al.[24], 2011 Academic facility – Germany	To investigate the survival of teeth, implants, and double crown-retained removable dental prostheses.	1973 to 2010 Observational studies (n=11) Number of patients = 1126	RDPs supported by: dental implants, natural teeth, dental implants and tooth	Survival rates
Kim et al.[25], 2011	To calculate the cost of treatment modality for failed root canal treatment	To 2010 Meta-analysis (n=3) Number of patients – NR	Non-surgical endodontic retreatment Endodontic microsurgery FPD Implant-supported crowns	Survival/ success rates

FPD= fixed partial denture; **NR=** not reported; **RPD=** removable partial denture;

* McGill statement stated that "*the evidence currently available suggests that the restoration of the edentulous mandible with a conventional denture is no longer the most appropriate first choice prosthodontics treatment. There is now overwhelming evidence that a two-implant overdenture should become the first choice of treatment for the edentulous mandible".* And the York statement concluded that "*a substantial body of evidence is now available demonstrating that patients' satisfaction and quality of life with implant-supported mandibular overdentures is significantly greater than for conventional dentures".*

Table 3. Characteristics of the Clinical Trials on the Comparative Clinical Effectiveness and Safety of Dental Implant Therapy and the Conventional Prosthetic Therapies

First Author, Publication Year, Setting – Country, Financial support	Study Objectives	Inclusion Criteria, Sample Size (Patients/ implants)	Intervention, Comparator/ Length of follow-up	Clinical Outcomes
Clinical Trials on the Safety of Dental Implant Therapy and the Conventional Prosthetic Therapies				
Pineiro et al.[26], 2009 Academic facility – Spain Governmental funding	To investigate the prevalence, duration and aetiology of bacteraemia secondary to the placement of implants and to examine the prophylactic efficacy of rinsing with chlorhexidine before the procedure	Patients suitable for oral rehabilitation using dental implants Sample size = 50 patients	Chlorhexidine 0.2% (10 ml for 1 minute) – n=30 Placebo – no=20	Prevalence of bacteremia
Clinical Trials on the Efficacy of Dental Implant Therapy and the Conventional Prosthetic Therapies				
Awad et al.[21] 2012, Canada Governmental and industrial (Straumann) funding	To assess the effects of mandibular implant-overdenture on the nutritional status of edentate patients as compared with complete denture.	Edentates for > 5 years who wish to replace their existing complete dentures Sample size = 255 patients	Implant-supported overdenture versus conventional dentures	Blood serum concentration of homocysteine
Sagirkaya et al.[27], 2012 Academic facility – Turkey Sources of financial support were not disclosed	To compare the outcomes of zirconia crowns and fixed partial dentures supported by teeth or implants.	Patients with excessive loss of tooth structure requiring full veneer crowns/ FPDs needing replacement, and missing tooth/teeth requiring tooth or implant-supported crowns/ FPDs Sample size = 59 patients	Different Zirconia materials: Cercon ZirkonZahn, Lava, Kanata And Implant-supported crowns versus tooth-supported	Survival probability of prostheses
Harris et al.[28] 2011 Academic facility – Ireland Trial financed by Industry (Straumann Ltd)	To determine differences in patient response to implant overdentures compared with conventional complete dentures alone	Patients requiring replacement of conventional dentures Sample size= 122	Implant-supported overdenture versus conventional denture	Quality of life measured by DSQ and OHIP

DSQ= Denture Satisfaction Questionnaire; **OHIP=** Oral Health Impact Profile;

* summary of these scales is provided in Appendix 5

Table 4. Characteristics of the Systematic Reviews on the Comparative Clinical Effectiveness and Safety of the Different Dental Implant Systems Available in Canada

First Author, Publication Year, Setting - Country	Study Objectives and Design	Literature search limits Type of included studies Number of included studies Total number of patients	Intervention Comparator	Clinical Outcomes
Laurell et al.[29] 2009 Academic facility – Sweden	To compare the peri-implant marginal bone level changes between implants systems currently available on the market	1980 to 2007 Controlled clinical trials (n=12) Case studies (18) Number of patients = 2073	Different dental implant systems: AstraTech, Branemark, and Straumann	Mean marginal bone loss

Table 5. Characteristics of the Clinical Trials on the Comparative Clinical Effectiveness and Safety of the Different Dental Implant Systems Available in Canada

First Author, Publication Year, Setting – Country, Financial support	Study Objectives	Inclusion Criteria, Sample Size (Patients/ implants)	Intervention, Comparator/ Length of follow-up	Clinical Outcomes
Akoglu et al.[30] 2011 Academic facility – Turkey Sources of financial support were not disclosed	To evaluate the clinical outcomes, post-treatment care, and patient satisfaction with implant-supported overdenture treatment	Edentates for >1 year, mandibular height in the symphysis region between 15 to 25 mm. Sample size = 36 patients/ 72 implants	Different dental implant systems: Straumann, Zimmer Dental, and AstraTech	Marginal bone loss, Probing depth, Esthetic, Chewing, Retention
Ho et al.[31] 2011 Academic facility – Australia Trial was supported by the Australian Periodontology Research Foundation and by industry (Nobel Biocare)	To evaluate the short-term clinical and radiological efficacy of the NobelActive system compared to Branemark implant system	Patients with bilateral comparable edentulous spaces in either maxilla or mandible Sample size = 32 patients / 64 implants	Different dental implant systems: Nobel Biocare and Branemark	Survival rate Marginal bone loss
Meijier et al.[32] 2009, Academic facility – Netherlands Authors declared that the study did not obtain external funding	To evaluate the survival, condition of peri-implant tissues, patient satisfaction of three implant systems IMZ, Branemark, and ITI supporting a mandibular over-denture.	Patients with severely resorbed mandible who had persistent problems with their conventional dentures Sample size = 90 patients	Different dental implant systems: IMZ, Branemark , and Straumann	Functional complaints, Esthetic
Park et al.[33] 2009 Academic facility, Korea The trial was supported by governmental funding	To compare the implant stability and clinical outcomes obtained with two types of non-submerged dental implants	Patients with unilateral loss of one or two molars from the mandible, tooth had been extracted before > 6 months, and had sufficient bone. Sample size = 53 patients/ 71 implants	Different dental implant systems: Straumann versus Osstem SSII	Primary stability Marginal bone loss

APPENDIX 4: Critical Appraisal of the Included Studies

Table 6. Critical Appraisal of Studies on the Comparative Clinical Effectiveness and Safety of Dental Implant Therapy and the Conventional Prosthetic Therapies

Strengths	Limitations
Systematic Reviews on the Safety of Dental Implant Therapy and the Conventional Prosthetic Therapies	
Emami et al.[17] 2012	
• Prevalence of denture stomatitis was obtained from the inclusion of observational studies • The selection of literature and data extraction was conducted by two independent researchers • The quality of evidence was assessed using the American Association of Critical Care Nurses new-evidence leveling system	• The included studies measured the prevalence of DS; these measures do not permit the establishment of causality (risk factor) relationship between the partial RDP and DS • The included trials did not compare the prevalence of DS in RDP wearers with those who use different type of prosthesis such as FDP or implants.
Jané-Salas et al.[1] 2012	
• The study had a clear research question and objectives	• The review included case-study publications; and this type of publications do not permit the evaluation of the cause –effect relationship • The quality of the included studies was not evaluated or considered in the interpretation of results
Javed et al.[18] 2011	
• The selection of literature was conducted by more than one researcher; however, the role of each author in the selection was not defined	• The included studies and the reported results do not permit the evaluation of cause-effect relationship. • The reported allergic reactions included non-specific symptoms of hypersensitivity and inflammation; however, it was not clear if other possible causes of this inflammation and hypersensitivity were excluded. • The quality of the included studies was not evaluated or considered in the interpretation of results
Esposito et al.[19] 2010	
• The review conducted a systematic literature search and selection • The risk of bias in the included studies was assessed and considered in the interpretation of results	• The follow-up duration in the included studies ranged from three to five months after implant placement; implant failure during this period might be caused by several other factors other than infection or bacteremia resulted from the implant placement.
DS= denture stomatitis; **FDP=** Fixed dental prosthesis; **RDP**= removable dental prosthesis;	
Systematic Reviews on the Efficacy of Dental Implant Therapy and the Conventional Prosthetic Therapies	
Abt et al.[20] 2012	
• The review conducted a systematic literature search and selection • The risk of bias in the included studies was assessed and considered in the interpretation of results	• Limited research data, • Criteria for patient selection in the included trials were not provided
Thomson et al.[22] 2012	
• The study had a clear research question and objectives	• The review did not report the methodology used for literature search or the selection criteria for the research literature. • The review considered the results of systematic reviews and reported the results of the primary trials included in these systematic reviews; however, this review did not consider the quality of the systematic reviews or their limitations. • Some conclusions from the included systematic reviews did not support the overall conclusions of the review.

Table 6. Critical Appraisal of Studies on the Comparative Clinical Effectiveness and Safety of Dental Implant Therapy and the Conventional Prosthetic Therapies

Strengths	Limitations
	• The quality of the included studies was not evaluated or considered in the interpretation of results
Pjetursson et al.[23] 2011	
• The selection of literature and data extraction was conducted by two independent researchers • The quality of reporting was assessed using the STROPE Statement	• The review was mainly based on studies that were conducted in academic facilities or specialized dental clinics. Therefore, the long-term outcomes might not be generalized to private dental services. • The review defined survival as an FDP remaining in situ with or without modifications. This definition did not account for the complications the prosthesis might have or for patient satisfaction.
Koller et al.[24], 2011	
• The selection of literature and data extraction was conducted by two independent researchers	• The reviewed literature was uncontrolled retrospective studies only • Definition of the survival and failure of teeth, implant or RDP did not account for the possible complications each element could have, and it did not consider patient satisfaction. • The survival analysis was inadequate. Results were presented in terms of survival rate, and it did not account for time of follow-up or time of failure • The quality of the included studies was not evaluated or considered in the interpretation of results
Kim et al.[25] 2011	
• The study had a clear research question and objectives	• The study used results from meta-analyses to support the cost-effectiveness analysis. However, the selection of these metal-analyses was not based on a systematic process, and the quality of these meta-analyses was not considered. • The analysis used both survival and success rates; however, the study did not provide a standardized definition for these terms. • The quality of the included meta-analyses was not evaluated or considered in the interpretation of results
Clinical Trials on the Safety of Dental Implant Therapy and the Conventional Prosthetic Therapies	
Pineiro et al.[26], 2009	
• Allocation of treatment was randomized	• The trial was not powered to detect the differences between the tested interventions • The number of implants/ patients might have affected the prevalence of bacteremia; nevertheless, it was not accounted for in the analysis of bacteremia.
Clinical Trials on the Efficacy of Dental Implant Therapy and the Conventional Prosthetic Therapies	
Awad et al.[21] 2012	
• Allocation of treatment was randomized • Assessment of outcomes were done at 6 and 12 months after treatment, and this period allow the patients to get accustomed to their new prosthesis	• The follow-up period (12 months) does not allow for the detection of clinical important changes in homocysteine and C-reactive protein concentrations • The included patients did not have clinically significant nutritional disorders at inclusion, and it might have been difficult to demonstrate any changes in these outcomes in relatively healthy patients.
Sagirkaya et al.[27], 2012	
• Allocation of treatment was randomized	• The study included small and unequal sample sizes. • The length of follow-up does not permit to conclude on the long-term outcomes of zirconia restorations on

Table 6. Critical Appraisal of Studies on the Comparative Clinical Effectiveness and Safety of Dental Implant Therapy and the Conventional Prosthetic Therapies

Strengths	Limitations
	implants and teeth. • Patient satisfaction was not considered in the evaluation of zirconia restorations
Harris et al.[28] 2011	
• Allocation of treatment was randomized • The sample size was based on power calculation	• The trial employed two patient centered scales the OHIP and DSQ; however, the clinical significance of changes in these scales scores is not established. • The authors gave arbitrary interpretation cutoffs for the changes in scores based on Cohen's effect size. However, the relationship between these cutoffs with the clinical significance is unknown.
DSQ= Denture Satisfaction Questionnaire; **OHIP=** Oral Health Impact Profile; **STROPE=** Standards recommended for reporting of cohort studies in epidemiology	

Table 7. Critical Appraisal of Studies on the Comparative Clinical Effectiveness and Safety of the Different Dental Implant Systems Available in Canada

Strengths	Limitations
Systematic Reviews	
Laurell et al.[29] 2009	
• The study had clear research question and objectives	• The type of alveolar bone, prosthetic restoration, and the periodontal health are potential confounders for the marginal bone changes. These factors were not considered in the meta-analysis. • The financial independence from industry and conflict of interest in the included studies were not discussed. • The quality of the included studies was not evaluated or considered in the interpretation of results
Clinical Trials	
Akoglu et al.[30] 2011	
• Patient allocation was randomized	• Sample size was not justified by power calculation, and it is not known if the trial had enough power to detect the differences between treatments
Ho et al.[31]	
• Patient allocation was randomized	• The sample size calculation was based on an expected survival time difference of three months. This difference was not justified; furthermore, the analysis was reported using survival rate rather than survival time. • The study used inappropriate analysis for the survival data. Results were provided by survival rate, and this type of information does not count for the time to failure. Analyses that use survival curves (e.g., Kaplan-Meier curves) with results presented in terms of hazard ratio would have been more appropriate for the survival outcomes. • Patient satisfaction and quality of life were not considered in this trial
Meijier et al.[32] 2009	
• Patient allocation was randomized • This article reported the results of an RCT with 10 years of follow-up	• Denture complaints were scored from 0 to 3; the article did not report if theses scores were validated or if they correlate with significant clinical differences
Park et al.[33] 2010	
• The statistical analyses were based on the patient as the unit rather than the implant. This type of analysis considers the differences between patients.	• The outcomes were not clearly defined in the publication. Furthermore, the protocol defined criteria for implant success; however, there were no success results reported. • The sample size calculation was based, according to the publication, on a previous *in vitro* trial; however, it the outcome used form that trial was not reported. And it was not clear how the results from *in vitro* trial could be used to estimate the sample size. Therefore, the absence of differences between the treatment groups might have been due to the underpowered analysis to detect the difference rather than a real absence of difference.

APPENDIX 5: Main Study Findings and Authors' Conclusions

Table 8. Summary of results of Studies on the Comparative Clinical Effectiveness and Safety of Dental Implant Therapy and the Conventional Prosthetic Therapies

Main Study Findings	First Author, Publication Year Authors' Conclusions
Systematic Reviews on the Safety of Dental Implant Therapy and the Conventional Prosthetic Therapies	
Emami et al.[17] 2012	
• The prevalence of DS in partial RDP wearers ranged from 1.1% to 36.7%. • Partial RDP wearers were less affected by DS than those who wore complete RDP. • Individuals with unstable partial RDPs had two times more risk of DS than those with stable prostheses.	• The occurrence of DS was inconsistent within partial RDP wearers, • The DS may be considered as a risk factor for DS
Jané-Salas et al.[1] 2012	
• The review included 13 case study articles; from which, 19 cases of oral squamous cell carcinoma were detected in patients with dental implants. • Of the 19 cases, 10 cases had prior history of squamous carcinoma, cancer in another region of the body or oral pre-malignant lesion.	• A clear cause-effect relationship cannot be established between dental implants and oral cancer.
Javed et al.[18] 2011	
• The review included two clinical trials, two observational studies, and three case-reports. The duration of follow-up ranged from 2 weeks to 2 years. • The number of implants was not reported in 4 studies, and in the other studies it varied from 2 to 6 implants. • The number of patients who had allergic reactions associated with dental implants was reported for one clinical trial and one observational study. In the clinical trial the number of patients (%) was 21/56 (37.5%) and in the observational study it was 9/35 (25%)	• "*The significance of titanium as a cause of allergic reactions in patients with dental implants remains unproven.*"
Esposito et al.[19], 2010	
• The risk-ratio of having implant failure (antibiotic versus placebo) was 0.40 [95% CI: 0.19, 0.84] – based on a meta-analysis of four trials (1007 patients) • There were no statistically significant difference between the amoxicillin group and placebo in postoperative infections and adverse events.	• There is evidence suggesting that 2g amoxicillin given orally 1 hour preoperatively significantly reduce early failure of dental implants. However, the preoperative antibiotic did not affect the incidence of postoperative infections and adverse events.
Systematic Reviews on the Efficacy of Dental Implant Therapy and the Conventional Prosthetic Therapies	
Abt et al.[20] 2012	
• One 10-year split mouth randomization trial (n=23) found no significant differences in the clinical outcomes between FDP supported by implants only and FDP supported by an implant and a natural tooth. Outcomes included 10-year survival rate, alveolar bone loss, and complications in abutment teeth.	• There was insufficient evidence to determine the relative advantages of implant supported FDPs versus tooth/implant supported FDPs.
Thomson et al.[22] 2012	
Patients assessed satisfaction and quality of life outcomes: the review considered the results of a systematic review conducted by Emami et al. in 2009. The systematic review concluded that • The available evidence suggests better patient-based outcomes with mandibular implant over dentures.	• "*There is overwhelming evidence to support the proposal that a two-implant overdenture should become the first choice of treatment for the edentulous mandible*."

Table 8. Summary of results of Studies on the Comparative Clinical Effectiveness and Safety of Dental Implant Therapy and the Conventional Prosthetic Therapies

<table>
<tr><th>Main Study Findings</th><th>First Author, Publication Year
Authors' Conclusions</th></tr>
<tr><td>However, the magnitudes of treatment effects were inconclusive.

Masticatory function and chewing ability outcomes: the review considered the results of a systematic review by Fueki et al. 2007. The systematic review concluded that:
• "implant-supported overdentures provide significant improvements in masticatory performance compared to conventional dentures for those having persistent functional problems with an existing mandibular conventional denture due to a severely resorbed mandible."</td><td></td></tr>
<tr><td colspan="2">Pjetursson et al.[23] 2011</td></tr>
<tr><td>Estimation of the relative failure rates
<table><tr><th>Type of restoration/ total number of reconstructions</th><th>relative failure rate (95% CI)*</th><th>p-value</th></tr><tr><td>Implant-supported SCs/ 259</td><td>1.00 (Reference)</td><td></td></tr><tr><td>Implant-supported FDPs/ 948</td><td>0.72 (0.49, 1.06)</td><td>0.098</td></tr><tr><td>Conventional FDPs/ 1163</td><td>1.37 (0.81, 2.33)</td><td>0.243</td></tr><tr><td>Cantilever FDPs/ 304</td><td>2.11 (1.39, 3.21)</td><td><0.001</td></tr><tr><td>Tooth-implant FDP/ 124</td><td>1.33 (0.37, 4.80)</td><td>0.661</td></tr><tr><td>Resin-bonded prosthesis/ 436</td><td>2.82 (1.45, 5.50)</td><td>0.002</td></tr></table></td><td>"the choice of reconstruction on teeth with end abutments,
• reconstruction on implants (both FDPs and SCs) should be given first priority,
• combined tooth-implant-supported constructions, cantilever reconstructions on teeth, and RBP represent options of second priority."</td></tr>
<tr><td colspan="2">Koller et al.[24] 2011</td></tr>
<tr><td>• For RDP supported by teeth: (7 studies, 923 patients)
○ Survival rate of teeth ranged from 81% to 95.3%
○ Survival rate of RDP ranged from 90% to 95.1% (data from 2 studies only)

• For RDP supported by implants: (3 studies, 59 patients)
○ Survival rate of implants ranged from 97% to 100%
○ Survival rate of RDP ranged from 95% to 100%

• For RDP supported by implant and tooth: (1 study, 22 patients)
○ Survival rates of implants, teeth and RDP were 100%</td><td>• The included literature did not provide sufficient data on the long-term outcome of double crown-retained RDPs.</td></tr>
<tr><td colspan="2">Kim et al.[25] 2011</td></tr>
<tr><td>Survival/success rates obtained from several meta-analyses:
• non-surgical endodontic retreatment:
○ Success rate of 77% to 78%
○ Survival rate (8 to 10 years) 87%
• Endodontic microsurgery
○ success rate: 94%
• Fixed partial dentures:
○ Success rate: 71.1% to 80%
○ Survival rate: 89.1%
• Dental implants:
○ Survival of implant-supported crowns: 94.5%
○ Survival of implants: 96.8%</td><td>For a failed endodontically treated first molar:
• Endodontic microsurgery was the most cost-effective among all treatment options
• Nonsurgical retreatment with a crown can be a more cost-effective treatment modality than an implant-supported crown.
• A fixed partial denture was more cost-effective than a single implant-supported crown but les cost-effective than nonsurgical retreatment with a crown.
• A single implant-supported crown, despite its high survival rate, was the least cost-effective.</td></tr>
</table>

Table 8. Summary of results of Studies on the Comparative Clinical Effectiveness and Safety of Dental Implant Therapy and the Conventional Prosthetic Therapies

<table>
<tr><th>Main Study Findings</th><th>First Author, Publication Year
Authors' Conclusions</th></tr>
<tr><td colspan="2">Clinical Trials on the Safety of Dental Implant Therapy and the Conventional Prosthetic Therapies</td></tr>
<tr><td colspan="2">Pineiro et al.[26], 2009</td></tr>
<tr><td colspan="2">Prevalence of Bacteremia, n (%)
<table>
<tr><th>Time point</th><th>Placebo (n=30)</th><th>CHX (n=20)</th><th>significance</th></tr>
<tr><td>Baseline</td><td>1 (3.3%)</td><td>0</td><td>NS</td></tr>
<tr><td>30 sec post-op</td><td>2 (6.7%)</td><td>0</td><td>NS</td></tr>
<tr><td>15 min post-op</td><td>1 (3.3%)</td><td>0</td><td>NS</td></tr>
</table>
• Implant placement using mucoperiosteal flap does not carry a significant risk of developing bacteremia.</td></tr>
<tr><td colspan="2">Clinical Trials on the Efficacy of Dental Implant Therapy and the Conventional Prosthetic Therapies</td></tr>
<tr><td colspan="2">Awad et al.[21] 2012</td></tr>
<tr><td>• The between group means for homocysteine were not different at 6 or 12 months post treatment (p=NS)
• Folate and vitamin B12 values were higher in the complete denture (CD) group than in the implant over-denture (IOD) group at 6 and 12 months (P<0.0035)
• IOD group had significantly more improvements than the CD group from baseline to 12 months in chewing ability and food habits.
• IOD group reported fewer difficulties chewing pieces of beef, vegetables, fruits and bread crust and nuts than did those in the CD group (p<0.0008)</td><td>• Although patients who received implant over dentures had significant improvement in ability to chew and food habits. Clinically important differences in blood nutrients and health parameters were not observed</td></tr>
<tr><td colspan="2">Sagirkaya et al.[27], 2012</td></tr>
<tr><td>• The 4-year Kaplan-Meier survival probability of implant-supported crowns was 1.00; for tooth –supported crowns, it was 0.936. The difference between groups was insignificant (p=0.182).</td><td>• The 4-year clinical outcomes of zirconia single crowns on teeth and implants were comparable</td></tr>
<tr><td colspan="2">Harris et al.[28] 2011</td></tr>
<tr><td>• The difference between the IOD and CD groups in terms of change from baseline to 3 months in denture satisfaction scale items showed that IOD had increased patients satisfaction more than CD, and the difference between groups was statistically significant in all the items except for the following item:
o "Refuse social invitations because of difficulties with denture"
• The difference between the IOD and CD groups in terms of change from baseline to 3 months in
o Denture Satisfaction Scale items showed that IOD had increased patients satisfaction more than CD, and the difference between groups was statistically significant in all the items except for the following item: "Refuse social invitations because of difficulties with denture"
o Oral Health Impact Profile (OHIP) items showed that IOD improved the OHIP scores more than CD on all items; however, the differences were statistically significant in four items out of seven. These are functional limitation, pain, psychological discomfort, physical disability.</td><td>• "When controlling for expectancy bias and variability in baseline levels, implant overdentures produce significant increases in patients satisfaction levels, perceived function and oral health-related quality of life compared with those achieved with conventional dentures."</td></tr>
<tr><td colspan="2">AE= adverse events; CHX= chlorhexidine; DS= denture stomatitis; FDP= fixed dental prosthesis; NS= not significant; RBP= resin-bonded prosthesis; RDP= removable dental prosthesis; SC= single crown;
* based on multivariable Poisson regression including all types of FDPs
** fisher's exact test, exact significance 2-sided</td></tr>
</table>

Table 9. Summary of results of Studies on the Comparative Clinical Effectiveness and Safety of the Different Dental Implant Systems Available in Canada

<table>
<tr><th colspan="6">Main Study Findings</th><th>First Author, Publication Year
Authors' Conclusions</th></tr>
<tr><td colspan="6">Systematic Reviews</td><td></td></tr>
<tr><td colspan="6">Laurell et al.[29] 2009</td><td></td></tr>
<tr><td colspan="3">Weighted* Mean Marginal Bone Level Changes</td><td colspan="3"></td><td rowspan="5">• Three implant systems, by the end of 2007, had scientific documentation on peri-implant marginal bone level changes in terms of 2 or more 5-year prospective clinical studies; the Astra Tech Dental Implant System, the Branemark System, and Straummann Dental Implant.
• These systems showed a mean marginal bone loss over 5 years will below what is accepted as success criteria.**</td></tr>
<tr><td colspan="2">Implant System</td><td colspan="4">Mean Change (95% CI)</td></tr>
<tr><td colspan="2">AstraTech (n=338)</td><td colspan="4">-0.27 (-0.356, -0.179)</td></tr>
<tr><td colspan="2">Branemark (n=1027)</td><td colspan="4">-0.72 (-0.776, -0.673)</td></tr>
<tr><td colspan="2">Straummann (n=708)</td><td colspan="4">-0.56 (-0.661, -0.481)</td></tr>
<tr><td colspan="6">Clinical Trials</td><td></td></tr>
<tr><td colspan="6">Akoglu et al.[30] 2011</td><td></td></tr>
<tr><td colspan="5">Results at five years</td><td rowspan="7">• There were no significant differences between the implant system and the observation times regarding the plaque index, bleeding index and patient satisfaction.
• Probing depths around Astra Tech implants were significantly higher than those around ITI and SwissPlus implants.</td></tr>
<tr><td></td><td>ITI (N=12)</td><td>SwissPlus (N=12)</td><td>Astra (N=12)</td><td>P-value</td></tr>
<tr><td>MBL††, mm (SD)</td><td>0.2 (0.04)</td><td>0.24 (0.05)</td><td>0.34 (0.03)</td><td>S</td></tr>
<tr><td>PD, mm (SD)</td><td>1.5 (0.42)</td><td>1.73 (0.53)</td><td>2.39 (0.43)</td><td>S</td></tr>
<tr><td>Esthetic, n (E/S/P)</td><td>10/2/0</td><td>10/2/0</td><td>9/3</td><td>NP</td></tr>
<tr><td>Chewing, n (E/S/P)</td><td>10/2/0</td><td>11/1/0</td><td>10/3/0</td><td>NP</td></tr>
<tr><td>Retention n (E/S/P)</td><td>11/1/0</td><td>9/3/0</td><td>10/2/0</td><td>NP</td></tr>
<tr><td colspan="6">Ho et al.[31] 2011</td><td></td></tr>
<tr><td colspan="2"></td><td>NobelActive N=32</td><td>Branemark (N=32)</td><td>P-value</td><td rowspan="3">• Short-term survival and marginal bone levels of NobelActive and Branemark implants are comparable
• The NobelActive implants are more technique sensitive than Branemark system</td></tr>
<tr><td colspan="2">6-months survival rate</td><td>87.5%</td><td>96.9%</td><td>0.64</td></tr>
<tr><td colspan="2">MBL‡‡, mm(SD)</td><td>1.2 (0.78)</td><td>1.39 (0.71)</td><td>0.14</td></tr>
<tr><td colspan="6">Meijer et al.[32] 2009</td><td></td></tr>
<tr><td colspan="5">Patients' satisfaction questionnaire§ (at 10 years evaluation), mean score (SD)</td><td rowspan="8">• Two implants (two-stage IMZ, two-stage Branemark, or one stage ITI) placed in the interforaminal region, connected with a bar, supply a proper base for the support of a mandibular overdenture in the (Cawood V-VI) edentulous patients
• After 10 years, no clinical relevant changes had developed between the three implant systems and the patients were still very satisfied with their implant-retained mandibular overdenture.</td></tr>
<tr><td></td><td>IMZ n= 27</td><td>Branemark n=27</td><td>ITI n=27</td><td>P-value</td></tr>
<tr><td>LD FC</td><td>0.4 (0.5)</td><td>0.5 (0.5)</td><td>0.3 (0.4)</td><td>NS</td></tr>
<tr><td>UD FC</td><td>0.2 (0.3)</td><td>0.2 (0.3)</td><td>0.3 (0.4)</td><td>NS</td></tr>
<tr><td>General FC</td><td>0.2 (0.3)</td><td>0.2 (0.3)</td><td>0.2 (0.2)</td><td>NS</td></tr>
<tr><td>Facial aesthetic</td><td>0.4 (0.7)</td><td>0.7 (0.8)</td><td>0.3 (0.5)</td><td>NS</td></tr>
<tr><td>Neutral space</td><td>0.3 (0.5)</td><td>0.4 (0..5)</td><td>0.2 (0.4)</td><td>NS</td></tr>
<tr><td>Aesthetic</td><td>0.2 (0.3)</td><td>0.1 (0.2)</td><td>0.2 (0.2)</td><td>ns</td></tr>
</table>

Table 9. Summary of results of Studies on the Comparative Clinical Effectiveness and Safety of the Different Dental Implant Systems Available in Canada

<table>
<tr><th colspan="4">Main Study Findings</th><th>First Author, Publication Year
Authors' Conclusions</th></tr>
<tr><td colspan="5">Park et al.[33] 2009</td></tr>
<tr><td></td><td>Standard Straumann implants</td><td>Osstem SSII implants</td><td>p-value</td><td rowspan="10">• The one year success rate was 100% for both the standard Straumann dental implant system and the Osstem Implant SSII system despite the presence of a significant difference in implant stability during surgery.</td></tr>
<tr><td colspan="4">Comparison of primary stability, Torque (Newton cm) (SD)</td></tr>
<tr><td rowspan="2">Torque, Newton cm (SD)</td><td>N=25</td><td>N=28</td><td></td></tr>
<tr><td>23.76 (8.23)</td><td>29.54 (6.84)</td><td>0.009</td></tr>
<tr><td colspan="4">Comparison of marginal bone loss at 1 year, mean (SD)</td></tr>
<tr><td>Area</td><td>N=24</td><td>N=26</td><td></td></tr>
<tr><td>Proximal</td><td>1.21 (0.57)</td><td>0.92 (0.68)</td><td>0.066</td></tr>
<tr><td>Distal</td><td>0.93 (0.39)</td><td>0.65 (0.37)</td><td>0.013</td></tr>
<tr><td>Average</td><td>1.07 (0.46)</td><td>0.79 (0.42)</td><td>0.048</td></tr>
<tr><td colspan="5">AE= adverse events; DS= denture stomatitis; FC= functional complaint; FDP= fixed dental prosthesis; LD= lower denture; MBL= marginal bone loss; n (E/S/P)= number of patients who had excellent, satisfactory or poor experience; NP= not provided; PD= probing depth; UD= upper denture; RBP= resin-bonded prosthesis; RDP= removable dental prosthesis; S= significant; SC= single crown; SD= standard deviation
* the analysis was weighted to account for the difference in the number of patients between the different studies
** it was reported in the article (based on three references) that a marginal bone loss in the order of 1 mm during the first year of service of the implant, and an annual bone loss thereafter not exceeding 0.2 mm is a natural feature and consistent with successful treatment
† based on a meta-analysis of 41 trials (38 publications)
†† marginal bone loss from baseline to the fifth year of follow-up
‡‡ marginal bone loss from baseline to 6 months
§the questionnaire consisted of 6 domains; functional problems of the lower denture, functional problems of the upper denture, general functional complaints, facial esthetics, accidental lip, cheek and tongue biting; and aesthetics of the denture. Each domain consisted of three to eighteen items. Each item was scored from 0 to 3 (0= no complaint, 1=little, 2= moderate, and 3= severe complaints)</td></tr>
</table>

APPENDIX 6: Definition of Outcomes

Outcome	Definition/ items	Authors who used the outcome
OHIP	Items: 1. Functional limitation 2. Psychological discomfort 3. Physical disability 4. Psychological disability 5. Social disability 6. Handicap Scoring method: unknown	**Harris et al.[28] 2011**
DSQ	Items: 1. Denture satisfaction general Performance of lower denture when chewing 2. Difficulties when speaking 3. Stay in place during use 4. Is denture comfortable 5. Quality of meals having worn lower denture 6. Choice of food limited by ability to eat with denture 7. Refuse social invitations because of difficulties with denture 8. Do you consider your lower denture to be foreign body or part of yourself 9. How do you evaluate your self-confidence after wearing denture 10. General health: how has your lower denture changed your life	**Harris et al.[28] 2011**
DSQ= Denture Satisfaction Questionnaire**; OHIP=** Oral Health Impact Profile;		