

Interventions for replacing missing teeth: hyperbaric oxygen therapy for irradiated patients who require dental implants (Review)

Esposito M, Grusovin MG, Patel S, Worthington HV, Coulthard P



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[Intervention Review]

Interventions for replacing missing teeth: hyperbaric oxygen therapy for irradiated patients who require dental implants

Marco Esposito¹, Maria Gabriella Grusovin¹, Satya Patel¹, Helen V Worthington², Paul Coulthard¹

¹Department of Oral and Maxillofacial Surgery, School of Dentistry, The University of Manchester, Manchester, UK. ²Cochrane Oral Health Group, MANDEC, School of Dentistry, The University of Manchester, Manchester, UK

Contact address: Marco Esposito, Department of Oral and Maxillofacial Surgery, School of Dentistry, The University of Manchester, Higher Cambridge Street, Manchester, M15 6FH, UK. espositomarco@hotmail.com. marco.esposito@manchester.ac.uk.

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ABSTRACT

Background

Dental implants offer one way to replace missing teeth. Patients who have undergone radiotherapy and those that have also undergone surgery for cancer in the head and neck region may benefit particularly from reconstruction with implants. Hyperbaric oxygen therapy (HBO) has been advocated to improve the success of implant treatment in patients who have undergone radiotherapy but this remains a controversial issue.

Objectives

To compare success, morbidity, patient satisfaction and cost effectiveness of dental implant treatment carried out with and without HBO in irradiated patients.

Search methods

We searched the Cochrane Oral Health Group's Trials Register, The Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE and EMBASE. Handsearching included several dental journals. We checked the bibliographies of relevant clinical trials and review articles for studies outside the handsearched journals. We wrote to authors of the identified randomised controlled trials (RCTs), to more than 55 oral implant manufacturers; we used personal contacts and we asked on an internet discussion group in an attempt to identify unpublished or ongoing RCTs. No language restriction was applied. The last electronic search was conducted on 13 June 2007.

Selection criteria

Randomised controlled trials of HBO therapy for irradiated patients requiring dental implants.

Data collection and analysis

Screening of eligible studies, assessment of the methodological quality of the trials and data extraction were conducted in duplicate and independently by two review authors. Results were expressed as random-effects models using mean differences for continuous outcomes and risk ratios for dichotomous outcomes with 95% confidence intervals.

Main results

Only one RCT was identified and included. Thirteen patients received HBO therapy while other 13 did not. Two to six implants were placed in fully edentulous mandibles to be rehabilitated with bar-retained overdentures. One year after implant loading four patients died from each group. One patient, treated with HBO, developed an osteoradionecrosis and lost all implants so the prosthesis could not be provided. Five patients in the HBO group had at least one implant failure versus two in the control group. There were no statistically significant differences for prosthesis and implant failures, postoperative complications and patient satisfaction between the two groups.

Authors' conclusions

Despite the limited amount of clinical research available, it appears that HBO therapy in irradiated patients requiring dental implants may not offer any appreciable clinical benefits. There is a definite need for more RCTs to ascertain the effectiveness of HBO in irradiated patients requiring dental implants. These trials ought to be of a high quality and reported as recommended by the CONSORT statement (www.consort-statement.org/). Each clinical centre may have limited numbers of patients and it is likely that trials will need to be multicentred.

PLAIN LANGUAGE SUMMARY

Interventions for replacing missing teeth: hyperbaric oxygen therapy for irradiated patients who require dental implants

We could only identify one study including a limited number of patients. This study suggested that the use of hyperbaric oxygen (HBO) therapy for patients who require dental implants after radiotherapy is of no apparent clinical benefit. HBO requires patients to breath pure oxygen under pressure in a specially designed chamber on several occasions. It has been suggested that HBO therapy will improve the healing of bone and tissues around dental implants, however the scarce scientific evidence available does not support this hypothesis. More reliable studies are needed to provide the final answer to this question.

BACKGROUND

Missing teeth and supporting oral tissues have traditionally been replaced with dentures or bridges permitting restoration of masticatory function, speech, and aesthetics. Since the 1970s dental implant supported prostheses have offered an alternative. Dental implants are surgically inserted into the jaw bone and are retained due to the intimacy of bone growth onto their surface termed osseointegration (Brånemark 1977). Osseointegrated dental implants have undoubtedly been one of the most significant scientific breakthroughs in dentistry over the past 40 years.

Teeth are lost due to dental diseases, trauma or may be congenitally absent. In addition there are some patients who have lost extensive oral and facial tissues following surgery for cancer. Reconstruction of these tissues can be difficult but implant therapy offers an improvement to previous treatment modalities (Franzen 1995). Some cancer patients have undergone radiotherapy in adjunct to surgery whereas others have only had radiotherapy treatment. Complications of radiotherapy treatment include oral mucosal damage (mucositis), dry mouth (xerostomia) as result of salivary gland damage, and damage to bone (osteoradionecrosis). Os-

teoradionecrosis is the most serious, as it is difficult to treat and may require partial jaw resection. It commonly affects the mandible although it may also affect other bones (sternum, skull, pelvis). Any surgical treatment involving the jaws following radiotherapy may show compromised healing or even lead to osteonecrosis hence dental implant treatment for such patients has been considered as a relative contraindication. Conversely, implant therapy is also of significant benefit to this group of patients.

Hyperbaric oxygen (HBO) therapy gained strong support for positive effects on compromised tissue following irradiation after its introduction in the 1970s (Marx 1984). HBO therapy consists of exposing a patient in a special chamber to intermittent, short term 100% oxygen inhalation at a pressure greater than one atmosphere. A typical protocol developed for osteoradionecrosis is the Marx-University of Miami protocol (Marx 1984) which requires a patient to receive 20 HBO treatments of 100% oxygen at 2.4 atmospheres for 90 minutes before surgery, followed by a further 10 HBO treatments of 100% oxygen at 2.4 atmospheres for 90 minutes after surgery. It has been proposed that HBO therapy may

improve osseointegration (Granström 1992).

The question as to whether HBO therapy effects implant success in irradiated patients is important because HBO therapy is not without risk of adverse effects. HBO therapy is time consuming, expensive and requires significant patient compliance. Despite several authors supporting HBO therapy (Larsen 1997; Granström 1999; Feldmeier 2002; Granström 2005), it remains a controversial issue and some clinicians consider HBO ineffective (Keller 1997). The advocates of HBO therapy have based their conclusions on clinical experience, retrospective case control studies (Granström 1999) and experimental animal studies (Larsen 1997). On the other hand, oral implant rehabilitation of irradiated patients has been shown to be successful without adjunctive hyperbaric oxygen (Franzen 1995).

The aim of this review was to compare dental implant treatment carried out with and without HBO therapy in irradiated patients.

OBJECTIVES

This review aims to test the null hypothesis of no difference in success, morbidity, patient satisfaction and cost effectiveness between dental implant treatment for irradiated patients with and without hyperbaric oxygen (HBO) therapy, against the alternative hypothesis of a difference.

METHODS

Criteria for considering studies for this review

Types of studies

Randomised controlled trials.

Types of participants

Patients who have had radiotherapy and who have missing teeth that require replacement with osseointegrated dental implants.

Types of interventions

Hyperbaric oxygen (HBO) therapy compared with no HBO therapy.

Types of outcome measures

Outcome measures of interest were.

- Prosthesis failure if secondary to implant failure.
- Implant failure: mobility and implant removal of stable implants dictated by progressive marginal bone loss.
- Radiographic marginal bone level changes on intraoral radiographs taken with a parallel technique.
- Preimplantation complications: all complications occurred after initiation of HBO therapy but prior to implant placement (eustachian tube dysfunction, tympanic membrane rupture, ear or sinus or tooth pain, pneumothorax, etc.).
- Postimplantation complications: all complications occurred after implant placement (mucosa ulceration, osteoradionecrosis, etc.).
- Patient satisfaction.
- Cost effectiveness.

Search methods for identification of studies

For the identification of studies included or considered for this review, we developed detailed search strategies for each database to be searched. These were based on the search strategy for searching MEDLINE via OVID but revised appropriately for each database. The search strategy used a combination of controlled vocabulary and free text terms and was run with phases 1 and 2 of the Cochrane Sensitive Search Strategy for Randomised Controlled Trials (RCTs) as published in Appendix 5b.2 of the *Cochrane Handbook for Systematic Reviews of Interventions* 4.2.6 (updated September 2006) and amended by the Cochrane Oral Health Group. See Appendix 1.

Searched databases

The Cochrane Oral Health Group's Trials Register (to 13 June 2007).

The Cochrane Central Register of Controlled Trials (CENTRAL) (*The Cochrane Library* 2007, Issue 2).

MEDLINE (1966 to 13 June 2007).

EMBASE (1980 to 13 June 2007).

The most recent electronic search was undertaken on 13 June 2007.

Language

There were no language restrictions.

Unpublished studies

We wrote to all the authors of the identified RCTs, we checked the bibliographies of all identified RCTs and relevant review articles, and we used personal contacts in an attempt to identify unpublished or ongoing RCTs. In the first version of this review

we also wrote to more than 55 oral implant manufacturers and we requested information on trials through an Internet discussion group (implantology@yahoo.com), however we discontinued this due to poor yield.

Handsearching

Details of the journals being handsearched by the Cochrane Oral Health Group's ongoing programme are given on the website: www.ohg.cochrane.org.

The following journals have been identified as being potentially important to be handsearched for this review: *British Journal of Oral and Maxillofacial Surgery*, *Clinical Implant Dentistry and Related Research*, *Clinical Oral Implants Research*, *European Journal of Oral Implantology*, *Implant Dentistry*, *International Journal of Oral and Maxillofacial Implants*, *International Journal of Oral and Maxillofacial Surgery*, *International Journal of Periodontics and Restorative Dentistry*, *International Journal of Prosthodontics*, *Journal of Clinical Periodontology*, *Journal of Dental Research*, *Journal of Oral Implantology*, *Journal of Oral and Maxillofacial Surgery*, *Journal of Periodontology*, *Journal of Prosthetic Dentistry*. Where these have not already been searched as part of the Cochrane Journal Handsearching Programme, the journals were handsearched by one review author up to the month in which the last electronic search was undertaken.

Data collection and analysis

The titles and abstracts (when available) of all reports identified through the electronic searches were scanned independently by two review authors. For studies appearing to meet the inclusion criteria, or for which there were insufficient data in the title and abstract to make a clear decision, the full report was obtained. The full reports obtained from all the electronic and other methods of searching were assessed independently by two review authors to establish whether the studies did meet the inclusion criteria or not. Disagreements were resolved by discussion. Where resolution was not possible, a third review author was to be consulted. All studies meeting the inclusion criteria then underwent validity assessment and data extraction. Studies rejected at this or subsequent stages were recorded in the 'Characteristics of excluded studies' table, and the reasons for exclusion recorded.

Quality assessment

The quality assessment of the included trials was undertaken independently and in duplicate by two review authors as part of the data extraction process.

Three main quality criteria were examined:

(1) Allocation concealment, recorded as:

- (A) Adequate
- (B) Unclear

(C) Inadequate, as described in the *Cochrane Handbook for Systematic Reviews of Interventions* 4.2.6 (section 6.3).

Allocation concealment was considered adequate if it was centralised (e.g. allocation by a central office unaware of subject characteristics); pharmacy-controlled randomisation; prenumbered or coded identical containers which were administered serially to participants; on-site computer system combined with allocation kept in a locked unreadable computer file that can be accessed only after the characteristics of an enrolled patient have been entered; sequentially numbered, sealed, opaque envelopes; and other approaches similar to those listed above, along with the reassurance that the person who generated the allocation scheme did not administer it. Some schemes may be innovative and not fit any of the approaches above, but still provide adequate concealment. Approaches to allocation concealment which were considered clearly inadequate included any procedure that was entirely transparent before allocation, such as an open list of random numbers. Ideally the surgeon should have known the group allocation just before the treatment was delivered. Those articles or authors stating that allocation concealment procedures were implemented but did not provide details on how this was accomplished, were coded as 'unclear'.

(2) Treatment blind to outcome assessors, recorded as:

(A) Yes

(B) No

(C) Unclear.

(3) Completeness of follow up (is there a clear explanation for withdrawals and drop outs in each treatment group?) assessed as:

(A) No drop outs/yes. In the case that clear explanations for drop outs were given, a further subjective evaluation of the risk of bias assessing the reasons for the drop out was made

(B) No.

After taking into account the additional information provided by the authors of the trials, studies were grouped into the following categories.

(A) Low risk of bias (plausible bias unlikely to seriously alter the results) if all criteria were met.

(B) High risk of bias (plausible bias that seriously weakens confidence in the results) if one or more criteria were not met as described in the *Cochrane Handbook for Systematic Reviews of Interventions* 4.2.6 (section 6.7).

Further quality assessment was carried out to assess sample size calculations, definition of exclusion/inclusion criteria, and comparability of control and test groups at entry. The quality assessment criteria were pilot tested using several articles.

Data extraction

Data were extracted by two review authors independently using specially designed data extraction forms. The data extraction forms were piloted on several papers and modified as required before use. Any disagreement was discussed and a third review author

consulted where necessary. All authors were contacted for clarification or missing information. Data were excluded until further clarification becomes available if agreement could not be reached. For each trial the following data were recorded:
Year of publication and country of origin.
Details of the participants including demographic characteristics and criteria for inclusion.
Details of the type of intervention.
Details of the outcomes reported, including method of assessment and time intervals.

Data synthesis

For dichotomous outcomes, the estimates of effect of an intervention were expressed as risk ratios together with 95% confidence intervals. For continuous outcomes, mean differences and standard deviations were used to summarise the data for each group. The statistical unit was the patient and not the implant.

Only if there were studies of similar comparisons reporting the same outcome measures was meta-analysis to be attempted. Risk ratios were to be combined for dichotomous data, and mean differences for continuous data, using a random-effects model.

The significance of any discrepancies in the estimates of the treatment effects from the different trials was to be assessed by means of Cochran's test for heterogeneity and the I^2 statistic, which describes the percentage total variation across studies that is due to heterogeneity rather than chance. Clinical heterogeneity was to be assessed by examining the types of participants and interventions for all outcomes in each study. It was planned to undertake sensitivity analyses to examine the effect of the study quality assessment on the overall estimates of effect. In addition, the effect of including unpublished literature on the review's findings was also to be examined, but there were insufficient trials to undertake this. The following subgroup analyses were planned, however there were insufficient studies to undertake this.

- (1) Whether the implants were placed in mandibles or maxillae.
- (2) Whether the implants were placed in augmented bone or not.
- (3) Whether radiotherapy was hyperfractionated (total dose over more than 12 fractions) or not.
- (4) Whether the cumulative dose was ≥ 60 grays or less.
- (5) Whether 1 year or more passed after the radiotherapy end and implant placement or not.
- (6) Whether the pressure (dose) of oxygen received was $>$ to 2.5 atmospheres or less.

RESULTS

Description of studies

See: [Characteristics of included studies](#).

See '[Characteristics of included studies](#)' table.

Characteristics of the trial settings and investigators

One potentially eligible trial was identified and included ([Schoen 2007](#)). It was conducted at the Head and Neck Oncology Group of the Groningen University Medical Center, the Netherlands, and included only adults.

Characteristics of interventions

Both groups received antibiotic prophylaxis with broad-spectrum antibiotics (cephradine 1 g, three times daily during 2 weeks) starting 1 day before implant surgery. The test group received 20 hyperbaric oxygen (HBO) treatments of 100% oxygen at 2.5 atmospheres for 80 minutes (four periods of 20 minutes), before implant surgery, and 10 HBO identical treatments after implant surgery. In all patients Brånemark implants were placed in the interforaminal region of the mandible according to a one-stage procedure. After 6 months, the fabrication of bar-retained overdentures was started, and overdentures were delivered.

Characteristics of outcome measures

Prosthesis failures: data presented.

Implant failures: data presented.

Radiographic bone level changes: data presented, but not used since extrapolated from oblique lateral radiographs.

Preimplantation complications: data presented.

Postimplantation complications: data presented.

Patient satisfaction: data presented. We used the 'overall denture satisfaction', however one patient from the HBO group who lost all the implants during the healing period and could not receive an implant-supported overdenture, was excluded from the trial. This is not correct since the treatment was clearly a failure, but its potentially negative consequences were not accounted for.

Cost effectiveness: data not presented but possible to extrapolate.

Risk of bias in included studies

Allocation concealment

After considering the reply from the author, the method of allocation concealment was considered inadequate.

Blinding

After considering the reply from the author, the outcome assessors were not blinded.

Completeness of follow up

After considering the reply from the author, the reasons for drop outs were clear.

Sample size

No sample size calculation was performed.

Main inclusion criteria

Patients with completely edentulous mandibles, treated for a first malignancy in the head and neck region (squamous cell carcinoma of the tongue, floor of the mouth, mandibular gingiva, buccal mucosa or oropharynx) with either radiotherapy or a combination of surgery and radiotherapy, having problems in retaining of their lower dentures.

Main exclusion criteria

None described.

Comparability of control and treatment groups at entry

The groups appeared to be comparable at entry. The agreed quality of the included trial after having incorporated the information provided by the authors is summarized in 'Additional Table 1'. The trial was rated as at high risk of bias.

Effects of interventions

One study (Schoen 2007) included 13 patients treated with hyperbaric oxygen (HBO) therapy and 13 patients who did not receive HBO therapy. Two patients, one from each group, died during the healing period of the implants. One year after placement of the overdentures three additional patients in each group were no longer alive. Eight implants failed in five patients subjected to HBO therapy versus three implants in two patients in the control group. Two postoperative complications (one osteoradionecrosis and some minor soft tissue complications) developed in two patients subjected to HBO therapy. The patient affected by osteoradionecrosis lost all implants, the implant-supported prosthesis could not be fabricated, and patient satisfaction was not evaluated. One year after delivery of the prosthesis there were no statistically significant differences for any of the outcome measures (Comparison 1, Outcomes 1.1-1.5).

DISCUSSION

The question of whether or not hyperbaric oxygen (HBO) therapy is effective for implant success in irradiated patients is important. HBO therapy requires significant patient compliance and involves substantial financial expense in terms of cost per patient treatment and equipment. It is not without risk of adverse effects. There are many scientific papers written about the subject, including a number of review articles (Esposito 1998; Granström 1998) but only one randomised controlled clinical trial (Schoen 2007) including a limited number of subjects. The results of this trial suggests that HBO therapy is of no benefit to prevent failures of dental implants or other serious complications such as osteoradionecrosis of the mandible. Patients treated with HBO performed worse in every aspect when compared to patients not subjected to HBO therapy. One patient from the HBO group lost all implants because of osteoradionecrosis and could not be restored with an implant-supported denture. The exclusion of this patient when evaluating patient satisfaction may have altered the results in favour of the HBO therapy. It can be hypothesised that by including this patient, the degree of satisfaction in the HBO group may have been lower. While these findings should be interpreted with a great deal of caution and should be confirmed by larger sample sizes, it appears that the level of efforts in terms of costs, patient compliance, and additional risk of adverse effects which are involved in delivering HBO therapy, are not justified.

Readers should be aware that the 'evidence' on this matter remains highly controversial. For instance, another Cochrane systematic review suggested a limited advantage of HBO therapy in reducing the chances of osteoradionecrosis in irradiated tooth sockets following dental extractions (Bennett 2005).

Despite the increased number of implant losses, irradiation therapy cannot be considered an absolute contraindication to dental implants in the mandible. In fact, only three out of the 26 patients included in the trial (Schoen 2007) did not benefit from their implant-supported overdentures. Two patients died during the implant healing period, and all implants failed in another patient because of osteoradionecrosis and the overdenture could not be fabricated. From the trial it clearly emerges that implant-retained mandibular overdentures improve life quality in terms of oral function and denture satisfaction in patients treated for head and neck cancer (Schoen 2007).

AUTHORS' CONCLUSIONS

Implications for practice

Despite the limited amount of research available, it appears that hyperbaric oxygen (HBO) therapy in irradiated patients requiring dental implants may not offer any appreciable clinical benefits.

Implications for research

There is a definite need for more randomised controlled trials

(RCTs) to ascertain the effectiveness of HBO therapy in irradiated patients requiring dental implants. These trials ought to be of a high quality and reported as recommended by the CONSORT statement (www.consort-statement.org/). Each clinical centre may have limited numbers of patients, it is likely that trials will need to be multicentred.

We wish to thank Sylvia Bickley (Cochrane Oral Health Group) for her assistance with literature searching; Emma Tavender, Luisa Fernandez and Phil Riley (Cochrane Oral Health Group) for their help with the preparation of this review; Pieter Schoen for providing us with information on his trial. We wish to thank Asbjørn Jokstad for the contribution he gave for earlier versions of this review. We would also like to thank the following referees who have reviewed various versions of this review: Gösta Granström, Steve Thomas, Pieter Schoen and Sylvia Bickley.

ACKNOWLEDGEMENTS

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Coulthard 2003

Coulthard P, Esposito M, Worthington HV, Jokstad A.
Therapeutic use of hyperbaric oxygen for irradiated dental
implant patients: a systematic review. *Journal of Dental
Education* 2003;**67**(1):64–8.

* *Indicates the major publication for the study*

CHARACTERISTICS OF STUDIES

Characteristics of included studies [ordered by study ID]

Schoen 2007

Methods	1-year follow up, randomised, parallel group study. Outcome assessor was not blinded. 8 patients (4 from each group) died at 1 year. 2 patients actually died during the healing period of the implants (1 from each group). They were considered as withdrawals
Participants	Patients with completely edentulous mandibles, treated for a first malignancy in the head and neck region (squamous cell carcinoma of the tongue, floor of the mouth, mandibular gingiva, buccal mucosa or oropharynx) with either radiotherapy or a combination of surgery and radiotherapy, having problems in retaining of their lower dentures. Exclusion criteria were not specified. Adults treated at the Head and Neck Oncology Group of the Groningen University Medical Center, the Netherlands. 26 enrolled (13 in each group) and results given for 24
Interventions	The control group received antibiotic prophylaxis (cephradine 1 g, 3 times daily during 2 weeks) starting 1 day before implant surgery, while the test group received 20 HBO treatments of 100% oxygen at 2.5 atmospheres for 80 minutes (4 periods of 20 minutes), before implant surgery, and 10 HBO identical treatments after implant surgery in addition to the antimicrobial prophylaxis as applied to the control group. Brånemark implants were placed in the interforaminal region of the mandible according to a 1-stage procedure. After 6 months bar-retained overdentures were delivered
Outcomes	Prosthesis and implant failures, perimplant marginal bone level changes on oblique lateral radiographs, postimplantation complications, plaque index, calculus, bleeding index, gingiva index, probing pocket depths, width of the attached gingiva, Periotest, functional assessment and quality of life, denture satisfaction, subjective chewing ability. Outcomes were assessed preoperatively when feasible, and 6 weeks and 1 year after placement of the prostheses
Notes	

HBO = hyperbaric oxygen

DATA AND ANALYSES

Comparison 1. HBO versus no HBO

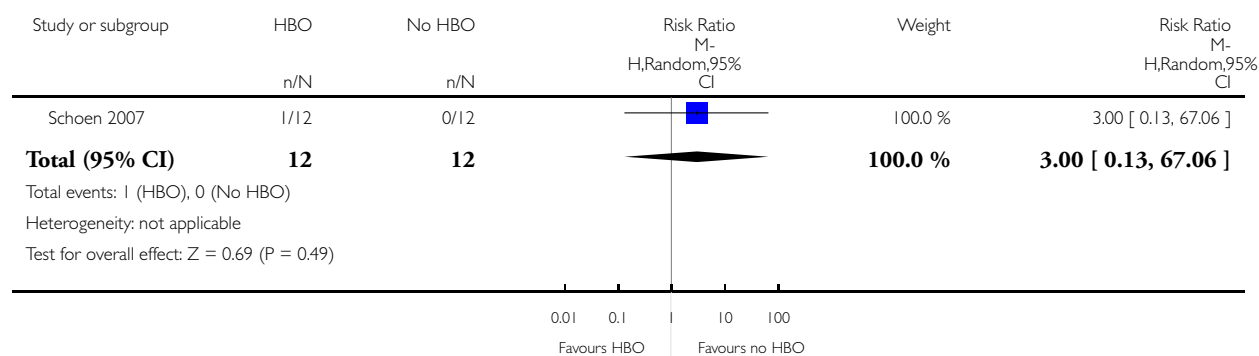
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Prosthetic failures	1	24	Risk Ratio (M-H, Random, 95% CI)	3.00 [0.13, 67.06]
2 Implant failures	1	24	Risk Ratio (M-H, Random, 95% CI)	2.5 [0.60, 10.46]
3 Preimplantation complications	1	24	Risk Ratio (M-H, Random, 95% CI)	Not estimable
4 Postimplantation complications	1	24	Risk Ratio (M-H, Random, 95% CI)	5.0 [0.27, 94.34]
5 Overall denture satisfaction	1	17	Std. Mean Difference (IV, Random, 95% CI)	-0.44 [-1.41, 0.53]

Analysis 1.1. Comparison 1 HBO versus no HBO, Outcome 1 Prosthetic failures.

Review: Interventions for replacing missing teeth: hyperbaric oxygen therapy for irradiated patients who require dental implants

Comparison: 1 HBO versus no HBO

Outcome: 1 Prosthetic failures

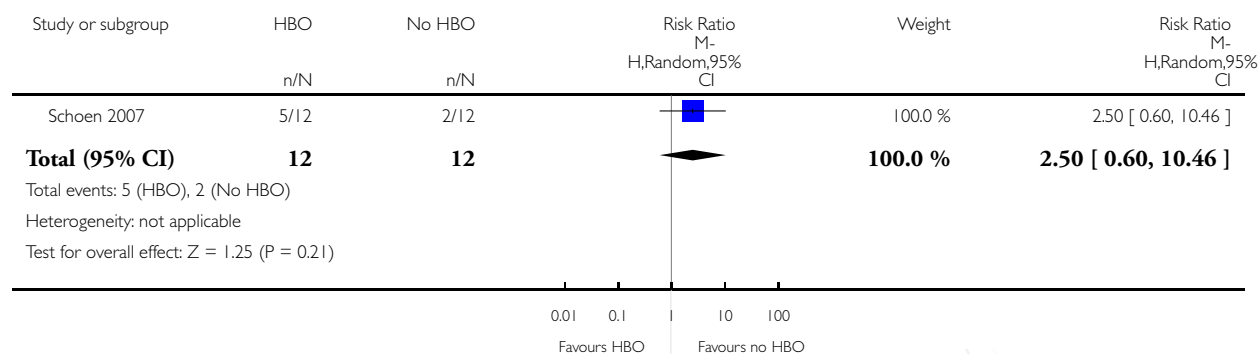


Analysis 1.2. Comparison 1 HBO versus no HBO, Outcome 2 Implant failures.

Review: Interventions for replacing missing teeth: hyperbaric oxygen therapy for irradiated patients who require dental implants

Comparison: 1 HBO versus no HBO

Outcome: 2 Implant failures

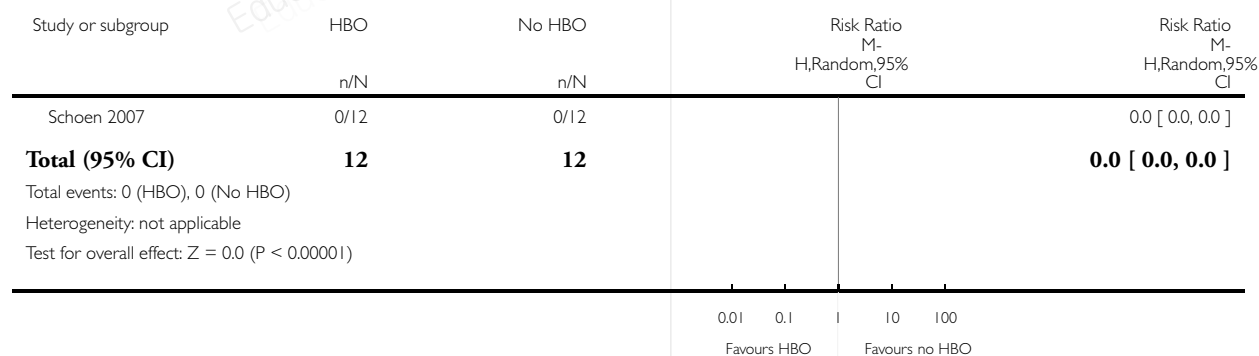


Analysis 1.3. Comparison 1 HBO versus no HBO, Outcome 3 Preimplantation complications.

Review: Interventions for replacing missing teeth: hyperbaric oxygen therapy for irradiated patients who require dental implants

Comparison: 1 HBO versus no HBO

Outcome: 3 Preimplantation complications



Analysis 1.4. Comparison 1 HBO versus no HBO, Outcome 4 Postimplantation complications.

Review: Interventions for replacing missing teeth: hyperbaric oxygen therapy for irradiated patients who require dental implants

Comparison: 1 HBO versus no HBO

Outcome: 4 Postimplantation complications

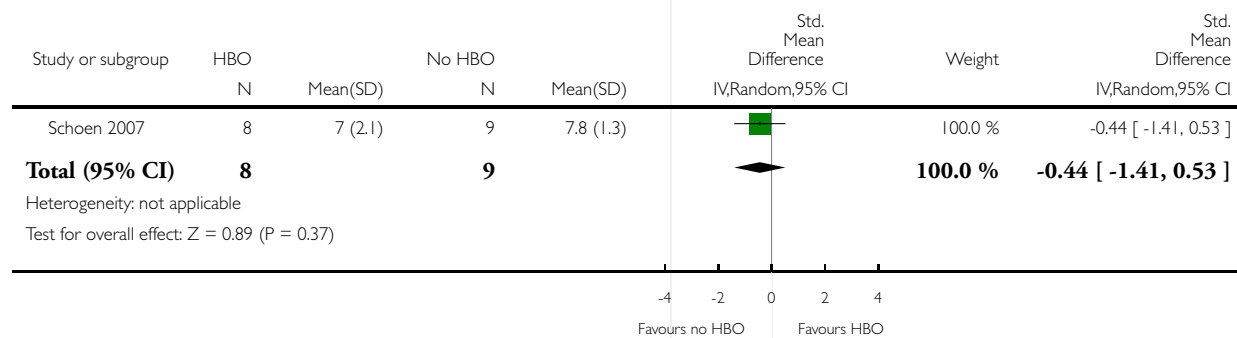


Analysis 1.5. Comparison 1 HBO versus no HBO, Outcome 5 Overall denture satisfaction.

Review: Interventions for replacing missing teeth: hyperbaric oxygen therapy for irradiated patients who require dental implants

Comparison: 1 HBO versus no HBO

Outcome: 5 Overall denture satisfaction



ADDITIONAL TABLES

Table 1. Results of quality assessment after correspondence with authors

Study	Allocation	Blinding of assessor	Withdrawals	Risk of bias
Schoen 2007	Inadequate	No	Yes	High

APPENDICES

Appendix I. MEDLINE (OVID) search strategy

1. exp Dental Implants/
2. exp Dental Implantation/ or dental implantation
3. exp Dental Prosthesis, Implant-Supported/
4. ((osseointegrated adj implant\$) and (dental or oral))
5. dental implant\$
6. (implant\$ adj5 dent\$)
7. (((overdenture\$ or crown\$ or bridge\$ or prosthesis or restoration\$) adj5 (Dental or oral)) and implant\$)
8. "implant supported dental prosthesis"
9. ("blade implant\$" and (dental or oral))
10. ((endosseous adj5 implant\$) and (dental or oral))
11. ((dental or oral) adj5 implant\$)
12. OR/1-11

WHAT'S NEW

Last assessed as up-to-date: 31 October 2007.

Date	Event	Description
12 June 2008	Amended	Converted to new review format.

HISTORY

Protocol first published: Issue 2, 2002

Review first published: Issue 3, 2002

Date	Event	Description
1 November 2007	New citation required and conclusions have changed	Substantive amendment. One randomised controlled trial (RCT) has been identified and included. Conclusions changed

CONTRIBUTIONS OF AUTHORS

Conceiving, designing and co-ordinating the review (Paul Coulthard (PC), Marco Esposito (ME)).

Developing search strategy and undertaking searches (ME, PC).

Screening search results and retrieved papers against inclusion criteria (ME, PC, Satya Patel (SP)).

Appraising quality (ME, SP).

Extracting data from papers (ME, Helen Worthington (HW), SP).

Writing to authors for additional information (ME).

Data management for the review and entering data into RevMan (HW, ME).

Analysis and interpretation of data (ME, HW).

Writing the review (ME, PC, SP).

Providing general advice on the review (HW, Maria Gabriella Grusovin (MG)).

Performing previous work that was the foundation of current study (ME, HW, PC).

DECLARATIONS OF INTEREST

None known.

SOURCES OF SUPPORT

Internal sources

- University Dental Hospital of Manchester, UK.

External sources

- No sources of support supplied

INDEX TERMS

Medical Subject Headings (MeSH)

*Dental Implants; *Hyperbaric Oxygenation; *Radiotherapy; Mouth, Edentulous [rehabilitation]

MeSH check words

Humans

Educational Purposes - Not to be Republished