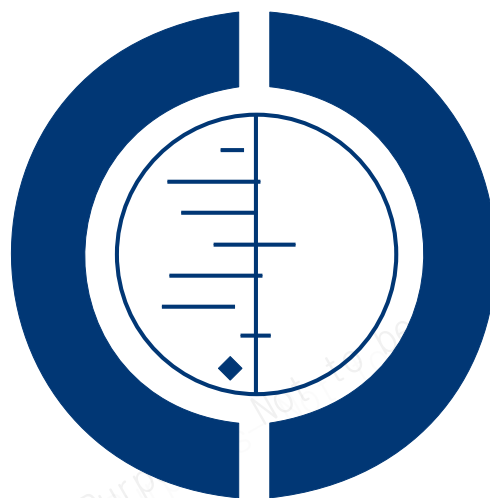


Interventions for replacing missing teeth: 1- versus 2-stage implant placement (Review)

Esposito M, Grusovin MG, Chew YS, Coulthard P, Worthington HV



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[Intervention Review]

Interventions for replacing missing teeth: 1- versus 2-stage implant placement

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ABSTRACT

Background

Implants may be placed penetrating the oral mucosa (1-stage procedure) or can be completely buried under the oral mucosa (2-stage procedure) during the healing phase of the bone at the implant surface. With a 2-stage procedure the risk of having unwanted loading onto the implants is minimized, but a second minor surgical intervention is needed to connect the healing abutments and more time is needed prior to start the prosthetic phase because of the wound-healing period required in relation to the second surgical intervention.

Objectives

To evaluate whether a 1-stage implant placement procedure is as effective as a 2-stage procedure.

Search methods

The Cochrane Oral Health Group's Trials Register, CENTRAL, MEDLINE and EMBASE were searched. Handsearching included several dental journals. Authors of all identified trials, an Internet discussion group and 55 dental implant manufacturers were contacted to find unpublished randomised controlled trials (RCTs). The last electronic search was conducted on 21 January 2009.

Selection criteria

All RCTs of osseointegrated dental implants comparing the same dental implants placed according to 1- versus 2-stage procedures with a minimum follow up of 6 months after loading. Outcome measures were: prosthesis failures, implant failures, marginal bone level changes on intraoral radiographs, patient preference including aesthetics, aesthetics evaluated by dentists, and complications.

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. Authors were contacted for missing information. 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

Five RCTs were identified and included reporting data on 239 patients in total. On a patient, rather than per implant basis, the meta-analyses showed no statistically significant differences for prosthesis and implant failures, though trends, especially in fully edentulous patients, favoured 2-stage (submerged) implants.

Authors' conclusions

The number of patients included in the trials was too small to draw definitive conclusions. The 1-stage approach might be preferable in partially edentulous patients since it avoids one surgical intervention and shortens treatment times, while a 2-stage submerged approach could be indicated when an implant has not obtained an optimal primary stability or when barriers are used for guided tissue regeneration, or when it is expected that removable temporary prostheses could transmit excessive forces on the penetrating abutments especially in fully edentulous patients.

PLAIN LANGUAGE SUMMARY

Interventions for replacing missing teeth: 1- versus 2-stage implant placement

Dental implants can be successful either if placed through the oral mucosa, sticking through the gums (1-stage procedure) or if completely buried under the soft tissues (2-stage procedure) to heal load-free for a few months. However, one additional minor surgical intervention is needed, if a 2-stage procedure is used, to allow the connection of the buried implants with the transgingival component which will hold the prosthesis in place.

The review found some evidence from five studies with 239 patients that 1- or 2-stage implant placement may have similar outcomes, though in patients with no teeth trends suggested more implant failures for those implants sticking through the gum. More research is needed to answer this question in a definitive way, but it appears possible to place dental implants following a 1-stage procedure (i.e. the implants are sticking through the gums during the bone healing period). The advantages of the 1-stage procedure are: (1) one minor surgical intervention can be avoided, and (2) the treatment time can be shortened, since it is not needed to wait for the healing/stabilization of the soft tissues after the second surgical intervention. Nevertheless there are situations when a 2-stage procedure could be preferable, for instance when a not optimal implant stability is achieved at implant placement or when there is the risk that the provisional denture transmits excessive forces to the portion of the implants sticking through the gums.

SUMMARY OF FINDINGS FOR THE MAIN COMPARISON *[Explanation]*

1-stage compared with 2-stage for placement of dental implants						
Patient or population: patients requiring dental implants Settings: hospital and private dental practices Intervention: 1-stage placement Comparison: 2-stage placement						
Outcomes	Illustrative comparative risks* (95% CI)		Relative effect (95% CI)	No of Participants (studies)	Quality of the evidence (GRADE)	Comments
	Assumed risk	Corresponding risk				
	2-stage	1-stage				
Prosthetic failure 6 to 12 months	Low risk population		RR 1.87 (0.33 to 10.40)	153 (3)	+++0 moderate quality	
	10 per 1000	19 per 1000 (3 to 104)				
	High risk population					
	100 per 1000	187 per 1000 (33 to 1040)				
Implant failure 6 to 12 months	Low risk population		RR 1.39 (0.59 to 3.27)	210 (4)	+++0 moderate quality	
	10 per 1000	14 per 1000 (6 to 32)				
	High risk population					
	200 per 1000	280 per 1000 (120 to 1000)				

*The basis for the **assumed risk** (e.g. the median control group risk across studies) is provided in footnotes. The **corresponding risk** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: Confidence interval; RR: risk ratios (relative risks); GRADE: GRADE Working Group grades of evidence (see explanations)

GRADE Working Group grades of evidence

High quality (+ + + +): Further research is very unlikely to change our confidence in the estimate of effect.

Moderate quality (+ + + 0): Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.

Low quality (+ + 00): Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.

Very low quality (+ 000): We are very uncertain about the estimate.

BACKGROUND

Missing teeth and supporting oral tissues have traditionally been replaced with dentures or bridges to restore the ability of patients to eat and speak and to improve appearance. However, in several instances, patients are not satisfied with the function of removable dentures and it is not always possible to place a fixed bridge if the number of remaining abutment teeth is insufficient. Since the 1970s, osseointegrated dental implants have offered an alternative (Brånemark 1977). They are surgically inserted into the jaw bones to support a dental prosthesis and are retained because of the intimacy of bone growth onto their surface (osseointegration). Dental implants have undoubtedly been one of the most significant scientific breakthroughs in dentistry over the past 30 years.

Traditionally to minimize implant failures, osseointegrated dental implants were inserted following a 2-stage protocol (Brånemark 1977). Implants were completely submerged under the soft tissues and left to heal for a period of 3 to 4 months in mandibles (lower jaws) and 6 to 8 months in maxillae (upper jaws). In fact, primary implant stability and lack of micromovements are considered to be two of the main factors necessary to achieve predictable high success of osseointegrated dental implants (Albrektsson 1981). A successful osseointegrated dental implant is anchored directly to bone, however, in the presence of movements during healing, the implant may be encapsulated by soft tissues instead (Brunski 1979), similarly to what happens with non-union bone fractures, causing the failure of the implant. To minimize the risk of soft tissue encapsulation, it has been recommended to keep the implants submerged and load-free during the healing period. With a 2-stage approach the risk of transmitting unwanted loading forces to the healing bone at the implant interface was minimized. However, a second surgical intervention (usually a minor one) is needed to connect the implants to the abutments holding the future prosthesis. In addition, after the second intervention, some weeks of healing are needed for the soft tissues to stabilize around the penetrating abutment to allow a predictable aesthetic outcome.

Other authors developed dental implants to be used with a 1-stage procedure (Buser 1988). With this approach flaps are sutured around the polished neck of the implants avoiding the need for a second surgical intervention. Longitudinal follow-up studies suggested that high early success rates could also be achieved using a 1-stage approach (Buser 1990; Buser 1997). Subsequent controlled clinical trials (Ericsson 1997; Collaert 1998) comparing implants placed according to a 1- versus 2-stage procedure, also suggested that implants placed with a 1-stage approach may achieve a high degree of success. It would be therefore useful to know whether there is any clinical significant difference among implants placed according to 1-stage (non-submerged) versus 2-stage (submerged) procedures.

OBJECTIVES

To test the null hypothesis of no difference between 1- versus 2-stage procedures, against the alternative hypothesis of a difference.

METHODS

Criteria for considering studies for this review

Types of studies

All randomised controlled trials (RCTs) comparing 1- versus 2-stage implant placement, including studies with parallel group and split-mouth designs.

Types of participants

Any subject receiving osseointegrated dental implants.

Types of interventions

1-stage versus 2-stage implant placement procedures. The same type of implants must be used in both groups with a minimum follow up of 6 months after loading. When possible all comparisons are presented after 1 year of implant in function.

Types of outcome measures

- Prosthesis failure if secondary to implant failure.
- Implant failures defined as implant mobility and removal of stable implants dictated by progressive marginal bone loss or infection.
 - Radiographic marginal bone level changes on intraoral radiographs taken with a parallel technique from surgical placement to 1 year in function.
 - Patient preference including aesthetics (only in split-mouth studies).
 - Aesthetics evaluated by dentists.
 - Any biological and biomechanical complication up to delivery of the implant supported prosthesis.

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 developed for MEDLINE (OVID) but revised appropriately for each database. The subject search (Appendix 1) used a combination of controlled vocabulary and free text terms and was run with the Cochrane Highly Sensitive Search Strategy (CHSSS) for identifying randomised controlled trials (RCTs) in MEDLINE: sensitivity maximising version (2008 revision) as referenced in Chapter 6.4.11.1 and detailed in box 6.4.c of the *Cochrane Handbook*

for *Systematic Reviews of Interventions* 5.0.1 (updated September 2008) (Higgins 2008).

Searched databases

The Cochrane Oral Health Group's Trials Register (to 9 January 2009) (Appendix 2).

The Cochrane Central Register of Controlled Trials (CENTRAL) (*The Cochrane Library* 2008, Issue 4) (Appendix 3).

MEDLINE (1966 to 21 January 2009) (Appendix 1).

EMBASE (1980 to 12 January 2009) (Appendix 4).

The most recent electronic search was undertaken on 21 January 2009.

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

Selection of studies

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 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 reasons for exclusion recorded.

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 was available or if agreement could not be reached.

For each trial the following data were recorded.

- Year of publication, country of origin and source of study funding.
- 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.

Assessment of bias in included studies

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.

Allocation concealment was considered adequate if it was centralised (e.g. allocation by a central office unaware of subject characteristics); pharmacy-controlled randomisation; pre-numbered 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 outcomes assessors, recorded as:

(A) Yes

(B) No

(C) Unclear

(D) Not possible.

(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.

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 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 summarize the data for each group. The statistical unit was the patient and not the implant.

Meta-analyses were done only if there were studies of similar comparisons reporting the same outcome measures. Risk ratios were combined for dichotomous data, and mean differences for continuous data, using a random-effects model. Data from split-mouth studies were to be combined with data from parallel group trials with the method outlined by Elbourne (Elbourne 2002), using the generic inverse variance method in Review Manager (RevMan). The techniques described by Follmann (Follmann 1992) were to be used to estimate the standard error of the difference for split-mouth studies, where the appropriate data were not presented and could not be obtained.

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 in the meta-analysis to undertake this.

(1) Whether turned (machined) or implants with a roughened surface were used.

(2) Whether implants were placed in partially or fully edentulous jaws.

RESULTS

Description of studies

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

Characteristics of the trial settings and investigators

All the five potentially eligible trials (Barber 1996; Heijdenrijk 2002; Cecchinato 2004; Becktor 2007; Cordaro 2009) could be included.

Two studies were conducted in Italy (Cecchinato 2004; Cordaro 2009); one in the Netherlands (Heijdenrijk 2002); one in Sweden and Norway (Becktor 2007), and one in the USA (Barber 1996). Four trials had a parallel group study design (Heijdenrijk 2002; Cecchinato 2004; Becktor 2007; Cordaro 2009) and one a split-mouth study design (Barber 1996). One study (Cecchinato 2004) was originally presented as a mixture of a parallel and split-mouth design trial and had to be excluded in the previous version of this review. Each future prosthesis (also within the same patient) was randomised to 1- or 2-stage implant placement. We requested the authors to provide only the data of the first prosthesis for each patient so the trial become of parallel group design. Since the authors kindly provided all the requested information we were able to include their trial in this review. This explains why the data presented in this review differ from the originally published data. Three trials were conducted at university or specialty dental clinics (Barber 1996; Heijdenrijk 2002; Becktor 2007) and two trials in private practices (Cecchinato 2004; Cordaro 2009). All trials received some form of support from industry. All trials included only adults.

Characteristics of the interventions

The following implant systems were used.

- IMZ cylindrical implants with a titanium plasma sprayed coating (Friedrichsfeld AG, Mannheim, Germany) were used in two trials ([Barber 1996](#); [Heijdenrijk 2002](#)).
- Astra screw shaped titanium implants with a TiO₂-blasted surface (AstraTech AB, Mölndal, Sweden) were used in one trial ([Cecchinato 2004](#)).
- Brånemark screw shaped titanium implants with a turned surface of standard and MKII types (Nobel Biocare AB, Göteborg, Sweden) were used in one trial ([Becktor 2007](#)).
- Tapered effect (TE) screw shaped titanium implants with SLA surface (Straumann Dental Implant System, Institut Straumann AG, Waldenburg, CH) were used in one trial ([Cordaro 2009](#)).

The load-free healing period after implant placement was.

- 3 to 4 months for mandibular implants ([Barber 1996](#); [Heijdenrijk 2002](#); [Becktor 2007](#)) and 6 months for maxillary implants ([Cecchinato 2004](#)).
- 3 months for both maxillary and mandibular implants ([Cordaro 2009](#)).

Characteristics of outcome measures

- Prosthesis failures (all trials).
- Implant failures (all trials).
- Radiographic marginal bone level changes on intraoral radiographs taken with a parallel technique from surgical placement to 1 year in function. Three trials presented radiographic bone level changes ([Heijdenrijk 2002](#); [Cecchinato 2004](#); [Cordaro 2009](#)), however, peri-implant bone level measurements of two trials could not be included because baseline data were collected at delivery of the prostheses ([Cecchinato 2004](#)) or 4 weeks after prosthesis delivery ([Heijdenrijk 2002](#)).
- Patient preference including aesthetics only in split-mouth studies (no trial).
- Aesthetics evaluated by dentists (one trial). One trial ([Cordaro 2009](#)) evaluated the variation in tenths of mm of the papillae and the mucosal margin, measured as the distance of the mesial and distal papilla and the adjacent tooth incisal margin and as the distance from the buccal gingival margin and the line connecting the incisal margin of the adjacent teeth, before tooth extraction and at provisional loading (12 weeks after placement), definitive loading (24 weeks after placement), and 1 year follow up. These three measurements were averaged for each tooth ([Analysis 1.4](#)).
- Complications. Three trials ([Barber 1996](#); [Becktor 2007](#); [Cordaro 2009](#)) reported complications up to delivery of the provisional or definitive implant supported prostheses. One trial ([Becktor 2007](#)) reported complications at implant level,

therefore, complications are described in the results section, but no data were imputed for this trial.

Risk of bias in included studies

See Additional [Table 1](#).

Allocation concealment

After considering the replies from the authors, the method of allocation concealment was considered adequate for two trials ([Cecchinato 2004](#); [Cordaro 2009](#)); inadequate for two trials ([Heijdenrijk 2002](#); [Becktor 2007](#)), and unclear for one trial ([Barber 1996](#)).

Blinding

After considering the replies from the authors, outcome assessors were judged to be blinded in one trial ([Cordaro 2009](#)); not to be blinded in three trials ([Barber 1996](#); [Heijdenrijk 2002](#); [Cecchinato 2004](#)), and it was unclear in one trial ([Barber 1996](#)). In one trial ([Cecchinato 2004](#)) an independent and blinded outcome assessor was used to measure bone level changes, but these data could not be used in the present review.

Completeness of follow up

After considering the replies from the authors, no drop outs occurred up to the follow up considered in this review in three trials ([Barber 1996](#); [Heijdenrijk 2002](#); [Cordaro 2009](#)). Explanations for drop outs were given in one trial ([Cecchinato 2004](#)) and not given in another trial ([Becktor 2007](#)).

Sample size

A priori sample size calculation was not performed in any of the trials. In one trial ([Cordaro 2009](#)) a post-hoc sample size calculation was performed, after the trial was completed, for the only statistically significant outcome found in the trial. The calculation was done to detect a difference of 1 mm of keratinised mucosa between the groups but insufficient information was presented.

Inclusion and exclusion criteria

Main inclusion criteria and description of interventions

- One trial ([Barber 1996](#)) included patients with bilateral free-end mandibular partial edentulism at least from the second premolar, who could be rehabilitated with two implants at each hemimandible. No mandibular provisional prostheses were used during the 3-month healing period.
- One trial ([Heijdenrijk 2002](#)) included patients with severely resorbed edentulous mandibles who were provided with two implants in the canine region to support an overdenture with clip

attachment to a bar. Patients were not allowed to wear mandibular dentures during the first 2 postoperative weeks.

- One trial (Cecchinato 2004) included healthy patients 25 to 75 years old with posterior partial edentulous jaws (first and second premolars were considered posterior teeth) to be treated with implants supporting fixed prostheses. No provisional prostheses were used during the implant healing time.
- One trial (Becktor 2007) included patients with edentulous mandibles who were provided with 4 to 6 implants to support a fixed prosthesis. Dentures were relined after 1 to 3 postoperative weeks.
- One trial (Cordaro 2009) included patients requiring a single postextractive implant in maxillary incisor, canine and premolar sites or mandibular canine and premolar sites. Vertical releasing and horizontal periosteal incisions were made to mobilize the flap to allow complete closure of the flaps in the submerged group. Provisional prostheses were used during the healing period. At implant exposure (8 weeks after implant placement) apically repositioned flaps were used.

Main exclusion criteria

- Untreated periodontitis (Cecchinato 2004; Cordaro 2009).
- Heavy clenchers or bruxers (Cecchinato 2004).
- Insufficient bone height (less than 9 mm) (Cecchinato 2004).
- A distance between the implant and the bone of the socket (only postextractive implants were included) superior to 2 mm (Cordaro 2009).
- Edentulous for less than 2 years (Heijdenrijk 2002).
- Previously irradiated jaws (Heijdenrijk 2002).
- History of preprosthetic surgery or previous oral implantology (Heijdenrijk 2002).
- Smoking more than 10 cigarettes a day (Cordaro 2009).
- Probing pocket depth more than 4 mm at adjacent teeth (Cordaro 2009).
- Adjacent implants (Cordaro 2009).
- None apart general contraindications for implant surgery and less than 20 years of age (Becktor 2007).
- Unknown exclusion criteria apart from untreated periodontal disease (Barber 1996).

Comparability of control and treatment groups at entry

For three trials it was unclear whether groups were comparable at entry (Barber 1996; Heijdenrijk 2002; Cecchinato 2004). No apparent differences between groups were noticed at entry for one trial for sex, age, implant length, bone quality and quantity (Becktor 2007).

The agreed risk of bias of the included trials after having incorporated the information provided by the authors is summarized in Additional Table 1. For each trial we assessed whether it was at

low or high risk of bias. All, but one (Cordaro 2009) trials were rated as at high risk of bias.

Effects of interventions

See: Summary of findings for the main comparison

In total 761 implants were originally placed in 239 patients. 375 implants were placed according to a 1-stage procedure in 121 patients and 386 implants according to a 2-stage procedure in 123 patients, counting twice the five split-mouth patients included in one study (Barber 1996). During the follow up considered in this review ranging from 6 months (Barber 1996; Becktor 2007) to 1 year (Heijdenrijk 2002; Cecchinato 2004; Cordaro 2009) 23 implants failed in 11 patients of the 1-stage group and nine implants failed in eight patients of the 2-stage group.

Barber 1996 (split-mouth design) compared two IMZ implants placed according to a 1-stage procedure with two IMZ implants placed according to a 2-stage procedure supporting fixed prostheses in partially edentulous mandibles for 6 months. Five patients were originally included. It is unclear whether baseline differences among the two groups existed. No withdrawals 6 months after loading. No implant failed and no biological complications were reported. There was no statistically significant difference for prosthesis or implant failures between the different procedures.

Heijdenrijk 2002 (parallel group design) compared two IMZ implants placed according to a 1-stage procedure with two IMZ implants placed according to a 2-stage procedure supporting mandibular overdentures for 1 year. Twenty patients were originally included in each group. It is unclear whether baseline differences among the two groups existed. No withdrawals 1 year after loading. One implant and its related prosthesis failed in each group. There was no statistically significant difference for prosthesis or implant failures between the different procedures.

Cecchinato 2004 (originally a mixture of parallel group and split-mouth design transformed into a parallel group-design) compared Astra implants placed in posterior jaws for 5 years. Forty-one patients received 111 implants placed according to a 1-stage procedure and 43 patients received 116 implants placed according to a 2-stage procedure. It is unclear whether baseline differences among the two groups existed. One patient of the 2-stage group dropped out (emigration) 1 year after loading. Three implants failed in three patients of the 1-stage group versus four implants in three patients of the 2-stage group. One planned prosthesis in the 1-stage group could not be placed because two implants failed. There was no statistically significant difference for prosthesis or implant failures between the different procedures.

Becktor 2007 (parallel group design) compared four to six Brånemark implants placed in fully edentulous mandibles for more than 1 year. Thirty-nine patients received 198 implants placed according to a 1-stage procedure and 41 patients received 206 implants placed according to a 2-stage procedure. No relevant baseline differences among the two groups were apparent. One pa-

tient of the 1-stage group and two patients of the 2-stage group dropped out for unknown reasons 6 months after loading. Seventeen implants failed in six patients of the 1-stage group versus five implants in four patients of the 2-stage group. No prosthesis was lost. There was no statistically significant difference for prosthesis or implant failures between the different procedures. Complications were reported but not at patient levels, no statistical calculations were made in the original paper, but complications clearly occurred more frequently in the 1-stage group.

Cordaro 2009 (parallel group design) compared one single Straumann implant placed in a postextractive socket of incisors, canines

and premolars: 14 implants were submerged and 16 implants were not. No relevant baseline differences among the two groups were apparent. No patient dropped out 1 year after loading. One implant failed in the 1-stage group (non-submerged). The only complications observed were that three 2-stage (submerged) implants demonstrated a minimal self exposure of the cover screws at abutment connection (8 weeks after implant placement). There was no statistically significant difference for prosthesis failures, implant failures, marginal bone level changes (Figure 1), complications (Figure 2), and mean tissue recessions (Figure 3) between the different procedures.

Figure 1. Forest plot of comparison: I 1- versus 2-stage implant installation, outcome: 1.3 Radiographic bone level changes.

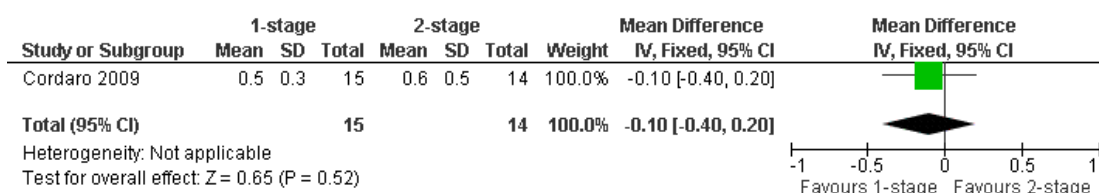


Figure 2. Forest plot of comparison: I 1- versus 2-stage implant installation, outcome: 1.5 Complications.

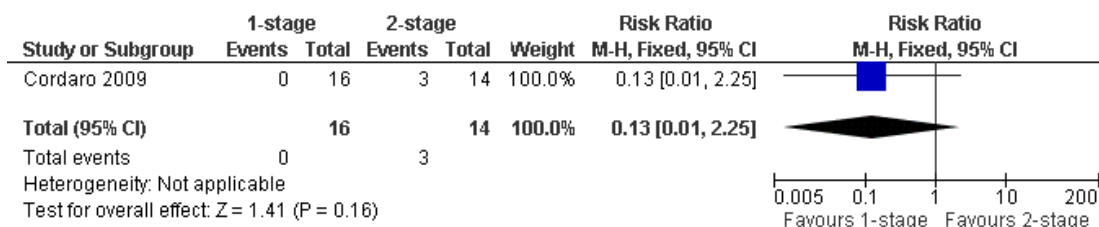
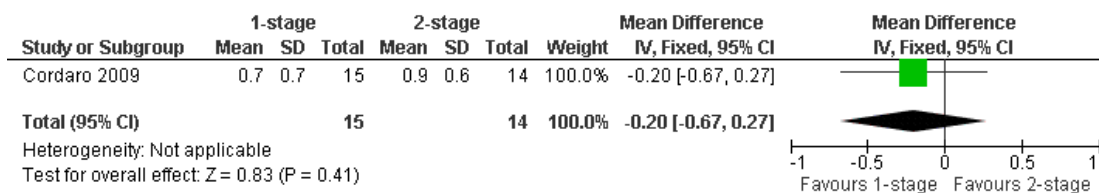


Figure 3. Forest plot of comparison: I 1- versus 2-stage implant installation, outcome: 1.4 Aesthetic (soft tissue recession).



The meta-analysis found no statistically significant differences among the two procedures for prosthesis failures (three trials) (Figure 4), implant failures (four trials) (Figure 5).

Figure 4. Forest plot of comparison: I 1- versus 2-stage implant installation, outcome: I.1 Prosthesis failure.

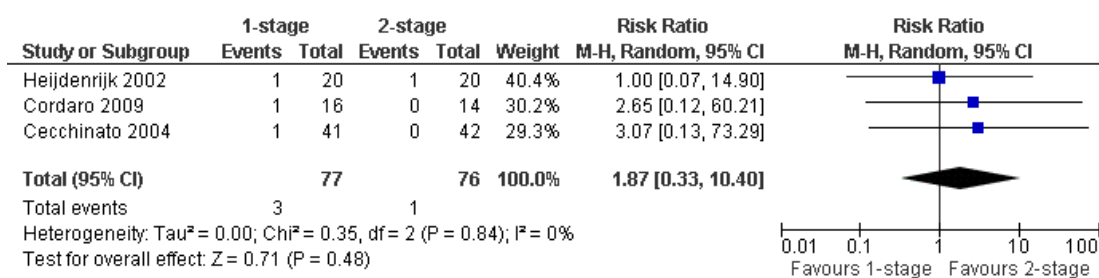
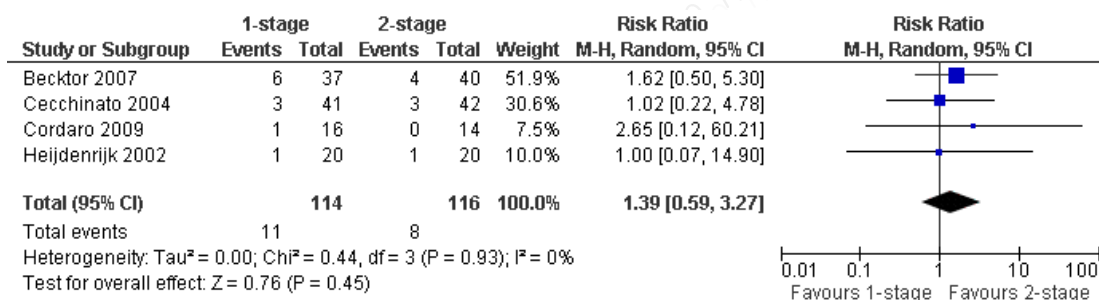


Figure 5. Forest plot of comparison: I 1- versus 2-stage implant installation, outcome: I.2 Implant failure.



DISCUSSION

Five trials were included in the present review, however only three trials (Heijdenrijk 2002; Cecchinato 2004; Cordaro 2009) could be used to evaluate failures of the prostheses (because no prosthesis failed in the remaining two trials). Four trials (Heijdenrijk 2002; Cecchinato 2004; Becktor 2007; Cordaro 2009) could be included in a meta-analysis evaluating implant failures. In addition, all but one of the included trials were considered at high risk of bias, therefore the evidence is not sufficient to draw reliable conclusions. Taken the results of all trials in consideration, it might be inferred with caution that no major clinical differences exist among the two procedures, though these preliminary findings need to be confirmed by more robust trials. When looking at

the absolute number of failed implants, it can be observed that in one trial comparing four to six implants in edentulous mandibles more failures of implants placed with a 1-stage occurred (Becktor 2007). In particular, 17 implants failed in six patients of the 1-stage group versus five implants in four patients of the 2-stage group, and these figures bear important clinical implications. Several factors could have played a role, but the most likely explanation for increased failure rates in edentulous patients when placing implants according to a 1-stage procedure could be that dentures transmitted excessive loading on the healing abutments while the osseointegration process was taking place. A possible contributing factor could be the surface characteristics of the used implants (machined or turned implant surface). In fact it has been hypothesised that implants with a turned surface may be at higher risk for early implant failures (Esposito 2007b) and this risk could be

even increased if these implants are loaded during the bone healing period.

Peri-implant marginal bone level changes were evaluated in three trials (Heijdenrijk 2002; Cecchinato 2004; Cordaro 2009). However the baseline measurements were taken at delivery of the prostheses (Cecchinato 2004) or 1 month after the delivery of the overdentures (Heijdenrijk 2002), after the effect, if any, of submerging or not the implant had taken place. It would have been more useful to use the time of implant placement as baseline, when possible differences, if any, were more likely to be spotted. The only trial that was possible to include did not show any significant difference in bone loss between the two procedures (Cordaro 2009).

Three trials (Barber 1996; Becktor 2007; Cordaro 2009) reported complications. One trial (Barber 1996) was not informative since only included five patients and no complication occurred. One study (Cordaro 2009) specifically included patients treated with single immediate postextractive implants and reported three minor complications all occurring in the 2-stage group. Three minor soft tissue dehiscences developed exposing part of the implant cover screws. While this complication can only occur at implants placed according to a 2-stage technique, they might have been more frequent than usual (in more than 20% of the implants) because of the nature of the implant sites included in the study. In fact, only postextractive sites were included and flaps had to be mobilised and stretched to cover the implant head. Under these circumstances soft tissue exposures are more likely to occur. More interesting information was presented in the other trial (Becktor 2007) since more complications occurred. This multicentre trial included 77 patients with edentulous mandibles and complications were described with sufficient detail, but were not presented at patient level, therefore data on complications could not be imputed in the meta-analysis. The impression was that there were much more complications up to abutment connection in the 1-stage group (i.e. soft tissue reactions: 13 versus 2; pain: 18 (in six patients) versus none; non-specified other complications: 13 versus 3).

Aesthetic outcomes were reported only in one trial (Cordaro 2009). There were no differences in soft tissue recession around postextractive single implants when using a submerged or non-submerged technique. The authors also evaluated changes in keratinised tissue height and found that at the 1-year follow up there was statistically significant less keratinised tissue (1.1 mm) around implants placed according to a 2-stage technique. While this finding applies to postextractive sites since flaps have to be mobilised to close the socket, thus moving the mucosal junction coronally, it is unlikely to apply in non-postextractive sites when no tissues have to be mobilised.

Generalization of the present findings can be done to other settings, keeping in mind the limited amount of available evidence and that there might be a potential increased risk to have early

implant failures and complications when using 1-stage implants in edentulous jaws (Becktor 2007). On the other hand, 1-stage implant placement appears to provide very good results in partially edentulous patients, shortening treatment time and decreasing patient morbidity. When a dentist is faced with the dilemma of submerging or not the implants, some considerations could be made: in case of poor implant stability a submerged technique may be recommendable. In case of excellent implant stability (implants placed with insertion torque > 32 Ncm), implants can be left healing according to a 1-stage procedure but an immediate loading technique could be considered as well (Esposito 2009). In case that it is expected that a provisional prosthesis could transmit excessive forces on the healing implants, it might be preferable to opt for a more conservative 2-stage procedure.

AUTHORS' CONCLUSIONS

Implications for practice

The number of patients included in the trials was too small to draw definitive conclusions. No statistically significant differences were observed between the two procedures, however trends suggested less implant failures with the 2-stage (submerged) approach especially in fully edentulous patients. If these findings are confirmed by larger trials, the major clinical implication will be that the 1-stage approach might be preferable in partially edentulous patients since it avoids one surgical intervention and shortens treatment times. However, there might be situations, for instance when an implant has not obtained an optimal primary stability or when barriers are used for guided tissue regeneration, or when it is expected that removable temporary prostheses could transmit excessive forces on the penetrating abutments especially in fully edentulous patients, where a 2-stage submerged approach might be still preferable.

Implications for research

More randomised controlled trials with a larger number of patients are needed to confirm these preliminary findings. If peri-implant marginal bone level changes on intraoral radiographs are used as an outcome measure, it may be useful to use radiographs taken just after implant placement as baseline measurement. Possible complications should also be thoroughly reported, and aesthetic outcomes could also be evaluated to see whether one of the procedures offers some advantages over the other.

ACKNOWLEDGEMENTS

We wish to thank Anne Littlewood and Sylvia Bickley (Cochrane Oral Health Group) for their assistance with literature searching; Luisa Fernandez Mauleffinch and Philip Riley (Cochrane Oral Health Group) for their help with the preparation of this review;

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* *Indicates the major publication for the study*

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Barber 1996

Methods	6-month follow up, randomised, split-mouth group study. Unclear whether outcome assessor was blinded or not. No withdrawals at 6 months
Participants	Patients with bilateral free-end lower jaws distal at least to the second premolars. Exclusion criteria were any sign of periodontal disease or contraindication to implant surgery. Adults treated in the university dental clinic of the School of Dental Medicine, University of Pennsylvania, USA. 5 patients enrolled and results given for 5 at 6 months
Interventions	2 implants placed according to a 1-stage procedure versus 2 implants placed according to a 2-stage procedure. The healing period was 3 months for both groups during which no provisional prostheses were allowed. IMZ (Friedrichsfeld AG, Mannheim, Germany) TPS titanium cylinders were used
Outcomes	Prosthesis/implant failures, Periotest, inflammation, gingival hyperplasia, gingival recession, plaque index, gingival index, calculus index, keratinised tissue width. 6-month data used
Notes	

Becktor 2007

Methods	3-year follow up (possibly), multicentre, randomised, parallel group study. Outcome assessors were not blinded. 3 withdrawals at 6 months for unknown reasons: 2 patients from the 1-stage group and 1 patient from the 2-stage group
Participants	Patients with edentulous mandibles. Exclusion criteria were general contraindication to implant surgery and age less than 20 years. Adults treated in 9 Swedish and Norwegian specialist and university clinics. 80 patients enrolled (41 patients in the 1-stage and 39 in the 2-stage group) and results given for 77
Interventions	4 to 6 implants placed according to a 1-stage or 2-stage procedure. The healing period was 3-4 months for both groups. Provisional dentures were allowed after 1-3 weeks of healing. Brånemark screw shaped titanium implants with a turned surface (Nobel Biocare AB, Göteborg, Sweden) were used
Outcomes	Prosthesis and implant failures, any type of complications. 6-month data used
Notes	

Cecchinato 2004

Methods	5-year follow up, multicentre, randomised trial of hybrid design (both parallel group and split-mouth design). With the assistance of the authors the split-mouth data were eliminated allowing the inclusion of the trial as a parallel group design. Outcome assessors were not blinded apart from radiographic evaluation (data not used). 1 withdrawal at 1 year from the 2-stage group for emigration
Participants	Healthy patients 25 to 75 years old with posterior partial edentulous jaws (first and second premolars were considered posterior teeth) to be treated with implants supporting fixed prostheses. Exclusion criteria were untreated periodontitis, mucosal and bone tissue lesions, heavy clenching and bruxism, less than 9 mm of bone in vertical height. Adults

Cecchinato 2004 (Continued)

	treated possibly in 5 Italian private practices. 84 patients enrolled (41 patients in the 1-stage and 43 in the 2-stage group) and results given for 83 at 1 year
Interventions	2 to 4 implants placed according to a 1-stage or 2-stage procedure and left to heal for 3 months in mandibles and 6 months in maxillae. No provisional prostheses were used during the healing time. Astra Ti screw shaped titanium implants with a TiO ₂ -blasted surface (AstraTech AB, Mölndal, Sweden) were used
Outcomes	Prosthesis and implant failures, marginal bone level changes on standardised intraoral radiographs, soft tissue inflammation, and plaque. The baseline measurements were taken at insertion of the provisional prostheses. 1-year data used
Notes	

Cordaro 2009

Methods	1-year follow up, multicentre, randomised, parallel group study. Outcome assessors were blinded. No withdrawals at 1 year
Participants	Patients requiring 1 immediate postextractive implant in maxillary incisors, canines and premolars and mandibular canines and premolars. Exclusion criteria were any systemic diseases that could interfere with implant therapy, uncontrolled periodontitis, probing pocket depth greater than 4 mm at the adjacent teeth, inadequate oral hygiene, smoking more than 10 cigarettes per day, adjacent implants, and a space larger than 2 mm between the implant surface and the socket bony wall. Adults treated in 2 Italian private practices in Rome and Turin. 30 patients enrolled (16 in the 1-stage group and 14 in the 2-stage group) and results given for 30 at 1 year
Interventions	1 postextractive implant that could be randomised either to be submerged (vertical releasing and horizontal periosteal incisions were made to mobilise the flaps to allow complete implant coverage; at implant exposure, 8 weeks after implant placement, apically repositioned flaps were used) or non-submerged (a healing abutment was placed and flaps were adapted to it). Provisional prostheses were used during healing. Provisional crowns were delivered 12 weeks after implant placement, followed by definitive crowns 12 weeks later. Tapered effect (TE) screw shaped titanium implants with SLA surface (Straumann Dental Implant System, Institut Straumann AG, Waldenburg, CH) were used
Outcomes	Prosthesis and implant failures, marginal bone level changes on intraoral radiographs, plaque, bleeding on probing, height of keratinised tissue, variations in soft tissue position (recession). 1-year data used
Notes	

Heijdenrijk 2002

Methods	5-year follow up, randomised, parallel group study. Outcome assessor was not blinded. No withdrawals at 1 year
Participants	Patients with resorbed edentulous mandibles for more than 2 years. Exclusion criteria were previous history of radiotherapy in the head and neck region, and preprosthetic surgery or previous oral implantology. Adults treated in the university dental clinic of the University of Groningen, the Netherlands. 40 patients enrolled (20 in each group) and results given for 40 at 1 year

Heijdenrijk 2002 (Continued)

Interventions	2 implants placed according to a 1-stage procedure versus 2 implants placed according to a 2-stage procedure. The healing period was 3 months for both groups. Provisional dentures were allowed after 2 weeks of healing. IMZ (Friedrichsfeld AG, Mannheim, Germany) TPS titanium cylinders were used
Outcomes	Prosthesis/implant failures, Periotest, marginal bone level changes on standardised intraoral radiographs, plaque index, gingival index, bleeding index, probing pocket depth, microbiological evaluation. 1-year data used. The baseline measurements were taken 4 weeks after the delivery of the implant-supported prostheses
Notes	

Educational Purposes - Not to be Republished

DATA AND ANALYSES

Comparison 1. 1- versus 2-stage implant installation

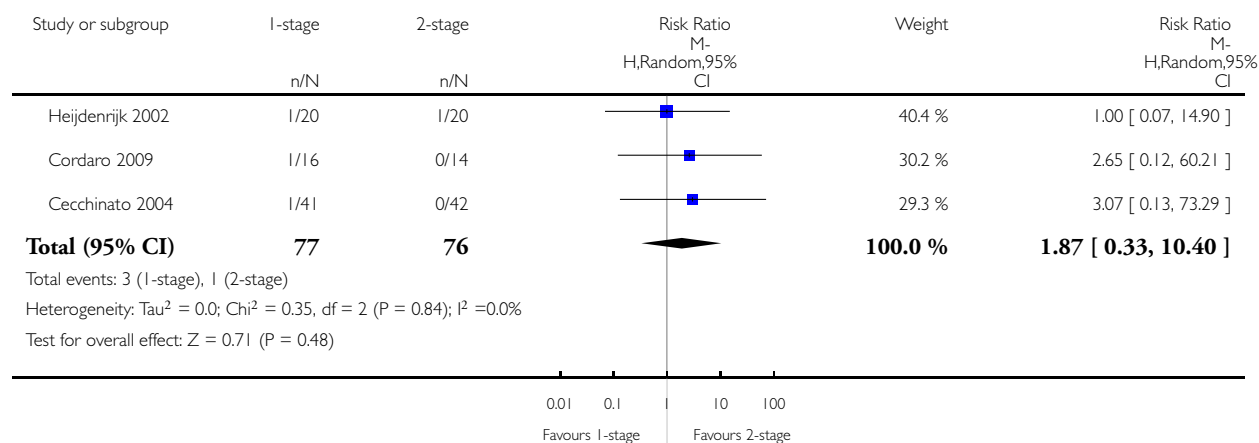
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Prosthesis failure	3	153	Risk Ratio (M-H, Random, 95% CI)	1.87 [0.33, 10.40]
2 Implant failure	4	230	Risk Ratio (M-H, Random, 95% CI)	1.39 [0.59, 3.27]
3 Radiographic bone level changes	1	29	Mean Difference (IV, Fixed, 95% CI)	-0.10 [-0.40, 0.20]
4 Aesthetic (soft tissue recession)	1	29	Mean Difference (IV, Fixed, 95% CI)	-0.20 [-0.67, 0.27]
5 Complications	1	30	Risk Ratio (M-H, Fixed, 95% CI)	0.13 [0.01, 2.25]

Analysis 1.1. Comparison 1 1- versus 2-stage implant installation, Outcome 1 Prosthesis failure.

Review: Interventions for replacing missing teeth: 1- versus 2-stage implant placement

Comparison: 1 1- versus 2-stage implant installation

Outcome: 1 Prosthesis failure

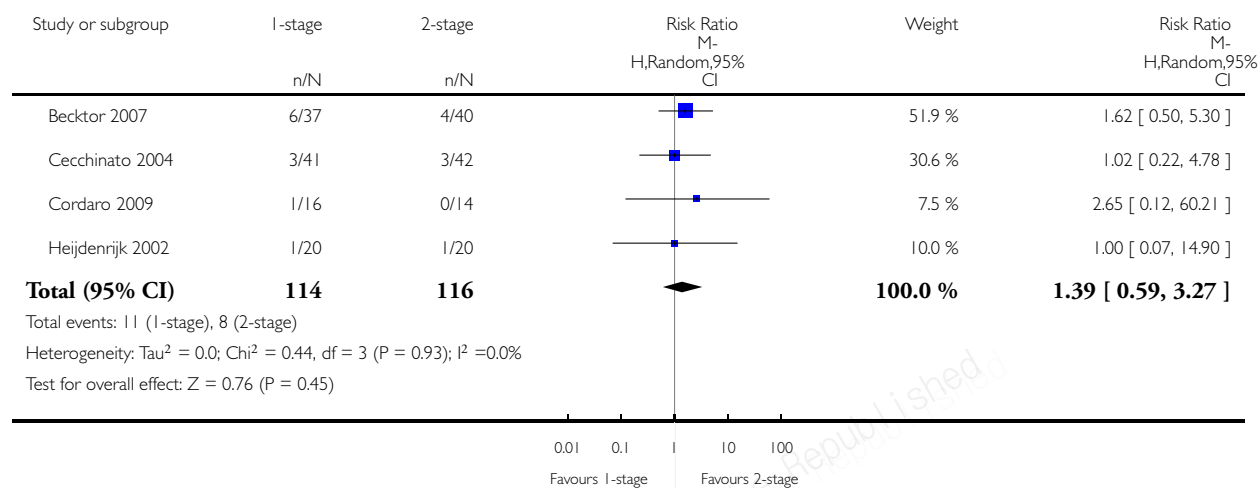


Analysis 1.2. Comparison 1 I- versus 2-stage implant installation, Outcome 2 Implant failure.

Review: Interventions for replacing missing teeth: I- versus 2-stage implant placement

Comparison: 1 I- versus 2-stage implant installation

Outcome: 2 Implant failure

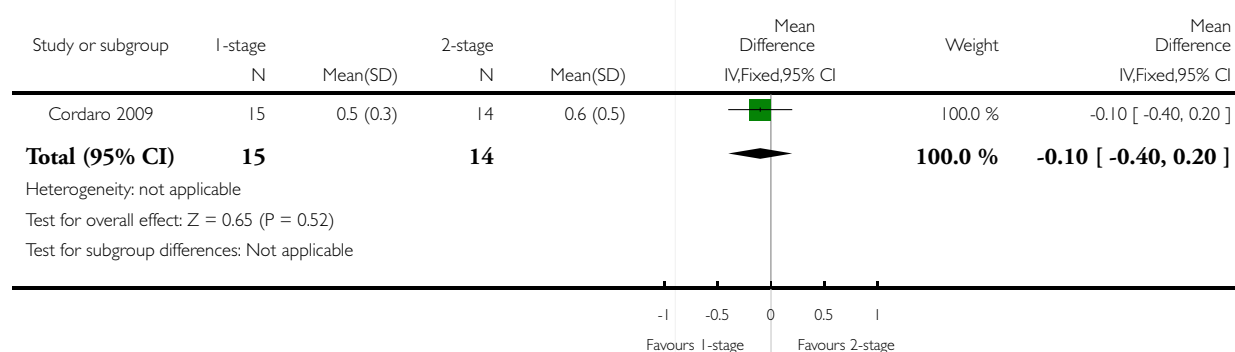


Analysis 1.3. Comparison 1 I- versus 2-stage implant installation, Outcome 3 Radiographic bone level changes.

Review: Interventions for replacing missing teeth: I- versus 2-stage implant placement

Comparison: 1 I- versus 2-stage implant installation

Outcome: 3 Radiographic bone level changes

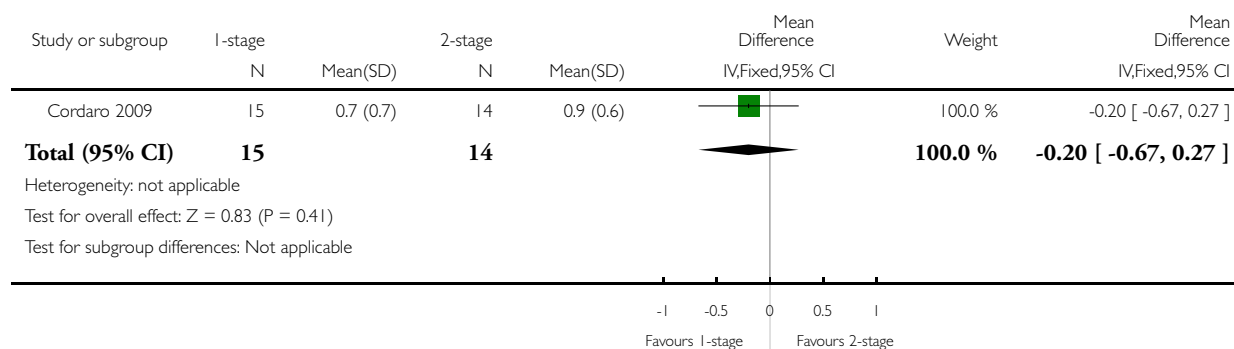


Analysis 1.4. Comparison 1 I- versus 2-stage implant installation, Outcome 4 Aesthetic (soft tissue recession).

Review: Interventions for replacing missing teeth: I- versus 2-stage implant placement

Comparison: 1 I- versus 2-stage implant installation

Outcome: 4 Aesthetic (soft tissue recession)

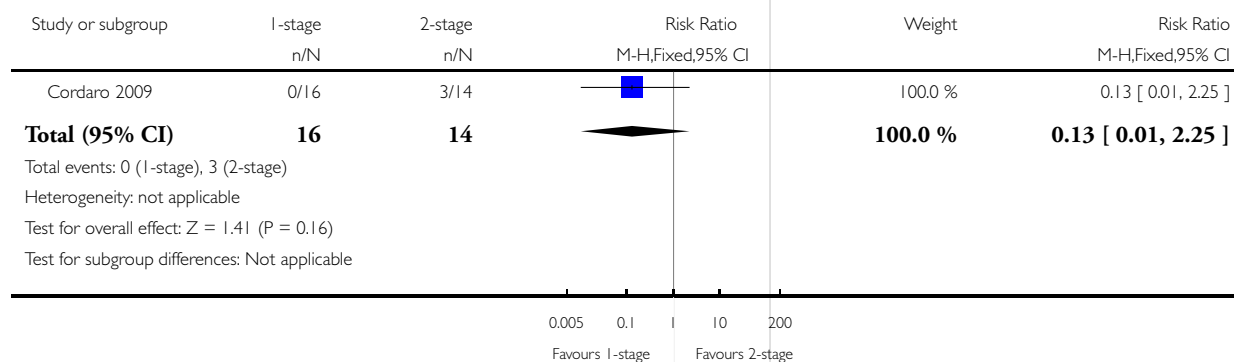


Analysis 1.5. Comparison 1 I- versus 2-stage implant installation, Outcome 5 Complications.

Review: Interventions for replacing missing teeth: I- versus 2-stage implant placement

Comparison: 1 I- versus 2-stage implant installation

Outcome: 5 Complications



ADDITIONAL TABLES

Table 1. Results of quality assessment after correspondence with authors

Study	Allocation concealment	Blinding	Withdrawals	Risk of bias
Barber 1996	Unclear	Unclear	None	High
Heijdenrijk 2002	Inadequate	No	None	High
Cecchinato 2004	Adequate	Only for radiographs, data not used	Reasons given	High
Beckor 2007	Inadequate	No	No reasons given	High
Cordaro 2009	Adequate	Yes	None	Low

APPENDICES

Appendix 1. 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

Appendix 2. Cochrane Oral Health Group's Trials Register search strategy

(dental-implants OR "dental implant*" OR "oral implant*" OR dental-implantation OR dental-prosthesis-implant-supported OR "implant supported" OR "implant supported prosthesis" OR dental-implantation-endosseous-endodontic OR "endosseous implant*" OR blade-implantation OR "blade implant*" OR (implant* AND (oral OR dental)) or dental-implantation-subperiosteal OR "subperiosteal implant" OR (implant* AND overdenture*) OR ((overdenture* OR crown* OR bridge* OR prosthesis OR prostheses OR restoration*) AND ("dental implant*" OR "Oral implant" OR (zygoma* AND implant*))))

Appendix 3. CENTRAL search strategy

- #1 DENTAL IMPLANTS explode all trees (MeSH)
- #2 DENTAL IMPLANTATION explode all trees (MeSH)
- #3 DENTAL PROSTHESIS IMPLANT-SUPPORTED single term (MeSH)
- #4 ((osseointegrat* near implant*) and (dental* or oral*))
- #5 (dental next implant*)
- #6 (implant* near dent*)
- #7 dental-implant*
- #8 ((overdenture* near dental*) and implant*)
- #9 ((overdenture* near oral*) and implant*)
- #10 ((crown* near dental*) and implant*)
- #11 ((crown* near oral*) and implant*)
- #12 ((bridge* near dental*) and implant*)
- #13 ((bridge* near oral*) and implant*)
- #14 ((prosthesis near dental*) and implant*)
- #15 ((prosthesis near oral*) and implant*)
- #16 ((protheses near dental*) and implant*)
- #17 ((protheses near oral*) and implant*)
- #18 ((restoration* near dental*) and implant*)
- #19 ((restoration* near oral*) and implant*)
- #20 (implant next supported next dental next prosthesis)
- #21 (blade next implant*)
- #22 ((endosseous near implant*) and dental)
- #23 ((endosseous near implant*) and oral*)
- #24 ((dental* near implant*) or (oral* near implant*))
- #25 (#1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20 or #21 or #22 or #23 or #24)

Appendix 4. EMBASE (OVID) search strategy

1. tooth implantation/
2. ((implant-supported or implant\$) adj support\$).mp. [mp=title, abstract, subject headings, drug trade name, original title, device manufacturer, drug manufacturer name]
3. ((osseointegrated adj implant\$) and (dental or oral)).mp. [mp=title, abstract, subject headings, drug trade name, original title, device manufacturer, drug manufacturer name]
4. ((dental implant\$ or dental-implant or implant\$) adj (dent\$ or oral or tooth)).mp. [mp=title, abstract, subject headings, drug trade name, original title, device manufacturer, drug manufacturer name]
5. (((overdenture\$ or crown\$ or bridge\$ or prosthesis or protheses or restoration\$) adj5 (dental or oral)) and implant\$).mp. [mp=title, abstract, subject headings, drug trade name, original title, device manufacturer, drug manufacturer name]
6. "implant supported dental prosthesis".mp. [mp=title, abstract, subject headings, drug trade name, original title, device manufacturer, drug manufacturer name]
7. ("blade implant\$" and (dental or oral or tooth or teeth)).mp. [mp=title, abstract, subject headings, drug trade name, original title, device manufacturer, drug manufacturer name]
8. ((endosseous adj5 implant\$) and (dental or oral or tooth or teeth)).mp. [mp=title, abstract, subject headings, drug trade name, original title, device manufacturer, drug manufacturer name]
9. ((dental or oral or tooth or teeth) and implant\$).mp. [mp=title, abstract, subject headings, drug trade name, original title, device manufacturer, drug manufacturer name]
10. or/1-9

The EMBASE subject search was run with the following sensitive search for controlled trials in EMBASE via OVID:

1. random\$.ti,ab.
2. factorial\$.ti,ab.
3. (crossover\$ or cross over\$ or cross-over\$).ti,ab.

4. placebo\$.ti,ab.
5. (doubl\$ adj blind\$).ti,ab.
6. (singl\$ adj blind\$).ti,ab.
7. assign\$.ti,ab.
8. allocat\$.ti,ab.
9. volunteer\$.ti,ab.
10. CROSSOVER PROCEDURE.sh.
11. DOUBLE-BLIND PROCEDURE.sh.
12. RANDOMIZED CONTROLLED TRIAL.sh.
13. SINGLE BLIND PROCEDURE.sh.
14. or/1-13
15. ANIMAL/ or NONHUMAN/ or ANIMAL EXPERIMENT/
16. HUMAN/
17. 16 and 15
18. 15 not 17
19. 14 not 18

WHAT'S NEW

Last assessed as up-to-date: 15 April 2009.

Date	Event	Description
17 September 2009	Amended	Minor edit.

HISTORY

Protocol first published: Issue 3, 2007

Review first published: Issue 3, 2007

Date	Event	Description
9 March 2009	New citation required but conclusions have not changed	Change of review authors. 3 new included studies.
9 March 2009	New search has been performed	New searches: January 2009.
12 June 2008	Amended	Converted to new review format.

CONTRIBUTIONS OF AUTHORS

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

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

Screening search results and retrieved papers against inclusion criteria (ME, Maria Gabriella Grusovin (MG), Yun Shane Chew (YSC)).

Appraising quality (ME, MG, YSC).

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

Writing to authors for additional information (ME, HW).

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

Analysis and interpretation of data (ME, HW, MG).

Writing the review (ME).

Providing general advice on the review (MG, PC).

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

DECLARATIONS OF INTEREST

None known.

SOURCES OF SUPPORT

Internal sources

- The University of Manchester, UK.

External sources

- No sources of support supplied

DIFFERENCES BETWEEN PROTOCOL AND REVIEW

None.

NOTES

This review derives from the original review 'Interventions for replacing missing teeth: surgical techniques for placing dental implants'. At the time only one eligible randomised controlled trial (RCT) (Barber 1996) was identified but was excluded. The same RCT is now included.

INDEX TERMS

Medical Subject Headings (MeSH)

*Dental Implants; Dental Implantation [*methods]; Gingiva [*surgery]; Jaw, Edentulous [*rehabilitation]; Mandible; Mouth Mucosa [*surgery]; Randomized Controlled Trials as Topic

MeSH check words

Humans

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