Evidence Summary

Intervention for replacing missing teeth: Different types of implants - evidence summary of updated Cochrane review

Balendra Pratap Singh, Hemant Jivanani
Department of Prosthodontics, King George’s Medical University, Lucknow, Uttar Pradesh, India

INTRODUCTION

Cochrane database of systematic reviews, published by the Cochrane Library provides the gold standard evidence for intervention, diagnosis, etc., The standard of systematic review is maintained by uniform criteria of the research question, selection of studies, and data analysis including interpretation. After publishing in the database, each systematic review has to be updated every 2 years to include studies if followed the inclusion and exclusion criteria.

Although the prevalence of tooth loss is decreasing,[1,2] a large proportion of patients visiting the dentists consist of partially or completely edentulous patients. Osseointegrated dental implants have revolutionized the treatment of these...
patients. They can be used to treat a variety of patients ranging from single tooth loss to complete oral rehabilitation. Dental implants have shown promising success rate and have now become a routine treatment when dealing with the replacement of teeth. However, as the use of dental implants is increasing, so is the research. Around 1300 different types of dental implants are available worldwide, with their manufacturers claiming their implants to be more successful than others. The clinicians are put in a perplexing situation to decide the ideal body shape of the implant, the ideal platform design, the ideal surface of the implant or the ideal material of the implant.

It is important for the clinician to understand the difference between the facts and the marketing gimmicks by various implant manufacturers. This updated Cochrane review presents evidence-based guidelines regarding different types of implants and their comparison in terms of various surface preparations, different shapes, and different materials. It attends to the question “whether the different surface modifications or coatings or different shapes of implants or different implant materials lead to better clinical outcomes?”

METHODOLOGY

The Cochrane handbook for systematic reviews of interventions is used as a guide to form the methodology of this review. Randomized controlled trials (RCTs) of the parallel group and split-mouth design in participants who received osseointegrated root form dental implants with at least 1-year of follow-up were included in this review. Comparison was done between identical implants placed following the same protocol, but differing only in terms of (1) surface modification or (2) implant shape or (3) implant material or (4) any combination of these. Nonrandomized/quasi-randomized trials were excluded. The primary outcome was described in terms of biological or mechanical failure, and the occurrence of periimplantitis was the secondary outcome.

Electronic search was conducted in the Cochrane Oral Health Group’s Trial Register, the Cochrane Central Register of Controlled Trials, MEDLINE through Ovid and EMBASE via Ovid; without any language filter, until January 17, 2014. A hand search of selected journals was also conducted. The titles and abstracts of the reports identified through electronic and hand search were scanned by two independent reviewers and full report to check if they met the inclusion criteria. Any disagreement was resolved by discussion and contacting a third reviewer. Data extraction forms were modified as needed and used to collect data. The risk of bias assessment was done using the recommended approach for Cochrane reviews. Risk ratio and 95% confidence interval (CI) were used to describe the measurement of treatment effect for dichotomous data and mean difference along with 95% CI was used for continuous outcomes. Heterogeneity assessment and sensitivity analyses were performed as per the Cochrane handbook for systematic reviews of interventions.

Eighty-one trials were identified in the search; however, most of them were nonrandomized or quasi-randomized studies, and many studies had a short follow-up, or the data were presented in an unusable way. Twenty-seven RCTs with either parallel group design or split mouth design, which met the inclusion criteria, were included in the review [Tables 1 and 2].

Critical analysis of included trials

Critical analysis of the included trials revealed that most of the studies were at unclear risk of bias for allocation concealment and low-risk of bias for sequence generation while a considerable number of studies were at high-risk of bias for blinding. Meta-analysis was performed among studies of similar comparisons reporting the same outcome measures. However, a sensitivity analyses could not be performed due to the lack of a sufficient number of trials in the meta-analyses. The severity of the risk of bias on the final results could not be assessed due to the lack of sensitivity analyses.

SUMMARY OF FINDINGS

Based on the data from the included trials, this Cochrane review failed to show any superiority of a particular implant surface, shape or material over others in terms of implant failure and bone level changes. The review found 81 trials during the search but, only 27 fulfilled the inclusion criteria which clearly indicates a lack of properly designed and reported RCTs. Even after an extensive review and a meta-analysis, a definitive guideline on which implant system should be chosen by the clinician could not be established. Nonetheless, it did become clear from the review that clinical outcomes are not significantly altered by various modifications put forth by different manufacturers. However, a strong evidence to support this statement is still missing [Table 3]. The review did fulfill its secondary objective and found weak evidence that roughened dental implants are more susceptible to periimplantitis than turned implants [Tables 4 and 5].

Future implications and research

A very prominent fact that came to light in the review was that only one-third of the searched trials (27/81) met the inclusion criteria. Those that did meet the inclusion criteria were at unclear or high-risk of bias. The number of
| Study | Design | Implants compared | Prosthesis | Follow-up period | Outcome | Risk ratio | Finding |
|-------|--------|-------------------|------------|-----------------|---------|------------|---------|
| Froberg 2006 | Randomized split mouth study | Brånemark Mark III implants: Turned versus oxidized surface (TiUnite) | Screw retained cross arch fixed prosthesis | 1.5 years | Implant failure (1-year) | - | No implant failures |
| Schincaglia 2007 | Randomized split mouth study | Brånemark Mark IV implants: Turned versus oxidized surface (TiUnite) | Immediately loaded, screw retained partially fixed prosthesis | 3 years | Implant failure | RR=0.33 (0.82−7.32) | Turned=0/10 Oxidized=1/10 |
| | | | | | Bone level | MD=0.11 (−0.38−0.60) | Turned=1.06±0.18 mm Oxidized=0.92±0.649 mm |
| | | | | | Bone level | MD=−0.15 (−0.56−0.26) | - |
| Heberer 2011 | Randomized split-mouth design | ITI regular neck: SLA standard versus SLActive surface | Early loaded at 6 weeks in mandibles and at 10 weeks in maxillas with 16 bar-supported overdentures and 4 fixed prostheses | 14 months | Implant failure (1-year) | RR=5.00 (0.26−98.00) | SLA standard=2/20 SLActive=0/20 |
| Esposito 2012 | Randomized parallel group study | MegaGen EZ Plus implants with blasted surface: Standard versus calcium-incorporated (Xpeed) surface | Early loaded screw-retained fixed prosthesis | 1-year | Implant failure (1-year) | Bone level | MD=0.04 (−0.13−0.21) | Xpeed Mean=−0.58, SD=0.31, 30 participants Standard Mean=−0.62, SD=0.36, 30 participants |
| | | | | | Bone level | MD=0.11 (−0.38−0.60) | P=0.66 |
| | | | | | Bone level | MD=−0.15 (−0.56−0.26) | P=0.48 |
| Esposito 2013a | Randomized split-mouth design | SPI element implants with SLA surface: Standard versus SurfLink-modified surface | Conventionally loaded cemented single implant crowns | 1-year | Implant failure (1-year) | Bone level | SurfLink Mean=−1.09, SD=0.76, 21 participants Element Mean=−1.36, SD=0.86, 21 participants | MD=0.27 (−0.01−0.55) P=0.0.057 |
| Lee 2007 | Randomized split-mouth design | Astra cylindrical versus Astra conical implants | Placed adjacent to each other and restored as a 2 unit fixed prosthesis | 3 years | Implant failure | - | No failures |
| Song 2009 | Randomized split-mouth design | Implantium microthreads at the top versus Implantium microthreads 0.5 mm below the top | Placed adjacent to each other and restored as a 2 unit fixed prosthesis | 1-year | Implant failure | - | No failures |
| Gatti 2002 | Randomized parallel group study | Brånemark Mark II type versus Brånemark conical transmucosal implants | Overdentures supported on 4 implants connected with bar | 2 years | Implant failure | - | No failures |
| Lang 2007 | Randomized parallel group study | ITI cylindrical versus ITI tapered implants | | 1-year | Implant failure | - | No failures |

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Table 1: Contd...

| Study          | Design                          | Implants compared                              | Prosthesis                                         | Follow-up period | Outcome                          | Risk ratio      | Finding                          |
|----------------|--------------------------------|------------------------------------------------|---------------------------------------------------|------------------|----------------------------------|-----------------|----------------------------------|
| Keilbassa 2009 | Randomized, multicenter, parallel group study | NobelActive external connection versus NobelActive internal connection implants | Immediate provisional single crown restorations | 3 years          | Implant failure                  | RR=1.06 (0.25-4.51) | *P*=0.94                   | Internal=4/63, External=3/50 |
|                |                                |                                                |                                                   |                  | Implant failure                  | RR=0.66 (0.17-2.58) | *P*=0.55                   | Internal=3/50, External=3/41 |
|                |                                |                                                |                                                   |                  | Bone level                       | MD=0.30 (-0.17-0.77) | *P*=0.21                   | Internal=5/45          |
| Keilbassa 2009 | Randomized, multicenter, parallel group study | NobelActive external connection versus NobelReplace implants | Immediate provisional single crown restorations | 3 years          | Implant failure                  | RR=0.67 (0.17-2.67) | *P*=0.57                   | External=3/56          |
|                |                                |                                                |                                                   |                  | Implant failure                  | RR=1.00 (0.21-4.67) | *P*=1.00                   | NobelReplace=5/56, External=3/41 |
|                |                                |                                                |                                                   |                  | Bone level                       | MD=0.00 (-0.41-0.41) | *P*=1.00                   | NobelReplace=3/41       |
| Keilbassa 2009 | Randomized, multicenter, parallel group study | NobelActive internal connection implants versus NobelReplace implants | Immediate provisional single crown restorations | 3 years          | Implant failure                  | RR=0.90 (0.25-3.15) | *P*=0.86                   | Internal=3/50          |
|                |                                |                                                |                                                   |                  | Implant failure                  | RR=1.00 (0.21-4.67) | *P*=1.00                   | NobleReplace=5/56, Internal=3/41 |
|                |                                |                                                |                                                   |                  | Bone level                       | MD=0.30 (-0.17-0.77) | *P*=0.21                   | NobleReplace=3/41       |
| Pozzi 2014     | Randomized, split mouth study   | NobelActive internal connection versus Nobel Speedy Groovy external connection implants | Placed in healed sites loaded after 4 months of healing with single crowns | 1-year           | Bone level                       | MD=−0.59 (-0.74-0.44) | *P*<0.001                | Mean=0.59, SD=0.98, 44 participants |
| Prosper 2009   | Randomized split mouth study    | WINSIX cylindrical versus WINSIX tapered implants | Conventionally loaded single crowns                | 2 years          | Implant failure                  | RR=2.00 (0.38-10.58) | *P*=0.41                   | Cylindrical=4/66, Tapered=2/66 |

*Wennstrom 2004 was not included in the primary outcome measurement as the author did not reply when asked about the removal of the screw retained prosthesis before measuring implant stability.

SD: Standard deviation, RR: Relative risk, MD: Mean difference, SLA: Sand-blasted acid-etched
Table 2: Available evidence from trials comparing different implant materials and combination

| Study                  | Design                                | Implants compared                                      | Prosthesis                           | Follow-up period (years) | Outcome          | Risk ratio       | Finding                  |
|------------------------|---------------------------------------|--------------------------------------------------------|--------------------------------------|--------------------------|-----------------|-------------------|--------------------------|
| Trials comparing implants with different materials | Al-nawas 2012 | Randomized split-mouth study | ITA SLActive implants: Titanium grade 4 versus titanium-13zirconium (Roxolid) | Overdentures on 2 implants connected with locator attachments | 1                | Implant failure  | RR=2.00 (0.18–21.66) P=0.57 | SLActive=2/89 Roxolid=1/89 |
|                        | Akoglu 2011 | Randomized parallel group study | Astra TiO2 blast versus ITI SLA titanium implants | Overdentures on 2 implants connected with ball attachments | 5                | Implant failure  | -                        | No failures              |
|                        | Alsabeeha 2011 | Randomized parallel group study | Southern regular versus turned Neoss implants | Single crowns | 1                | Implant failure  | RR=3.25 (0.15–72.36) P=0.46 | Southern regular=1/11 Neoss=0/12 |
|                        | Astrand 1999 | Randomized parallel group study | Astra TiO2 blast cylindrical versus turned Brånemark Mark II implants | Fixed prostheses | 5                | Implant failure  | RR=0.25 (0.03–2.12) P=0.20 | Southern wide=0/12 |
|                        | Batenburg 1998 | Randomized parallel group study | Brånemark MKII versus ITI TPS solid screw implants | Maxillary fixed prosthesis | 3                | Implant failure  | RR=0.05 (0.05–5.20) P=0.56 | Brånemark=1/28 ITI=2/28 |

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| Study          | Design                | Implants compared                        | Prosthesis                                                            | Follow-up period (years) | Outcome                     | Risk ratio | Finding                                      |
|---------------|-----------------------|------------------------------------------|----------------------------------------------------------------------|--------------------------|-----------------------------|------------|----------------------------------------------|
| Crespi 2009   | Randomized parallel group study | Ankylos Plus Dentsply versus Seven Sweden and Martina implants | Immediate postextractive and immediately loaded implants supporting single cemented crowns | 1                        | Bone level (1-year)         | MD=0.03   | Internal Mean=0.20, SD=0.58, 21 participants Replace Mean=0.17, SD=0.54, 27 participants            |
| Den Hartog 2011 | Randomized parallel group study | NobelReplace Select Tapered versus NobelReplace Groovy implants | Single crowns                                                      | 1.5                      | Implant failure             | RR=3.00   | Internal Mean=0.19, SD=0.57, 31 participants Branemark Mean=0.9, SD=0.57, 31 participants |
| Heydenrijk 2002 | Randomized parallel group study | IMZ titanium TPS versus ITI TPS solid implants | Overdentures on 2 implants connected with a bar                  | 5                        | Implant failure (1-year)    | IMZ=1/20  | RR=3.00 (0.13–69.52)                        |
| Payne 2003    | Randomized parallel group study | ITI SLA versus Southern implants          | Overdentures on 2 implants early loaded at 2 weeks                 | 10                       | Bone change (1-year)        | MD=−0.02  | ITI TPS Mean=0.26, SD=0.23, 12 participants Southern Mean=0.28, SD=0.15, 12 participants |
| Payne 2004    | Randomized parallel group study | Brånemark MKIV TiUnite versus Southern regular implants | Maxillary overdentures on 3 unsplinted implants early loaded at 12 weeks | 1                        | Implant failure (1-year)    | RR=0.57   | ITI TPS Mean=0.33, SD=0.55, 9 participants Southern Mean=0.41, SD=0.58, 9 participants |
| Tawse smith 2001, 2002 | Randomized parallel group study | Southern regular versus SteriOss implants | Mandibular overdentures on 2 implants conventionally loaded at 12 weeks | 10                       | Implant failure (1, 3, 5 and 10 years) | -         | Brånemark=4/19 Southern=7/19                  |

SD: Standard deviation, RR: Relative risk, MD: Mean difference, TPS: Titanium plasma-sprayed, SLA: Sand-blasted acid-etched
studies included in the meta-analysis was too low to carry out sensitivity analyses which could have been significant. Moreover, the included studies were from European, Australian and, East-Asian countries; while none was an Indian study. Many of the different implant systems that formed the intervention group in these studies are not even available in India; while those that are available and commonly used in India were not presented in the review. This clearly indicates the need for properly designed RCTs with adequate sample size, a follow-up period of at least 5 years and a low-risk of bias; that are reported according to the consolidated standards of reporting trials guidelines.

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Conflicts of interest
There are no conflicts of interest.
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