

Evaluation Of The Clinical Effectiveness Of The Conometric Concept - A Systematic Review

Review Article

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Abstract

Background: A Cone-in-cone Morse taper connection between abutments and crowns has been proposed to retain implant-supported definitive fixed dental prostheses (FDPs). This prosthetic approach, named the “Conometric Concept,” was used to retain both lithium disilicate (LS2) and zirconia restorations. The conometric concept consists of a cone-in-cone connection between an abutment and the respective coping to retain an implant supported restoration without either screws or cement. The fit between abutment and the restoration is achieved with prefabricated components. The conical coupling abutments use the friction between the abutment and the titanium coping to retain a prosthesis without the use of cement. The restoration has no access holes and can be removed easily with a spring fixed partial denture remover. The emergence profile of the restoration can be placed sub-gingivally without the risk of cement remaining at the abutment coping interface. The main objective of this study is to critically review articles that have used conometric concept and to evaluate its clinical effectiveness.

Materials And Method: An electronic search was performed in PubMed, Google scholar and Cochrane library till current date. The assessment of articles was done using predetermined selection criteria. Randomized, Non-randomized trials, prospective cohorts, prospective clinical trials and in vitro studies were included. Case series, case reports, conference paper and animal studies were excluded from this review. The risk of bias was evaluated, and findings were synthesized.

Results: Out of the 7 included studies, 8 outcome measures have been identified. A meta-analysis was not feasible as none of the included studies were randomized control studies. 2 studies have analysed cumulative survival rate. Cumulative survival rate was in a range of 97.4%-100%. 4 studies have analysed mean probing depth. The range was 1.3mm-2mm. One study analysed mean crestal bone loss. They gave a result of 0.4mm. 4 studies analysed the rate of framework fracture. The results were in a range of 0%-8.7%. 4 studies analysed the aesthetic satisfaction and overall patient satisfaction and the results were in the range of 82%-91.8% and 79%-91% respectively. 4 studies have analysed mean probing depth. The range was 1.3mm-2mm.

Conclusion: Based on the findings of this review, it can be concluded that the conometric concept offers a promising clinical outcome as a prosthetic treatment option. Further long-term studies need to be conducted to evaluate its feasibility as a commercial treatment modality.

Introduction

Edentulism is the condition of being toothless to at least some degree. Loss of some teeth is called partial edentulism, whereas loss of all teeth is called complete edentulism. Edentulism can lead directly to impairment, functional limitation, physical, psychological, and social disability, and handicap [24, 16, 26, 29, 2].

The treatment options available are complete dentures, removable partial dentures, fixed partial dentures and implant supported prosthesis [9]. The treatment given to the patient depends on physiological, anatomical, and socio-economic status of the patient. The most common treatment option for long span edentulous areas are removable appliances. However, the degree of patient satisfaction tends to decrease during the first couple of years after insertion [30, 4, 19, 23].

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Endosseous implants are commonly used to achieve dental prosthesis support and retention in both partially and completely edentulous patients [21, 3]. Modern implantology marks a great treatment innovation since edentulism is a frequent situation, especially in elderly people. Different types of implant-supported prostheses are available, depending on the number and position of implants, prosthetic design and material and type of retainer. [20, 25, 15, 14].

Treatment options include removable or fixed implant-supported prosthesis. Removable implant-retained prosthesis consists in a removable prosthesis anchored to implants by different kinds of retainers [25]. On the other side, a fully stable dentition is achieved through implant-supported fixed dental prostheses only [27]. For this kind of restoration, two types of connections between implants and prostheses have been mainly used. They are screw-retained and cement retained connections. Both systems are good and predictable, but they could typically show some drawbacks. Screw-retained prosthesis offers tight retention, but shows more mechanical complications, such as screw loosening and fractures. Cement-retained prosthesis allow better aesthetics, but they showed more biological complications, such as soft tissue inflammation around the implant neck, residual cement, un-retained prosthesis, dislodgement of prosthesis among a few [28, 31].

In 2018 Degidi et al, proposed using a cone-in-cone Morse taper connection between abutments and crowns to retain implant-supported definitive fixed dental prostheses. This Prosthetic approach, named the "Conometric Concept" was used to retain both lithium disilicate and zirconia restorations [1, 11, 12].

The conometric concept consists of a cone-in-cone connection between an abutment and the respective coping to retain an implant supported restoration without either screws or cement. It has a tapered coping that is fixed to the prosthesis and inserted in a tapered abutment. The fit between abutment and the restoration is achieved with prefabricated components. The conical coupling abutments use the friction between the abutment and the titanium coping to retain a prosthesis without the use of cement. When an insertion force is applied, as the system is activated, the cervical margin of the coping is slightly deformed by wedge effects, causing elastic stress fields within both the coping and the abutment. Such stresses will partially remain even if the insertion force is removed [10, 11, 6].

The use of cone-in-cone abutments to support definitive has given excellent short term prosthetic results [7]. Hence, the aim of this systematic review is to evaluate the clinical effectiveness of the conometric concept.

Aim

The aim of the current review is to evaluate the effectiveness and clinical efficiency of the conometric concept.

Structured Question

In cases requiring implants, is there a significant difference in effectiveness of the conometric abutment in comparison to conventional abutments?

Pico Analysis

Population: Healthy partially edentulous individuals with sufficient bone support for placement of implants.

Intervention: Implant crowns with conometric abutments.

Comparison: Implant crowns with conventional abutments.

Outcome Measures:

- Cumulative survival rate of the prosthesis- years
- Esthetics- Questionnaire
- Passive fit- Path of displacement(mm)
- Fracture resistance- Fatigue testing(N/cm)
- Crestal bone loss around the supporting implants
- Patient satisfaction- Questionnaire
- Vertical Fit of the framework- IOPAR
- Biofilm adherence to the crown- OHI index

Data Collection And Analysis

The data was collected from the studies that were included based on the author's name, publication year, study type, subjects, interventions, treatment time, method of measurements and outcomes assessed.

Searched Databases

The electronic databases that were included are National Library of Medicine (PubMed), Google Scholar and the Cochrane database of systematic reviews. No limitation regarding publication date was included in the search. The electronic search was supplemented by a manual search in the Journal of Prosthetic Dentistry, Journal of Prosthodontics, Clinical and Oral Implants related Research and the Clinical Oral Implant Journal.

Search Protocol

The search methodology employed was a combination of MeSH terms and Keywords. The keywords were categorized as Population, Intervention, Comparison, Outcome measures. Keywords within each group were combined using the Boolean operator (OR). The Boolean operator (AND) was used to combine all four categories together to attain the search results.

Eligibility Criteria

The title and abstract of the entries from the initial electronic database searches were read. Full text versions of the studies that could be potentially included in this review were read and a final selection was done according to the inclusion and exclusion criteria.

Inclusion Criteria

- Articles reporting cone in cone concept or conometric concept.
- Articles comparing conometric concept with other systems.
- Randomized control studies, Prospective clinical trials and In vitro studies

POPULATION	Edentulous patients, partially edentulous patients, completely edentulous patients, partially edentulous maxilla, partially edentulous mandible
INTERVENTION	Conometric abutments, Cone in cone abutment connection, Acuris
COMPARISON	Cement retained prosthesis, Cement retained abutments, Screw retained prosthesis, Screw retained abutments
OUTCOME	Passivity, Cumulative survival rate of the prosthesis, Crestal bone loss around the supporting implants, Patient satisfaction, Esthetics, Fracture resistance, Vertical fit of the framework, Biofilm adherence to the crown

Exclusion Criteria

- Review articles
- Case reports and series
- Animal studies

Results

The search strategy returned 22 articles from PubMed, 7 articles from Google scholar and 2 articles were handpicked. 18 clinical trials were included from the PubMed search of which 13 were excluded based on title and abstract and a total of 5 articles were selected. Of the 7 articles obtained from Google scholar, 5 were eliminated based on heading and abstract, and a total of 2 articles were selected. The total number of studies which were selected from the database were 9, of which 2 were eliminated as it did not meet the inclusion criteria and/or outcome measures and 7 articles were included based on core data. These 7 articles were reviewed and consolidated as given in the table below.

Data Extraction

The data of the selected studies were extracted using standardized abstraction tables. Information extracted from each study included the following in one table as general characteristics of the study. The outcome variables of the extracted data from the studies were interpreted in detail. The level of evidence for each included article was also tabulated according to the Oxford Centre for Evidence-Based Medicine (March 2009).

Analysis

Out of the 7 included studies, 8 outcome measures have been identified. However, a meta-analysis was not done as none of the included studies were randomized control studies. 2 studies have analyzed cumulative survival rate. Cumulative survival rate was in a range of 97.4%-100% [10,7]. 4 studies have analyzed mean probing depth. The range was 1.3mm-2mm [13, 11, 5]. One study analyzed mean crestal bone loss. They gave a result of 0.4mm [7]. 4 studies analysed the rate of framework fracture. The results were in a range of 0%-8.7%. 4 studies analysed the esthetic satisfaction and overall patient satisfaction and the results were in the range of 82%-91.8% and 79%-91% respectively [10, 7]. 4 studies have analyzed mean probing depth. The range was 1.3mm-2mm [13, 11, 5].

Discussion

Dental implantology is a reliable technique for treatment of partially and completely edentulous patients. The achievement of stable dentition is ensured by implant-supported fixed or removable

dental prostheses. Titanium dental implants extended the treatment alternatives for edentulous patients using either implant-retained fixed or removable prostheses [8, 25]; 'Implant-Supported Rehabilitation of Completely and Partially Edentulous Patients', 2017).

A debate still exists within dentistry over the optimal connection between a fixed restoration and an implant. Screw retained restorations have less complications overall, but the failure rate of cement retained restorations was not influenced by cement choice. The presence of excess cement in cement retained restorations has increased association with incidence of peri-implant disease and bone loss. Conversely, the screw retained prosthesis is cost effective, as it facilitates prosthesis retrieval without the risk of damaging the prosthesis [18, 28, 32, 17].

The conometric concept involves the use of cone-in-cone Morse tapered connection between the abutment and the prosthesis to retain an implant supported fixed dental prosthesis. The reported advantages of this concept are absence of cement and screws, simple maintenance, favorable emergence profile, and cost effectiveness [12].

The conical coupling abutments use friction between the abutment and the coping to retain the prosthesis without the use of cement. When an insertion force is applied, the system is activated. The cervical margin of the coping is slightly deformed by wedge effect, causing elastic stress fields within both the coping and the abutment. This stress will partially remain even if the insertion force is removed. This residual stress provides the retentive capability of the system [10-12].

According to a 2 year prospective study by Degidi et al showed that Cone in cone approach was successful in 2 year followup with a mean probing depth of 2 ± 0.90 , framework fracture of 8.7% and patient satisfaction of 79% [11].

In a 3 year prospective study done by Degidi et al, Titanium reinforced partial restorations with conic coupling retention supported by immediate implants provide a successful, cost effective treatment modality with a mean probing depth of 1.3 ± 0.20 , framework fracture of 0% and patient satisfaction of 91% [13].

Another 3 year prospective study by Degidi et al stated that Conical abutment prostheses coupling connections were successful within the 3-year timeframe of this study with a mean probing depth of 2 ± 0.82 , framework fracture of 3% and patient satisfaction of 90% [13].

A 5 year prospective study done by the same author stated that Cone in cone connections was successful in 5 year followup with

a cumulative survival rate of 97.4%, framework fracture of 1.4% and patient satisfaction of 88% [10].

Bressan et al did a 2-year prospective study and noted that time and cost of treatment was reduced with conical crown concept. He noted a cumulative survival rate of 100%, mean crestal bone loss of -0.4 ± 0.2 and a patient satisfaction of 98% [7].

Another in-vitro study done by Bressan et al showed that there was minimal bacterial invasion in both internal conical and Morse taper internal connection [5]. One of the major limitations in this review is the lack of randomised control trials comparing conometric coupling with other abutment prosthetic connections. Further studies are needed in this area to determine the effectiveness of conometric coupling as a routine retention modality in commercial dental implants.

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APPENDIX

Figure 1: Flow Chart Depicting the search methodology describing the total number of articles obtained, the ones excluded, inclusion of handpicked articles and finally the total number of articles that were retrieved for analysis.

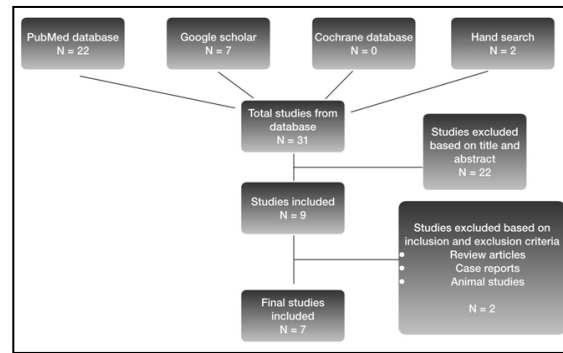


Table 1. Showing the studies that have been excluded.

S No	Author	Year	Type of study	Reason for exclusion
1	Alghamdi O	2020	Prospective study	Did not include conometric abutments
2	Waller T et al	2020	Randomised control trial	Did not include conometric abutments
3	Yao KT et al	2020	Pilot study	Did not include conometric abutments
4	Degidi M et al	2020	Review article	Review
5	Benjaboonyazit K	2019	In-vitro study	Did not include conometric abutments
6	Alsheri et al	2017	In-vitro study	Did not include conometric abutments
7	Albiero AM et al	2018	Review article	Review
8	Gehrke SA	2019	In-vitro study	Did not include conometric abutments
9	Szyszkowshi et al	2019	Randomised control trial	Did not include conometric abutments

Table 2. Shows Outcome Measures evaluated in this systematic review.

S.no	Outcome Measurements
1	Cumulative survival rate of the prosthesis- years
2	Aesthetics- Questionnaire
3	Patient satisfaction (Questionnaire)
4	Crestal bone loss around the supporting implants
5	Vertical Fit of the framework- IOPAR
6	Biofilm adherence to the crown- PI index

Table 3. Shows a summary of all included articles in the systematic review and outcome measures.

S.no	Author&Year	Groups	No. of Implants	Brand of Implants	Software	No. of years of study
1	Degidi, 2016	1 group	78	Ankylos, Dentsply	Meazure 2.0 Build 158	3 years
2	Bressan, 2013	1 group	100	Ankylos, Dentsply	MIWin 2.24	2 years
3	Degidi, 2019	1 group	50	Ankylos, Dentsply	InLab software v.4.2	2 years
4	Degidi, 2018	1 group	134	Ankylos, Dentsply	Meazure 2.0 Build 158	5 years
5	Degidi, 2016	1 group	130	Ankylos, Dentsply	SPSS 20	3 years
6	Bressan, 2019	1 group	100	-	-	5 years
7	Bressan, 2017	2 groups Group A - Internal conical connection Group B - Morse taper internal connection	24	Ankylos, Dentsply	-	-

Table 4. Contains a compilation of data and statistics in the articles included as part of the systematic review.

Author&Year	Groups	Sample size	Type of study	Type of statistical method used	Outcome Assessment	Inference
Degidi, 2016	1 group	67	Prospective study	Pearson correlation	Mean Probing depth measurements (mm) 1.3 ± 0.2 mm Esthetics 91% Framework fracture 0% Patient satisfaction 91%	Titanium reinforced partial restorations with conic coupling retention supported by immediate implants provide a successful, cost effective treatment modality.
Bressan, 2013	1 group	25	Prospective study	KolmogorovSmirnov test McNemar test	Cumulative survival rate 100% Mean crestal Bone loss -0.4±0.2 Patient satisfaction 98%	Reduced time and cost of treatment with conical crown concept
Degidi, 2019	1 group	25	Prospective study	Kaplan-Meier analysis Shapira-Wilk test Friedman test Bonferroni paired sign-rank test Pearson correlation	Mean probing depth 2 ± 0.90 mm Framework fracture 8.70% Patient satisfaction 79% Esthetics 82%	Cone in cone approach was successful in 2 year follow-up.
Degidi, 2018	1 group	78	Prospective study	Shapira-Wilk test Friedman test Bonferroni corrected Wilcoxon paired sign-rank test Pearson correlation	Cumulative survival rate 97.40% Esthetics 90.10% Patient satisfaction 88% Framework fracture 1.40%	Cone in cone connections was successful in 5 year follow-up.
Degidi, 2016	1 group	65	Prospective study	Shapira-Wilk test Friedman test Bonferroni coorrected Wilcoxon paired sign-rank test Pearson correlation	Mean probing depth 2 ± 0.82 mm Framework fracture 3% Patient satisfaction 90% Esthetics 91.80%	Conical abutment prostheses coupling connections were successful within the 3-year timeframe of this study
Bressan, 2019	1 group	25	Prospective study	Chi square test	Mean probing depth 1.4 ± 0.5 mm Patient satisfaction 85% PI Index 1-31% 2-36% 3-61%	Conometric retention system can be used to give fixed retention to a complete prosthesis supported by 4 implants.
Bressan, 2017	2 groups Group A - Internal conical connection implant Group B - Morse taper internal connection implant	24	In-vitro study	Fisher exact test	Bacterial amount Group A - 4.23X105 Group B - 3.45X105 Real time PCR Group A - +ve in 4 out of 10 Group B - +ve in 6 out of 10	Minimal bacterial infiltration in both systems.

Table 5. Showing levels of evidence of included articles.

S No	Included articles	Study design	CEBM levels of evidence
1	Degidi, 2016	Prospective study	Level 1b
2	Bressan, 2013	Prospective study	Level 1b
3	Degidi, 2019	Prospective study	Level 1b
4	Degidi, 2018	Prospective study	Level 1b
5	Szyszkowski, 2019	Randomised control trial	Level 1b
6	Bressan, 2017	In-vitro study	Level 5

Table 6. Showing Risk of Bias in included studies.

S No	Included articles	Risk of Bias
1	Degidi, 2016	Low risk
2	Bressan, 2013	Low risk
3	Degidi, 2019	Low risk
4	Degidi, 2018	Low risk
5	Szyszkowski, 2019	High risk
6	Bressan, 2017	Low risk