Occlusal Stability of Cantilever Fixed Partial Denture: A Systematic Review with Meta Analysis

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ABSTRACT

Background: The cantilever fixed partial denture (CFPD) is a type of fixed partial denture in which one or more than one abutments are present at one end while there is no abutment support on the other end.Dental professionals have been using these cantilever based prosthesis since many years but the success achieved have been moderate. There have been failures in large number of cases. This large number of failures cannot be attributed as mere accidents. Therefore, there was necessity to investigate the problem in details.

Aim: To carry out systematic review and meta-analysis on the available research regarding occlusal stability of cantilever fixed partial denture.

Methods and Materials: An extensive search was carried out and literature was obtained from the reliable database like Pubmed, Scopus, Web of Sciences. Initially there was search using keywords like cantilever fixed partial denture, removable partial denture, occlusal stability. There was elimination of article according to the inclusion and exclusion criteria and analysis of abstracts and title. Full text was obtained for the selected articles which were screened further. There was systematic review focussing on characteristics of occlusal stability. Meta analysis was carried out with proper statistical analysis which involved calculation of 95% CI for various features.

Results: A total of 121 articles were identified after the extensive search using the keywords. Then 64 articles were excluded after screening of the title and abstracts. Complete text was sought for 57 articles. There was thorough screening of the full text of articles after which 27 articles were excluded. Finally, forty articles were included in the study. Studies included were randomized control trials, prospective

studies, cross sectional studies. It was observed that studies which carried out comparison between the removable partial denture and cantilever fixed partial denture regarding occlusal stability concluded that there was significant difference between these two types of prosthesis regarding masticatory function (95% CI -3.0 to 3.6). But the patient satisfaction was greater in case of patients treated with cantilever fixed partial denture (95% CI 42.6–52.3). When there was further analysis then it was observed that patient using removable partial denture were found to have more proportion of caries (95% CI 2.4–6.0), gingival inflammation (95% CI 2.1–6.2) and compromised oral hygiene (95% CI 2.1–6.2).

Conclusion: Increasing abutment teeth while reducing the number and size of cantilevered pontics is widely agreed to be crucial to achieving greater occlusal stability in cantilever fixed partial dentures. Although the cantilever is considered a compromise, it is favoured over the RPD in cases with unilateral edentulous dentitions.

Keywords: Cantilever fixed partial denture, occlusal stability, systematic review, meta-analysis
Tob Regul Sci.™ 2021;7(6-1): 7039-7049
DOI: doi.org/10.18001/TRS.7.6.1.33

INTRODUCTION

The cantilever fixed partial denture (CFPD) is a type of fixed partial denture in which one or more than one abutments are present at one end while there is no abutment support on the other end. It has been advocated that analysing the comparative advantages and disadvantages is necessary for selection of the type of prosthesis.[1] The selection of the nature of prosthesis depends upon the clinical situation and it require vast experience in the clinical field.In case of cantilever fixed partial denture one end is not supported by abutment while another end is supported by one or more than one abutments. These fixed prostheses are used as an optional treatment in cases where the number of teeth in oral cavity is low and the patients are not ready to accept removable partial dentures.[2]

The intensity of masticatory forces are reduced when cantilever fixed prosthesis are placed in one side of the arch involving the posterior teeth which are compromised periodontically. It has been found that quadrants which consisted of the cantilever fixed prosthesis are normally not utilized for chewing by these patients. However, if there is stable occlusion and no premature contacts in the cantilevers then these cantilevers can withstand the heavy forces of mastication and can be used for chewing. Several research has been conducted which have showed that cantilever fixed partial dentures can be used to replace the missing teeth involving the specific abutments which are isolated and periodontically stable.[3,4]

It has been found that stability was achieved for prolonged duration in cantilever fixed partial denture by establishing occlusion which is non traumatic and stable alongwith proper periodontal health. In order to prevent increase in mobility of abutment, tilting of abutment and migration of abutment there is need for establishment of balancing contacts. It become more important in situations where probability of mobility of fixed partial denture is more during the movements of mandible.[5,6]

It has been observed that a major number of dental professionals are utilizing the fixed partial denture with cantilever due to the demands placed by the patients regarding the use of fixed prosthesis instead of removable partial dentures and widespread restoration steps required for complete rehabilitation of the oral cavity. Dental professionals have been using these cantilever-based prosthesis since many years but the success achieved have been moderate. There have been failures in large number of cases. Increased failures cannot be attributed as mere accidents. Therefore, there was necessity to investigate the problem in details.[7,8]

It has been postulated that each dental professional should emphasize on the importance of occlusal stability in cantilever fixed partial denture because significant link exists between the mechanical and biological aspects while carrying out treatment with either removable and partial fixed denture.[9,10] For dentists there has been an important concern regarding the proper distribution of forces within the normal physiological limits among the supporting structures of the both fixed and removable partial dentures. This condition also applies to the cantilever fixed partial denture. Treatment using the cantilever kind of fixed partial denture is relatively rare in dental circumstances.[11,12]

Therefore this systematic review of the existing literature has been conducted along with meta-analysis on the occlusal stability in cantilever fixed partial denture.

METHODS AND MATERIALS

Search strategy

Using PubMed, an electronic database (Medline) was used to search for all relevant publications published between 1966 and March 20, 2021. Only articles published in English dentistry publications containing human research were included in the search. Following a search of the databases, the results were filtered to include only articles that met certain inclusion criteria: Two types of articles: (1) articles in which patients had distal extension edentulous space(s) in the posterior region (Kennedy Class I or Class II condition) of maxilla and/or mandible; and (2) articles in which the distal extension edentulous space was restored with RDP, IFDP or CFPDs; and (3) articles in which statistical comparisons of outcome measures were made between patients with RPDs, CFPD, IFPDs, or no prosthetic treatments. Meta-analysis-free review papers were omitted from the study. Besides the database search, suitable papers fulfilling inclusion criteria were obtained from the references of retrieved articles by manual search.

Article analysis

Characteristics of studies such as the authors, publication year, dentition, number of patients, original papers were used to extract the follow-up duration, outcome measures, and findings. When it comes to treating missing posterior teeth (premolar occlusion), CFPDs were viewed as the SDA idea, while treatment with RPDs (replacement of missing posterior teeth) or IFPDs (replacement of missing posterior teeth) was seen as the conventional concept. A clinical epidemiology-based categorization was used to evaluate the study design.

Two writers graded the evidence in accordance with the recommendations of the United States Agency for Healthcare Research and Quality (I, meta analysis of multiple studies; II, experimental studies; III, well-designed, quasi-experimental studies; IV, well designed, non-experimental studies; and V, case reports and clinical examples).

Statistical Analysis

Microsoft Excel Version 14 and IBM SPSS Version were used in the systematic review analysis. Tests on raw data were used to compare age and gender between groups; t-test confidence intervals (CIs) indicate the difference between group means and the difference between population proportions, respectively; chi-squared CIs represent the difference between population proportions. Stata 15.1 was used for the meta-analyses. Random-effects models were used to compute prevalence and summary statistics with CI using the metaprop command. According to these models, researchers can draw assumptions about population characteristics based on the variability in effect sizes seen between studies.

RESULTS

A total of 121 articles were identified after the extensive search using the keywords. Then 64 articles were excluded after screening of the title and abstracts. Complete of the article was sought for 57 articles. There was thorough screening of the full text of articles after which 27 articles were excluded. Finally, forty articles were included in the study. There was no meta-analysis found, 12 papers were categorized as level II evidence. 4 papers were categorized as level III evidence, 13 articles were categorized as level IV evidence. (Figure 1)

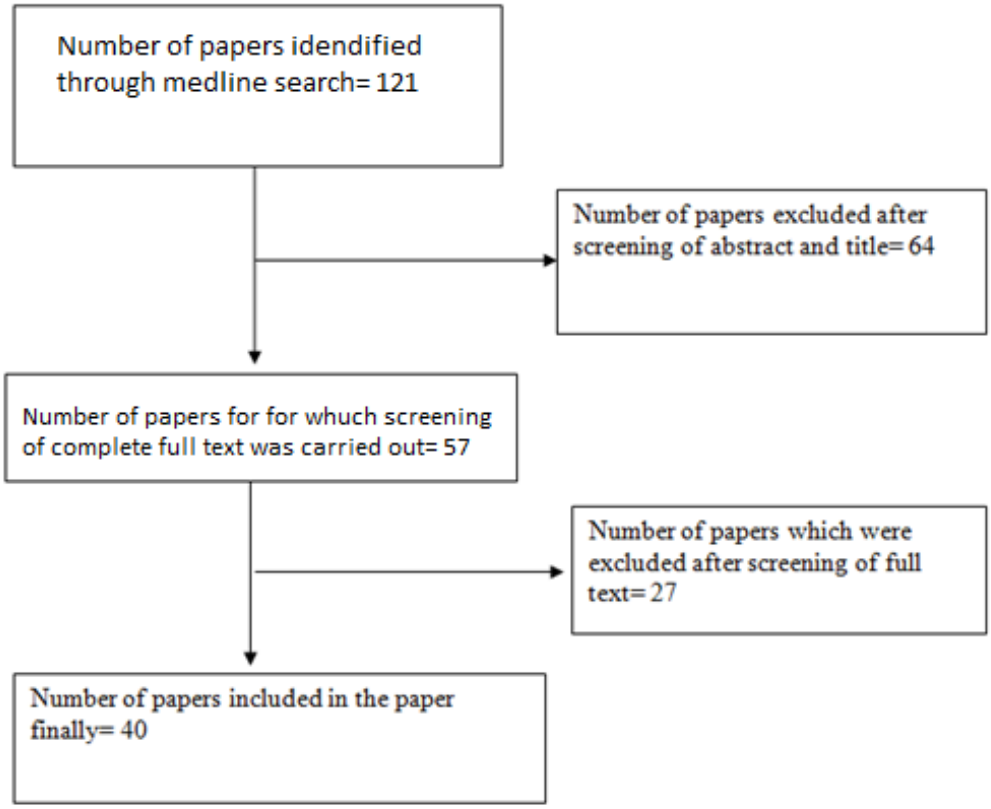


Figure 1: Systematic representation of the systematic review

It was observed that studies which carried out comparison between the removable partial denture and cantilever fixed partial denture regarding occlusal stability concluded that there was significant difference between these two type of prosthesis regarding masticatory function (95% CI -3.0 to 3.6). But the patient satisfaction was greater in case of patients treated with cantilever fixed partial denture (95% CI 42.6–52.3). When there was further analysis then it was observed that patient using removable partial denture were found to have more proportion of caries (95% CI 2.4–6.0), gingival inflammation (95% CI 2.1–6.2) and compromised oral hygiene (95% CI 2.1–6.2). It was also found that rate of survival of prosthesis and loss of tooth in patients with cantilever fixed partial denture were statistically similar to that of patients using removable partial denture (95% CI -3.1 to 3.6). (Figure 2,3,4)

However patients with removable partial denture were found to have increased number of visits to the dentist for maintenance of the prosthesis as compared to the CFPDs (95% CI 42.6–53.3). Treatment with CFPDs has a substantial benefit over treatment with detachable partial dentures in terms of occlusion. TMD and occlusal instability were not significantly different between CFPDs and RPDs in terms of the risk of complications. (95% CI 2.4–6.8).(Graph 1, 2)

Patients with CFPDs had better chewing abilities with a detachable partial denture, according to a randomised controlled experiment. There was a significant difference in the prevalence of TMD between RPD and CFPD patients in cross-sectional and longitudinal investigations, whereas an RCT indicated that TMD was more commonly recognised in RPD patients compared to CFPD patients. (Table 1 and Table 2)

Table 1: Important details of some studies included in the study

Contributors in	Level of evidence	Year of publication	Size of sample of the study group	Design of study	Parameters analysed	Status of dentition	Period of Follow up

research							
Budtz-Jorgensen et al.	II	1987	CFPD(27)/RPD(26)	RCT	Chewing ability, TMD, caries incidence, maintenance	Mandibular SDA and maxillary complete denture	2 years
Isidor et al.	II	1987	CFPD(27)/RPD(25)	RCT	Periodontal condition, oral hygiene	Mandibular SDA and maxillary complete denture	2 years
Budtz-Jørgensenet al.	II	1990	CFPD(27)/RPD(26)	RCT	Clinical outcome	Mandibular SDA and maxillary complete denture	5 years
Isidor et al.	II	1990	CFPD(27)/RPD(25)	RCT	Periodontal condition	Mandibular SDA and maxillary complete denture	5 years
Moynihan et al.	II	2000	Resin-bonded CFPD(30)/RPD(30)	RCT	Nutrition intake	Mandibular SDA	1 year
Jepson et al.	II	2001	Resin-bonded CFPD(30)/RPD(30)	RCT	Caries incidence	Mandibular SDA	2 years
Jepson et al.	II	2003	Resin-bonded CFPD(30)/RPD(30)	RCT	Patient satisfaction	Mandibular SDA	1 year
Thomason et al.	II	2007	Resin-bonded CFPD(30)/RPD(30)	RCT	Survival time, maintenance	Mandibular SDA	5 years
Walter et al.	II	2010	CFPD or NR(106)/ RPD(109)	RCT	Survival rate	Maxillary and/or mandibular SDA	3 years

Wolfart et al.	II	2005	CFPD(13)/RPD(17)	RCT	OHRQoL, TMD	Maxillary and/or mandibular SDA	1 year
Jemt et al.	III	1983	RPD(6)	Pros	Masticatory movements	Mandibular bilateral SDA and maxillary complete denture	5—8 weeks
Gunne et al.	III	1985	RPD(19)	Pros	Dietary intake, masticatory performance, chewing ability	Mandibular bilateral SDA and maxillary complete denture	2 months
Witter et al.	IV	1989	NR(55)/NR with past experience of RPD(19)/RPD(25)	Cross	Chewing ability, esthetics, occlusal stability, TMD	Maxillary and/or mandibular SDA	—
Witter et al.	IV	1990	NR(55)/NR with past experience of RPD(19)/RPD(25) CD(72)	Cross	Subjective chewing function, esthetics, TMD, functional habit	Maxillary and/or mandibular SDA	
Armellini et al.	IV	2008	NR(65)/RPD(57) CD(38)	Cross	Generic QoL, OHRQoL	Maxillary and/or mandibular SDA with/ without anterior unrestored missing teeth	—
Aras et al.	IV	2009	NR(10)/RPD(10) CD(10)	Case control	Masticatory performance, maximum bite force,	Maxillary complete dentition and mandibular bilateral	1 year

					occlusal contact area	SDA	
Fazal A	IV	2012	159 (ICLPD)	Retrospective	Masticatory performance, maximum bite force, occlusal contact area	Maxillary and mandibular partial edentulous areas	Four years

Table 2 : Meta analysis on outcomes of occlusal stability in patients with CFPDs

Outcomes	$\chi^{2(df)}$	95% CI	P value
Objective masticatory function	19.88	2.8–7.4	0.07
Masticatory performance	0.26	-3.0 to 3.6	0.08
Maximum bite force	9.25	2.1–4.8	0.07
Tooth contact area	169.51	42.6–52.3	0.09
Perceived chewing ability	0.05	-3.1 to 3.1	0.08
Nutrient intake	8.83	2.1 –6.2	0.06
TMD	9.25	2.4–6.8	0.06
Patient satisfaction	269.51	42.6–52.3	0.11
Tooth mobility	0.21	-3.0 to 3.5	0.03
Occlusal contact	9.25	2.4–6.1	0.04
Overbite	167.31	41.4–52.3	0.01
Interdental space	0.15	-3.1to 3.1	0.08
Time to survival	8.83	2.1–6.2	0.04
Tooth loss	9.25	2.4–6.0	0.04
Maintenance visits	147.51	42.6–53.3	0.01
Jaw movement	0.02	-3.1 to 3.1	0.07
Gingival inflammation	8.53	2.1–6.2	0.09
Alveolar bone height	9.25	2.4–6.0	0.04
Failure rate	18.21	42.6–52.3	0.09
Survival rate	0.26	-3.1 to 3.6	0.703
Technical complications	9.25	2.4–6.0	0.04

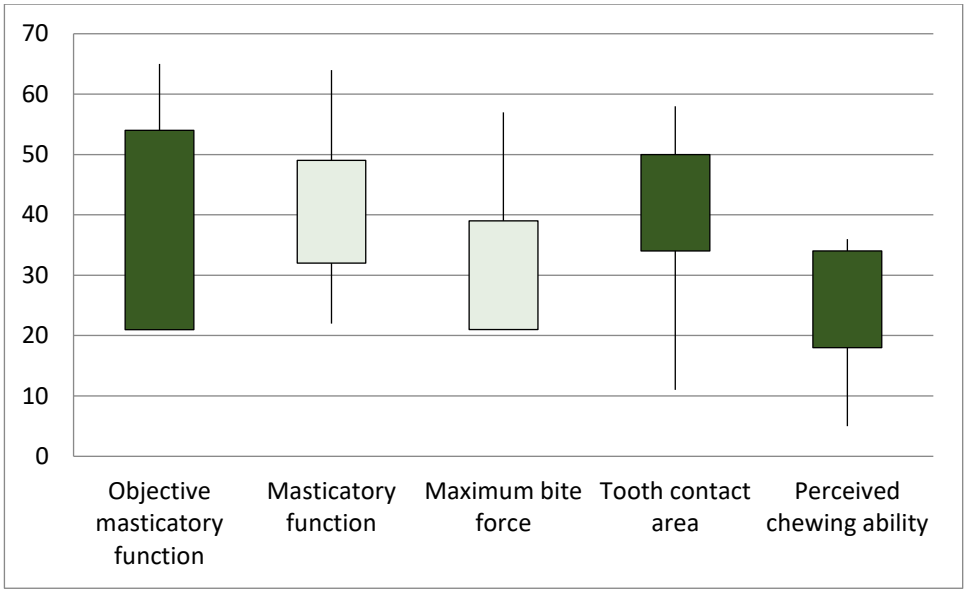


Figure 2: First box and whisker plot based on outcomes and 95% CI

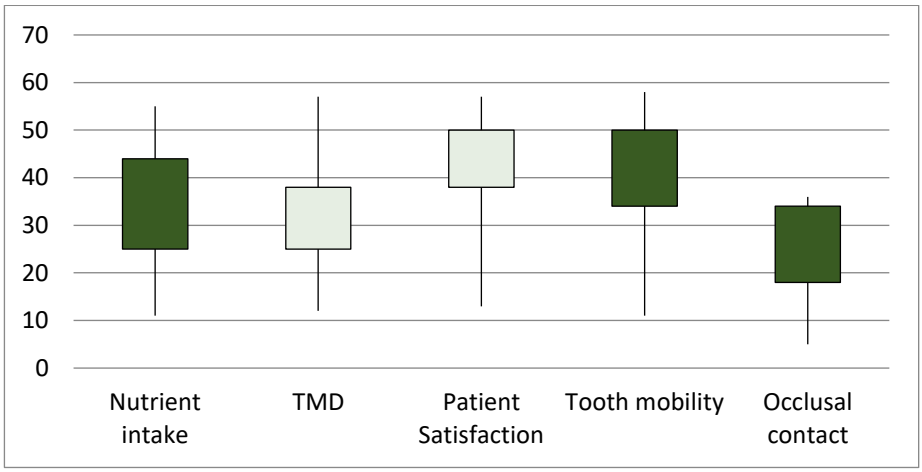


Figure 3: Second box and whisker plot based on outcomes and 95% CI

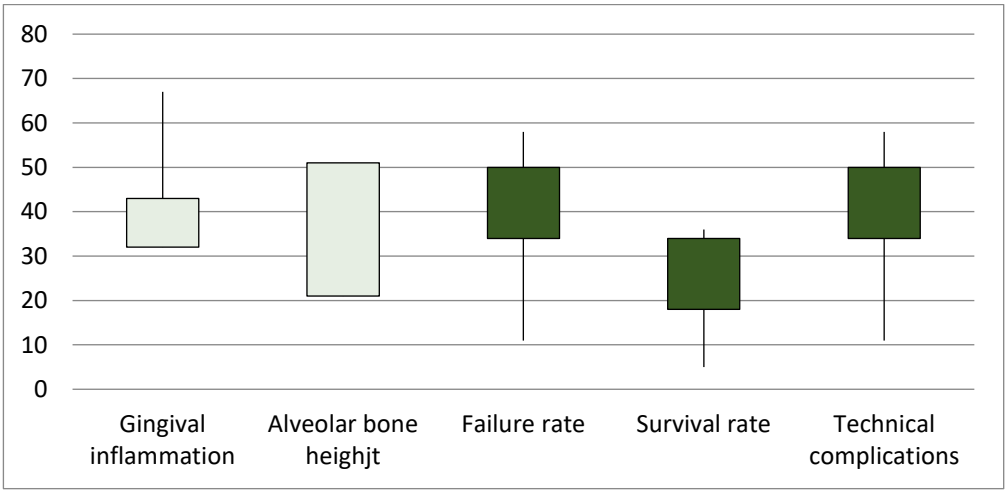
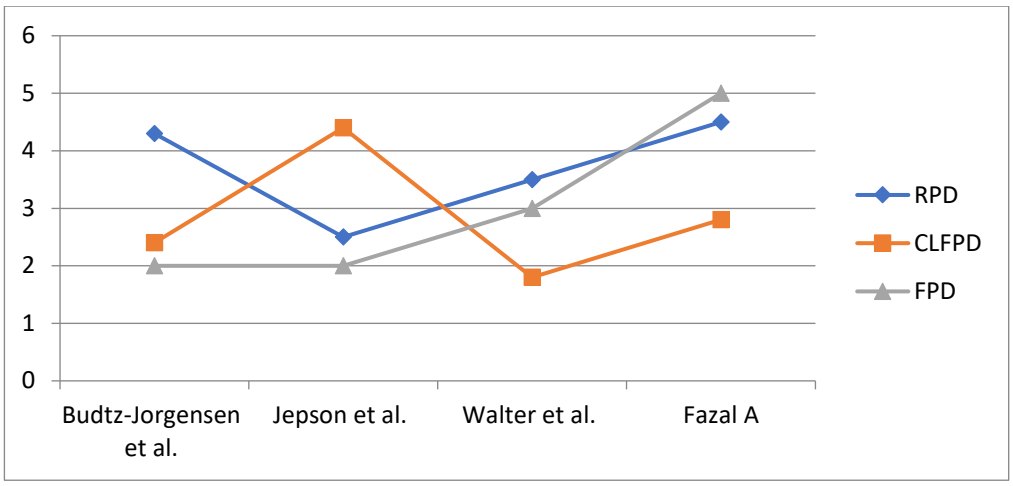
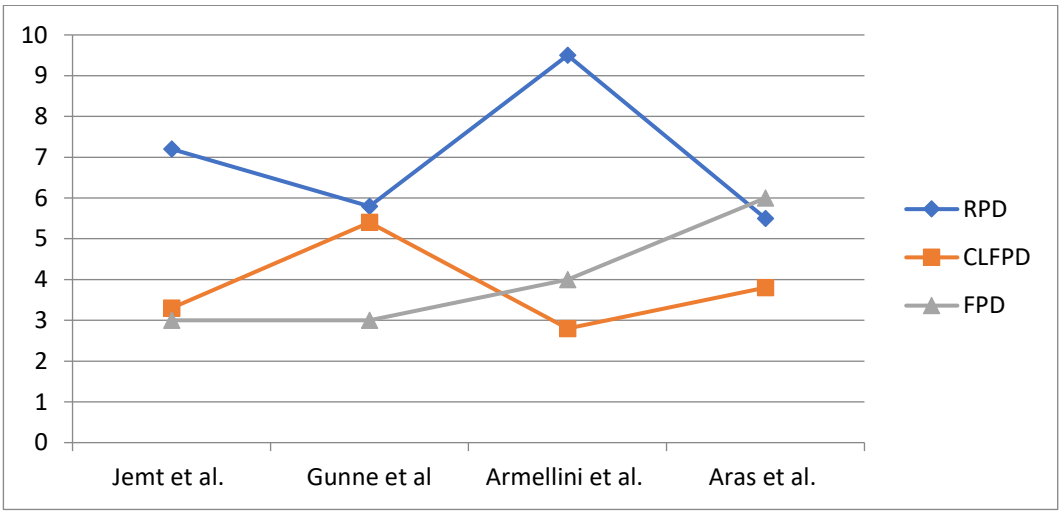


Figure 4: Third box and whisker plot based on outcomes and 95% CI



Graph 1: Representation of different studies



Graph 2: Representation of different studies

DISCUSSION

The type of prosthesis chosen is determined by the clinical condition, and it necessitates extensive clinical experience. One end of a cantilever fixed partial denture is not supported by an abutment, whereas the other end is supported by one or more abutments. These fixed prostheses are used as an alternative to removable partial dentures in circumstances where the number of teeth in the oral cavity is minimal and the patient is unwilling to accept them.[13,14] When cantilever fixed prostheses are implanted on one side of the arch involving the posterior teeth that are periodontally damaged, the intensity of masticatory forces is reduced. The cantilever fixed prosthesis quadrants have been discovered to be underutilised for chewing by these individuals.[15,16]

However, if the cantilevers have a stable occlusion and no early contacts, they can endure the strong forces of mastication and be employed for chewing. Several studies have shown that cantilever fixed partial dentures can be utilised to replace missing teeth with isolated and periodontically stable abutments.[17,18]

Due to patient preferences for fixed partial dentures rather than removable partial dentures and the extensive restoration processes required for complete oral cavity rehabilitation, it has been observed that a large number of dental professionals are using the fixed partial denture with cantilever.[19,20] Dental experts have been employing these cantilever-based prostheses for a number of years, but the results have been mixed. However, in a considerable number of cases, there have been failures. This enormous number of failures cannot be explained by chance. As a result, a thorough investigation of the situation was required.[21,22]

It was also found in our systematic review and meta analysis that rate of survival of prosthesis and loss of tooth in patients with cantilever fixed partial denture were statistically similar to that of patients using removable partial

denture. However patients with removable partial denture were found to have increased number of visits to the dentist for maintenance of the prosthesis as compared to the CFPDs. These indicate that treatment with removable partial denture does nothave significant advantage over treatment with CFPDs in terms of occlusal stability. Risksfor TMD and occlusal instability of CFPDs were not statistically different than that for treatment with RPDs.[23,24]

It was observed in this systematic review and meta-analysis that studies which carried out comparison between the removable partial denture and cantilever fixed partial denture regarding occlusal stability concluded that there was significant difference between these two types of prosthesis regarding masticatory function. But the patient satisfaction was greater in case of patients treated with cantilever fixed partial denture. When there was further analysis then it was observed that patient using removable partial denture were found to have more proportion of caries, gingival inflammation and compromised oral hygiene.[25,26]

For dentists, the appropriate distribution of stresses within normal physiological limitations among the supporting structures of both permanent and removable partial dentures has been a major challenge. The cantilever fixed partial denture is similarly affected by this issue. It's not uncommon for the dental professionals to be faced with oral conditions that need the use of a cantilever-style fixed partial denture.[27,28]

It was discovered that by establishing a non-traumatic and stable occlusion, together with adequate periodontal health, stability was attained for a long time with cantilever fixed partial dentures.In order to prevent increase in mobility of abutment, tilting of abutment and migration of abutment there is need for establishment of balancing contacts. It become more important in situations where probability of mobility of fixed partial denture is more during the movements of mandible.[29,30]

CONCLUSION

A decrease in the quantity and size of cantilevered pontics is necessary to achieving improved occlusal stability in cantilever fixed partial dentures, according to the majority opinion. For patients with unilateral edentulous dentitions, the cantilever is a better option than the RPD.

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