

## The Impact of Removable Partial Dentures on the Health of Oral Tissues: A Systematic Review

Amna Ali Elmagtuf Ezawi, David Geoffrey Gillam and Philip Duncan Taylor\*

Dental Institute, Bart and the London School of Medicine and Dentistry, Queen Mary University of London, London, England, UK

\*Corresponding author: Philip Duncan Taylor, Dental Institute, Bart and the London School of Medicine and Dentistry, Queen Mary University of London, London, England, UK, E-mail: [p.d.taylor@qmul.ac.uk](mailto:p.d.taylor@qmul.ac.uk)

Received date: 15 Nov 2016; Accepted date: 27 Dec 2016; Published date: 02 Jan 2017.

Citation: Ezawi AAE, Gillam DG, Taylor PD (2017) The Impact of Removable Partial Dentures on the Health of Oral Tissues: A Systematic Review. Int J Dent Oral Health 3(2): doi <http://dx.doi.org/10.16966/2378-7090.226>

Copyright: © 2017 Ezawi AAE, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

### Abstract

**Objectives:** The aim of the present study was to review the available literature data to identify relevant studies for inclusion and to verify whether there is evidence to support the hypothesis that the insertion of an RPD into the oral cavity has a deterioration effect on the oral health status.

**Materials and methods:** 570 articles were identified, from searching both electronic databases (e.g., PUBMED) and manual searching of relevant written journals using an agreed search protocol up to 31st December 2011. The extraction of data for inclusion was conducted by two independent reviewers. The main outcomes of intervention involved both methodology and assessment tools applied by investigators to assess the effect of a RPD in terms of plaque accumulation, caries incidence, and gingival tissue (inflammation).

**Results:** 401 articles were excluded following an initial screening; 169 articles were included for the further review. At a second round screening, 163 articles were also rejected and six (Randomised Clinical Trials [RCTs]) articles were eventually accepted for inclusion. Based on the results, there was some scientific evidence supporting the hypothesis that RPDs placement may increase plaque accumulation and gingival inflammation. The importance of an established prevention program for RPD wearers (including good plaque control and OHI) either prior to or during treatment was emphasised by all investigators in the included studies. Among the limitations, however when evaluating the data, was the lack of homogeneity between the included studies (e.g., study design and duration, calibration details, clinical parameters to be evaluated, reporting of dropout rates and treatment intervention).

**Conclusion:** The conclusion from this present review would indicate that there were insufficient RCTs to adequately address the original research question, although a number of suggestions may be recommended. There was no doubt from the evidence presented in the published literature that in the absence of good oral hygiene measures a RPD may promote accumulation of the plaque which may in turn lead to gingival inflammation. Furthermore, there also appears to be a higher risk of dental caries (particularly root caries) in RPD wearers in the absence of good oral hygiene measures. The importance of an integrated prosthodontics maintenance programme with regular recall visits including both oral and denture hygiene care of a RPD cannot be under-estimated and should be adopted as a gold standard in general dental practice.

**Keywords:** Partial denture; Oral cavity; Oral hygiene

### Introduction

According to Tanaka et al. [1] the placement of a removable partial denture [RPDs] in the oral cavity would appear to affect both the quality and quantity of the bacteria by increasing the accumulation of plaque on the remaining teeth. For example, the insertion of RPDs into the oral cavity may restrict the cleaning mechanism of the tongue and lips, which in turn, may increase plaque accumulation [2]. Local factors that compromise oral hygiene and encourage plaque retention could also potentially increase the risk of development of caries and periodontal disease especially in the abutment teeth used to support the prosthesis. The question as to whether or not RPDs *per se* can cause damage to both the hard and soft tissues in the oral cavity is somewhat controversial. For example, it has been previously suggested that a RPD has a high biological cost on both soft and hard tissues which may (in time) lead to an increase in gingival inflammation, periodontal pocket depth, tooth mobility and dental caries [3-6]. However, other investigators have reported that RPDs may only cause minimal or no damage to the remaining teeth and periodontal tissue [7-13]. Furthermore, it has been reported that both gingival inflammation and periodontitis can be adequately treated by the clinician if the patient's plaque control is well regulated [14]. The aim of the present study was to review the published literature to identify appropriate studies for inclusion

and to verify whether there was any justification to support the hypothesis that the insertion of an RPD into the oral cavity has a deterioration effect on the health of the soft and hard tissues.

### Materials and Methods

The search methodology used for the present study was based on the PRISMA statement [15].

#### Selection criteria

**Types of study:** The review included any type of studies (e.g., clinical trials, randomized controlled trials (RCT), quasi RCT, *in vivo* and long term studies) as well as studies describing PICO questions and/or a PRISMA statement in which patients wearing RPDs were assessed for both their caries and periodontal status during the duration of the study.

**Types of participants:** Inclusion criteria for potentially eligible studies were partially edentulous patients who were over the age of 18 years and classified as either new RPD wearer or patients with an existing RPD.

#### Types of interventions:

1. Oral hygiene motivation prior to and during treatment with RPDs, in terms of any mechanical methods such as oral hygiene

instruction including brushing and/or adjunctive aids such as mouth washes were considered for inclusion.

2. Modification in the existing partial denture design (replacement denture).
3. Report of follow up period e.g. a minimum of 6 months after the insertion of the RPD.
4. Scaling procedures prior to and after the insertion of the RPD.

**Types of language:** Only completed published papers in English were considered for inclusion in this review.

**Types of outcome measures:** 1. The health status of denture bearing areas for example: soft tissue, periodontal tissues (for example pocket depth, plaque index, attachment loss, gingival recession, gingival index) as well as the hard tissues-teeth (caries).

### Search strategy

The search strategy involved electronic database search in Medline/PUBMED combined with hand searching up to 31st December 2011. Hand searching also included examining any relevant published or incomplete journals. The search key words in PUBMED were (“removable partial dentures” AND “attachment loss” OR “periodontal health” OR “gingival health”), (removable partial dentures AND oral hygiene OR scaling procedures), (removable partial dentures AND caries), randomized controlled trial OR controlled clinical trial OR cohort OR longitudinal OR “follow up” OR prospective OR case-control).

### Method of the review

A review of the abstracts and titles was conducted by A.Ezawi [AE] who then obtained copies of all the relevant studies where available for further consideration. Two reviewers (AE and DG) sought to determine the eligibility of the papers and data extraction. Any differences as to inclusion or exclusion of articles were resolved following discussion between AE and DG.

### Quality assessment of the included studies

The methodological quality of the included studies was assessed based on the criteria for the concealment of treatment allocation as described in the Cochrane Handbook for Systematic Review of Intervention [15]. Excluded studies were those studies where the random (or quasi-random) allocation of treatment was clearly not used in the study or random allocation was not stated, and was not implied/or possible to interpret. Studies that failed to clearly detail any open outcome assessment used, or blind outcome assessments that were not reported and subsequently considered unlikely by the reviewer(s) were also excluded.

## Results

### Overall description of the included and excluded studies

After the first screening of the identified papers for the current review, 570 potentially relevant articles were identified by searching either the electronic database (PUBMED) or by hand searching articles from the published literature. Unpublished articles were found by searching both the electronic databases or by hand searching. 169 articles were considered as relevant for full-text reading and 401 articles were excluded at the initial screening stage (Figure 1). Following an assessment of the selected 169 articles, 163 articles were excluded [1-12,14,16-165]. A review on denture base materials was identified following the completion of the study [166]. 6 articles were subsequently included in the present review [13,167-171]. The flow diagram of the selection procedure is demonstrated below (Figure 1).

From the 6 included articles, one article investigated denture connector designs (Lingual plate and lingual bar) [167], one article investigated

the effect of different denture clasps designs (gingivally and occlusally approaching clasps) [13], 3 articles compared two denture groups; e.g., Fixed Partial Denture [FPD] or RPD [168-170], one article compared two groups of patients who were either called back for regular check-ups with patients who were not on a regular check-up programme [171].

### Excluded studies

**General overview of the excluded studies:** There were a total of 401 articles excluded at the initial screening stage with 169 articles considered as relevant for further full-text reading (Figure 1). The reason for exclusion of 163 articles were as follows: 1) 30 review articles [4,14,16-46], 2) 9 *in vitro* articles [47-54]; 3) 4 case reports [55-58], 4) 2 pilot studies [59,60], 5) 5 incomplete data (no details of patient’s age) [5,61-64], 6) 2 survey articles [65,66], 7) Age criteria not meeting the inclusion criteria [67], 8) 2 articles could not be obtained [68-69 (duplicate of 29)], 9) 1 Randomised control trial Short-term study [70], 11) Remainder of the excluded articles were of a non-randomized controlled trial (RCT) design (short and long term studies) including investigation into microbiological impact on gingival health, denture design etc. [71-165]. A review on denture base materials was identified following the completion of the study [166].

### Analysis of the included studies

**Study design:** The six studies (long term) included in the current review were of a RCT design (Table 1) [13,167-171].

**Study population:** Most of the studies were conducted in the University hospitals. The recruited study subjects in these studies were partially dentate, elderly and adult who received periodontal treatment and all necessary restorative treatment prior to commencing the study. Regarding the gender distribution, most of the included studies enrolled almost equal numbers of female and male participants (Table 1). [167-171]. One study included only male subjects [13]. The total number of participants was 366 from the 6 included studies as described in Table 1.

**Study duration:** The duration of the included studies ranged from 2 years to 5 years (Table 1).

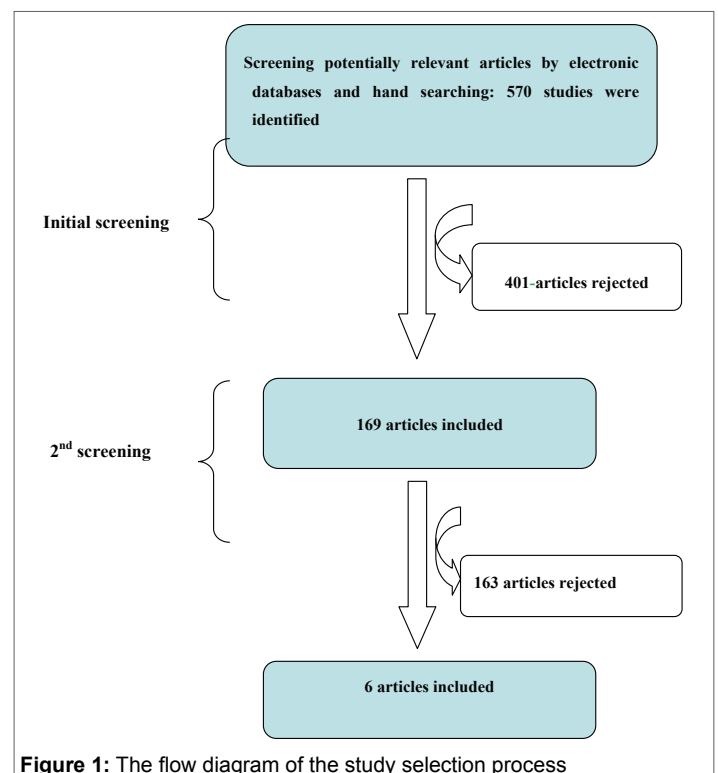


Figure 1: The flow diagram of the study selection process

No	Study	Duration	Participants	Intervention	Outcome investigated
1	Kapur et al. [13]	5 years	99 completing out of 134 (M: 134)	I-bar clasp vs. circumferential clasp	Plaque index, calculus index, gingival inflammation, pocket depth, gingival recession, bone height level, tooth mobility. Success rate
2	Akaltan & Kaynak [167]	2 ½ years	36 completing out of 36 (Not recorded)	Lingual palate major connector vs. lingual bar major connector	Gingival index, plaque index, tooth mobility, pocket depth, gingival recession, attachment loss
3	Jepson et al. [168]	2 years	50 completing out of 60 (M: 23, F: 35)	Cantilever RBB vs. RPDs	New and recurrent caries incidence, defective restoration, endodontic complication and tooth fracture
4	Budtz-Jorgensen & Isidor [169]	2 years	53 FPD (M: 13, F: 14) RPD (M: 12, F: 14)	FPDs vs. RPDs	Gingival index, plaque index, pocket depth, radiographic bone level, caries. Prosthetic parameters, functional, masticatory system by palpation.
5	Budtz-Jorgensen & Isidor [170]	5 years	42 completing out of 53 (M: 25, F: 28)	FPDs vs. RPDs	Gingival index, plaque index, pocket depth, radiographic bone level, caries. Prosthetic parameters, functional, masticatory system by palpation. Study appears to be a continuation of Budtz-Jorgensen & Isidor [169].
6	Vanzeveren et al. [171]	2 years	30 completing out of 30 (M: 19, F: 11)	Plaque control, reinforcement instruction, denture hygiene control, and professional prophylaxis vs. not recalled	Gingival index, plaque index, tooth mobility, pocket depth, attachment level, bacteriological examination

**Table 1:** Characteristics of the included studies

Study	Statistical test
Kapur et al. [13]	Log rank test, two-trial t-test
Akaltan & Kaynak [167]	ANOVA, student's t-test, Mann-Whitney H-test, paired t-test, Wilcoxon signed ranks test
Jepson et al. [168]	Uni-variate and multi-variate regression analysis
Budtz-Jorgensen & Isidor [169]	Chi-square test
Budtz-Jorgensen & Isidor [170]	--
Vanzeveren et al. [171]	Wilcoxon test, Mann-Whitney test, MANOVA

**Table 2:** Statistical tests used in the included studies

### Statistics power calculation

There were a wide variety of statistical tests used in the included studies (Table 2) [13,167-171].

In most of the six included studies, the degree of concealment was unclear (e.g., random allocation stated/indicated but the actual allocation concealment method was neither described, or that an apparently adequate concealment scheme was reported but there was a degree of uncertainty as to whether the allocation was adequate concealed). Only in the Jepson et al. [168] study were the selected participants randomly assigned to one of the treatment groups by gender, stratified by age using computer generated random numbers.

### Consideration of withdrawals and dropouts

Withdrawals and dropouts were only reported in three out of the six included studies (Table 1). The reasons for 'drop out' in the included studies were not recorded in three of the included studies (16, 18, 20) with no explanation provided in one study [13]. The remaining two studies [168, 171] reported that the 10 participants in each of the two studies dropped out for either personal reasons, ill health/debilitating diseases or death.

### Data analysis

No further analyses were performed. The heterogeneity among the included studies ruled out the conduct of a meta-analysis.

### Previous history of dental and gingival conditions at baseline

Baseline data were recorded after the participants were provided with periodontal treatment, scaling and polishing, restorative treatment and after completion of the prosthetic therapy. Some studies, for example, Jepson et al. [168] reported that the plaque score should be not more than 20% in order to be included in the study; whereas Kapur et al. [13] excluded medically compromised patients.

### Types of treatment intervention

In all the six included studies [13,167-171] oral hygiene instruction, periodontal therapy and scaling and polishing and all necessary restorative treatment were conducted before commencing the study.

### Clinical methodology used to assess the outcomes

There was a number of different assessment methods used for the clinical outcome measurements in the six included studies. However, the most commonly reported method used by investigators to assess the effect of the RPDs on both hard and soft tissues were: gingival index (GI) and plaque index (PI) and pocket depth (PD) (Table 1) Regarding the subjective assessment in the six included studies there were no reports of any subjective assessment made during the duration of the studies (Table 1).

### Measurement of Compliance

There were no reported measurements of patient compliance in any of the included studies.

### Blindness of the studies

No blinding of the examiners or interventions was described in any of the included studies.

### Overall conclusions from the included studies

The overall conclusions that were reported by Investigators in the included studies are described in Table 3 [13,167-171].

### Discussion

One of the problems in evaluating the effect of RPDs in the oral cavity was that there was considerable variation in the studies (e.g., duration, methodology used to assess the outcome(s) as well as the variation in the denture design, the status of the opposing arch and information relating

No	Study	RPD effects
1	Kapur et al. [13]	No evidence was provided on the unfavourable clinical outcomes (e.g., plaque (PII), calculus, gingival health (GI, PD, GR, BL, TM scores). The results from the study would suggest that a well-constructed RPD (of either design), supported by the abutment teeth with healthy periodontal tissues, and a six-month regular follow up may be a satisfactory treatment modality
2	Akaltan & Kaynak [167]	The results from the study indicated that both RPDs designs demonstrated a considerable reduction in all the periodontal parameters during the study period apart from the increase in gingival recession scores
3	Jepson et al. [168]	There was a significantly greater incidence of both new and recurrent caries lesions in patients provided with RPDs compared with patients with cantilever RBBs
4	Budtz-Jorgensen & Isidor [169]	The risk of dental caries and its consequences was higher in the RPD wearers than in the FPDs group
5	Budtz-Jorgensen & Isidor [170]	The risk of dental caries and its consequences e.g. tooth fracture, extraction and root canal treatment was higher in the RPD group than in the FPDs group and this may be as a result of the increased plaque accumulation in RPD wearers
6	Vanzeveren et al. [171]	According to the investigators the significant increase in the plaque scores during the study period was as a result of the patient's neglect and not as a result of the insertion of the partial denture

**Table 3:** Conclusions that were reported by investigators in the included studies

to the oral hygiene instructions. A number of investigators have suggested that the insertion of RPD into the oral cavity promoted changes in both the quantity and quality of the plaque and as a consequence increased the gingival inflammation or caries status as observed on the supporting teeth [3-4,168,68,92,133]. For example, Addy & Bates [6] suggested that the insertion of a RPD increased the risk of increased plaque levels and gingival inflammation. However, it was not clear from this particular study whether the subjects were new or existing RPD wearers or how they lost their teeth in the first place. A number of investigators [5,117] have suggested that improvements in the design of a RPD in conjunction with good oral hygiene procedures may limit any potential impact of a RPD on both the hard and soft tissues. According to Karpur et al. [13] a well-constructed removable partial denture of either design, supported by favourable abutments and accompanied by a regular recall program offers a satisfactory treatment modality. Furthermore, the incorporation of a well-designed RPD together with the implementation of a prosthetic maintenance programme, with regular check-ups and interventions may therefore be the ideal solution for the preservation and wellbeing of RPD wearers [8,12,92]. It is also important to acknowledge that the patient's personal hygiene procedures and motivation together with a supervised oral hygiene program may also play an important role for preventing any possible deterioration effects on the health of the oral tissues [1,169]. However, as Erpenstein [34] suggested that the interrelation between the periodontal status of a patient and a particular prosthetic appliance is of paramount importance when prosthetic treatment planning is to be designed. It is therefore essential that there was co-operation between both the Prosthodontic/Restorative and Periodontic specialties regarding the resolution of any periodontal therapy prior to initiating prosthetic treatment with the patient. From the published literature however, there appears to be very limited data on the instructions given to patients regarding the care of a RPD, relatively few investigators recorded this information [9,117] and as such it may be difficult to interpret the importance of any of these recommendations from the evidence in the published literature. As mentioned earlier in this review there may be a major impact on the quality of life of RPD wearers and while this aspect was not a major consideration when designing this present review there is no doubt that this topic deserves further investigation in future reviews on the impact of RPDs in the oral cavity. It was evident from the published literature that the caries risk, especially root surface caries was reported to be higher in RPD wearers, particularly if a regular follow-up appointment was not considered [3,124]. Fluoride therapy was also recommended by a number of Investigators as a preventive measure in RPD treatment; with a further recommendation that any coverage by the RPD and its components on the exposed root surface should be avoided [60,100,126]. Although not specifically covered the present systematic

review it should be recognised that there have been major advancements in the development of acrylic denture base materials e.g., poly methyl methacrylate resin (PMMA) over the last decade or so. For example, to improve the poor impact strength and low fatigue resistance of PMMA fiber reinforced resins have been introduced to improve the physical and mechanical properties of the material [166]. According to Vivek & Soni [166] the introduction of thermoplastic resins provided a number of advantages over the conventional powder-liquid systems, for example, in esthetics, stability, and comfort as well as improved mechanical properties such as wear characteristics and solvent resistance. The non-porous nature of these materials may also have a role in reducing the number of bacteria which may in turn reduce the amount of plaque accumulation.

One of the concerns when reading the methodology in the study design section of the various published studies was the lack of detail on how the examiners were trained and calibrated (e.g., Kappa values). It was evident from the review of the published literature that a number of the so-called classic studies failed to provide this information on any of the clinical outcomes that they were under investigation (e.g., 3,7,8,10 and 12). There were also limited data on study blinding, allocation, randomisation, drop outs etc., from a number of the excluded studies and some of these aspects were also missing from the included studies. Jepson et al. [168] did however mention that there was calibration of the examiners for caries diagnosis but no Kappa values were stated in their paper and this may raise concerns regarding the reproducibility of the outcomes being assessed. In retrospect there were also concerns that by conducting a very stringent review solely based on RCTs, the present study would find only a few studies that were robust for inclusion in the review. For example, a number of the so-called classic studies on the impact of RPDs and the importance of oral hygiene measures [12] were excluded on the basis of no randomisation etc. The final number of studies that were included was six in number and whether sufficient information and subsequent conclusions on the impact of RPDs on both the caries and periodontal status of denture wearers can be proposed on the basis of a relatively small number of studies may be questionable. The lack of homogeneity in the number of the included studies may also prevent any valid (evidence based) recommendations being proposed. There is undoubtedly a need for well conducted longitudinal RCTs to be conducted as proposed by Gomes and co-workers [35,45].

## Conclusion

The conclusion from this present review would indicate that there were insufficient RCTs to adequately address the original research question, although a number of suggestions may be recommended. There was no doubt from the evidence presented in the published literature that in the absence of good oral hygiene measures a RPD may promote



the accumulation of the plaque which may in turn lead to gingival inflammation. Furthermore, there also appears to be a higher risk of dental caries (particularly root caries) in RPD wearers in the absence of good oral hygiene measures. The importance of an integrated prosthodontics maintenance programme with regular recall visits to include both oral and denture hygiene care of a RPD cannot be under-estimated and should be adopted as a gold standard in general dental practice.

## References

1. Tanaka J, Tanaka M, Kawazoe T (2009) Longitudinal research on the oral environment of elderly wearing fixed or removable prostheses. *J Prosthodont Res* 53: 83-88.
2. Brill N, Tryde G, Stoltze K, El Ghamrawy EA (1977) Ecologic changes in the oral cavity caused by removable partial dentures. *J Prosthet Dent* 38: 138-148.
3. Carlsson GE, Hedegård B, Koivumaa KK (1965) Studies in partial dental prosthesis. IV. Final results of a 4-year longitudinal investigation of dentogingivally supported partial dentures. *Acta Odontol Scand* 23: 443-472.
4. Berg E (1985) Periodontal problems associated with use of distal extension removable partial dentures--a matter of construction? *J Oral Rehabil* 12: 369-379.
5. Orr S, Linden GJ, Newman HN (1992) The effect of partial denture connectors on gingival health. *J Clin Periodontol* 19: 589-594.
6. Addy M, Bates JF (1979) Plaque accumulation following the wearing of different types of removable partial dentures. *J Oral Rehabil* 6: 111-117.
7. Derry A, Bertram U (1970) A clinical survey of removable partial dentures after 2 years usage. *Acta Odontol Scand* 28: 581-598.
8. Schwalm CA, Smith DE, Erickson JD (1977) A clinical study of patients 1 to 2 years after placement of removable partial dentures. *J Prosthet Dent* 38: 380-391.
9. Bergman B, Hugoson A, Olsson CO (1971) Periodontal and prosthetic conditions in patients treated with removable partial dentures and artificial crowns. A longitudinal two-year study. *Acta Odontol Scand* 29: 621-638.
10. Bergman B, Hugoson A, Olsson CO (1977) Caries and periodontal status in patients fitted with removable partial dentures. *J Clin Periodontol* 4: 134-146.
11. Bergman B, Hugoson A, Olsson CO (1982) Caries, periodontal and prosthetic findings in patients with removable partial dentures: a ten-year longitudinal study. *J Prosthet Dent* 48: 506-514.
12. Bergman B, Hugoson A, Olsson CO (1995) A 25 year longitudinal study of patients treated with removable partial dentures. *J Oral Rehabil* 22: 595-599.
13. Kapur KK, Deupree R, Dent RJ, Hasse AL (1994) A randomized clinical trial of two basic removable partial denture designs. Part I: Comparisons of five-year success rates and periodontal health. *J Prosthet Dent* 72: 268-282.
14. Bergman B (1987) Periodontal reactions related to removable partial dentures: a literature review. *J Prosthet Dent* 58: 454-458.
15. Higgins JPT & Green S editors (2006) *Cochrane Handbook for Systematic Reviews of Intervention* 4.2.6.
16. Carr AB (2003) Effect of prosthetic remedial treatments on the oral health status of individuals and populations. *Int J Prosthodont* 55-58.
17. Nassif J (1975) Instructions for patients--a positive factor in removable partial denture service. *J Am Dent Assoc* 91: 1221-1223.
18. Tautin FS (1979) Abutment stabilization using a nonresilient gingival bar connector. *J Am Dent Assoc* 99: 988-989.
19. Carlsson GE, Hedegård B, Koivumaa KK (1970) The current place of removable partial dentures in restorative dentistry. Based on longitudinal investigations of dento-gingivally supported partial dentures. *Dent Clin North Am* 14: 553-568.
20. Hedegård B (1973) Longitudinal follow-up studies in prosthetic dentistry. *Int Dent J* 23: 489-494.
21. Leung KCM; Pow EHN (2009) Oral rehabilitation with removable partial dentures in advanced tooth loss situations. *Hong Kong Dental Journal* 6: 39-45.
22. Bui DX. Removable Partial Denture and its Effects on Periodontal Health.
23. Duckmanton NA (1979) Abutment preservation in partial denture design for older patients. *Ann R Australas Coll Dent Surg* 6: 62-74.
24. Davenport JC, Basker RM, Heath JR, Ralph JP, Glantz PO (2000) Removable partial dentures. 1. Need and demand for treatment. *Br Dent J* 189: 364-368.
25. Budtz-Jorgensen E, Bochet G (1998) Alternate framework designs for removable partial dentures. *J Prosthet Dent* 80: 58-66.
26. Budtz-Jørgensen E (1996) Restoration of the partially edentulous mouth--a comparison of overdentures, removable partial dentures, fixed partial dentures and implant treatment. *J Dent* 24: 237-244.
27. Preshaw PM, Walls AW, Jakubovics NS, Moynihan PJ, Jepson NJ, et al. (2011) Association of removable partial denture use with oral and systemic health. *J Dent* 39: 711-719.
28. Rocha EP, Luvizuto ER, Sabotto SF (2008) Biofilm formation and caries incidence with removable partial dentures. *Dent Today* 27: 62-63.
29. Knak G, Hahn P (1980) Caries incidence, tooth stability and the health of edentulous areas in patients wearing removable cast dentures. *Proc Eur Prosthodontic Assoc* 19-21.
30. Jones JD, Turkyilmaz I, Garcia LT (2010) Removable partial dentures--treatment now and for the future. *Tex Dent J* 127: 365-372.
31. Kerschbaum T (1982) Influence of removable partial dentures on tooth mobility. *Rev Belge Med Dent* 37: 101-110.
32. Walmsley AD (2003) Acrylic partial dentures. *Dent Update* 30: 424-429.
33. Hedegard B, Landt H (1983) Cantilever bridges or removable partial dentures in Kennedy Class I cases? *Quintessence Int Dent Dig* 14: 173-182.
34. Erpenstein H (1986) The role of the prosthodontist in the treatment of periodontal disease. *Int Dent J* 36: 18-29.
35. Gomes BC, Renner RP, Bauer PN (1980) Periodontal considerations in removable partial dentures. *J Am Dent Assoc* 101: 496-498.
36. Roberts BW (1980) The recall system. A necessary part of a partial denture service. *Br Dent J* 149: 46-48.
37. Owall B, Budtz-Jørgensen E, Davenport J, Mushimoto E, Palmqvist S, et al. (2002) Removable partial denture design: a need to focus on hygienic principles? *Int J Prosthodont* 15: 371-378.
38. Petridis H, Hempton TJ (2001) Periodontal considerations in removable partial denture treatment: a review of the literature. *Int J Prosthodont* 14: 164-172.
39. Cavalaris CJ (1973) Pathologic considerations associated with partial dentures. *Dent Clin North Am* 17: 585-600.
40. Dyer MR (1972) The 'Every' type acrylic partial denture. *Dent Pract Dent Rec* 22: 339-341.
41. Radford DR, Walter JD (1993) A variation in minor connector design for partial dentures. *Int J Prosthodont* 6: 50-54.
42. Mericske-Stern R (2009) Removable partial dentures. *Int J Prosthodont* 22: 508-511.
43. Waliszewski MP (2010) Turning points in removable partial denture philosophy. *J Prosthodont* 19: 571-579.

**Citation:** Ezawi AAE, Gillam DG, Taylor PD (2017) The Impact of Removable Partial Dentures on the Health of Oral Tissues: A Systematic Review. *Int J Dent Oral Health* 3(2): doi <http://dx.doi.org/10.16966/2378-7090.226>

44. Cook RJ (1991) Response to the oral mucosa of denture wearers. *J Dent* 19: 135-147.
45. Gomes BC, Renner RP (1990) Periodontal considerations of the removable partial overdenture. *Dent Clin North Am* 34: 653-668.
46. Fueki K, Yoshida E, Igarashi Y (2011) A systematic review of prosthetic restoration in patients with shortened dental arches. *Japanese Dental Science Review* 47: 167-174.
47. Muraki H, Wakabayashi N, Park I, Ohshima T (2004) Finite element contact stress analysis of the RPD abutment tooth and periodontal ligament. *J Dent* 32: 659-665.
48. Cecconi BT, Asgar K, Dootz E (1971) Removable partial denture abutment tooth movement as affected by inclination of residual ridges and type of loading. *J Prosthet Dent* 25: 375-381.
49. Cecconi BT, Asgar K, Dootz E (1971) The effect of partial denture clasp design on abutment tooth movement. *J Prosthet Dent* 25: 44-56.
50. Cecconi BT, Asgar K, Dootz E (1971) Fit of the removable partial denture base and its effect on abutment tooth movement. *J Prosthet Dent* 25: 515-519.
51. Cecconi BT, Asgar K, Dootz E (1972) Clasp assembly modifications and their effect on abutment tooth movement. *J Prosthet Dent* 27: 160-167.
52. Hebel KS, Graser GN, Featherstone JD (1984) Abrasion of enamel and composite resin by removable partial denture clasps. *J Prosthet Dent* 52: 389-397.
53. Jones RM, Goodacre CJ, Brown DT, Munoz CA, Rake PC (1992) Dentin exposure and decay incidence when removable partial denture rest seats are prepared in tooth structure. *Int J Prosthodont* 5: 227-236.
54. Hosman HJ (1990) Influence of clasp design of distal extension removable partial dentures on the periodontium of the abutment teeth. *Int J Prosthodont* 3: 256-265.
55. Krysiński Z, Fernando N (1988) A caries-free pattern of response by oral tissues to coverage by a mucosa-borne removable partial denture. *Quintessence Int* 19: 313-317.
56. Chaiyabutr Y, Brudvik JS (2008) Removable partial denture design using milled abutment surfaces and minimal soft tissue coverage for periodontally compromised teeth: a clinical report. *J Prosthet Dent* 99: 263-266.
57. Ogunbodede EO, Ojo MA, Otuyemi DO, Hollist NO (1992) Response of the oral tissues to prolonged uninterrupted coverage by a removable partial denture. Case report. *Aust Dent J* 37: 103-106.
58. Dello Russo NM (1982) Gingival autografts as an adjunct to removable partial dentures. *J Am Dent Assoc* 104: 179-181.
59. Lechner SK (1965) Partial Dentures and Gingival Health. *Aust Dent J* 10: 223-226.
60. Gomes BC, Renner RP, Antos EW, Baer PN, Carlson M (1981) A clinical study of the periodontal status of abutment teeth supporting swinglock removable partial dentures—a pilot study. *J Prosthet Dent* 46: 7-13.
61. Qudah, SA, Nassrawin N (2004) Effect of removable partial denture on periodontal health. *JRMS* 11: 17-19.
62. de Kok M, Thomas CJ (1990) Clinical study of the modified Equipoise clasp. *Aust Prosthodont J* 4: 53-57.
63. Eid M el-S, Abdel-Razek MK, Kamer AA (1974) A study of the different types of microorganisms present under removable and fixed prosthodontics. *Egypt Dent J* 20: 13-26.
64. Vanzeveren C, D'Hoore W, Bercy P, Leloup G (2003) Treatment with removable partial dentures: a longitudinal study. Part II. *J Oral Rehabil* 30: 459-469.
65. Hultén J, Tillström B, Nilner K (1993) Long term clinical evaluation of conical crown retained dentures. *Swed Dent J* 17: 225-234.
66. Eichner K (1979) Conservative and prosthetic rehabilitation procedures in the dentition of old people. *Int Dent J* 29: 285-297.
67. Murtooma H, Könönen M, Laine P (1992) Age and maintenance of removable dentures in Finland. *J Oral Rehabil* 19: 123-128.
68. Knak G, Hahn PP (1980) Caries incidence, tooth stability and the health of edentulous areas in patients wearing removable cast dentures. *Protet Stomatol* 30: 197-200.
69. Jung T (1982) Reaction of gingival tissues after insertion of removable partial dentures. *Protet Stomatol* 32: 21-26.
70. McHenry KR, Johansson OE, Christersson LA (1992) The effect of removable partial denture framework design on gingival inflammation: a clinical model. *J Prosthet Dent* 68: 799-803.
71. Carlsson GE, Hedegård B, Koivumaa KK (1961) Studies in partial dental prosthesis. II. An investigation of mandibular partial dentures with double extension saddles. *Acta Odontol Scand* 19: 215-237.
72. Carlsson GE, Hedegård B, Koivumaa KK (1962) Studies in partial dental prosthesis, III. A longitudinal study of mandibular partial dentures with double extension saddles. *Acta Odontol Scand* 20: 95-119.
73. Carlsson GE, Thilander H, Hedegård B (1967) Histologic changes in the upper alveolar process after extractions with or without insertion of an immediate full denture. *Acta Odontol Scand* 25: 21-43.
74. Mäkilä E, Koivumaa K, Jansson H (1971) Clinical investigations of skeletal partial dentures with lingual splint (continuous clasp). I. Periodontal and dental changes. *Suom Hammaslaak Toim* 67: 312-324.
75. Nyquist G, Hansson L, Glantz PO (1971) Effect of partial dentures on lactobacillus count in saliva. *Odontol Revy* 22: 19-26.
76. Bergman B, Carlsson GE (1972) Review of 54 complete denture wearers. Patients' opinions 1 year after treatment. *Acta Odontol Scand* 30: 399-414.
77. App GR (1973) Periodontal treatment for the removable partial prosthesis patient. Another half-century? *Dent Clin North Am* 17: 601-610.
78. Wagner AG (1973) Maintenance of the partially edentulous mouth and care of the denture. *Dent Clin North Am* 17: 755-768.
79. Budtz-Jørgensen E, Stenderup A, Grabowski M (1975) An epidemiologic study of yeasts in elderly denture wearers. *Community Dent Oral Epidemiol* 3: 115-119.
80. Carlsson GE, Hedegård B, Koivumaa KK (1976) Late results of treatment with partial dentures. An investigation by questionnaire and clinical examination 13 years after treatment. *J Oral Rehabil* 3: 267-272.
81. Ghamrawy EE (1976) Quantitative changes in dental plaque formation related to removable partial dentures. *J Oral Rehabil* 3: 115-120.
82. Addy M, Bates JF (1977) The effect of partial dentures and chlorhexidine gluconate gel on plaque accumulation in the absence of oral hygiene. *J Clin Periodontol* 4: 41-47.
83. Demer WJ (1977) Maintenance and aftercare for removable partial denture patients (I). *Quintessence Int Dent Dig* 8: 39-43.
84. el-Ghamrawy E (1977) Ecologic oral changes caused by removable partial dentures. *Egypt Dent J* 23: 23-35.
85. Nakazawa I (1977) A clinical survey of removable partial dentures. --Analysis of follow-up examinations over a sixteen-year period. *Bull Tokyo Med Dent Univ* 24: 125-137.
86. Bates JF, Addy M (1978) Partial dentures and plaque accumulation. *J Dent* 6: 285-293.
87. Welker WA, Kramer DC (1978) Claspless chrome-cobalt transitional removable partial dentures. *J Am Dent Assoc* 96: 814-818.
88. Abere DJ (1979) Post-placement care of complete and removable partial dentures. *Dent Clin North Am* 23: 143-151.
89. Bauman R (1979) Minimizing post insertion problems: a procedure for removable partial denture placement. *J Prosthet Dent* 42: 381-385.

**Citation:** Ezawi AAE, Gillam DG, Taylor PD (2017) The Impact of Removable Partial Dentures on the Health of Oral Tissues: A Systematic Review. *Int J Dent Oral Health* 3(2): doi <http://dx.doi.org/10.16966/2378-7090.226>

90. Benson D, Spolsky VW (1979) A clinical evaluation of removable partial dentures with I-bar retainers. Part I. *J Prosthet Dent* 41: 246-254.
91. el-Ghamrawy E, Runov J (1979) Offsetting the increased plaque formation in partial denture wearers by tooth brushing. *J Oral Rehabil* 6: 399-403.
92. Rissin L, House JE, Conway C, Loftus ER, Chauncey HH (1979). Effect of age and removable partial dentures on gingivitis and periodontal disease. *J Prosthet Dent* 42: 217-223.
93. el-Ghamrawy E (1980) Effective plaque control on successful distribution of partial denture patients. *Egypt Dent J* 26: 139-145.
94. el Ghamrawy E (1980) Plaque recordings as a guide to the prognosis for partial denture treatment. *J Oral Rehabil* 7: 117-121.
95. Runov J, Kroone H, Stoltze K, Maeda T, El Ghamrawy E, et al. (1980) Host response to two different designs of minor connector. *J Oral Rehabil* 7: 147-153.
96. Schulte JK, Smith DE (1980) Clinical evaluation of swinglock removable partial dentures. *J Prosthet Dent* 44: 595-603.
97. Zarb GA, MacKay HF (1980) The partially edentulous patient. I. The biologic price of prosthodontic intervention. *Aust Dent J* 25: 63-68.
98. Cerny R (1981) The clasplless partial denture. *Aust Dent J* 26: 1-4.
99. Langer A (1981) Telescope retainers for removable partial dentures. *J Prosthet Dent* 45: 37-43.
100. Gomes BC, Renner RP, Antos EW Jr, Baer PN (1982) A three year study of the periodontal health status of the natural teeth supporting swing-lock removable partial dentures. *Quintessence Int Dent Dig* 13: 965-972.
101. Lofberg PG, Ericson G, Eliasson S (1982) A clinical and radiographic evaluation of removable partial dentures retained by attachments to alveolar bars. *J Prosthet Dent* 47: 126-132.
102. Kratochvil FJ, Davidson PN, Guijt J (1982) Five-year survey of treatment with removable partial dentures. Part I. *J Prosthet Dent* 48: 237-244.
103. Firtell DN, Jacobson TE (1983) Removable partial dentures with rotational paths of insertion: problem analysis. *J Prosthet Dent* 50: 8-15.
104. Chandler JA, Brudvik JS (1984) Clinical evaluation of patients eight to nine years after placement of removable partial dentures. *J Prosthet Dent* 51: 736-743.
105. Germundsson B, Hellman M, Odman P (1984) Effects of rehabilitation with conventional removable partial dentures on oral health--a cross-sectional study. *Swed Dent J* 8: 171-182.
106. Hirschfeld Z, Friedman M, Golomb G, Ben-Yaacov D (1984) New sustained release dosage form of chlorhexidine for dental use: use for plaque control in partial denture wearers. *J Oral Rehabil* 11: 477-482.
107. Spielberger MC, Lubow RM, Bange AA, Mayhew RB (1984) Effect of retentive arm clasp design on gingival health: a feasibility study. *J Prosthet Dent* 52: 397-401.
108. Germundsson B, Hellman M, Odman P (1985) Effects of rehabilitation with conventional removable partial dentures on oral health--a cross-sectional study. Part II. A comparative study of treatment results at two Public Dental Clinics and the Faculty of Odontology in Gothenburg. *Swed Dent J* 9: 233-240.
109. Rissin L, Feldman RS, Kapur KK, Chauncey HH (1985) Six-year report of the periodontal health of fixed and removable partial denture abutment teeth. *J Prosthet Dent* 54: 461-467.
110. Bergman B, Ericson G (1986) Cross-sectional study of patients treated with removable partial dentures with special reference to the caries situation. *Scand J Dent Res* 94: 436-442.
111. Bazirgan MK, Bates JF (1987) Effect of clasp design on gingival health. *J Oral Rehabil* 14: 271-281.
112. Kapur KK (1987) Veterans Administration Cooperative Dental Implant Study--comparisons between fixed partial dentures supported by blade-vent implants and removable partial dentures. Part I: Methodology and comparisons between treatment groups at baseline. *Prosthet Dent* 58: 499-512.
113. Lappalainen R, Koskenranta-Wuorinen P, Markkanen H (1987) Periodontal and cariological status in relation to different combinations of removable dentures in elderly men. *Gerodontology* 3: 122-124.
114. Nada M, Gharrphy S, Badawy MS (1987) A two year longitudinal study on the effect of removable partial denture design on the health of the remaining teeth. *Egypt Dent J* 33: 85-95.
115. Nada MA, Shoeib MA, Abbas N (1987) Microbiological study on early plaque formation in partial denture wearers. *Egypt Dent J* 33: 173-199.
116. Nyssönen V, Lappalainen R, Honkala E, Markkanen H, Paunio I (1987) Subjective need of removable denture treatment in Finnish adults. *J Oral Rehabil* 14: 393-398.
117. Gillam DG (1988) The effect of coverage by a partial denture on plaque and gingival health. MSc Thesis University of London, London UK.
118. Mihalow DM, Tinanoff N (1988) The influence of removable partial dentures on the level of *Streptococcus mutans* in saliva. *J Prosthet Dent* 59: 49-51.
119. Tuominen R, Ranta K, Paunio I (1988) Wearing of removable partial dentures in relation to dental caries. *J Oral Rehabil* 15: 515-520.
120. Bergman B, Ericson G (1989) Cross-sectional study of the periodontal status of removable partial denture patients. *J Prosthet Dent* 61: 208-211.
121. Chew CL, Tan PH (1989) Flange design in removable partial dentures. *Ann Acad Med Singapore* 18: 560-563.
122. Hiroto T, Yoshihara A, Ogawa H, Miyazaki H (2012) Tooth-related risk factors for tooth loss in community-dwelling elderly people. *Community Dent Oral Epidemiol* 40: 154-163.
123. Kapur KK (1989) Veterans Administration Cooperative Dental Implant Study--comparisons between fixed partial dentures supported by blade-vent implants and removable partial dentures. Part II: Comparisons of success rates and periodontal health between two treatment modalities. *J Prosthet Dent* 62: 685-703.
124. Tinanoff N, Manwell MA, Zameck RL, Grasso JE (1989) Clinical and microbiological effects of daily brushing with either NaF or SnF<sub>2</sub> gels in subjects with fixed or removable dental prostheses. *J Clin Periodontol* 16: 284-290.
125. Tuominen R, Ranta K, Paunio I (1989) Wearing of removable partial dentures in relation to periodontal pockets. *J Oral Rehabil* 16: 119-126.
126. Isa Z, Yusof Z (1990) Other dental treatment needs in patients who requested removable partial dentures. *J Oral Rehabil* 17: 541-550.
127. Wright PS, Hellyer PH, Beighton D, Heath R, Lynch E (1992) Relationship of removable partial denture use to root caries in an older population. *Int J Prosthodont* 5: 39-46.
128. Drake CW, Beck JD (1993) The oral status of elderly removable partial denture wearers. *J Oral Rehabil* 20: 53-60.
129. Berg T, Caputo AA (1993) Maxillary distal-extension removable partial denture abutments with reduced periodontal support. *J Prosthet Dent* 70: 245-250.
130. Mjör IA, Christensen GJ (1993) Assessment of local side effects of casting alloys. *Quintessence Int* 24: 343-351.
131. Molin M, Bergman B, Ericson A (1993) A clinical evaluation of conical crown retained dentures. *J Prosthet Dent* 70: 251-256.
132. Mullally BH, Linden GJ (1994) Periodontal status of regular dental attenders with and without removable partial dentures. *Eur J Prosthodont Restor Dent* 2: 161-163.

**Citation:** Ezawi AAE, Gillam DG, Taylor PD (2017) The Impact of Removable Partial Dentures on the Health of Oral Tissues: A Systematic Review. *Int J Dent Oral Health* 3(2): doi <http://dx.doi.org/10.16966/2378-7090.226>



133. Yamaga T, Kmoda Y, Soga K, Ono M, Asada T, et al. (1994) Root surface caries of denture wearers in middle-aged and elderly people. *J Osaka Univ Dent Sch* 34: 65-71.
134. Yusuf Z, Isa Z (1994) Periodontal status of teeth in contact with denture in removable partial denture wearers. *J Oral Rehabil* 21: 77-86.
135. Jepson NJ, Thomason JM, Steele JG (1995) The influence of denture design on patient acceptance of partial dentures. *Br Dent J* 178: 296-300.
136. Mojon P, Rentsch A, Budtz-Jørgensen E (1995) Relationship between prosthodontic status, caries, and periodontal disease in a geriatric population. *Int J Prosthodont* 8: 564-571.
137. Owall B (1995) Precision attachment-retained removable partial dentures: Part 2. Long-term study of ball attachments. *Int J Prosthodont* 8: 21-28.
138. Wright PS, Hellyer PH (1995) Gingival recession related to removable partial dentures in older patients. *J Prosthet Dent* 74: 602-607.
139. Bassi F, Mantecchini G, Carossa S, Preti G (1996) Oral conditions and aptitude to receive implants in patients with removable partial dentures: a cross-sectional study. Part I. oral conditions. *J Oral Rehabil* 23: 50-54.
140. Besimo C, Gächter M, Jahn M, Hassell T (1997) Clinical performance of resin-bonded fixed partial dentures and extracoronary attachments for removable prostheses. *J Prosthet Dent* 78: 465-471.
141. Igarashi Y, Goto T (1997) Ten-year follow-up study of conical crown-retained dentures. *Int J Prosthodont* 10: 149-155.
142. Marxkors R (1997) Mastering the removable partial denture. Part one: Basic reflections about construction. *J Dent Technol* 14: 34-39.
143. Marxkors R (1997) Mastering the precision removable partial denture. Part Two. Connection of partial dentures to the abutment teeth. *J Dent Technol* 14: 24-30.
144. Steele JG, Walls AW, Murray JJ (1997) Partial dentures as an independent indicator of root caries risk in a group of older adults. *Gerodontology* 14: 67-74.
145. Rich B, Kurtz KS (1998) The new removable denture patient: treatment procedures. *J Prosthet Dent* 80: 124-128.
146. Mojon P, Budtz-Jørgensen E, Rapin CH (1999) Relationship between oral health and nutrition in very old people. *Age Ageing* 28: 463-468.
147. Wagner B, Kern M (2000) Clinical evaluation of removable partial dentures 10 years after insertion: success rates, hygienic problems, and technical failures. *Clin Oral Investig* 4: 74-80.
148. Yeung AL, Lo EC, Chow TW, Clark RK (2000) Oral health status of patients 5-6 years after placement of cobalt-chromium removable partial dentures. *J Oral Rehabil* 27: 183-189.
149. Zlatarić DK, Celebić A, Valentić-Peruzović M (2002) The effect of removable partial dentures on periodontal health of abutment and non-abutment teeth. *J Periodontol* 73: 137-144.
150. Knezović Zlatarić D, Celebić A, Valentić-Peruzović M, Jerolimov V, Pandurić J (2003) A survey of treatment outcomes with removable partial dentures. *J Oral Rehabil* 30: 847-854.
151. Polansky R, Haas M, Lorenzoni M, Wimmer G, Pertl C (2003) The effect of three different periodontal pre-treatment procedures on the success of telescopic removable partial dentures. *J Oral Rehabil* 30: 353-363.
152. Rocha EP, Francisco SB, Del Bel Cury AA, Cury JA (2003) Longitudinal study of the influence of removable partial denture and chemical control on the levels of *Streptococcus mutans* in saliva. *J Oral Rehabil* 30: 131-138.
153. Nevalainen MJ, Närhi TO, Ainamo A (2004) A 5-year follow-up study on the prosthetic rehabilitation of the elderly in Helsinki, Finland. *J Oral Rehabil* 31: 647-652.
154. Chiba T, Kawata T, Koyama S, Gorai S, Toki N, et al. (2005) The effects of RPD wearing on periodontal conditions of abutment and non-abutment teeth. *International Congress Series* 1284: 69-70.
155. Jorge JH, Giampaolo ET, Vergani CE, Machado AL, Pavarina AC, et al. (2007) Clinical evaluation of abutment teeth of removable partial denture by means of the Periotest method. *J Oral Rehabil* 34: 222-227.
156. Saleh Saber F, Abou Alfazli N (2008) The Effects of Removable Partial Dentures on the Periodontal health status of abutment and nonabutment teeth. *Journal Of Dentistry (Shiraz University Of Medical Sciences)* 9: 156-162.
157. Barreiro DM, Scheid PA, May LG, Unfer B, Braun KO (2009) Evaluation of procedures employed for the maintenance of removable dentures in elderly individuals. *Oral Health Prev Dent* 7: 243-249.
158. Dong C, Zhang FQ (2009) Effect of denture base materials on mRNA expression of the adhesion-associated genes from the *Streptococcus mutans* biofilms. *J Oral Rehabil* 36: 894-901.
159. Mine K, Fueki K, Igarashi Y (2009) Microbiological risk for periodontitis of abutment teeth in patients with removable partial dentures. *J Oral Rehabil* 36: 696-702.
160. Ribeiro DG, Pavarina AC, Giampaolo ET, Machado AL, Jorge JH, et al. (2009) Effect of oral hygiene education and motivation on removable partial denture wearers: longitudinal study. *Gerodontology* 26: 150-156.
161. Matsuda K, Ikebe K, Enoki K, Tada S, Fujiwara K, et al. (2011) Incidence and association of root fractures after prosthetic treatment. *J Prosthodont Res* 55: 137-140.
162. doAmaral BA, Barreto AO, Gomes Seabra E, Roncalli AG, da Fonte Porto Carreiro A, et al. (2010) Clinical follow-up study of the periodontal conditions of RPD abutment and non-abutment teeth. *J Oral Rehabil* 37: 545-552.
163. Correa MB, Peres MA, Peres KG, Horta BL, Gigante DP, et al. (2010) Life-course determinants of need for dental prostheses at age 24. *J Dent Res* 89: 733-738.
164. Pellizzer EP, Mazaro JV, Verri FR, Antenucci RM, Goiato MC (2010) Removable partial denture in combination with a milled fixed partial prosthesis as interim restorations in long-term treatment. *J Prosthodont* 19: 77-80.
165. Shimura Y, Wadachi J, Nakamura T, Mizutani H, Igarashi Y (2010) Influence of removable partial dentures on the formation of dental plaque on abutment teeth. *J Prosthodont Res* 54: 29-35.
166. Vivek R, Soni R (2015) Denture base Materials: Some Relevant Properties and their Determination. *Int J Dent Oral Health* 1.
167. Akaltan F, Kaynak D (2005) An evaluation of the effects of two distal extension removable partial denture designs on tooth stabilization and periodontal health. *J Oral Rehabil* 32: 823-829.
168. Jepson NJ, Moynihan PJ, Kelly PJ, Watson GW, Thomason JM (2001) Caries incidence following restoration of shortened lower dental arches in a randomized controlled trial. *Br Dent J* 191: 140-144.
169. Budtz-Jørgensen E, Isidor F (1987) Cantilever bridges or removable partial dentures in geriatric patients: a two-year study. *J Oral Rehabil* 14: 239-249.
170. Budtz-Jørgensen E, Isidor F (1990) A 5-year longitudinal study of cantilevered fixed partial dentures compared with removable partial dentures in a geriatric population. *J Prosthet Dent* 64: 42-47.
171. Vanzeveren C, D'Hoore W, Bercy P (2002) Influence of removable partial denture on periodontal indices and microbiological status. *J Oral Rehabil* 29: 232-239.