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Comparative Evaluation of Esthetic Materials Used For Fixed Partial Prosthesis on the Periodontal Status – A One Year Retrospective Follow-UP

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Abstract

Objective: Sound periodontal foundation is essential for successful restorative therapy and also for long-term success of prosthodontic restorations. A number of novel esthetic materials have become popular in fixed prosthodontics today. Endodontically treated teeth are commonly required to serve as abutments for crowns, fixed or removable partial dentures. Many clinicians are of the opinion that endodontically treated teeth do not serve as well as vital teeth. The present study aimed to assess the long term effect and tissue responses of various types of fixed partial prosthesis using endodontically treated as abutments on the periodontal parameters both clinically and radiographically.

Methodology: Following ethical committee approval, the study group comprised of 52 abutment teeth in 26 systemically healthy patients (14 males and 12 females) aged between 18 – 45 years who had received 3 unit fixed prosthesis(IPS empress, PFM or zirconia), having equigingival margins using endodontic teeth as abutments with post and core. The following parameters were assessed at baseline, phase 1, 3 and 4 (1 year follow up) – CAL, Probing depth, Distance between CEJ/ cervical crown margin and alveolar crest of the abutment teeth(radiograph).

Results: Statistical analysis carried out by SPSSV22 software revealed significant changes in clinical and radiographic parameters from baseline and phase 1 to phase 4 with all the three types of materials with IPS empress proving to be better.($P<0.01$).

Conclusion: The response of the periodontal tissues to the various types of fixed prosthesis on endodontically treated

abutment teeth with post and core was almost similar with slight variation.

Introduction

The fixed partial denture (FPD) for the restoration of partially edentulous ridges, serves as an excellent means of replacing missing teeth, where the dental implant is relatively or totally contraindicated. (1). This is largely dependent upon the health and stability of the surrounding periodontal structures. (2). The knowledge of the responses of periodontal tissues to fixed partial dentures is crucial in the development of treatment plan with predictable prognosis. Several studies have in the past indicated that poor marginal adaptation,(3) sub-gingival margin placement, (4) and over-contoured crowns (5) can contribute to localized periodontal inflammation. These studies have forced clinicians and researchers to focus on the qualities of FPDs and crowns in order to reduce the periodontal inflammation and ensure long term prognosis of the prosthesis as periodontal health governs FPD survival to a large extent. PFM crowns have been popular FPD materials for a long time.

All-ceramic crowns have been used over the last four decades as an alternative for PFM crowns to overcome their esthetic limitations (6). All-ceramic crowns can be made from different types of ceramic materials such as lithium disilicate, zirconia, leucite-reinforced glass, and glass-infiltrated alumina, and such newer metal-free crowns are increasingly being used in dental practice.(6)

Ceramic abutments, fabricated from yttrium stabilized-zirconium oxide (ZrO2), have been developed for their color, (similar to that of teeth), high loading strength, tissue tolerability, and intrasulcular design enhancement (7). As a result of patient demand, veneers and crowns are currently available in ZrO2 or, recently, in lithium disilicate (LS2) ceramic(8).

Endodontically treated teeth are commonly required to serve as abutments for crowns, fixed partial dentures, or removable partial dentures. Many clinicians are of the opinion that endodontically treated teeth do not serve as well as vital teeth.(9). However some researchers believe that with appropriate preparation designs, endodontically treated teeth can serve well as abutments for crowns. Wegner et al (10) concluded that the endodontically treated teeth restored with endodontic posts and crowns had a good survival rate (92.7%) when observed for a 5 year period. In some fixed partial denture designs, the use of endodontically treated teeth may be contraindicated.

Since most of the relevant studies were carried out in different European countries because of the lack of such studies from other parts of the world, it would be interesting to investigate in other populations with different cultural, ethnic and dietary backgrounds. Thus, the aim of the present cross sectional study was to assess the periodontal conditions in a group of Saudi adults who had received regular oral prophylaxis following the insertion of FPDs.

Materials and methods

Following approval from the institutional Ethical Committee at ISNC, nearly 200 patients treated with 3 unit FPDs in the period between January 2017 and December 2018 were screened. Of these 52 patients were selected for the study based on the following inclusion criteria:

(1) adults who were systemically healthy, non-smokers, and who had 3 unit FPDs for at least one year and

(2) Abutment teeth that were endodontically treated with post and core and equigingival margins with plaque and gingival indices less than 10%.

Informed consents were obtained from the enrolled subjects after explaining the nature of the study and possible risks involved.

Clinical and radiographic measurements were made on the abutment teeth in the various phases of treatment:

Phase 1 – 4 weeks after baseline

Phase 3 (restorative phase) – 4 weeks after phase 1

Phase 4 – 1 year after phase 3

The following measurements were made clinically on the abutment teeth at baseline and end of phase 1, phase 3 and phase 4 with a UNC 15 periodontal probe.(company name)

1. Probing depth(facial and lingual)
2. Clinical attachment level(CAL) (facial and lingual)

A total of 6 measurements, 3 each on the facial and lingual surfaces and an average of these was used as a final value.

The following measurements were made on the radiographs on the abutment teeth at baseline and end of phase 3 and phase 4 using grids.

1. Distance from CEJ to alveolar crest. (baseline)
2. Distance from cervical margin of crown to alveolar crest. (phase 3 and 4)

Care was taken to ensure that the radiographic techniques and the radiographs were standardized to maintain homogeneity in measurements.

The linear distances in two dimensions were measured using the following mathematical formula:

$$\frac{\text{Actual distance between two points (grid)}}{\text{Measured distance between two points (grid)}} = \frac{\text{Actual distance between two points (anatomic)}}{\text{Measured distance between two points (anatomic)}}$$

The distance measured was between 2 points - cement-enamel junction/ crown margin to alveolar crest.

The patients were given appropriate oral hygiene instructions to ensure maintenance of low plaque scores throughout the duration of the study.

Results

Statistical analysis was carried out using SPSSV22 software. Since the data was not normal, a non-parametric test such as Freidman test was used and to assess the differences in the various phases of each material, post hoc analysis with Wilcoxon signed rank tests was conducted with a Bonferroni correction applied.

IPS EMPRESS : (TABLE 1)

The abutment teeth receiving IPS empress crowns revealed a statistically significant reduction in probing depth from baseline to phase 4, phase 1 to 4 and phase 3 to 4($P<0.01$). In addition, there was also a significant reduction in CAL from Phase 1 to 4 only($P<0.01$). However, no significant changes were observed in the bone levels seen in the radiographs from baseline to phase 3 and 4.($p>0.05$)

Porcelain fused to Metal(PFM): (TABLE 2)

The abutment teeth receiving PFM crowns revealed a statistically significant reduction in probing depth from baseline to phase 4, phase 1 to 4 and phase 3 to 4($P<0.01$). In addition, there was also a significant reduction in CAL from baseline to phase 3 and 4; Phase 1 to 4 and phase 3 to 4($P<0.01$). Moreover, there was also a significant improvement in bone levels from baseline to phase 3 and 4($P<0.01$) but not from phase 3 to 4($P>0.05$).

Zirconia: (TABLE 3)

The abutment teeth receiving zirconia crowns revealed a statistically significant reduction in probing depth from baseline to phase 4 only.($P<0.01$). With regard to CAL, there was also a significant reduction from phase 3 to 4 only ($P<0.01$) and not in the other phases($p>0.05$). However, there was a significant improvement in bone levels from baseline to phase 4 and phase 3 to 4 ($P<0.01$) but not from baseline to phase 3($P>0.05$).

Changes in periodontal parameters in phase 3 in the different materials: (TABLE 4)

Kruskal-Wallis test showed that there was a statistically significant difference in phase 3 in Probing depth between the different material (PFM, IPS, ZIRC), Chi-Sqaure (d.f=2) = 9.46, p = 0.009, with a mean rank of

38.10 for IPF, 25.96 for PFM and 20.13 for ZIRC. There was no significance difference found in CAL and RBL .

Changes in periodontal parameters in phase 4 in the different materials: (TABLE 5)

Difference in phase 3 and phase 4 has no statistically significant difference in Probing depth, CAL and RBL between the different material (PFM, IPS, ZIRC)

Discussion

The need for this study had risen from the growing popularity of the newer esthetically and biologically compatible materials used in fixed partial dentures today. Although PFM has been a popular choice for a long time, newer esthetic materials such as IPS empress and zirconia are gradually replacing it.

This study was designed to assess the periodontal status of a group of Saudi adult patients following the insertion of FPDs. Such an assessment is considered valuable since the FPD is still a very common replacement option for edentulous ridges and it seems essential to adequately understand the oral health status of such patients in order to establish effective preventive programs.

It was decided to include only bridges in which the abutment teeth were endodontically treated with post and core and the crown margins were equigingival. Only 3 unit bridges were included in order to standardize the occlusal load on the abutments and keep it uniform. Bridges with multiple units would have further led to variations in clinical and radiographic parameters owing to variations in the load bearing capacity of the abutments. This made it easier to standardize the study population and perform appropriate measurements both clinically and radiographically as the landmarks could be easily determined for linear measurements. There is a great deal of evidence surrounding the suitability of endodontic teeth as abutments with an equal number of them supporting and against their use as suitable abutments.

Biocompatibility and chemical durability are highly important properties in dental materials. Zirconia ceramics have been reported not to have potential toxic or genotoxic effects (11), (12), (13) and to present satisfactory soft tissue responses. (14) De Baker reported that irrespective of margin configuration, it is the baseline periodontal health that determines the long term periodontal success of a fixed restoration. (15)

Weishaupt et. al. (16) presented an interesting theory. According to their findings, particular alloy type may have a stabilizing effect on gingival health irrespective of level of margin placement. Contrary to the claim made by Weishaupt, Reitemeier et al (17) did not find any effect of the type of alloy on gingival health and reported that type of alloy did not affect the level of plaque accumulation and gingival health was similar around any alloy. Christensen in a comparison of zirconium to metal fused to porcelain crowns also made similar conclusions. (18) Kancyper also noted similar findings.(19) Abidi et al (20) concluded that the type of restorative material had no effect on the health of periodontal tissues. Alsinaidi et al 2014 (2) indicated that in subjects with fixed partial dentures, the abutment teeth are more prone to periodontal inflammation than the non-abutment teeth. Additionally, the individual's age, duration of insertion of fixed partial dentures and location of the crown margins affect the periodontal health of the abutments.

On the basis of such varying evidences, it was decided to assess the effects of recent materials used in fixed prosthesis today on the periodontal status by evaluating the clinical and radiographic status. The abutment teeth on each of the materials revealed significant changes from baseline and phase 1 to phase 3 & 4 of treatment with regard to PD, CAL, RBL suggesting thereby that all of them have a positive effect on the periodontal tissues. A comparative evaluation of the 3 materials from phase 3 to

phase 4 revealed significantly better outcomes in clinical and radiographic parameters with zirconia and PFM compared to IPS empress.

These findings are in contrast to the findings of Mishary et al, who concluded that within the limits of this study, ceramic fused to metal crowns appear to be associated with more periodontal breakdown than full ceramic crown. (6)

There has been a lot of conflicting evidence with regard to endodontically treated teeth as abutments. Our study showed that the type of material used for FPD did not considerably affect the periodontal parameters of the abutment teeth in spite of endodontic treatment. This is in accordance with the findings of De Backer et al (2007) who suggested that there was no difference between complete crowns on vital abutments versus endodontically treated ones or post and core treated abutments.(15) Speilman et al (21) concluded that one of the factors associated with restorative success for endodontically treated teeth was good periodontal health thus suggesting that the type of material used may not be relevant.

Thus in our study, although the baseline PPD and CAL values were significantly high; at the end of phase 1 all the values had reduced significantly and there were insignificant differences between all the 3 types of abutment materials. However, PFM and zirconia also revealed significant changes in radiographic bone levels in phase 3 and 4 compared to IPS empress. Overall, PFM material abutments revealed a significantly better periodontal status in comparison to IPS empress and zirconia in the 1 year follow up period.

Limitations

A larger sample size on a larger cross section of the population including vital abutments is recommended for more authenticity in results.

Conclusion

Within the limitations of the study, overall, the type of material used in FDP may not influence the long term periodontal status, nevertheless, PFM and Zirconia materials were found to be more tissue friendly compared to IPS empress material.

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List of Tables

Table 1: Comparison of clinical parameters and radiologic parameters with IPS Impress material :

	PROBING DEPTH			CAL			Radiographic bone level		
Phases	Z	Asymp. Sig. (2-Tailed)	Significance	Z	Asymp. Sig. (2-Tailed)	Significance	Z	Asymp. Sig. (2-Tailed)	Significance
Baseline to phase 1	-.816[b]	0.414		-2.271[b]	.023				
Baseline to phase 3	-.108[b]	.914		-.771[b]	.441		-.108[b]	.914	
Baseline to phase 4	-2.877[c]	.004*	significant	-1.930[c]	.054		-.649[b]	.516	
Phase 1 to phase 3	-.632[c]	.527		-.284[c]	.776				
Phase 1 to phase 4	-2.836[c]	.005*	significant	-2.699[c]	.007*	significant			
Phase 3 to phase 4	-2.699[c]	.007*	significant	-1.697[c]	.090		-.541[b]	.589	

Table 2: Comparison of clinical parameters and radiologic parameters with PFM material :

	PROBING DEPTH			CAL			Radiographic bone level		
Phases	Z	Asymp. Sig. (2-Tailed)	Significance	Z	Asymp. Sig. (2-Tailed)	Significance	Z	Asymp. Sig. (2-Tailed)	Significance
Baseline to phase 1	-2.352[b]	.019		-3.448[b]	.001*	significant			
Baseline to phase 3	-2.277[b]	.023		-2.825[b]	.005*	significant	-2.640[b]	.008*	significant
Baseline to phase 4	-3.778[b]	.000*	significant	-3.964[b]	.000*	significant	-3.153[b]	.002*	significant
Phase 1 to phase 3	-1.292[b]	.196		-1.735[b]	.083				
Phase 1 to phase 4	-3.279[b]	.001*	significant	-3.477[b]	.001*	significant			
Phase 3 to phase 4	-2.765[b]	.006*	significant	-3.626[b]	.000*	significant	-.905[b]	.366	

Table 3: Comparison of clinical parameters and radiologic parameters with ZIRCONIA material

	PROBING DEPTH			CAL			Radiographic Bone Level		
Phases	Z	Asymp. Sig. (2-Tailed)	Significance	Z	Asymp. Sig. (2-Tailed)	Significance	Z	Asymp. Sig. (2-Tailed)	Significance
Baseline To Phase 1	-2.889[b]	.004*	Significant	-1.084[b]	.279				
Baseline To Phase 3	-2.038[b]	.042		-1.103[b]	.270		-1.414[b]	.157	
Baseline To Phase 4	-3.126[b]	.002*	Significant	-1.588[c]	.112		-3.051[b]	.002*	Significant
Phase 1 To Phase 3	-.054[c]	.957		-.108[b]	.914				
Phase 1 To Phase 4	-1.732[b]	.083		-2.397[c]	.017				
Phase 3 To Phase 4	-1.857[b]	.063		-2.725[c]	.006*	Significant	-2.714[b]	.007*	Significant

Table 4: Changes In The Periodontal Parameters Of The Different Material In Phase 3, Kruskal-Wallis Test Results

	Material	Mean Rank	Chi-Square	Significance	
PD	PFM	25.96	9.460	.009*	Significant(IPS empress)
	IPS	38.10			
	ZIRC	20.13			
CAL	PFM	22.35	4.112	.128	Not Significant
	IPS	31.30			
	ZIRC	30.25			
RBL	PFM	26.42	0.762	.683	Not Significant
	IPS	29.50			
	ZIRC	24.75			

Table 5: Changes In The Periodontal Parameters Of The Different Material In Phase 4, Kruskal-Wallis Test Results

	Material	Mean Rank	Chi-Square	Significance	
PD	PFM	26.71	0.357	.836	Not Significant
	IPS	28.35			
	ZIRC	25.00			
CAL	PFM	22.71	3.426	.180	Not Significant
	IPS	29.70			
	ZIRC	30.66			
RBL	PFM	25.94	0.348	.840	Not Significant
	IPS	25.30			
	ZIRC	28.16			