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# Clinical, radiographic and microbial comparison of stainless steel, zirconia and reinforced composite crowns on supporting tissues of primary mandibular molars – A comparative invivo study

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## Abstract

**Aim:** To evaluate changes in clinical, radiographic and microbial parameters on supporting tissues before and after placement of stainless-steel crowns, zirconia crowns and reinforced composite crowns in primary mandibular molars in children 5-10 years of age

**Materials and method**: The study was carried out on 60 primary mandibular molars of children aged 5-10 years. The teeth were randomly assigned to all the three groups. After pulpectomy, full coronal restoration was done with three crowns i.e. stainless steel crowns, zirconia crowns and reinforced composite crowns after this clinical radiographic and microbiological analysis was done over a period of 6 months of follow up.

**Results:** Clinical success rate at 6 months follow up period was found to be that Pediatric zirconia (93.5%) and stainless-steel crowns (96.7%) showed good clinical success rate with no significant difference between the two groups (p=0.317) and reinforced composite crowns showed the least success and non-remarkable outcomes. Recurrent caries, marginal integrity, occlusal wear, accumulation of plaque and gingival health were better with zirconia crowns compared to SSC and reinforced composite crowns. Whereas reinforced composite crowns showed statistically significant difference (p=0.029) in terms of marginal integrity and proximal contact (p=0.015) at 6 months follow-up. Adhesion of S. mutans was low on the surface of zirconia crowns with a mean CFU count 3.183 ±0.564, 3.183 ±0.416 and 3.169

±0.497 showing a significant decrease when compared to SSC and reinforced composite crowns. Interproximal bone resorption was not significantly affected by either crown marginal extension or adaptation, preserving tight proximal contact between molars, oral hygiene level or duration.

**Conclusion:** The clinical, radiographic and microbiological outcomes of zirconia and stainless-steel crowns were found to be comparable whereas the group restored with reinforced composite crowns showed inferior results.

**Keywords:** Dental caries, crowns, gingival health, radiographic bone level, microbiological analysis, USPHS criteria

**Introduction**

Selecting an ideal restorative material for restoring a grossly decayed teeth is a challenging task mutilated primary teeth can be restored in order to preserve the integrity of primary dentition until their natural exfoliation this can be achieved with the help of preformed crowns. Stainless steel crowns are always the choice of full coronal restoration.[1] The only major disadvantage of SSC is their unesthetic appearance The need to meet the demand for aesthetic restorations led to the introduction of Zirconia crowns which are potentially less technique sensitive when compared to other esthetic alternatives. The potential disadvantages include need for more tooth reduction, inability to crimp or contour the crown and they are also expensive.[2] To overcome all these disadvantages reinforced composite crowns have been recently introduced for full coverage restoration of primary teeth. This study aims to evaluate changes in clinical, radiographic and microbial parameters on supporting tissues before and after placement of stainless-steel crowns, zirconia crowns and reinforced composite crowns in primary mandibular molars in children 5-10 years of age.

**Methodology**

A randomized controlled study was conducted on 60 children age group of 5-10 years visiting Inderprastha dental college and Hospital, Sahibabad Ghaziabad, UP for treatment. The primary mandibular molars that were indicated for pulpectomy were divided into the following three groups according to the crowns placed:

Group 1: Stainless- steel crowns

Group 2: Zirconia crowns

Group 3: Reinforced composite crowns

After parental consent, the teeth were randomly allocated to each of the three groups using draw of lots. Ipsilateral tooth of the same patient which was not restored with crown was taken as control.

Tooth preparation was done for stainless steel crown, zirconia and reinforced composite crowns according the manufacturer's instructions and luted with type 1 GIC, and final occlusion was checked. (Figure 1)

Clinical evaluation was done using the modified United states public health service (USPHS) criteria. To check for crown retention, marginal integration, crown discolouration, secondary caries and gingival status for the crown and ipsilateral natural tooth.

Radiographic examination was done using bitewing radiographs. A standardized angulation of the X-ray cone was applied using the Rin XCP positioning device and a radiographic grid was also used. The radiographs were selected on the following basis:

a. Minimal evidence of distortion

b. Minimal overlapping between the adjacent molar proximal surfaces

c. A clear image of the cemento-enamel junction and the alveolar bone crest between the primary molars.

The following radiographic criteria was for all the three crowns, the interproximal bone level was considered normal or non-resorbed when the distance between the crest of interdental bone and the cemento enamel junction was 2 mm or less. Bone was considered resorbed when this distance was more than 2 mm.[3,4] (Figure 2)

For microbiological analysis a sterile cotton swab with HDPE tube (Axiom Easy pick sampler, Axiom India) were used to collect plaque samples from buccal and occlusal surfaces of SSC, zirconia crowns and reinforced composite crowns and for the ipsilateral natural tooth of each patient at baseline, 3- and 6-months following crown placement. Plaque sample collection was performed in the microbiological laboratory of Inderprastha dental college and Hospital, and the swabs were immersed in 1 mL phosphate buffered saline immediately. The sample was vortexed for 15 s and serially diluted till $10^{-3}$, and using a micropipette, 0.1 ml (100 µL) of this diluted sample was inoculated and plated on TYCSB (tryptone-yeast-cystine sucrose-bacitracin) agar, a selective media for S. mutans. The plates were incubated in a candle jar at 37 °C in 5–10% $CO_2$ for 48 h. After 48 h, colony characteristics were studied and the number of colony forming units (CFU/ml) of S. mutans was counted using a digital colony counter. (Figure 3)

Plaque levels were assessed on the buccal and lingual surfaces of all teeth and recorded using the Plaque Index of Silness & Loe[5], scoring as follows: 0: no plaque; 1: film of plaque adhering to the free gingival margin and adjacent area of the tooth, the plaque detected only by using an explorer on the tooth surface; 2: moderate accumulation seen with the naked eye; and 3: abundance of soft debris. A total plaque score was calculated for the entire group. Mean regional plaque scores were also calculated for

(i) the anterior region: the buccal and lingual surfaces of the four maxillary and mandibular incisors;

(ii) the posterior region: the buccal and lingual surfaces of the maxillary and mandibular canines and molars;

(iii) the lingual surfaces: all lingual surfaces in either the maxillary or mandibular arch; and

(iv) the buccal surfaces: all buccal surfaces in either the maxillary or mandibular arch. (Figure 4).

**Results**

A total of 60 teeth were included in the study of which 20 cases each were randomly allocated to three Groups. The mean age of the study population for Group I (SSC) 6.95 ± 1.43 years, Group II 7.85 ± 1.59 years while Group III (FC) 7.35 ± 1.03 years. There was no statistically significant difference among three groups. The gender distribution of the study subjects was Group I 70% males and 30% females. Group II had 50% males and 50 % females while Group III had 75% males and 25% females. Intergroup comparison of clinical evaluation criteria of stainless-steel, zirconia and reinforced composited crowns showed higher success rate of ZC in terms of marginal integrity, gingival health, recurrent caries and proximal contact and in terms of occlusal wear SSC showed higher success late showing no occlusal wear of the opposing tooth over a period of 6 months. (Table 1,2).

Comparison of plaque score among three groups at baseline, the mean plaque scores for Stainless steel crown were 1.16 ± 0.437. For zirconia crown were 0.937 ±0.462. For Figaro crown were 1.038 ±1.038. The comparison was done using Kruskal Wallis test. At 3 months, the mean plaque scores for Stainless steel crown 1.20 ±0.340. For Zirconia crown 1.025 ±0.490. For Figaro crown were 1.448 ±0.343. The comparison was

done using Kruskal Wallis test. At 6 months, the mean plaque scores for Stainless steel crown were 1.242 ±0.390. For Zirconia crown were 1.183 ±1.025. For Figaro crown were 1.46 ±0.343. The comparison was done using Kruskal Wallis test. (Table 4). The intergroup comparison of three crowns didn't reach the level of significance when compared a baseline, three months and six months. (Table 3)

When intragroup comparison among three groups was done for stainless steel crown, the plaques scores. The difference failed to reach the level of significance at various follow up time periods. For zirconia crown, the plaques scores were compared using Friedman test. The difference reached the level of significance (p=0.001) at various follow up time periods. On pair wise comparison using Wilcoxon paired t test, significant differences were seen for plaque scores at baseline and 6 months only. For reinforced composite crown, the plaques scores were compared using Friedman test. The difference failed to reach the level of significance at various follow up time periods. On pair wise comparison using Wilcoxon paired t test, significant differences were seen for plaque scores at baseline and 6 months (p=0.001). (Table 4).

For S. mutans count comparing natural tooth and stainless-steel crown. At baseline, 3 months and 6 months *S. mutans* count was found to be significantly higher at natural tooth as compared to stainless steel crown mean CFU count was 3.010 ± 0.408 (p=0.025),3.141 ± 0.281 (p=0.001). and 3.197 ± 0.231 (p=0.000). (Table 5)

*S. mutans* count was compared between natural tooth and zirconia crown at baseline, 3 months and 6 months the difference failed to reach the level of significance in the entire follow-up period. Mean CFU of zirconia crown was 3.183 ± 0.564, 3.183 ± 0.416 and 3.169 ± 0.497. The mean CFU count of ipsilateral opposite tooth when compared a baseline,3 months and 6 months showed a statistically significant increase in the mean CFU count. (Table 6)

*S. mutans* count when compared between natural tooth and reinforced composite crown CFU count was found to be significantly higher at natural tooth as compared to reinforced composite crown mean CFU 3.114 ± 0.236 (p=0.006),3.224 ± 0.120(p=0.050) and 3.287 ± 0.097 (p=0.005). (Table 7)

In intergroup comparison of S. mutans count of stainless-steel, zirconia and reinforced composite crowns. Mean CFU count was lowest of zirconia crown among all the three groups during the 6 months follow up period. (Table 8)

For radiographic evaluation the interproximal bone level was measured. The effect of SSC on interproximal bone level considerably adequate at baseline where only 25% cases showed inadequate proximal bone height. At 3 months follow up 30% cases inadequate bone height and at 6 months follow up 35% cases showed inadequate bone height and the values failed to reach the level of significance by using chi square test. (Table 9)

Effect of zirconia crowns on interproximal bone level showed a baseline only 5% cases showed inadequate bone height. At 3 months 20% cases showed inadequate bone height and values reached the level of significance (p=0.018). At 6 months follow-up 30% cases showed inadequate bone height but values failed to reach the level of significance. (Table 10).

Effect of reinforced composite crowns on interproximal bone level showed that at baseline 20% cases showed inadequate bone height and values doesn't reach the level of significance. At 3 months 55% cases showed inadequate bone height and values reach the level of significance (p=0001). At 6 months of follow-up 60% cases showed inadequate bone height and again the

values reach the level of significance (p=0.024) by using chi-square test. (Table 11)

On intergroup comparison Reinforced composite crowns showed the most inadequate bone height at the interproximal area in the subsequent follow-up period when compared with other two crowns using chi square test but the values failed to reach the level of significance. (Table 12)

**Discussion**

This study showed the comparison of primary molar teeth restored with SSC, Zirconia and Figaro crowns. The crowns were assessed clinically, radiographically and microbiologically over a duration of 6 months.

For clinical evaluation the crowns were assessed using modified USPHS criteria This criterion was developed by Ryge in the 1970s and was developed based on amalgam restoration which was commonly used that time. (Bayne & Schmalz, 2005)[6]. In our study, for evaluation of each crown we have considered four criteria, namely marginal integrity, gingival health, recurrent caries, proximal contact and occlusal wear similar to the study done by Abdulhadi B et al. (2017)[7] where clinical evaluation between zirconia and SSC was done using these criteria and also recent studies by Abbas AN et al. (2021)[8] and Laila M et al. (2020)[9] on fiberglass and pre-formed metal crowns (PMC) clinical evaluation was done on the basis of the clinical criteria similar to our study. This was in corcondance with the study done by Laila M et al. (2020) where in a follow-up period of 6 months, four cases of Figaro crowns out of 20 showed recurrent caries and it was seen that secondary caries were seen seen in those patients only who have had a poor oral hygiene and dietary habits. Johnsen et al. (1988)[10] stated that patients diagnosed with ECC had higher tendency to develop recurrent caries after treatment.

The marginal integrity of reinforced composite crowns showed the least success in the terms of adaptation, out of 20 crowns, 6 crowns were found to be decremented during the time of follow-up. Which is consistent with the study of Mohammad Z et al. (2016)[11] where six custom-made Fiber reinforced composite crowns (FRC) were lost due to decementation from primary molars after 1 year follow up period. Whereas Zirconia crowns showed 15% tooth wear in opposing teeth at the end of 6$^{th}$ month follow up. These results were similar to the study of Aly G et al (2016) who too concluded that more severe wear in primary teeth is caused by mechanical mismatching between zirconia crown and natural enamel. After 6 months of follow up, the Figaro crowns showed significant failure in crown retention it was found that only 70% of the crowns were intact after the 6-month follow up period. This was not in accordance with the manufacturers. As they claim that Figaro crowns shows higher fracture resistance scores than PMC. Results are consistent with the study done by Laila M (2020)[9] where only 38% Figaro were intact over a period of 6 months of follow up.

For the microbial evaluation around three crowns, S. mutans was chosen in our study as it is one of the pioneering organisms in plaque formation which leads to two important biofilm mediated infection i.e dental caries and periodontitis.[12] Moreover, S. mutans has been discovered in early dental plaque and is regarded as one of the major causative agents for dental caries Adhesion of S. mutans to dental restorative materials is an important component in the etiology of secondary caries formation.[13] In the present study, reinforced composite crowns exhibited significantly higher microbial adhesion with a significant increase in mean CFU count 3.114 ± 0.236, 3.224 ± 0.120 and 3.287 ± 0.097 at baseline,3 months and 6 months follow-up when compared with

SSC 3.010 ± 0.408, 3.141 ± 0.281 and 3.197 ± 0.231 and zirconia crowns 3.183 ±0.564, 3.183 ±0.416 and 3.169 ±0.497 (Table). The role of surface properties of the crowns such as chemical composition, surface free energy, and surface roughness influences the adhesion of S. mutans, and this explain the difference in the count of S. mutans on reinforced composite crowns, SSC and zirconia.[14]

Scheuermann et al. (2013)[15] stated that the irregularities of polymeric surfaces promote bacterial adhesion and biofilm deposition, whereas the ultra-smooth surface does not favor bacterial adhesion and biofilm deposition. Zirconia is glazed and polished compared to SSC which prevents the adhesion of microorganisms. Myers et al. (1980)[16] reported that plaque will readily form on the surface of SSC the characteristics of SSCs such as surface roughness and surface energy influence the microbial growth, therefore, oral hygiene instructions should be emphasized to minimize the accumulation of plaque.[17]

Poor gingival health and greater plaque accumulation was found to be associated with reinforced composite crowns with a significant increase in mean plaque score 1.038 ± 0.469, 1.448 ± 0.343 and 1.460 ± 0.319 when compared with mean plaque score of SSC 1.160 ± 0.437, 1.200 ± 0.340 and 1.242 ± 0.390 and mean plaque score of zirconia crowns 1.038 ±0.469,1.448 ±0.343 and 1.460 ±0.319. Long term predictable periodontal health around crowned teeth is associated with good marginal integrity, and absence of luting cement remnants in the sulcus, all of which relate to plaque accumulation. In primary teeth, subgingival margin placement is not preferable; however, retention of full coverage crowns generally requires subgingival adaptation.[18] In our study the crowns were placed by a single trained expert hence, the chance of operator variability affecting periodontal outcomes is significantly reduced. Taran et al. (2018)[19] investigated the periodontal health associated with SSC and zirconia crowns among 7–8-year-old children and reported zirconia crowns to have better periodontal health and lesser plaque retention. This finding was corroborating with our results. Similarly, Walia et al. (2014)[20] reported significantly less plaque accumulation on preformed zirconia teeth due to its superior polished surface. The biofilm formed on zirconia is reported to be thin, and the plaque accumulation over zirconia surface in our study was significantly less compared with SSC and reinforced composite crowns. This finding could be attributed to the crown manipulation and adjustment procedures as the surface texture is modified for proper adaptation, and it could be the primary factor contributing towards plaque accumulation between the three crowns tested in our study.

In the present study alveolar bone loss was assessed by measuring the interproximal bone level height from the crest of interdental bone to the CEJ and it is to be associated with inadequately placed crown margins and gingivitis as in agreement with Beimstein et al. (1996)[21] who reported an association between alveolar bone resorption and inadequately placed stainless steel crowns and also in sites adjacent to proximal caries. Guelman et al. (1983)[22] stated that a well-adapted crown in second primary molar does not facilitate the appearance of marginal alveolar bone loss on the adjacent first permanent molar. However, the number of inadequate crowns in our study was comparatively low therefore, other factors may have played a role in causing bone resorption.

Another finding showed that crown extension and adaptation or even maintaining intact contact between teeth had no effect on interproximal bone level which again agrees with published work that did not confirm a

direct correlation between stainless steel crowns and interproximal bone resorption.[23,24,25,26]

In present study during the entire follow-up period it was seen that there was no significant effect on either the gingival condition or the interproximal bone level in zirconia and SS crowns but the cases showing bone inadequacy increases around reinforced composite crowns the percentage increase in the interproximal bone inadequacy increases from 20% at baseline to 60% in 6 months and this could be due to increased gingival plaque accumulation and inflammation around reinforced composite crowns as the mean plaque score also increases from 1.038 ± 0.469, 1.448 ± 0.343 and 1.460 ± 0.319 in a follow-up period from baseline, 3 months and 6 months. But this particular finding needs further clinical evaluation and studies to prove.

Considering the individual evaluation criteria outcomes, zirconia crowns came out be a good reliable option when compared with SSC and reinforced composite crowns on the basis of lesser plaque accumulation, no gingival inflammation, no recurrent caries, lesser microbial count in the entire 6 months of follow up. Both SSC and zirconia crowns are an excellent choice for posterior primary teeth as their clinical performance was very satisfactory comparing to the reinforced composite crowns which was not up to the mark. However, stainless steel is still considered as gold standard when it comes to full coronal restorations in primary teeth. But when esthetic is the prime concern zirconia crowns is a good call.

**Conclusion**

Clinical performance of zirconia and stainless-steel crowns was good. The choice of the crowns during treatment plan can be made specific to each child based on the demands of the parents and the clinical scenario. Further laboratory studies are needed to reassure the clinical performance of reinforced composite crowns because as the most important requirement of restoration in children is a durable, long-lasting treatment to save the child from unnecessary subsequent visits and uneasiness.

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**Legend Figures**

Table 1: Distribution of patients among three groups.

| | | N | % |
|---|---|---|---|
| Group i | Stainless steel crown: ssc | 20 | 33.3 |
| Group ii | Zirconia crown | 20 | 33.3 |
| Group iii | Reinforced composite crowns | 20 | 33.3 |
| Total | | 60 | 100 |

Table 2: Mean age distribution among the three study groups

| | | Mean | Sd |
|---|---|---|---|
| Group i | Stainless steel crown: ssc | 6.95 | 1.43 |
| Group ii | Zirconia crown | 7.85 | 1.59 |
| Group iii | Reinforced composite crowns | 7.35 | 1.03 |

Table 3: Comparison of plaque scores among three groups (INTER GROUP)

| Plaque scores | | N | Mean | Std. Deviation | 95% Confidence Interval for Mean | | Minimum | Maximum | Chi square value, p value |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound | | | |
| Baseline | Ss | 20 | 1.160 | 0.437 | 0.955 | 1.364 | 0.250 | 1.800 | 1.099 0.577, NS |
| | Zirconia | 20 | 0.937 | 0.462 | 0.720 | 1.153 | 0.250 | 1.500 | |
| | Figaro | 20 | 1.038 | 0.469 | 0.818 | 1.258 | 0.280 | 1.480 | |
| 3 months | Ss | 20 | 1.200 | 0.340 | 1.041 | 1.358 | 0.280 | 1.500 | 2.938, 0.230, NS |
| | Zirconia | 20 | 1.025 | 0.490 | 0.795 | 1.254 | 0.250 | 1.800 | |
| | Figaro | 20 | 1.448 | 0.343 | 1.287 | 1.609 | 1.200 | 2.100 | |
| 6 months | Ss | 20 | 1.242 | 0.390 | 1.060 | 1.424 | 0.320 | 1.600 | 0.548, 0.761, NS |
| | Zirconia | 20 | 1.183 | 0.525 | 0.937 | 1.428 | 0.160 | 2.000 | |
| | Figaro | 20 | 1.460 | 0.319 | 1.311 | 1.609 | 1.160 | 2.000 | |

Kruskal Wallis test, level of significance set at $p < 0.05$

*Statistically significant

Table 4: Comparison of plaque scores among three groups (INTRA GROUP)

| Plaque scores | | N | Mean | Std. Deviation | 95% Confidence Interval for Mean | | Minimum | Maximum | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound | | | CHI square value, p value | pair wise comparison |
| Stainless steel | At baseline | 20 | 1.160 | 0.437 | 0.955 | 1.364 | 0.250 | 1.800 | 2.304, 0.316, NS | not applicable |
| | At 3 months | 20 | 1.200 | 0.340 | 1.041 | 1.358 | 0.280 | 1.500 | | |
| | At 6 months | 20 | 1.242 | 0.390 | 1.060 | 1.424 | 0.320 | 1.600 | | |
| Zirconia | At baseline | 20 | 0.937 | 0.462 | 0.720 | 1.153 | 0.250 | 1.500 | 14.632, 0.001*, SIG | at baseline< at 6 months |
| | At 3 months | 20 | 1.025 | 0.490 | 0.795 | 1.254 | 0.250 | 1.800 | | |
| | At 6 months | 20 | 1.183 | 0.525 | 0.937 | 1.428 | 0.160 | 2.000 | | |
| Figaro | At baseline | 20 | 1.038 | 0.469 | 0.819 | 1.258 | 0.280 | 1.480 | 14.911, 0.001*, SIG | at baseline< at 3 months, at 6 months |
| | At 3 months | 20 | 1.448 | 0.343 | 1.288 | 1.609 | 1.200 | 2.100 | | |
| | At 6 months | 20 | 1.460 | 0.319 | 1.311 | 1.609 | 1.160 | 2.000 | | |

Friedmann test [a], level of significance set at P < 0.05, Wilcoxon paired t test [b] *statistically significant

Table 5: S. mutans count comparing natural tooth and stainless-steel crown

| | | Mean | Std. Deviation | p value |
|---|---|---|---|---|
| baseline | Stainless steel crown | 3.010 | 0.408 | 0.025* |
| | Natural tooth | 3.197 | 0.231 | |
| at 3 months | Stainless steel crown | 3.141 | 0.281 | 0.001* |
| | Natural tooth | 3.248 | 0.211 | |
| at 6 months | Stainless steel crown | 3.197 | 0.231 | 0.000* |
| | Natural tooth | 3.305 | 0.218 | |

Wilcoxon paired t test [b]; level of significance set at P < 0.05

*Statistically significant

Table 6: S. mutans count comparing natural tooth and zirconia crown

| | | Mean | Std. Deviation | p value |
|---|---|---|---|---|
| Baseline | Zirconia crown | 3.183 | 0.564 | |
| | Natural tooth | 3.169 | 0.497 | 0.133 |
| 3 months | Zirconia crown | 3.183 | 0.416 | |
| | Natural tooth | 3.250 | 0.416 | 0.188 |
| 6 months | Zirconia crown | 3.169 | 0.497 | |
| | Natural tooth | 3.219 | 0.399 | 0.068 |

Wilcoxon paired t test [b]; level of significance set at P < 0.05

*Statistically significant

Table 7: S. mutans count comparing natural tooth and reinforced composite crown

| | | Mean | Std. Deviation | p value |
|---|---|---|---|---|
| baseline | Figaro crown | 3.114 | 0.236 | |
| | Natural tooth | 3.287 | 0.097 | 0.006* |
| 3 months | Figaro crown | 3.224 | 0.120 | |
| | Natural tooth | 3.281 | 0.140 | 0.050 |
| 6 months | Figaro crown | 3.287 | 0.097 | |
| | Natural tooth | 3.370 | 0.103 | 0.005* |

Wilcoxon paired t test [b]; level of significance set at P < 0.05

*Statistically significant

Table 8: Intergroup comparison of S. mutans count of stainless-steel, zirconia and reinforced composite crowns.

| S. mutans count | | N | Mean | Std. Deviation | 95% Confidence Interval for Mean | | Minimum | Maximum | Chi square value, p VALUE |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound | | | |
| Baseline | Ss | 20 | 3.0102 | 0.4080 | 2.8192 | 3.2011 | 2.1827 | 3.7268 | 0.415, 0.813, ns |
| | Zirconia | 20 | 3.1829 | 0.5637 | 2.9191 | 3.4467 | 2.1240 | 4.1827 | |
| | Figaro | 20 | 3.1144 | 0.2361 | 3.0039 | 3.2249 | 2.4534 | 3.5425 | |
| 3 months | Ss | 20 | 3.1408 | 0.2811 | 3.0092 | 3.2723 | 2.4022 | 3.7268 | 1.994, 0.369, ns |
| | Zirconia | 20 | 3.1832 | 0.4164 | 2.9883 | 3.3781 | 2.2925 | 4.0959 | |
| | Figaro | 20 | 3.2235 | 0.1197 | 3.1675 | 3.2795 | 3.0331 | 3.4445 | |
| 6 months | Ss | 20 | 3.1965 | 0.2307 | 3.0885 | 3.3045 | 2.7268 | 3.7268 | 4.507, 0.102, ns |
| | Zirconia | 20 | 3.1690 | 0.4973 | 2.9363 | 3.4017 | 1.7604 | 4.0959 | |
| | Figaro | 20 | 3.2868 | 0.0974 | 3.2412 | 3.3324 | 3.0959 | 3.4850 | |

Kruskal Wallis test, level of significance set at P < 0.05

*Statistically significant

Table 9: Effect of stainless steel on interproximal bone level.

| | Stainless steel | | Natural tooth | |
|---|---|---|---|---|
| | N | % | N | % |
| Radiographic evaluation: At baseline (p value=0.500) | | | | |
| Adequate | 15 | 75 | 16 | 80 |
| Inadequate | 5 | 25 | 4 | 20 |
| Radiographic evaluation: At 3 months (p value=0.054) | | | | |
| Adequate | 14 | 70 | 18 | 90 |

| | | | | |
|---|---|---|---|---|
| Inadequate | 6 | 30 | 2 | 10 |
| Radiographic evaluation: At 6 months (p value=0.597) | | | | |
| Adequate | 15 | 75 | 16 | 80 |
| Inadequate | 5 | 35 | 4 | 20 |

Chi square test, level of significance set at $p < 0.05$

*Statistically significant

Table 10: Effect of zirconia crown on interproximal bone level.

| | Zirconia | | Natural tooth | |
|---|---|---|---|---|
| | N | % | N | % |
| Radiographic evaluation: At baseline (p value=0.500) | | | | |
| Adequate | 19 | 95 | 18 | 90 |
| Inadequate | 1 | 5 | 2 | 10 |
| Radiographic evaluation: At 3 months (p value=0.018*) | | | | |
| Adequate | 16 | 80 | 16 | 80 |
| Inadequate | 4 | 20 | 4 | 20 |
| Radiographic evaluation: At 6 months (p value=0.580) | | | | |
| Adequate | 14 | 70 | 14 | 70 |
| Inadequate | 6 | 30 | 6 | 30 |

Chi square test, level of significance set at $p < 0.05$

*Statistically significant

Table 11: Effect of reinforced composite crowns on interproximal bone level.

| | Figaro | | Natural tooth | |
|---|---|---|---|---|
| | N | % | N | % |
| Radiographic evaluation: At baseline (p value=0.053) | | | | |
| Adequate | 16 | 80 | 20 | 100 |
| Inadequate | 4 | 20 | 0 | 0 |
| Radiographic evaluation: At 3 months (p value=0.0001*) | | | | |
| Adequate | 9 | 45 | 16 | 80 |
| Inadequate | 11 | 55 | 4 | 20 |
| Radiographic evaluation: At 6 months (p value=0.024*) | | | | |
| Adequate | 4 | 35 | 11 | 55 |
| Inadequate | 16 | 60 | 9 | 45 |

Chi square test, level of significance set at $p < 0.05$

*Statistically significant

Table 13: Intergroup comparison of radiographic evaluation between three groups

| | Stainless steel | | Zirconia | | Figaro | |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| Radiographic evaluation: At baseline | | | | | | |
| Adequate | 15 | 75 | 19 | 95 | 16 | 80 |
| Inadequate | 5 | 25 | 1 | 5 | 4 | 20 |
| Radiographic evaluation: At 3 months | | | | | | |
| Adequate | 14 | 70 | 16 | 80 | 9 | 45 |
| Inadequate | 6 | 30 | 4 | 20 | 11 | 55 |
| Radiographic evaluation: At 6 months | | | | | | |
| Adequate | 15 | 75 | 14 | 70 | 4 | 35 |
| Inadequate | 5 | 35 | 6 | 30 | 16 | 60 |

Chi square test, level of significance set at $p < 0.05$

*Statistically significant

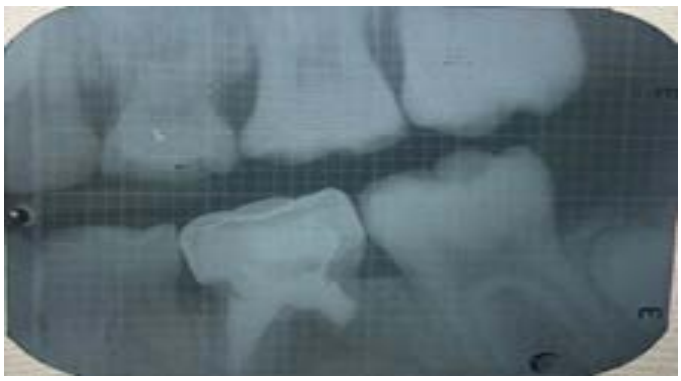
Figure 1: Post-operative pictures of stainless-steel, zirconia and reinforced composite crowns.

a. post-operative picture of stainless-steel crown w.r.t 75

b. post-operative picture of zirconia crown w.r.t 84

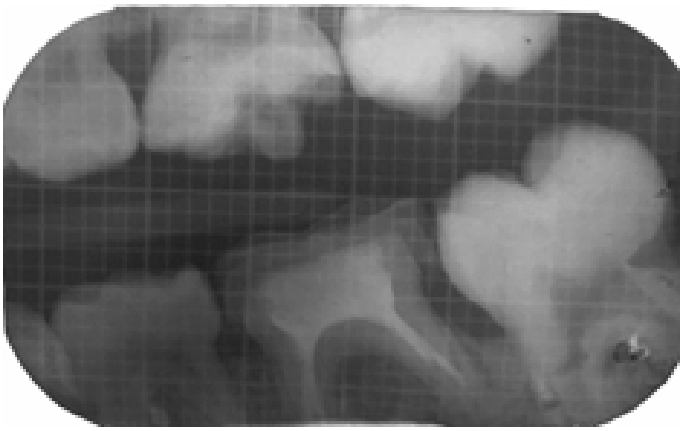
b. post-operative picture of reinforced composite crown w.r.t 85

Figure 2: Radiographic evaluation of stainless-steel, zirconia and reinforced composite crowns.



a. Bitewing radiograph of stainless-steel crown

b. Bitewing radiograph of zirconia crown.



c. Bitewing radiograph of reinforced composite crown.

Figure 3: Microbiological evaluation of stainless-steel, zirconia and reinforced composite crowns.

(b)

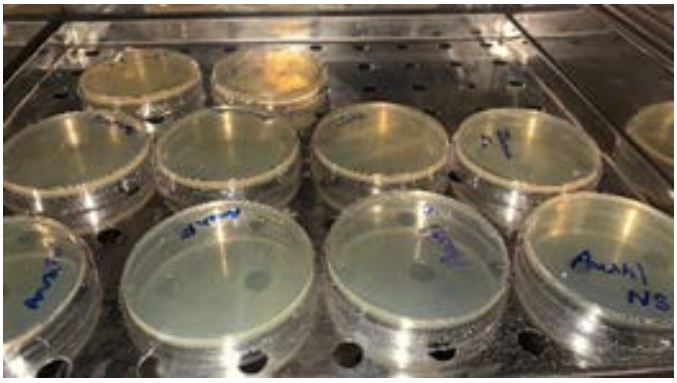
(c)

E, f, g Sample collection from zirconia, stainless-steel and reinforced composite crowns

(a)

(d)

(e)



(F)

(g)

Figure 4:Clinical evaluation of plaque score

a. Evaluation of plaque score from natural tooth.

b. Evaluation of plaque score from zirconia crown