

# Comparative Evaluation of Adhesion of Streptococcus mutans on Figaro crowns in primary molars - A Randomised Controlled Clinical Trial

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## Abstract

**Introduction-** Figaro Crowns placed into the oral cavity has the potential to create a niche for adhesion of the micro-organisms on to the surface of the crown, which in the due course can result in various complications. As there are no studies in the literature reporting the bacterial adhesion on Figaro crowns in primary teeth, the aim of the present study was to comparatively evaluate the adhesion of streptococcus mutans on Figaro crowns with that of the stainless-steel crowns in primary molars. **Materials and Method-** 30 children between the ages of 6- and 9-years requiring pulp therapy and crowns in bilateral mandibular second primary molars were included in the trial and were randomly allotted with Figaro crowns and stainless-steel crowns. Plaque samples were collected from the surfaces of the crowns at baseline, 3 months, 6 months, 9 months and 12 months and were subjected to microbiological analysis for estimation of streptococcus mutans levels. The streptococcus mutans levels were estimated in colony forming units and were subjected to statistical analysis. **Results-** At baseline and 3 months there is no significant difference in the S.mutans count with Figaro crowns and stainless steel crowns, however, at 6, 9 and 12 months a statistically significant reduction in the S.mutans count is noticed with Figaro crowns (P value =0.01, 0.02, 0.04 respectively). **Conclusion-** There is a significantly decreased adhesion of the Streptococcus mutans on the Figaro crowns over a period of time.

## 1. Introduction

Management of multi-surfaced decayed primary teeth served to be challenging for a paediatric dental practitioner until the introduction of stainless-steel crowns by Humphrey in 1950. Since then, the Stainless-steel crowns (SSC) served as the choice of treating primary teeth with multi-surface carious lesions, thus retaining them in its place until the physiological exfoliation of the primary teeth. Though the stainless steel crowns outperformed the other restorative materials for restoration of posterior primary teeth in terms of cost, durability and longevity, thus retaining the primary teeth for a long term until its period of exfoliation, the metallic appearance of the stainless steel crowns remained as the focal area of concern for both the parents and the children.[1-3] A survey conducted in 2009, reported that the majority of the parents, about 87% of them were concerned about the aesthetics during the restoration of the primary molars with stainless steel crowns.[4] Another study

conducted among the children regarding the preference for colour of the restoration in their primary teeth, on comparing the tooth coloured composite restoration and silver coloured amalgam restoration, the children showed more preference towards tooth coloured restorations.[5] This optimal aesthetic demands from the parents and the children led to the hunt for more aesthetic and affordable crowns in paediatric dental practice.

The judicious search for the aesthetic full coverage restorations for primary teeth left the paediatric practitioners with various options like open-faced stainless-steel crowns, pre-veneered stainless steel crowns and polycarbonate crowns for posterior primary teeth. However, all of these crowns presented with various disadvantages and did not serve the purpose. [6,7] Zirconia crowns were then introduced into paediatric dental practice in 1991 and despite various pitfalls, Zirconia crowns continued to be the only viable aesthetic alternative to stainless steel

crowns in primary teeth. However, more tooth reduction was needed for the placement of Zirconia crowns in primary teeth. The anatomy of primary teeth thus required a compulsive pulp therapy for the placement of zirconia crowns. Also, an added disadvantage of the zirconia crowns are that these crowns cannot be crimped, thus hampering the marginal adaptability and increasing the risk of marginal leakage. High cost, low grade of abrasion of the opposing natural dentition are the other disadvantages of zirconia crowns that cannot be neglected.[8,9] These drawbacks of zirconia crowns in primary teeth necessitated the need for an alternative aesthetic crown for primary teeth.

The persistent increase in the demand for an alternate cost-effective aesthetic crown for primary tooth instigated Fiber re-inforced glass crowns - The FIGARO Crowns for full coverage restoration of the primary teeth among the paediatric dental practitioners. The Figaro crowns are preformed fibreglass crowns composed of the fibre mesh sheets of aramid carbon and quartz embedded in the resin. The Figaro crowns were introduced for use in primary teeth in the year 2018. The manufacturers have declared these Figaro crowns to be metal and bisphenol A free. An added advantage of these Figaro crowns are that, they are autoclavable. The manufacturers insists that these crowns are based on flex fit technology and have increased strength and aesthetics.[10] A recent systematic review evaluating the clinical success rates of various preformed aesthetic crowns for primary teeth have also declared Figaro crowns to be a promising and cost effective replacement to Stainless steel crowns.[11] After which, various studies were done with Figaro crowns on evaluating the different factors such as the gingival health, retention rate, marginal leakage, marginal adaptation and discrepancy which influences its success for use in primary teeth.[10, 12,13]

One such factor that needs to be researched on is the adhesion of the micro-organisms around the Figaro crowns. With the known fact that the placement of crowns into the oral cavity sets up a new niche for the micro-organisms to adhere, which can not only impair the gingival health but also develop secondary caries in due time, thus hampering the success of the crowns, it is important to evaluate the adhesion of micro-organisms around the Figaro crowns to declare it as a successful replacement to stainless steel crowns. Of the various microorganisms present in the oral cavity Streptococcus mutans have been reported to be the most commonly isolated micro-organisms. [14,15] There are no studies in the literature reporting the bacterial adhesion on Figaro crowns in primary teeth. Hence, the present study was conducted to comparatively evaluate the adhesion of streptococcus mutans on Figaro crowns and stainless-steel crowns in primary molars.

## 2. Materials and Method

The present study was conducted as a split mouth randomised controlled clinical trial. Ethical approval

was obtained from the institutional review board prior to the start of the study.

### Sample size calculation

The sample size for the present study was calculated from a pilot study that was conducted in 5 children involving 10 bilateral molars. The power was set at 85% and arrived to a total sample size of 60 teeth (30 per group). Hence, a total of 30 healthy children who required bilateral pulp therapy in mandibular second molars were recruited for participation in the study at the Department of Paediatric and Preventive Dentistry, Saveetha Dental College, Chennai.

### Inclusion and exclusion criteria

Healthy and co-operative children between the ages of 6 and 9 years with decayed bilateral mandibular second molars requiring pulp therapy were included in the trial. Children with grossly decayed tooth that required extraction or those teeth that cannot be restored were excluded from the trial. Mandibular molars which showed the signs of internal or external resorption were also excluded from the trial. Also, uncooperative children and children lacking cooperative ability were excluded from the trial.

### Informed consent

The objectives of the trial were explained to the parents/ guardians of the children who met the inclusion criteria and a written informed consent was obtained from the parents/ guardians prior to enrolling the selected children into the trial.

## 3. Randomisation

The teeth in the children were then randomly allotted to either Figaro crowns or stainless-steel crowns using the random selection method just before the tooth preparation after the completion of the pulp therapy.

### Clinical Procedure

All the clinical procedures, which includes the pulp therapy, tooth preparation and crown cementation was done by a single operator to avoid operator bias. After pulp therapy, the tooth preparation in mandibular second molars was done according to the manufacturers recommendation for Figaro crowns which is similar to that of the tooth preparation for stainless steel crowns. The tooth was prepared and either Figaro crowns or Stainless-steel crowns were cemented according to the random sequence obtained.

### Plaque sample collection

The plaque samples were collected from the Figaro crowns and Stainless steel crowns to evaluate the adhesion of streptococcus mutans on the crown surface using sterile cotton swabs. A sterile cotton swab was brushed on the buccal, lingual and occlusal surfaces of the Figaro and stainless-steel crowns in each patient. The swabs were then immediately immersed

into a sterile centrifuge tube containing 1 ml of phosphate buffered saline solution. The plaque samples were collected at baseline, 3 months, 6 months, 9 months and 12 months interval.

#### Estimation of *S. mutans* count

The sample was then placed in vortex for 15 seconds following which the samples were serially diluted. 0.1ml of the diluted sample was then inoculated on Tryptone yeast cystine sucrose bacitracin [TYCSB] agar plate, which is a selective media for Streptococcus mutans. The plates were then incubated at 37 degrees Celsius for 48 hours in 5% CO<sub>2</sub> in a candle jar. After 48 hours, the colonies of Streptococcus mutans were counted using a digital colony meter.

### 4. Statistical Analysis

Data was entered in Microsoft Excel spreadsheet and analyzed using SPSS software (IBM SPSS Statistics, Version 20.0, Armonk, NY: IBM Corp.). Descriptive statistics were used for data summarization and presentation. A p value of 0.05 was considered to be statistically significant. Shapiro wilks test was used to find the normality of the data. Friedman test was used to compare the mean streptococcus mutans

count and Plaque Index score within Groups at baseline, 3,6,9 and 12 months' time period. Kruskal wallis test was used to compare the mean streptococcus mutans count between Groups at baseline, 3,6,9 and 12 months' time period.

### 5. Results

The mean distribution of Streptococcus mutans from the plaque sample collected from Figaro crowns and stainless steel crowns at baseline, 3 months, 6 months, 9 months and 12 months is depicted in Table 1 and 2. It is seen that there is a gradual decrease in the Streptococcus mutans count in both Figaro crowns as well as Stainless steel crown groups from baseline upto 12 months. This decrease in the S. mutans count within the group at baseline, 3 months, 6 months, 9 months and 12 months is found to be highly statistically significant ( $p=0.001$ ). Intergroup comparison of the S. mutans count between Figaro crowns and Stainless steel crowns at baseline and 3 months shows no significant difference, however, at 6,9 and 12 months a statistically significant reduction in the S. mutans count is noticed with Figaro crowns with a P value of 0.01, 0.02, 0.04 respectively (Table 3).

**Table 1: Mean distribution of streptococcus mutans count of Group I (Figaro) at baseline, 3,6,9 and 12 months' time period**

Time period	N	Mean	Std. Deviation	Friedman test value	P value
BASELINE	15	65400.00	54968.56	38.17	0.001**
THREE MONTHS	15	39400.00	29011.82		
SIX MONTHS	15	26466.67	15733.80		
NINE MONTHS	15	26333.33	15728.35		
TWELVE MONTHS	15	26266.67	15709.26		

**Table 2: Mean distribution of streptococcus mutans count of Group II (Stainless steel) at baseline, 3,6,9 and 12 months' time period**

Time period	N	Mean	Std. Deviation	Friedman test value	P value
BASELINE	15	69800.00	41056.06	42.33	0.001**
THREE MONTHS	15	56266.67	30268.95		
SIX MONTHS	15	49000.00	27357.42		
NINE MONTHS	15	47600.00	28126.75		
TWELVE MONTHS	15	46000.00	26957.64		

**Table 3: Comparison of mean streptococcus mutans count between Group I and Group II at baseline, 3,6,9 and 12 months' time period**

Time period	GROUPS	Kruskal wallis test value	P value
BASELINE	I	0.27	0.60
	II		
THREEMONTHS	I	2.42	0.11
	II		
SIXMONTHS	I	5.90	0.01*
	II		
NINEMONTHS	I	5.02	0.02*
	II		
TWELVEMONTHS	I	4.05	0.04*
	II		

### 6. Discussion

Dental diseases like gingivitis, periodontitis, as well as secondary caries formation and re-infection, are

caused because of the adhesion of the microorganisms on the surfaces of the crowns cemented in the oral cavity. It is well established that the surface texture and surface area of the foreign restorative material attracts the microbial colonisation. Hence, it is

crucial to consider this factor when determining the clinical success of the crowns in primary dentition. In order to determine the therapeutic success of the crowns for use in paediatric dental practice, it is significant to assess the adhesion of microorganisms to the surfaces of these crowns.

As a more affordable and aesthetically pleasing alternative to Zirconia crowns and Stainless-steel crowns, Figaro crowns are the newest crowns to enter into the pedodontic market. The present investigation was carried out to compare the adherence of the most commonly isolated microorganism from the oral cavity, *S. mutans*, on the surfaces of the Figaro crowns and the gold standard Stainless steel crowns since there is no evidence existing in the literature on the adhesion of these microorganisms onto the surfaces of Figaro crowns.

The present study was conducted as a split mouth randomised clinical trial as the other types of study designs can have a bias in the results due to compounding factors like dietary habits, brushing technique, brushing frequency, type of toothpaste used and etc. Isolation of *S. mutans* was done from the surfaces of crowns in the present study as *S. mutans* are the primary colonisers and they have higher surface free energy to bind to the surfaces the crowns placed in oral cavity. [16]

A comparative study done comparing the adherence of *S. mutans* on Pre veneered crowns and stainless steel crowns showed reduced adherence on both Pre veneered crowns and Stainless steel crowns at the end of 4 weeks. However intergroup comparison showed a statistically decreased adhesion of *S. mutans* only in Stainless steel crowns.[17] The reduction in the adherence of *S. mutans* on the Stainless less crowns can be attributed to the highly polished surface that will not favour the formation and retention of biofilm. Also, it is easy to clean the surfaces. Another study done comparing the adherence of *S. mutans* on Zirconia crowns and Stainless steel crowns showed no significant reduction in the *S. mutans* count in both the groups. However comparison between zirconia and stainless steel crowns showed significantly low counts of *S. mutans* on Zirconia crowns. The authors of this study have stated that zirconia crowns are glazed and polished, hence has an ultra-smooth surface that will not promote the bacterial adhesion and plaque deposition. [18]

The results of the present study shows that there is a statistically significant reduction in the adherence of *S. mutans* to the surfaces of both Figaro crowns and stainless steel crowns from baseline to 12 months review period ( $P=0.001$ ). Intergroup comparison of the *S. mutans* count between Figaro crowns and Stainless steel crowns at baseline and 3 months shows no significant difference, however, at 6,9 and 12 months a statistically significant reduction in the *S. mutans* count is noticed with Figaro crowns. In the study done by Bin AlShaibah et al, the follow up period was only for 4 weeks. In the present study also, no significant difference was noticed between the 2 groups until 3 months. Only at 6th month and thereafter the

adherence of *S. mutans* was found to be more on stainless steel crowns. The characteristics of Stainless-steel crowns such as surface roughness and surface energy influence the microbial growth, which is evident from the results of previous and the present study. On the other hand, Figaro crowns are pre-formed fibreglass crowns composed of the fibre mesh sheets of aramid carbon and quartz embedded in the resin. These Figaro crowns are metal and bisphenol A free. An added advantage of these Figaro crowns are that, they are autoclavable.

Further studies needs to be conducted to evaluate the difference in adherence of *S. mutans* on a new and autoclaved Figaro Crown to check if autoclaving of the crowns as indicated by the manufacturer has an impact on the adherence of *S. mutans*.

## 7. Conclusion

The adhesion of *S. mutans* is significantly lower on the surfaces of Figaro crowns.

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