COMPARATIVE EVALUATION OF OCCLUSAL FORCE DISTRIBUTION AMONG CHILDREN AGED 5-10 YEARS UNDERGOING STAINLESS STEEL CROWN PLACEMENT BY CONVENTIONAL AND HALL'S TECHNIQUE USING T-SCAN™: A RANDOMISED CLINICAL TRIAL

By

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ABSTRACT

AIM: To evaluate and compare the occlusal force distribution among children aged 5-10 years undergoing stainless steel crown placement by Conventional and Hall's technique using T-scan™.

METHOD: Forty children requiring stainless steel crown placement were included. Twenty children underwent crown placement by conventional technique (Group I) and other twenty underwent crown placement by Hall's technique (Group II). Occlusal bite force distribution and bite force on crowned tooth was recorded using T-scan™ preoperatively, immediate postoperatively and at 1 month follow-up.

RESULTS: There was no significant difference seen (p=0.603) in Conventional group for Bite force on crowned tooth at pre-operative, immediate post-operative and at 1 month follow up. But, highly significant difference was seen (p=0.000**) in Hall's group for Bite force on crowned tooth at pre-operative, immediate post-operative and at 1 month follow up. No significant difference was seen in Conventional as well as Hall's group for occlusal bite force distribution on left and right sides at pre-operative, immediate post-operative and at 1 month follow up. Highly significant difference was seen among Conventional (p=0.001**) and Hall's (p=0.000**) group for occlusal prematurities at immediate post-operative and at 1 month follow up.

CONCLUSION: Uniform occlusal bite force distribution was seen on left and right side of the arch among both the groups at pre-operative, immediate post-operative and 1-month follow-up interval. From pre-operative to 1-month follow-up, temporary occlusal discrepancies were seen which settled with time as significant reduction in prematurities was seen in both, conventional and hall's group.

KEYWORDS: Bite force, Children, Conventional technique, Halls technique, Stainless-steel crown, T-scan.

LIST OF ABBREVIATIONS

Sl. No.	Abbreviation	Expanded form
1.	AAPD	American Academy of Pediatric Dentistry
2.	BMI	Body Mass Index
3.	CTRI	Clinical Trial Registry of India
4.	CT	Conventional technique
5.	EMG	Electromyography
6.	HT	Halls technique
7.	MBF	Maximum Bite Force
8.	MIP	Maximum Intercuspal/ Intercuspation Position
9.	MOBF	Maximum Occlusal Bite Force
10.	MVBF	Maximum voluntary bite force
11.	OVD	Occlusal Vertical Dimension
12.	PMC	Preformed Metal Crown
13.	SSC	Stainless steel crown
14.	TMD	Temporomandibular joint dysfunction
15.	TMJ	Temporomandibular Joint
16.	%	Percentage
17.	α	Alpha
18.	β	Beta

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INTRODUCTION

"A balanced occlusion is the foundation of functional and aesthetic oral health."

— Occlusion Principles in Dentistry

Restoring primary teeth is essential for preserving oral health, function, and arch integrity in children. Untreated carious primary molars can result in pain, infection, and loss of space, which may adversely impact the development and alignment of the permanent dentition. Among various restorative options, stainless steel crowns (SSCs) are widely used due to their durability, full coronal coverage, and ability to withstand masticatory forces. SSCs can be placed using different techniques, with the conventional method and the Hall technique.[1,2]

The conventional technique of tooth preparation and cementation of the crown provides better crown adaptation but requires more chair-side time, patient cooperation, and often necessitates local anesthesia. In contrast, the Hall technique, pioneered by Dr. Norna Hall, is a conservative method in which a stainless steel crown (SSC) is luted over decayed primary molar without any removal of the decay or tooth preparation. By sealing the carious lesion beneath the crown, this approach inhibits bacterial activity and halts disease progression. [2,3]

The Hall technique offers several advantages over the conventional method, particularly in children with poor compliance. It is painless, does not require local anesthesia or tooth preparation, and significantly reduces chair-side time. Studies have shown that it provides similar clinical success rates compared to conventional SSC placement. However, the major disadvantage of the Hall technique is the occlusal discrepancy, as the crown is placed without reduction of the occlusal surface. This results in an initial increase in vertical dimension, which can lead to discomfort,

altered mastication, and occlusal trauma. Despite these concerns, multiple studies have demonstrated that these discrepancies are self-corrected within four weeks due to the adaptation of the occlusal musculature and dental compensation mechanisms. [4,5,9,11,12,27]

Assessing occlusal discrepancies is crucial for determining the effect of restoration with stainless steel crown (SSC) on bite force distribution and maintaining occlusal balance.Traditional methods such as articulating paper provide only qualitative assessments, whereas advanced digital methods like the T-Scan system offer precise, real-time quantitative data on occlusal force distribution, contact points, and timing of occlusion. T-Scan enables clinicians to assess premature contacts and occlusal balance objectively, making it a valuable tool in evaluating the occlusal effects of SSC placement.[6,7]

Although the Hall technique is gaining widespread acceptance, there is a scarcity of literature comparing its occlusal force distribution to that of the conventional method using T-Scan analysis. This randomized controlled trial aims to compare occlusal force distribution in children aged 5–10 years receiving stainless steel crowns, using either the conventional method or the Hall method through T-Scan™ analysis.

AIM AND OBJECTIVES

AIM OF THE STUDY:

To evaluate and compare the occlusal force distribution among children aged 5-10 years undergoing stainless steel crown placement by Conventional and Hall's technique using T-scan™.

OBJECTIVES OF THE STUDY:

1. To evaluate the occlusal force distribution among children aged 5-10 years undergoing stainless steel crown placement by Conventional and Hall's technique using T-scan™.
2. To compare the occlusal force distribution among children aged 5-10 years undergoing stainless steel crown placement by Conventional and Hall's technique using T-scan™.

RESEARCH HYPOTHESIS

NULL HYPOTHESIS:

There is no difference in occlusal force distribution among children aged 5-10 years undergoing stainless steel crown placement by Conventional and Hall's technique using T-scan™.

ALTERNATIVE HYPOTHESIS:

There is difference in occlusal force distribution among children aged 5-10 years undergoing stainless steel crown placement by Conventional and Hall's technique using T-scan™.

REVIEW OF LITERATURE

Literature showing use of T-Scan™ for assessment of occlusal bite force in children:

A clinical study conducted to assess and compare changes in bite force at maximum intercuspal position and parental satisfaction after the restoration with stainless steel and zirconia crowns on primary molars. In children aged 6–9 years, 36 primary molars requiring pulp therapy were randomly distributed between two study groups: Group A received stainless steel crowns, while Group B received zirconia crowns. Bite force was measured using the T-Scan III digital occlusal analysis system at three intervals—prior to crown placement, immediately after, and one month postoperatively. The findings revealed a considerable rise in bite force and vertical dimension over time, with zirconia crowns demonstrating a higher mean bite force.[8]

A study conducted to assess bite force changes at maximal intercuspal position (MIP) before and after stainless steel crown (SSC) cementation using the conventional method on deciduous molars, while also evaluating the influence of age and gender. Twenty children underwent bite load and intercuspal contact analysis with the T-Scan III system at three intervals: pre-treatment, immediately post-cementation, and after four weeks. Although no significant change in bite force was observed on the crowned tooth over time, a significant reduction in occlusal prematurities was noted at one-month follow-up ($p = 0.03$). Children over seven years showed a statistically significant increase in bite force ($p = 0.006$).The study concluded that SSCs remain clinically acceptable over time, and the masticatory system adapts effectively regardless of age or gender during growth and development.[9]

A study was conducted to compare occlusal bite force and muscle activity in 30 children (15 boys and 15 girls) aged 9–12 years with mixed dentition, using T-Scan and electromyography (EMG). Occlusal force and the activity of the masseter and temporalis muscles were recorded. No significant difference in occlusal force was found between the left and right sides; however, boys showed significantly higher bite force overall, and EMG revealed greater right masseter activity, particularly in boys. The study concluded that T-Scan and EMG are effective tools for assessing occlusal force and muscle function in mixed dentition, highlighting gender-based differences in muscle dynamics.[10]

A study assessed alterations in vertical overlap and bite strength following stainless steel crown (SSC) restoration using the Hall's method in 20 children with carious primary molars involving enamel and dentin. Digital vernier callipers were used to record measurements, and the occlusal load during maximum intercuspation was analyzed with T-Scan III. Measurements were taken preoperatively, immediately post-placement, and at a follow up interval after a month. The results showed a noticeable increase in vertical height, greater bite force on the tooth with the crown, and fewer early contacts between the teeth. Occlusal re-equilibration was achieved by the one-month.[11]

A clinical study assessed the effect of restoration with full coverage stainless steel crown (SSC) on maximum intercuspation (MI) in 20 children using the T-Scan III system. Occlusal forces were recorded preoperatively, post-anesthesia, post-SSC cementation, and after 1 month. SSC placement significantly altered MIP ($P = 0.0013$), but in most cases, MI returned to baseline within a month ($P = 0.3$), indicating a temporary occlusal disruption that stabilizes over time.[12]

Literature showing influence of hall's technique of crown placement on occlusal parameters in children:

A study evaluated the timing and mechanism of occlusal settling following preformed metal crown (PMC) cementation using the Hall method, along with potential temporomandibular joint dysfunction (TMD). Forty-four children were assessed for changes in overbite and occlusal vertical dimension (OVD) before treatment, immediately after, and weekly for four weeks. OVD returned to baseline by week three ($p = 0.42$), and overbite stabilized by week four ($p = 0.58$), indicating natural occlusal adaptation. No signs or symptoms of TMD were observed at follow-up, suggesting that the Hall technique does not contribute to TMD and that tooth extrusion is not involved in occlusal settling.[13]

A study involving 48 children assessed the impact of preformed metal crowns (PMCs) placed using the Hall method on occlusal vertical dimension (OVD), occlusal interference, and bite equilibration time in primary dentition. The distance between the maxillary and mandibular primary canines was measured before treatment, immediately after crown placement, and at 15 and 30 days post-treatment. The mean distance dropped from 2.45 mm pre-treatment to 0.54 mm immediately after, increased to 1.96 mm at 15 days, and returned to 2.75 mm in the remaining patients by 30 days. The reduction in overbite was attributed to molar intrusion, and equilibration was achieved within a month.[14]

Literature showing use of bite force gauge or gauge sensors for assessment of occlusal bite force in children:

A study evaluated changes in occlusal bite force over six months in children aged 4–6 years after stainless steel crown (SSC) placement on deciduous molars. Using a portable bite force gauge, measurements were taken at baseline, immediately after cementation, and during follow-ups. Results showed an initial increase in bite force followed by gradual occlusal adaptation, supporting the long-term functional effectiveness of SSCs.[15]

In a study involving 1,085 preschool children (aged 3–6 years), maximum occlusal bite force (MOBF) was assessed in relation to different molar relationships—flush terminal, distal step, and mesial step. MOBF was measured with a hydraulic gauge, and clinical parameters like overjet, overbite, and wear facets were recorded. Higher MOBF was observed in children with distal step relationships, while the lowest was in those with mesial step. Gender differences were also noted in some groups.[16]

A study on children between the age group 6–9 years assessed changes in occlusal biting force before and after restoring carious primary molars. With the use of a hydraulic bite force meter, significant increases in bite force were recorded post-treatment, especially in children with multi-quadrant caries. Improvements were noted even on contralateral sound teeth in unilateral cases, indicating that restoring carious teeth enhances overall bite force.[17]

Literature showing use of pressure sensitive sheets for assessment of occlusal bite force in children:

A study involving 20 healthy children aged 3.2 to 5.8 years (11 boys, 9 girls) examined the relationship between biting strength and occlusal force distribution in deciduous dentition. Using pressure-sensitive sheets, occlusal forces were recorded at clenching intensities from 20% to 100% of maximum effort. Results showed that occlusal force distribution remained stable across all clenching levels, indicating a consistent occlusal pattern in primary dentition.[18]

Literature assessing maximum voluntary bite force in children and its correlation with age and gender:

A cross-sectional study of 400 Iraqi children aged 8–10 years evaluated maximum bite force (MBF) in relation to age, gender, and nutritional status. Using a bite force sensor and BMI data, findings showed higher MBF in boys, with significant gender differences emerging in older children. MBF also positively correlated with BMI, highlighting the influence of nutritional status.[19]

In a study of 40 children aged 8–12 years with normal occlusion, maximum voluntary bite force (MVBF) was assessed using a bite force sensor. Results showed that bite force increased with age, and males exhibited higher values than females, indicating significant age and gender influences.[5]

A study measuring molar bite force with a dynamometer in individuals aged 7–80 years found that bite force and masticatory muscle thickness increased with age, peaking at 41–60 years and declining thereafter. Males had approximately 30% higher bite force across all ages, underscoring the role of age and gender.[22]

Among 205 children aged 3–6 years, bite force was measured at various primary teeth sites using a custom gauge. Caries and malocclusion were present in 30.4% and 17.1% of participants, respectively. Bite force ranged widely (12.61–353.64 N), offering important reference values for pediatric dentistry.[21]

A study on 350 individuals with malocclusion assessed maximum occlusal force and skeletal patterns. Bite force increased with age and was consistently higher in males. In females, force plateaued in the late teens, while males showed continued growth into their 20s. A negative correlation was noted with mandibular plane angle in some age groups.[23]

Bite force was evaluated in 2,594 schoolchildren aged 3–17 years using a hydraulic gauge. Bite force increased with age, with males generally showing higher values except in the youngest group. Malocclusion prevalence rose with age, indicating developmental changes in occlusion and masticatory function.[24]

In a study of 30 children aged 3–6 years, bite force was measured across three occlusion types—normal, crossbite, and open bite. Despite variations, no significant differences were found among groups. A weak positive correlation was observed between bite force and both weight and height.[25]

A study on 208 Japanese children aged 7–9 years examined occlusal force and masticatory efficiency using MPM-3000 and ATP particles. Results showed declining occlusal force overall, with a significant increase at age 9. Gender differences emerged only at age 9, and occlusal force correlated strongly with age ($r > 0.6$).[26]

Literature comparing conventional and hall's technique of stainless-steel crown cementation in children:

A randomized controlled trial compared conventional stainless steel crowns (SSCs) and the Hall technique in managing carious primary molars in 3–8-year-old children using a split-mouth design. Each method was used for 25 restorations, with clinical and radiographic evaluations over 12 months. Both techniques showed comparable success rates ($P > 0.05$), but the Hall technique required significantly less placement time ($P = 0.001$), highlighting its efficiency and suitability for resource-limited settings.[27]

MATERIALS AND METHODS

The present randomised controlled trial was conducted in the Department of Pediatric and Preventive Dentistry and Department of Prosthodontics Crown and Bridge and Implantology at KAHER's KLE VK Institute of Dental Sciences, which was designed to evaluate and compare the occlusal force distribution among children aged 5-10 years undergoing stainless steel crown placement by Conventional and Hall's technique using T-scan™.

STUDY DESIGN

This is a Randomized control, double arm, parallel group study. (Figure 1)

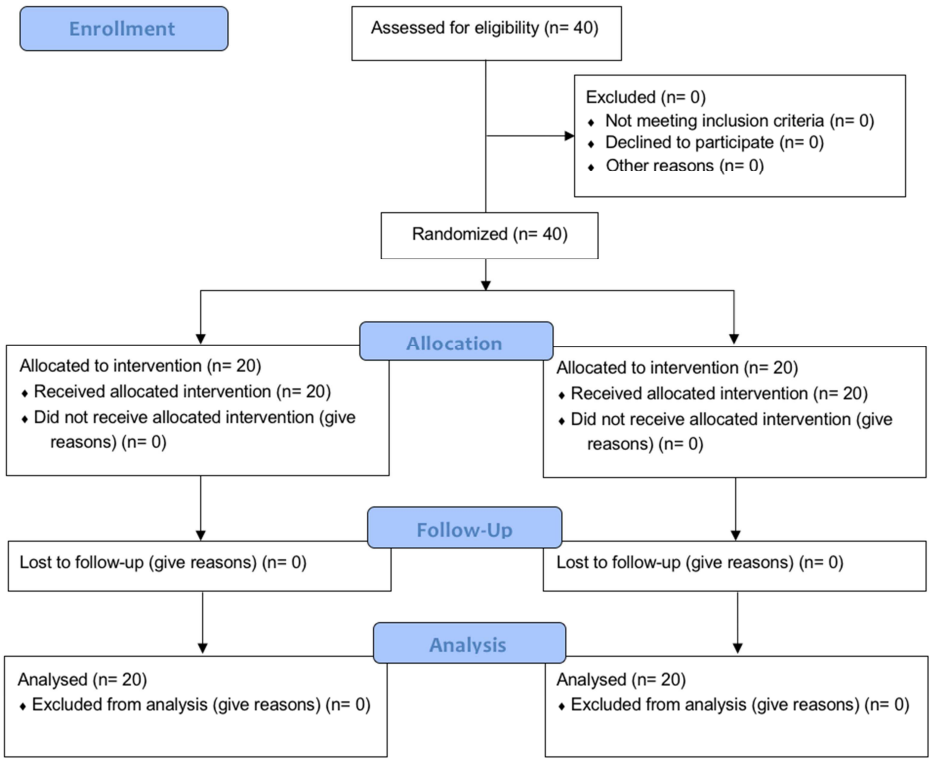


Figure 1: CONSORT 2010 Flow Diagram

INCLUSION CRITERIA

- Children and/or parents who provide informed consent to be enrolled in the study.
- Children of 5-10 years (As per dental age).
- Unilateral primary mandibular molars those who have undergone pulpotomy/pulpectomy.
- Unilateral primary mandibular molars having multi-surface caries involving enamel, dentin and not approaching pulp.

EXCLUSION CRITERIA:

- Children with medical conditions requiring specialized care.
- Children diagnosed with TMJ-related dysfunctions
- Children with any malocclusion.
- Posterior cross-bite and anterior segmental cross-bite.
- Teeth with more than 2/3rd root resorption and less than 2 years' time left for exfoliation.
- Parafunctional habits.

PERMISSIONS TAKEN:

Ethical clearance was granted by the Institutional Research and Ethics Committee of KLE VK Institute of Dental Sciences, Belagavi, and the study was registered with the Clinical Trial Registry of India (CTRI/2024/04/065092).

SAMPLE SIZE ESTIMATION:

The sample size was estimated according to the given formula.

$$n = \frac{(Z_{1-\alpha/2} + Z_{1-\beta})^2 (SD_1^2 + SD_2^2)}{(\bar{x}_1 - \bar{x}_2)_2}$$

Where:

Z 1-α =1.96, Z 1-$_\beta$ = 1.29, SD_1 = 9.41, SD_2 = 15.89,

$\bar{x}_1$ = 46.1

$\bar{x}_2$ = 60.39

(α = probability of type I error, Z 1-$_\beta$ = power of the study, S = standard deviation)

A sample size of 17 was calculated, considering dropouts a sample size of 20 was considered.

So, **n = 40, hence 20 in each group.**

ARMAMENTARIUM:

FIGURE 2: Armamentarium required for crown placement

METHODOLOGY:

1. Consent and Assent

Written informed consent was obtained from parents, and assent was secured from all eligible child participants. (**Annexure III & IV**)

2. Study group and Randomisation

The study samples were equally divided into two groups: Group I (Conventional Technique) and Group II (Hall Technique) by lottery method to ensure random allotment.

3. Case History records:

A detailed case history was documented for the selected patients so as to have a systematic and methodological recording of all the observations and information. (**Annexure V**) Following the documentation of preliminary information, clinical and radiographic examinations were performed in accordance with standard operating protocols. Children meeting the inclusion criteria were seated comfortably in the dental chair, and the procedure was thoroughly explained to both the parents and the children by the Principal Investigator (PI).

If the tooth warrants local anaesthesia administration, then the local anaesthesia was given and then the following procedure was perform.

4. **Tooth preparation and crown placement procedure using Conventional Technique:**

Tooth Preparation:

a) Occlusion reduction of 1.0-1.5 mm was done with the No. 330 or tapered diamond bur. The 1.0-1.5 mm reduction was The marginal ridge alignment was assessed by comparing it with the adjacent teeth.

b) Mesial and distal surfaces were sectioned using a No. 169L bur, taking care to avoid contact with adjacent teeth. The bur was angled slightly relative to the long axis of the tooth, and the cut extended to the buccal and lingual line angles.

c) All sharp angles and line angles were smoothed and rounded. The bur was taken mesio-distally across the surface of the tooth, ending gingivally in a feather edge.

Crown Selection:

The three main considerations for selecting the appropriate stainless-steel crown are adequate mesiodistal diameter, light resistance to seating, and proper occlusal height, which were determined using the trial-and-error method.

Crown Adaptation:

a) The crown was initially positioned on the lingual surface and then seated buccally. It fit loosely, extending 2–3 mm beyond the gingival margin. A scratch mark was made around the crown's gingival margin using a scaler to indicate the gingival contour and the excess portion to be trimmed.

b) The crown was removed, and using crown and bridge scissors, it was trimmed 1 mm below the scratch line to ensure it extended 1 mm subgingivally.
c) Crown adaptation was refined by contouring with pliers. The gingival third was recontoured using No. 114 pliers for better fit.
d) Marginal crimping was done using No. 800-417 crown crimping pliers to ensure the crown engaged the undercuts of the preparation.
e) The crown was tried in and seated from the lingual to the buccal direction, snapping into place with firm finger pressure.
f) An explorer was used to verify complete marginal adaptation.

Crown Finishing:

a) A large green stone was used to create a knife-edge finish at the cervical margin of the crown.
b) The margins were then smoothened and polished using a rubber wheel.
c) Final polishing of the entire crown was done using a wire brush along with rouge, whiting, or a fine polishing agent to achieve a high-lustre finish.
d) With the crown seated on the prepared tooth, occlusion was assessed against the opposing arch to ensure proper cuspal alignment and occlusal interdigitation.

Crown Cementation:

Crown was filled with Type I (Luting) Glass Ionomer Cement and seated on the lingual side and then the buccal side. Excess cement from the buccal and lingual areas was removed with a probe, while cement from the interdental area was removed using dental floss.[1]

5. Crown placement procedure using Hall's Technique:

a) To facilitate crown placement using the Hall technique, orthodontic separators were inserted with separator module pliers and left in place for five days. After removal, an appropriately sized crown was selected.

b) A crown size was chosen to cover the occlusal surface snugly, providing slight resistance or "spring back" when seated up to, but not beyond, the contact points. The crown was loaded with Type I glass ionomer luting cement and firmly seated onto the tooth until it fit completely. Excess cement was immediately removed, and the child was instructed to bite firmly on the crown for two minutes to aid proper seating and initial cement setting.

c) Residual cement was cleared, contact points were flossed, and post-operative instructions were given—informing that any sensation of the crown feeling "high" would subside within a day or two.[2]

6. Recording Occlusal Bite Parameters Using T-Scan™:

- Each patient was assigned with their individualized sensor which were used for recording all three readings (preoperative, postoperative and at 1 month follow-up) during evaluation.
- Each child was instructed to bite on the sensor, and occlusal readings were generated by the software.
- All three recordings were obtained by a single calibrated examiner.

(Annexure VI).

FIGURE 3a: Group I **pre-operative** occlusion

FIGURE 3b: Group I **immediate post-operative** occlusion

FIGURE 3c: Group I **1-month follow up** occlusion

FIGURE 3d: **Pre-operative** scan at maximum intercuspation in Group I

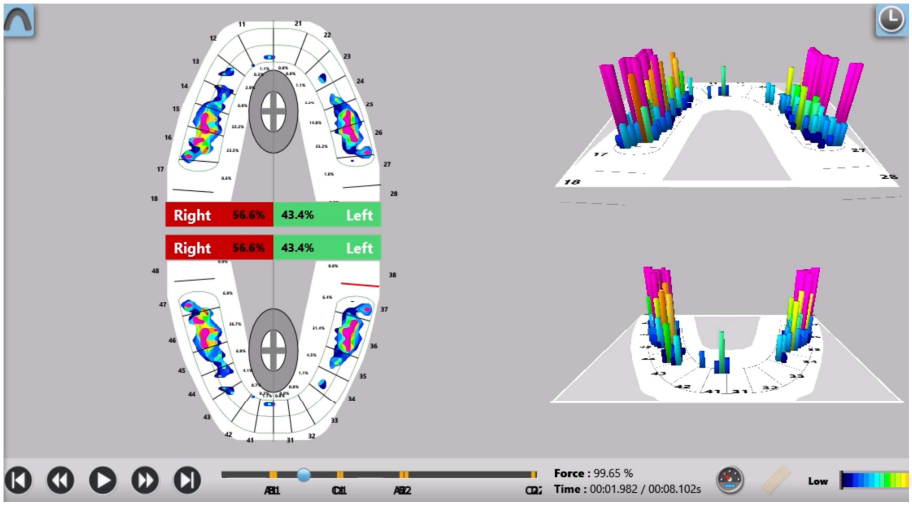


FIGURE 3e: **Immediate post-operative** scan at maximum intercuspation in Group I

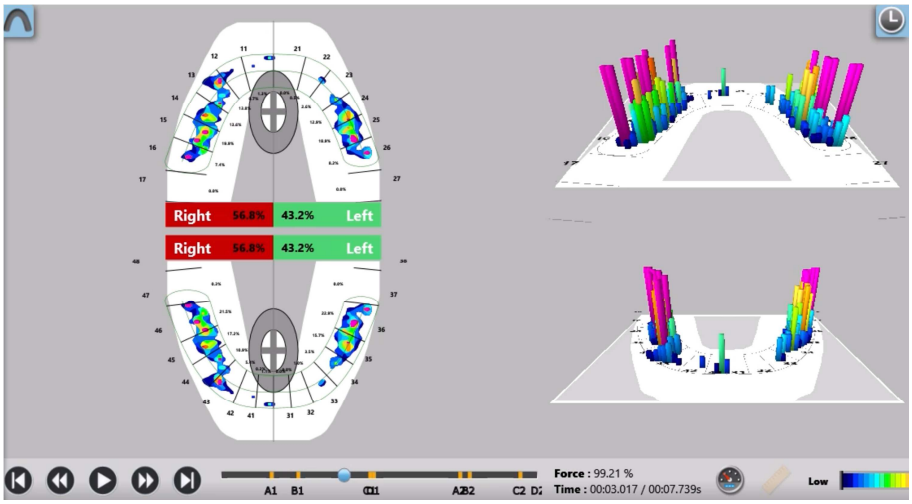


FIGURE 3f: **1-month follow up** scan at maximum intercuspation in Group I

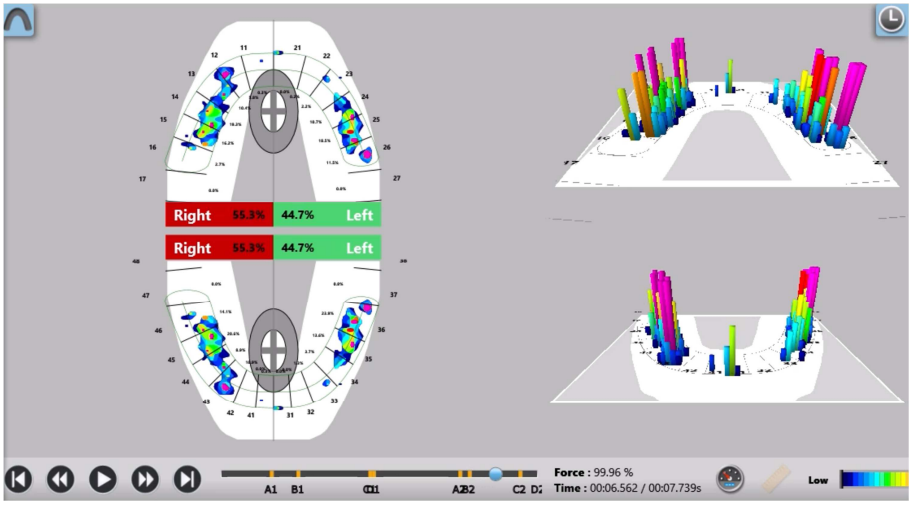


FIGURE 4a: Group II placement of orthodontic separators

FIGURE 4b: Group II **pre-operative** occlusion

FIGURE 4a: Group II **immediate post-operative** occlusion

FIGURE 4a: Group II **1-month follow up** occlusion

FIGURE 4e: **Pre-operative** scan at maximum intercuspation in Group II

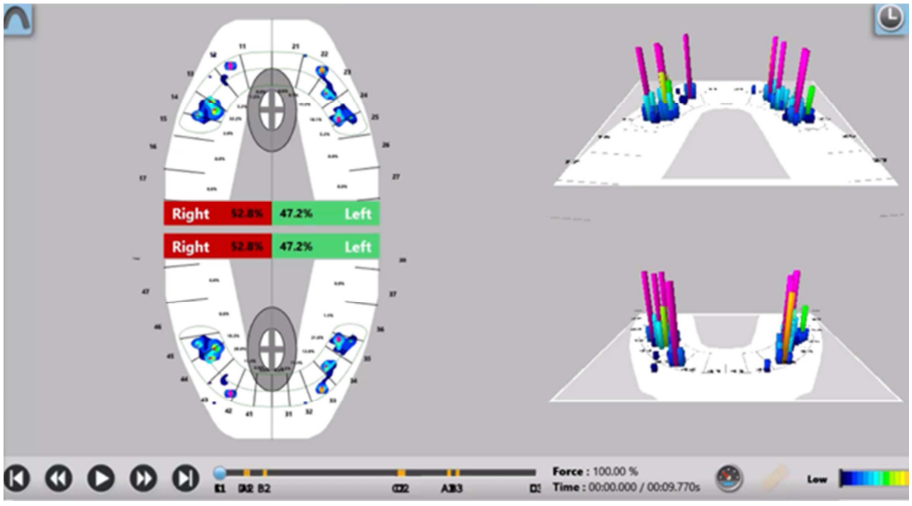


FIGURE 4f: **Immediate post-operative** scan at maximum intercuspation in Group II

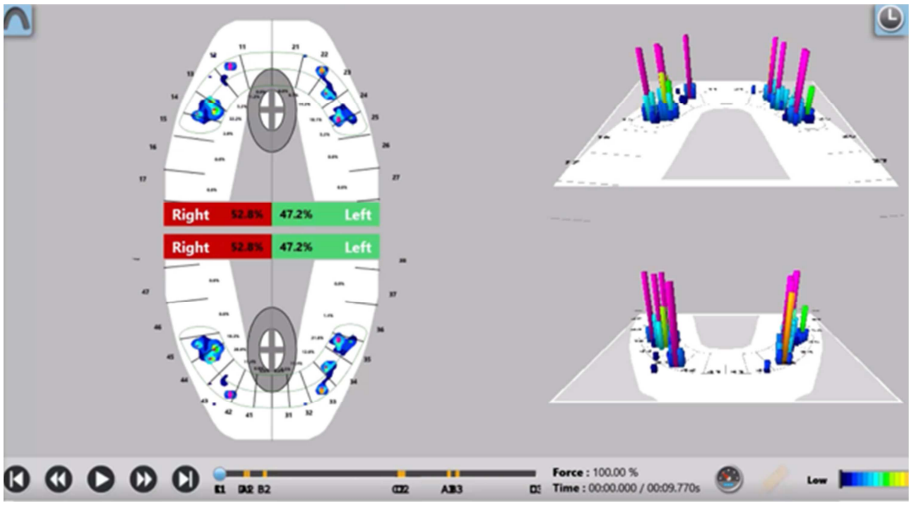
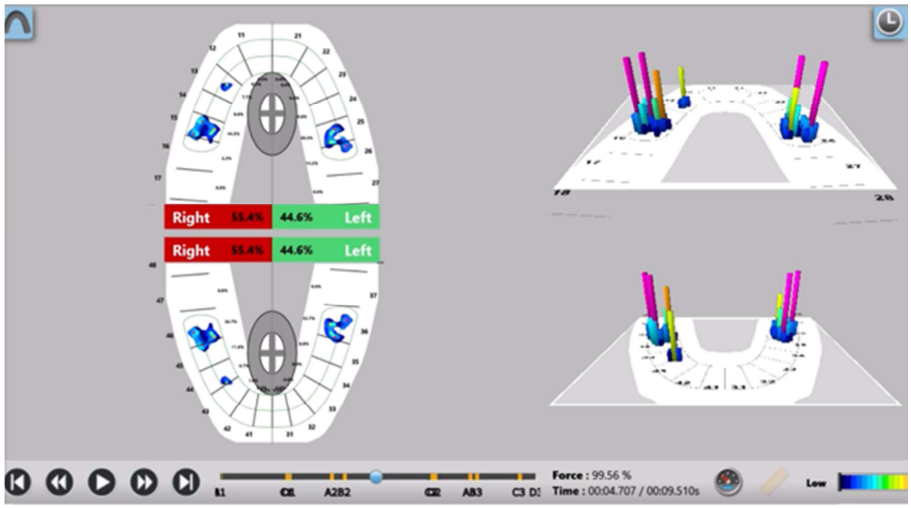


FIGURE 4g: **1-month follow up** scan at maximum intercuspation in Group II



RESULTS

The collected data were entered into an MS Excel sheet (Microsoft Corp) and analyzed statistically, with the level of significance set at $p < 0.05$. Participants in Groups I and II ranged in age from 7 to 10 years, with a mean age of 7.60 ± 0.94 in Group I and 7.75 ± 0.85 in Group II. Of the 40 participants, 21 were male and 19 female. Chi-square analysis showed no statistically significant gender difference between the groups, indicating a nearly equal gender distribution.

Table 1: Comparison of age distribution among Conventional group (Group I) & Hall's group (Group II) by independent t test:

Variables		**Group I n (%)**	**Group II n (%)**	**Total**	**p- value**
Age	Mean ± SD	7.60 ± 0.94	7.75 ± 0.85	7.68 ± 0.89	0.1130
Gender	Male	13 (65.0)	8 (40.0)	21 (52.5)	0.064#
	Female	7 (35.0)	12 (60)	19 (47.5)	
	Total	20 (100)	20 (100)	40 (100)	

#indicates statistically nonsignificant p>0.05.

Table 2: Bite force measurements on the crowned tooth in the Conventional group (Group I) compared at various time intervals using the Friedman Test.

	N	Mean	Std. Deviation	Minimum	Maximum	Chi-Square value	p value of Friedman Test
Preoperative	20	23.59	6.707	11	44	1.013	0.603#
Immediate Post-operative	20	21.18	5.282	11	29		
1 month follow-up	20	21.99	4.511	14	30		

#indicates statistically nonsignificant p>0.05.

There was no statistically significant difference ($p > 0.05$) in bite force on the crowned tooth, indicating that the bite force remained relatively stable at the pre-operative, immediate post-operative, and 1-month follow-up time intervals.

Table 3: Bite force measurements on the crowned tooth in the Hall's group (Group II) compared at various time intervals using the Friedman Test.

	N	Mean	Std. Deviation	Minimum	Maximum	Chi-Square value	p value of Friedman Test
Preoperative	20	23.04	3.248	18	29	36.400	0.000**
Immediate Post-operative	20	40.41	3.793	32	52		
1 month follow-up	20	25.07	2.304	22	29		

**indicates highly statistically significant p<0.01.

The bite force on the crowned tooth showed a highly significant change ($p < 0.01$) across the pre-operative, immediate post-operative, and 1-month follow-up time points. Also, bite force increased considerably at the immediate post-operative interval, which again decreased and became almost equal to the pre-operative value at 1-month follow up interval.

Table 4: Bite force measurements on the crowned tooth between Conventional group (Group I) and Hall's group (Group II) compared at various time intervals

	Group	N	Mean	Std. Deviation	Median	Z value	P value
Bite force on crowned tooth (%) Preoperative	Conventional	20	23.59	6.707	22.75	-0.379	0.705#
	Hall's	20	23.04	3.248	22.4		
Bite force on crowned tooth (%) Immediate post-operative	Conventional	20	21.18	5.282	20.85	-5.413	0.000**
	Hall's	20	40.41	3.793	40.5		
Bite force on crowned tooth (%) 1-month follow-up	Conventional	20	21.99	4.511	21.2	-2.518	0.012*
	Hall's	20	25.07	2.304	24.05		

using the Friedman Test.

**indicates highly statistically significant p<0.01.

Bite force on the crowned tooth was significantly higher ($p < 0.01$) in the Hall group compared to the Conventional group at both the immediate post-op and 1-month follow-up stages. This suggests that while the force on the crowned tooth initially increased immediately after stainless steel crown placement, it decreased at the one-month follow-up but remained higher than in the conventional group.

Graph 1: Comparative Analysis of Bite Force on Crowned Tooth between the study groups

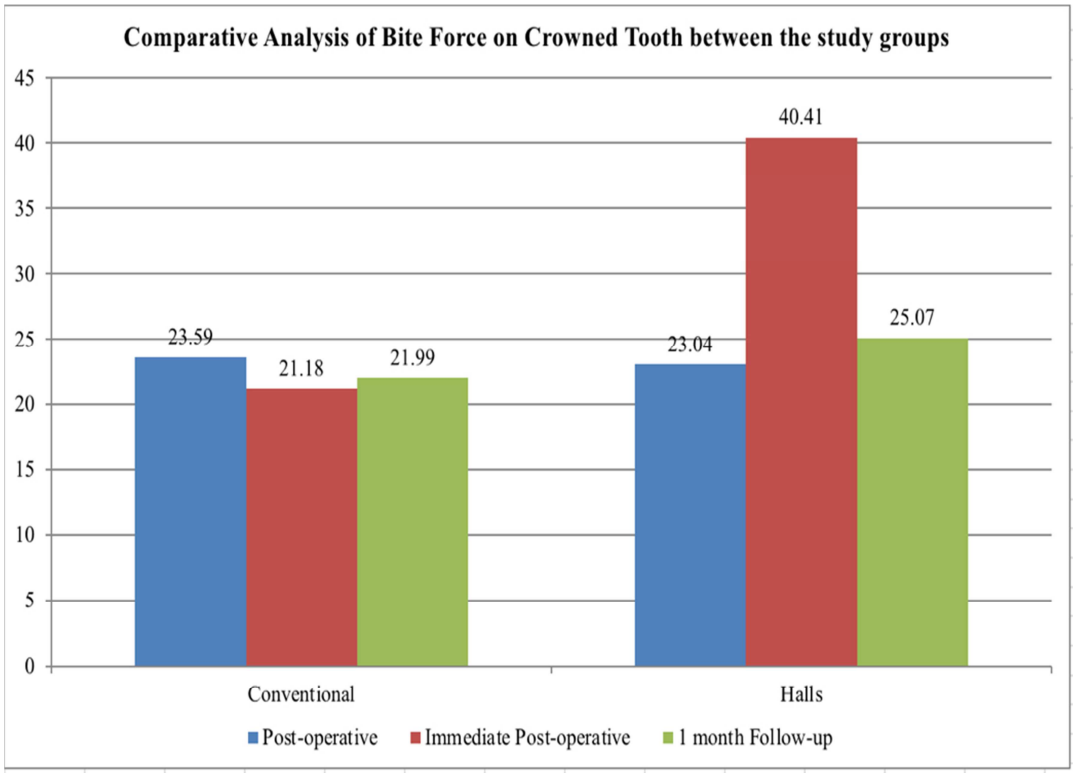


Table 5: Bite Force Distribution measurements on left and right quadrants of the arch among Conventional group (Group I) at various time intervals:

Group	Side	Mean	SD	Mean Diff.	t-value	p-value
Pre-operative	Left	50.56	8.056	0.88	0.2328	0.978#
	Right	49.45	8.056			
Immediate post-operative	Left	50.33	10.35	2.31	0.5406	0.543#
	Right	48.01	10.15			
1-month follow up	Left	49.88	5.77	-0.40	-0.153	0.807#
	Right	50.28	5.93			

#indicates statistically nonsignificant p>0.05.

Bite force distribution between the left and right quadrants of the arch in Group I showed no statistically significant variation ($p > 0.05$), indicating that the bite force distribution was uniform and remained relatively stable at the pre-operative, immediate post-operative, and 1-month follow-up time intervals in Conventional group.

Table 6: Bite Force Distribution measurements on left and right quadrants of the arch among Hall's group (Group II) at various time intervals

Group	Side	Mean	SD	Mean Diff.	t-value	p-value
Pre-operative	Left	50.89	5.52	7.67	1.7494	0.465#
	Right	49.11	5.52			
Immediate post-operative	Left	56.78	17.59	13.56	1.7234	0.062#
	Right	43.22	17.59			
1-month follow up	Left	51.21	4.34	2.42	1.2459	0.058#
	Right	48.79	4.34			

#indicates statistically nonsignificant p>0.05.

Bite force distribution between the left and right quadrants of the arch in Group II showed no statistically significant variation ($p > 0.05$), indicating that the bite force distribution was uniform and remained relatively stable at the pre-operative, immediate post-operative, and 1-month follow-up time intervals in Hall's group.

Table 7: Comparison of Bite Force Distribution between Conventional & Hall's group (Group I & II)

Group	Comparison	Mean	S.D	Mean Difference	t-value	p-value
Conventional	Left	54.4	6.788	8.8	5.80	0.0000138**
	Right	45.6	6.788			
Halls	Left	53.05	4.17	6.10	6.54	0.0000029**
	Right	46.95	4.17			

**indicates highly statistically significant $p<0.01$.

Bite force distribution between the left and right quadrants of the arch in both the Conventional and Hall's groups showed highly significant variation ($p<0.01$), indicating that the bite force distribution was not uniform on left and right side of the arch in both treatment modalities.

Table 8: Comparison of prematurities on crowned tooth among Conventional group (Group I) at various time intervals using Chi-square test

	Baseline		Immediate post-op		1 month		Chi-Square value	p value
Prematurities	n	%	n	%	n	%		
Yes	0	0	6	30	0	0	13.333	0.001**
No	20	100	14	70	20	100		

**indicates highly statistically significant p<0.01.

Prematurities in the conventional group showed highly significant variation (p<0.01) at various time points. Also, presence of prematurities were seen only at the immediate post-operative interval, indicating that the prematurities present got resolved on its own at 1-month follow up interval.

Graph 2: Prematurities on crowned tooth among Conventional group (Group I) compared at various time intervals

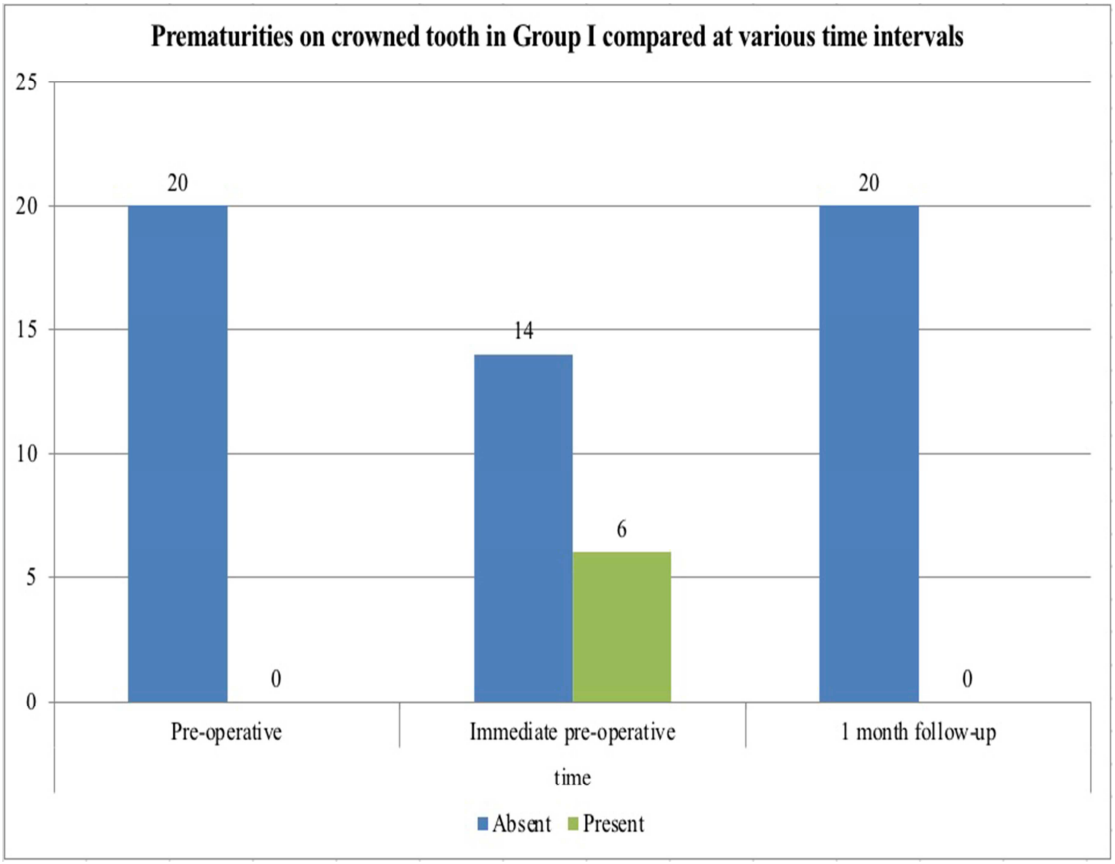


Table 9: Comparison of prematurities on crowned tooth among Hall's group (Group II) at various time intervals using Chi-square test

	Baseline		Immediate post-op		1 month		Chi-Square value	p value
Prematurities	n	%	n	%	n	%		
Yes	0	0	20	100	0	0	60.000	0.000**
No	20	100	0	0	20	100		

**indicates highly statistically significant p<0.01.

Prematurities in the Hall's group showed highly significant variation (p<0.01) at various time points, which was seen in all the participants of the group only at the immediate post-operative interval, indicating that the prematurities present got resolved on its own at 1-month follow up interval.

Graph 3: Prematurities on crowned tooth among Hall's group (Group II) compared at various time intervals

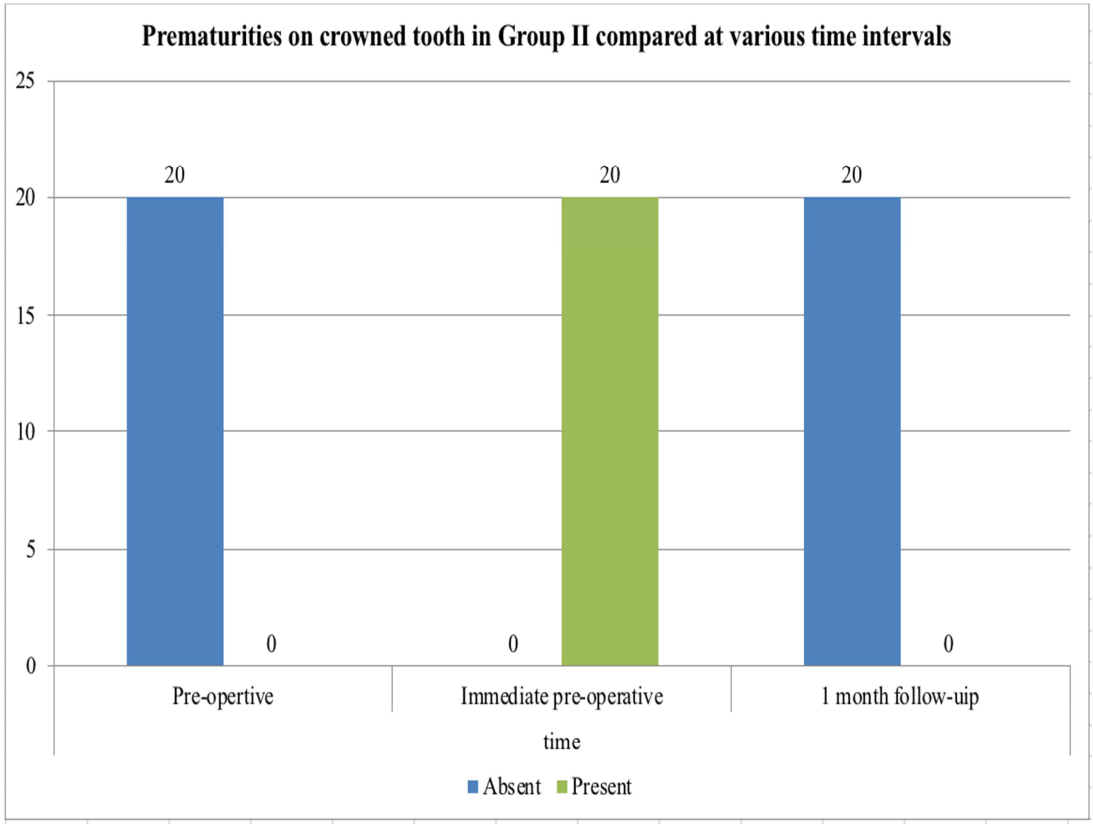


Table 10: Prematurities on crowned tooth between Conventional group (Group I) and Hall's group (Group II) compared at Immediate post-operative interval using Chi-square test

	Group I		Group II		Chi-Square value	p value
Prematurities	n	%	n	%	21.538	0.000**
Yes	6	30	20	100		
No	14	70	0	0		
Total	20	100	20	100		

**indicates highly statistically significant p<0.01.

Prematurities between the Conventional group and Hall's group showed a very highly significant variation (p<0.01) at immediate post-operative interval, with prematurities seen in 100% of the participants of Hall's group whereas in conventional group only 30% of the participants had prematurities.

DISCUSSION

"Occlusal equilibrium in children is a delicate balance—dentists must intervene with precision, preserving function and growth potential."

Principles of Occlusal Rehabilitation

Full-coverage restorations in pediatric patients, the stainless-steel crowns (SSCs) are considered gold standard due to their clinical success rate, and are widely preferred for extensively decayed or pulp-treated primary molars due to their durability, cost-effectiveness, and ease of placement.[1,2] SSCs can be placed using the conventional technique (CT) and the Halls Technique (HT), which is a minimally invasive technique.

Several studies have highlighted the efficacy and benefits of the Hall Technique (HT) for placing stainless steel crowns (SSCs) in children. Randomized controlled trials have shown that HT and the conventional technique (CT) have comparable clinical and radiographic success rates over 12 months ($P > 0.05$), with HT offering significantly shorter procedure times ($P = 0.001$; 9.1 vs. 33.9 minutes), lower anxiety levels ($P < 0.001$), fewer failures, and reduced treatment costs ($2.45 vs. $7.81).[25-27] An umbrella review supported these findings, noting HT's reduced treatment discomfort, pain, and major failure risk, reinforcing its role as a minimally invasive and reliable approach for managing dentinal decay in deciduous teeth.[28] Additionally, a study reported that 90% of children found the HT acceptable, highlighting its high acceptance and practicality in dental settings.[29]

Since all the clinical outcomes of conventional and halls technique are clinically acceptable in children, these two methods were selected for comparison of occlusal force distribution among children. For digital analysis of occlusal bite force

parameters, the T-Scan III system (Tekscan Corp., Boston, MA, USA) was used. It facilitated the evaluation of bite force on the crowned tooth, comparison of occlusal force distribution between the right and left sides, and detection of premature occlusal contacts. The use of T-Scan was found to be simple, quick, and not technique-sensitive. [7]

The conventional technique for stainless steel crown (SSC) placement involves occlusal and proximal reduction, selection and adaptation of a preformed crown, crimping, cementation, and final occlusal adjustments which ensures a precise fit.[1] This approach was compared with the minimally invasive Hall Technique, in which the SSC is luted over the decayed tooth without any tooth preparation.[2] In literature only few studies exist which have digitally assessed the occlusal parameters following fitting of stainless-steel crown using alternative methods.

Few recent studies have evaluated occlusal parameters in children following stainless-steel crown placement using the conventional technique with T-Scan™, revealing a temporary increase in bite force on the restored tooth, leading to occlusal imbalances and the presence of premature contacts. However, occlusion typically stabilised and returned to its pre-operative state within four weeks.[8,9] Along with this, other study findings suggested that children can tolerate minor occlusal interferences (<1 mm) due to effective dentoalveolar compensation and an adaptable masticatory system.[12]

In a study, a rise in maximum occlusal bite force has been observed six months after preformed metal crown (PMC) placement compared to baseline measurements.[38] Increased frequency and intensity of occlusal contacts have also been associated with higher bite force.[39,40] Preformed crowns may get placed slightly higher than the natural occlusal plane, leading to an increase in interocclusal space. If

the crown is not fully adapted or passively seated, it may result in premature contacts and uneven distribution of occlusal forces. These factors can temporarily disrupt functional occlusion, affecting chewing efficiency and causing mild discomfort or occlusal interferences.[31,33,34]

Our study is in accordance with these studies, in which there was significant difference in the right-left bite force on occlusion which suggested discrepancies in the occlusion and occlusal prematurities were seen in 30% of the cases and these parameters were seen to be resolved at 1 month follow-up. Contrary to this, the bite force on crowned tooth remained relatively stable at the pre-operative, immediate post-operative and 1 month follow-up time intervals.

In the present study, a few cases in the Hall's Technique group exhibited tight interproximal contacts that impeded crown placement. Orthodontic separators were therefore placed using Separator Module Pliers and left for five days. After removal, a suitably sized crown was selected to fully cover the occlusal surface while providing a slight "spring-back" effect upon seating, indicating a secure fit.[2]

Several studies evaluating the influence of Hall Technique method of stainless-steel crown placement on occlusal vertical analysis with T-Scan in primary teeth have reported a transient increase in OVD, accompanied by elevated biting force on the tooth which is crowned. This initially led to disturbances in occlusal force distribution. However, both OVD and occlusal load balance were observed to return to baseline within four weeks, suggesting a natural occlusal adaptation following crown placement.[11,30]

These discrepancies could be due to the placement of the crown in supra-occlusion in halls group, as it does not involve prior occlusal reduction. This initially

raised concerns about potential occlusal discrepancies. However, studies have shown that these changes are temporary and typically resolve without the need for adjustments. Over time, natural adaptation leads to a gradual reduction in occlusal interferences. While a temporary increase in occlusal vertical dimension (OVD) is often observed, most children's occlusion stabilizes within a month.[11,35,36] A systematic review on the effectiveness of the Hall Technique further reported that nearly all children return to normal occlusal contacts within six months, with complete normalisation by twelve months.[33]

These findings is in accordance with these study, in which there was increase in the bite load on crowned tooth which caused disruption in the right-left bite force on occlusion and premature contact of the crowned tooth in all the children at immediate post-operative time interval. Stabilization of the bite load on crowned tooth, occlusal force distribution along with absence of premature contacts were seen in Halls group at 1 month follow-up interval.

Although a few patients reported minor discomfort or pain around the crowned tooth following placement using the Hall Technique, these symptoms were effectively managed with analgesics and the pain subsided in two/ three days.

The adaptation which occurs is attributed to dentoalveolar compensation and the dynamic nature of a child's occlusion during growth and development, which allow for natural re-establishment of proper occlusion following crown placement.[11,37] Along with effective management of carious lesions, these factors contribute to the successful occlusal adaptation seen with the Hall Technique, making it an equally efficient, child-friendly, and reliable option for managing carious primary molars.[25,27-9,32]

CONCLUSION

The present study led to the following conclusions:

1. The Hall group exhibited a greater rise in occlusal force on crowned tooth compared to the conventional group, both immediately after crown placement and at the one-month follow-up.
2. Occlusal bite force was evenly distributed between the left quadrant and the right quadrant of the arch in both groups at all time points pre-operative, immediate post-operative, and one-month follow-up.
3. Temporary occlusal discrepancies were observed from pre-operative to one-month follow-up in both groups; however, these resolved over time, as evidenced by a notable reduction in premature contacts.

SUMMARY

The goal of the study was to examine and compare the distribution of bite force in children aged 5–10 years undergoing stainless steel crown (SSC) restoration using either the Conventional or Hall's procedure, assessed with the T-Scan™ system.

SSCs are considered the gold standard for the restoration of primary molars due to their durability, reliability, and full coronal coverage.In this study, the conventional SSC placement technique, requiring tooth reduction and local anesthesia, was compared with the minimally invasive Hall Technique, which involves no tooth preparation or anesthesia. While both techniques have shown comparable clinical success, literature and this study indicate that the Hall Technique offers additional benefits, including reduced chairside time, lower treatment costs, and greater acceptance among pediatric patients due to minimal discomfort and anxiety.

Using the T-Scan III system for digital occlusal system, this study evaluated bite force distribution, premature contacts, and occlusal changes across different time intervals. A significantly higher immediate post-operative bite force was observed on crowned teeth in the Hall group, which gradually returned to near pre-operative values, supporting findings from earlier studies on occlusal adaptation. Though 100% of the Hall group exhibited premature contacts immediately post-op, compared to 30% in the conventional group, these resolved by the one-month follow-up. Bite force distribution between the left and right arches remained uniform within each group over time, but intergroup comparisons revealed statistically significant differences. These results support existing evidence that children's occlusions adapt efficiently following SSC placement, especially with the Hall Technique, making it a reliable, child-friendly, and minimally invasive restorative option..

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ANNEXURE I : ETHICAL CLEARANCE CERTIFICATE

Research and Ethics Committee
KLE VK INSTITUTE OF DENTAL SCIENCES
A Constituent Unit of KLE Academy of Higher Education & Research
Accredited 'A' Grade by NAAC Placed in Category 'A' by MHRD (GoI)
Nehru Nagar, Belagavi - 590 010, Karnataka State
☎: 0831-2470362 Web: http://www.kledental-bgm.edu.in
FAX: 0831-2470640 E-mail:principal@kledental-bgm.edu.in

Sl. No. : 1635

CERTIFICATE

This is to Certify that the synopsis titled

Comparative Evaluation of Occlusal Force Distribution among children aged 5-10yrs undergoing stainless steel Crown placement by Conventional and Hall's technique using T Scan — A Randomised control trial *Submitted by*

Dr. REG.NO. IJ0222001 *P. G. Student /*

Staff, Guided by _____ *from Department of* Pedodontics and Preventive Dentistry *has been critically evaluated by committee members and granted ethical clearance to conduct the above mentioned study*

Date : 27/3/25

Member Secretary
Research and Ethical Committee
KLEVK Institute of Dental Sciences
Belagavi

Chairman
Research and Ethical Committee
KLEVK Institute of Dental Sciences
Belagavi

ANNEXURE II : CTRI REGISTRATION CERTIFICATE

CLINICAL TRIALS REGISTRY - INDIA
ICMR - National Institute of Medical Statistics

PDF of Trial
CTRI Website URL - http://ctri.nic.in

Clinical Trial Details (PDF Generation Date :- Sun, 07 Apr 2024 11:56:13 GMT)

CTRI Number	CTRI/2024/04/065092 [Registered on: 02/04/2024] - **Trial Registered Prospectively**
Last Modified On	26/03/2024
Post Graduate Thesis	Yes
Type of Trial	PMS
Type of Study	Dentistry
Study Design	Randomized, Parallel Group Trial
Public Title of Study	Comparative evaluation of occlusal force distribution using T-scan™ among children aged 5-10 years undergoing stainless steel crown placement by Conventional and Halls technique.
Scientific Title of Study	Comparative evaluation of occlusal force distribution among children aged 5-10 years undergoing stainless steel crown placement by Conventional and Halls technique using T-scan™: A randomised clinical trial.

Secondary IDs if Any

Secondary ID	Identifier
NIL	NIL

Details of Principal Investigator or overall Trial Coordinator (multi-center study)

Details of Principal Investigator	
Name	
Designation	Post graduate student
Affiliation	KAHERs KLE VK Institute of Dental Sciences
Address	Department of Pediatric and Preventive Dentistry, KAHERs KLE VK Institute of Dental Sciences, JNMC Campus, Nehru Nagar, Belagavi, Karnataka. Belgaum KARNATAKA 590010 India
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Details Contact Person (Scientific Query)

Details Contact Person (Scientific Query)	
Name	
Designation	Professor
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CLINICAL TRIALS REGISTRY - INDIA
ICMR - National Institute of Medical Statistics

PDF of Trial
CTRI Website URL - http://ctri.nic.in

		KARNATAKA 590010 India
	Phone	
	Fax	
	Email	

Source of Monetary or Material Support

Source of Monetary or Material Support
> KAHERS KLE VK Institute of Dental Sciences, JNMC Campus, Nehru Nagar, Belagavi, Karnataka 590010.

Primary Sponsor

Primary Sponsor Details	
Name	
Address	Department of Pediatric and Preventive Dentistry, KAHERs KLE VK Institute of Dental Sciences, Belagavi
Type of Sponsor	Research institution and hospital

Details of Secondary Sponsor

Name	Address
NIL	NIL

Countries of Recruitment

List of Countries
India

Sites of Study

Name of Principal Investigator	Name of Site	Site Address	Phone/Fax/Email
	KAHERs KLE VK Institute of Dental Sciences, JNMC Campus, Nehru Nagar, Belagavi.	Department no.06, Department of Pediatric and Preventive Dentistry. Belgaum KARNATAKA	

Details of Ethics Committee

Name of Committee	Approval Status	Date of Approval	Is Independent Ethics Committee?
RESEARCH AND ETHICS COMMITTE, KLE VK Institute of Dental Sciences, Belagavi, Karnataka.	Approved	16/11/2023	No

Regulatory Clearance Status from DCGI

Status	Date
Not Applicable	No Date Specified

Health Condition / Problems Studied

Health Type	Condition
Patients	Necrosis of pulp

Intervention / Comparator Agent

Type	Name	Details
Intervention	Halls technique	Evaluation of occlusal force distribution among children aged 5-10 years undergoing stainless steel crown placement by Halls technique using T-scan™ pre-operatively, post-operatively and at 1 month follow up.
Comparator Agent	Conventional technique	Evaluation of occlusal force distribution among children aged 5-10 years undergoing stainless steel crown placement by Conventional technique using T-scan™ pre-operatively,

CLINICAL TRIALS REGISTRY - INDIA
ICMR - National Institute of Medical Statistics

PDF of Trial
CTRI Website URL - http://ctri.nic.in

			post-operatively and at 1 month follow up.

Inclusion Criteria

Inclusion Criteria	
Age From	5.00 Year(s)
Age To	10.00 Year(s)
Gender	Both
Details	Unilateral primary mandibular molars those who have undergone pulpotomy or pulpectomy. Unilateral primary mandibular molars having multi-surface caries involving enamel, dentin and not approaching pulp.

Exclusion Criteria

Exclusion Criteria	
Details	

Method of Generating Random Sequence	Coin toss, Lottery, toss of dice, shuffling cards etc
Method of Concealment	Pre-numbered or coded identical Containers
Blinding/Masking	Outcome Assessor Blinded

Primary Outcome

Outcome	Timepoints
Occlusal bite force and occlusal force distribution	Occlusal bite force and occlusal force distribution evaluation pre-operatively, post-operatively and at 1 month follow up.

Secondary Outcome

Outcome	Timepoints
NIL	NIL

Target Sample Size	**Total Sample Size=**40 **Sample Size from India=**40 **Final Enrollment numbers achieved (Total)=**Applicable only for Completed/Terminated trials **Final Enrollment numbers achieved (India)=**Applicable only for Completed/Terminated trials
Phase of Trial	Post Marketing Surveillance
Date of First Enrollment (India)	15/04/2024
Date of First Enrollment (Global)	No Date Specified
Estimated Duration of Trial	**Years=**1 **Months=**0 **Days=**0
Recruitment Status of Trial (Global)	Not Yet Recruiting
Recruitment Status of Trial (India)	Not Yet Recruiting
Publication Details	N/A
Brief Summary	Children who fulfill the inclusion criteria will be made to snit comfortably on the dental chair and the procedure to be done will be explained to the patient as well as the parent. Detailed case history will be recorded and written consent will be taken from the parents. Pre-operative recording of occlusal bite parameters will be done using alu wax and T-scan, following this crown placement procedure will be carried out depending on the group in which the participant is allotted. Post-operative and 1 month follow up recording of occlusal bite parameters will be done using alu wax and T-scan.

ANNEXURE III: CONSENT FORM

K L E
VISHWANATH KATTI
INSTITUTE OF DENTAL SCIENCES,
Constituent college of
K.L.E. Academy of Higher Education and Research
J.N.M.C. Campus, Nehru Nagar Belagavi -590010 Karnataka, India.
Department of Pediatric & Preventive Dentistry

INFORMED PARENTAL CONSENT FORM FOR CLINICAL TRIAL (ANNEXURE Ia)

This Informed Consent form is for children between 5-10 years, with decay in the milk tooth, who attend the Department of Pediatric & Preventive Dentistry, KLE VK INSTITUTE OF DENTAL SCIENCES, NEHRU NAGAR, BELAGAVI.

The title of our research project is "Comparative evaluation of occlusal force distribution among children aged 5-10 years undergoing stainless steel crown placement by Conventional and Halls technique using T-scan™: A Randomised Clinical Trial."

Name of Principal investigator:

Post-graduate student, Dept. of Pediatric & Preventive Dentistry
KLE ACADEMY OF HIGHER EDUCATION AND RESEARCH
KLE VK INSTITUTE OF DENTAL SCIENCES, NEHRU NAGAR, BELAGAVI
Telephone number:

Name of co-investigator 1:

(Research guide) Professor, Dept. of Pediatric & Preventive Dentistry
KLE ACADEMY OF HIGHER EDUCATION AND RESEARCH
KLE VK INSTITUTE OF DENTAL SCIENCES, NEHRU NAGAR, BELAGAVI
Telephone number:

Name of Organization: KLE ACADEMY OF HIGHER EDUCATION AND RESEARCH
KLE VK INSTITUTE OF DENTAL SCIENCES, NEHRU NAGAR, BELAGAVI

Name of Sponsor: None

This Informed Consent Form has two parts:

- **PART I:** Information Sheet (to share information about the research with you)
- **PARTII:** Certificate of Consent (for signatures if you agree to take part) You will be given a copy of the full Informed Consent Form

PART I: INFORMATION SHEET

Introduction

I am studying as a post-graduate student at Department of Pediatric & Preventive Dentistry, KLE Academy of Higher Education and Research, KLE VK Institute of Dental Sciences, Nehru Nagar, Belagavi. We are doing research on occlusal force distribution among children who have undergone stainless steel crown placement by conventional and hall's technique using T-scan™. I am going to give you information and invite your child to be part of this research. You do not have to decide today whether or not your child will participate in the research. Before you decide, you can talk to anyone you feel comfortable with about the research.

There may be some words that you do not understand. Please ask me to stop as we go through the information, and I will take time to explain. If you have questions later, you can ask them of me, the study doctor or the staff.

Purpose of the research

Mastication provides the adequate stimulus for proper functioning and normal development of maxilla and mandible. Several factors potentially influence masticatory efficiency including occlusal contact area, number of functional teeth and bite force. Hence the purpose of this study was to compare occlusal force distribution among children undergoing stainless steel crown placement by Conventional and Hall's technique using T-scan.

Type of Research Intervention

This research will involve standard treatment for children undergoing stainless steel crown placement by conventional and hall's technique using T-scan.

Participant selection

We are inviting all children between 5-10 years of age who have undergone unilateral primary molar pulpectomy/pulpotomy procedures or those having multi-surface caries involving enamel, dentin and not approaching pulp, who attend to Department of Pediatric & Preventive Dentistry, KLE Academy of Higher Education and Research, KLE VK Institute of Dental Sciences, Nehru Nagar, Belagavi for treatment to participate in the research. Your child will be included in the research only if the child has undergone stainless steel crown placement unilaterally due to dental decay.

Voluntary Participation

Your child's participation in this research is entirely voluntary. It is your choice whether to allow your child to participate or not. Whether you choose to participate or not, all the services you receive at this institute will continue and nothing will change. If you choose not to participate in this research project, you will be offered the treatment that is routinely offered in this hospital for the stainless steel crown and decayed tooth, and we will tell you more about it later. You may change your mind later and stop participating even if you agreed earlier.

The device that we are using for evaluation of occlusal force distribution is called the T-scan.

The device we are using is a new computerized device (T-scan system; Sentek Crop, Boston, MA, USA) which precisely and dynamically records the time, force, and area of occlusal contacts and is used as a precise and simple clinical diagnostic device that detects the bite force using paper-thin disposable sensors. The safety of this method is extensively proved in scientific literature. Some participants in the research will not be treated with the method which we are testing. Instead, they will be treated using the Hall's technique for crown placement which is already existing in the literature.

Procedures and Protocol

Because we do not know if the new technique, that is the hall's technique is better than the currently available conventional technique for crown placement in children, we need to compare the two. To do this, we will put children taking part in this research into two groups. The groups are selected by computer allocation method.
Participants in group I will be treated with conventional technique for crown placement that is currently being used and Participants in Group II will be treated with the Hall's technique for crown placement. While it is important that neither you nor we know which among the two methods are used for the reduction of anxiety. This information will be in our files, but we will not look at these files until the research is finished. This is the best way we have for testing without being influenced by what we think, or hope might happen. We will then compare which of the two has the best results.
If there is anything you are concerned about or that is bothering, you about the research please talk to me or one of the other researchers.
You will receive the treatment of your condition according to standard guidelines.

Description of the Process

During the research you make two visits to the clinic.

FIRST VISIT - In the first visit, case history will be recorded, the occlusal force distribution will be recorded using alu wax and T-scan, pre-operatively, crown placement will be done according to the group allotted that is by conventional technique or by hall's technique, and the post-operative occlusal force distribution will be recorded using alu wax and T-scan.

SECOND VISIT - The second visit will be the follow up visit, where the occlusal force distribution will be recorded using alu wax and T-scan after 1 month.

Duration

The research completes in two visits; however the remaining treatment will be completed in the subsequent visits during that time, it will be necessary for you to come to the clinic/hospital/health facility for thirty minutes every visit.

Side Effects

There are no known/reported side effects.

Risks

There is risk that the hall's technique of crown placement may have occlusal discrepancies when compared with conventional technique of crown placement.

Benefits

By participating in this study, though there will be no immediate and direct benefit to your child or to you, but your child's participation will likely help us find out more about the most efficient treatment for crown placement in children.

Confidentiality

The information that we collect from this research project will be kept confidential. Information about you that will be collected during the research will be put away and no-one, but the researchers will be able to see it. Any information about you will have a number on it instead of your name. Only the researchers will know what your number is, and we will lock that information up with a lock and key. It will not be shared with or given to anyone except, Ph.D registration committee KLE ACADEMY OF HIGHER EDUCATION AND RESEARCH, BELAGAVI.

Sharing the Results

The knowledge that we get from doing this research will be shared with you before it is made widely available to the public. Confidential information will not be shared. We will share the results with scientific community through presentation in research circles and by publishing in scientific journals in order that other interested people may learn from our research.

Right to refuse or withdraw

You do not have to take part in this research if you do not wish to do so. You may also stop participating in the research at any time you choose. It is your choice, and all of your rights will still be respected.

Alternatives to participating.

If you do not wish to take part in the research, you will be provided with the established standard treatment available at the centre/institute/hospital.

PART II: CERTIFICATE OF CONSENT

I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions that I have asked to have been answered to my satisfaction. I consent voluntarily to participate as a participant in this research.

Name & Signature of Participant _____

Date _____

If illiterate

A literate witness must sign (if possible, this person should be selected by the participant and should have no connection to the research team). Participants who are illiterate should include their thumbprint as well.

I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

Print name of witness _____ AND Thumb print of participant

Signature of witness _____

Date _____

STATEMENT BY THE RESEARCHER/PERSON TAKING CONSENT

I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands that the following will be done:

1.

2.

3.

I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

A copy of this informed consent form has been provided to the participant.

Name and Signature of Researcher /person taking the consent _____

Date _____

ANNEXURE IV: ASSENT FORM

KLE Academy of Higher Education and Research.

K.L.E. V.K. Institute of Dental Sciences, Belagavi.

Department of Pediatric and Preventive Dentistry

My name is I am a dentist. I am doing a study to learn about a new occlusal bite registration technique. I am going to restore your teeth with stainless steel crown and access the occlusal bite force using T-scan sensor. The sensor is totally painless and will not cause any harm to you.

You can ask questions at any time that you might have about this study. Also, if you decide at any time not to finish, you may stop whenever you want. Signing this paper means that you have read this, or had it read to you and that you want to be in the study. If you don't want to be in the study, don't sign the paper. Your parent(s) know that I am asking you to do these things. Remember, being in the study is up to you, and no one will be angry if you don't sign this paper or even if you change your mind later.

Signature of participant _____ Date _____

Signature of investigator 1 _____ Date _____

Signature of investigator 2 _____ Date _____

ANNEXURE V: MASTER CHART

S.no	Age/ Gender	Tooth under treatment	Bite force on crowned tooth (%)	Bite Force Distribution		Prematurities	
				Left	Right	Yes	No

ANNEXURE VI: CASE HISTORY FORMAT

KLE Academy of Higher Education and Research.
K.L.E. V.K. Institute of Dental Sciences, Belagavi.
Department of Pediatric and Preventive Dentistry

Name: Sex:

Age: Parent/Guardian:

Address: Contact Number:

HISTORY:

Chief Complaint:

History of Present Illness:

Relevant Medical History:

Previous Dental History:

NATAL HISTORY:

POST NATAL HISTORY:

GENERAL EXAMINATION:

INTRA-ORAL EXAMINATION

Soft Tissue Examination:
Hard Tissue Examination:
No of Teeth:
Decayed Teeth:
Filled Teeth:
Missing Teeth:
Root Stumps:
Mobility:

PROVISIONAL DIAGNOSIS:

INVESTIGATION:

FINAL DIAGNOSIS:

TREATMENT PLANNING:

ANNEXURE VII: BIOSTATISTICS CERTIFICATE

K L E
VISHWANATH KATTI
INSTITUTE OF DENTAL SCIENCES
A Constituent college of
K.L.E. Academy of Higher Education and Research
J.N.M.C. Campus, Nehru Nagar Belagavi -590010 Karnataka, India.
Department of Pediatric and Preventive Dentistry

BIOSTATISTICS CLEARANCE CERTIFICATE

This is to certify that the Biostatistics art of Dissertation/ Research work of

IJ0222001 **Postgraduate student** under the guidance of **Professor, Department of Pediatric and Preventive Dentistry** entitled **"Comparative Evaluation of the Magnitude and Occlusal Force Distribution among Children aged 5-10 years undergoing Stainless Steel Crown Placement using Conventional and Hall's technique using T-scan – A Randomised Clinical Trial."** has been done under my guidance and considered satisfactory.

Place: Belagavi
Date: 19. 03. 2025

Name and signature of Biostatistician
Dr. S. B. Javali. Ph.D.
Professor in Statistics
Department of Community Medicine
JSM KLE International Medical Programme,
BELAGAVI-590010.

ANNEXURE VIII: PLAGIARISM REPORT

Scientific Correspondence and Review Committee

KLE VK Institute of Dental Sciences
A Constituent Unit of KLE Academy of Higher Education and Research
(Deemed-to-be-University u/s 3 of the UGC Act, 1956)
Nehru Nagar, Belagavi - 590 010, Karnataka State
Accredited 'A+' Grade by NAAC (3rd Cycle) Placed in Category 'A' by MHRD (GoI)
☎: 0831-2470362 Web: http://www.kledental-bgm.edu.in
FAX: 0831-2470640 E-mail:principal@kledental-bgm.edu.in

Date : 15/04/2025 Serial No. : 403

PLAGIARISM CHECK REPORT

Name of the Applicant : IJ0222001
UG / PG / Ph.D / Staff :
Batch & Year : 2022 – 2025
Department : Pediatric & Preventive Dentistry

The soft copy of Research Work / Manuscript by IJ0222001 entitled

"Comparative evaluation of occlusal force distribution among children aged 5-10 Yrs undergoing stainless steel crown placement by conventional & hall's technique using T-Scan" ARCT

under the guidance of .....has been submitted for Anti-Plagiarism check to the Scientific Correspondence & Review Committee of KLE VK Institute of Dental Sciences using "Turn-it-in" software.

The scan has been carried out and the scanned output reveals a Similarity Index of .....7.....%, which is **within / not within** the acceptable limits of 10% as per the UGC guidelines.

15/04/2025
Member Secretary
Scientific Correspondence and Review Committee
KLEVK Institute of Dental Sciences
KAHER-Belagavi

15/04/25
Chairman
Scientific Correspondence and Review Committee
KLEVK Institute of Dental Sciences
KAHER - Belagavi