

## Effect of Rubber Dam on Arterial Oxygen Saturation in Children

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### Abstract:

**Background:** The placement of rubber dam has the potential to alter the airflow through nasal and oral cavities. Pediatric dentist should be aware whether the use of a rubber dam affects the oxygen saturation (SpO<sub>2</sub>) in children. To assess the effect of rubber dam on arterial blood SpO<sub>2</sub> in children of 6-12 years age.

**Materials and Methods:** Totally, 60 ASA Class I patients of 6-12 years age, randomly allocated in two groups: Group A: Rubber dam isolation of maxilla and Group B: Isolation of the mandible. A pulse oximeter was used to detect SpO<sub>2</sub>. To establish a baseline, each patient's SpO<sub>2</sub> was recorded every 30 s for 2 min. A rubber dam was then placed which extended over the nose. Class I cavity and glass ionomer cements restoration were performed. The rubber dam was cut to expose the nasal cavities SpO<sub>2</sub> were recorded every 30 s for 5 min throughout the procedure. A two-way ANOVA test was applied.

**Results:** In both groups there was no significant difference in SpO<sub>2</sub> after rubber dam placement with nose covered or uncovered ( $P > 0.05$ ).

**Conclusion:** There was no significant change in SpO<sub>2</sub> after rubber dam isolation with nose covered or uncovered in children of 6-12 years age.

**Key Words:** Oxygen saturation, pulse oximeter, rubber dam

### Introduction

The rubber dam was introduced to the dental profession by Dr. Stanford C Barnum in 1864. Since then a number of publications have appeared related to its practicality and methods of application.<sup>1</sup> The use of a rubber dam has significant advantages in operative procedures especially in

children. It protects the patient's oropharynx from aspiration of medicaments, instruments etc.<sup>2,3</sup> However, the use of rubber dam alters airflow in both the oral and nasal cavities depending on the method of application. This could result in a decrease in arterial oxygen saturation (SpO<sub>2</sub>) which may cause serious problems in medically compromised patients. Any significant reduction in oxygen supply causes impairment of vital organs such as the brain, heart tissue. The pulse oximeter is a reliable, non-invasive instrument that measures hypoxia at its early stage.<sup>4</sup> Good-day and Crocker evaluated the effect of rubber dam on SpO<sub>2</sub> in dental patients and found no change in SpO<sub>2</sub> before or after rubber dam isolation.<sup>5</sup> Very few studies have been done assessing effect of rubber dam on SpO<sub>2</sub> in children.

Hence, the present study was carried out to evaluate the effect of rubber dam placement on SpO<sub>2</sub>, while carrying out operative procedures in children of the 6-12 year age group.

### Materials and Methods

The study consisted of 60 ASA Class I patients of the 6-12 years age group.<sup>6</sup> Informed consent was taken from the parents and patients. Ethical clearance was obtained from Ethical Committee of Navodaya Medical Institution Raichur, Karnataka, India. Totally, 60 children with Class I caries lesion on second primary molars were selected and randomly allocated in two groups: Group A: 30 children had rubber dam isolation of maxillary primary second molar and Group B: 30 children had rubber dam isolation of the mandibular second primary molar. A pulse oximeter was used to detect arterial blood SpO<sub>2</sub> at every 30 s in both the groups. To establish a baseline, each patient's SpO<sub>2</sub> was recorded every 30 s for 2 min (Figure 1). A rubber dam was then placed which extended over the nose (Figure 2). Operative procedure of Class I cavity preparation and glass ionomer cements (GIC) restoration were performed. Throughout the operative procedure patients, SpO<sub>2</sub> was recorded every 30 s for 5 min. Then the rubber dam was cut to expose the nasal cavities, and SpO<sub>2</sub> was recorded every 30 s for 5 min (Figure 3).

### Statistical analysis

A two-way ANOVA test was performed to compare the measurements taken before and after rubber dam placement in each group. Repeated measures ANOVA were used to compare SpO<sub>2</sub> at different time points in both groups ( $P < 0.05$ ) was taken as statistically significant. The data were entered and verified using the statistical software SPSS version 16.0.



**Figure 1:** Measurement of baseline oxygen saturation.



**Figure 2:** Operative procedure performed with nose covered by rubber dam.

## Results

The average values of SpO<sub>2</sub> in both the groups are shown in Table 1. The average change in SpO<sub>2</sub> from pre-operative baseline till 5 min is shown in Tables 2 and 3. The baseline average SpO<sub>2</sub> for Group A and B was 98.20% and 97.37%, respectively. Placement of rubber dam with nose covered resulted in SpO<sub>2</sub> of 96.93% in Group A and 96.70% in Group B at the end of 5 min. After cutting the rubber dam, the SpO<sub>2</sub> resulted in 97.13% in Group A and 97% in Group B.

There was the highly significant difference in means of SpO<sub>2</sub> in Group A ( $P < 0.0001$ ) at 3.5 min (SpO<sub>2</sub> of 96.9%) from baseline when the nose was covered by rubber dam given by *post-hoc* analysis. There was significant difference in means of SpO<sub>2</sub> in Group B ( $P < 0.02$ ) after covering the nose with rubber dam at 1.5 min ( $P < 0.01$ ) and 2 min ( $P < 0.05$ ) from baseline given by *post-hoc* analysis. The SpO<sub>2</sub> fell to 95.37% at 1.5 min and 95.8% at 2 min from baseline.

## Discussion

In the present study, fingertip pulse oximeter was used to detect the oxygen level in blood. It is a sensitive tool in identifying low blood SpO<sub>2</sub>, which is useful for continuous monitoring of the patient's status. Mueller found pulse oximeter to be more



**Figure 3:** Operative procedure performed with nose uncovered by rubber dam.

sensitive to hypoxic changes than measurements of heart rate, blood pressure, respiratory rate or visual observation of cyanosis.<sup>7</sup>

In children, SpO<sub>2</sub> of 90-95% is considered as safe level for adequate oxygenation of vital organs.<sup>8</sup> Hypoxia will commence when SpO<sub>2</sub> falls below 90%. Medically compromised children with diseases such as asthma, chronic obstructive pulmonary disease, emphysema, congestive heart failure are prone for hypoxia. The dental procedures like rubber dam application which alters airflow may induce similar situation. Bello and Darwish investigated the effect of restorative dental treatment on blood pressure, pulse rate, and SpO<sub>2</sub> in children and found some insignificant desaturations below the pre-operative baseline and found that the maximum decrease occurred during rubber dam application.<sup>9</sup>

In this regard, very few studies have been performed in children. Hence, in the present study children of the 6-12 years age group were selected. To standardize the procedure, Class I cavity preparation and GIC restoration were performed on second primary molars in both maxillary and mandibular arches. The statistical analysis showed that, after rubber dam application in the maxillary arch-Group A, the SpO<sub>2</sub> dropped by 1.3% i.e., to SpO<sub>2</sub> of 96.9% at 3.5 min ( $P < 0.0001$ ) and in mandibular arch-Group B, the SpO<sub>2</sub> fell by 2% i.e., to SpO<sub>2</sub> of 95.37% at 1.5 min ( $P < 0.01$ ) and recovered to SpO<sub>2</sub> of 96.75% at 5 min. In both the groups, the SpO<sub>2</sub> did not fall below 95%. Therefore, the use of rubber dam with nose covered or uncovered showed no statistically significant effect on the SpO<sub>2</sub> in children of the 6-12 years age group. The results of the present study are in accordance with the study done by Good-day and Crocker.<sup>5</sup> Furthermore, Poiset *et al.* showed no significant effect on the SpO<sub>2</sub> and heart rate when routine dental procedures were performed under rubber dam application.<sup>10</sup> In case of medically compromised patients who are prone for hypoxia, further studies are required to evaluate the effect of rubber dam on SpO<sub>2</sub> with due consideration to ethical aspects.

Table 1: Summary of SpO<sub>2</sub> in both the groups.

Groups	Baseline at 30 s (%)	Baseline at 2 min (%)	Nose covered at 30 s (%)	Nose covered at 2 min (%)	Nose covered at 5 min (%)	Nose uncovered at 30 s (%)	Nose uncovered at 2 min (%)	Nose uncovered at 5 min (%)
Group A	98.10	97.77	97.43	97.17	96.93	97.10	97.20	97.13
Group B	97.53	97.03	97.50	95.80	96.70	96.43	97.03	97.00
Average	97.82	97.40	97.47	96.49	96.82	96.77	97.12	97.07

SpO<sub>2</sub>: Oxygen saturationTable 2: Measurement of SpO<sub>2</sub> from baseline at different time intervals till 5 min in Group A.

Group A	Baseline	30 s	1 min	1.5 min	2 min	2.5 min	3 min	3.5 min	4 min	4.5 min	5 min
Rubber dam with nose covered (%)	98.20±0.10	97.43±0.22	97.23±0.22	97.30±0.20	97.17±0.29	97.30±0.26	97.23±0.26	96.90±0.26	96.97±0.25	96.97±0.30	96.93±0.29
Rubber dam with nose uncovered (%)	98.20±0.10	97.10±0.25	97.07±0.26	97.10±0.22	97.20±0.30	97.17±0.31	97.07±0.31	97.03±0.25	97.10±0.22	97.17±0.26	97.13±0.26

All data are mean±SEM. Significantly different from baseline, P<0.05, P<0.01, P<0.0001, Dunnett multiple comparisons test. SEM: Standard error of the mean. SpO<sub>2</sub>: Oxygen saturationTable 3: Measurement of SpO<sub>2</sub> from baseline at different time intervals till 5 min in Group B.

Group B	Baseline	30 s	1 min	1.5 min	2 min	2.5 min	3 min	3.5 min	4 min	4.5 min	5 min
Rubber dam with nose covered (%)	97.37±0.36	97.50±0.31	96.40±0.59	95.37±0.87	95.80±0.74	96.73±0.43	96.47±0.49	96.77±0.44	96.93±0.41	96.73±0.42	96.70±0.46
Rubber dam with nose uncovered (%)	97.37±0.36	96.43±0.51	96.57±0.54	96.73±0.46	97.03±0.44	97.10±0.31	96.77±0.36	97.10±0.31	97.03±0.36	97.07±0.29	97±0.33

All data are mean±SEM. Significantly different from baseline, P<0.05, P<0.01, P<0.0001, Dunnett multiple comparisons test. SpO<sub>2</sub>: Oxygen saturation

## Conclusion

There was no significant change in arterial SpO<sub>2</sub> after rubber dam application with nose covered or uncovered in both maxillary and mandibular arch of healthy children of the 6-12 years age group.

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