

# Effect of Full Mouth Oral Rehabilitation on Bite Force and Body Mass Index in Patients with Early Childhood Caries: A Study Protocol

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## ABSTRACT

**Introduction:** Early Childhood Caries (ECC) is a common condition affecting children, including chewing, aesthetics, the development of permanent teeth and phonetics. Full-mouth rehabilitation is crucial for addressing both immediate dental consequences and long-term oral health. Rehabilitating bite force can help detect stomatognathic system diseases and in understanding mandibular movements. Untreated dental caries can lead to malnutrition, linear growth failure and a negative Body Mass Index (BMI).

**Need of the study:** Bite force assessment in the context of full-mouth rehabilitation of ECC will help measure functionality, monitor stability, finding issues early, ensuring treatment effectiveness and recommend any necessary adjustments for the child's best dental health, to improve post-treatment quality of life.

**Aim:** The study aims to evaluate the effects of comprehensive oral rehabilitation on ECC patients by measuring bite forces and assessing changes in BMI in a paediatric population with primary dentition.

**Materials and Methods:** An experimental study will be conducted in the Department of Paediatric and Preventive Dentistry at Sharad Pawar Dental College and Hospital, Maharashtra, India, from August 2024 to December 2025. The Maximum Bite Force (MBF) in young children aged 4-5 years will be recorded at the central incisors and the right and left molar regions using a Portable Bite Force Measurement Device (BYTE). Anthropometric measurements of height and weight will be taken using scales, a portable stadiometer and a calibrated electronic device. The child's BMI will be derived through weight and height calculations using an established equation. Participants will undergo bite force measurements and BMI evaluations both pre- and post-full mouth rehabilitation (which includes patient education along with preventive treatments like fluoride application and restorative procedures such as fillings, crowns and extractions). Anthropometric measurements will be taken post-treatment and results will be compared before and after the treatment. Statistical analysis will be done using the paired t-test and Pearson's correlation test. Results will be considered statistically significant when the p-value is <0.05.

**Keywords:** Anthropometric measurements, Bite force measurement device, Dental caries, Full mouth rehabilitation

## INTRODUCTION

The ECC is a highly prevalent condition in children. Sometimes, even with all the oral health measures taken, there are concerns about maintaining the oral health of children with ECC [1].

The development of phonetics, the mastication system, aesthetics and preserving enough room for permanent teeth in the growing dentition are all influenced by primary teeth [2,3]. Severe Early Childhood Caries (S ECC) in children aged 3 to 5 is characterised as one or more deciduous maxillary anterior teeth that are cavitated, missing (from caries), or have smooth surface caries, or by DMFS scores of  $\geq 4$  (age 3),  $\geq 5$  (age 4), or  $\geq 6$  (age 5) [4]. Children who lose their anterior teeth at a young age may have psychological effects, altered oral habits, diminished vertical dimension, an unpleasant facial expression and mispronunciation of labiodental sounds like "f" and "v [5]." As a result, this may hinder the development of a child's personality and conduct. To restore all functions, including the child's appearance, dental rehabilitation and prosthetic therapy are crucial [6]. To address the acute dental problems associated with ECC, full mouth rehabilitation is vital for maintaining optimal dental function and alignment in the long-term. A comprehensive strategy to treat and prevent ECC in young children may include rehabilitation of biting force. The distribution of these balanced forces, such as the MBF or Maximum Voluntary Bite Force (MVBFB), may be measured to create an index that can be used to determine how normal or deviant dental health is. The evaluation of occlusion

and the stresses experienced by the stomatognathic system when in occlusion can help quantify a patient's clinical difficulties in any impaired dentition [7]. The bite force is an important factor in evaluating masticatory system performance. Bakke (2006) defines masticatory force as "the pressure exerted on the occlusal surfaces of teeth by the masticatory muscles." Deviations in craniofacial biomechanics can lead to alterations in the jaw elevator muscles [8]. Maximum Occlusal Bite Forces (MOBFs) vary depending on the developmental stage of dentition; during the early primary stage, it is 176 N, in the late primary stage, it is 240 N, whereas during the early mixed dentition, it increases to 289 N, in the late mixed dentition stage, it is 433 N and it reaches its highest value in the permanent dentition, which is 527 N [9]. Various factors have been identified as influencing the intensity of biting strength, including age, gender, temporomandibular joint function, arch form, pain, dental occlusion, density and function of the masticatory muscles, the degree of dental caries, the existence of clinical signs (such as discomfort and abscesses in the teeth), the count of teeth in occlusal alignment, stages of dental eruption and the condition of dentition [10,11].

Untreated dental caries may impact the development and growth of young children. Inadequate dietary intake combined with recurrent infections can lead to malnourishment, stunted growth and changes in BMI in children [12]. Full mouth rehabilitation can positively impact a child's BMI by improving their ability to chew and process food, leading to better nutrition and overall growth. This study aims to

evaluate the effects of comprehensive oral rehabilitation on patients with ECC by measuring bite forces and assessing changes in BMI in a paediatric population with primary dentition.

**Primary objective:** To evaluate the Maximum Comfortable Voluntary Bite Force (MCVBF) at baseline, immediately after treatment completion and at 1-month follow-up.

**Secondary objectives:** To compare BMI at baseline and at the 1-month follow-up and to correlate bite force and BMI.

**Null hypothesis:** There will be no significant correlation between the bite force and BMI after full mouth rehabilitation in ECC patients.

**Alternate hypothesis:** There will be a significant correlation between bite force and BMI after full mouth rehabilitation in ECC patients.

## REVIEW OF LITERATURE

Many conditions, such as various joint and muscle problems, occlusion disorders, dentures, age, gender, orthognathic surgery, psychological issues and trauma, may affect the function of the stomatognathic system. The force exerted by the masticatory muscles during tooth occlusion is known as the bite force. Understanding individual bite forces in different dentitions helps dentists evaluate the therapeutic effects of restorative rehabilitation and comprehend the mechanics of mastication [9].

In a study conducted by Singh R et al., 30 children with deciduous and mixed dentition were subjected to an in-vivo examination to measure maximal voluntary biting strength before and after dental intervention. The study revealed a mean biting intensity of 167.83 N, with males exhibiting 175.39 N and females 166.29 N. Following treatment, the mean biting force increased to 182.60 N. The study concluded that dental cavities and clinical signs have an adverse effect on maximal biting force [12].

Raghu R et al., conducted a study to evaluate the change in oral health-related quality of life in children under five undergoing complete oral rehabilitation under general anaesthesia. The study involved 50 healthy children affected by ECC. Quality of life was assessed using the Early Childhood Oral Health Impact Scale (ECOHIS) questionnaire, with significant reductions observed in all domains and total ECOHIS scores between baseline and one month and baseline and three months post-treatment. The study concluded that oral health-related quality of life significantly improved after complete oral rehabilitation under general anaesthesia and this improvement was sustained beyond the immediate post-treatment period [13].

Nandini K et al., studied 288 children aged 4 to 6 to determine maximal molar biting force. The research revealed that boys exhibited higher overall occlusal bite force than girls and non-carious teeth demonstrated higher masticatory bite force. Additionally, the flush terminal plane molar relationship exhibited the greatest occlusal force [14].

Mountain G et al., investigated biting forces in deciduous dentition and the impact of caries and malocclusion on maximal bite force in 251 children aged three to six. The study identified significant intra- and inter-individual variance in bite forces [15].

Amirabadi F et al., explored the effect of ECC treatment on the BMI of children aged 3-6 years [16]. The study, involving 96 children divided into three groups, revealed significant changes in mean BMI within six months. Group I, which received comprehensive dental treatment under general anaesthesia at baseline, exhibited significantly greater BMI changes than the other two groups. The study concluded that although a significant negative relationship was found between ECC and BMI, oral hygiene and nutritional behaviour were the main confounding variables [16]. The findings suggest that the treatment of ECC had a significant positive effect on BMI, highlighting the importance of healthcare professionals in identifying and treating at-risk children.

## MATERIALS AND METHODS

An experimental study will be conducted in the Department of Paediatric and Preventive Dentistry at Sharad Pawar Dental College and Hospital, Maharashtra, India, from August 2024 to December 2025. The Institutional Ethics Committee has granted ethical approval for the research project (REF. NO. DMIHER(DU)/IEC/2024/235). The procedure will be explained to the parents and kids who are participating in the study. In addition, written informed parental consent will be obtained.

### Inclusion criteria:

- Children aged 4 to 5 years.
- Children with primary dentition.
- Children with a Frankel behaviour rating score of positive (+) or definitely positive (++)
- Children with atleast two opposing carious primary molars.
- Children in good psychological and physical health.

### Exclusion criteria:

- Children requiring specialised healthcare.
- Children with developmental dental anomalies.
- Children with temporomandibular joint disorders.
- Children with malocclusions.
- Children with parafunctional habits.
- Children with traumatic injuries.

**Sample size calculation:** Calculation using the T statistic and non centrality parameter:

A value of  $N=48.3030$  gives the following calculations:

$NCP=Non\ Centrality\ Parameter=\sqrt{N} * E/S_{\Delta}=2.8601$  [12]:

$DF=Degrees\ of\ freedom=N-1=47.3030$ .

$t_{\alpha}=Inverse\ of\ the\ two-tailed\ T\ distribution\ given\ probability\ of\ 1-(\alpha/2)$  and  $DF\ of\ 47.3030=2.0114$ .

$Beta(t_{\alpha}, DF, NCP)=0.199998$ . If  $N$  was calculated correctly, this should closely approximate the selected value of  $\beta$ , above.

The 'N' calculated is rounded up to the next highest integer to give the group size.

N Group size 'N': 49

## Study Procedure

**Evaluating occlusal bite force:** All bite force measurements will be recorded with the help of the Portable Bite Force Measurement Device (BYTE). It analyses force using a 12-bit ADC resolution with a mean range of 0 to 4096. Force measurements will be recorded in Newtons, weight (in kg) and pressure (in kPa) as SI units [17]. Medical standards, Electrostatic Sensitive Instrumentation (ESI)/ Electromagnetic Interference (EMI)-certified and safety standards will be used to evaluate the occlusal bite force before and after full-mouth rehabilitation of ECC patients. Full-mouth rehabilitation interventions in ECC patients will include restorative procedures such as fillings, crowns and extractions, with preventive treatments like fluoride application and oral hygiene education. These interventions will be administered comprehensively within two weeks to ensure uniformity and allow for consistent follow-up measurements.

To evaluate the bite force, the child should sit straight, facing ahead, with their head in a natural, unsupported posture and their back comfortably supported. The Frankfurt plane should be aligned with the ground and their feet should rest flat on the ground. Before recording, the child will be trained to perform their highest possible bite force without moving their head for 3 to 4 seconds. A 60-second break between multiple recordings will be given to avoid fatigue of the masticatory muscles. The greatest value will be selected as the peak bite force. Bite forces will be measured at the central incisors and the right and left molar regions [14]. Next, the biting circular part with an acrylic stent will be placed exactly between the affected

segment or group of teeth or the quadrant teeth and a single-use plastic bag cover will be placed at the biting end of the head. The program will instantly display changes on the reading Organic Light-emitting Diode (OLED) screen as soon as the youngster begins to bite. The measurements will go back to zero after the patient stops biting [18].

**Anthropometric measurements:** A weight and height scale will be used to collect anthropometric data, such as weight and height measurements. The child's height will be measured to the closest 1.0 mm using a portable stadiometer. The child will stand against the measuring scale with their head in the Frankfurt plane, maintaining an upright posture and their feet correctly positioned about the foot posture corrector. A calibrated electronic portable instrument will be used to determine the child's weight. BMI will be computed using a standard formula that considers height and weight [19].

$$\text{Body Mass Index (BMI)} = \frac{\text{Weight (kg)}}{\{\text{Height (m)}\}^2}$$

The BMI-for-age percentile growth charts will be used according to the Centres for Disease Control and Prevention, as shown in [Table/Fig-1] [20]. Every participant will have their BMI and biting force measured three times. The first measurement will be taken right before dental treatment begins. The same bite force measurements will be taken after the necessary dental treatment is completed and repeated four weeks±seven days later. Height and weight assessments will also be taken using the same format used for the pretreatment measurements.

Body weight category	Percentile classification
Underweight	<5 <sup>th</sup> percentile
Healthy weight	5 <sup>th</sup> percentile to <85 <sup>th</sup> percentile
Overweight	85 <sup>th</sup> to <95 <sup>th</sup> percentile
Obesity	≥95 <sup>th</sup> percentile

**[Table/Fig-1]:** Age- and gender-specific Body Mass Index (BMI) percentile classification [20].

**Primary outcome:** The primary outcome of this study is to evaluate the change in bite force in ECC patients after undergoing full-mouth oral rehabilitation. This will be measured using a bite force transducer or a similar device before and after the rehabilitation procedure to assess improvements in masticatory efficiency and functional bite strength.

**Secondary outcome:** BMI measurements will be taken before and after the rehabilitation to determine if improved oral health and function contribute to better nutritional intake and overall growth in young children.

## STATISTICAL ANALYSIS

The results of the outcome variables will be tabulated and described using descriptive statistics and analysed using the Statistical

Package for Social Sciences, Version 19.0 (SPSS) for Windows (SPSS Inc., Chicago, IL). A paired t-test will be used to compare the differences between the bite force values. Pearson's correlation test will be used to correlate bite force and BMI. The results will be considered statistically significant when the p-value is <0.05.

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