

Original Article

# Posed Smile Reproducibility Before and After Orthodontic Treatment Using the Modified Smile Index: A Randomized Clinical Trial

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## Abstract:

**Aim:** The objective of this 2-arm parallel trial was to assess the reproducibility of the posed smile after using two bracket placement strategies: the smile arc protection (SAP) versus McLaughlin, Bennett and Trevisi (MBT) placement guide approaches.

**Subjects and Methods:** Twenty-two adult female patients were randomized to SAP or MBT groups. Eligibility criteria included patients who required orthodontic treatment with non-extraction treatment plan. Interventions entailed bracket placement using either SAP or MBT placement guide approaches. The primary outcome was to assess the reproducibility of the posed smile after the leveling and alignment stage using standardized extraoral photographs of the posed smile. This was assessed by comparing the modified smile index (MSI) between pre and post photographs. Blinding was applicable for the participants, outcome assessors and data analyst.

**Results:** Twenty-two patients were randomized with 1:1 allocation ratio to the intervention or comparator group. Only twenty patients were included in the final analysis. Baseline characteristics were similar between both groups. No statistically significant differences were found between the MSI values between pre and post photographs.

**Conclusions:** The posed smile was found to be reproducible between occasions and can be reliably used for orthodontic outcomes' assessment.

**Keywords:** photographs, orthodontic patients, bracket placement, SAP, MBT.

## Introduction

Orthodontic treatment plays a crucial role in enhancing smiles and their social impact. Research has shown that smiles are universally recognized as positive facial expressions, fostering social communication. A pleasing smile not only enhances facial attractiveness but also contributes to increased confidence and self-esteem (Van Der Geld et al., 2007). Therefore, orthodontic treatment not only benefits oral health but also has a significant impact on social well-being by promoting positive social interactions through a confident and attractive smile.

In a previous article, the components of a balanced smile were discussed and the importance of their consideration during orthodontic treatment was emphasized (Sabri, 2005). To assess these factors and

their contribution to the final esthetic outcome of orthodontic treatment, it is crucial to ensure reproducibility of the smile that is used for the assessment.

Based on the mentioned background, the aim of the current study was to assess the posed smile reproducibility after using the SAP bracket placement protocol compared the MBT placement guide using conventional twin-bracket.

## Subjects and Methods

### Study Setting

This double-blinded randomized clinical trial sample was from the Egyptian population and were selected from the out-patients clinic at Department of Orthodontics, Faculty of Dentistry, Cairo University,

Egypt, where the study was conducted from June 2022 till March 2023. All the 22 subjects were informed by the nature of the study, and an informed consent was signed by each patient before starting.

### **Eligibility Criteria**

The study included adult female patients who required orthodontic treatment with non-extraction treatment plan. Any patient with history of cleft lip or previous orthodontic treatment was excluded.

### **Interventions**

The study commenced with a thorough examination of the patients to determine their eligibility. Once this assessment was completed, a comprehensive set of orthodontic records was obtained, and a standardized extraoral photograph of the posed smile was captured. The standardized photograph featured a white background and utilized a consistent artificial external light source. The patients' chair was securely fixed to the ground, and a cephalostat equipped with two ear rods was employed to stabilize the head. A tripod was utilized to establish a fixed camera height, with three points marked on the ground to ensure proper repositioning. Two rulers were utilized to adjust the magnification ratio. The photographs were taken using a Nikon D7500 digital single-lens reflex camera (Tokyo, Japan), coupled with an 85mm Nikkor Macro Lens in manual focus mode. The occlusal plane was aligned parallel to the floor, with the head positioned in the natural head position. Indirect bonding was done with leveling and alignment till 0.017×0.025 StSt archwires were placed. Post-alignment records were taken and standardized extraoral frontal photographs for the posed smile were captured at the end of the alignment stage for the outcome assessment. The reproducibility of the posed smile was enhanced by showing the patients the frontal posed smile photographs captured

before the treatment and instructed to repeat the same smile, three shots were captured and the one with the highest resemblance to the pretreatment photograph was selected for outcome assessment. In case of inability of the patient to reproduce the posed smile, videos were used to capture screenshots of a similar posed smile.

### **Photographs Management**

The modified Smile Index (MSI) described by Krishnan et al., (2008) was used to check for reproducibility of the posed smile at the two time points (pre-alignment and post alignment) (**Figure 1**), it was calculated for the two images by the following formula:

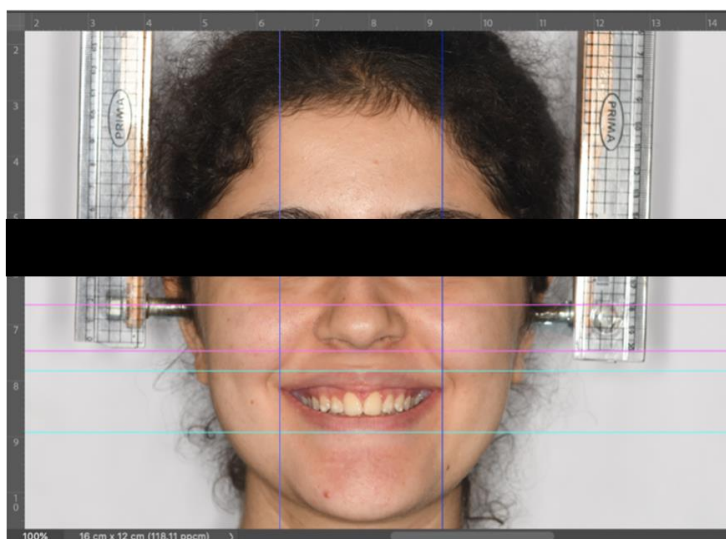
$$MSI = \frac{\text{intervermillion distance at the midline}}{\text{intercommissural distance}} \times 100$$

### **Outcomes**

Pre- and post-alignment standardized extraoral frontal photographs of the posed smile were used to assess the smile reproducibility at the two time points.

### **Sample Size Calculation**

The sample size was calculated based on type I error probability of 0.05, the power of the statistical test was set at 80% using one previous study (**Amin et al., 2020**). Means of -3.7 (standard deviation [SD] = ± 1.38) were reported for the intervention group. Considering dropouts, a sample size of 22 patients was considered appropriate. Twenty patients were included in the analysis, with ten patients in each group. Two patients were lost to follow-up, with one patient in the intervention group traveling to another country, while the other patient in the comparator group did not attend follow-up visits until the end of the study.



**Figure (1): Modified smile index**

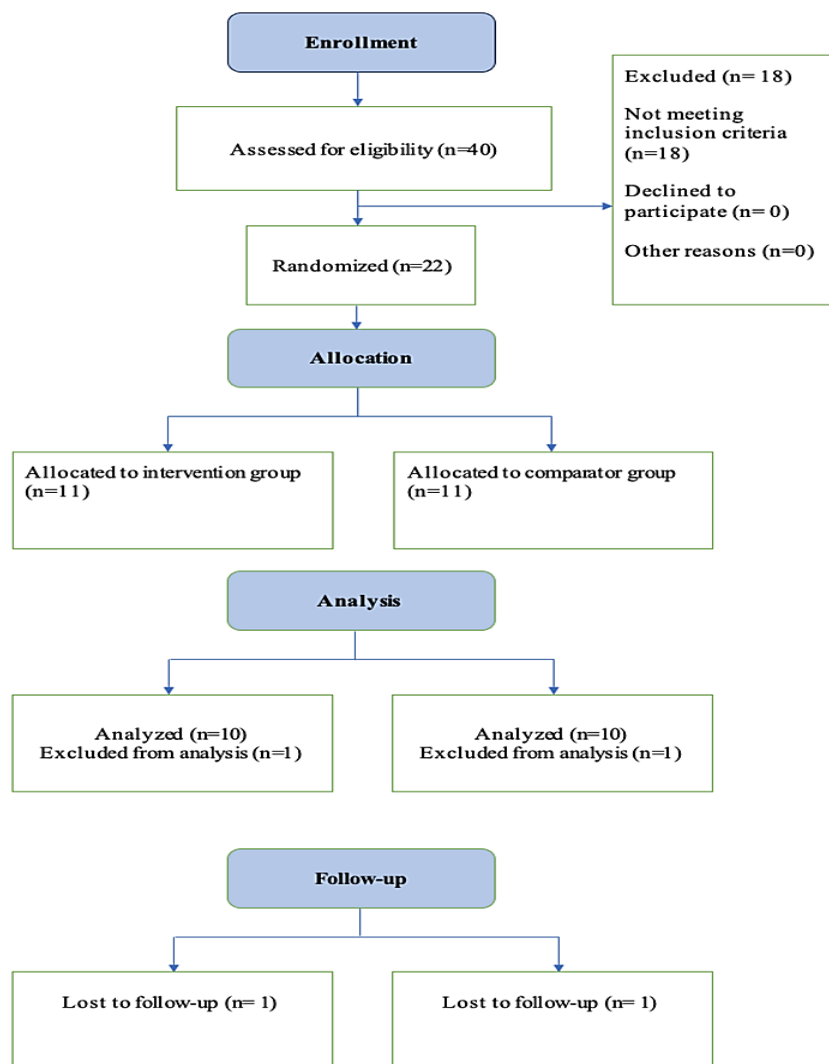


Figure (2): CONSORT flow diagram

### **Randomization**

Simple randomization was performed with a 1:1 allocation ratio. The sequence of individuals in the intervention and the comparator group was generated using computer generated random sequence. This was done using Microsoft Office Excel 2016 sheet. Allocation concealment was done by making opaque sealed envelopes containing the grouping generated previously and titled by numbers from 1 to 22 and the randomization codes were not released until the patients had been recruited into the trial. On the day of starting, one of the opaque envelopes was chosen to be able to detect the randomization sequence and determine which group she was assigned to. The principal investigator had the code for each patient.

### **Statistical Methods**

Paired t-test for the pre and post photographs was used.

### **Results**

#### **Recruitment**

Patients were recruited from June 2022 to September 2022 with six months follow-up period from the start of subject's assignment to the group.

**Participants flow:** Clarified according to CONSORT statement in (Figure 2).

#### **Baseline Data**

Regarding the age of group I (intervention) and group II (comparator), mean and standard deviation were calculated for each group in years, the mean age of group I was 19.4 years, while the mean age of group II was 20.9 years (Table 1)

**Table (1): baseline data (age)**

| Age | Minimum | Maximum | Median | Mean  | Standard Deviation | P value |
|-----|---------|---------|--------|-------|--------------------|---------|
| SAP | 18.00   | 23.00   | 18.00  | 19.40 | 2.07               | 0.19    |
| MBT | 18.00   | 26.00   | 20.50  | 20.90 | 2.81               |         |

Independent t test was performed to detect the level of significance between both groups, with no statistically significant difference between the two groups (P-value > 0.05).

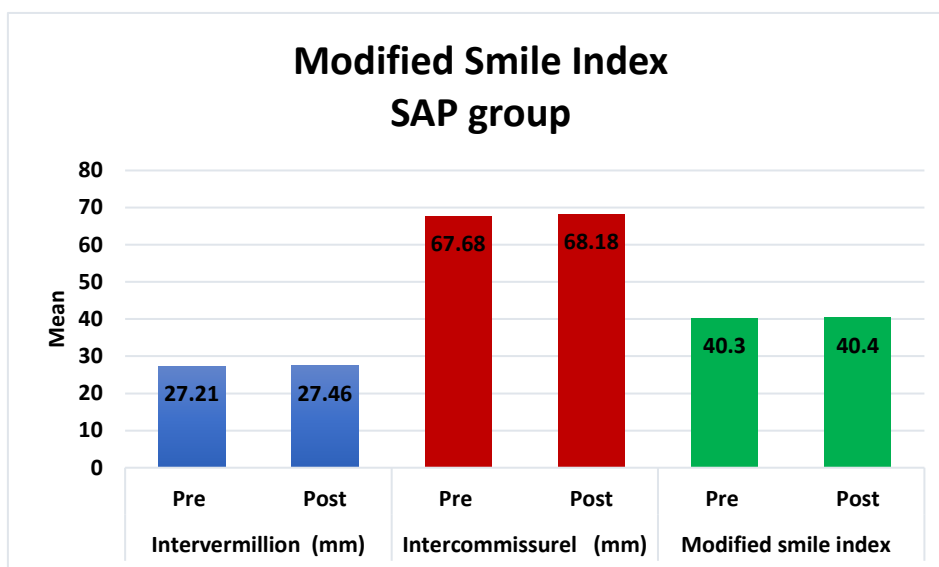
#### Numbers Analysed

Twenty patients were included in the final analysis, 10 patients from each group.

#### Outcomes

##### **SAP group:**

Mean and standard deviation were calculated for each pre-treatment and post alignment photograph for further statistical evaluation. The mean MSI of pre photos was 40.3, while the mean MSI of the post photos was 40.4 (**Figure 3**).

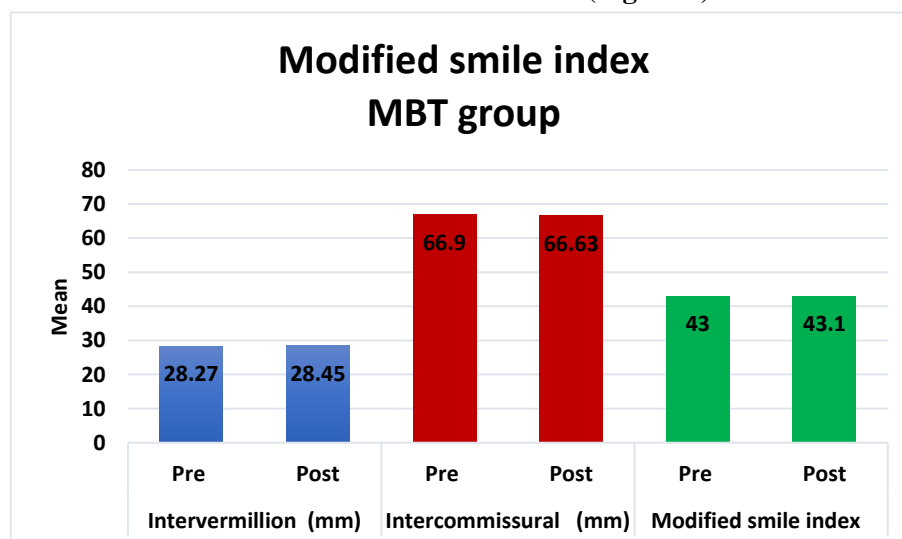


**Figure (3): Modified smile index in SAP group**

Paired t test was performed to detect the level of significance between the pre and post values, with no statistically significant difference between both values (P-value > 0.05).

##### **MBT group:**

Mean and standard deviation were calculated for each pre-treatment and post alignment photograph for further statistical evaluation. The mean MSI of pre photos was 43, while the mean MSI of the post photos was 43.1 (**Figure 4**).



**Figure (4): Modified smile index in MBT group**

Paired t test was performed to detect the level of significance between the pre and post values, with no statistically significant difference between both values (P-value > 0.05).

## Discussion

Soft tissue esthetics and smile have become essential components of modern orthodontic treatment planning. While traditional orthodontic goals such as improving occlusion and teeth alignment are still important, an increasing number of patients seek orthodontic treatment to enhance the overall appearance of their smile and facial soft tissues (**Van Der Geld et al., 2007**).

The aim of the current RCT was to assess the reproducibility of the posed smile at two time points. A technique for the posed smile comparison was used by millimetric measurements on standardized photographs (modified smile index).

To ensure consistency and accuracy in the image capture process, the commonly reported method for seating patients was used, which involved using a cephalostat and a fixed tripod height. This method helped to standardize the patient's position and minimize any potential variations in image capture due to differences in patient positioning which is very critical for accurate smile arc assessment.

Extraoral frontal photograph of the posed smile was selected for the assessment of the posed smile reproducibility as described by **Janu et al., (2020)**. The MSI was used to ensure the repeatability of the posed smile as described by **Krishnan et al., (2008)**. In the current study, the significant and excellent correlation that was found between the MSI of the posed smile photographs taken at the two times ensured that the posed smile is reproducible, this finding was consistent with the findings of **Krishnan et al., (2008)** and **Walder et al., (2013)**.

## Conclusion

The study's overarching conclusion was that the posed smile was found to be reproducible and can be used reliably for orthodontic treatment outcome assessment.

## Recommendations

Due to limited research available, more clinical trials with larger samples assessing the posed smiles of both genders and different age groups are needed.

## Conflict of Interest:

The authors declare no conflict of interest.

## Funding:

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

## Ethics:

Ethical approval was obtained prior to the start of the study by Research Ethics Committee (REC), Faculty of Dentistry, Cairo University with identification number: 13621.

## Data Availability:

Data will be available upon request.

## Clinical Trial Registration:

This trial was registered in [clinical trials.gov](https://clinicaltrials.gov) with ID: NCT05277506.

## Credit statement:

Author 1: Data curation, Writing - review & editing, Writing-original draft, Methodology, Conceptualization, Resources

Author 2: Data curation, Conceptualization, Project administration, Supervision, Methodology, Writing - review & editing, Writing - original draft

Author 3: Methodology, Writing - original draft, Writing - review & editing, Investigation, Formal analysis, Supervision, Data curation.

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