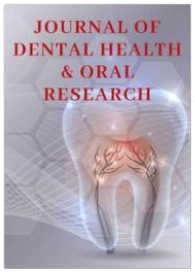

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Accuracy of a Novel Designed Standard Operating Procedure for Orthodontic Diagnosis (SOPOD) Compared with Routine Methods Among Dental Interns: A Comparative Cross Sectional Study

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Abstract

Objective: To compare the diagnostic accuracy and time efficiency of a Standard Operating Protocol for Orthodontic Diagnosis (SOPOD) with routine diagnostic methods among dental interns.

Materials and Methods: Twenty seven dental interns with ≥2 weeks of orthodontic clinical posting participated. Baseline diagnoses were established by an experienced orthodontist. Each intern first diagnosed selected malocclusion cases using routine procedures based on Proffit's approach, followed by re diagnosis of the same cases using SOPOD. Diagnostic accuracy scores and time taken were recorded.

Comparisons between methods were analyzed using paired t tests.

Results: SOPOD yielded significantly higher diagnostic accuracy and improved consistency compared with routine methods. Variability among interns was reduced and diagnostic time was shorter. Differences between the two approaches were statistically significant ($p < 0.05$).

Conclusion: SOPOD enhanced diagnostic accuracy and efficiency among dental interns. Incorporating SOPOD training into undergraduate orthodontic curricula may strengthen diagnostic competence and clinical decision making.

Keywords: SOPOD; Orthodontic Diagnosis, Dental Interns; Diagnostic Accuracy; Orthodontic Education; Clinical Training

Introduction

Orthodontic diagnosis is the cornerstone of effective treatment planning. Orthodontic diagnosis requires a systematic approach involving history taking, clinical examination, radiographic interpretation and comprehensive problem listing [1]. Accurate evaluation of skeletal, dental and soft tissue relationships is essential for identifying treatment needs and predicting outcomes [2]. Achieving the best orthodontic outcome begins with an accurate, timely and thorough diagnosis before starting the treatment phase [3]. However, diagnostic procedures demand considerable clinical experience and a systematic approach, which can be challenging for undergraduate dental students and interns.

Contemporary orthodontic success is assessed not merely by achieving ideal occlusion, but also by maintaining or enhancing facial aesthetics, profile harmony, lip position and soft tissue balance [4]. Routine diagnostic methods, such as Proffit's approach, are widely accepted in clinical practice. However, novice clinicians may experience difficulty in consistently assessing multiple

diagnostic parameters. The absence of a structured examination sequence may lead to missed findings, diagnostic variability and reduced clinical confidence [5].

To overcome these limitations, the Standard Operating Procedure for Orthodontic Diagnosis (SOPOD) was developed as a novel, self designed protocol aimed at improving diagnostic accuracy and consistency among dental interns. SOPOD integrates essential clinical findings into a structured framework, guiding interns in formulating a provisional orthodontic diagnosis.

The present study was designed to evaluate the effectiveness of SOPOD in enhancing diagnostic accuracy among dental interns. Additionally, it compared the time required for orthodontic diagnosis using routine methods with that required when applying SOPOD, thereby assessing the efficiency of this standardized approach.

Materials and Methods

Study Design

A within subjects repeated measures quasi experimental design was adopted. Participants comprised dental interns from Chhattisgarh Dental College and Research Institute (CDCRI), Rajnandgaon, Chhattisgarh, India selected using purposive sampling. Each intern served as their own control by performing orthodontic diagnosis using both routine methods and the SOPOD protocol.

Sample Size Estimation

Sample size estimation was performed using G*Power software (version 3.1.9.7; Heinrich Heine Universität Düsseldorf, Germany). A priori power analysis for a paired t test (difference between two dependent means) was conducted under the assumptions of a one tailed hypothesis, an effect size (dz = 0.5), a significance level ($\alpha = 0.05$) and a statistical power of 80%. Based on these parameters, the required sample size was calculated to be 27 participants.

Methodology

Dental interns who had completed a minimum of two weeks of orthodontic clinical posting at Chhattisgarh Dental College and Research Institute, Rajnandgaon, India were included. Postgraduate students and interns from other institutions were excluded. The Standard Operating Procedure for Orthodontic Diagnosis (SOPOD) is a novel, self designed protocol comprising ten diagnostic parameters intended to standardize orthodontic diagnosis and facilitate treatment planning (Fig. 1). These parameters are broadly categorized into:

- Extraoral examination: patient profile, lip competency and facial symmetry
- Intraoral examination: molar relationship (Angle's Class I, II, III), maxillary alignment (aligned, spacing, crowding), mandibular alignment (aligned, spacing, crowding), presence/absence of anterior crossbite, deep bite, proclination and midline diastema with high frenal attachment

By systematically following these steps, interns performed a comprehensive clinical assessment and established a provisional diagnosis. Orthodontic malocclusion cases were selected from the departmental outpatient clinic. An experienced orthodontist established the reference diagnosis for each case. SOPOD parameters were evaluated by comparing clinical findings with standardized reference photographs provided in the protocol.

The study was conducted in two phases:

- Group I - Routine Diagnostic Method: Participants diagnosed each case using the conventional orthodontic diagnostic approach based on Proffit's method
- Group II - SOPOD Method: Participants subsequently diagnosed the same cases using SOPOD

A total of ten patients were examined in a predetermined sequence. Each intern attended individually at designated time slots. Initially, each intern diagnosed all ten cases using routine methods. One point was awarded for each correct diagnosis (maximum score = 10) and the total time taken was recorded. Following completion of the routine assessment, the patient order was randomized and the same intern re-evaluated the cases using SOPOD. Again, one point was awarded per correct diagnosis (maximum score = 10) and the total time required was recorded (Fig. 2).

Statistical Analysis

Data analysis was performed using SPSS version 25. Descriptive statistics were expressed as mean ± standard deviation. Diagnostic accuracy and time required for diagnosis were compared between routine methods and SOPOD using paired t tests, appropriate for within subjects repeated measures. Statistical significance was set at $p < 0.05$.

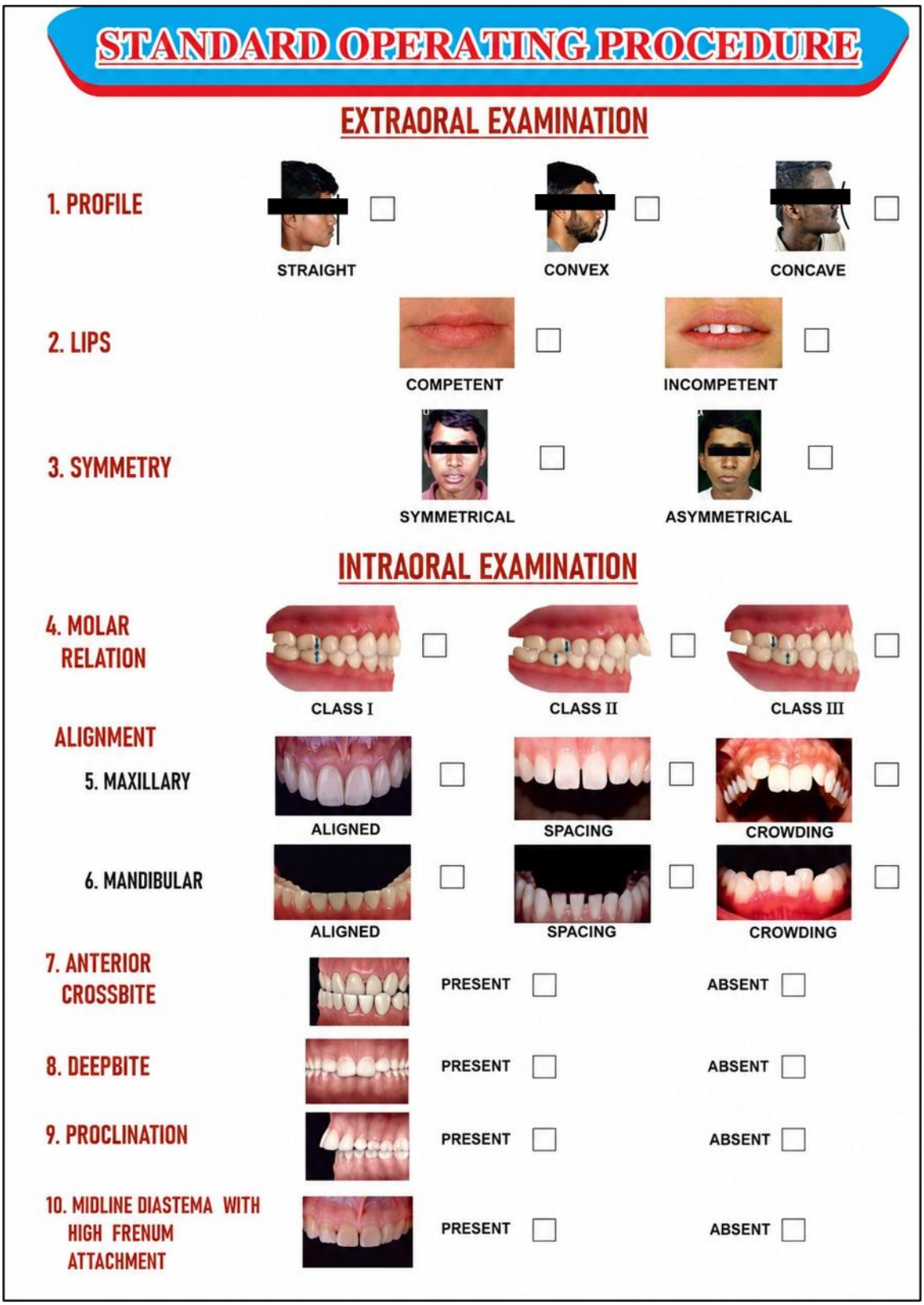

Figure 1: Standard Operating Procedure for Orthodontic Diagnosis (SOPOD).

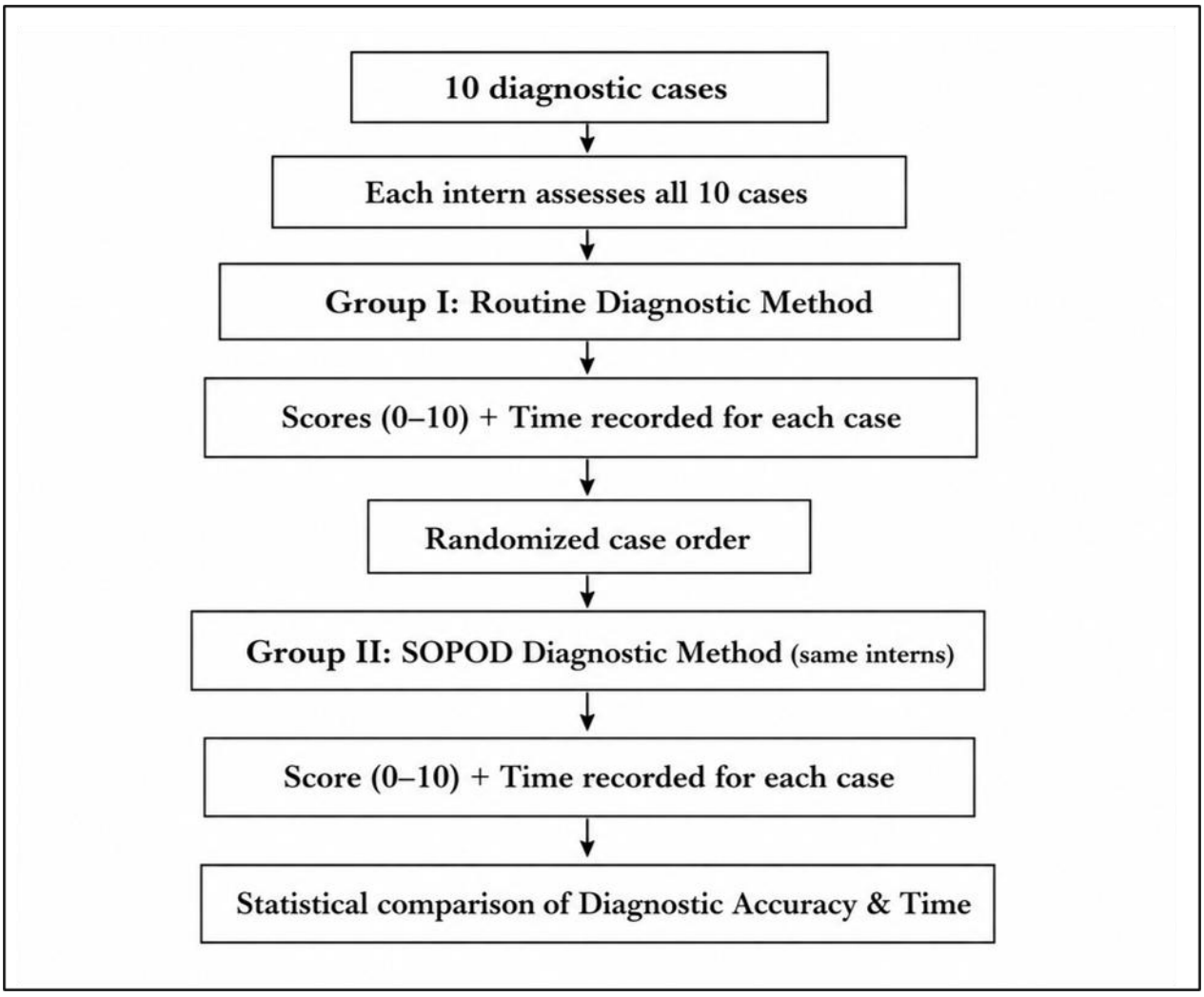

Figure 2: Flowchart depicting intern assessments using routine and SOPOD diagnostic methods.

Results

The implementation of SOPOD led to a measurable improvement in diagnostic accuracy among dental interns. As shown in Table 1, the mean diagnostic accuracy score using routine methods was 7.67 ± 1.47, whereas the SOPOD method yielded a higher mean score of 9.07 ± 0.83. This represents an increase of 1.40 ± 1.24 in correct diagnosis scores, which was statistically significant ($t = -5.806$, $p < 0.05$), indicating enhanced diagnostic reliability with SOPOD.

In terms of efficiency, the mean time required to establish a diagnosis using the routine method (Group I) was approximately 3.01 ± 0.92 minutes. Following SOPOD implementation (Group II), the mean diagnostic time was reduced to 1.22 ± 1.00 minutes (Table 2). The mean difference of 1.78 ± 1.39 minutes reflects a substantial reduction in diagnostic time, highlighting improved efficiency. Statistical comparison using paired t tests confirmed that the difference between the two methods was significant ($t = 6.667$, $p < 0.05$).

Groups	N	Mean ± SD	Mean Difference	t value	p value
Group I	27	7.667 ± 1.468	1.400 ± 1.240	-5.806	0.000*
Group II	27	9.074 ± 0.829			
*P <0.05 = statistically significant					

Table 1: Comparison of diagnostic accuracy between SOPOD and routine methods among dental interns.

Groups	N	Mean ± SD	Mean Difference	t value	p value
Group I	27	3.006 ± 0.917			
Group II	27	1.222 ± 0.999	1.784 ± 1.391	6.667	0.000*
*P < 0.05 = statistically significant					

Table 2: Comparison of diagnostic time between SOPOD and routine methods among dental interns.

Discussion

Orthodontic diagnosis requires a systematic assessment of multiple clinical and diagnostic parameters and inconsistency in the examination sequence may result in missed findings and variability, particularly among inexperienced clinicians. Standardized diagnostic protocols may therefore help improve the completeness, consistency and efficiency of clinical assessment. The present study demonstrated that implementation of the SOPOD significantly improved both diagnostic accuracy and efficiency among dental interns. Following SOPOD use, participants correctly diagnosed approximately nine out of ten orthodontic cases, showing high agreement with the reference diagnosis established by an experienced orthodontist. Compared with the routine diagnostic approach, the structured sequence of SOPOD enabled interns to perform more comprehensive and systematic examinations, thereby minimizing omissions and reducing diagnostic variability. These findings suggest that standardized diagnostic protocols can enhance consistency among inexperienced clinicians.

An equally important outcome was the significant reduction in diagnostic time. The average time using routine methods was approximately three minutes, whereas SOPOD reduced this to about one minute and twenty five seconds (Table. 2). This demonstrates that a structured sequence not only improves accuracy but also enhances efficiency. The organized flow of SOPOD minimized unnecessary repetition and allowed interns to reach a diagnosis more quickly while maintaining diagnostic quality. The principles incorporated into SOPOD closely parallel the systematic orthodontic diagnostic approach described by Proffit, which emphasizes a logical sequence beginning with the patient's chief complaint and history, followed by extraoral and intraoral examination, occlusal evaluation, skeletal and dental assessment, record analysis, problem list formulation and treatment planning [5]. While Proffit's framework remains the gold standard for comprehensive diagnosis, it primarily serves postgraduate training. In contrast, SOPOD translates these principles into a concise, checklist based format suitable for undergraduate education. By simplifying the sequence into clearly defined steps, SOPOD reduces cognitive load, minimizes omissions and enables novice clinicians to perform standardized assessments more efficiently. This structured format likely explains the improved diagnostic accuracy and shorter diagnostic time observed. The rationale for these improvements lies not only in the simplified sequence itself but in its educational adaptability: by providing interns with a reproducible, chairside friendly framework, SOPOD transforms complex diagnostic principles into a practical training tool that enhances learning, promotes examiner uniformity and accelerates clinical decision making in undergraduate settings.

The findings align with Sastri, et al., who reported greater orthodontic knowledge among non orthodontic specialists compared with general practitioners, underscoring the need for improved clinically oriented orthodontic education [6]. In contrast to their questionnaire-based study, which primarily explored students' knowledge and attitudes, the present study focused on the application of a structured diagnostic protocol and objectively assessed its effect on diagnostic performance. The findings demonstrated improvements in both diagnostic accuracy and the time required to complete the assessment. Similarly, Kapoor, et al., highlighted deficiencies in orthodontic knowledge among general practitioners but did not assess clinical performance [7]. In contrast, the present study objectively demonstrated that SOPOD can bridge the gap between theoretical knowledge and clinical application, thereby enhancing competence and consistency. The present findings correspond with those reported by Agrawal, who concluded that dental students had good knowledge and a positive attitude toward orthodontic treatment, with greater awareness among house surgeons than first-year students [8]. Similarly, the present study demonstrated improved orthodontic diagnostic performance among dental interns. However, unlike the questionnaire-based assessment of knowledge and attitude, the present study evaluated the impact of a structured Standard Operating Procedure for Orthodontic Diagnosis (SOPOD) and showed significant improvements in diagnostic accuracy and efficiency.

Comparable observations were made by Ismail, et al., in 2025, who reported limited confidence among dental students and alumni in orthodontic diagnosis due to insufficient structured training [9]. They emphasized strengthening undergraduate orthodontic teaching through systematic approaches. The present study supports this recommendation, showing that SOPOD provided interns with a structured pathway that improved diagnostic accuracy and efficiency. Although confidence was not

directly measured, the improved performance suggests that structured protocols may also enhance confidence and clinical decision making. Similar findings were reported by Alshammari, et al., who observed better orthodontic knowledge and attitudes among non-orthodontic specialists than general practitioners, highlighting the impact of professional training [10]. Likewise, the present study demonstrated that SOPOD significantly improved the diagnostic performance of dental interns. However, unlike their questionnaire-based study, the present study evaluated a structured educational intervention and demonstrated measurable improvements in diagnostic accuracy and efficiency.

From an educational perspective, SOPOD facilitates systematic clinical reasoning by encouraging interns to evaluate patients using a standardized sequence. This not only improves diagnostic confidence but also promotes uniformity among examiners. As a simple, reproducible and chairside friendly tool, SOPOD has the potential to bridge the gap between theoretical principles and practical application in undergraduate training.

From a clinical standpoint, the reduction in diagnostic time may improve outpatient efficiency, reduce patient waiting and facilitate earlier treatment planning. Accurate and timely diagnosis can enhance patient confidence and contribute to a more positive clinical experience. Thus, SOPOD represents a practical educational adaptation of Proffit's philosophy, offering additional advantages of efficiency, standardization and ease of implementation in undergraduate orthodontic education.

Merits of the Study

Given its simplicity, reproducibility and chairside applicability, SOPOD shows promise as a valuable educational tool in undergraduate orthodontic training. However, validation through larger, multicenter studies with diverse cohorts and long term follow up is warranted to confirm its broader applicability and to explore its potential integration into standard curricula.

Future Implications

In the future, its incorporation into undergraduate curricula and clinical postings could provide students with a standardized framework for performing orthodontic diagnosis and improve consistency across different learners. Future research could also evaluate the effectiveness of SOPOD across different levels of clinical experience and explore its integration with digital diagnostic tools and computer-assisted learning platforms. Such developments may facilitate standardized orthodontic training, improve diagnostic decision-making and support the transition of novice clinicians from supervised learning to independent clinical practice.

Conclusion

The present study demonstrated that the SOPOD is an effective adjunct for enhancing the diagnostic performance of dental interns. Compared with routine methods, it significantly improved accuracy, reduced diagnostic time and promoted a more comprehensive evaluation through its structured sequence. Beyond measurable outcomes, SOPOD fostered greater confidence and independence among interns, streamlined clinical workflow and contributed to a more positive patient experience.

Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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Acknowledgement

The authors have no acknowledgments to declare.

Data Availability Statement

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

Ethical Statement

Ethical approval for the study was obtained from the Institutional Review Board of Chhattisgarh Dental College and Research

Institute, Rajnandgaon, Chhattisgarh, India. [Reference no.: CDCRI/DEAN/ETHICSCOMMITTEE/ORTHO/PG-03/2025].

Informed Consent Statement

Written informed consent was obtained from all participants prior to enrollment in the study.

Authors' Contributions

All authors contributed substantially to the conception, design, data collection, analysis, manuscript preparation and final approval of the manuscript.

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