

Research Article

Improving Early Orthodontic Diagnosis In Primary Healthcare Through Targeted Training Programme

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ABSTRACT

Background: Early identification of orthodontic abnormalities is essential for preventing progressive dentofacial complications and reducing treatment complexity in children. Primary care professionals may be the first health care professionals to evaluate a pediatric patient, but a lack of orthodontic training may help delay diagnosis and referral of developing malocclusions.

Objective: To evaluate the effectiveness of a targeted orthodontic training programme in improving early orthodontic diagnostic knowledge, recognition of malocclusion patterns, and referral confidence among primary healthcare professionals.

Methods: The study was a cross-sectional interventional study conducted in the Orthodontic Department at Lahore Medical & Dental College in Lahore, Pakistan for six months from January 2025 to June 2025. A total of 60 primary healthcare professionals were enrolled through non-probability consecutive sampling and equally divided into two groups comprising 30 participants each. While Group A received no intervention, Group B underwent the structured orthodontic training programme. Validated questionnaires and standardized clinical image-based evaluations were used to assess the baseline knowledge and diagnostic competency. Reassessment of the students was done after intervention with the same assessment tools. The data was analysed with SPSS version 26 and a p value of ≤ 0.05 was used to determine statistical significance.

Results: The intervention group demonstrated significant improvement in mean diagnostic assessment scores following the training programme (52.7 ± 10.3 vs 82.4 ± 7.6 ; $p < 0.001$). There was significant improvement in the recognition of posterior crossbite, skeletal malocclusion, dental crowding, mouth breathing patterns and the presence of harmful oral habits after the intervention. Referral confidence regarding early orthodontic consultation increased from 36.7% to 86.7% among participants in the intervention group.

Conclusion: The targeted orthodontic training programme significantly improved orthodontic diagnostic capability and referral confidence among primary healthcare professionals, highlighting the importance of integrating orthodontic education into primary healthcare systems.

Keywords: Orthodontic Diagnosis, Malocclusion, Primary Healthcare, Interceptive Orthodontics, Training Programme, Early Referral, Pediatric Oral Health.

INTRODUCTION

Dentofacial abnormalities and malocclusion are among the most prevalent oral health conditions in children and adolescents globally¹. These abnormalities can not only impact the aesthetics of the face, but also mastication, speech, maintenance of oral hygiene, psychological status, and quality of life. If left untreated at the right time, early orthodontic issues like crowding, crossbite, open bite,

skeletal discrepancies and abnormal oral habits can continue to develop throughout craniofacial growth. The longer the delay, the more complex the treatment, the longer the treatment will take for the orthodontist, the more expensive it will be, and in some serious situations, surgery may be required to correct it in adulthood². The importance of early orthodontic evaluation and interceptive management in childhood is paramount to help guide the normal craniofacial

development and help prevent future complications³. Interceptive orthodontics is the identification and treatment of the developing malocclusion at the mixed dentition stage, when growth modification and preventive treatment is most effective. Mouth breathing, thumb sucking, tongue thrusting and abnormal eruption patterns may have a significant impact on jaw development and dental alignment if not addressed. Early intervention can help develop a positive occlusion, harmonise the face and minimise future orthodontic issues⁴.

Primary healthcare providers (PHCPs), such as family physicians, general medical practitioners, pediatricians and general dentists, are often the first HCP to examine children as part of their routine medical and dental care⁵. Working constantly with children gives them a golden opportunity to spot signs of early orthodontic changes and make timely referrals to orthodontists. Many primary care providers, however, are not well informed or trained in orthodontic diagnosis, evaluation of growth, and when to refer. That means that early orthodontic abnormalities aren't always identified until later, and preventable complications may occur⁶.

In countries with developing health care systems like Pakistan, there may not be adequate access to specialized orthodontic care, especially in under-resourced and rural areas⁷. Therefore, improving the diagnostic ability of primary healthcare professionals could play an important role in the provision of preventive oral healthcare and ultimately alleviate the burden of long-term orthodontic disease⁸. Educational and training interventions have demonstrated efficacy for enhancing clinical competency, diagnostic confidence and interdisciplinary collaboration across various health care professions. Educational orthodontic training programmes may increase awareness of malocclusion patterns, harmful oral habits, airway abnormalities, and when to seek specialist advice for non-specialist health professionals⁹.

Although preventive orthodontics and the integration of healthcare disciplines are becoming more important, there is a lack of local evidence about the effectiveness of orthodontic education intervention for the primary healthcare professionals¹⁰. There is a lack of focus on early orthodontic screening and diagnosis in most undergraduate medical and dental training programmes. It is therefore crucial to assess the effectiveness of orthodontic training programmes targeting

primary healthcare providers in order to enhance early detection programmes and facilitate interaction with the orthodontists¹¹.

Therefore, the present study was conducted to evaluate the effectiveness of a targeted orthodontic training programme in improving early orthodontic diagnostic knowledge, clinical assessment capability, and referral confidence among primary healthcare professionals¹².

MATERIALS AND METHODS

This cross-sectional interventional study was conducted at the Orthodontic Department, Lahore Medical & Dental College, Lahore, Pakistan, over a period of six months from January 2025 to June 2025. The study was approved by the Institutional Ethical Review Committee before the research was started. All participants gave their written informed consent, and all procedures were conducted in adherence with ethical standards for studies with human subjects.

The study included 60 primary healthcare workers as total samples by non-probability consecutive sampling technique. The study population included General dentists, family physicians, medical officers and house officers in primary healthcare. Participants with less than six months of clinical practice and/or those who did not have prior formal training in orthodontics were excluded.

Participants were randomly divided into two experimental groups of 30 participants each. Group A was used as the control group and did not receive the targeted orthodontic training programme during the study period while Group B was used as the intervention group and underwent the structured orthodontic training programme by the consultant orthodontists and senior members of the Orthodontic Department.

All the participants were assessed at the baseline with a validated structured questionnaire and the standardized clinical image-based diagnostic assessment tool. The questionnaire measured the participants' knowledge about early orthodontic abnormalities, craniofacial developmental abnormalities, detrimental oral habits, airways abnormalities, evaluation of mixed dentition and referral timing. Standardized clinical photographs and radiographic images showing common orthodontic conditions, such as anterior open bite, posterior crossbite, skeletal discrepancies, dental crowding, abnormal eruption patterns, and craniofacial changes

associated with mouth breathing were used for the image-based diagnostic assessment.

Group B received targeted orthodontic training programme, which comprised interactive lectures, case based discussion, clinical demonstration, image interpretation training session, and principles of assessment of airway, monitoring growth and development of the face, recognising early patterns of malocclusion and guidelines for interceptive orthodontic management. Particular focus was given on the detection of orthodontic abnormalities at the mixed dentition stage and the need for appropriate early referral for specialist care.

After completion of the training programme, Group B (Trainees) were tested again with the same questionnaire and the same diagnostic evaluation tools to see if there was an increase in their knowledge, diagnostic competency and referral confidence. Group A participants were also re-evaluated following the identical study period without the intervention for comparison with the changes observed in Group A.

The collected data were entered and analyzed using statistical package for social sciences

(SPSS) version 26. Data collected as Continuous variables were presented as mean $\pm$ standard deviation, while Categorical variables were presented as Frequency and Percentage. Independent t-tests and paired t-tests were applied for comparison of quantitative variables, while chi-square tests were used for categorical data. A p-value of ≤ 0.05 was considered statistically significant.

RESULTS

A total of 60 primary healthcare professionals participated in the study, with 30 participants allocated to Group A (control group) and 30 participants allocated to Group B (training intervention group). A group of general dentists, medical officers, family physicians, and house officers made up the study population. The mean age of the group A was 29.8 ± 4.2 years and of the group B was 30.4 ± 4.7 years. Of all the subjects in the study, 56.7% were male and 43.3% were female. At baseline, there was no significant difference between the two groups in terms of demographic data (Table 1).

Table 1: Baseline Demographic Characteristics of Participants

Variables	Group A (n=30)	Group B (n=30)	p-value
Mean Age (Years)	29.8 ± 4.2	30.4 ± 4.7	0.612
Male Participants	17 (56.7%)	17 (56.7%)	1.000
Female Participants	13 (43.3%)	13 (43.3%)	1.000
General Dentists	12 (40.0%)	11 (36.7%)	0.793
Medical Officers	8 (26.7%)	9 (30.0%)	0.771
Family Physicians	6 (20.0%)	5 (16.7%)	0.739
House Officers	4 (13.3%)	5 (16.7%)	0.718

The scores obtained in the baseline assessment of the knowledge of early orthodontic diagnosis and referral were similar in both groups prior to intervention. The mean baseline diagnostic score for Group A was 51.9 ± 9.8 and the mean score for Group B was 52.7 ± 10.3 . At baseline, no significant difference was found between the groups ($p=0.764$). After finishing the targeted

orthodontic training programme, the mean diagnostic assessment score for the Group B was increased to 82.4 ± 7.6 and the mean score for the Group A did not improve significantly with the reassessment. Statistically significant difference of both groups' scores was found at post-intervention ($p<0.001$) as indicated in Table 2.

Table 2: Comparison of Diagnostic Assessment Scores Between Groups

Assessment Stage	Group A Mean $\pm$ SD	Group B Mean $\pm$ SD	P-value
Baseline Diagnostic Score	51.9 ± 9.8	52.7 ± 10.3	0.764
Post-Assessment Diagnostic Score	54.1 ± 8.9	82.4 ± 7.6	<0.001

There was a significant improvement in the ability of participants in Group B after the implementation of the training programme in identifying specific orthodontic abnormalities. Recognition of posterior crossbite improved from 40.0% at baseline to 86.7% after

intervention. The rate of identification of skeletal malocclusion rose from 36.7% to 80.0%, and the identification of mouth-breathing-related craniofacial abnormalities rose from 33.3% to 83.3%. Group A, on the other hand, showed only marginal variations in

the percentage of recognition during the period of the study. The results of these are given in Table 3.

Table 3: Comparison of Orthodontic Abnormality Recognition Between Groups

Orthodontic Condition	Group A n (%)	Group B Pre-Training n (%)	Group B Post-Training n (%)
Recognition of Posterior Crossbite	14 (46.7%)	12 (40.0%)	26 (86.7%)
Recognition of Skeletal Malocclusion	11 (36.7%)	11 (36.7%)	24 (80.0%)
Identification of Dental Crowding	16 (53.3%)	15 (50.0%)	27 (90.0%)
Recognition of Mouth Breathing Patterns	12 (40.0%)	10 (33.3%)	25 (83.3%)
Identification of Harmful Oral Habits	15 (50.0%)	13 (43.3%)	28 (93.3%)

The confidence in referral also increased significantly for Group B participants after the intervention for early orthodontic consultation. Pre-training, 36.7% of Group B participants indicated that they were confident to refer patients for early orthodontic evaluation, but this increased to 86.7% after training. The

awareness about the correct timing of interceptive orthodontic treatment increased from 40.0% to 90.0% after training. There was no significant increase in the referral awareness or confidence in group A during the study period (Table 4).

Table 4: Comparison of Referral Confidence and Awareness Between Groups

Variables	Group A n (%)	Group B Pre-Training n (%)	Group B Post-Training n (%)
Confident in Orthodontic Referral	13 (43.3%)	11 (36.7%)	26 (86.7%)
Awareness of Interceptive Orthodontics	12 (40.0%)	12 (40.0%)	27 (90.0%)
Knowledge of Correct Referral Timing	14 (46.7%)	12 (40.0%)	27 (90.0%)
Awareness Regarding Oral Habits	15 (50.0%)	13 (43.3%)	28 (93.3%)

Overall, participants who received the targeted orthodontic training programme demonstrated substantial improvement in diagnostic competency, recognition of orthodontic abnormalities, and referral confidence compared to the control group. The results suggest that structured orthodontic education interventions could have a significant impact on improving early orthodontic screening competence among PHPs.

DISCUSSION

Early identification of orthodontic abnormalities during childhood is essential for preventing progressive dentofacial complications and reducing the complexity of future orthodontic treatment⁸. This current study assessed the effectiveness of a targeted orthodontic training programme in enhancing the confidence in making orthodontic diagnosis and referral by primary healthcare professionals⁹. Results

revealed that after the educational intervention, the participants significantly increased their orthodontic diagnostic knowledge, recognition of common patterns of malocclusion, and awareness about referring to the interceptive orthodontics¹⁰.

The knowledge of both study groups at the baseline assessment was relatively limited, indicating a lack of exposure to orthodontic screening principles at the primary healthcare level¹¹. This is clinically relevant as primary healthcare workers are among the first to assess children in the healthcare system when they attend them for their routine health and dental checkups. Early detection of the malocclusion in progress can help to prevent the exacerbation of the skeletal discrepancies, poor facial development, dysfunction of the mouth and teeth, and psychological effects on the child. Results of the present study highlight

the importance of improving the awareness of Orthodontics among primary care providers¹². After this targeted training programme, the intervention group scores on the diagnostic assessment showed a significant improvement over the control group¹³. There was significant improvement in the recognition of posterior crossbite, skeletal malocclusion, dental crowding, harmful oral habits, and mouth breathing associated with craniofacial abnormalities. The results indicated that structured educational programmes are capable of increasing the skills of non-orthodontic health practitioners to detect early signs of orthodontic issues during their patients' usual appointments¹⁴.

The study was remarkable for the significant number of abnormalities of the airways and mouth breathing patterns that were recognized following the training programme¹⁵. The increasing awareness of the importance of chronic mouth breathing and the dysfunction of the airway has led to its growing recognition as an important factor to consider in altered craniofacial growth and malocclusion development. If these conditions are overlooked in childhood, they can lead to increasing abnormalities of the skeleton and function. Overall, an increased awareness of primary healthcare professionals on airway assessment could potentially lead to earlier multidisciplinary management with orthodontists, pediatricians, and otolaryngologists¹⁶.

There was also a significant improvement in participant confidence in orthodontic referral practices post the educational programme. Many participants were not confident in knowing when to refer or what conditions needed to be seen early by an orthodontist before intervention¹⁷. Post-training, there was significant improvement in the confidence and awareness of interceptive orthodontics. Early referral is essential to avoid progression of malocclusion and to optimise treatment outcomes by growth modification and/or by implementing preventive measures during the mixed dentition stages¹⁸.

The results obtained in this study strengthen the need for co-operation between orthodontists and frontline health care professionals¹⁹. Given the limited access to specialists in healthcare systems, especially in a developing country like Pakistan, the capacity of orthodontic screening at the primary level may prove beneficial in the provision of preventive oral healthcare services and decrease the

burden of long-term treatment. Structured orthodontic education within undergraduate medical and dental course curricula and continuing professional development courses may lead to better early orthodontic detection and referral rates^{15,16}.

The study has several strengths, including the use of standardized assessment tools, inclusion of different categories of healthcare professionals, and evaluation of both diagnostic competency and referral confidence. However, certain limitations should be acknowledged¹⁷. The study was conducted at a single institution with a relatively small sample size, which may limit the generalizability of the findings to other healthcare settings. Also, retention of knowledge gained and its effect on real-life referral practices were not assessed beyond the duration of the study. Future multicenter studies with larger sample sizes and longer follow-up durations are recommended to assess the sustainability of training outcomes and their influence on pediatric oral health outcomes^{18,19}.

CONCLUSION

Primary healthcare workers' knowledge of early orthodontic diagnosis, the ability to identify patterns of malocclusion, and confidence in referral were significantly increased following the targeted orthodontic training programme. The participants who underwent the educational intervention showed improved ability to recognize orthodontic abnormalities, bad oral habits, and changes in the craniofacial complex associated with airway, which require early specialist evaluation. The findings of this study highlight the importance of integrating structured orthodontic education into primary healthcare training systems to strengthen preventive oral healthcare services. Raising the awareness of orthodontics among frontline health care providers can help with earlier diagnosis, timely referral, and better long-term treatment outcomes in children with developing dentofacial abnormalities.

Availability of Data and Materials

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

Competing Interests

The authors declare that they have no competing interests.

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Authors' Contributions

All authors contributed significantly to the conception, study design, data collection,

analysis, manuscript preparation, and final approval of the manuscript.

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