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Preventive and interceptive orthodontic treatment needs of 6 and 9-year-old school-going children of Visakhapatnam – A prevalence cross-sectional study

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Abstract

Background: Malocclusion is a craniofacial growth and developmental disorder affecting the overall health, quality of life, as well as self-esteem of children and demands timely prevention and interception. Currently, no data is available regarding orthodontic treatment needs among school-going children of Visakhapatnam.

Aims: To evaluate preventive and interceptive orthodontic treatment needs among 6-year-old and 9-year-old school-going children of Visakhapatnam.

Settings and Design: An observational, cross-sectional, double-stage sampling study was conducted among school-going children of Visakhapatnam.

Methodology: A total of 616 children aged 6 years (297 children) and 9 years (319 children) were evaluated utilizing the Index for Preventive and Interceptive Orthodontic treatment Needs (IPION). The three treatment need categories of 'no treatment need', 'moderate treatment need', and 'definite treatment need' were arrived at by calculating cumulative final scores after examining a total of five components, namely, primary component, anterior component, posterior component, occlusion component, and soft tissue component.

Statistics used: Data from the final cumulative scores was analysed using IBM SPSS Statistics for Windows, 2017, to evaluated distribution of preventive and interceptive orthodontic treatment needs among the studied population groups. Additionally, Pearson's chi-square test was used to detect differences in prevalence of the treatment needs between boys and girls for both age groups.

Results: Among the 6-year-old group children, 68.7% of children were in 'no treatment need', 17.5% were in 'moderate treatment need', and 13.8% were in 'definite treatment need' category. Among the 9-year-old group children, 34.2% were in 'no treatment need', 29.2% were in 'moderate treatment need', and 36.7% were in 'definite treatment need' category. No statistically significant difference was found for prevalence of orthodontic treatment needs between boys and girls of both age groups.

Conclusion: The school-going children in Visakhapatnam have moderate to definite orthodontic treatment needs. Most of these malocclusion conditions can be successfully averted and treated during the children's growth.

Keywords: IPION, Observational cross-sectional study, Orthodontic treatment needs, Malocclusion, Prevalence of malocclusion, Preventive and interceptive orthodontics.

Introduction

"In studying a case of malocclusion, give no thought to the methods of treatment or appliances until the case shall have been classified and all peculiarities and variations from the normal in type, occlusion, and facial lines have been thoroughly comprehended. Then the requirements and proper plan of treatment become apparent." – Edward H. Angle.[1]

Malocclusion is a craniofacial growth and developmental disorder which leads to functional aberrations, impacts oro-facial esthetics, affects the self-esteem and Oral Health-Related Quality of Life (OHR QoL) of children and adolescents. This poses a major public health issue and demands timely interception and prevention.[2] Recognizing the manifestations of malocclusion during the early phases of growth and development helps in building a baseline data, assessing risk vs prognosis, thereby reducing the cost and time taken for extensive orthodontic treatment procedures later on.[3,4] The prevalence of such malocclusion differs based on several geographic and demographic factors with variations seen in between nations and within various regions of a nation.[3,5]

With the global orthodontic treatment needs standing at an astounding 54.2%, there is a growing emphasis for early orthodontic treatment. The European countries report orthodontic treatment need to be 51.6% whereas it is 28.8% in the South-East Asian countries.[6] In comparison, an estimated 20% to 43% of children are affected by malocclusion in India with 31.4% of them from the southern region of the country.[6,7] Several of the malocclusion traits thus examined and detected can be intercepted and prevented with minimal detrimental effects on the occlusal system when identified early.[3,8] There is a lack of information regarding the prevalence of any such malocclusion traits or the treatment needs of children from Visakhapatnam and therefore, this study was undertaken with an aim to assess the orthodontic treatment needs among the school-going children aged 6 years and 9 years from Visakhapatnam.

Methodology

The study was conducted from November 2018 to March 2020 with the approval and ethical clearance from the 'GITAM Ethical Committee' in addition to permissions from each selected school covering all the zones of Visakhapatnam. The sample size was calculated using the formula $n = Z^2P(1-P)/d^2$ (Daniel 1999) with a confidence level of 95% with a 5% margin of error. [9] As there was no data available regarding the orthodontic treatment needs or prevalence of malocclusion among the school-going children of Visakhapatnam, a probability of 50% was considered and a minimum sample size of 384 was arrived at. A total of 22 schools

(government, aided and private) representing all the constituency areas of Visakhapatnam were selected in the first stage sampling.

In the second stage, children aged 6 years and 9 years were chosen from each of the selected schools. A total of 616 children aged 6 years (297 children) and 9 years (319 children) [Figure 1] were examined by a single calibrated examiner, maintaining universal precautions and infection control procedures based on World Health Organisation (WHO) Oral Survey Basic Methods.[11] The Index for Preventive and Interceptive Orthodontic treatment Needs (IPION) was used to construct separate datasheets for both the 6- and 9-year-old group children to evaluate their malocclusion traits with an intent to chart out their orthodontic treatment needs. IPION was the only index applicable to mixed dentition stage of dental development. [4,9,10]

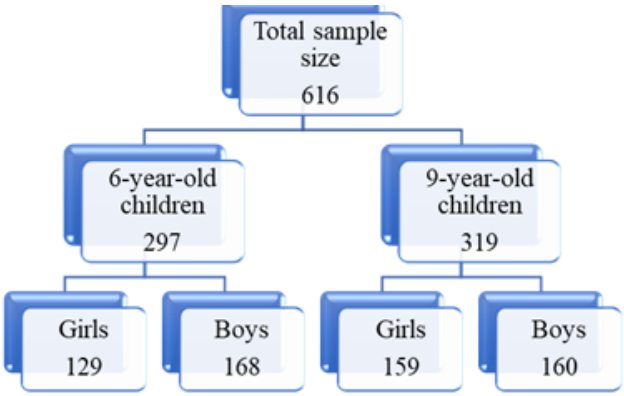


Figure 1

Inclusion criteria

- School-going children aged 6 years and 9 years.

Exclusion criteria

- Children not willing to participate in the study.
- Children undergoing orthodontic treatment at the time of the study.
- Children with congenital craniofacial abnormalities.
- Clinical examination:

Clinical examination was done based on the WHO Oral Survey Basic Methods with universal precautions and infection-control procedures.[11,12] All clinical examinations were conducted by a single calibrated examiner in a well-ventilated classroom or a corridor with ample natural light.[11,13,14] Children from the ages of 5 years 9 months to 7 years were examined under the 6-year-old group category and children from the ages of 8 years 6 months to 9 years 6 months were examined for 9-year-old group category.[9,13]

Radiographic examination was not undertaken as this was a school-based survey. [15,16,17] Children were asked to rinse their mouth with water before commencing the examination. Separately constructed data sheets for both the age groups were used to record the various parameters of IPION comprising of five components namely, primary component, anterior component, posterior component, occlusion component, and soft tissue component.[10] The malocclusion traits recorded and scored were interproximal caries, early loss of primary teeth, presence of supernumerary teeth, rotation, tipping and impended eruption of first permanent molars, active frenum, diastema, absent permanent incisors, overjet, overbite, open bite, anterior and posterior crossbite, molar relation and lip competency.

Scoring criteria

The components examined were scored based on the criteria given by the IPION. Interproximal caries was scored when structural discontinuity in tooth surface appreciable by visual examination, [18,19] early tooth loss was scored when a tooth was missing from the oral cavity due to any reason,[10] the primary first and second molars were scored to be submerged when they were inferior to the occlusal plane, [4,10] supernumerary teeth were scored only when they were visible intra-orally, [4,10]

active frenum was scored when there was blanching of interdental papilla between the central incisors,[4,10,20]

diastema between maxillary central incisor at the level of central papilla[21] was measured in millimeters using a metal scale and scored,[4,10] total number of absent permanent incisors not seen intra-orally was scored,[4,10] rotation of maxillary first permanent molar was scored when primary first molar or primary second molar in the same quadrant was missing or had interproximal caries,[4,10] and confirmed when an imaginary line extending between disto-buccal cusp and mesio-lingual cusp of maxillary first permanent molar crossed distal to contact point of contralateral primary first and second molars.[4,10] Disposable wooden spatulas were used to create this imaginary line intra-orally (Figure 2a). Mesial tipping of mandibular first permanent molar was recorded (Figure 2b) only when primary second molar in the same quadrant was prematurely lost or caries involved its marginal ridges.

A. A modified metal scale (Figure 2c) was held parallel to gingival margins of teeth in mandibular arch and when the long axis of the mandibular first permanent molar was inclined more than 15^{o} mesially it was scored as a tipped mandibular first permanent molar.[10] Total number of impending eruption of first permanent molars was noted following visual examination and scored.[4,10] For overjet, only the most prominent positive overjet was scored, the greatest verticle overlap of existing incisors from incisal tip of mandibular incisors to maxillary incisal edge (overbite) was scored,[4,10,22] anterior open bite was scored when there was lack of perpendicular overlap of maxillary and mandibular incisors.[14] With teeth in occlusion, antero-posterior relationship of first permanent molars was scored, anterior crossbite was scored if one or more maxillary incisors were positioned lingual to mandibular incisors, [4,10,14] transverse buccal occlusion was scored to be positive when buccal cusps of maxillary posterior teeth were lingual in relationship to mandibular posterior teeth during occlusion, if palatal cusps of maxillary posterior teeth were placed buccal to mandibular posterior teeth in occlusion, a scissors-bite was recorded and cusp-to-cusp relationship of maxillary and mandibular posterior teeth during occlusion was scored to be crossbite tendency[10] and finally lip incompetency (inter-labial gap) was measured with a metal scale and scored.[4,10,14]

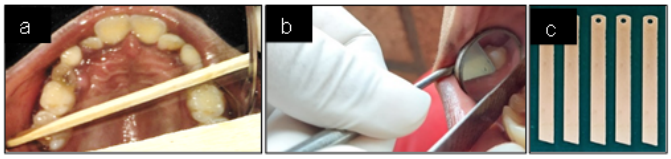


Figure 2:
a – evaluation of upper molar rotation, b – evaluation of lower molar tipping, c – modified metal scales to evaluate lower molar tipping.

Each component was given separate weightage factor based on their applicability for the two age groups. Total scores from each sub-category of the five components were added to arrive at a final score. The data was transferred to separate excel sheets for both the groups. The final scores were then grouped into three treatment need categories of ‘no treatment need’, ‘moderate treatment need’, and ‘definite treatment need’.[10] This data was subjected to statistical analysis using IBM SPSS Statistics for Windows and Pearson’s chi-square test was applied to elicit differences in the prevalence of malocclusion traits and treatment need between boys and girls for both age groups.

Table 1: Treatment needs among 6-year-old and 9-year-old children

Orthodontic treatment need	6-year-old group (*) (†)			9-year-old group (‡) (§)		
	Girls	Boys	Total	Girls	Boys	Total
No need	83 (28%)	121 (40.7%)	204 (68.7%)	56 (17.6%)	53 (16.6%)	109 (34.2%)

Moderate need	26 (8.8%)	26 (8.8%)	52 (17.5%)	46 (14.4%)	47 (14.7%)	93 (29.2%)
Definite need	20 (6.7%)	21 (7.1%)	41 (13.8%)	57 (17.9%)	60 (18.8%)	117 (36.7%)

(*) $X^2 = 2.016$, p = 0.365; (‡) $X^2 = 0.167$, p = 0.920.

(†) 0 to 4 = No treatment need; 5 to 13 = Moderate treatment need; 14+ = Definite treatment need

(§) 0 to 5 = No treatment need; 6 to 14 = Moderate treatment need; 15+ = Definite treatment need

Results

Table 1 shows the treatment need among both the groups. The treatment need was 68.7%, 17.5%, and 13.8% among the 6-year-old group children, and it was 34.2%, 29.2%, and 36.7% among the 9-year-old children for the 'no treatment need', 'moderate treatment need', and 'definite treatment need' categories respectively with no statistically significant difference between boys and girls.

Chart 1 shows the 6-year-old group children of 'no treatment need', 'moderate treatment need', and 'definite treatment need'. The 'definite treatment need' was scored as: eight for interproximal caries involving marginal ridge of left primary maxillary second molar, four for early molar loss of right primary mandibular second molar, four for mesial tipping of right mandibular permanent first molar due to early loss of right primary mandibular second molar, and one for overbite (more than 2/3rd coverage of permanent mandibular incisors by permanent maxillary incisors) giving a total score of seventeen. The 'moderate treatment need' was scored as: four for interproximal caries not involving marginal ridge of left primary mandibular second molar, four for early loss of left and right primary mandibular first molars giving a total score of eight. The 'no treatment need' score was zero as none of the components examined had abnormal findings.

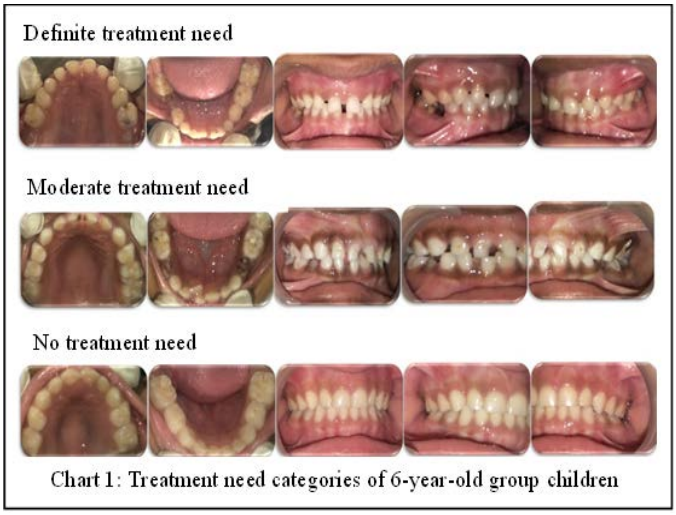


Chart 1: Treatment need categories of 6-year-old group children

Chart 2 shows 9-year-old group children of 'no treatment need', moderate treatment need', and 'definite treatment need'. The 'definite treatment need' was scored as: eight for interproximal caries involving marginal ridges of right primary maxillary and mandibular second molars, four for supernumerary tooth palatal to right permanent central incisor, eight for absent permanent maxillary right and left lateral incisors and one for overbite more than 2/3rd coverage, giving a total score of twenty-one. The 'moderate treatment need' was scored as: four for overjet of 5.1 to 7mm, one for overbite more than 2/3rd coverage, two for molar relation, and two for lip competency giving a total score of nine. The 'no treatment need' was scored as: two for interproximal caries primary maxillary first molar), two for overbite more than or equal to full coverage, giving a total score of four.

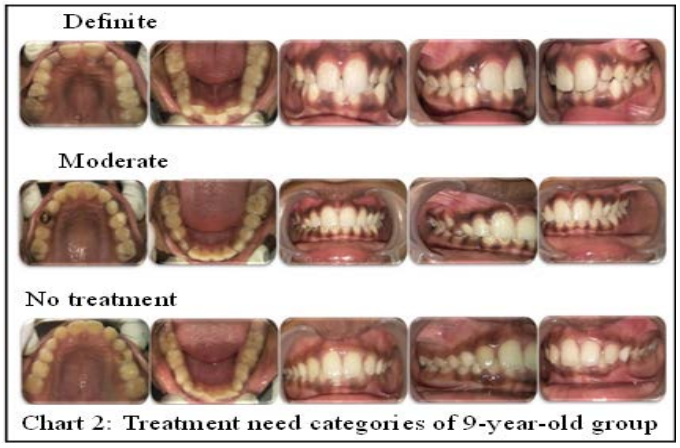
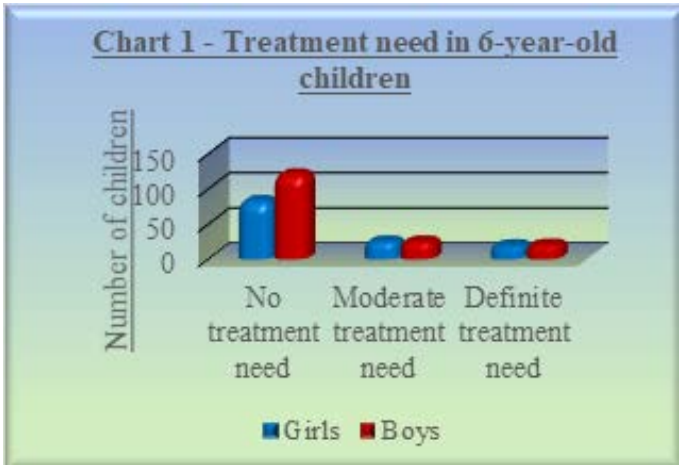


Chart 2: Treatment need categories of 9-year-old group

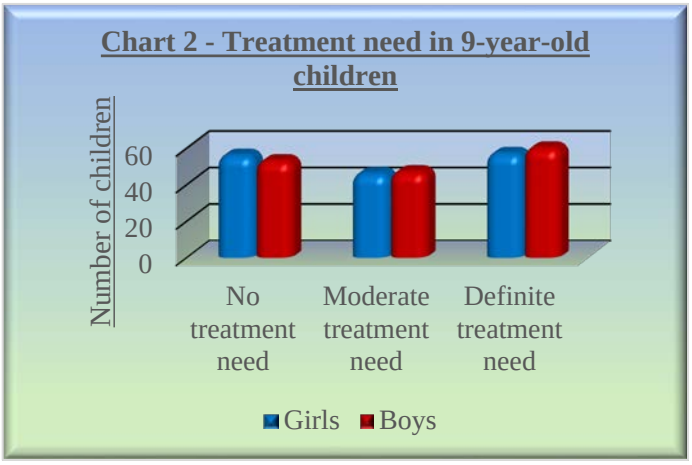
Chart 3 and Chart 4 show comparative prevalence of orthodontic treatment need among 6-year-old and 9-year-old children. The 'definite treatment need' in the 6-year-old group children (13.8%) was nearly three times less than that of the 9-year-old children (36.7%) whereas the 'no treatment need' in the 6-year-old group children (68.7%) were approximately half than the children in the 9-year-old group (34.2%).



Discussion

The central indications for orthodontic treatment needs are based on functional and esthetic criteria.[23] The benefits of diagnosing and successfully treating the developing malocclusion lie in achieving occlusal harmony, function plus dento-facial esthetics with both short-term and long-term implications.[24]

Though assessing orthodontic treatment needs has several advantageous and is essential for planning public



health programmes, treatment for patients and training modules for professionals, it greatly varies [Table 2] from population to population and also the geographic location.[25]

Table 2: Orthodontic treatment needs in mixed dentition stages

Study	Age group	Treatment need		
		No need	Moderate need	Definite need
Tungaraza JP, 2109 [14]	6-year-old children (Tanzania)	28.4%	25.2%	46.4%
	9-year-old children (Tanzania)	36.9%	25.7%	37.4%
Marias, 2013 [20]	7- to 10-year-old children (Cape Town)	8%	13%	79%
M M Ibrahim, 2018 [22]	6-old-children (Egypt)	63.6%	-	28%
	9-year-old children (Egypt)	36.4%	-	72%

Babler-Zeltmann S, 1998 [26]	9-year-old children (Sweden)	36%	32%	32%
Rauten AM, 2016 [27]	6-year-old children (Poland)	76.8%	13.03%	10.13 %
	9-year-old children (Poland)	42.3%	33.33%	24.35 %

The clinical guidelines laid down by the American Academy of Pediatric Dentistry (AAPD) on the 'Management of the Developing Dentition and Occlusion in Pediatric Dentistry' states that: "Guidance of eruption and development of primary, mixed and permanent dentitions is an integral component of comprehensive oral healthcare for all pediatric dental patients. Such guidance should contribute to the development of a permanent dentition that is in a stable, functional, and acceptable occlusion. Early diagnosis and successful treatment for developing malocclusions can have both short-term and long-term benefits while achieving the goals of occlusal harmony, function, and dentofacial esthetics." [24]

The early mixed dentition stage is significant as it is feasible to recognize symptoms of progressive malocclusion.[27] The 6 to 9-year-old age group (early mixed dentition stage) is more prone to deleterious effects of local influences which could lead to significant malocclusion if left undetected.[28]

Inter-canine width of the mandible is established by the age of 8 years with the eruption of central and lateral incisors. With the incisor alignment and inter-canine width established, interceptive treatments carried out during this phase permit harmonious alignment of teeth with symmetric arch development and coinciding midlines.[2]

Malocclusion traits have several negative influences on the quality of life of an individual and such traits in children with an increased prevalence for orthodontic treatment needs should be identified and corrected.[15] Early diagnosis and treatment interventions help in reducing the possibility of complex procedures later-on.[29]

Carrying out preventive and interceptive treatment modalities in children improve the existing malocclusion and reduces the necessity for further treatment.[31] Though appliance therapy can be considered in cooperative younger children who are conducive to wearing an appliance, the timing of advocating and using functional appliances should coincide with the stages of active growth for successful corrections to occur and the ideal stage for this would be the mid-to late-mixed dentition stage.[31.32]

The advantages of intervention methods during these stages are that treatment planning can be directed to address crowding, space management, the transverse width of dental arches and guiding the teeth into more desirable positions with long-term stable results as well as modifying any skeletal malocclusion traits noted by dentofacial orthopedics using peak growth rates which can positively influence arch development, skeletal discrepancy, and facial balance. [2]

The results of the present study demonstrate that the treatment need was 68.7%, 17.5%, and 13.8% among the 6-year-old group children, and it was 34.2%, 29.2%, and 36.7% among the 9-year-old children for the 'no treatment need', 'moderate treatment need', and 'definite treatment need' categories respectively with no statistically significant difference between boys and girls.

The 'definite treatment need' in the 6-year-old group children was nearly three times more than that of the 9-year-old children in the present study and these results are similar to the study by Haider Z. [4] Similarly, Stahl F and Grabowski R [33] also found that children in their primary dentition had significantly lesser malocclusion traits than children in their mixed dentition stages. Souames M, Bassigny F, Zenati N, Riordan PJ and Boy-Lefevre ML [25] and Dias PF and Gleiser R [29] reported treatment needs varying between 21% and 33% in 9 to 12-year-old children.

A longitudinal study [34] demonstrated that if a child needs treatment in the early mixed dentition, there are definitive chances that the child will still need treatment at various stages of dental development. Therefore, it is imperative to initiate examination of children for malocclusion at an early age during the mixed dentition and also continue repeated check-ups till the children are of 15 years of age. This will aid in better evaluation of actual treatment needs.[34]

Oro-facial and dental appearances that deviate from normal have an undesirable influence on the psychological and social wellbeing of an individual. The frequency at which malocclusion occurs increases with an increase in the age of the child.[35] Early recognition of the manifestations of malocclusion, especially during the phases of growth is possible by epidemiological surveys that can build a baseline data for amenable treatment orientations so that risking prognosis for a later orthodontic therapy can be avoided[3] and costs involved plus time taken for extensive orthodontic procedures during the permanent dentition can be minimized.[4]

Children should be monitored throughout the eruption stages of primary as well as permanent dentition. Such monitoring should be scheduled during the primary dentition, the early mixed dentition, the late mixed dentition, the adolescent dentition, and also the early adult dentition stages. This is particularly advantageous because the objectives at each stage are different, but they conclusively aim at dealing with the adverse growth patterns, correcting the growth discrepancies (both skeletal and dental) that finally lead to an improvement in the occlusion and result in reassuring effects on self-image.[24]

Early treatment modalities are conceivably easy to perform, consume less time, and are pocket-friendly. Although interceptive measures may not always lead to a final finishing result, they might contribute to a considerable and advantageous reduction of treatment need in children aged between 8 to 12 years.[35]

Treatment modalities like genetic counseling, fluoridation, restorative procedures, and space maintenance, aimed at averting developmental aberrations from even initiating, fall under the 'preventive orthodontics' class and any treatment procedures looking at eradicating the already developed interference fall under 'interceptive orthodontics' class.[36] An exponential number of malocclusions that are treated can be averted and their severity lessened and a few malocclusions could have been prevented with interceptive measures carried out at the right time.[31,37]

The following recommendations can be made from the findings of this current study

- There is a need to examine, evaluate and monitor children of Visakhapatnam from their deciduous dentition stages to recognize any developing malocclusion traits.
- Further longitudinal studies in this particular geographical location are required to assess reasons for the greater treatment need in children as age increases with special emphasis on deleterious oral habits.

➢ The vulnerable group of children need to be examined and observed through the various stages of growth till the dental development is complete, especially from the countries with constraints of economic resources as well as limited availability of specialist dentists.

Limitations of the current study are as follows

➢ Though malocclusion traits are prevalent among school-going children in Visakhapatnam, a larger sample size might be required to generalize the findings and have conclusive evidence.

➢ Radiographic evaluation will aid in ascertaining a few of the malocclusion traits like supernumerary teeth, absent permanent incisors, impended eruption of first permanent molars.

Clinical significance of this article

This is the first study carried out to assess the orthodontic treatment needs among the school-going children of Visakhapatnam and the findings show that there is an increase in orthodontic treatment need in the 9-year-old children as compared to the 6-year-old children. Therefore, the study will not only provide a baseline data for conducting a longitudinal study but also to ascertain the etiological factors causing the increase in orthodontic treatment need as children age. This will further enable planning of preventive and interceptive orthodontic treatment among children of Visakhapatnam.

Conclusion

Though comprehensive pediatric dental care encompasses concepts of monitoring the developing dentition, recognizing, diagnosing, and managing any abnormalities that arise during the various stage of development, establishing credible evaluations for malocclusion prevalence is a difficult and diligent task. Nevertheless, early recognition and effective management of such developing malocclusion has far-fetched benefits and supports dentofacial esthetics, functional and occlusal harmony

Patient consent declaration

The authors certify that all appropriate consents from the patients have been obtained for publishing their images and findings of their clinical examination without their names, initials or any other information that leads to their identification being revealed. Though all efforts have been made to conceal their identity, anonymity cannot be guaranteed.

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