Early Orthodontic Treatment Needs of Children in High Caries Population Using Index for Preventive and Interceptive Orthodontic Treatment Needs

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ABSTRACT

Aim: Early identification and management of developing malocclusion can reduce or eliminate the need for future complicated treatment procedures. The present study was undertaken to assess early orthodontic treatment needs in 6- and 9-year-old children using the index for preventive and interceptive orthodontic treatment need (IPION) in Pune, India.

Materials and methods: A total of 360 children reporting to the Department of Pediatric and Preventive Dentistry were evaluated clinically and on their respective dental casts according to the IPION requirement. The overall scores were then categorized into "no treatment need," "moderate treatment need," and "definitive treatment need."

Results: The final data obtained that around 6.1% of the children had no treatment need, 25% of the children had moderate treatment need, and 68.8% of the children had definitive treatment need.

Conclusion: Within the limitations of the study, we conclude that the studied population had a high early orthodontic treatment needs which can be attributed to the high caries in the study population.

Clinical significance: This study provides a better alternative to determine early orthodontic treatment needs using IPION, as it includes more relevant orthodontic parameters in high caries population compared to conventional orthodontic treatment need indices.

Keywords: Caries orthodontic index, Index for preventive and interceptive orthodontic treatment need, IOTN, IPION, Orthodontic treatment need, Treatment need index.

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INTRODUCTION

Malocclusion is a condition that signifies an expression of change when maxillary and mandibular teeth occlude.[1] They are one of the most significant oral health problems, ranking third after dental caries and periodontal disease.[2] Presence of malocclusion not only affects esthetics but also escalates the risk of dental caries and affects periodontal health and sometimes leads to traumatic dental injuries and temporomandibular joint problems.[3–5] Malocclusions are not just limited to dental consequences but also have a great impact on psychosocial behavior of an individual, thus lowering their self-esteem.[6] Identifying and treating patients at an early stage of developing malocclusion can abbreviate the chances of complicated orthodontic treatment procedures, minimize or eliminate future costly treatments, and help healthcare centers manage with minimum resources.

Mixed dentition period is the time of greatest opportunity for occlusal guidance and correction of developing malocclusion since permanent teeth are emerging into the oral cavity to replace the exfoliating primary teeth. Pathological abnormalities, deformities, or any disturbing environment that intervenes with the normal development of occlusion may lead to malocclusion.[7]

Several indices have been put forward in the literature to analyze orthodontic treatment needs in children; commonly used indices in mixed dentition are the occlusal index (OT) by Björk et al. in 1964,[8] index of orthodontic treatment need (IOTN) by Brook and Shaw[9] and the dental esthetics index (DAI) by Cons et al.[10] Even though these indices included occlusal and functional parameters and also cleft lip and palate in the method of evaluation, they have not included few important components such as dental caries and

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premature loss of primary teeth, that can be a causative factor for occlusal discrepancies and may require preventive and interceptive orthodontic treatment (AAPD).[11] Hence, these factors may weaken the impact of these indices and are not completely suitable for identifying orthodontic treatment needs in mixed dentition, especially in populations with high caries prevalence.[7]

Therefore, index for preventive and interceptive orthodontic treatment need (IPION) was introduced by Coetzee and intended to meet early orthodontic treatment needs in mixed dentition of young children. IPION is only recommended for use in children ages 6 and 9 years, which are categorized as "IPION-6" and "IPION-9," respectively, since mixed dentition is initiated in 6-year-old children and canine–premolar eruption in 9-year-old children. This index comprises a few dental components to be examined in children. These components give an IPION score which reflects the

child's amenability to get treated at an early stage. The scores are categorized into "no treatment need," "moderate treatment need," and "definite treatment need."[12]

There is a scarcity of studies that have focused on identifying orthodontic treatment needs in early mixed dentition period. There are even less studies that have taken into consideration the impact of high caries prevalence and early loss of primary teeth on orthodontic treatment need. According to the systematic review by Pandey et al., the overall prevalence of dental caries among the Indian population was 58 and 54% in the mixed and primary dentition, respectively.[13] Therefore, it is imperative to understand the impact of high prevalence of dental caries on the orthodontic treatment needs. The study was undertaken with the objective of identifying early orthodontic treatment needs using IPION among 6- and 9-year-old children with high caries prevalence.

MATERIALS AND METHODS

This observational study was conducted among 360 children aged 6 and 9 years, reporting to the outpatient department of pediatric and preventive dentistry in a tertiary care hospital, in Pune, India. The inclusion criteria were children with no history of orthodontic treatment and the parents who agreed to give their consent. The exclusion criteria were children who were uncooperative and unable to be guided for a stable occlusion.

Prior to the commencement of the study, permission to conduct the study was taken from the Institutional Ethics Committee (DYP/484/39/2021). Parents of the children were explained the

purpose of the study and those who agreed to participate were finally enrolled in the study after taking written informed consent. Clinical examination was carried out using mouth mirror, explorer, and Michigan periodontal probe; the functional components such as active frenum and lip competence, were recorded clinically. Alginate impression of both maxillary and mandibular arch was taken with occlusion using wax bite. The impressions were poured immediately in dental stone, which after drying was trimmed in centric occlusion.

IPION-6 comprises nine components, namely interproximal caries (primary canine, primary first and second molar, and first permanent molar). Early loss of primary canine, primary first and second molar, supernumerary teeth, tilting/rotation of permanent maxillary and mandibular first permanent molar, overjet, overbite, open bite, anterior crossbite, and transverse buccal occlusion (Table 1).

Whereas, IPION-9 comprises 14 components, namely interproximal caries (primary canine, primary first and second molar, and first permanent molar). Early loss of primary second molar, submerged primary molars, supernumerary teeth, diastema, absent permanent incisors, tilted/rotated permanent maxillary and mandibular first permanent molar, impeded eruption of first permanent molar, overjet, overbite, open bite, anterior crossbite, antero-posterior molar relationship, and transverse buccal occlusion (Table 1).

Each IPION component score was multiplied by its respective weighting factors, and then all of the component scores were summed up to achieve the IPION treatment need score. All

Table 1: Occlusal traits and criteria measured by IPION and their weighing scores

Description of variable for IPION-6	Weighing score	Description of variable for IPION-9	Weighing score
Caries of maxillary and mandibular primary canines	1	Caries of maxillary and mandibular primary canines	1
Caries of maxillary and mandibular first primary molars	2	Caries of maxillary and mandibular first primary molars	2
Caries of maxillary and mandibular second primary molars	4	Caries of maxillary and mandibular second primary molars	4
Caries of maxillary and mandibular first permanent molars	4	Caries of maxillary and mandibular first permanent molars	4
Early loss of maxillary primary canines	1	Early loss of maxillary second primary molars	2
Unilateral early loss of mandibular primary canines	8	Early loss of mandibular second primary molars	3
Bilateral early loss of mandibular primary canines	2	Submerged (ankylosed) first primary molars	1
Early loss of maxillary and mandibular first primary molars	2	Submerged (ankylosed) second primary molars	2
Early loss of maxillary and mandibular second primary molars	4	Active frenum	1
Supernumerary teeth	4	Supernumerary teeth	4
Rotation of maxillary first permanent molars	4	Diastema	4
Overjet	2	Rotation of maxillary first permanent molars	4
Anterior crossbite	10	Tipping of mandibular first permanent molars	4
Posterior crossbite without functional lateral shift of the mandible during closing	1	Impeded (ectopic) eruption of first permanent molars	4
Posterior crossbite with functional lateral shift of the mandible during closing	10	Overjet	2
Lip competency	1	Anterior crossbite	10
		Overbite	1
		Anterior open bite	4
		Molar relationship	1
		Posterior crossbite without functional lateral shift of the mandible during closing	1
		Posterior crossbite with functional lateral shift of the mandible during closing	10
		Lip competence	1

the parameters were recorded independently by two examiners. The kappa statistics were used to check the interreliability score.

RESULTS

Out of 360 children included in the study, 186 belonged to the 6-year-old group and 174 to the 9-year-old group. 162 (45.0%) were girls and 198 (55.0%) were boys out of the total sample. The prevalence of caries in the studied population was 93.8%. Mean caries score was 5.4 in 6-year-olds and 3.2 in 9-year-olds (Fig. 1). The primary first molar was most commonly affected teeth by caries in 6- and 9-year-old children.

The prevalence of premature loss of primary teeth in the studied population was 20.5% (74). 36.5% (68) of 6-year-olds had premature loss of primary teeth with primary first molars being the most commonly lost teeth, while 3.4% of 9-year-olds had premature loss of primary teeth. A high prevalence of anterior crossbite [8.6% (16)], increased overbite [17.2% (32)], and mesially tilted maxillary first permanent molars [8.7% (14)] was observed in 6-year-old age-group (Table 2). Whereas the most common occlusal discrepancies found in 9-year-old children were increased overjet [8% (14)], anterior crossbite [17.2% (30)], posterior crossbite and crossbite tendency [19.5% (34)], incompetent lips [9.1% (16)], and impeded eruption of permanent first molars [13.7% (24)] (Table 3).

All the components were multiplied with their respective weighing score to achieve the final IPION score. In IPION-6, 4.3% (8) children showed no treatment need, 23.6% (44) had moderate treatment need, and 72.04% (134) definite treatment need. In IPION-9, 8.0% (14) children had no treatment need, 26.4% (46) had

moderate treatment need, and 65.5% (114) children had definite treatment need.

The overall orthodontic treatment needed in 6- and 9-year-old children was noted to be 68.8% (248) under definite treatment need, 25.0% (90) in moderate treatment need, and 6.1% (22) in no treatment need category (Fig. 2). Interexaminer reliability calculated using kappa statistics was found to be good (0.82).

DISCUSSION

Monitoring and intervening conditions predisposing to malocclusion is an integral part of preventive and interceptive orthodontics. Several indices have been put forward to determine the early orthodontic treatment need; IPION is one such index used to examine and measure the features relevant to preventive and interceptive orthodontics.

In the present study, majority of the children (68.8%) were categorized into definitive treatment needs. High percentage of children having definitive treatment needs in the present study can be attributed to the very high caries prevalence in the study population. Similar results were obtained by Rapeepattana et al. in a study conducted in Southern Thailand using IPION-9 in 8–9-year-
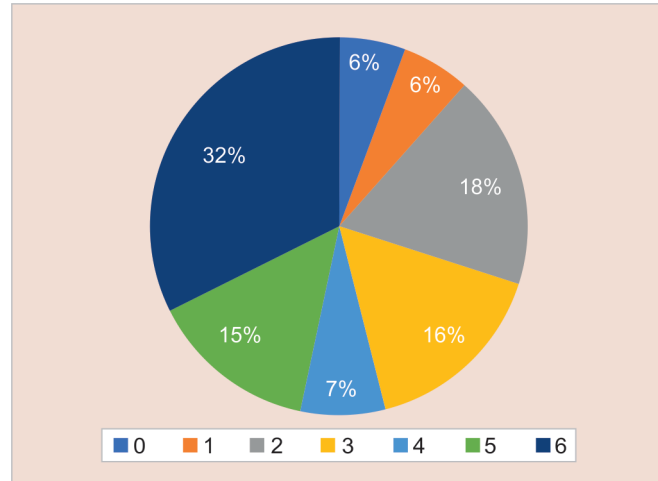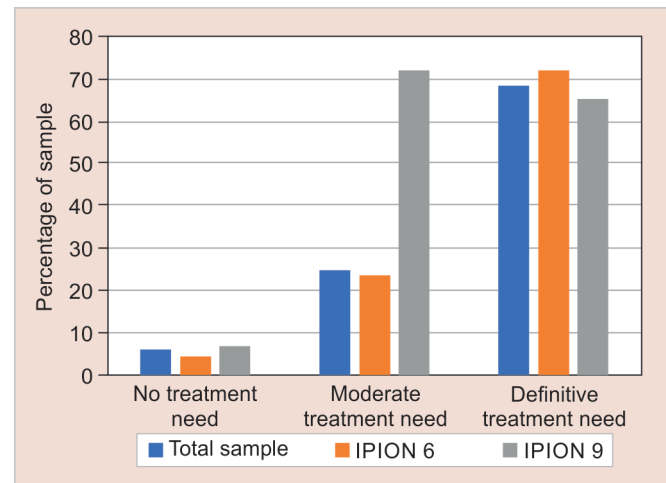

Fig. 2: Treatment need distribution according to the IPION of 6-year-old (IPION-6) and 9-year-old (IPION-9) children

Table 3: Distribution of occlusal parameters in 9-year-old patients

Parameters of IPION-9	n (%)
Interproximal caries	162 (93.1%)
Premature loss of primary teeth	6 (3.4%)
Overjet	14 (8.0%)
Anterior crossbite	30 (17.2%)
Overbite	6 (3.4%)
Openbite	6 (3.4%)
Posterior crossbite and crossbite tendency	34 (19.5%)
Incompetent lips	16 (9.1%)
Submerged primary molars	6 (3.4%)
Active frenum	6 (3.4%)
Supernumerary teeth	6 (3.4%)
Diastema	6 (3.4%)
Absent permanent incisors	10 (5.7%)
Impeded eruption of permanent first molars	24 (13.7%)

Fig. 1: Caries score among studied sample

Table 2: Distribution of occlusal parameters in 6-year-old patients

Parameters of IPION-6	n (%)
Interproximal caries	176 (94.6%)
Premature loss of primary teeth	68 (36.5%)
Mesially tilted maxillary first permanent molars	14 (8.7%)
Overjet	6 (3.2%)
Anterior crossbite	16 (8.6%)
Overbite	32 (17.2%)
Openbite	10 (5.3%)
Posterior crossbite and crossbite tendency	6 (3.2%)

old children. They concluded that majority of the children (83.6%) come under the category of definitive treatment needs.[7] The high proportion of children needing definitive orthodontic treatment in their study was attributed to high caries prevalence rate (91%), these findings were similar to our study.

In a Syrian study by Burhan and Nawaya, majority (57.9%) of the sample population was classified with definitive orthodontic treatment needs.[14] Similarly, Haider conducted a study in the United States of America using the IPION index. A considerable number of children (60.92%) in their study, were categorized under definitive orthodontic treatment needs. In their study they modified the original IPION to also include previously restored carious teeth and scored accordingly, contemplating it as carious teeth. They claimed that modification was well suited for a low-carious population.[15] Tungaraza et al. conducted a study evaluating association of sociodemographic characteristics with the overall IPION score; they also concluded that 41.7% of the children deciphered definitive orthodontic treatment needs commonly in Tanzanian boys.[16]

Karaiskos in their study conducted among 6- and 9-year-old Canadian children, modified the IPION index and chose a value of >5 as a reasonable indicator for the need for treatment. A total of 42 children in the 6-year-old group (20.9%) and 72 in the 9-year-old group (37.1%) had a score of >5. The contrasting results in this study can be attributed to the low prevalence of caries in the studied population as 69.7% of 6-year-olds and 79.4% of 9-year-olds were caries-free.[17] Another study by Galui and Pal which was conducted among children in West Bengal, revealed that the highest number of 6- and 9-year-old children (49.1%) came under the category of no treatment need when compared with definitive treatment need (35.5%). A modified IPION score was used to exclude the highest weighing component (interproximal caries and restoration), although the scoring was reduced but the treatment needs category remained the same.[18] These results were contradicting the outcomes of the present study, mainly due to the modifications made in the IPION scoring.

Apart from the interproximal caries being a major contributing factor in our study, premature tooth loss of primary teeth was another considerable factor. Similar results were obtained in the study conducted by Karaiskos, 2.9% of 6-year-olds and 16% of 9-year-olds had early loss of teeth.[17] In a Tanzanian study, commonly observed premature loss was seen with primary second molars, 6% of 6-year-old children and 4.9% of 9-year-old children had early loss of second primary molars.[16]

When the results of the present study using IPION for detection of early orthodontic treatment needs were compared with other studies done in India using other indices and the treatment need assessed through IPION was found to be higher.[19–22] This can be attributed to the fact that proximal caries in canines, primary molars and first permanent molars are an important factor in determining the level of treatment need in this index. It is reasonable that these factors were agreed for a high weighing score, since together they may root for more arch discrepancies due to tilting or drifting of the adjacent teeth, crowding, rotation of posterior segment, and change of molar relationship in sagittal aspect.[12]

In a study conducted in a similar demographic area by Kumar et al., 32.8% of the children were found to be in need of orthodontic intervention. This study used the IOTN index and determined the orthodontic treatment need in 10–15-year-old children going to army schools. Although the percentage of children requiring definitive orthodontic treatment was less in this study, the authors concluded that the children with high

decayed, missing, and filled teeth (DMFT) had an increased requirement for orthodontic treatment.[23] The correlation of dental caries and malocclusion has also been reported by Disha et al.,[24] Mtaya et al.,[25] and Gábris et al.[26] However, not many attempts have been made in incorporating presence of dental caries specifically proximal caries while determining orthodontic treatment needs.

The IPION index also has few limitations, as it does not identify the type of preventive and interceptive treatment required. Also, few relevant radiographic findings were not detected such as presence of supernumerary teeth, depth of caries, and missing permanent successor teeth. Few parameters like midline shift and presence of skeletal discrepancies are not considered in the IPION index.[7] Despite these limitations, IPION has good strengths like different weighing factors are given for different clinical findings. Conditions like anterior crossbite and posterior crossbite tendency have very high weighing factors. It also includes a wide range of occlusal parameters like impeded eruption of permanent first molar, increased overjet, overbite, and incompetent lips.[12]

CONCLUSION

Within the limitations of this study, we conclude that according to the IPION index, the proportion of children needing orthodontic treatment was high in this high caries prevalence study sample. Higher proximal caries in primary dentition and early loss of primary teeth were correlated with higher caries prevalence in the sample population.

Clinical Significance

This study provides a better alternative to determining early orthodontic treatment need using IPION, as it includes more relevant orthodontic parameters compared to conventional orthodontic treatment need indices.

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