

# Anterior crossbite malocclusion: prevalence and treatment with a fixed inclined plane orthodontic appliance

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**Aim:** To evaluate the prevalence of anterior crossbite and to verify the effectiveness of the orthodontic appliance Inclined Plane in the correction of this malocclusion. **Methods:** The clinical examination was performed 702 children in the deciduous or mixed dentition of 7 schools and in those found the anterior crossbite was performed treatment with fixed Inclined Plane. **Results:** The prevalence of the anterior crossbite was 2.14%, characterizing 15 of the 702 children evaluated, of which 60% were female and 40% male, all of which were dental crossbites. Only 12 accepted the treatment with an average duration of 4.4 weeks. **Conclusion:** The prevalence of anterior crossbite was 2.14%. The inclined plane proved to be a viable and effective therapy in the correction of anterior crossbite. It is one of the options of the orthodontic treatment in patients in the deciduous or mixed dentition, propitiating greater possibility of dentoskeletal development, since the malocclusion is corrected. However this method needs to be correctly indicated and its execution technique rigorously followed.

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## Introduction

Anterior crossbites are malocclusions observed relatively frequently during the period of deciduous dentition and onset of mixed dentition, with a prevalence of around 7.6% of children<sup>1,2</sup>. It stands out due to its functional and aesthetic alterations, being defined as an abnormal lingual vestibular relation of one or more teeth of the maxilla in relation to the mandible, the two arches being in occlusion, with the anterior superior teeth occluding by lingual in relation to the inferior<sup>3</sup>.

In functional anterior crossbite, or pseudoclasse III, a protrusion of the mandible occurs during occlusion that can be attributed to inclinations of the upper incisors for palatine and vestibularization of the mandibular incisors, forcing an anterior positioning of the mandible. It can be caused by hypertrophy of the tonsils and or adenoids, digital sucking habits, pacifiers or even the upper lip. It can also be caused by an interference in the trajectory of the mandibular closure, where premature contacts during centric occlusion lead the child to adopt a deviant mandibular posture by accommodation<sup>4,5</sup>.

In the case of anterior crossbite is observed the involvement of a single tooth or set of teeth, with the upper incisors inclined to the palate and / or the lower incisors to the vestibular, maintaining a good positioning of the apical bases in relation to the base of the cranium<sup>6</sup>.

The skeletal anterior crossbite is characterized by mandibular protrusion, maxillary retrusion or the combination of both. It can be derived from the genetic inheritance of the individual, or due to an endocrine disorder, such as, for example, acromegaly<sup>7,8</sup>.

Early treatment of dental, functional or skeletal crossbite ensures that craniofacial development and occlusion occur normally, as obstacles are removed during the active phase of growth<sup>9,10</sup>.

Class III malocclusion is of a relevant aesthetic and functional impairment. It is believed that early diagnosis, during deciduous or mixed dentition, and orthodontic intervention with one of the innumerable interceptive orthodontic appliances, specifically the inclined plane, will enable the harmonic growth of the jaws, even in skeletal Class III of functional or environmental origin, once the dental interference has been corrected.

It is justified to perform this clinical research to prove that it is feasible to intercept the evolution of Class III malocclusion, be it functional, dental or skeletal, if the orthodontic intervention with specific devices, especially the inclined plane, is performed in deciduous dentitions or mixed, prior to the maxillary growth spurt.

In view of the functional and aesthetic problems that the anterior crossbite can generate to the patient, the objective of this study was to evaluate the prevalence of anterior crossbite and to verify the efficacy of the Inclined Plan orthodontic appliance in the correction of this malocclusion.

## Material and Methods

This study was approved by the Research Ethics Committee of the State University of Piauí - CEP / UESPI, under number 2.199.979, being of the transverse type,

non-random clinical intervention. It was a cross-sectional, quantitative, intervention study. The sample calculation was based on the target population: children between 3 and 5 years or between 6 and 8 years old, specifically in the school phase, of the city of Parnaíba in 2017, totalizing 5.087 students.

The estimated sample size was 702 children, who were selected, according to the inclusion criteria, as the population representative of the municipality of Parnaíba-PI. The seventeen schools of the municipal network of the city of Parnaíba-PI were chosen by lot to obtain the sample. This minimum number of participants is considered sufficient considering the proposed analyzes, the sampling error of 5%, and a 95% confidence level, indicating that the probability of the mistake made by the survey does not exceed 5%<sup>11</sup>.

Inclusion criteria were children in the complete deciduous dentition (between 3 and 5 years of age) and those in the initial phase of the mixed dentition, with one to eight permanent incisors (between 6 and 8 years of age) of both genders, with anterior crossbite, without posterior crossbite. Children above this age range (even with only previous crossbite) and children presenting with posterior crossbite or other type of malocclusion associated with anterior crossbite were excluded from this study because orthodontic intervention in these cases is more complex and should be orthopedic and orthodontic, without indication of Fixed Inclined Plane (FIP), device to be used in the research.

The researchers were trained in the Clinical School of Dentistry (CEO) of the State University of Piauí by means of calibration exercises with 10 children not participating in the sample plan, who received dental care at the CEO during their routine operation. The training consisted of identifying the crossbite anterior by means of midline evaluation and clinical examination of the occlusion, observing if the upper incisors were occluding behind the lower incisors and this analysis according to the methodology described by Peres et al.<sup>11</sup>.

First, a superficial clinical examination of the children's occlusion was performed, observing whether the upper incisors were occluding behind the lower incisors, characterizing the anterior crossbite. In children in whom this situation was present, a thorough examination was performed to classify the crossbite into functional, dental or skeletal.

The midline evaluation was performed because possible functional deviations could occur during complete dental occlusion. For the diagnosis of functional cross-bite in maximal habitual intercuspation (MIH), the patient presents a Class III dental relationship with anterior crossbite, while in the centric relation (CR), a Class I interarcos relationship (normocclusion), with top relationship between the upper and lower incisors. The inclination of the upper incisors to the lingual and / or lower incisors to the vestibular are the main factors responsible for the occlusal interference that lead the patient to occlude with the mandible designed for anterior<sup>12</sup>.

In cases of dental anterior crossbite, a localized inclination of one or more teeth is observed at the level of the alveolar process, without affecting the size or shape of the bone bases. The teeth are not centralized in the alveolar process and the most important diagnostic factor is an asymmetry of the dentoalveolar arch. In cases of skeletal

crossbite, the concave profile is observed, deficiency of the maxilla associated or not to the excessive jaw in relation to the skull and anterior crossbite.

For the three types of anterior crossbite mentioned, the FIP was implanted because it would correct the dental relationships in the anteroposterior direction, favoring the normal development of the bone bases down and forward.

After a conversation with the parents and the explanation about the treatment alternatives, the reasons for choosing the FIP, which were due to the patient's age and the patient's cooperation difficulty, fast result and low cost.

The pilot study involving 10 children participating in the sample had the objective of testing the proposed methodology. As a result, its viability was observed without adjustments. To measure intra- and inter-examiner diagnostic reproducibility, 10% of the total sample was double checked by each of the examiners, with the Kappa coefficient for intra- and inter-examiner agreement of 0.98 and 0.99, respectively.

The children who presented the malocclusion were referred to the orthodontics department of the Clinical School of Dentistry (CEO) of the State University of Piauí (UESPI) for their correct treatment. From each patient, two periapical radiographs were taken from the upper and lower incisors, respectively, to visualize the germs of the permanent successors and to verify if there was any extra tooth included in the region of the incisors (mesiodentes) and if present, it would be extracted prior to placement the appliance.

For the confection of the appliance, a pair of working models was obtained for each patient. The lower model was isolated with thin layer of wax utility and then applied a layer of self-curing acrylic resin on the middle and incisal thirds, buccal and lingual side of canine to lower canine at a 45 ° angle, without making contact with the gingival tissue to prevent inflammation (Figure 1). Subsequently, the finishing and polishing of the appliance was performed<sup>12</sup>.



**Figure 1.** Appliance used in the research.

For each tooth to be uncrossed, two teeth were used as support in the lower arch. For the installation the "say-show-do" conditioning technique was used, obtaining, in this way, patient acceptance and collaboration. Then, the adjustment of the apparatus was carried out and soon after cementation with glass ionomer, due to its advantages

such as fluoride release, good adhesion, biological compatibility, low volumetric and thermal coefficient of change, low solubility in the mouth. During the cementation, relative insulation and suction system were performed, essential for an effective cementation of the FIP<sup>12,13</sup>.

The children returned to the clinic for control examination on a weekly basis. If it were observed that the bite had not yet been uncrossed, wear on the vestibular of the apparatus could be accomplished by maintaining the 45 degree angulation so that only the tooth (s) to be uncrossed touched the acrylic. Removal of the tooth would occur after the uncrossing and the realignment of the teeth, using as a criterion the obtainment of 2mm of overjet<sup>13</sup>.

The SPSS statistical package, version 23, was used to calculate proportion and percentage measures to characterize the prevalence. The degree of association between the prevalence between genders was determined using the chi-square test and the comparison between groups with Mann-Whitney Test and Kruskal-Wallis Test, considering a significance level of 5%.

## Results

The prevalence of anterior dental crossbite was 2.14%, characterizing 15 of the 702 children evaluated, with mean and standard deviation of age of 5.3 years  $\pm$  2.2, which 60.11% were female (n= 422) and 39.89% male (n=280) with mean and standard deviation of age of 5.5 years  $\pm$  2.3 for female and 5.1 years  $\pm$  2 for male respectively. Table 1 shows data on treated children. With the result of the statistical calculation  $\chi^2$  (chi-square),  $\chi^2$  (1) = 0.601, p = 0.44, it was verified that there was no difference of statistically significant association between the genders of the participants.

**Table 1.** Data of children who placed the plane inclined device

Case	Gender	Age	Crossed incisors	Treatment time (weeks)
1	Male	5 anos	51, 52, 61, 62	4
2	Male	8 anos	11, 21	4
3	Female	5 anos	51, 52, 61, 62	3
4	Male	7 anos	11, 21	5
5	Female	8 anos	11, 21	5
6	Female	5 anos	51, 52, 61, 62	4
7	Female	8 anos	11	6
8	Male	4 anos	51, 52, 61, 62	4
9	Female	4 anos	51, 52, 61, 62	4
10	Female	8 anos	11, 21	5
11	Female	8 anos	11	6
12	Male	4 anos	51, 52, 61, 62	4

Among the 12 children who were treated, there were no differences between genders, chi-square,  $\chi^2 (1) = 0.331$ ,  $p = 0.56$ , considering a significance level of 5% with mean age of 5.6 years for male gender and of 5.8 year for female gender. As for the treatment time, the chi-square test was also performed, and it was verified that no statistically significant differences were also found ( $\chi^2$  (chi-square),  $\chi^2 (1) = 0.601$ ,  $p = 0.44$ ), even estimating that 50% of the cases were treated in 4 weeks, 33.3% in 5 weeks, 8.3% in 6 weeks and 8.3% also in 3 weeks. A non-parametric Mann-Whitney Test was performed, which found that there was no statistically significant difference between the genders and the treatment time ( $U=15$ ,  $p = 0.65$ ). The Kruskal-Wallis non-parametric test showed statistically significant differences between the three groups of crossed teeth ( $p = 0.02$ ), suggesting that the group with 1 crossed tooth was the one that took the most time to correct (9.5 weeks), followed by 2 teeth (8.8 weeks) and 4 teeth (3.9 weeks) respectively (Table 2).

**Table 2.** Variables studied in the 12 treated children

Variables	Test	Valor	p valor	Significance
Difference between the genders	chi-square test	$\chi^2 (1) = 0.33$	0.56	n.s
Treatment time	chi-square test	$\chi^2 (1) = 0.60$	0.44	n.s
Relationship between treatment time and gender	Mann-Whitney test	$U = 0.15$	0.65	n.s
Relationship between number of corrected teeth and time of treatment	Kruskal-Wallis test	1 tooth (9.5 weeks) 2 teeth (8.8 weeks) 4 teeth (3.9 weeks)	0.02	*

n.s (not significant); \*( $p \leq 05$ )

## Discussion

In this cross-sectional study, a prevalence of lower anterior crossbite of 2.14% was observed. This data corroborates those found in the studies of Morais et al.<sup>1</sup> (2014) and Fernandes et al.<sup>13</sup> (2007), whose prevalence was 2.2% and 3.10% respectively.

The prevalence of anterior crossbite has been shown to be lower than that of posterior crossbite<sup>13-15</sup>. This fact is understandable by the complex etiological factor of the previous crossed bites that according to Lee<sup>15</sup> (1978) is the result of traumatic injuries, bone sclerosis or fibrous tissue barrier, inadequate bow length and upper lip interposition habits.

When analyzing the gender in this study there was a higher prevalence for the female gender (60%). This finding distances itself from that found by Woitichunas et al.<sup>14</sup> (2001), which presented a tendency for males (56%).

Regarding the treatment of this malocclusion, Dias et al.<sup>16</sup> (2018) affirmed that the performance of the pediatric dentist in the early diagnosis constitutes a clinical instrument of relevance because it allows the interceptive treatment, besides minimizing future damages to the patients.

For Figueiredo et al.<sup>10</sup> (2014) a good treatment option is given with the flat inclined flat appliance because it is a quick and low cost technique, corroborating this work, which was adopted in 12 schoolchildren in the deciduous dentures and mixed.

When the treatment time was analyzed, half of the cases (6) were corrected in 4 weeks, 33.3% (4 cases) in 5 weeks, 8.3% (1 case) in 3 weeks and 8.3 (1 case) at 6 weeks, differing from Manjarrés and Silva<sup>17</sup> (2017) who corrected ten cases of anterior crossbite at 7 weeks.

Analyzing the groups of teeth that were crossed in this study it was verified that the treatment became faster in descending order in the cases, where four crossed teeth were found, followed by the two teeth crossed and with a crossed tooth. This fact suggest that the more crossed teeth are supported on the plateau of the Inclined Plane the shorter the treatment time.

Prakash and Durgesh<sup>18</sup> (2011) treated two cases, the first with a crossed incisor tooth and the second with four crossed incisors in three weeks. Dias et al.<sup>16</sup> (2018), when treating a crossbite that affected a group of six teeth (53 to 63), obtained a four-week uncrossing and Araujo et al.<sup>19</sup> (2017) when treating a single-crossover case tooth got its complete uncrossing in 2 weeks. These findings show that the treatment time is relative to each patient, but it is configured as a rapid treatment.

The treatment of the anterior crossbite should be started as soon as possible, so that it allows adequate growth of the jaws and correct dental positioning. The treated cases have been followed up and no relapse was observed. Guzzo et al.<sup>20</sup> (2014) elucidated that 51.6% of the interviewees in the city of Florianopolis-SC considered the correction of crossbite at the Basic Health Units (BHU) necessary.

It was concluded that the prevalence of anterior crossbite was 2.14%. The Inclined Plane proved to be a viable and effective therapy in the correction of anterior crossbite. It is one of the options of the orthodontic treatment in patients in the deciduous or mixed dentition, propitiating greater possibility of dentoskeletal development, since the malocclusion is corrected.

Because it is low cost, easy to make, effective and with reduced treatment time, it can be used in undergraduate courses and in UBS. However this method needs to be correctly indicated and its execution technique rigorously followed.

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