

COMPARATIVE EVALUATION OF THE EFFECTIVENESS OF FIXED VERSUS REMOVABLE ORTHODONTIC APPLIANCES IN CORRECTING ANTERIOR CROSSBITE IN MIXED DENTITION.

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ABSTRACT :

Background: Anterior crossbite is a common malocclusion whose prevalence vary from country to country. It is around 6-8% in India.

Aim & Objective: To evaluate the effectiveness of fixed versus removable orthodontic appliances in correction of anterior crossbite in the mixed dentition.

Material & Methods: A sample size of 75 subjects were selected on differential selective criteria with history of no previous orthodontic treatment, mixed dentition, anterior crossbite with moderate space discrepancy (< 3mm), non-extraction orthodontic mechanotherapy with ANB > 0°. A written consent was signed. Treatment with two parallel mode was designed, either with a removable appliance with springs or a fixed appliance with orthodontic brackets. To standardize the design for evaluation "Randomized Controlled Trials" (RCTs) were applied and parameters like rate of success, treatment duration, pre & post treatment differences in the overjet, overbite and arch length were accessed.

Results: The treatment was successfully completed in all the patients by both the treatment modalities. Method Error Analysis (MEA) & Statistical Package for the Social Sciences (SPSS) were used for statistical analysis. SPSS significantly showed the average treatment time by the fixed appliance was comparatively less (1.4 months, P < 0.05). Increase in arch length and overjet in both treatment modalities were recorded, but it was significantly higher in fixed mechanotherapy (P < 0.05 and P < 0.01).

Conclusion: Both, fixed and removal orthodontic appliances can successfully treat anterior crossbite in mixed dentition with short- term orthodontic treatment.

KEY WORDS : Anterior Crossbite, Mechanotherapy, Mixed Dentition, STC.

INTRODUCTION :

The prevalence of anterior crossbite varies with topography. Studies show Finland (2.2 %) ¹, Canada (10%) ², Germany (8 %) ^{3,4}, India (6-8%) ⁵ prevalence of crossbite in mixed dentition. All types of crossbite correction in the mixed dentition is advisable just after first diagnosis in order to prevent dentofacial growth discrepancies in all three planes. ^{2,3,6,7}

Anterior crossbite in mixed dentition can be corrected both by fixed & removable mechanotherapy. ⁸⁻¹⁰ Since there are very less studies to indicate which treatment modality is more effective. Hence the aim of this study was designed for scientific assessment of different parameters involved in the effectiveness of the treatment with removable and fixed orthodontic appliances.

MATERIAL AND METHODS :

Sample size of 75 subjects with mixed dentition between 6 to 9 years of age were differentially selected after undergoing following inclusion criteria:

- A. History of no previous orthodontic treatment.
- B. Early to late mixed dentition with anterior crossbite.

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- C. Moderate space discrepancy < 3mm.
- D. Non-extraction orthodontic mechanotherapy with ANB > 0°.

ASSESSMENT PARAMETERS:

The assessment parameters included:

- A. Success percentage of anterior crossbite correction
- B. Time of treatment in months i.e. from appliance insertion to date of appliance removal.
- C. Pre & post treatment difference in overjet, overbite in millimetres.
- D. Pre & post treatment difference in Arch length to incisal edge (ALI) in millimetres (Fig- 1)
- E. Pre & post treatment difference in Arch length to crevicular gingiva at central incisor (ALG) in millimetres (Fig- 1).

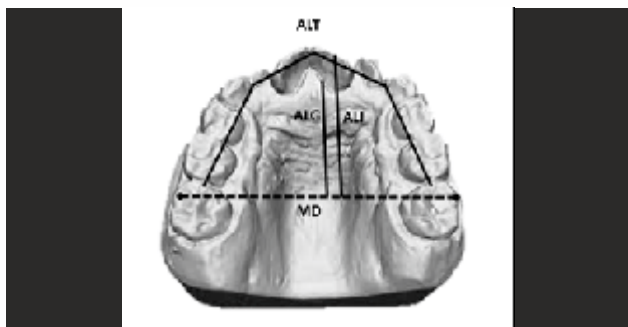


Fig- 1: Sagittal and Horizontal measurements made on the maxillary study.

- F. Tipping of maxillary incisor.(i.e. incisal arch length minus gingival arch length)
- G. Maxillary dental arch length total (ALT) in millimetres (Fig- 1)
- H. Transverse maxillary molar distance (MD) in millimetres (Fig- 1)

Successful treatment was defined as positive overjet for all incisors within a year, and the success rate was assessed by comparing study models from before (T0) and after treatment (T1). The overjet, overbite, and the arch length were measured with a digital sliding digital vernier caliper.

Fig-1(A)



Fig-1A - Digital Vernier Caliper

Calibrations were done to the nearest tenth of the millimetre. All readings were covert i.e. the inspector was unaware which treatment the patient had received, or whether the data were for T0 or T1. Difference in the measurements were noted between T1 and T0. Treatment time was registered too from the datas.

Datas on all patients were analysed on "Successful Treatment Completion" basis (STC) basis, i.e. if the anterior crossbite was not corrected during the first year of the treatment, the result was declared unsuccessful. Thus, all patients with STC or not, were registered in the final analysis. Subjects showing non-compliance or discontinuing the treatment were considered unsuccessful.

Removable Appliance

Components of the removal appliance were Methyl-Metha Acrylate (MMA) plate, a double cantilever spring (Z-Spring) for anterior teeth proclination, Adam's Clasps (22- gauge round hard stainless wire) for retention and anchorage & Jack's Expansion Screw for lateral corrections (Fig-2A).

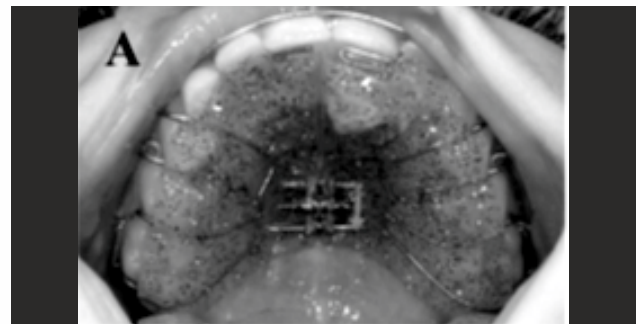


Fig- 2A: Occlusal view of the Removable Appliance

Z-Spring was activated every fortnight until desired overjet of the incisors were achieved. A short passive

labial bow was incorporated to control the excess labial tipping of the anterior teeth. Poster bite plate was incorporated to keep anterior occlusal clearance and augment retention. The Jack Screw remained passive until lateral expansion was required. Strict instructions were given to remove appliance only during eating and brushing. Datas and measurements of progress/regress were evaluated and noted after every 30 days. After correction the appliance was retained for 3 months as a passive retainer, lest some torquing or habit breaking was required.

Fixed Appliance

Components of fixed appliance had 0.022 slot MBT stainless steel brackets, as they are versatile with tip and torque. They could be bonded from deciduous molar or premolar if present with elastic modules. Bondable buccal tubes can be also used as per requirement due to mixed dentition. NiTi wires (0.012/0.014 gauge) were used to apply very light, continuous orthodontic force for tipping the teeth in the crossbite. (Fig- 2B).

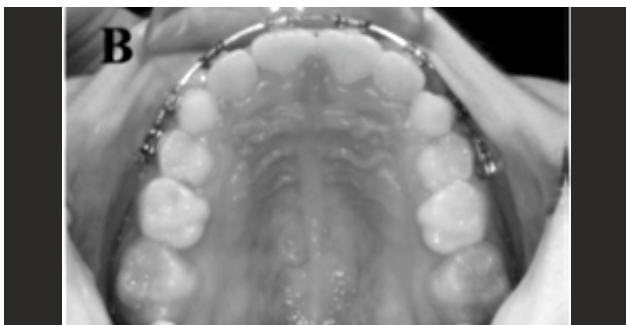


Fig- 2B: Occlusal view of the Fixed Appliance

Subjects receiving fixed appliance were treated with MBT prescription.¹² The arch-wire sequence followed was .012, .014 & .016 beta nickel-titanium. Rectangular NiTi (16x22) wires were used if there was torque loss in the teeth with crossbite. To create anterior occlusal clearance, coloured light cured composite (3M Unitek) was bonded to the occlusal surfaces of both mandibular second deciduous molars. After the completion of the treatment composite was removed by 30/15 flutes carbide bur as soon as the anterior crossbite was corrected. Datas and measurements of progress/regress were

evaluated and noted after every 15 days. Appliance was retained as a passive retainer for 3 months after correction of the cross bite.

Statistical Analysis

Method Error Analysis (MEA) & Statistical Package for the Social Sciences (SPSS) software (version 20.0) were used for statistical analysis of the data. On the basis of SPSS significance level of $\alpha = 0.05$ and a power $(1-\beta)$ of 90 per cent to detect a mean difference of 1 month (± 1 month) in treatment duration between the groups, the sample size for each group was calculated. Each group required a sample size of 21 subjects. To increase the power further and to compensate for possible dropouts, it was decided to select further a 20 patients, i.e. 31 patients for each group. For numerical variables, arithmetic means and standard deviations were calculated. Analysis of means was made with independent sample t-test to compare active treatment duration and treatment effects between the groups. P value of less than 5 per cent ($P < 0.05$) was regarded as statistically significant. On the basis of MEA, ten randomly selected study casts were measured on two separate occasions. Paired t-tests disclosed no significant mean differences between the records. The method error¹³ did not exceed 0.2 mm for any measured variable.

RESULTS:

Seventy five subjects were selected on differential selective criteria with history of no previous orthodontic treatment, mixed dentition, anterior crossbite with moderate space discrepancy ($< 3\text{mm}$), non-extraction orthodontic mechanotherapy with $\text{ANB} > 0^\circ$, but 13 subjects declined before the treatment.

Thus, 62 patients were randomly divided into two groups (Fig- 3). Group-A with mean age = 9.1 years, $\text{SD} = 1.19$ comprised 18 boys & 13 girls. Group-B with mean age = 10.4 years, $\text{SD} = 1.65$, had 19 boys & 12 girls. All the subjects had anterior crossbite before the treatment. Table-1 summarises the basic measurement variable. Before the beginning of the treatment, no significant differences were found



between the groups, except for age ($P < 0.05$).

Table 1. Baseline measurements (in mm) before treatment (T0) for the removable appliance group (A) and the fixed appliance group (B).

Parameters	Group A (N = 31)		Group B (N = 31)		P
	Mean	SD	Mean	SD	
Overjet	-1.4	0.47	-1.4	0.63	NS
Overbite	2.2	0.84	2.0	1.07	NS
Arch length to incisal edge, ALI	26.3	2.95	25.1	2.74	NS
Arch length gingival, ALG	22.8	2.60	21.6	2.51	NS
Arch length total, ALT	75.5	3.79	75.4	3.76	NS
Transversal molar distance, MD	50.9	2.98	50.4	2.39	NS

NS = not significant; Removable appliance is group (A), and the fixed appliance is group (B).

Crossbite of all the patients in the group treated by fixed appliance were corrected. Crossbite of all but one patient in the group treated by removal appliance were corrected. The specific patient showed non-compliance with the removable appliance which was later corrected by the fixed mechanotherapy. Hence the success of correction rate success rate in both groups was very high, and result statistically of both the groups were not significant. Patients showed more compliance for the fixed mechanotherapy. The average duration of active treatment was 3.9 months (SD = 2.8) in the removable appliance group and 2.5 months (SD = 1.41) in the fixed appliance group. Thus, treatment duration was statistically significant and less in the fixed appliance group ($P < 0.05$).

The increase in overjet after treatment was significantly more in the fixed appliance group ($P < 0.05$). Also, the increases in ALI and ALG were statistically significant and

greater in the fixed than in the removable appliance group (Table 2). After treatment, no significant intergroup differences were observed with respect to overbite, total maxillary dental arch length, or transverse maxillary MD (Table 2). The tipping effect of the incisors was relatively small, with no significant intergroup difference (Table 2). Within the groups, overjet, ALI, and the tipping effect of the incisors

increased significantly (Table 2). The fixed appliance group also showed a significant increase in ALG (Table 2).

Table 2. Changes of the different measures (in mm) within and between groups and calculated as the difference between the after (T1) and before treatment (T0).

Parameters	Group A (N = 31)		Group B (N = 31)		P
	Mean	SD	Mean	SD	
Overjet	3.5***	1.15	4.2***	1.26	*
Overbite	-0.1	0.75	0.0	1.07	NS
ALI	2.5**	1.04	3.7***	2.06	**
ALG	0.9	0.85	1.7**	1.20	**
ALT	1.1	1.10	1.8	1.90	NS
Tipping effect, ALI/ALG/ALI	0.6***	0.59	0.6***	0.44	NS
MD	0.6	0.87	0.7	0.76	NS

Removable appliance is group (A), and the fixed appliance is group (B).
NS = not significant. * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$

DISCUSSION :

Results evaluated through null hypothesis highlighted that fixed or removable appliance therapy for anterior crossbite are equally effective. Another significant statistical data was that fixed mechanotherapy took marginally 45 days less than the treatment by removable appliance. Although it's uncertain to what extent this factor will be important to choose the treatment different modalities, it is important to differentially analyse the parameters for this difference in the treatment time. Most important factors which attribute to this is the light continuous force applied through the fixed mechanotherapy in comparison to the light interrupted force applied through removable appliances. Another factor affecting treatment time is patient's better compliance for the fixed appliance. Hence this should be a major parameter influencing the choice between two appliances. It was noted that treatment time with removable appliance of child with good compliance was almost at par with the fixed appliance.

It must also be acknowledged that clinical trials run the risk of the Hawthorne effect¹⁴ (positive bias)¹⁴, whereby subjects tend to perform better when they are participants in an experiment. Consequently, the



Hawthorne influenced both groups, i.e. the patients were more compliant than the average orthodontic patient, in everyday orthodontic practice.

All evaluations and data records in the study were double blinded and hence unbiased. Further to standardize the design for evaluation "Randomized Controlled Trials" (RCTs) were applied. RCTs are considered to generate the highest level of evidence and provide the least biased assessment of differences in effects between two or more treatment alternatives.¹¹ The study design also implied that basic parameters like treatment progress, duration of treatment, and side-effects were observed closely and evaluated accurately. This ensured authentic and good external validity of the findings. Finally, from a clinical point of view, the STC approach is of great importance. Although exclusion was very low (only one patient withdrew), it is important to include incomplete as well as complete cases in the final analysis to avoid the risk of false-positive treatment results. This is in contrast to the high success rate in this study. Patients with anterior crossbite are more aware of their malocclusion: unlike posterior crossbite, it is very obvious and aesthetically disturbing. Hence, subjects were highly motivated and keen to complete the treatment.

Advantages with removable appliance were that teeth doesn't have to undergo invasive processes like etching, bonding, and debonding procedures. Maintenance of oral hygiene was comparatively better. Food habits were not altered as in case of fixed appliance. Furthermore, if purely tipping movement of the incisors were required, it could easily be created with a removable appliance. But if tip & torque both were required then fixed mechanotherapy was the choice of treatment.

It has been claimed that early treatment of anterior crossbite (pseudo class III malocclusion) in the mixed dentition will reduce the likelihood of the child developing a true Class III malocclusion.^{3, 5-7} In this study, it was found that anterior crossbite in the mixed dentition can be successfully corrected by either fixed or removable appliance therapy in a short-term

orthodontic treatment. The basic goal of orthodontic treatment is to produce a normal occlusion that is functionally stable and aesthetically well accepted. Since early correction of anterior crossbite is undertaken in the growing child, it is important to also evaluate the post-treatment changes for at least 3 years.

This study evaluated a relatively limited number but very relevant parameters. Thus opening gateway for other research studies with parameters such as cost-effectiveness, functional shift, patients' perceptions of the treatment etc.

CONCLUSION :

Anterior crossbite in the mixed dentition can be successfully corrected by either fixed or removable orthodontic appliances as a short term treatment.

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