EVALUATION OF ORTHODONTIC TREATMENTS USING MBT* STRAIGHT WIRES IN CROSSBITE PATIENTS

Nguyen The Dung[1]

ABSTRACT

The deviation and misalignment of teeth and jaw can lead to Angle's Class I malocclusion (division 3 and 4 according to Anderson) and Angle's Class III malocclusion. It causes anterior or posterior cross bite with a relatively high proportion. The proportion of patients with Angle's Class I malocclusion (division 3 and 4 according to Anderson) and Angle's Class III malocclusion due to the combination of maxillary laterally deficiency and mandibular prognathism varies in races and residential areas. In clinical practice, we conducted treatments for 86 patients with Angle's Class I malocclusion, Anderson 3,4 subdivisions and Angle's Class III malocclusion to the following. ***Objectives***: Evaluate dentofacial phenotypes, X-ray images of patients having Angle's Class I malocclusion (division 3 and 4 according to Anderson) and Angle's Class III malocclusion. Analyze the results of treatments using MBT straight wires in patients with Angle's Class I malocclusion (division 3 and 4 according to Anderson) and Angle's Class III malocclusion. ***Methods:*** Interventional study (patients was clinically compared between pre and post treatment). ***Results:*** The prevalence of Angle's Class I malocclusion (division 3 and 4 according to Anderson) is high with 79.06 %, and that of Angle's Class III malocclusion is 20.93%. The collected data on Cephalometric films before and after of Class III malocclusion treatments showed improvements in prognosis, especially with a good correspondence in sagittal plane (anterior to posterior relationship). Results of treatments have been achieved in accordance with the standard functionality, aesthetics, X - ray and PAR scores in both pre-and post-treatments. The percent of good results is 90.69 % and that of mediocre result is 9.30 %. The average duration of the treatments is 24.68 ± 2,366 months.

Keywords: *Angle's class I, class III malocclusion, cross-bite, orthodontics.*

I. INTRODUCTION:

Misalignment of teeth and deviation of jaw can lead to class I, III Angle malocclusion with a relatively high rate of teeth crowding. According to Dong Khac Tam and Hoang Tu Hung studies, [3], in Viet Nam, malocclusion percentage of population aged 17-27 years old is 21.7%. Angle class I malocclusion can lead to 13.4% anterior cross-bite and 11.8% posterior cross-bite (Anderson class III, IV sub-division).

The percentage of Angle class I, Anderson3 and 4 subdivision malocclusion due to the deficiency of horizontal development of the maxilla bone varies in races and residential areas. In the US, the percentage of cross-bite in Caucation is 7% and that of in Africa-American is less than 1-2% (Sim 1972 and Mills, 1966). In Japan, the percentage of crossbite is about 4-16% (1987). In Taiwan, the rate of pseudo Angle Class III is 2.31% and that of Angle class III is 1.65% (Lim, 1985) meanwhile this rate in Europe is 13.2%.

[1] *Khanh Hoa College of Medicine*
**MTB straight wire: Mclaughlin, Bennett, Trevisi-straight wire.*
Responsible person: Nguyen The Dung
Email: anmypy@gmail.com
Date of receipt:
Date of scientific judgment:
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Angle Class I Anderson class 3,4 subdivision malocclusion and Angle class III cause reduction in esthetic, chewing function, phonetic or easily cause occlusal trauma; hence consequently lead to periodontitist [5]. Besides, it can also cause TMJ pain, thus patients are very uncomfortable, reduce quality of life. However, most of patients seeking orthodontics treatment for malocclusion because they mainly want to improve the esthetic aspect, and then mastication function and phonetics.

In clinical practice, we have more often seen patients with Angle class I, Anderson class 3,4 subdivision malocclusion and Angle class III malocclusion. These patients were treated and achieved good outcomes. Therefore, we chose to evalute of the outcomes of fixed orthodontics treament with straight wire appliances in cross-bite malocclusion with the following objectives.

Investigation of clinical and radiographic chatacteristics of Angle class I, Anderson class 3,4 subdivision and Angle class III malocclusion patients.

Evaluation of treatment outcomes in patients with Angle Class I, Anderson 3,4 subdivision, treated with straight wire appliances.

II. PARTICIPANTS AND METHODS

2.1. Participants

Angle class I, Anderson 3,4 subdivision malocclusion and Angle class III malocclusion patients.

Selection criteria: patients are older than 12 years old, diagnosed with Angle Class I, Anderson 3,4 subdivision and Angle Class III malocclusion and agree to proceed with orthodontic treatment.

Exclusion ctriteria: patient are less than 12 years old, diagnosed with different classification of malocclusion and did not agree to participate in orthodontic treatment.

2.2. Methods: Interventional study (patients was clinically compared between pre and post treatment).

2.3. Data collection:Treatment process were tracked and noted in patients' charts.

Instruments to collect data: dental mirrors, periodontal probe, PAR ruler, camera and caliper to measure.

Data collection method: clinical examination to study occlusion, cephalometric Xray, Panorex and Xray analysis, straight and lateral extra oral photos, study stone models.

Treatment plan formation and treatment plan explanation and discussion with patients

Implement the treatment plan: periodontitis treatment, maxilla bone expander, braces attachment, straightening the vertical dimension, protruding maxilla and retruding the mandible (Angle class III), closing all diastemas, final modification and maintenance the achieved outcomes.

Duration of treatment: from 18 to 28 months without the maintenance period of time.

2.4. Data Analysis

Based on the criteria: function, esthetic and PAR scores before and after treatment to evaluate the results. Good: percentage of PAR reduction more than 30% with the PAR index reduction more than 22 scores.

Mediocore: percentage of PAR reduction more than 30%.

Bad: percentage of PAR reduction less than 30%. The PAR multiplier for occlusion components is calculated according to British index.

Occlusal components	British index	Scores
1. Alignment of maxillary anteriors	1	
2. Alignment of mandibular anteriors	1	
3. Overbite	2	
4. Overject	6	
5. Midline	4	
6. Right posterior teeth occlusion	1	
7. Left posterior teeth occlusion	1	

2.5. Data software analysis: Software SPSS for Windows 19.0.

III. RESULTS

Table 1: Distribution of patients based on sex and age group.

		Age group			Total	Percentage %
		12-18 years old	**19-25 years old**	**> 25 years old**		
Sex	Male	12	7	0	19	**22,09**
	Female	42	18	7	67	**77,90**
Total		54	25	7	**86**	100%
Percentage %		**62,79**	**29,06**	**8,13**	100%	

Table 2: Distribution of patient based on occlusal classification.

Occlusion	Patients			Percentage %
Angle class I, Anderson 3,4 subdivision malocclusion	Anderson 3 subdivision	50		
	Anderson 4 subdivision	18	68	**79,06**
Skeletal class III malocclusion	Abnormal XÔR	2		
	Skeletal class III malocclusion with insufficient development of maxilla	10	18	**20,93**
	Skeletal class III malocclusion with insufficient development of maxilla and excess development of mandible	6		
Total			**86**	100

Within 86 cross-bite malocclusion patients, there are 18 patients having skeletal class III malocclusion (20.93%).

Table 3: Straight front view portrait of patients before and after treatments.

Straight front view portrait before treatment			**Straight front view portrait after treatment**	
Faceial shape	Patients	Percentage %	Patients	Percentage %
Wide	8	**9,30**	8	**9,30**
Average	52	**60,46**	63	**73,25**
Narrow	26	**30,23**	15	**17,44**
Total	**86**	100%	**86**	100%

Before treatment, straight view portrait photos indicated the percentage of patients with narrow face was 30.23% but that reduced to 17.44% after the treatment. The average width of facial shape increased from 60.46% to 73.25%.

Table 4: Lateral view portrait of patients before and after treatments.

Lateral view portrait of patients before treatment			**Lateral view portrait of patients after treatment**	
Facial shape	Patients	Percentage %	Patients	Percentage %
Protrusion	6	**6,97**	6	**6,97**
Straight	26	**30,23**	42	**48,83**
Retrusion	54	**62,79**	38	**44,18**
Total	**86**	100%	**86**	100%

Before treatment, lateral view portrait indicated the percentage of patients having straight facial shape was 30.23% and this percentage increased to 48.83%. After treatment, the percentage of patients having retrusion face reduced from 62.79% to 44.18%.

Table 5: TMJ condition before and after treatments.

	Before		After	
TMJ	Patients	Percentage %	Patients	Percentage %
Normal	75	**87,20**	80	**93,02**
Pathological injuries	11	**12,79**	6	**6,97**
Totalal	**86**	100	**86**	100

Before treatment, the percentage of patients having TMJ pathological injuries is 12.97% and this percentage reduced to 6.97% after treatment (p>0.05).

Table 6: Curve of Spee before and after treatments.

	Before		After	
Curve of Spee	Patients	Percentage %	Patients	Percentage %
Deep	26	**30,23**	8	**9,30**
Average	58	**67,44**	71	**82,55**
Flat	2	**2,32**	7	**8,24**
Total	**86**	100	**86**	100

Before treatment, the percentage of average curve of Spee was 67.44% and this percentage increased to 82.55% after treatment (p>0.05).

Table 7: Classification of PAR index before and after treatments.

	Before		After	
Groups	Patients	Percentage %	Patients	Percentage %
1 (5 - 10 scores)	4	4,65	86	**100**
2 (11 - 20 scores)	10	11,62		
3 (21 - 30 scores)	54	62,79		
4 (> 31 scores)	18	20,93		
Total	**86**	**100**		

Before treatment, PAR index average was 26,53±5,368, the least was 6 and the greates was 49. PAR index of the group 3 having 21-30 scores was the most, which is 62.79%

After treatment, PAR index average was 3,68±1,108, the least was 2 and the greatest was 9, group 1 having 5-10 scores was 100%. The difference between PAR indexes before and after treamtnets is statisfically significant with p<0,05.

Table 8: The relationship between the PAR index groups before treatments and insuficiente spaces in patients having tooth extraction.

		Tooth extraction		Total
		Extraction	**Non-extraction**	
PAR index group before treatments	**1** (5-10 scores)	0	4	4
	2 (11- 20 scores)	0	10	10
	3 (21- 30 scores)	54	0	54
	4 (> 31 scores)	18	0	18
Total		**72**	**14**	**86**
Percentage %		**83,72**	**16,27**	**100%**

Patients with PAR index from 21-31 scores and having tooth extraction were 83.72%

Table 9: Mean of index on Cephalometric in skeletal class III malocclusion.

Angle	Before	After
SNA angle	81,1573 ± 0,2796	81,5869 ± 0,6971
SNB angle	83,2689 ± 0,1262	81,4968 ± 0,1278
ANB angle	-2,1116 ± 0,1534	0,0901 ± 0,5693

The index values based on cephalometric before and after treatments in skeletal class III indicated the good results.

Table 10: Treatment outcomes

Outcomes	Patients	Percentage %
Good	78	90,69
Average	8	9,30
Bad	0	
Total	**86**	100

The good outcomes were 90.69% and the average of treatment duration was 24,68 ± 2,366 months.

IV. DISCUSSION

Currently, orthodontic treamtment follows the concept of multidisciplinar orthodontics. The good of orthodontic treatment is to provide patients a good result in terms of function, esthetic, stable occlusion and good oral health. The orthodontic treatment result can be achieved by intergrating the knowledge and clinical techniques of all specialties such oral surgery, periodontology, prosthetics and implantology. Orthodontics is not only occlusion correction specialty but also Science and art of dentistry.

William R. Proffit (1986-1993) [6] stated that the goal of modern orthodontic treament is to create the best acceptable occlusal relationship and stable occlusion including monitoring, guiding and correcting facial growth, correcting deviation and pathological abnomalies by adjusting the teeth and skeletal bones by using foces to stimulate and redirect the growth of craniofacial complex.

Time of treatment

According to Stven M.H. Lee [7], the optimal time for treatment of skeletal class III malocclusion (by using face mask or reverse pull headgears) is when the primary

central incisors are replaced by permanent central incisors, especially in pseudo class III malocclusion because this type of malocclusion requires early treatment in order to avoid erosion of primary incisors. The habit of mandibular thrust can lead to severe true skeletal class III. More than half of posterior cross-bite patients cause the jaw to slip when closing the mouth. Therefore, these patients should have been treated as soon as possible in order to protect the TMJ and prevent disproportional growth. From 6 to 9 years old are the ideal period time for skeletal class III intervention because of the possibility of expanding of the skeletal bones by wearing reverse pull headgears. In addition, widening the growth of the maxilla in vertical dimension also help to protrude the posterior teeth and rotate the mandible downward and backward to create the normal occlude between upper and lower arches anterior-posterior direction. Therefore, the retrusion of midface can improve.

However, according to Thomas M. Graber [9], it is necessary to pay more attention both favorable and unfavorable of tissue responses to orthodontic appliances. It has been shown the clinically relevant of force strength, force type, force direction and duration of force application. This becomes more important in treatments for elderly patients. Therefore, even treatment duration in elderly patients could be longer, however, studies have demonstrated that there was no difference in duration of treatment between elderly patients and aldolescent patients. Patients in our study, permanent teeth have fully erupted. (the selection criteria was patients older than 12 years old). In 18 skeletal class III , there are 2 cases are class III due to dentition-alveolar bone. Therefore, according to the classic classification, these cases are classified as elderly patients and the treatment might not achieve a good outcome because the base of the maxilla would not lengthen during treatment for elderly patients [8]. However, none of authors has specified patient's ages classified as elder group. In our 18 skeletal class III patients, the average ages was 14 tuổi± 0,568 and average of duration of treatment was 24,68 ± 2,366 months, the outcomes achieved all function, aesthetic, TMJ stable. Patients are satisfied with the achived outcomes.

Angle class I, Anderson 3,4 subdivision malocclusion and Angle class III due to abnomaly of alveolar bones.

ANB angles in most of these malocclusion cases are within normal limit, maxillary anteriors (or maxillary posteriors) are lingually inclined and mandibular anteriors (or mandibular posteriors) are buccally inclined. Therefore, the goal of treatment for these patients is to adjust the relation between anterior and posterior teeth [1]. With 70 cases (68 cases with Angle class I, Anderson 3,4 subdivision and 2 cases with Angle class III due to anomaly of teeth and alveolar bones), treatment is pretty simple. It only needs to expand the upper arch and move anteriors or posteriors forwardly and outwardly the mandibular teeth. It resulted in good function, normal development.

Skeletal class III malocclusion due to insufficient development of maxilla bone

This type of malocclusion is often seen in patients having lip clefts or palatal clefts. These developmental anomalies cause the maxilla bone to be insufficient growth and maxillary anteriors are lingually inclined, SNA angle is smaller than normality and SNB angle is within the range of normality. The treatment for these cases is simple, after the expansion of maxilla in order to enlarge

both vertical and horizontal dimensions of dentition arches. Straightening the vertical dimension by only using straight wire and without any external force will help maxillary anterior incisors tilt outward. In 6 treated cases, patients were satisfied with nice aesthetic, good function, stable occlusion and healthy soft tissues without pathological damage to TMJ.

Skeletsal class III malocclusion due to deficient development of maxilla bone

For skeletal class III malocclusion, there is teeth compensation, in which maxillary incisors are labially outward on the maxilla retrognathism or undergrowth while mandibular are lingually inward on the mandibular prognathism. In these cases, the mandible is overgowth and is more outward comparing to the maxilla. SNA angle is less than normal range while SNB angle is greater than normal range, which result in ANB is less than zero degree. Moreover, the tongue is flat and positioned more inferiorly and anteriorly. Additionally, there are anterior and posterior cross-bite malocclusion and most often, the maxillary arch is narrow. Many researchers asserted that orthodontal surgery correction is the most optimal approach [2]. However, according to William. R. Proffit et al. [10], when diagnosing and planning the orthodontal treatments, it is necessary to analyze thoroughly all the aspects of the relation between diagnosis and treatment plan. Although there are many dfferent treatment plans achieving the same goal, the foundation of these treatment plans is collect and analyze all the necessary assessments. In the 16 cases of cross-bite in skeletal class III malocclusion due to undergrowth of maxilla and overgrowth in length of mandible, our initial treatments have achieved great results in all 16 patients, none of which required surgery.

V. CONCLUSION:

Treatment outcomes collecting from 86 cross-bite orthodontal treated with straight wire appliances were analyzed and concluded that:

The percentage of Angle class I, Anderson 3,4 subdivision malocclusion is 79.06% and that of skeletal class III malocclusion is 20.93% comparing to total of cross-bite treated patients. Clinical findings include the following notes:

Before treatments, straight front facial photos indicated narrow facial profile was 30.23% and reduced to 17.44% after treatment. After treatments, normal facial profile increased from 60.46% to 73.25%.

Before treatments, lateral facial profile photos indicated straight facial profile was 30.23 and it increased to 48.83% after treatment. After treatments, facial concavity reduced from 62,79% to 44.18%.

Before treatments, TMJ with pathological injuries was 12.79% and it reduced to 6.97% after treatments ($p>0.05$.)

Normal curve of Spee was 67.44% and it increased to 82.55 % after treatment ($p>0.05$).

All the indexes collecting on Cephalometric before and after orthodontal treatments of skeletal class III malocclusion indicated good process and good correlation of maxilla and mandible in the anteroposterior direction.

Before treatments, the average of PAR index was 26,53±5,36, the smallest number was 6 and the greatest was 49. Group 3 (21-30 scores) was accounted for the highest percentage, 62,79%.

After treatments, the average of PAR index was 3,68±1,108, the smallest number was 2 and the greatest was 9. Group 1 (5-10 scores) was accounted for 100% (comparing before and after treatments with $p<0.05$).

The average index collecting from Cephalometric of skeletal class III malocclusion patients:

Before treatments, SNA angles were: 81,1573 ± 0,2796 and after treatments are 81,5869 ± 0,6971.

Before treatments, SNB angles were: 83,2689 ± 0,1262, and after treatments are 81,4968 ± 0,1278.

Before treatments, ANB angles were: -2,1116 ± 0,1534, and after treatments are 0,0901 ± 0,5693.

Treatment outcomes are satisfied according to all criteria including function, aesthetic, PAR index before and after treatments and Xrays. The percentage of good result is 90.69%, that of average result is 9.30%. Lastly, the average of treatment duration was 24,68 ± 2,366 months.

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RESULTS OF SEVERAL CROSS-BITE TREATMENTS

1. NGUYEN ANH THU, 15 years old, Angle class I, Anderson 3,4 subdivision malocclusion.

2. ĐOAN THANH LAN, 16 years old, Angle class I, Anderson 3,4 subdivision. malocclusion

3. NGUYEN HUU PHUOC, 18 years old, skeletal class III malocclusion due to undergrowth maxilla (patient had palatal cleft correction surgery).

4. HON DANG KHOI, 25 years old, Angle class III due to alveolar bones.

5. NGUYEN DOAN CAM TU, 21 years old, Angle class III malocclusion (maxilla retrognathism and mandible prognathism).