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Case Series

Significance of saddle angle in myofunctional therapy: A case series

Ghazala Farheen[1]*, Sankalp Bansal[1], Gurinder Singh[1], Sangeeta Sunda[1], Suvansh Gupta[1]

[1]*Dept. of Orthodontics and Dentofacial Orthopedics, Genesis Institute of Dental Sciences and Research, Firozpur, Punjab, India*

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ABSTRACT

Myofunctional appliances are highly effective in growing patients and are often used to correct jaw discrepancies and promote optimal growth. The twin block appliance is widely considered as the most efficacious myofunctional appliance for treating skeletal class II malocclusion in growing patients. The success of treatment with any myofunctional appliance depends on a variety of factors, including the patient's age, growth status, growth pattern, the specific malocclusion being treated, patient compliance, the type of appliance, and other case selection criteria, such as clinical examination and certain cephalometric parameters that are not typically considered in routine practice. Among cephalometric parameters, the saddle angle is of utmost importance and should always be considered before commencing myofunctional therapy. Patients with a large saddle angle may have a class II skeletal relationship, characterized by a posteriorly positioned mandible. These cases can be more challenging to treat with functional appliances alone and may require additional orthodontic or surgical interventions. This paper presents a detailed description of three cases illustrating the importance of the saddle angle in the success of myofunctional therapy.

1. Introduction

Class II malocclusion is one of the most common problem around the globe affecting about one third of the patients seeking orthodontic treatment. McNamara stated that a retrusive mandible is the most common feature of this malocclusion.[1] Functional appliances can be used to correct both skeletal and dental problems in these patients. These appliances have been used since the 1930s. despite their long history, there is still much controversy surrounding their use, mode of action, and effectiveness. Twin block appliance therapy is more effective at correcting class II malocclusion through skeletal changes than most other appliances, making it suitable for early orthodontic treatment in patients with class II malocclusion.[2] Myofunctional therapy is not a universal treatment approach for all growing patients, and several factors must be considered when choosing the best course of care. Saddle angle is one of the most crucial factors in the success of myofunctional treatment.

Saddle angle: Saddle angle, a concept introduced by Rakosi, is the angle between the anterior and posterior cranial bases.[3] (N-S-Ar; nasion-sella- articulare) as shown in Figure 1.

A large saddle angle indicates a posterior position of the fossa and a small saddle angle indicates an anteriorly positioned fossa.

Graber, Rakosi, and Petrovic suggested that a large saddle angle often indicates a posteriorly displaced condyle and mandible relative to the cranial base and maxilla. This is unless the fossa position is compensated for specific angular

* *Corresponding author*.
E-mail address: ghazalafarheen121@gmail.com (G. Farheen).

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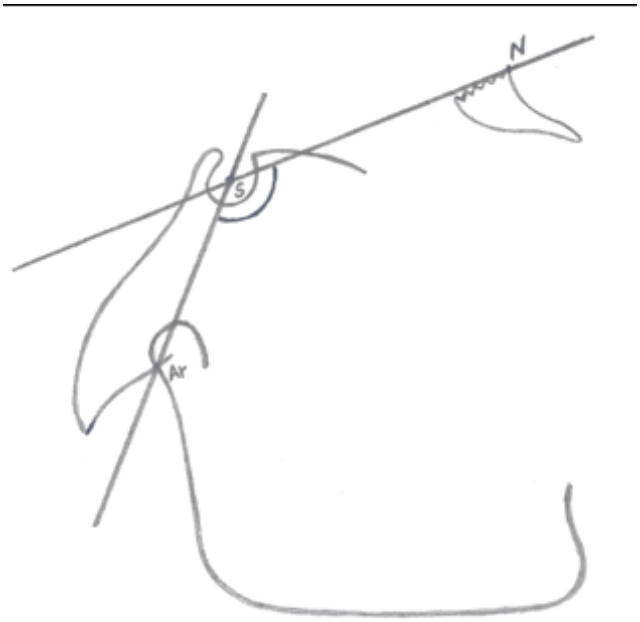

Figure 1: Saddle angle (N-S-Ar)

(articular angle) and linear (ramal length) relationships. Notably, a non-compensated posterior mandibular position due to a large saddle angle is highly resistant to correction through functional appliance therapy.[4]

There are three case reports in this study that describe growing patients treated with a twin block appliance to correct skeletal class II malocclusion. All parameters were favorable for myofunctional therapy, except for the increased saddle angle. These cases demonstrate the impact of saddle angle (N-S-Ar) on the effectiveness of myofunctional treatment.

2. Case Report 1

12 years old prepubertal male diagnosed with class II skeletal base, orthognathic maxilla, retrognathic mandible, straight path of closure. He had Angle's class II malocclusion: increased inclination of maxillary anteriors and retroclined mandibular incisors, increased overjet and overbite, deep curve of the spee. The upper and lower midlines did not coincide. Patient's profile was convex, with an obtuse nasolabial angle (Figures 1 and 2). The cephalometric measurements are mentioned in Table 1.

2.1. Problem list

2.1.1. Skeletal problem

1. Class II skeletal base
2. Retrognathic mandible

2.1.1.1. Dental problem (Figure 3).

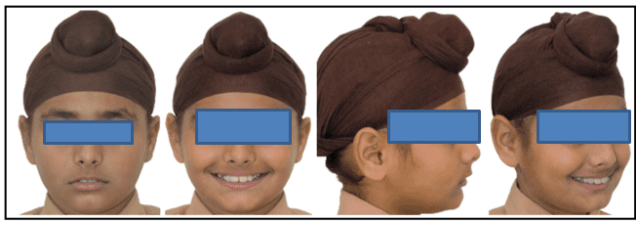

Figure 2: Pretreatment extraoral photographs

Figure 3: Pretreatment intraoral photographs

1. End on molar relation
2. Increased inclination of the maxillary anteriors
3. Retroclined mandibular incisors
4. Increased overjet and overbite
5. Non coinciding midlines
6. Deep curve of spee

2.1.2. Soft tissue problems

1. Convex profile
2. Obtuse nasolabial angle
3. Retruded lower lip

2.2. Treatment objectives

1. To achieve a Class I skeletal base
2. To achieve Class I molar and canine relations on both sides.
3. To correct overjet and overbite
4. Normal inclination of the upper and lower anteriors
5. To achieve levelling and alignment
6. To correct the midline
7. To achieve a harmonious soft tissue profile

2.3. Growth prediction

(i) CVMI 2 (acceleration stage): 65 – 85% growth remaining (Figure 4)

The treatment plan was divided into two phases:

2.3.1. Phase I

Functional therapy with the Twin Block appliance

2.3.2. Phase II

Fixed mechanotherapy

Figure 4: Pretreatment lateral cephalogram

Figure 5: Pretreatment hand wrist radiograph

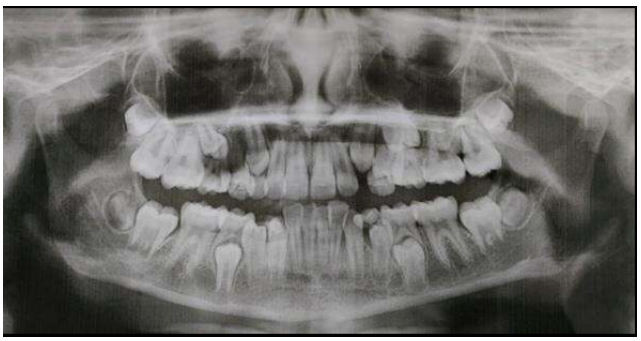

Figure 6: Pretreatment OPG

2.3.3. Phase I

Functional therapy with the Twin Block appliance

The patient was treated with twin block appliance, to bring mandible forward till a class I skeletal base was achieved. Phase 1 therapy was completed in 9 months.

Figure 7: Twin block delivered

I. Objectives achieved after phase I (Figures 8 and 9)

1. Class I skeletal base
2. Class I molar relation
3. Class I canine relation
4. Normal overjet and overbite

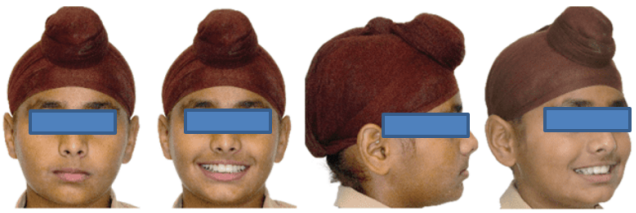

Figure 8: Post orthopedic extraoral photographs

2.3.4. Phase II

Fixed mechanotherapy

Figure 9: Post orthopedic intraoral photographs

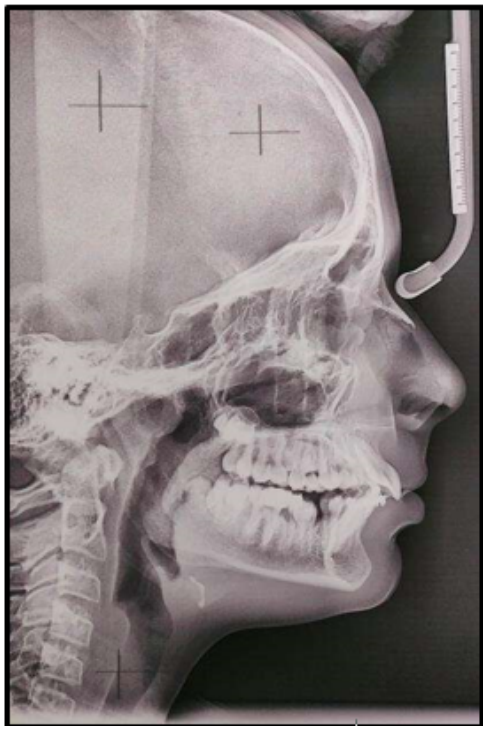

Figure 10: Post-orthopedic lateral cephalogram

Figure 11: Post-orthopedic OPG

After the first phase was completed, the second phase began with fixed mechanotherapy in a pre- adjusted edgewise MBT.022-inch slot. Initially, 0.016 Heat Activated Nickel Titanium wire was used for levelling and alignment.

2.4. Treatment outcome

After two months of completion of phase 2 (levelling and alignment), it was found out that the treatment had undergone relapse. (Figures 12 and 15)

Cranial base to point A angle was the same, cranial base to point B angle had decreased due to retropositioned mandible (ANB = 8°) resulted in increased overjet.

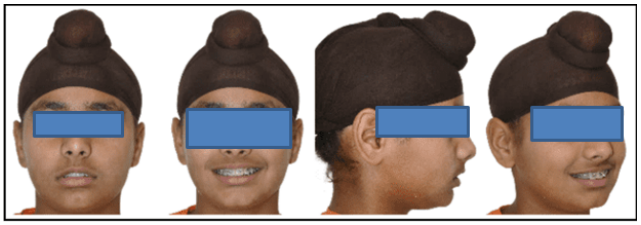

Figure 12: Extraoral photographs after relapse

Figure 13: Intraoral photographs after relapse

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3. Case Report 2

13 years old prepubertal female diagnosed with class II skeletal base, orthognathic maxilla, retrognathic mandible, straight path of closure with Angle’s class II malocclusion: increased inclination of maxillary anteriors and retroclined mandibular incisors, increased overjet and overbite. Patient’s profile was convex, with an obtuse nasolabial angle. (Figure 17) The cephalometric measurements are mentioned in Table 2.

3.1. Problem list

3.1.1. Skeletal problem

1. Class II skeletal base
2. Retrognathic mandible
3. Average growth pattern

Table 1: Comprehensive cephalometric evaluation

Measurements	Normal	Pretreatment	After completion of Phase 1	After levelling and alignment of lower arch
SNA	82° ± 2°	80°	81°	81°
SNB	80° ± 2°	73°	77°	73°
ANB	2°	7°	4°	8°
Beta angle	27° - 35°	22°	23°	21°
Yen angle	117°-123°	113°	118°	115°
Pie angle	1.3°-5°	1°	2°	1°
W angle	51° - 56°	45°	50°	46°
N perpendicular to point A	0±2mm	0mm	1mm	1mm
N perpendicular to point – pog	0 - -4mm	-9 mm	-6mm	-9mm
Saddle angle	123°±5°	131°	130°	131°
Articular angle	143°±6°	141°	139°	141°
Gonial angle	128° ± 7°	122°	123°	122°
Effective mandibular length	120 ± 3.4mm	96mm	97mm	97mm
Effective maxillary length	92.1 ± 2.7mm	81mm	83mm	83mm
Witts appraisal	0-2 mm	4mm	1mm	4mm
Upper incisor to NA	22°/4mm	39°/7mm	40°/7mm	40°/7mm
Lower incisor to NB	25°/4mm	24°/2mm	26°/2mm	27°/5mm
IMPA	90°	93°	95°	98°
Interincisal angle	131°	121°	119°	118°
Y axis	66°	58°	62°	61°
Upper lip to S line	0mm	2mm	0mm	2mm
Lower lip to S line	0mm	-1mm	0mm	-1mm
Nasolabial angle	90°-110°	118°	121°	123°
Intercanine width		U- 33mm L- 26mm	U- 33mm L- 26mm	U- 33mm L- 26mm
Intermolar width		U- 42mm L- 37mm	U- 42mm L- 37mm	U- 42mm L- 37mm

3.1.2. Dental problem (Figure 18)

1. End on molar relation and end on canine relation on both sides
2. Increased inclination of the maxillary anteriors
3. Retroclined mandibular incisors
4. Increased overjet and overbite
5. Forwardly placed upper incisors

3.1.3. Soft tissue problems

1. Convex profile
2. Obtuse nasolabial angle
3. Retruded lower lip
4. Protrusive upper lip

3.2. Treatment objectives

1. To achieve a Class I skeletal base
2. To achieve Class I molar and canine relations on both sides
3. To correct overjet and overbite
4. To achieve normal inclination of the upper and lower anteriors
5. To achieve levelling and alignment
6. To achieve a harmonious soft tissue profile

3.3. Growth prediction

I. CVMI 3 (transition stage) represented 25 – 65% of remaining growth. (Figure 19)

3.4. Treatment plan

Considering the growth status of the patient the treatment plan decided for this patient was twin block therapy followed by fixed mechanotherapy.

3.5. Treatment outcome

Twin block treatment was done for 9 months (Figure 20), and monthly follow up was done. There were no positive response to the treatment obtained. (Figures 21 and 22)

4. Case Report 3

12 years old prepubertal male diagnosed with class II skeletal base, orthognathic maxilla, retrognathic mandible,

Table 2: Comprehensive cephalometric evaluation

Measurements	Normal	Pretreatment	After completion of myofunctional therapy
SNA	82° ± 2°	80 °	81°
SNB	80° ± 2°	74°	74°
ANB	2°	6°	7°
Beta angle	27°-35°	25°	23°
Yen angle	117°-123°	115°	118°
Pie angle	1.3° -5°	1°	2°
W angle	51°-56°	49°	50°
N perpendicular to point A	0 ± 2mm	0 mm	1mm
N perpendicular to point – pog	0 - -4mm	-9 mm	-6mm
Saddle angle	123°±5°	134°	134°
Articular angle	143°±6°	139°	139°
Gonial angle	128°±7°	122°	123°
Effective mandibular length	120±3.4mm	93mm	94mm
Effective maxillary length	92.1±2.7mm	81mm	82mm
Witts appraisal	0-2 mm	4mm	1mm
Upper incisor to NA	22°/4mm	39°/7mm	40°/7mm
Lower incisor to NB	25°/4mm	24°/2mm	25°/2mm
IMPA	90°	95°	95°
Interincisal angle	131°	118°	119°
Y axis	66°	64°	65°
Upper lip to S line	0mm	2mm	0mm
Lower lip to S line	0mm	-1mm	0mm
Nasolabial angle	90°-110°	113°	114°
Intercanine width		U- 30mm L- 27mm	U- 30mm L- 27mm
Intermolar width		U- 43mm L- 39mm	U- 43mm L- 39mm

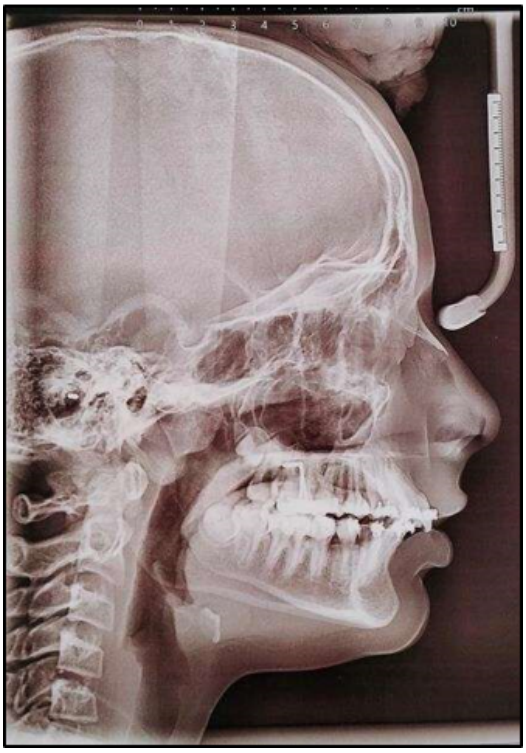

Figure 14: Lateral cephalogram after relapse

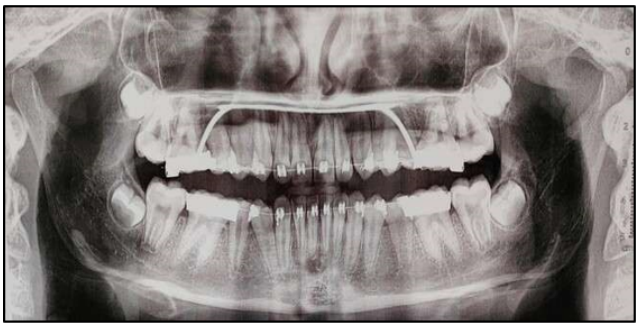

Figure 15: OPG after relapse

straight path of closure with Angle's class II malocclusion: increased inclination of maxillary anteriors and proclined mandibular incisors, increased overjet. Patient's profile was convex, with an obtuse nasolabial angle (due to upturned nose). (Figure 27) The cephalometric measurements are mentioned in Table 3.

4.1. Problem list

4.1.1. Skeletal problem

1. Class II skeletal base
2. Retrognathic mandible

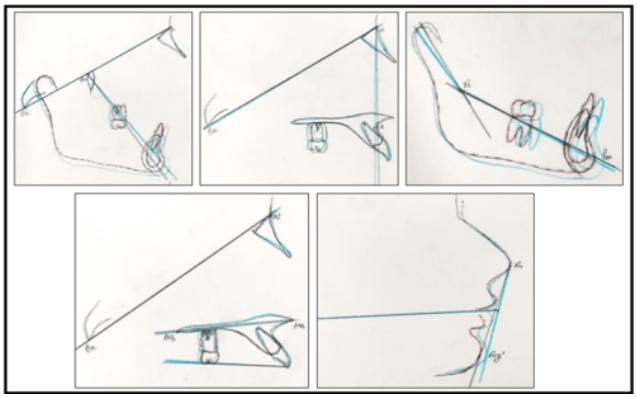

Figure 16: Superimposition Case 1 Pretreatment cephalometric tracing Post functional cephalometric superimposition Superimposition after relapse

Figure 17: Pretreatment extraoral photographs

Figure 18: Pretreatment intraoral photographs

Figure 19: Pretreatment lateral cephalogram

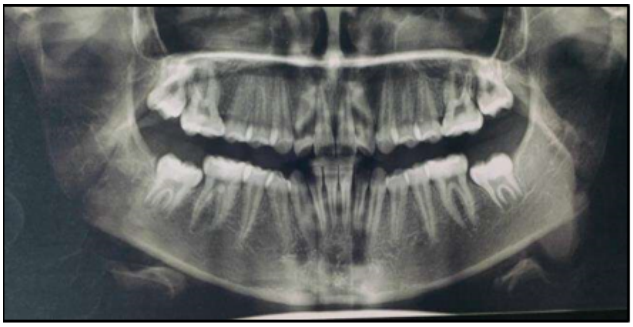

Figure 20: Pretreatment OPG

Figure 21: Pretreatment hand wrist radiograph

Figure 22: Twin block appliance

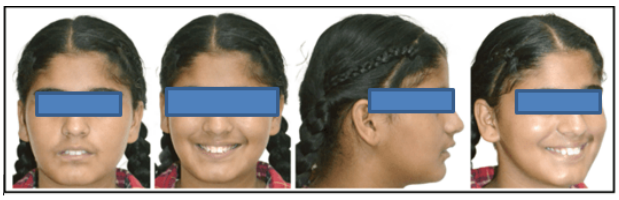

Figure 23: Post orthopedic extraoral photographs

Figure 24: Post orthopedic intraoral photographs

Figure 25: Post orthopedic lateral cephalogram

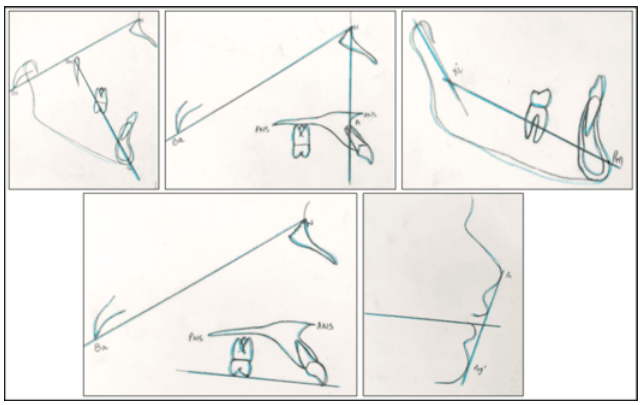

Figure 26: Superimposition Case 2Pretreatment cephalometric tracing Superimposition after relapse

4.1.2. Dental problem (Figure 28)

1. Angle's class II molar relation and end on canine relation on both sides
2. Increased inclination of the maxillary anteriors
3. Retroclined mandibular incisors
4. Increased overjet
5. Forwardly placed upper incisors
6. Spacing in upper and lower arch

4.1.3. Soft tissue problems

1. Convex profile
2. Obtuse nasolabial angle
3. Potentially incompetent lips
4. Retruded lower lip
5. Protrusive upper lip

Figure 27: Pretreatment extraoral photographs

Figure 28: Pretreatment intraoral photographs

4.2. Treatment objectives

1. To achieve a Class I skeletal base
2. To achieve Class I molar and canine relations on both sides
3. To achieve normal overjet
4. To correct the inclination of the upper and lower anteriors
5. To close spacing in upper and lower arch
6. To achieve levelling and alignment
7. To achieve a harmonious soft tissue profile

Table 3: Comprehensive cephalometric evaluation

Measurements	Normal	Pre-treatment	After completion of myofunctional therapy
SNA	82° ± 2°	81°	81°
SNB	80° ± 2°	74°	74°
ANB	2°	7°	7°
Beta angle	27°-35°	22°	23°
Yen angle	117°-123°	113°	118°
Pie angle	1.3°-5°	1°	2°
W angle	51°-56°	45°	50°
N perpendicular to point A	0±2mm	0mm	1mm
N perpendicular to point – pog	0 - -4mm	-9 mm	-6mm
Saddle angle	123°±5°	135°	135°
Articular angle	143°±6°	138°	138°
Gonial angle	128°±7°	123°	124°
Effective mandibular length	120±3.4mm	96mm	97mm
Effective maxillary length	92.1±2.7mm	81mm	83mm
Witt's appraisal	0-2 mm	4mm	1mm
Upper incisor to NA	22°/4mm	42°/7mm	44°/7mm
Lower incisor to NB	25°/4mm	23°/2mm	25°/2mm
IMPA	90°	96°	96°
Interincisal angle	131°	121°	119°
Y axis	66°	61°	62°
Upper lip to S line	0mm	2mm	0mm
Lower lip to S line	0mm	-1mm	0mm
Nasolabial angle	90°-110°	106°	105°
Inter-canine width		U- 29mm L- 23mm	U- 29mm L- 23mm
Inter-molar width		U- 38mm L- 36mm	U- 38mm L- 36mm

Figure 29: Pretreatment lateral cephalogram

4.3. Growth prediction

I. CVMI 2 (acceleration stage): 65 – 85% growth remaining (Figure 29)

4.4. Treatment plan

Considering the growth status of the patient the treatment plan decided for this patient was twin block therapy alongwith fixed mechanotherapy.

4.5. Treatment outcome

Patient was given fixed twin block for 9 months (Figure 30), and simultaneously fixed mechanotherapy was started but there were no positive results obtained after completion of myofunctional therapy due to increased saddle angle. (Figures 31, 32 and 33).

5. Discussion

Management of class II malocclusion has wide spectrum of options. Growth modulation is often the best option for growing patients. Functional appliances can be used to achieve this goal, and they can be very effective in producing the desired outcome.

The twin block functional appliance has several well-documented advantages over other functional appliances.

Figure 30: Twin block appliance alongwith fixed mechanotherapy

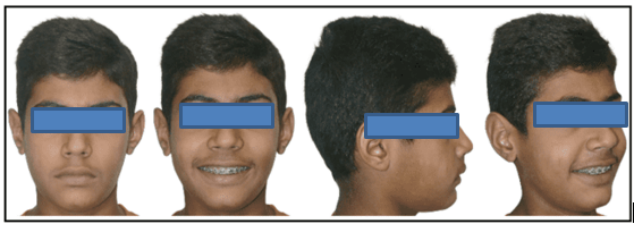

Figure 31: Post orthopedic extraoral photographs

Figure 32: Post orthopedic intraoral photographs

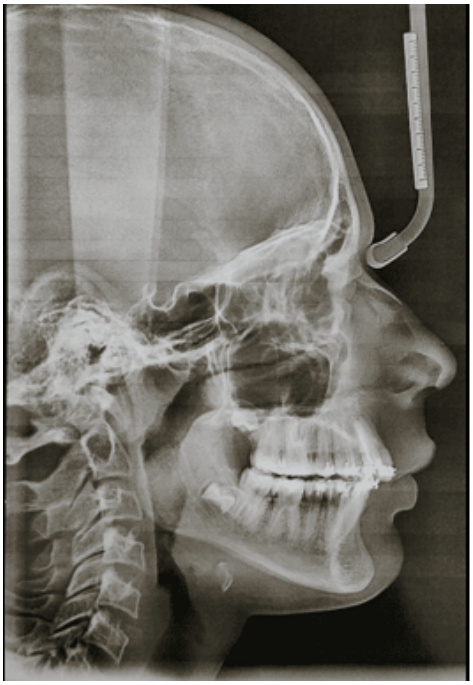

Figure 33: Post orthopedic lateral cephalogram

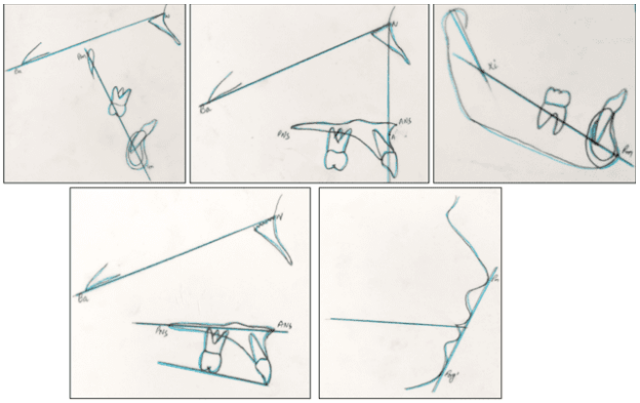

Figure 34: Superimposition Case 3 pretreatment cephalometric tracing superimposition after relapse

It is better tolerated by patients,[5] more durable, easier to repair, and can be used in both permanent and mixed dentition. Additionally, patients can function normally while wearing the twin block, which makes it easier to wear full-time.

Dr. William J. Clark has stated that patients must be actively growing in order to achieve favorable skeletal changes during treatment. Treatment that coincides with the pubertal growth spurt may produce a more rapid skeletal response.[6]

Baccetti et al. found that the best time to start Twin-block therapy for Class II malocclusion is during or slightly after the onset of the pubertal growth spurt.[7]

To achieve a successful outcome, it is important to choose the right treatment approach for each patient. Not every growing patient with a Class II skeletal base is a good candidate for functional appliance therapy. In addition to do the clinical examination, it is essential to perform a cephalometric evaluation to assess the patient's individual needs before deciding whether to use functional appliances.

Saddle angle emerges as a crucial cephalometric parameter that warrants careful consideration prior to embarking on myofunctional treatment.

Characterized by a sharp drop in early infancy, the saddle angle exhibits a subsequent slowdown in its descent, finally reaching a plateau a few years after puberty. This initial rapid decline, averaging around 5 degrees within the first two years, occurs irrespective of Class I or Class II occlusion. Notably, individual variations in the angle's progression become less pronounced as one matures, with a strong tendency towards stability post-puberty.[8]

In a study done by Al Maaitah et al stated that, saddle angle was found to be larger in Class II skeletal relationship as compared to Class I and Class III skeletal relation.[9]

Increased saddle angle is present in the cases with posteriorly positioned glenoid fossa and decreased saddle angle is present in cases with anteriorly positioned glenoid fossa. In orthognathic profiles, this deviation in the position

of glenoid fossa is compensated by the length of ramus and if not, results in either prognathic or retrognathic profile. Cases with large saddle angle are difficult to treat with functional appliance.[4]

In the present study, all the factors are in favour of myofunctional therapy except the saddle angle that was increased.

Following successful completion of the 9-month Phase 1 functional therapy, we achieved all our treatment goals in our first case. Notably, the twin block treatment led to an increase in mandibular unit length, subsequently reflected in a rise in the SNB angle, consistent with C.M. Mills' findings in his study.[10] However, after just 2 months of fixed mechanotherapy, relapse occurred. The remaining two cases exhibited no response to the initial myofunctional phase. In all three cases, an elevated saddle angle emerged as the culprit behind treatment relapse, indicating significant mandibular retropositioning relative to the cranial base prior to treatment initiation.

The effectiveness of myofunctional therapy is contingent upon a multitude of factors, rather than a single determinant. This study has demonstrated the substantial influence of saddle angle on achieving successful outcomes in myofunctional treatment.

6. Conclusion

1. Functional appliances are widely used in growing patients to achieve the best possible outcomes. However, it is important to remember that every patient is unique, and the effectiveness of treatment can vary depending on a number of factors, most notably the saddle angle.
2. The saddle angle is a critical determinant of success in functional appliance therapy. Saddle angles between 123° ± 5° are most conducive to successful treatment outcomes. Cases with large saddle angles are less likely to respond to treatment or may relapse.
3. Meticulous patient selection and personalized treatment planning are essential not only for achieving successful results in myofunctional treatment, but also prevents unnecessary discomfort to the patient and avoiding the wastage of their time on unnecessary treatments.

7. Source of Funding

None.

8. Conflict of interest

None.

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Author biography

Ghazala Farheen, PG Student https://orcid.org/0009-0008-5631-5323

Sankalp Bansal, UG Student

Gurinder Singh, Reader

Sangeeta Sunda, Professor

Suvansh Gupta, Senior Lecturer

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