Review Article

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Dentistry Section

Transformative Non-surgical Strategies for Adult Class III Malocclusion: A Narrative Review

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ABSTRACT

Adult skeletal Class III malocclusion presents a complex orthodontic challenge, often necessitating orthognathic surgery for definitive correction. However, in carefully selected adult patients with mild to moderate skeletal discrepancies, non-surgical treatment strategies offer promising alternatives. This narrative review highlights current advancements in non-surgical management, including Bone-Anchored Maxillary Protraction (BAMP), Micro-Implant Assisted Rapid Palatal Expansion (MARPE), and hybrid tooth-bone-anchored appliances. These modalities enable maxillary advancement and transverse expansion while minimising undesirable dentoalveolar effects. Camouflage treatment, utilising extraction or non-extraction protocols, offers functional and aesthetic correction through controlled dental compensation. Techniques such as the Multiloop Edgewise Archwire (MEAW) and Mandibular Molar Distalisation (MMD), facilitated by Temporary Anchorage Devices (TADs), miniplates, aligners, or the Carriere Motion Three-Dimensional (3D) appliance, expand the spectrum of treatment options. While these strategies do not modify underlying skeletal bases, they offer improved occlusal function and facial aesthetics, particularly in well-selected cases. Emerging technologies such as digitally guided planning, 3D-printed expansion devices like the Dutch Maxillary Expansion Device (D-MED), and skeletal anchorage innovations continue to evolve the landscape of non-surgical Class III correction. Optimal outcomes hinge on accurate diagnosis, individualised planning, and patient compliance. Non-surgical management represents a dynamic, patient-centred alternative to surgery in selected adult Class III cases.

Keywords: Camouflage, Maxillary protraction, Non-surgical orthodontic treatment, Skeletal anchorage, Temporary Anchorage Devices

INTRODUCTION

In 1899, Angle EH, the founder of modern orthodontics, introduced a classification system for malocclusion that remains foundational to contemporary diagnosis and treatment planning [1]. Angle's classification divided malocclusion into three categories- Class I, Class II, and Class III- based on the alignment of teeth relative to the line of occlusion and the anteroposterior relationship between the permanent first maxillary and mandibular molars.

Among these, skeletal Class III malocclusion is considered one of the most complex and challenging conditions to manage in orthodontic practice. Charles Henry Tweed later refined the classification by distinguishing between two forms of Class III malocclusion: Category A (pseudo-Class III): characterised by a normal mandibular position and a retrusive maxilla, and Category B (true skeletal Class III): marked by mandibular prognathism or a combination of mandibular protrusion and maxillary deficiency [2].

The management of skeletal Class III malocclusion is influenced by multiple factors including the patient's age, growth potential, severity of the skeletal discrepancy, and overall facial aesthetics. Treatment options range from orthopaedic intervention in growing patients, to orthodontic camouflage or orthognathic surgery in non-growing adolescents and adults. In cases of severe skeletal discrepancy, orthognathic surgery is often the preferred treatment modality [3]. However, in borderline cases- typically those with mild to moderate skeletal imbalance- orthodontic camouflage can offer an effective non-surgical alternative, provided careful diagnosis and strategic planning are undertaken.

The Aetiology of Class III Malocclusion

The aetiology of Class III malocclusion is complex and wide-ranging and so is its spectrum of craniofacial patterns. It can be broadly grouped into genetic, environmental and gene-environment interactions [Table/Fig-1] [4].

Genetic factors	Environmental factors
Both monogenic (commonly autosomal dominant with incomplete penetrance) and polygenic modes of inheritance.	**Dental** Ectopic eruption of the maxillary central incisors Early loss of the deciduous molars **Functional** Macroglossia and abnormal tongue position Nasal obstruction Mouth breathing Neuromuscular condition

[Table/Fig-1]: Aetiology of Class III malocclusion.

Managing Class III malocclusion involves orthodontic strategies aimed at achieving functional and aesthetic improvements. These non-surgical approaches are typically suitable for patients with mild to moderate skeletal discrepancies and focus on dental compensation to mask the underlying skeletal imbalance [Table/Fig-2].

S. No.	Age of the patient	Management of Class III malocclusion	Subcategories	Example
1	Growing patients	Interception of the problem through dentofacial orthopaedics	Appliances to restrain the growth of the mandible	Chin cup
			Appliances primarily directed for orthopaedic effect on the maxilla	Protraction facemask
2	Adults	Orthognathic surgery	Le Fort I Osteotomy Bilateral Sagittal Split Osteotomy - BSSO Genioplasty	
		Camouflage treatment	Extraction Non-extraction	

[Table/Fig-2]: Management of Class III malocclusion.

Management of Class III Malocclusion

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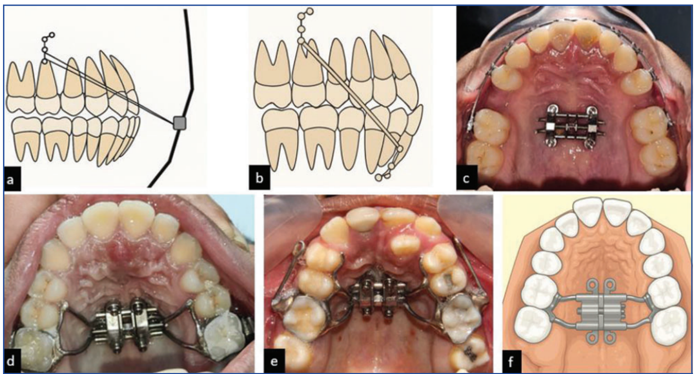
Non-surgical Management of Class III Malocclusion in Adults

Non-surgical management of Class III malocclusion in adults can be challenging, but is feasible with various orthodontic approaches. Here are some common non-surgical treatment options [Table/Fig-3].

I) Maxillary protraction appliances	II) Camouflage treatment	II) Distalisation techniques
Bone-anchored maxillary protraction	Non-extraction approach	Mandibular Molar Distalisation (MMD) via a fixed appliance
Micro-implant-Assisted Rapid Maxillary Protraction (MARPE)	Extraction approach	MMD with skeletal anchorage
Maxillary skeletal expander		MMD with clear aligners
Dutch Maxillary Expansion Device (D-MED)		Carriere Class III motion appliance

[Table/Fig-3]: Non-surgical management of Class III malocclusion.

I) Maxillary protraction appliances: The protraction facemask, an extraoral orthopaedic appliance designed to correct maxillary deficiencies, was first introduced by Potpeschnigg in 1875 [5]. It gained renewed attention in 1944 when Oppenheim [6] proposed that forward displacement of the maxilla could serve as a compensatory strategy for cases involving excessive mandibular growth. Since then, the facemask has become a well-established modality in the treatment of Class III malocclusions, particularly in growing patients (7-13 years), by promoting anterior maxillary advancement and improving the maxillomandibular relationship [Table/Fig-4a-f].



[Table/Fig-4]: Maxillary protraction appliances: (a) Type 1 BAMP Therapy; (b) Type 2 BAMP Therapy; (c) Bone-anchored appliances; (d) Tooth-bone-anchored (hybrid) appliances; (e) MSE expansion appliance (Pictures-c, d - Courtesy of Dr. Raed Saeed); (f) Occlusal view of the digital D-MED.

a) Bone-Anchored Maxillary Protraction (BAMP): The two major types of BAMP therapy are:

Type 1: It involves the installation of two miniplates at the infrazygomatic crest and the use of a facemask for protraction [Table/Fig-4a].

Type 2: It involves the installation of two miniplates, each at the infrazygomatic crest and the mandibular symphysis and the use of Class III intermaxillary elastics for protraction [Table/Fig-4b] [7].

b) Micro-Implant Supported Maxillary Protraction (MARPE): While BAMP offers significant benefits, its primary drawbacks include the necessity for surgical placement and removal of miniplates, along with risks of infection and potential root damage during insertion. An alternative method is the MARPE, which anchors the expansion screw to the basal bone using palatal implants.

MARPE designs vary and can be classified as:

i Bone-anchored or

ii Tooth-bone-anchored (hybrid) appliances.

Allam AH evaluated the effectiveness of a modified 7-week Alt-RAMEC protocol combined with MARPE in young adults with transverse maxillary deficiency [8]. Twenty-nine patients (mean age: 21.3 years) were randomly assigned to either conventional MARPE or Alt-RAMEC + MARPE groups. Both protocols effectively expanded the maxilla and displaced mid-palatal, frontonasal, and intermaxillary sutures. Only the Alt-RAMEC group showed significant expansion of the zygomaticomaxillary sutures. Alt-RAMEC resulted in more bodily molar movement, while conventional MARPE caused buccal tipping. Gingival health was slightly more affected in the Alt-RAMEC group due to longer treatment. Overall, the modified Alt-RAMEC protocol proved effective for skeletal expansion with minimal dental side effects in young adults.

Jia H et al., evaluated the effectiveness of MARPE versus the Hyrax expander in 60 post-pubertal patients with skeletal maxillary deficiency [9]. MARPE showed a higher success rate of suture separation and achieved greater skeletal expansion and skeletal-to-dental contribution. MARPE also resulted in less buccal tipping and alveolar bone loss compared to Hyrax. Overall, MARPE proved to be a more effective and reliable option for maxillary expansion in post-pubertal patients.

i) Bone-anchored appliances: Winsauer H et al., introduced the MICRO ("mini-implant collar-retained orthodontic") expander- a fully bone-borne device anchored by four or six miniscrews (2-2.5 mm in diameter and 10-14 mm in length) inserted into the paramedian region of the anterior palate [10]. The MICRO-4 Hyrax, equipped with four screws, was designed for use in adolescents, while the MICRO-6 Hyrax, with six screws, was recommended for adult patients. For retention following expansion, it was advised to maintain the MICRO-4 device in situ for six months and the MICRO-6 for 12 months [Table/Fig-4c].

Yoon S et al., conducted a three-dimensional finite element analysis to evaluate the influence of miniscrew number, placement, and length on bone-borne Rapid Palatal Expansion (RPE) [11]. Their findings indicated that using four miniscrews arranged in an anteroposterior configuration enhanced stress distribution and facilitated transverse expansion. The study also revealed that miniscrew length and the anteroposterior positioning of the expander had minimal impact on the amount of maxillary expansion achieved. However, anterior placement of the expander was associated with greater extrusive displacement of the premaxilla compared to posterior positioning.

ii) Tooth-bone-anchored (hybrid) appliances: Lee KJ et al., introduced a modified Hyrax-type RPE featuring four extension arms with helical hooks positioned beneath the jackscrew for miniscrew engagement [12]. The lateral arms were soldered to bands on the first premolars and first molars, while two anterior hooks were placed in the rugae area and two posterior hooks in the parasagittal region. The authors recommended inserting orthodontic miniscrews (1.8 mm collar diameter, 7 mm in length) centrally within these hooks and instructing patients to activate the jackscrew once daily. This design was intended to achieve effective dentoalveolar expansion with reduced dental tipping and minimised pressure on the buccal cortical plates by promoting more even force distribution along the midpalatal and associated sutures [Table/Fig-4d].

c) Maxillary Skeletal Expander (MSE): Moon W developed the MSE, a MARPE device engineered to facilitate maxillary expansion in skeletally mature patients [Table/Fig-4e] [13]. The device comprises a central expansion screw featuring four parallel guide holes (each 1.8 mm in diameter and 2 mm in thickness) designed to ensure precise micro-implant placement and minimise implant tipping during activation. Four lateral arms extend from the expander body and are soldered to molar bands for additional anchorage and stabilisation.

The MSE is positioned at the level of the first molars to deliver expansion forces more posteriorly, specifically targeting the pterygomaxillary buttress. This placement aims to achieve a more parallel opening of the midpalatal suture compared to conventional anteriorly positioned expanders. After cementation of the device, micro-implants (diameter: 1.8 mm; length: 9 mm, 11 mm, or 13 mm) are inserted through the guide holes using a manual driver. Implant length is selected based on palatal thickness measured via CBCT imaging, ensuring at least 5-6 mm of bicortical bone engagement for optimal primary stability [13].

The activation protocol proposed by Liao YC et al., varies by patient age [Table/Fig-5] [14]. In adult patients, activation is typically performed once daily, with a reduced frequency recommended after visible interincisal diastema formation to prevent excessive force application.

Age range	Suggested activation protocol
Beginning of adolescence	3~4 turns/week
End of adolescence	1 turn/day
Young adults	2 turns/day
Older than 25 years old	2 turns or more/day

[Table/Fig-5]: Activation protocol suggested by Liao YC et al., [14].

Lin Y compared the effects of tooth-borne and bone-borne rapid maxillary expanders in late adolescent patients using Cone-Beam Computed Tomography (CBCT) [15]. Both appliance types were effective in achieving transverse maxillary expansion; however, the MSE demonstrated significantly greater skeletal changes and produced a more parallel midpalatal suture opening compared to the conventional RME. The MSE group exhibited reduced alveolar inclination and less dental tipping, suggesting improved orthopaedic effects attributable to skeletal anchorage. Due to the remodeling nature of alveolar bone surrounding the teeth, it remains challenging to differentiate between alveolar bending and true dental tipping. Nonetheless, the minimised tipping observed with MSE is likely a result of its bicortical engagement through skeletal anchorage. The 11 mm miniscrews employed in the MSE design effectively engage both the oral and nasal cortical plates, providing superior stability during expansion [15].

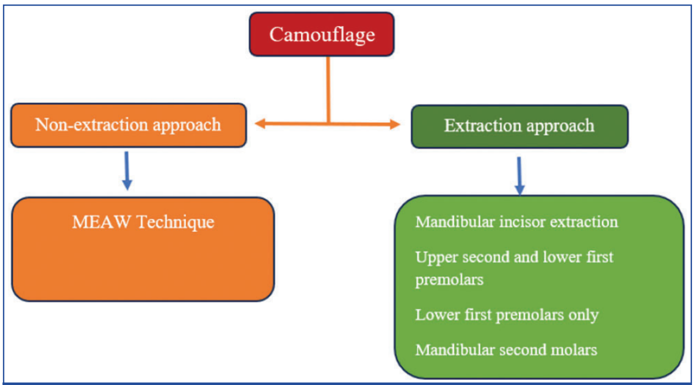
A recent innovation in MARPE design, the Unite by Locking (UxL) system, aims to simplify appliance fabrication while maintaining the anatomical advantages of skeletal anchorage. This reconceptualised expander utilises a square-shaped expansion screw with a turnbuckle mechanism and four integrated mini-holes, allowing for direct insertion of miniscrews. The design eliminates the need for soldering or welding, streamlining laboratory procedures. Each mini-hole is compatible with guiding tubes, predrilling burs, and miniscrews, facilitating secure attachment of the expander to the palatal bone [16].

d) Dutch Maxillary Expansion Device (D-MED): The D-MED is a custom, 3D-designed MARPE appliance based on intraoral scans (TRIOS 3, 3Shape) and created using OnyxCeph3™ software. It is 3D-printed with a selective laser melting printer (Concept Laser) using stainless steel (60.5% cobalt, 28% chrome, 9% tungsten, 1.5% silicon). The device has two bands around the upper first molars and four rigid connectors with screw holes (internal diameter: 2.2 mm, external diameter: 3.6 mm) positioned 3 mm above the palate to prevent mucosal overgrowth. Four self-tapping miniscrews (Quattro®, PSM Medical Solutions) secure the appliance to the palate [Table/Fig-4f] [17].

The miniscrews are placed perpendicular to the occlusal plane, 2 mm off the midpalatal suture, at the level of the upper second premolars (anterior) and upper second molars (posterior), avoiding the nasal septum and soft palate junction. After 3D printing, an expansion screw (Forestadent) is soldered onto the structure at the level of the upper first molars, with an expansion capacity of 10 or 12 mm, depending on the required expansion. Expansion begins right after insertion, with daily 0.25 mm activation and weekly check-ups. Progress is measured at the screw, central diastema, and between the molars and canines. Expansion ends when the upper molars' palatal cusps touch the lower molars' buccal cusps. The screw is locked with composite, and the D-MED is placed for three months for bone remodelling [17].

II) Camouflage treatment: In some class III cases with mild to moderate skeletal deformity, non-surgical orthodontic treatment can correct the dental malocclusion without negatively affecting facial soft tissue. This approach, known as camouflage treatment, involves moving teeth into positions that create an acceptable occlusion while preserving facial aesthetics and long-term stability, without addressing the underlying skeletal discrepancy. It is typically used in patients who have completed their pubertal growth spurt, with most growth already complete, and who often exhibit a horizontal rather than vertical facial pattern. Camouflage treatment can also be applied in cases with a mild open bite [18].

Essentially, two approaches are used once a case is selected for treatment with camouflage [Table/Fig-6]:



[Table/Fig-6]: Camouflage treatment.

1. Non-extraction approach- The Multiloop Edgewise Archwire (MEAW) technique;
2. Extraction approach.

1. Non-extraction approach: This approach is used when both dental arches can accommodate all teeth without major movement. Minor maxillary crowding can be managed with arch expansion and incisor proclination, while a crowding-free mandibular arch allows for lower incisor retroclination. If these adjustments correct the negative overjet, a non-extraction strategy is preferred.

The MEAW Technique: The MEAW technique, introduced by Kim YH in 1987 [18], has been effectively utilised for the management of complex malocclusions, particularly severe anterior open bites. The MEAW archwire resembles a conventional edgewise wire but incorporates strategically placed boot-shaped loops. These vertical loops serve as mechanical breaks between teeth, increasing the wire's flexibility and allowing for precise three-dimensional control of individual tooth movements, including vertical, sagittal, and transverse corrections. Yang WS et al., emphasised that this design not only enhances the flexibility of the archwire but also contributes to fine horizontal adjustments in tooth positioning [19].

The MEAW technique is typically implemented after levelling and alignment are completed and necessitates the consistent use of vertical elastics, particularly in the anterior segment. Originally designed for 0.018-inch bracket slots and used with 0.016 × 0.022-inch stainless steel archwires, the system facilitates controlled intrusive and extrusive forces due to its lower load-deflection rate. In skeletal Class III cases, MEAW is frequently paired with Class III elastics as a non-surgical camouflage approach. It enables uprighting of retroclined lower incisors, reshaping of the occlusal plane, posterior torque control, arch coordination, and reduction of sagittal discrepancies [19].

He S et al., investigated the efficacy of combining maxillary mini-implants with the MEAW technique for the camouflage treatment of skeletal Class III malocclusion [20]. In their study, 20 patients were treated using MEAW in conjunction with modified Class III elastics anchored to mini-implants, while 24 control patients received conventional long Class III elastics without skeletal anchorage. Cephalometric analysis revealed that both groups achieved satisfactory occlusal outcomes. However, the mini-implant-supported MEAW group demonstrated enhanced control of Mandibular Molar Distalisation (MMD) without extrusion, minimised lower incisor proclination, prevention of clockwise mandibular rotation, and reduced upper incisor flaring. This method proved particularly advantageous in managing high-angle and open-bite Class III cases.

2. Extraction approach: Deciding to extract teeth in Class III malocclusion cases is critical due to their irreversible nature and should be based on specific treatment goals. The extraction pattern varies depending on individual case requirements, primarily focussing on the planned position of the incisors and the need to resolve crowding.

In Class III malocclusion, where chin prominence is already a concern, retracting lower anterior teeth post-extraction can further accentuate chin prominence by altering the lower lip position. Therefore, extractions are typically planned to alleviate crowding and correct negative overjet and overbite.

The acceptable limits for incisor movement in camouflage treatment of Class III malocclusion are up to 120° to the SN plane for upper incisors and 80° to the mandibular plane for lower incisors [21].

Depending on the specific case requirements, extraction choices may include:

1. Mandibular incisor extraction;
2. Upper second and lower first premolars;
3. Lower first premolars only;
4. Mandibular second molars.

III) Mandibular Molar Distalisation (MMD): The MMD is a non-extraction orthodontic technique used to create space in the mandibular arch by shifting the molars distally [Table/Fig-7,8] [22].

Fixed appliances	Skeletal anchorage	Aligners	Carriere Class III Motion Appliance.
Intermaxillary elastics	Temporary Anchorage Devices (TADs)	Fixed TADs + aligners	The Carriere Motion 3D Class III Appliance corrects Class III malocclusion in two stages.
Open coil springs	Miniplates	Controlled movements	
	Ramal plates	Useful for mild to moderate distalisation needs	

[Table/Fig-7]: Techniques for mandibular molar distalisation

a) MMD with Fixed Appliance: The MMD in clinical practice can be achieved through various fixed appliance methods. The most common approach is using intermaxillary elastics, while another involves placing open coil springs between selected brackets to apply distal force on the molars [23].

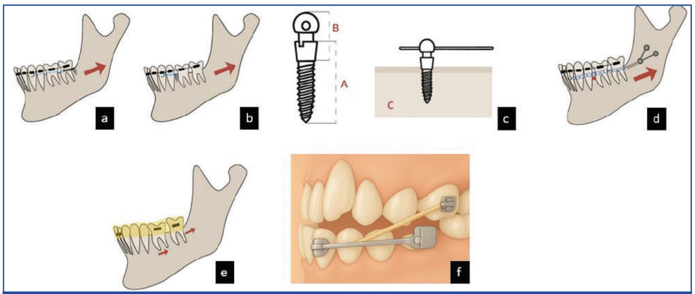
Hu H et al., presented a case of MMD using fixed appliances, intermaxillary elastics, and open coil springs, resulting in a stable occlusion and improved facial profile [24].

Besides elastics and springs, distalising components can be integrated into the archwire. Oliveira DD et al., utilised a Sliding Jig (SJ) combined with intermaxillary elastics, enabling controlled and efficient forces on individual teeth for precise molar movement. Although patient cooperation posed some challenges, the treatment resulted in functional occlusion and enhanced dental aesthetics [25].

b) MMD with Skeletal Anchorage: Skeletal anchorage is essential in orthodontics for treating malocclusions. It uses stable implants or mini-plates to provide a fixed point for force application, reducing the need for patient compliance. This approach allows precise tooth movement and improves treatment predictability.

i. **TADs:** TADs provide reliable anchorage in orthodontics, especially for significant tooth movement. They enhance mechanics, require minimal patient cooperation, and reduce unwanted effects like mesial movement of anterior teeth, premolar tipping, molar extrusion, and anterior protrusion. TADs also offer shorter treatment time, easy insertion and removal, and a low risk of complications [26].

In most cases, two TADs are placed in the mandibular arch after leveling the occlusal plane. One TAD is positioned between the right second premolar and first molar, and the other between the left second premolar and first molar [Table/Fig-8a,b]. If needed, alternative sites, like between the left first and second molars, are chosen to avoid root damage during insertion [27].



[Table/Fig-8]: (a-b) TADs application sites for MMD; (c) C-orthodontic micro implant (C-implant): (A) screw part, (B) head part, (C) Diagram of placed C-implant; (d) Mini-plates with TADs; '(e) Aligners for MMD; (f) Carriere Class III motion appliance.

Numerous skeletal anchorage systems are available, with the design of the upper part of the miniscrews being crucial for various orthodontic treatments. Conventional miniscrews are less suitable for intermaxillary elastics compared to orthodontic tubes. To overcome these limitations, the C-orthodontic microimplant (C-implant, Dentium Inc, Seoul, Korea) was developed as a versatile anchorage system that can function independently or support traditional mechanics [Table/Fig-8c]. The C-implant's two-component design (screw and head) reduces the risk of neck fracture during placement and removal, while its extended span minimises gingival irritation during retraction. The screw has a 1.8-mm diameter and comes in 8.5 - 9.5-, or 10.5-mm lengths, with a sandblasted and acid-etched surface except for the upper 2 mm. The head, with a 2.5-mm diameter, is available in three heights (5.35, 6.35, 7.35 mm) and offers different hole-to-screw distances (1, 2, or 3 mm) with a 0.8 mm hole diameter [28].

ii. **Mini-Plates:** Mini-plates provide stable skeletal anchorage, secured by multiple mini-screws [Table/Fig-8d] making them suitable for applying heavy forces. They are effective for mandibular arch in Class III patients. Two elastomeric chains, stretched from the canine and first premolar to the mini-plates on both sides, applied about 250 g of force each, achieving 4 mm of mandibular distalisation. The force vector above the mandibular arch's centre of resistance created a counterclockwise moment, helping correct the anterior open bite [29].

iii. **Ramal plates:** Ramal plates are placed in the retromolar fossa, between the mandibular ramus and temporal crest. A flap is created in the retromolar area and an L-shaped plate is fixed with two 5 mm × 2 mm screws, and the flap was sutured, positioning the anterior hole 3 mm lateral to the second molar for a force vector parallel to the functional occlusal plane.

In levelled arches with steel posted wires, an elastic chain connected the plate's last ring to the arch hook. During distalisation, it is crucial to manage anterior tooth movement. Since the force vector is above the anterior teeth's center of resistance, there's a risk of counterclockwise rotation and uncontrolled tipping. Applying third-order bends (torque) to the anterior arch can help control root apex positions [29].

c) MMD with Clear Aligners: Over the past two decades, clear aligners have gained substantial popularity as an orthodontic treatment modality due to their superior aesthetics, minimally invasive design, and facilitation of improved oral hygiene when compared to conventional fixed appliances. Within the context of Class III correction, particularly for mandibular molar distalisation, the sequential distalisation protocol has emerged as a strategic approach [30]. This technique initiates distalisation with the second molars; once these achieve approximately 50% of their planned movement, distalisation proceeds to the first molars, followed sequentially by the premolars and canines. The final phase involves en masse retraction of the anterior teeth. Throughout this process, inter-arch elastic- typically Class III elastics- are used to reinforce anchorage via the opposing arch [30].

Although conceptually advantageous in offering controlled and phased tooth movement, the clinical predictability and efficacy of this protocol in achieving bodily molar distalisation remain subjects of ongoing investigation. Inchingolo AM et al., reported a case involving a Class III patient with Temporomandibular Joint (TMJ) disorder who declined orthognathic surgery [31]. A sequential distalisation protocol was employed using clear aligners, allowing for staged distal movement of posterior teeth while preserving the anchorage of adjacent segments. This method enabled efficient space management and improved control over tooth movement [Table/Fig-8e].

Rota E et al., evaluated the effectiveness of Invisalign in achieving MMD using the sequential protocol [32]. Their findings indicated that while aligners could achieve measurable MMD, the predominant tooth movement was tipping rather than bodily translation, highlighting the biomechanical limitations of aligner-based distalisation in certain clinical contexts.

In a 2019 retrospective case series, Malekian K et al., treated two non-growing adult patients (aged 31 and 23 years) presenting with Class III molar and canine relationships [33]. Clear aligners were used in combination with Class III elastics worn for 22 hours daily. The mandibular molars were successfully distalised by 3.0 mm and 2.5 mm, respectively, underscoring the potential of aligner therapy to contribute to non-surgical Class III correction in adults.

d) Carriere Class III Motion Appliance: The Carriere Motion 3D Class III Appliance is a contemporary tool designed to facilitate efficient and minimally invasive correction of Class III malocclusions [34]. The appliance comprises an anterior pad bonded to the mandibular canine, incorporating a hook for interarch elastics, and a rigid arm extending posteriorly to engage the first molar. A bayonet bend near the molar end induces approximately 10° of controlled distal rotation, allowing the appliance to conform closely to the dental anatomy and avoid occlusal interference with maxillary teeth or brackets [Table/Fig-8f]. When connected to maxillary anchorage via Class III elastics, the appliance delivers consistent distalising forces to the lower posterior segment, promoting a transition to a Class I molar and canine relationship with optimal intercuspation.

The appliance leverages the relatively low-density, vascularised trabecular bone of the mandibular posterior region, flanked by dense cortical bone, to facilitate effective dentoalveolar movement. Treatment is performed in two sequential phases:

Stage One involves the en bloc distalisation of the mandibular posterior segment (canine to molar) to establish a Class I platform. This movement repositions the mandible by inducing counter clockwise rotation of the occlusal plane, creating space for alignment of the lower incisors. Additional effects include molar intrusion, canine extrusion, and occlusal plane levelling, all contributing to improved function and facial aesthetics.

Stage Two proceeds with full-arch bonding using Carriere SLX™ 0.022" self-ligating brackets and copper nickel-titanium (CuNiTi) archwires. Light, biologically compatible forces delivered through small round wires reduce binding and enhance tooth movement while minimising root resorption. This low-force environment fosters favourable bone remodelling, improved vascular flow, and optimal cellular activity [34].

Beyond distalisation, the appliance causes skeletal and dental changes, altering the occlusal plane and maxillomandibular relationships. It repositions the condyle within the TMJ and contributes to a counterclockwise rotation of the occlusal plane. Combined with posterior tooth movement and incisor retraction, these changes collectively improve facial profile and maxillomandibular harmony [34].

Comparison of Different Modalities of Treatment for Non Surgical Management of Class III in Adults

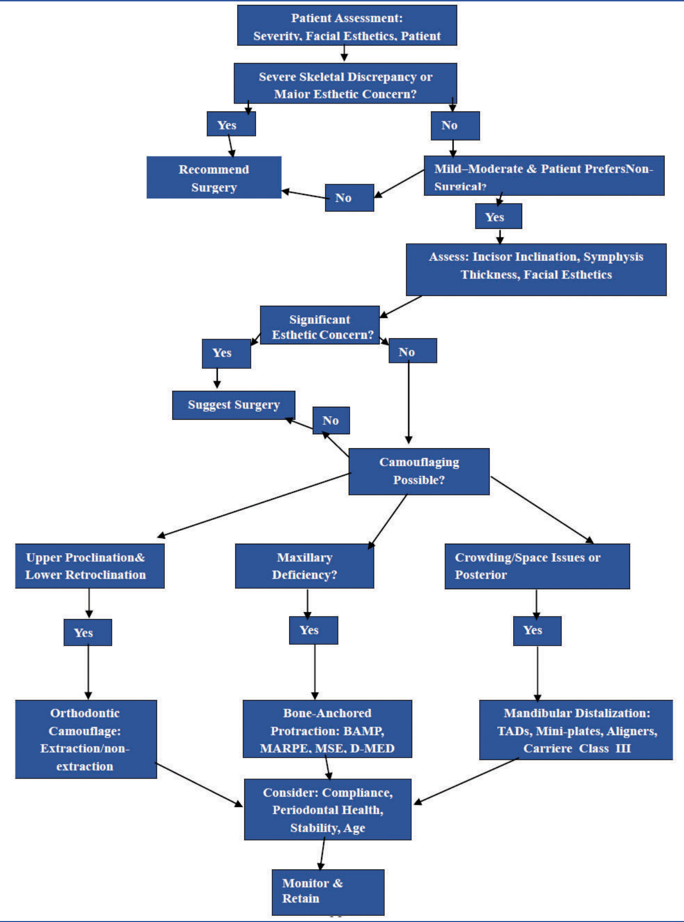
[Table/Fig-9] provides a comparative summary of the principal non-surgical treatment modalities available for the management of Class III malocclusion in adults. The table highlights the underlying mechanisms, key devices, clinical indications, anchorage types, advantages, and limitations associated with each approach.

Decision Tree to Guide Clinicians in Selecting Appropriate Treatment Approaches

The decision tree mentioned below [Table/Fig-10] provides a structured approach to guide clinicians in determining the

Modality	Mechanism/ key devices	Indications	Anchorage type	Key advantages	Key limitations/considerations
Maxillary protraction appliances	Facemask, BAMP MARPE, D-MED	Mild/moderate maxillary deficiency	Tooth, bone, or hybrid	Anterior advancement of maxilla; effective in mild deformity	Invasive for bone-anchored; best in younger adults
MARPE (Micro-Implant Assisted Rapid Palatal Expansion)	MARPE, MSE, D-MED	Transverse maxillary deficiency	Bone or tooth-bone	Minimal dental tipping; skeletal effect adults	Requires surgical placement of miniscrews
Camouflage treatment	MEAW, extractions, conventional fixed appliance	Mild-moderate skeletal discrepancy; adulthood	Tooth	Non-invasive, improves dental relationships	Does not address underlying skeletal cause
Mandibular molar distalisation via fixed appliance	Intermaxillary elastics, open coil springs, Sliding Jigs (SJ)	Mild-moderate Class III; space creation	Tooth	Widely available; non-invasive	Relies on patient compliance with elastics
Mandibular molar distalisation with aligners	Clear aligners + sequential distalisation, Class III elastics	Mild-moderate Class III in compliant adults	Tooth or skeletal	Aesthetics, hygiene, controlled tooth movement	Limited bodily movement; possible tipping
Carriere Class III motion appliance	Carriere Class III motion appliance + elastics	Mild-moderate dentoalveolar Class III	Tooth/Hybrid	Simple, efficient, can improve occlusal plane	Requires highly specific patient selection

[Table/Fig-9]: Comparison of different modalities of treatment.



[Table/Fig-10]: Decision tree to guide clinicians in selecting appropriate treatment approaches.

most appropriate management strategy for adult patients with Class III malocclusion. It integrates clinical parameters such as skeletal severity, facial aesthetics, incisor inclination, symphyseal morphology, and patient preferences to differentiate between surgical and non-surgical pathways. The flowchart emphasises individualised decision-making, balancing functional correction, aesthetic improvement, and long-term stability.

CONCLUSION(S)

The non-surgical management of Class III malocclusion in adults represents a clinically valuable alternative to orthognathic surgery, particularly in cases exhibiting mild to moderate skeletal discrepancies. Techniques such as camouflage therapy, maxillary protraction, mandibular molar distalisation, and the use of skeletal anchorage systems provide effective means to achieve both functional correction and aesthetic enhancement without the need for invasive procedures.

Advancements in orthodontic appliances, including MARPE, TADs, mini-plates, clear aligners, and the Carriere Motion 3D Class III Appliance, have further expanded treatment options. While these interventions do not modify the underlying skeletal architecture, they enable controlled dentoalveolar compensation that can mask discrepancies, optimise occlusal relationships, and improve facial aesthetics.

The selection of an appropriate treatment approach must be guided by comprehensive diagnostic evaluation, including skeletal and dental relationships, patient age, growth potential, compliance, and individual treatment objectives. With meticulous case selection and individualised biomechanical planning, non-surgical strategies can yield stable and satisfactory long-term outcomes. Ongoing research, combined with emerging technologies such as digital planning and biomechanically optimised appliances, is expected to further refine these techniques- enhancing both their efficiency and efficacy in managing adult Class III malocclusion.

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