

EXPANDING THE THERAPEUTIC HORIZON: A REVIEW OF MODIFICATIONS AND INNOVATIONS OF THE QUAD HELIX APPLIANCE

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BACKGROUND : Crossbite represents one of the most prevalent dentofacial irregularities encountered in clinical orthodontic practice, constituting a significant component of developing malocclusion. Its occurrence during the primary and mixed dentition phases is well documented, and early identification remains paramount, as failure to intervene in a timely manner may precipitate the progression of a diagnostically straightforward condition into a clinically complex skeletal and dental discrepancy. A spectrum of therapeutic modalities has been described for the management of both anterior and posterior crossbites during the mixed dentition period. Among these, the Quad Helix appliance has undergone numerous innovations and modifications to address varied clinical situations. The present review aims to comprehensively synthesize the existing literature on these modifications and their contemporary clinical applications. **AIM :** The present review aims to comprehensively evaluate the various innovations and modifications of the Quad Helix appliance across diverse clinical situations, appraising its efficacy and adaptability as documented in the existing literature. **MATERIAL & METHOD :** A comprehensive literature search was conducted across electronic databases including PubMed, Google Scholar, and Scopus using relevant keywords. Case reports, case series, and clinical studies reporting modifications and innovations of the Quad Helix appliance were identified, screened, and included based on predetermined eligibility criteria. **CONCLUSION :** The various modifications of the Quad Helix appliance have substantially expanded its therapeutic window, enabling effective management of diverse clinical situations. Its versatility establishes it as a multifunctional orthodontic tool of continued relevance in contemporary practice.

Key Words : Quad helix, maxillary expansion, transverse deficiency.

1. INTRODUCTION

The quad helix is a fixed expansion spring normally used in conjunction with other appliance systems. It has evolved from the W spring used in a removable appliance originally described by Coffin (Coffin, 1881). Ricketts increased the flexibility of the spring by adding posterior and subsequently anterior helices to produce the quad helix appliance (Ricketts, 1975). The quad helix appliance is used to produce maxillary expansion by both orthodontic and orthopaedic movement. The expansion is carried out over several months and is slow rather than rapid in type.¹ Quad helix being a multifaceted appliance has varied neoteric design. As a result of placing .045" wire sections in the headgear tubes of the maxillary molar bands, the appliance may be used in combination with a protraction face mask in the direction of advance the maxilla. The anterior bar of the quad helix appliance may be modified to control the eruption of anterior teeth. This appliance may also be used to maintain space and to augment anchor-age when required.² The posterior unilateral crossbite was treated successfully with the modified quad helix.³ The anterior bar of the quad helix appliance may be modified to intercept thumb sucking habit and simultaneous correction of posterior crossbite.⁴ To achieve slow maxillary expansion and also to gain space for labially placed tooth simultaneously an novel approach of gaining space in the maxillary anterior region by modification of anterior arm of quad helix. Appliance design could be of help for pediatric dentists in treating such similar malocclusions.⁵ The technique of slow maxillary expansion using a novel modified quadhelix appliance in an adult patient with unilateral cleft lip and palate and collapsed maxillary arch.⁶ Modification of quad helix appliance which incorporates acrylic anterior bite plane for

simultaneous bite opening with maxillary expansion.⁷ Another novel appliance modification in patients with bilateral cleft lip and palate and collapsed maxillary arch. The quad-helix which is in use for a long period has been modified with the self-cure acrylic but-tens bilaterally in the palatal dehiscence area to prevent nasal regurgitation that indirectly improved the overall health of the child patient.⁸ Quad helix modification to expand the upper arch without the use of RPE (rapid palatal expansion)⁹.

2. HISTORICAL EVALUATION

2.1. Conventional Quad Helix Appliance (Birnie and McNamara, 1980)

The Quad Helix appliance evolved from the Coffin transpalatal spring, subsequently modified by Ricketts in 1975 through the addition of four helical loops to upper molar bands. Fabricated from 1.00 mm hard stainless steel wire or 0.95 mm blue Elgiloy, each helix contributes an additional 25 mm of wire, delivering a continuous low-level force of approximately 360 g. The appliance produces slow maxillary expansion through combined orthodontic and orthopaedic mechanisms. It is indicated for correction of unilateral and bilateral posterior crossbite, molar derotation, and mild arch expansion. Documented modifications include addition of extra helices for incisor proclination, omission of anterior helices for space maintenance, addition of light wire springs for minor tooth movements, and incorporation of tongue spurs and grids for habit elimination.

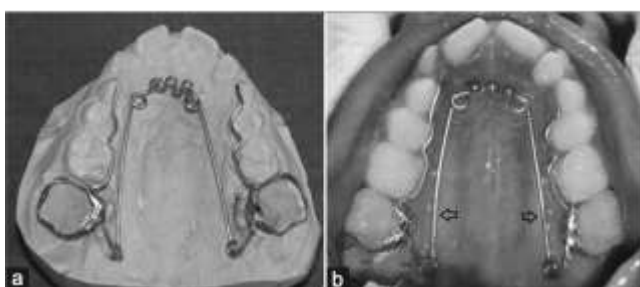
2.2 Quad Helix in Bioprogressive Therapy (Bench, 1998)

Bench elaborated the biomechanical principles of the Quad

Helix within the Bioprogressive technique, emphasizing its reciprocal force system whereby unilateral molar derotation simultaneously generates a distalizing force at the contralateral molar. The appliance delivers forces between 200–600 g, significantly lower than jackscrew expanders. Modifications described include attachment of 0.045-inch wire extensions through molar band headgear tubes for combined use with a protraction face mask for maxillary advancement, modification of the anterior bar for thumb sucking and tongue thrusting habit correction, and adaptation for eruption control of anterior teeth. It is indicated in Class II malocclusions requiring molar derotation, collapsed cleft palate arches, and cases requiring differential anteroposterior expansion.

2.3. Modified Quad Helix with Anterior Crib (Vinay et al., 2013)

This modification involves reshaping the anterior component of the conventional Quad Helix into three continuous cribs fabricated from 0.036-inch stainless steel wire, while the pos-



terior component retains its conventional design. Unlike previously described crib modifications, this design eliminates the need for soldering of cribs to the anterior segment, thereby removing associated metallurgical complications. The appliance simultaneously delivers 100–150 g of transverse expansion force and acts as a physical deterrent to digit placement. It is indicated for simultaneous interception of digit sucking habits and correction of associated bilateral posterior crossbite and anterior open bite in the mixed dentition.

2.4. Biomex Quad Helix (Bapat et al., 2014)

The Biomex Quad Helix incorporates an acrylic anterior bite plane into the conventional Quad Helix framework by extending the anterior bridge anteriorly with two symmetric vertical V-bends providing retention and stability for the

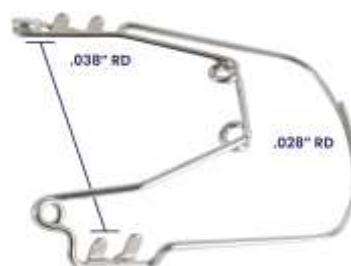


acrylic component, while keeping the anterior helices exposed and fully functional. The appliance combines the slow maxillary expansion capability of the Quad Helix with the occlusal disengagement properties of an anterior bite plane within a single fixed unit. It is indicated in Class I and Class II malocclusions presenting with anterior deep bite concurrent with maxillary arch constriction, cases requiring occlusal deprogramming, and patients with temporomandibular joint symptoms requiring occlusal unlocking alongside arch expansion.

2.5. Quad Helix with Mandibular Incisor Extraction (Mon-

isha and Arvind, 2017)

This clinical application utilizes the conventional Quad Helix as the initial phase of a treatment protocol incorporating asymmetric mandibular incisor extraction, demonstrating the appliance's versatility as part of a comprehensive interdisciplinary treatment plan. The Quad Helix was employed for upper arch expansion activated monthly over four months prior to fixed appliance placement, followed by single



mandibular incisor extraction to resolve lower anterior crowding identified through Bolton's analysis. It is indicated in carefully selected Class I borderline cases presenting with concurrent maxillary arch constriction and mandibular anterior

tooth material excess where single incisor extraction and upper arch expansion can resolve discrepancy while preserving the soft tissue profile.

2.6. Hexa-Helix (Bhandari et al., 2018)

The Hexa-Helix is a six-loop modification of the Quad Helix in which two additional anterior helices are incorporated into the appliance design, with the free anterior ends looped around specific teeth requiring repositioning. The additional helices further increase total wire length, delivering lighter and more continuous forces than the conventional four-loop design. This fully fixed appliance eliminates compliance de-



pendency entirely. It is indicated in non-compliant pediatric patients requiring simultaneous slow maxillary expansion and space creation for labially or ectopically positioned anterior teeth in the mixed dentition.

2.7. Modified Reverse Quad Helix (Fayeez et al., 2021)

The Modified Reverse Quad Helix, also described as a Penta-Helix, reverses the conventional force direction of the Quad Helix to preferentially direct expansion forces anteriorly rather than posteriorly. Fabricated with 0.36-inch stainless steel wire incorporating a large central loop and four small helices bilaterally — with maxillary first molars deliberately excluded from the design to maintain flexibility — the appliance selectively expands the anterior maxillary region while minimizing posterior expansion. It is indicated in cleft palate patients with greater anterior than posterior maxillary constriction, skeletally mature patients refusing surgically assisted rapid palatal expansion, and Class III skeletal relationships with collapsed anterior maxillary segments requiring pre-surgical arch preparation.



2.8. Obturator Quad Helix (Deepika et al., 2021)

The Obturator Quad Helix incorporates self-cure acrylic buttons bilaterally at the terminal portions of the conventional Quad Helix wire framework in the region of palatal dehiscence, enabling the appliance to simultaneously function as a maxillary expander and a palatal obturator. Fabricated from 0.036-inch stainless steel wire soldered to primary second molar bands, the acrylic buttons seal the palatal defect during the active expansion phase. This modification represents a true two-in-one appliance design eliminating the need for a separate obturator. It is specifically indicated in young cleft lip and palate patients with collapsed maxillary arches, posterior crossbite, and active palatal dehiscence causing nasal regurgitation, where pre-surgical arch expansion is required prior to secondary alveolar bone grafting.

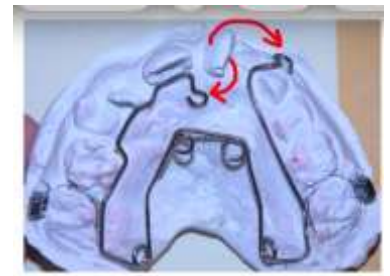


2.9. F-Quad Helix (Fahim, Othman, and von See, 2023)

The F-Quad Helix is a contemporary modification of the conventional Quad Helix introduced by Fahim and colleagues, fabricated from 0.036-inch stainless steel wire, incorporating customized anterior extension arms with hooks bent to accommodate elastomeric chains. The extension arms are designed to generate pure rotational couples — two forces of equal magnitude with parallel but non-collinear lines of action — capable of correcting tooth rotations without undesirable tipping. The appliance is expanded every six weeks at 8 mm

activation distance, with light elastomeric chain forces of 0.3–0.6

Newtons applied for tooth alignment simultaneously with arch expansion. The anterior extension arms can be removed prior to alveolar bone grafting without disturbing the expansion function of the appliance. It is indicated in unilateral cleft lip and palate patients requiring simultaneous maxillary arch expansion with rotation correction of maxillary central incisors adjacent to the alveolar cleft, and traction of palatally ectopic maxillary canines, both before and after secondary alveolar bone grafting.



2.10. Bi-Helix (D'souza, Chalakkal, and de Noronha de Ataíde, 2024)

The Bi-Helix is a simplified modification of the Quad Helix in which the anterior helices are eliminated, retaining only the two posterior helices. This design reduces appliance complexity while preserving the core biomechanical function of molar derotation and space maintenance. By convention,



the Bi-Helix terminology also applies to a two-helix appliance placed in the mandibular arch to upright lower buccal teeth concurrently with maxillary Quad Helix expansion. It is indicated in cases where molar derotation and space maintenance are the primary objectives without the requirement for full arch expansion.

3. CONCLUSION

The Quad Helix appliance has established itself as a cornerstone in the orthodontic management of crossbites during the primary and mixed dentition phases. The continuous innovations and modifications introduced over the years have substantially expanded its therapeutic window, enabling clinicians to effectively address an increasingly diverse range of clinical situations that were previously beyond the scope of the conventional appliance. Each documented modification reflects an evidence-based response to specific clinical challenges, collectively reinforcing the remarkable versatility and adaptability of this appliance. It may therefore be concluded that the evolving modifications of the Quad Helix have transformed it from a conventional expansion device into a multi-functional orthodontic tool capable of meeting varied treatment demands. Future clinical studies and long-term evaluations are warranted to further validate and refine its expanding applications in contemporary orthodontic practice.

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