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CASE REPORT

"TORKO" Appliance for Severe Mandibular Crowding–A Challenging Clinical Scenario

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ABSTRACT

Background: Tooth size-arch length discrepancy (TSALD) is a consequence of disharmony between the size of the teeth and the space available to accommodate them in the dental arches, they are manifested in the form of either crowding or spacing. Crowding is the deviation in tooth position such as rotation, overlapping, tooth emergence inside or outside the dental arch and impaction due to the lack of space. Crowding may occur due to different reasons, for example, growth, maturation, aging of dentition, mesial drift, soft tissue pressures, and tooth morphology. The correction of severe mandibular crowding could be carried out by extraction, distalization, surgical and non-surgical expansion of the mandible.

Aim: The aim of this case report is to describe a novel method of non-surgical mandibular expan-sion.

Case report: This case report demonstrates a non-surgical dentoalveolar expansion by the use of a translingual force mandibular expander appliance ('TORKO' Leone rapid micro expander screw) for the correction of severe mandibular crowding with posterior bilateral scissor bite in an adolescent patient with reduced inter canine and premolar width. This is a case report first of its kind which demonstrates a severe crowding case treated by an expansion device and outlines the challenges faced in achieving well stable results.

Conclusion: The overall active orthodontic treatment lasted for 16 months, an expansion of 6 mm of inter-canine width is achieved. The one year follow up showed a stable mandibular arch following the treatment using TORKO appliance.

Clinical significance: In this case report we have discussed the concept of increasing mandibular inter-canine width in an adolescent patient presenting severe lower anterior crowding and the factors affecting its stability.

Keywords: Crowding, Mandibular expansion, Nonsurgical expansion, Orthodontics, Orthodontic appliance.

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INTRODUCTION

Tooth size-arch length discrepancy (TSALD) is a consequence of disharmony between the size of the teeth and the space available to accommodate them in the dental arches.[1] They are manifested in the form of either crowding or spacing. Crowding is a deviation in tooth position such as rotated, overlapping, tooth emergence inside or outside the dental arch and impaction due to the lack of space. Crowding may occur due to different reasons, for example, growth, maturation, aging of dentition, mesial drift, soft tissue pressures and tooth morphology.[2] As described by Van der Linden, crowding can be primary, secondary and tertiary depending upon the nature of the cause.[3] An early sign of a developing crowding is the absence of spacing in the primary dentition. A 'closed' primary dentition prohibits the mesial shift of the erupting permanent molars into a class I molar relationship during the closure of the private space and also account for the failure in accommodation of the size differential between the primary and permanent incisors.[4] In the early mixed dentition, clinical signs of crowding may include dentoalveolar protrusion without interproximal spacing, overlapping incisors, or premature exfoliation of deciduous canines.[5] This evidence-based understanding of the signs of crowding from its stage of inception and nature of cause helped in formulating a treatment plan which aimed at correcting the malocclusion to the maximum potential.

The correction of severe mandibular crowding could be carried out by extraction, distalization, surgical and non-surgical expansion of the mandible. This case report demonstrates a nonsurgical dentoalveolar expansion by the use of a translingual force mandibular expander appliance ('TORKO' Leone rapid micro expander screw) for the correction of severe mandibular crowding with posterior bilateral scissor bite in an adolescent patient with reduced inter canine and premolar width. As suggested by Hadelman the concurrent rule of expansion for the mandibular arch when the inter-premolar and the inter-molar width was less than 25 and 34 mm respectively was adapted.[6]

CASE REPORT

Appliance Design

The "TORKO" appliances were the first mono guide, hygienic expansion to appear in the market, They are a

line of a sturdy specialized Expansor screw designed to accommodate the needs of orthodontic treatment. The Torko screws are made with a unique torque and no weld marks to avoid accumulation of food, debris and plaque construct mandibular hygienic appliances. With these appliances both transverse and sagittal dentoalveolar expansion can be accomplished which increased the arch length and facilitated alignment of crowded dentition. This expander has a screw length of 11 mm and an arm's length of 62 mm and produces a maximum expansion of 11 mm. One whole turn of activation gives an expansion of 0.8 mm. This appliance needs to be placed in the intercanine mandibular area for optimum expansion. They are generally indicated in patients with very narrow palates and mandibular constriction.

Diagnosis and Etiology

A young boy, 15 years of age, sought treatment for his chief complaint of crooked teeth. The patient was devoid of any abnormal oral habits. He was in good health and had no history of dental trauma. The initial clinical evaluation and facial photographs (Fig. 1) showed the patient had a convex profile with posterior divergence and obtuse nasolabial angle and increased lower anterior facial height with incompetent lips. No temporomandibular joint disorder signs or symptoms were observed in the questionnaire or on clinical examination.

The intraoral examination and study model exhibited half step class II molar relation on the right side and full cusp class I on the left side. The canine relationships on both sides were class II. The maxilla exhibited mild crowding with proclined incisors, and the mandible had a severe crowding as the result of ectopically placed right lateral incisor and left central incisor with moderate proclination. Bilaterally posterior teeth were in scissors bite due to constricted mandibular arch. The inter canine, inter premolar, the intermolar width being 23 mm, 22 mm and 34 mm respectively. The maxillary midline was coinciding with the facial midline, whereas the mandibular midline was shifted towards the left by 4 mm.

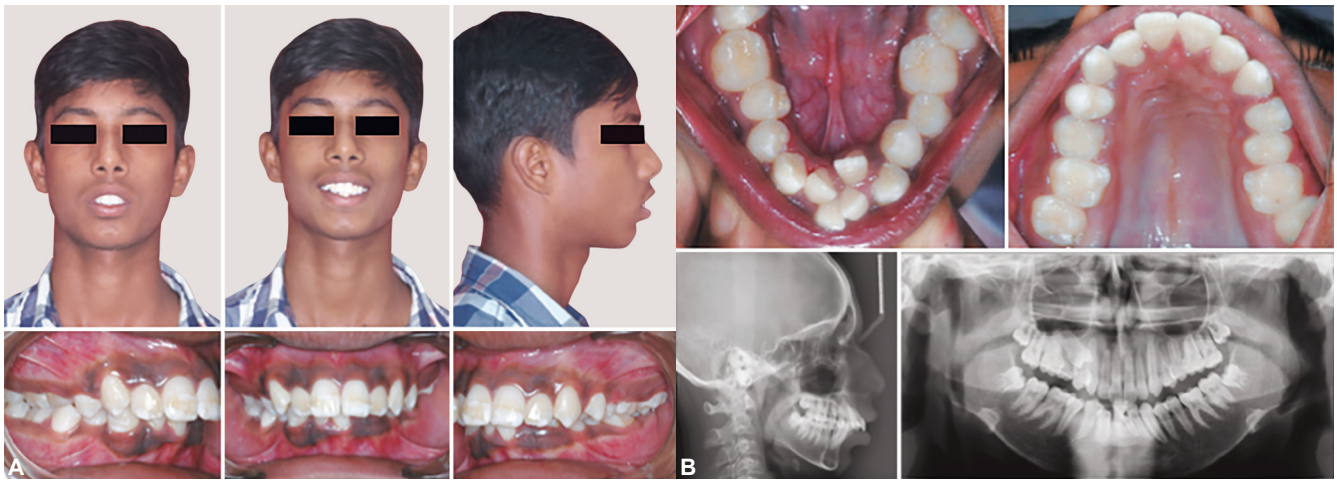
The panoramic radiograph showed maxillary impacted 15, retained deciduous 55 and erupt third molars in both maxilla and mandible. The cephalometric analysis showed a class II skeletal base [SNA-800, SNB-750, ANB-50, Witt's appraisal +4mm] with a high mandibular plane angle (FMA, 300) and increased lower anterior facial height (ANS- GN- 66 mm). The maxillary incisors were severely proclined (U1 to NA–11 mm and 480, U1 to SN–1180) and mandibular incisors were proclined (L1 to NB–8 mm and 300, IMPA–980) and reduced interincisal angle (1080). The upper lip and lower lip were 1 mm and 3 mm in relation to the Rickett's esthetic plane respectively indicating protrusive lower lip.

The dental cast analysis showed an overjet of 7 mm and an overbite of 8 mm. The measured Tooth size-arch length discrepancy was 5.6 mm in the maxilla and 9.8 mm in the mandible. Functional analysis indicated no deviation on opening and closing of the mandible.

Based on these findings, he was diagnosed with a Class II Division 1 subdivision malocclusion.

Treatment Objectives

- Correct the skeletal discrepancy
- Correct the bilateral posterior scissors bite
- Relieve crowding in both maxilla and mandible by bringing the lingually positioned right lateral incisor and buccally positioned left central incisor into alignment.
- Restore a satisfactory occlusion with functional molar and class I canine relationships on both sides
- Correct the midline
- Create ideal overbite and overjet, and
- To improve facial esthetics.



Figs 1A and B: A 15-year old patient with Class II division 1 malocclusion with severe lower anterior crowding before treatment

Treatment Plan

A teen patient had a principal complaint of protrusive and irregular maxillary dentition which needed correction. As the patient was past the growth stage, he was initially suggest to undergo maxillary and mandibular premolar extractions followed by surgical correction of the class II profile. However, the callous manner of the patient towards the surgery and extractions made us consider the non-surgical treatment. As the patient's third molars were in the stage of eruption, the distalization treatment plan was a rudimentary one. A much more practical treatment plan addressing the patient's complaint, nature of the problem and phlegmatic approach towards surgery, was the one which included an extraction of maxillary first premolars and an approach involving dentoalveolar expansion of the mandible to relieve the crowding and posterior scissors bite.

To accomplish this dentoalveolar expansion in the mandible to relieve a severe crowding in the mandible which involved an ectopically placed right lateral incisor and left central incisor and with a space requirement of more than 10 mm in the mandible, the previously illustrated TORKO appliance was used. After the consent from the patient, the extraction option was advocated.

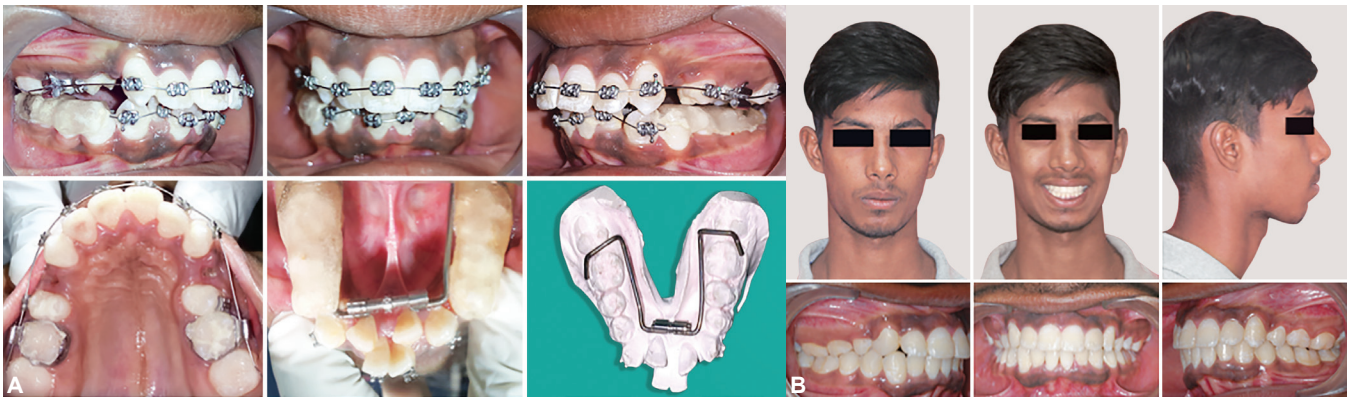
Treatment Progress

The treatment began with the extraction of retained deciduous 55 after the consent of the patient for extractions in the maxilla. This removal of retained deciduous guided in the eruption of 15. The orthodontic treatment commenced with the fabrication and insertion of a posterior bite plane in the maxillary arch. The lower arch was strapped up using 022 × 028 MBT prescription and was subject to alignment and leveling. This facilitated the correction of posterior scissors bite by correcting the lingual inclination of the lower posterior teeth without the resistance of the upper arch. Following the scissor bite correction, the posterior bite plane was discontinued, and maxillary arch alignment was carried out. The posterior scissors bite correction and initial alignment results in the reduction of the overbite.

The next step in the treatment plan was to accomplish the dentoalveolar expansion using the 'TORKO' appliance. The expansion device was contoured to fit the mandibular arch and acrylized and modified to form a bite plane (Fig. 2). The appliance delivered the much needed translingual force to bring about dentoalveolar expansion in both the transverse and sagittal directions. The activation of the appliance was done in the following protocol comprising of, one-quarter turn in the morning and one-quarter turn in the evening, this gave an expansion of 0.4 mm in a day. This protocol for expansion was followed for 28 days which brought forth an expansion of 11 mm providing leeway for relapse. After the desired expansion was achieved in the mandible, the appliance was removed, and final alignment was carried out using a 0.016 Niti. The wires were sequenced through 0.016 × 0.022 Niti, 0.017 × 0.025 Niti, 0.019 × 0.025 Niti, 0.021 × 0.025 Niti, and 0.021 × 0.025 SS; subsequently, the amount of expansion achieved through the expander is stabilized using lingual arch.

Seven months after the start of the treatment, extractions of maxillary first premolars were carried out, and retraction was accomplished using teardrop loops which aided in the reduction of overjet. After space closure arch coordination and final detailing were carried out in 0.014 Niti archwires, elastics from right maxillary canine to left mandibular canine was employed for midline correction along with settling triangular elastics bilaterally from maxillary canine to mandibular canine and premolars.

The overall active orthodontic treatment lasted for 16 months after which debonding was carried out. Retention protocol consisted of maxillary Begg's wrap-around retainer and fixed bonded lingual retainer in the mandibular arch.



Figs 2A and B: During treatment records, (A and B) Appliance in place

Treatment Results

The assessment of the treatment outcomes showed a well-aligned dentition, the severe crowding that resulted due to ectopically placed right lateral incisor and left central incisor with slight proclination was corrected. Facial photographs demonstrated a harmonious smile and well balanced facial profile and competent lips.

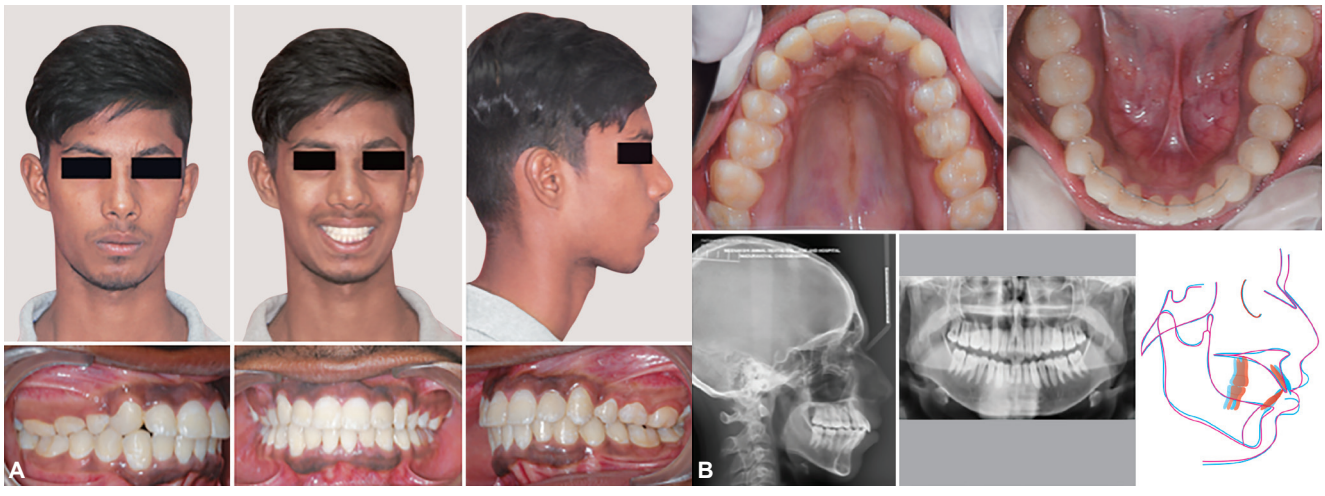
Table 1: Cephalometric evaluation

Parameters	*Pretreatment Values*	*Pretreatment Values*
SNA	80°	80°
SNB	75°	75°
ANB	5°	5°
WIT's appraisal	+ 4 mm	+ 4 mm
FMA	30°	31°
ANS-Gn	66	67
Upper - 1 SN	118°	108°
IMPA	98°	103°
Interincisal angle	108°	126°
Nasolabial angle	135°	116°
Lower Lip - E line	+ 5 mm	+ 2 mm

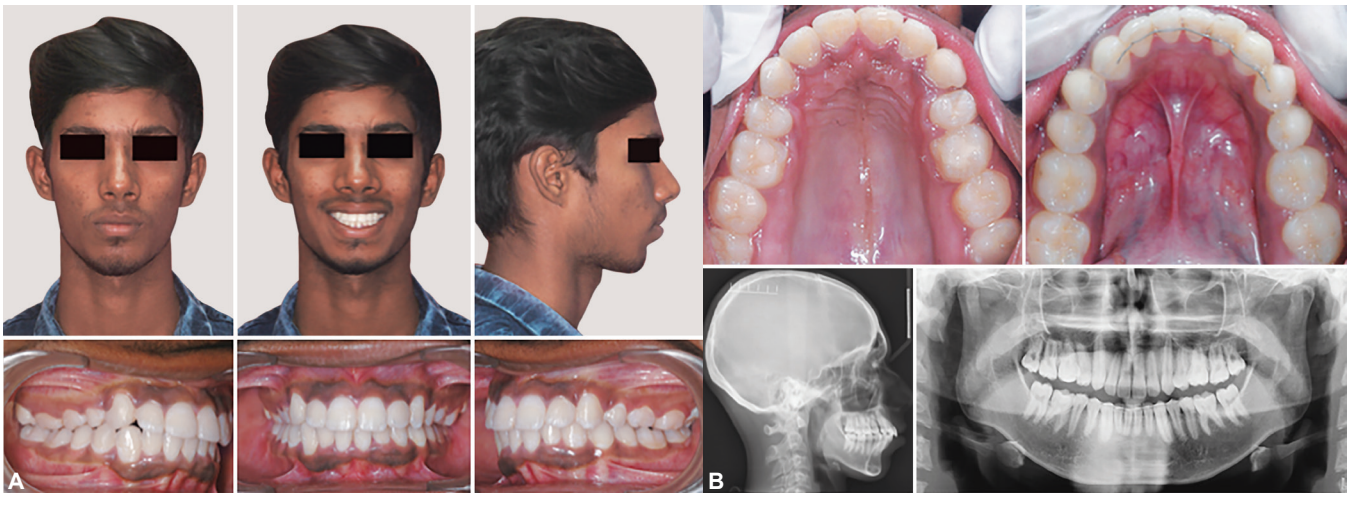
Assessment of the cephalometric analysis and superimposition demonstrated an admirable reduction in proclination in the maxillary incisors (U1 to NA 6 mm and 300, U1 to SN, 1080), However, the mandibular incisors proclination increased (L1 to NB 10 mm and 320, IMPA 1030) with the correction of severe crowding (Table 1).

The intraoral photographs and study model (Fig. 3) demonstrated a functional occlusion following the posterior scissor bite correction with class II molar and class I canine relationship on both the sides. The maxillary inter canine, inter premolar, inter-molar width increased to 29 mm, 33 mm and 44 mm respectively. This significant increase in the mandibular inter-canine and inter-premolar widths with the use of 'TORKO' appliance was highly evident (Fig. 4). The overjet and overbite were well-reduced post-treatment.

The patient was delighted with the treatment results and improved facial appearance. One year follow up (Fig. 5) shows a well-progressed intercuspation and highly stable dentoalveolar correction. There is an evident improvement in the profile owing to the chin development.



Figs 3A and B: Post-treatment records, Superimposition of pre- and post- cephalometric tracing



Figs 4A and B: One year post-treatment records

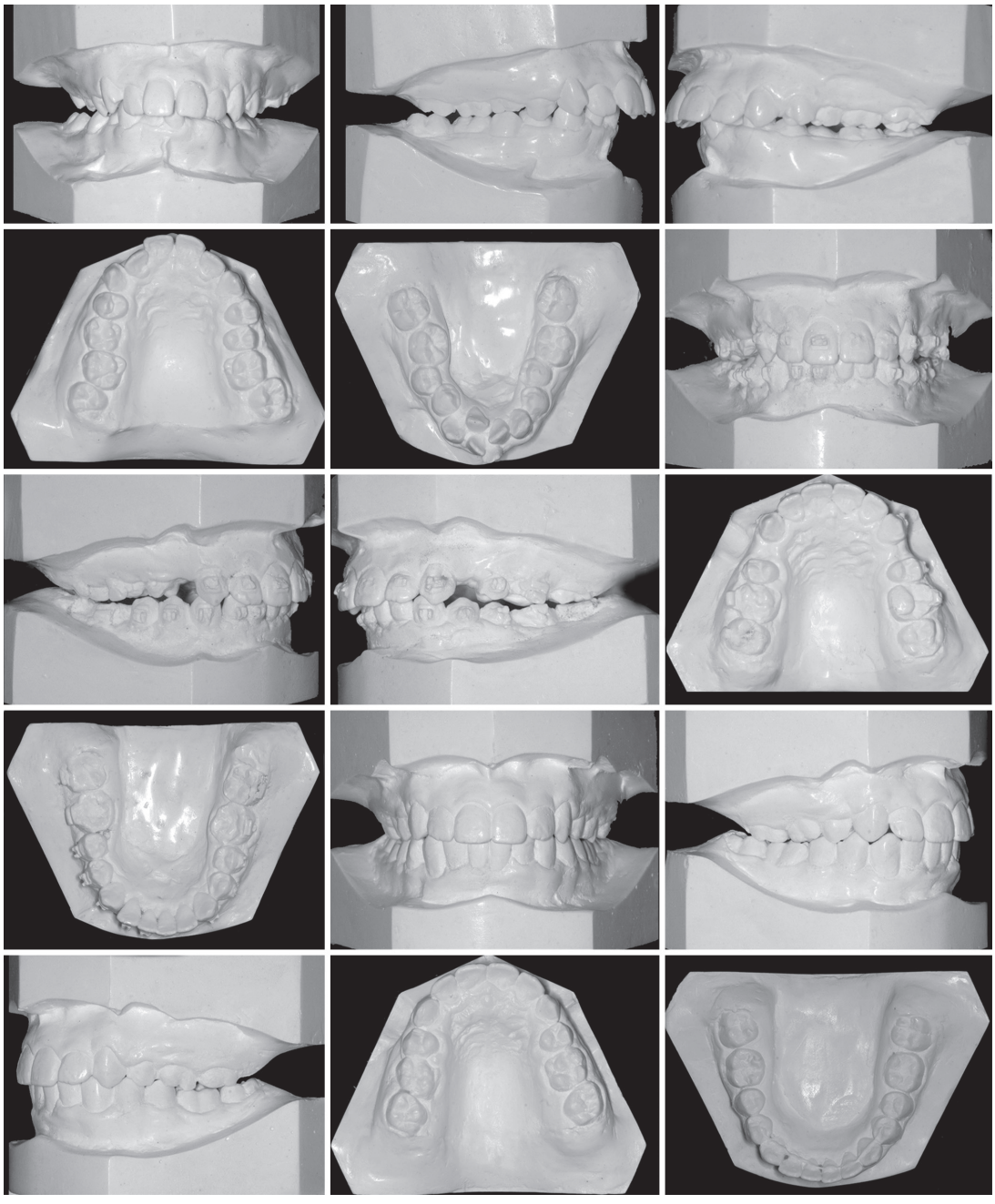


Fig. 5: Model comparison records

DISCUSSION

The camouflage treatment of skeletal class II is challenging and often requires a high level of expertise and patient co-operation.[7] The treatment regime of mandibular crowding varies largely in respect to the treating orthodontist. The most commonly followed space gaining procedures often involve inter-proximal reduction or extractions of either first or second premolars, also at times, the extraction of mandibular incisors are carried out. Furthermore, procedures involve expansion of the mandible through surgical and non-surgical techniques are a rare treatment choice. The surgical expansion involving the mandible is a distraction osteogenesis, which involves osteotomy cuts placed in the symphyseal region further followed by traction applied through either intra- or extra-oral distractors.[8] Such a highly complicated procedure involves innumerable conflicting effects on the surrounding structures and patients mental health. This present case report is an illustration of one such rare attempt comprising non-surgical expansion of the mandibular arch for severe crowding correction. There exist certain previous mandibular expanders such as the Schwarts mandibular expander, E-arch expander and, Arnold expander which have been used in non-surgical correction of mandibular transverse discrepancies.[9,10] The appliance fabricated in this case report has an advantage over the previous appliances by reducing the resultant force on

the molar segments and thereby enhancing more of a dentoalveolar expansion rather than molar distalization. Also, the posterior bite plane incorporated with the anterior expander provided the much-required bite opening of the maxillary and mandibular posterior segments. With the opening of the screw in the anterior mandibular region produced buccal movement of the posterior segments, thereby enhancing the correction of bilateral scissors bite.

The more recent transforce appliance by Clark in 2005, suggested the use of this nature of appliance is more tailored for the class II division 2 or a class I malocclusion with bimaxillary retrusion.[11] However, we have applied this concept in class II division 1 subdivision with severe mandibular crowding and have found an increase in the mandibular intercanine arch width by 6mm of non-surgical expansion of the mandible.

Moyers et al. in 1976, had recorded values of ideal inter canine width as 24.8 mm at the age of 18 years.[12] In the case report showcased about the inter canine collapse was evident from the pre-treatment inter canine width being 23 mm accompanied by severe anterior crowding, which prompted us to consider the mandibular expansion. However, the longstanding controversy of stability of mandibular expansion exists since Nance regarding the mandibular inter-canine expansion.[13] The recent shreds of evidence by Herberger suggest the stability of mandibular expansion in inter canine width is highly stable with 68% of expansion remained stable even after six years.[14] Also, Myers, more recently suggested in his long-term follow up of 15 years showed the post-treatment stability of mandibular anterior crowding relapsed by a very negligible amount of 16% and this relapse is inherently associated to the type of growth variable.[15] These factors encouraged us to proceed with the TORKO appliance

By far the most challenging part of the treatment was the control of the labial movement of the mandibular anterior teeth combined with expansion for decrowding with the maintenance of vertical facial height. To overcome the proclination the use of segmental mechanics, cinching the wire distal to the molars combined with the use of a – 60 torqued lower incisor MBT brackets were advocated. However, with the application of transverse force for dentoalveolar expansion, there was a distolingual rotation for mandibular molars which in turn resulted in increased mandibular incisor inclination despite all the anchor efforts, this was acceptable considering the facial profile and skeletal malocclusion. The retention plan of fixed lingual retainer was followed in accords with the retrospective longitudinal study of Housley et al. in 2013 which stated the fixed lingual retainers as the best retention plan following the transverse expansion of mandibular arch.[16] The one year follow up showed a stable mandibular arch following the treatment using TORKO appliance.

From our clinical experience, the "TORKO" appliance is more suited for patients of growing age and adolescence, Where there exists a collapse in the inter-canine width. This appliance produces an incremental increase in the inter-canine width by dentoalveolar expansion. Nonsurgical orthodontic treatment options for a transverse deficiency in adult patients are limited because of the lack of growth potential. Although dentoalveolar expansion is feasible in adults,[17] it has an increased risk for fenestration and gingival recession, especially in the mandible, because of the intrinsic tendency for a reduction of intermolar distance.[18,19] Also, the literature contradicts the stability on increase in inter-canine width in adults when compared with growing age group.[20,21] For these reasons a long-term follow-up and further case studies of the "TORKO" appliance is required to better understanding of stability.

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