Journal of Advanced Medical and Dental Sciences Research

@Society of Scientific Research and Studies ***NLM ID:*** *101716117*

Journal home page: www.jamdsr.com doi: 10.21276/jamdsr Indian Citation Index (ICI) Index Copernicus value = 91.86

(e) ISSN Online: 2321-9599; (p) ISSN Print: 2348-6805

Original Research

Maxillary molar distalization with Invisalign: A retrospective study

[1]Jan Mohd Bhat, [2] Jobin Baby, [3]Mohammed Ribin Melethil

[1-3]PG 3rd year, Department of Orthodontics and Dentofacial Orthopaedics, IDST, Modinagar, Uttar Pradesh, India

ABSTRACT:

Background: Maxillary molar distalization is frequently required in class II non-extraction patients. Resolving class II molar relationships by distalizing maxillary molars may be indicated for patients with minor skeletal discrepancies. The aim of the present study was to test the hypothesis that bodily maxillary molar distalization was not achievable in aligner orthodontics. **Materials & Methods:** Forty lateral cephalograms obtained from 20 non-growing subjects (9 male, 11 female; average age 29.73 years) (group S), who underwent bilateral distalization of their maxillary dentition with Invisalign aligners (Align Technology, Inc., San José, CA, USA), were considered for the study. Skeletal class I or class II malocclusion and a bilateral end-to-end class II molar relationship were the main inclusion criteria. Cephalograms were taken at two time points: (T0) pretreatment and (T1) post-treatment. Treatment changes were evaluated between the time points using 39 variables by means of paired t test. The level of significance was set at $P < 0.05$. Reproducibility of measurements was assessed by the intraclass correlation coefficient (ICC). **Results:** The mean treatment time was 24.3 ± 4.2 months. At the post-treatment point, the first molar moved distally 2.25 mm without significant tipping ($P = 0.27$) and vertical movements ($P = 0.43$). The second molar distalization was 2.52 mm without significant tipping ($P = 0.056$) and vertical movements ($P= 0.25$). No significant movements were detected in the lower arch. SN-GoGn and SpP-GoGn angles showed no significant differences between pre- and post-treatment cephalograms ($P = 0.22$ and $P = 0.85$, respectively). **Conclusion:** Aligner therapy in association with composite attachments and class II elastics can distalize maxillary first molars by 2.25 mm without significant tipping and vertical movements of the crown. No changes to the facial height were revealed.

Key words: Class II, Aligners, Molar distalization, Adult patients

Received: 23 April, 2022 Accepted: 29 May, 2022

Corresponding author: Mohammed Ribin Melethil, PG 3rd year, Department of Orthodontics and Dentofacial Orthopaedics, IDST, Modinagar, Uttar Pradesh, India

This article may be cited as: Bhat JM, Baby J, Melethil MR. Maxillary molar distalization with Invisalign: A retrospective study. J Adv Med Dent Scie Res 2022;10(6):131-135.

INTRODUCTION

In class II cases with minimal to moderate crowding or incisor proclination in the maxilla, the distalization of molars is often indicated in order to avoid premolar extractions. Since 1950's headgear has been the most frequently used appliance for maxillary molar distalization.[1,2] Unfortunately this appliance requires considerable patient compliance, so several alternative intraoral methods had been proposed to reduce or cut out patient's cooperation. Despite the effectiveness of many of these appliances, clinicians must consider many side effects like increase in lower face height, clockwise mandibular rotation, extrusion of first premolars, undesirable tipping of the maxillary molars and loss of anterior anchorage during distalization.[3,4,5] Simon et al reported a high accuracy (88 %) of the bodily movement of upper molars with aligners when a mean distalization movement of 2.7 mm was prescribed.[6] The authors reported the best accuracy when the movement was supported by the presence of an attachment on the tooth surface. Furthermore, they underlined the importance of staging in the treatment predictability. However, a detailed analysis of the underlying skeletal and dental changes induced by aligners during class II treatment in adult patients is still lacking.[5] On the basis of these considerations, a retrospective multicenter study has been conducted to analyze dentoalveolar and skeletal changes following maxillary molar distalization therapy with the Invisalign protocol in adult patients. The study was conducted in order to test the hypothesis that maxillary molar bodily distalization is not achievable with aligners.

MATERIALS & METHODS

20 patients who met the following inclusion criteria were selected from the department of orthodontics and dentofacial orthopaedics IDST Modinagar: (1) age more than 18 years old, (2) skeletal class I or class II malocclusion and a bilateral end to-end class II molar relationship, (3) normodivergence on the vertical plane (SN-GoGn angle less than 37°), (4) mild crowding in the upper arch (≤4 mm), (5) absence of mesial rotation of the upper first molar according to Ricketts, (6) standardized treatment protocol, (7) good compliance during the treatment (wearing aligner time ≥ 20 h per day), (8) absence or previous extraction of the upper third molars, and (9) good quality radiographs, with adequate landmark visualization and head rotation control.

The exclusion criteria were (1) transversal dental or skeletal discrepancies, (2) vertical dental or skeletal discrepancies, (3) extraction treatment (except for third molars), (4) unilateral distalization, (5) signs and/or symptoms of temporomandibular disorders (TMDs) according to Diagnostic Criteria for TMDs, (6) periodontal disease, (7) endodontic treatments of the maxillary molars, (8) prosthodontic rehabilitations of the maxillary molars.

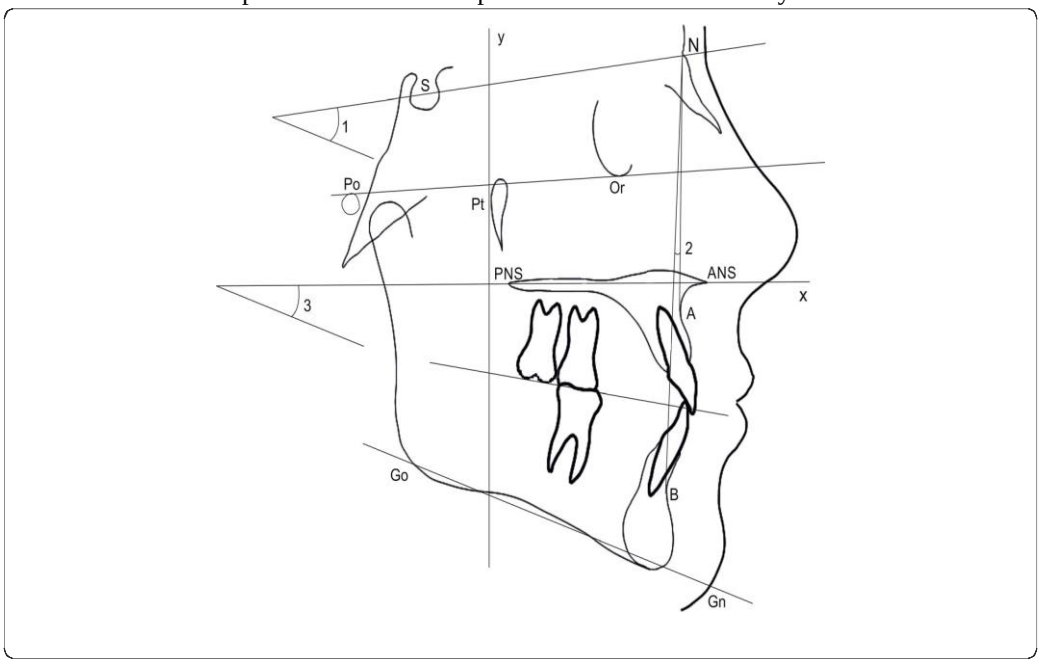
Forty lateral cephalograms in habitual occlusion were thus considered for the study. Cephalometric headfilms

were collected at the beginning (T0) and at the end of the Invisalign orthodontic treatment (T1). The mean time period between the initial T0 radiograph and the post-treatment T1 radiograph was 24.3 ± 4.2 months. Gender differences were not considered since only nongrowing subjects were considered for the study.

The distalization started with the upper second molars, and once the second molars were two thirds of the way, then the upper first molars moved back, then premolars, and so on until the enmasse retraction of the four incisors completed the treatment plan. The protocol comprised the use of attachments and class II elastics. Intermaxillary elastics were used during the retraction of premolars, canines, and incisors. The attachments were engineered by Align Technology to achieve predictable tooth movements and placed according to the Align Technology attachment protocol. The average number of required aligners was 42.6 ± 4.4 on the upper arch and 21.4 ± 3.2 on the lower arch. Each couple of aligner was worn for 14 days, as recommended by the manufacturer. A refinement phase, corresponding to the finishing phase, with a mean number of 9.1 ± 2.2 aligners on the upper arch and 6.7 ± 3.1 on the lower arch was requested for each case: during the refinement phase, each aligner was worn for 10 days.

The mean treatment time was 24.3 ± 4.2 months.

For each patient enrolled in the study, pre- and post treatment lateral radiographs were collected. Different X-ray devices for cephalometric radiographs were used, and for this reason, lateral cephalograms for each patient at T0 and T1 were standardized to life size using the ruler present in each X-ray examination. On the lateral headfilms, the palatal plane/mandibular plane (PP/MP) and the SN/mandibular plane angles were evaluated as indicators of skeletal posterior vertical dimension changes. On the initial (T0) and final (T1) cephalograms, the reference axes were represented by the palatal plane (x axis) and by a perpendicular line to the palatal plane passing through the Ricketts' Pt point (y axis) (Fig. 1).The occlusal plane was traced as well, passing through the upper central incisor's incisal edge and the mesial cusp of the first molar. The palatal plane was used to measure vertical and angular movements (Fig. 2), the occlusal plane was used to measure vertical movements only, while the y axis was used to measure sagittal movements of the second molar, of the first molar, and of the central incisor (Fig. 3).The data obtained was statistically evaluated.



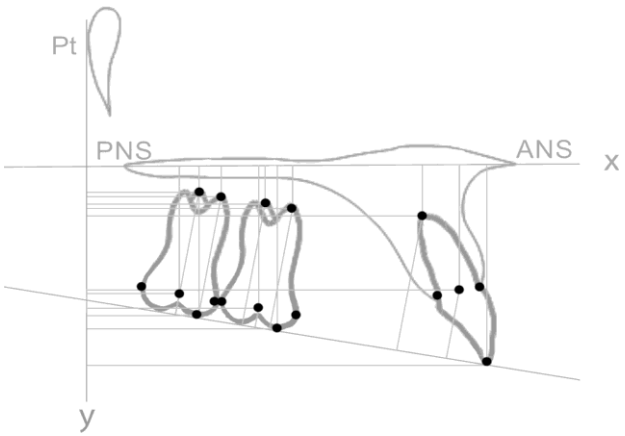


Fig. 2 Schematic Illustration of angular measurements (°) of maxillary second molar (1), maxillary first molar (2), and central incisor (3). The angle between the tooth long axis (passing trough the mesiobuccal cusp and mesiobuccal root's apex for the first andthe second molar; passing through the incisal edge and root's apex for the central incisor) and *x* axis (palatal plane) expressed the inclination of the tooth.

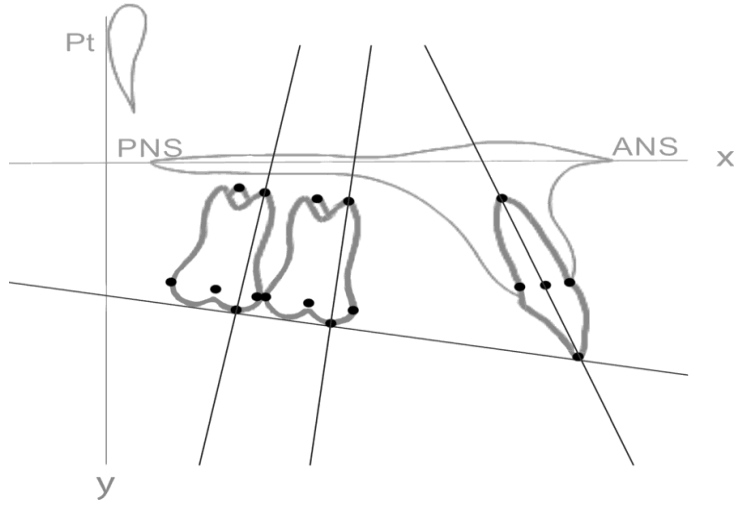


Fig. 3 Schematic illustration of linear measurements (mm) considered in the study. Horizontal measurements were expressed by the distance between the following points and the y axis (a perpendicular line to the palatal plane passing through the Ricketts'Pt point); second molar horizontal distance from the center of the crown, from the mesiobuccal cusp, from the mesiobuccal root's apex, from the palatal root's apex; first molar horizontal distance from the center of the crown, from the mesiobuccal cusp, from themesiobuccal root's apex, from the palatal root's apex; central incisor distance; central incisor edge distance, central incisor radicular apex distance. Vertical distances were expressed by the distance betweenthe same points and the x axis (palatal plane) and between the occlusal plane (except for incisor edge point and mesiobuccal cusp point, both tangential the occlusal plane)

RESULTS

The mean, standard deviation, and 95% CI values of the change in dental and skeletal variables were reported. Significant changes in the sagittal positions of upper first and second molars ($P < 0.01$) were revealed after distalization. The second molar showed a distal average movement of 2.52 mm measured on the mesiobuccal cusp and of 2.12 mm measured on the center of the crown, without significant tipping ($P = 0.056$) and vertical movements of the crown ($P = 0.25$). The mean amount of maxillary first molar distalization was 2.25 mm measured on the mesiobuccal cusp and 2.03 mm on the center of the crown, without significant vertical movements of the crown ($P = 0.43$) and tipping movements ($P = 0.27$). The maxillary central incisor edge was retracted by 2.23 mm ($P < 0.01$) without significant vertical movements ($P = 0.43$) and with a good control of its orientation with respect to the palatal plane (initial

value 109.60° ± 6.70°, post-treatment value 106.70° ± 6.66°, P <0.05).

With regard to skeletal changes of the maxilla, the SNA (angle measured at Sella point, Nasion point, A Downs point) angle showed no statistical differences between pre- and post-treatment cephalograms (P = 0.45). The craniofacial vertical dimension was not affected by the distalization of maxillary molars with aligners. SN-GoGn and SPP-GoGn angles showed no significant differences between pre- and post-treatment cephalograms (P = 0.22 and P = 0.85, respectively).

DISCUSSION

Distalizing maxillary molars have been frequently used for Class II malocclusion with minor skeletal discrepancies and maxillary dentoalveolar protrusion to establish a Class I molar and canine relationship and a normal overjet. Recent advances in the Invisalign system allow predictable distalization of posterior teeth to facilitate treatment of Class II cases.[5,7] To this end, Distalization with invisalign aligners can be achieved with the sequential movement of the posterior teeth. The aim of this study was to evaluate the Invisalign aligner's effects in distalizing maxillary molars.

The distalization movement with Invisalign aligners was not associated with significant distal tipping of the distalized molars. The self-limiting 0.25-mm activation of each aligner (as opposed to the more continuous activation of nickel titanium springs or elastomeric chain) means that any tip created by the aligner during space

closure is probably not due to the teeth "falling" or even being "pushed" into a pontic space, or to a lack of counter moment surface, but to insufficient moments being generated to control root movement.[5,8,9] Rectangular

and vertical attachments located on the buccal aspect of the distalizing molars are required in order to create a

sufficient moment to oppose the tipping movement.[10]

The patient's vertical growth pattern is an important point to consider while planning molar distalization. A

clockwise rotation of the mandible due to premature contacts may worsen the profile and cause bite opening.

The distal movement measured in our study was not associated with extrusion or intrusion movements of the

teeth.[11] However, the thickness of the aligners and the consequent bite block effect might explain the absence

of any change of anterior vertical dimension.[12] Class II elastics seemed to have any effect on the lower arch: any significant tipping of the lower first molar or proclination of the lower incisors was revealed.[13,14]

Although these results are encouraging, this topic would need further investigation, for example, with randomized

clinical trials and a larger sample size. Retrospective studies have some disadvantages with respect to prospective studies. Among the biases which can negatively impact the veracity of this type of study are selection bias and misclassification or information bias as a result of the retrospective aspect. However, it is quite difficult to conduct a prospective study investigating the effects of an uncommon clinical procedure due to the difficulties to achieve a proper sample size. This is the reason why the retrospective design seemed to be the more indicated study design at this stage of our knowledge on aligner orthodontics. To avoid selection bias, all subjects who met the inclusion criteria were included in the study regardless the treatment result. However, we are aware that a prospective study could lead to less significant results considering a proper sample selection and the risk of dropouts of the study design.

CONCLUSIONS

Within the limitations of a retrospective study design, and of a small sample size, this study demonstrated that Invisalign aligners are effective in distalizing maxillary molars in non-growing subjects without significant vertical and mesiodistal tipping movements.

BIBLIOGRAPHY

1. Ravera S, Castroflorio T, Garino F, Daher S, Cugliari G, Deregibus A. Maxillary molar distalization with aligners in adult patients: a multicenter retrospective study. *Prog Orthod.* 2016;17:12-15.
2. Schupp W, Haubrich J, Neumann I. Class II correction with the Invisalign system. *J Clin Orthod.* 2010; 44: 28-35.
3. Li C, Chung CH. A Simple Technique Using a Modified Nance Appliance as Anchorage for Maxillary Molar Distalization-Two Case Reports. *App Sci 2002;*12(2):76-8.
4. Angelieri F, de Almeida RR, Janson G, Castanha Henriques JF, Pinzan A. Comparison of the effects produced by headgear and pendulum appliances followed by fixed orthodontic treatment. *Eur J Orthod.* 2008;30(6): 572-9.
5. Haydar S, Uner O. Comparison of Jones jig molar distalization appliance with extraoral traction. *Am J Orthod Dentofacial Orthop.* 2000;117(1): 49-53.
6. Simon M, Keilig L, Schwarze J, Jung BA, Bourauel C. Treatment outcome and efficacy of an aligner technique - regarding incisor torque, premolar derotation and molar distalization. *BMC Oral Health.* 2014;14:68.
7. Ayidaga C, Kamiloglu B. Effects of Variable Composite Attachment Shapes in Controlling Upper Molar Distalization with Aligners: A Nonlinear Finite Element Study. *Journal of Healthcare Engineering.* 2021;1:1-8.
8. Simon M, Keilig L, Schwarze J, Jung BA, Bourauel C. Forces and moments generated by removable thermoplastic aligners: incisor torque, premolar

derotation, and molar distalization. *Am J Orthod Dentofacial Orthop.* 2014;145(6):728-736.

9. Dallel I, Bergeyron P, Chok A, Tobji S, Ben Amor A. Intramaxillary devices of molar distalization on fixed appliance and with aligners. *Orthod Fr*. 2017;88(4):355-366.
10. McNamara JA Jr. A method of cephalometric evaluation. Am J Orthod. 1984; 86(6):449-69.
11. Giancotti A, Farina A. Treatment of collapsed arches using the Invisalign system. J Clin Orthod. 2010;44:416-25.
12. Grippaudo C, Oliva B, Greco AL, Sferra S, Deli R. Relationship between vertical facial patterns and dental arch form in class II malocclusion. Prog Orthod. 2013;7(14):43-46.
13. Poletti L, Silvera AA, Huanca Ghislanzoni LT. Dentoalveolar class III treatment using retromolar miniscrew anchorage. Prog Orthod. 2013;14:7.
14. Kook YA, Park JH, Bayome M, Kim S, Han E, Kim CH. Distalization of the mandibular dentition with a ramal plate for skeletal Class III malocclusion correction. Am J Orthod Dentofacial Orthop. 2016;150(2):364-77.