Original Article

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Dentistry Section

A Noble, Easy and Conceptual Radiographic Analysis to Assess the Type of Tooth Movement (Molar Distalization)

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ABSTRACT

Context and Aim: Bodily tooth movement is desirable in the field of Orthodontics and so is with molar distalization. Till date there is no such analysis available which could gauge and quantify the molar distalization and the type of tooth movement achieved, therefore one was required.

Materials and Methods: An OPG and Lateral cephalogram was used taking Inter orbitale plane and FH plane respectively as reference lines and the analysis was devised to measure the amount and type of tooth movement achieved in distalization of molar.

Conclusion: This analysis is a noble, easy and conceptual analysis to assess the type of tooth movement achieved during molar distalization and other molar movements using Lateral cephalogram and orthopantomogram.

Keywords: Anchorage, Anchor loss, Cephalometric analysis, OPG analysis

INTRODUCTION

Orthodontics, generally aims for the bodily tooth movement and so is for molar distalization [1-3]. Molar distalization can be achieved using various distalization appliances available and published in the literature, many of which claims for bodily tooth movement and few of which produces minimal tipping of the molar [4-10].

Bodily tooth movement is said to be achieved, if the whole tooth moves to the same distance maintaining the same inclination and angulation as that was present before the tooth movement. Thus, if pre treatment and post treatment angulation of the tooth is same, it suggests that no tipping has occurred, and the tooth has moved bodily. The distance between pre treatment and post treatment long axis of tooth will quantify the linear movement of the teeth. On the other hand, change in angulation of the long axis of the tooth will suggest tipping of teeth which could be quantified by measuring the change in angulation of the long axis of the tooth. The same criteria is the parent thought for this radiographic analysis, which will guide us in determining the type of tooth movement, and also will help us quantify the amount of tooth movement achived, specially for molar distalization.

Till date there is no literature available on method used to analyse the type of tooth movement (distalization of molar) achieved using distalization appliances. Thereby, we put forward a noble, easy and conceptual radiographic analysis (Distanalysis) using Lateral cephalogram and OPG to assess and gauge the type of tooth movement achieved during molar distalization.

MATERIALS AND METHODS

This analysis was formulated in the year 2014 at Al-Badar Dental College and Hospital, Gulbarga, Karnataka. Formulation of this analysis is done, taking the reference of literature and proved facts about the cephalograms and superimpositions, along with the lines and concepts used in various stable analyses [11-15].

The materials required for analysis are as follows:

- Pre distalization and Post distalization lateral cephalogram and OPG.
- 8 x 10 inch Acetate matte tracing paper, (0.003 inch thick).
- A sharp 3H drawing pencil.
- Masking tape.
- Tracing table.
- Geometry box, and stationary materials.

Landmarks Used:

On lateral cephalogram:

- Sella
- Nasion
- Mesial and distal cusp tips of upper molar
- Mesial root tip of upper molar
- Mesial tooth surface of the upper molar.

On OPG:

- Orbitale – left and right
- Mesial and distal cusp tips of the upper molar.

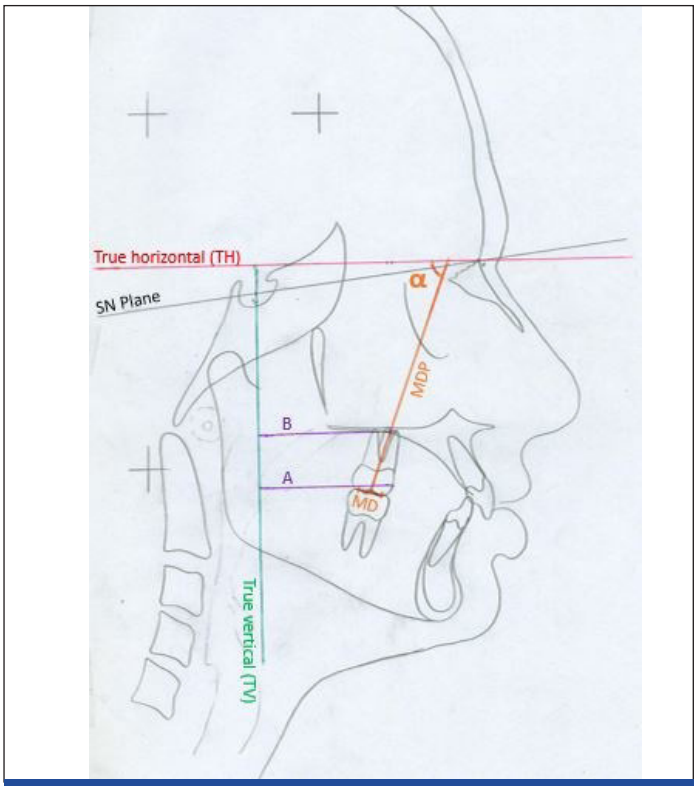
Analysis on Lateral Cephalogram [Table/Fig 1]:

- Considering Sella Nasion (SN) plane as stable line, use it as a plane for superimposition at Sella.
- Draw true horizontal (TH) at 7 degree to SN plane as done in COGS analysis.
- Draw a Sella perpendicular to true Horizontal which will be considered as true vertical (TV).
- Draw Perpendiculars from true vertical to the most prominent mesial tooth surface and the mesial root tip of upper molar (lines A and B respectively).
- Measure the linear value of both the lines (lines A and B).
- Do the same for the Post treatment lateral cephalogram (lines A' and B').
- The difference between (A' & A) and (B'& B) is the amount of distalization achieved.
- If the values of the differences of (A' – A) and (B'- B) differs

by the same amount, it implies that there was a bodily tooth movement, because both the structures moved by the same distance.

- If there is any discrepancy between the two, it implies there is tipping produced.
- To know the amount of tipping, progress to the following.
- Draw the mesial and distal cusp tips of upper molar (MD), which are stable landmarks because tooth structure does not change in short span of time.
- Draw a perpendicular bisector (MDP) to the line MD extending to the true horizontal.
- Measure the distal angle (Alpha Angle) for both pre and post distalization cephalograms, the difference of which gives the amount of tipping produced.

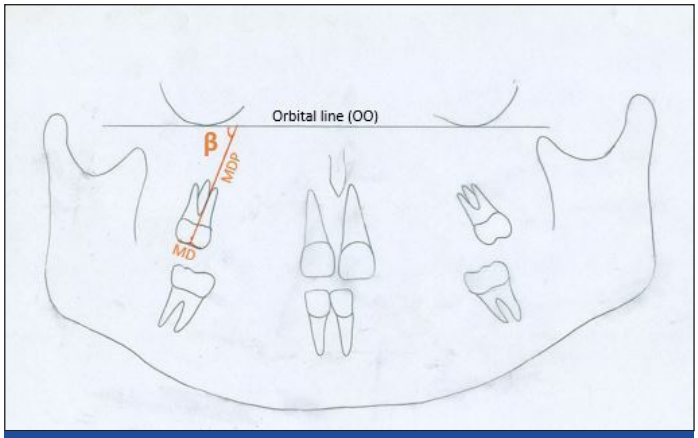
Similarly, can make use of OPG for analysis of the type of tooth movement.



[Table/Fig-1]: Lateral Cephalogram Tracing
SN Plane – Sella Nasion Plane
TH plane – True Horizontal plane (7 degree to SN Plane)
TV Plane – True Vertical Plane (Perpendicular line to True horizontal at Sella)
A line – Line parallel to TH plane and Perpendicular to TV plane to the mesial surface of molar.
B line - Line parallel to TH plane and Perpendicular to TV plane to the mesial root tip of molar.
MDP – Perpendicular bisector of line joining cusp tips of molar.
Alpha angle – Distal angle of MDP to TH plane

OPG Analysis [Table/Fig-2]:

- Draw a line joining the orbitale points of left and right side (OO Line). This line is a stable line.
- Draw the mesial and distal cusp tips of upper molar (MD).
- Draw a perpendicular bisector (MDP) of the line MD extending to the OO line.
- Do the same for post distalization OPG.
- Measure the distal angle (Beta Angle) for both pre and post distalization cephalogram.
- If the angle is the same, there is bodily movement, if not the difference of the angles in pre and post distalization OPG, gives the amount of tipping produced.
- The distance between the two perpendicular bisectors (pre and post distalization) is the amount of distalization produced, which is checked on superimposing the OPG along OO line at O point.



[Table/Fig-2]: OPG tracing
OO Line – Line joining Orbital points
MDP – Perpendicular bisector of line joining cusp tips of molar.
Beta angle – Distal angle of MDP to OO line

Other assessments:

- By measuring the length of the perpendicular bisectors, we can assess the vertical changes in the molar.
- Same analysis can also be used to assess the molar anchor loss.

Uses: This analysis can be used for assessing the following:

- Quantifies bodily tooth movement and tipping of tooth.
- Vertical extrusion and intrusion effects of various orthodontic mechanics.
- Can quantify the distalization, anchor loss, and other effects produced by various mechanics in orthodontics.
- Thus, this method is a useful tool for assessing the type of tooth movement achieved.

Advantages:

- It is easy, simple and effective.
- It quantifies the type of tooth movement both for bodily and tipping type of tooth movements.
- Can also be used for measuring the Anchor loss, distal tipping due to anchor bend, and other effects due to various orthodontic mechanics.
- As SN plane is used instead of FH plane (Porion is difficult to locate on conventional radiograph) [16], therefore it eliminates the errors and gives a more accurate measurement.
- No additional cost or radiation exposure of CT or CBCT to the patient.

Limitations:

- This method uses two dimensional radiographs.

DISCUSSION

Various types of tooth movement are performed orthodontically among which bodily tooth movement is the dream tooth movement for orthodontists. Various types of tooth movements are Tipping (Controlled and Uncontrolled), Bodily tooth movement, torquing, & rotations. The easiest type of tooth movement is uncontrolled tipping which frequently occurs in the initial wires during fixed mechanotherapy. The most difficult of all is torquing. Thereby to prevent torque loss, the bodily tooth movement is tried to be achieved.

Various appliances are used to perform molar distalization, which again should move bodily [17]. Various appliances presently available claims to achieve bodily tooth movement & the method to assess the relative amount and type of tooth movement achieved is by superimposition but no literature is available till date to quantify or suggest the type and amount of tooth movement achieved during

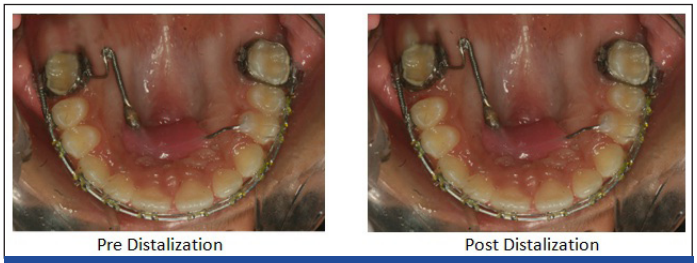
molar distalization. Thereby the need for the same was tried to be fulfilled by introduction of this Analysis. The idea behind this concept is based on the mathematical geometry, which suggests that if two lines are placed at a distance but maintains same angulation to a line intersecting them, they are parallel. This also suggests that if a line moves along another line, maintaining same angulation to that before moving, the final position of line will be parallel to its previous position.

The same occurs in bodily tooth movement. Therefore, if the angulation of long axis of tooth is maintained same as that before treatment, means bodily tooth movement is achieved, and if the angulation is changed, it suggests tipping of the tooth. The distance between the two will quantify the amount of tooth moved from initial to final position. This is as explained in the literature above. Thereby, this analysis is a pure mathematical concept, which is a proof in itself because mathematics is something which doesn't change. The counterpart cross check of the same is done on OPG which also gives same readings, which suggests that both the analysis is valid. Furthermore, this analysis fulfilling the KISS principle (Keep It Simple Sir) [18], which doesn't strains the patient & the clinician, neither expose patients to extra radiation like CT, CBCT, etc nor it add extra costs for the patients.

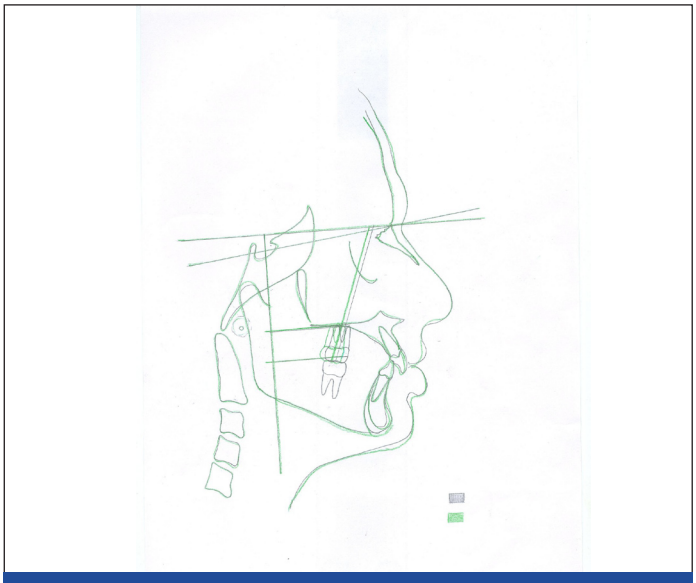
Therefore this analysis is the only one of its kind which quantifies the molar distalization and type of tooth movement, and it could be clinically used for the same, both in private practice and also by Orthodontic Post Graduate students to validate their findings.

Example of a case [Table/Fig-3-5]:

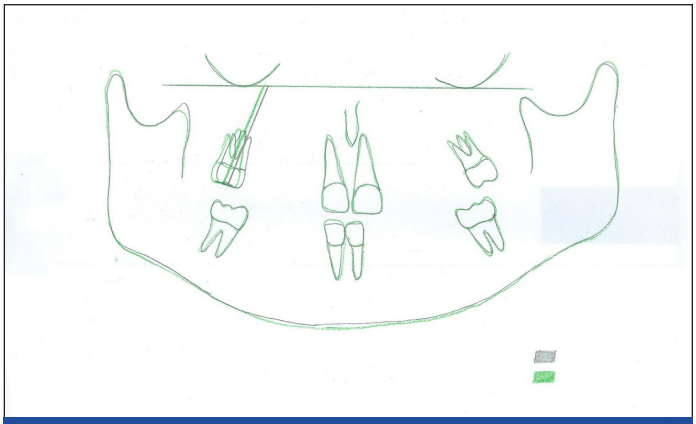
Distalization was performed in a female patient aged 12 years with Class II div 1 subdivision malocclusion. She had a mild convex profile, yaw in upper arch and minor crowding. Distalization was performed by a customized distalization appliance designed by the Author. The pre and post distalization occlusal photographs and superimposition results are shown in the [Table/Fig-3-5] respectively having following values.



[Table/Fig-3]: Pre Distalization and Post Distalization Intra Oral Occlusal Photographs showing the amount of distalization achieved



[Table/Fig-4]: Superimposition of Lateral cephalogram along TV and TH plane at Sella - pre distalization and post distalization



[Table/Fig-5]: Superimposition of OPG pre distalization and post distalization along OO line at Orbitale points

Alpha angle = 65 degree

Beta Angle = 65 degree

Difference between A and A' in Lateral Cephalogram = 3 mm

Difference between B and B' in lateral cephalogram = 3 mm

Difference between MDP and MDP' on OPG = 3 mm

As noted, the pre and post distalization Alpha and Beta angles are same and the linear distance between the perpendicular lines is 3 mm, this implies that there was a bodily movement of molar achieved in this case.

This is how we could apply the same analysis for distalization, tipping, and anchor loss evaluation.

CONCLUSION

This analysis thereby is based on mathematical facts and Geometry which is a proof in itself for its validity. The angulations and linear measurements and geometrical concepts need no further support to say whether the lines are parallel or angulated. Thereby, this analysis is valid in itself fulfilling the KISS principle, which neither expose patients to extra radiation like CT, CBCT, nor does it add extra costs for the patients. Thus, this is a noble, easy, effective and conceptual analysis for the assessment of the type of tooth movement achieved by distalization. The use of this method in our department is a testimony of its usefulness.

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