Research Article

Influence of maxillary canine vertical position on the perception of smile esthetics among orthodontists and laypersons

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ABSTRACT

Background: Most patients seek orthodontic treatment to enhance the esthetics of their smile. Orthodontists must consider the influence of mini – esthetics on smile.

Objective: This study aimed to analyze the attractiveness of a frontal smile in a model with altered vertical position of the canine and to evaluate the difference between the esthetic perceptions of orthodontists and laypersons.

Materials and Methods: An adult female was selected for this study who was adjudged to have an ideal smile by the authors. The frontal posed smile photograph was digitally altered by adjusting the vertical positions of the maxillary canines above, below, or coincident with the incisal line in increments of 0.5 mm within a range of 1 mm of extrusion and intrusion. For assessment, a web-based survey was formed with six images. A scale was present underneath each image, graded from 0 to 10 (0: unattractive; 10: the most attractive). Images were rated by 98 participants (45 orthodontists and 53 laypersons). The chi-square test was used to compare the ratings between orthodontists and laypersons.

Result: Both orthodontists and laypersons scored 0-mm image as highest with ratings of 8.04 ± 1.33 and 8.24 ± 1.34 respectively and 1-mm extrusion image as lowest with ratings of 2.87 ± 2.31 and 5.23 ± 2.81 respectively. There was a statistically significant difference in the ratings of 1-mm and 0.5-mm canine extrusion images among orthodontists and laypersons.

Conclusion: Both orthodontists and laypersons rated the standard smiles (considered harmonious with respect to the smile line) and the smiles with 0.5 mm of intrusion as the most attractive. In general, both groups found smiles with 1 mm of extrusion and 1 mm of intrusion to be less attractive.

KEYWORDS: Canine, Laypersons, Orthodontists, Smile

INTRODUCTION

Esthetics has traditionally been associated with profile enhancement in the orthodontic literature since long. Both the Angle's classification of malocclusion and the cephalometric appraisal have focused on the profile rather than the frontal view.[1] The primary objective of the traditional orthodontic diagnosis and treatment planning termed the "Angle paradigm" was ideal dental occlusion and acceptable skeletal relationships.[2] The times have changed considerably though. With the advent of the new "Soft tissue paradigm", the characteristic feature of facial soft tissue and harmony among them constitute the main core of advanced diagnosis and treatment planning.[3]

According to Sabri R, an esthetic smile consists of eight components i.e., lip line, smile arc, upper lip curvature, lateral negative space, smile symmetry, frontal occlusal plane, dental components and gingival components.[1] Subtleties in the proportions and shape of the teeth and associated gingival contours have been emphasized in the burgeoning literature on "cosmetic dentistry" in recent years. In a frontal smile, incisors attract more attention and play a vital role in forming the smile arc. Therefore, their influence on the smile has been inspected from many aspects. Contrarily, less literature has been reported regarding the effect of canines on smile attractiveness though being the cornerstone of dentition and having an effective role in esthetics and function. From a functional standpoint of view, canine guidance provides posterior disocclusion during lateral movements of the jaw.[4]

It is imperative to analyse smiles from laypersons' point of view as their priorities and concerns may be significantly different from those of the treating orthodontist. It has been reported that Dentists detect a transverse roll at 1 mm from side to side, whereas laypersons are more forgiving and see it at 2 to 3 mm— but at that point, it is a problem.[5] Similarly in cases where incisors are tipped mesiodistally from the midline, Laypersons find this objectionable esthetically when the inclination of the mesial proximal surface of an incisor exceeds a 2-mm deviation from where we would expect the normal, slightly angulated, surface to intersect the occlusal plane.[2]

The aim of this study was to evaluate the attractiveness of a frontal smile in a model with altered vertical position of the canine and to evaluate the differences between the esthetic perceptions of orthodontists and laypersons.

MATERIALS AND METHOD
Ethical approval for the study was obtained from the Institutional Review Committee of Chitwan Medical College (CMC-IRC/080/081-024). An adult Nepali female with ideal smile characteristics was selected by the authors. She had no previous restorative procedures in the anterior region, no previous orthodontic treatment, and her periodontal structures were healthy. The model was instructed to wear no makeup. The frontal posed smile photograph was taken as a close-up view, while the head position was standardized so that the Frankfort horizontal plane and the pupillary line were parallel to the true horizontal. Photographs were taken with a Canon EOS 550D DSLR Camera, with Canon Ultrasonic EF 100 mm 1:2.8 USM lens (Tokyo, Japan) and macro ring lite YONGNUO YN14exII (USA). Subjects had their mouth slightly open to provide a background with darker colors of the oral cavity and to minimize the exposure of lower teeth during visual evaluation.

Photographs were edited with Adobe Photoshop v.7.0 (Adobe Systems, California, USA). Skin irregularities of the model were eliminated. Modified versions for each model were created by adjusting the vertical positions of the maxillary canine teeth symmetrically above, below, or coincident with this line in increments of 0.5 mm within a range of 1 mm of extrusion and 1 mm of intrusion. For calibration, the maxillary central incisors were measured directly with a digital caliper (Liaoning MEC Group Co., Ltd. China) to the nearest 0.01mm and the measurements were used as a reference for the calibration of a ruler in the software. The proportion between width and height was not changed and this image was mirrored to ensure perfectly symmetrical changes. The images were cropped under soft tissue orbitale (the soft tissue point located at the most inferior level of each infraorbital rim) to eliminate the possible attraction of the eyes. Final images were named in two designators: the first representing the growth pattern as N (normal position of canine) and the second representing the vertical canine displacement as -1, -0.5, 0, 0.5, or 1. The direction of the movement was defined by (-) indicating intrusion and (+) indicating extrusion.[4]

For evaluation, a web-based survey was done using Google forms with 6 images as shown in Figure 1. The 0-mm image was used twice for each model to evaluate intrarater agreement. The scale was present under each image, graded from 0 to 10 (0 = most unattractive, 10 = most attractive). The image of each model was shown on separate screens to remove bias. The images were rated by 98 participants as per convenience sampling during the study period, among which 45 were orthodontists and 53 were laypersons with no dental training. Various studies have suggested no gender bias in the ratings of smile esthetics.[6–8] Hence, orthodontists' and laypersons' judgements were only compared in the present study.

Figure 1: Six modelled images of various vertical position of canine with "+" indicating extrusion and "– "indicating intrusion of maxillary canines on both right and left side

All the data were then entered in excel worksheet and then were analysed using Statistical Package for Social Sciences (SPSS) version 25. The intrarater reliability was measured using Cohen's kappa analysis. Descriptive statistics were then measured for each image. The difference in ratings between the orthodontists and laypersons was measured using chi-square test.

RESULTS

Kappa analysis showed substantial agreement with the value of 0.8 for intrarater reliability among orthodontists and 0.82 for laypersons. The descriptive statistics for each image rating are shown in Table 1. The highest rating was for 0-mm image with a value of 8.04 ± 1.33 for orthodontists and 8.24 ± 1.33 for laypersons and the lowest rating was for 1-mm extruded canine images with a value of 2.87 ± 2.31 for orthodontists and 5.23 ± 2.81 for laypersons. The difference between the ratings of orthodontists and laypersons was determined using the chi-square test (Table 2) and the test showed a statistically significant difference between orthodontists and laypersons ratings regarding 1-mm canine extrusion image ratings and 0.5-mm canine extrusion images.

Table 1. Descriptive statistics for each image model by orthodontists and laypersons

	ONO	ON+1	0N-1	0N+ 0.5	0N-0.5	LNO	LN+1	LN-1	LN+0.5	LN-0.5
No. of participants	45	45	45	45	45	53	53	53	53	53
Mean	8.04	2.87	5.19	5.32	6.87	8.24	5.23	6.67	6.76	7.41
S.D.	1.33	2.31	1.9	2.1	2.12	1.34	2.81	2.05	1.93	1.54
Minimum	5	0	0	1	0	5	0	2	1	3
Maximum	10	8	8	8	10	10	10	10	10	10

Note: "O" denotes Orthodontists; "L" denotes Laypersons; "+" denotes canine extrusion; "- "denotes canine intrusion

Table 2. Statistical Difference in the ratings of orthodontists and laypersons for each model image

S.N.	Model Image	Chi-square value	p- value
1.	N0	4.19	0.65
2.	N+1	24.6	0.006*
3.	N-1	19.83	0.1
4.	N+0.5	19.77	0.048*
5.	N-0.5	11.23	0.51

* denotes statistically significant difference between the ratings of orthodontists and laypersons

DISCUSSION

The vertical position of the canine is very much essential in terms of smile esthetics and functional occlusion. During the lateral excursion contact occurs only between the upper and lower canine, and the first premolar on the working side. There is no contact between the teeth on the non-working side. The canine is the most appropriate tooth to guide the mandible during lateral excursions as it has a good crown: root ratio capable of tolerating high occlusal forces, greater surface area than adjacent teeth providing greater proprioception, the concave shape of the palatal surface of canine suitable for guiding lateral movements.[9,10,11,12] Upper canines also serve as a transition point from the front to the posterior teeth. Furthermore, the upper canines, together with the central and lateral incisors, define the character of a smile.[13]

Close-up images were preferred rather than the full-face image to avoid distractions as some studies suggest that the perception of smile details may be considered more relevant when close-up images are used rather than full-face images.[14,15]

A study by Katsis et al. demonstrated that no correlation was found between the subjects with the best or worst esthetic outcomes and their respective canine positions.[16] However, differing from this study, the methodology for obtaining the reference points was based on bone tissues, and different posttreatment smiles were used for evaluations. Such differences make it difficult to observe the position of the canines from the same perspective. Anatomic factors such as lip thickness, dental morphology, and gingival display all influence esthetic perception.

Our study showed that extreme changes were more unpleasant for both orthodontists and laypersons. 1 mm extrusion images received lowest ratings among both groups but laypersons were of more forgiving nature as the difference of the score for 1 mm extrusion images was statistically significant. Similar findings were reported by Correa et al.[17] and Paiva de et al.[18]

0.5 mm extrusion images also showed statistically significant difference among orthodontists and laypersons with mean score of 5.32±2.1 and 6.76±1.3 respectively. A trend toward greater rejection of extruded canines, when compared with intruded ones, was observed in our study.

According to the study by Schwefer et al., the most esthetically pleasing canines are about the same length as the central incisors, match the shade of the other front teeth, blend well within a lighter overall tooth color, are positioned with a neutral or slightly palatal tilt, and feature an incisal edge that is right-angled or rounded (≥ 90°). On the other hand, canines that are considered least esthetic tend to be longer than the central incisors, darker in color, inclined outward (labially), and have a tapered incisal edge.[8] Similar findings were reported in the present study as well in relation to the vertical position of canines.

Occasionally, during orthodontic treatment finishing, the strategy to extrude the canines can be used to obtain better canine guides. These mechanics can cause esthetic prejudice because the gingival margin accompanies the extrusive movement, generating a lack of harmony in the gingival contour that can be observed mainly when there is gingival display while smiling. In addition, the canine cusps turn out to be more prominent, which may result in a smile with incisal edges of the central incisors above the canine cusps and a reverse or straight smile, unpleasant for not presenting vertical dominance of the central incisors.[19,20] Similar findings were corroborated by the present study.

Moreover, a limitation of this study was the difficulty in defining a reference line to change the position of the canines, since the smile harmony line is curved, which makes its use unfeasible for the vertical changes proposed in this research. No attempt was made to quantify the amount of exposed gums or the esthetics directly related to it.

CONCLUSION

1. Both orthodontists and laypersons rated the standard smiles (considered harmonious with respect to the smile line) and the smiles with 0.5 mm of intrusion as the most attractive.
2. In general, smiles with 1mm of extrusion and 1mm of intrusion were found to be less attractive by both groups.
3. Orthodontists were more critical in their assessments, giving significantly lower scores for all images evaluated.

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REFERENCES

1.   Sabri R. The eight components of a balanced smile. J Clin Orthod 2005;39(3):155–67.

2.   Proffit WR, Fields HW Jr, Sarver DM. Contemporary Orthodontics. 5th edition. St. Louis: Mosby; 2014.

3.   Sarver DM. Interactions of hard tissues, soft tissues, and growth over time, and their impact on orthodontic diagnosis and treatment planning. Am J Orthod Dentofacial Orthop 2015;1483:380–6.

4.   Acar YB, Abuhan E, Boyaciyan R, Özdemir F. Influence of facial type on attractiveness of vertical canine position from the perspective of orthodontists and laypeople. Angle Orthodontist 2022;92(2):233–9.

5.   Kokich VO Jr, Kiyak HA, Shapiro PA. Comparing the perception of dentists and lay people to altered dental esthetics. J Esthet Dent 1999;11:311–24.

6.   Moore T, Southard KA, Casko JS, Qian F, Southard TE. Buccal corridors and smile esthetics. American Journal of Orthodontics and Dentofacial Orthopedics 2005;127(2):208–13.

7.   Ioi H, Nakata S, Counts AL. Effects of buccal corridors on smile esthetics in Japanese. Angle Orthodontist 2009;79(4):628–33.

8.   Schwefer N, Freitag-Wolf S, Meyer G, Kern M. Investigation of the esthetic perception of different canine parameters. Clin Oral Investig 2022;26(12):6973–83.

9.   D'amico A. Canine Teeth-Normal functional relation of the natural teeth of man. J South Calf D A 1958;26:239–41.

10. Shaw DM. Form and function in teeth, and a rational unifying principle applied to interpretation. International Journal of Orthodontia, Oral Surgery and Radiography 1924;10(11):703–18.

11. Nagao M. Comparative Studies on the Curve of Spee in Mammals, with a Discussion of Its Relation to the Form of the Fossa Mandibularis. J Dent Res 1919;1(2):159–202.

12. Clark JR, Evans RD. Functional Occlusion: I. A Review. J Orthod 2001;28(1):76–81.

13. Bothung C, Fischer K, Schiffer H, Springer I, Wolfart S. Upper canine inclination influences the aesthetics of a smile. J Oral Rehabil 2015;42(2):144–52.

14. Flores-Mir C, Silva E, Barriga MI, Lagravère MO, Major PW. Lay Person'S Perception of Smile Aesthetics in Dental and Facial Views. J Orthod 2004;31(3):204–9.

15. William Arnett G, Bergman RT. Facial keys to orthodontic diagnosis and treatment planning—part II. American Journal of Orthodontics and Dentofacial Orthopedics 1993;103(5):395–411.

16. Katsis J, Behrents RG, Araujo EA, Oliver DR, Kim KB. Posttreatment evaluation of maxillary canine positions in 15-year-old subjects. American Journal of Orthodontics and Dentofacial Orthopedics 2016;149(4):481–90.

17. Correa BD, Vieira Bittencourt MA, Machado AW. Influence of maxillary canine gingival margin asymmetries on the perception of smile esthetics among orthodontists and laypersons. American Journal of Orthodontics and Dentofacial Orthopedics 2014;145(1):55–63.

18. Paiva TT de, Machado RM, Motta AT, Mattos CT. Influence of canine vertical position on smile esthetic perceptions by orthodontists and laypersons. American Journal of Orthodontics and Dentofacial Orthopedics 2018;153(3):371–6.

19. Krishnan V, Daniel ST, Lazar D, Asok A. Characterization of posed smile by using visual analog scale, smile arc, buccal corridor measures, and modified smile index. American Journal of Orthodontics and Dentofacial Orthopedics 2008;133(4):515–23.

20. Sarver DM, Ackerman MB. Dynamic smile visualization and quantification: Part 2. Smile analysis and treatment strategies. American Journal of Orthodontics and Dentofacial Orthopedics 2003;124(2):116–27.