

Cephalometric Comparison of Collum Angle in Horizontal and Vertical Growth Patterns

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Citation

Shrestha D, Shrestha RM, Dhakal J, Bajracharya S. Cephalometric comparison of Collum angle in horizontal and vertical growth patterns. J Kantipur Dent Coll. 2022;3(1):17-20.

ABSTRACT

Introduction: Collum angle; the crown-root angulation is a common interest for orthodontists. It is formed by the intersection of long axis of the crown to the long axis of root observed in lateral cephalogram. It affects the extent to which the roots can be torqued and it can also alter the intended intrusive and extrusive forces on the tooth.

Objective: To compare the Collum angle of maxillary central incisor tooth between horizontal and vertical growth patterns.

Materials and methods: It is a cross-sectional comparative study using lateral cephalogram of sixty subjects of the age range 13-30 years. The samples were divided into horizontal grower and vertical grower according to the Jarabak ratio. The Collum angle of maxillary central incisor was manually traced and measured by two observers. Student's t-test was performed to compare the angle between horizontal and vertical growth patterns and between male and female subjects ($p < 0.05$).

Results: The mean Collum angle of horizontal growers were 6.15 ± 7.33 and of vertical growers were 0.23 ± 8.94 . The difference between them were statistically significant ($p = 0.007$). There was no significant difference in angle among the gender groups ($p = 0.22$).

Conclusion: Collum angle of maxillary central incisor was measured significantly greater in horizontal growth pattern as compared to vertical growth pattern.

Keywords: Collum angle, horizontal growth pattern, jarabak ratio, lateral cephalogram, vertical growth pattern.

INTRODUCTION

Improvement in esthetics is an important factor for patients seeking orthodontic treatment.¹ Determining the variation of individual tooth morphology is an important aspect for the establishment of finesse in esthetics during orthodontic treatment.² The size and shape of the crown has a strong genetic control. However, root formation process usually follow local environmental factors and vary morphologically.³⁻⁵

Orthodontists usually have interest in root to crown angulation in anterior single rooted tooth, known as Collum angle. It is formed by the intersection of long axis of crown to long axis of root, traced in lateral cephalogram. The crown root angulation usually affects treatment outcome in orthodontic procedure. It influences the extent to which the roots can be torqued particularly in lingual direction in relation to the cortical plates. Also, the angulated tooth can alter the intended intrusive or extrusive forces causing

the root portion to impinge on labial or lingual cortical plates.⁵⁻⁶

Formation of Collum angle was explained by Logan, Backlund and Srinivasan et al. as they concluded that lower lip force and genetic factor play role in crown-root angulation of maxillary central incisors. It resulted in the bending phenomenon of Collum angle. If lower lip rested on the middle of the crown of central incisors, they showed significantly larger Collum angle. This may be due to pressure exerted by the lower lip at the time of eruption. This indicates a high predilection of lower lip as an etiologic factor for increased Collum angle.⁷⁻⁹ Studies suggest that different dentofacial disharmonies have variable lip closure patterns. Relapse tendencies are more when there is failure to guide a proper lip closure in skeletal Class II malocclusions.^{9,10}

Numerous studies in the literature compares Collum angle in various skeletal patterns and also different Angle's

molar relations.⁵⁻¹⁰ However, research about comparison of Collum angle in vertical malocclusions is scarce. This study highlights the comparison of Collum angle in horizontal and vertical growth patterns in Nepali sample.

MATERIALS AND METHODS

The study was a cross-sectional comparative study on lateral cephalogram of patients visiting Department of Orthodontics, Kantipur Dental College & Hospital, Kathmandu. The inclusion criteria were lateral cephalograms of patient of age range 13-30 years and the exclusion criteria were severe crowding in anterior tooth, previous orthodontic treatment, inferior image quality and history of craniofacial trauma that may hamper the growth. The study period was during March to April 2022. Ethical clearance was obtained from Institutional Review Committee, Kantipur Dental College (IRC Reference Number 4/022).

The sampling technique was convenience sampling and sample size was calculated using the data from the study done by Delivanis⁶ using the formula:

$$N = 2X(Z\alpha + Z\beta)^2 X \rho^2 / D^2$$

Where, $Z\alpha$ at 95% confidence is 1.96, $Z\beta$ is 1.28 in 90% power, ρ is the average of standard deviation and D is the difference of mean in that similar study.⁶

The value from above equation was 30. Hence, another 30 sample was added due to the design effect. Therefore, total sample size was 60. The samples were divided into 30 each for horizontal and vertical growers.

Secondary data were obtained from the departmental records. Manual tracing of the films were done and then measurements were recorded in the proforma sheet by two observers separately. The samples were divided into two groups; vertical and horizontal growth patterns according to Jarabak ratio.¹¹ Anatomic landmarks used to determine the ratio included Sella (S), Nasion (N), Menton (Me), Gonion (Go). The linear measurements used were S-Go

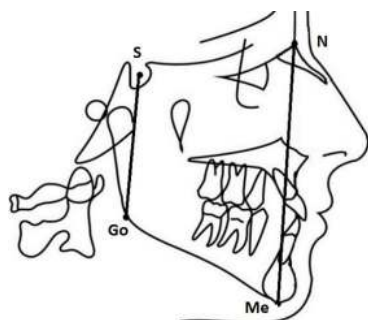


Figure 1: Cephalometric points and linear measurements

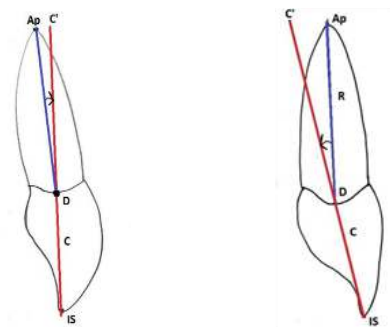


Figure 2: Positive Collum Angle Figure 3: Negative Collum Angle

(posterior facial height) and N-Me (anterior facial height) (Figure 1).

Collum angle⁵ was traced and measured in both growth pattern samples. The angle was formed by longitudinal axis of the crown with longitudinal axis of the root. It has either positive or negative angulations.

The anatomic landmarks used to define the angle were; Point Ap – radiographic apex of the root; Point D - located between lingual and facial projection of cemento-enamel junction; Point IS - Incision Superious - incisor tip of maxillary central incisor; R - longitudinal axis of root; C - longitudinal axis of crown extended towards root; Collum Angle was formed by points Ap-D-C'(Figure 2 and 3)

SPSS V21 was used to compare the means of Collum angle between the horizontal and vertical growers and between genders. Student's t-test was used for the comparison of means. The level of significance was set at $p < 0.05$.

RESULTS

The sample size of the study was 60 including 30 samples of horizontal and 30 sample of vertical growth patterns. The mean angulations and comparison between the growth patterns and between the genders are shown in Table 1. The difference between Collum angle of horizontal

Table 1: Mean Collum angle of different variables and t – test of significance

Variable	n	Mean ± SD	p-Value
Horizontal growth pattern	30	6.15±7.33	0.007*
Vertical growth pattern	30	0.23±8.94	
Female	30	1.83±8.56	0.226
Male	30	4.55±8.63	

*Significant at $p < 0.05$

and vertical growth pattern was statistically significant ($p=0.007$). Difference between male and female was not significant ($p=0.226$).

DISCUSSION

This study showed significant difference in Collum angle of maxillary central incisor between vertical and horizontal growth patterns with greater Collum angle in horizontal growth pattern sample.

The relationship between Collum angle and sagittal relationship was shown by various studies. Shailaja et al. and Delivanis observed that the incisal angulation of crowns were found in Class II division 2 patients with positive Collum angle.^{6,12} As the patients with Class II division 2 malocclusions are considered horizontal growers, their findings are similar to the results of this study. On the other hand, Harris et al. found no difference in Collum angle between Class I and Class II malocclusions. Larger Collum angles are found in Class III patients.⁵ Their eruptive pathway is deflected by the forwardly placed mandibular incisors into more upright position.^{5,6} Arvind et al. observed that the Collum angle was decreased in Class II division 1 patients. This variation in Collum angle suggests the use different torque prescriptions and necessitates the use of alternative mechanics for tooth movement in maxillary anteriors.¹³ Pai et al. found that the increased Collum angle increase the stress and strain in lingual and labial orthodontics with more pronounced effect in lingual mechanics.¹⁴

When compared in vertical relationship, Goma et al. found larger Collum angle in horizontal growth pattern which is similar to the findings of the present study.¹⁵ In contrast, Behroz et al. showed difference in Collum angle in different growth patterns with increased angle in high angle cases.¹⁶ Wang et al. measured Collum angle of maxillary central incisor in different growth patterns and differences were not significant although the mean Collum angle were higher in horizontal growth pattern.¹⁷

The comparison of Collum angle in horizontal and vertical growers has been done in various studies. A graph was plotted to compare the mean Collum angle in various studies which took in different places (Figure 4). It was observed that the graphs were quite variable. The horizontal grower has greater Collum angle in Nepali and Egyptian population.¹⁵ However, opposite finding was observed in Pakistani sample as there was increased Collum angle in vertical growth pattern.¹⁶ The Chinese population did not show much difference in the angle between growth patterns.¹⁷

The variation in mean Collum angle with growth pattern in various studies suggest that there is a tendency towards increased Collum angle in horizontal growth pattern with few exceptions.

This study relied on manual tracings of cephalogram to obtain Collum angle. Further exploration can be done using digital platforms for measurements for more accuracy. Furthermore, CBCT studies is also a probable arena to explore more into this topic.

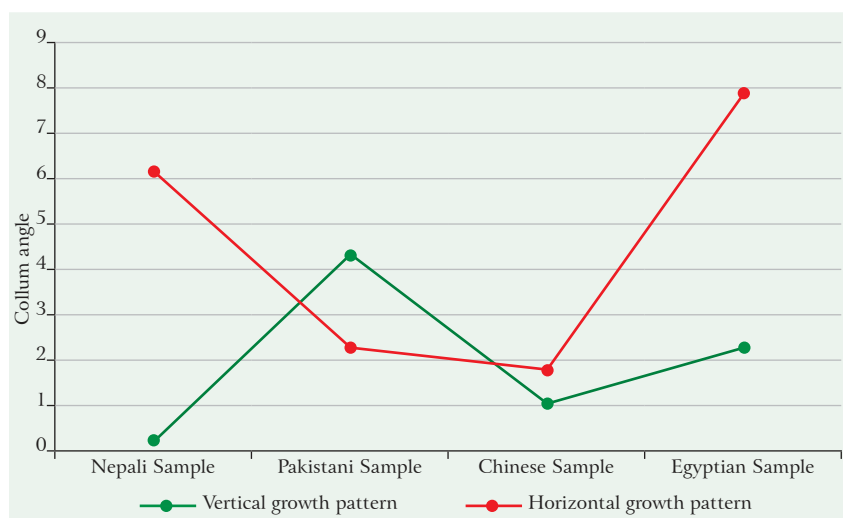


Figure 4: Mean Collum angle in different country sample

CONCLUSION

Following conclusions can be drawn from the study:

- The relation of Collum angle with different growth pattern is shown to significantly vary between horizontal and vertical growth patterns.
- Larger Collum angle is found in horizontal growth pattern.

ACKNOWLEDGEMENT

The authors would like to thank Dr Sujita Shrestha, faculty, Department of Community Dentistry for support in statistical analysis. Also, humble gratitude to Dr Ujjwal Pyakurel and Dr Alka Gupta, faculties of Department of Orthodontics, for their guidance in manuscript writing.

CONFLICT OF INTEREST: None.



REFERENCES

1. Kilpeläinen PV, Phillips C, Tulloch JF. Anterior tooth position and motivation for early treatment. *Angle Orthod.* 1993;63(3):171-4.
2. Bryant RM, Sadowsky PL, Dent M, Hazelrig JB. Variability in three morphologic features of the permanent maxillary central incisor. *Am J Orthod.* 1984;86(1):25-32.
3. Townsend GC, Brown T. Inheritance of tooth size in Australian Aborigines. *Am J Phys Anthropol.* 1978;48(3):305-14.
4. Kolakowski D, Bailit HL. Segregation analyses of tooth size in a Melanesian population. *Ann Hum Biol.* 1981;8(3):255-62.
5. Harris EF, Hassankiadeh S, Harris JT. Maxillary incisor crown-root relationships in different angle malocclusions. *Am J Orthod.* 1993;103(1):48-53.
6. Delivanis HP, Kuflinec MM. Variation in morphology of the maxillary central incisors found in Class I, Division 2 malocclusions. *Am J Orthod.* 1980;78(4):438-43.
7. Backlund ER. Tooth from and overbite. *Trans Eur Orthod Soc.* 1960;36(1):97-103.
8. Logan WR. Deckbiss- A clinical evaluation. *Trans Eur Orthod Soc.* 1959;35(1):313-7.
9. Srinivasan B, Kailasam V, Chitharanjan A, Ramalingam A. Relationship between crown-root angulation (Collum angle) of maxillary central incisors in Class II, division 2 malocclusion and lower lip line. *Orthodontics (Chic.)*. 2013;14(1):66-74.
10. Koletsi D, Makou M, Pandis N. Effect of orthodontic management and orofacial muscle training protocols on the correction of myofunctional and myoskeletal problems in developing dentition. A systematic review and meta-analysis. *Orthod Craniofac Res.* 2018;21(4):202-15.
11. Jarabak JR, Fizzell JA. *Technique and treatment with light-wire edgewise appliances*, ed. 2, St. Louis, The CV Mosby Company; 1972.
12. Shailaja AM, Gowda NC, Gowda S. The Collum angle of Maxillary Central Incisors in different skeletal malocclusions – A Cephalometric study. *Int J Appl Dent Sci.* 2016;2(3):33-6.
13. Arvind TR P, Felicita AS. Correlation between collum angle and lower lip position in different Class II malocclusions - A retrospective cephalometric study. *Orthod Waves.* 2021;80(2):81-6.
14. Pai SS, Panda S, Pai V, Anandu M, Vishwanath E, Suhas AS. Effects of labial and lingual retraction and intrusion force on maxillary central incisor with varying Collum angles: A three-dimensional finite elemental analysis. *J Ind Orthod Soc.* 2017;51(1):28-37.
15. Gomaa N, Elmarhoumy S, Fakhry N. Maxillary Central Incisors' Collum angle in different skeletal vertical malocclusions - A Cephalometric study. *Egypt Dent J.* 2019;65(1):1-7.
16. Behroz E, Ahmed HZ, Rafi S.M.T, Qadeer TA, Shah M, Fatima S. Comparison of Collum angle of maxillary central incisor in high angle and low angle patients. *J Pak Dent Assoc.* 2021;30(2):113-7.
17. Wang X, Ma L, Wang J, Xue H. The crown-root morphology of central incisors in different skeletal malocclusions assessed with cone-beam computed tomography. *Prog Orthod.* 2019;20(1):1-11.