



Non-metric trait “winging” in dental malocclusion: A scoping review

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ABSTRACT-

Background: Dental non-metric and metric traits provide valuable evidence in anthropology and ethnicity determination in forensics. Of the various non-metric dental traits, “winging” and “counter-winging” represent the rotation of upper incisors, described by various authors, and are known to be influenced by gene-environment interplay. Thus, it shows association to various dental and skeletal classes of malocclusion which may have anthropological and clinical implications.

Material and methods: The current scoping review was planned with the aim to study skeletal and dental malocclusions associated to “winging”. A thorough literature search was conducted in June 2023 in ‘PubMed’, ‘Scopus’ and ‘Web of Science’ with MeSH and free text terms, “winging”, “orthodontics” in combination with Boolean terminologies. Study designs including clinical trials, case series, and case reports were included with no limitation of date and language. Initial search was done with a pre-determined search strategy, followed by duplicate removal, further exclusion by strict inclusion criteria, and full text retrieval of final included records.

Results: PRISMA revealed 47 records in initial search, followed exclusion of 43 records, and final inclusion of 4 articles where orthodontic intervention had been attempted for correction of winged maxillary incisors. All studies had attempted derotation of winging successfully, of which one of the studies intervened with aligner therapy, and the other three with sectional fixed orthodontic appliances. Of these, one case report on a cleft patient mentioned a 6-year retention follow-up.

Discussion and conclusion: Winging represents an unusual dental morphological pattern in an individual and is frequently associated with dental/skeletal malocclusions and growth abnormalities like cleft lip and palate, as has been presented in the current scoping review. It also highlights the challenges in management of winging in orthodontic correction and the requirement of long-term retention in such cases. This review brings forth the need to explore further the genetic overlap of winging with other dental and skeletal traits. Also, “winging” should be documented as a separate malocclusion trait in regular orthodontic assessments with a huge potential in individual identification in forensics.

Keywords: Winging, dental non-metric trait, malocclusion, forensics, scoping review, orthodontics

Introduction

Winging is a non-metric dental trait describing the position of upper incisors where a wing-like appearance is formed by maxillary incisors due to the rotation of these teeth in their sockets. (Figure 1a) However, different terminologies have been used for rotation of upper incisors by different authors: “Mesio- palatal torsion” by Nelson¹, and Leigh², “bilateral mesial rotation” by Dahlberg, Enoki, and Nakamura 1958³, and “bilateral V shape incisors” by Wright in 1941⁴.

In appearance, winging describes the incisors’ position when the tooth (or teeth) is rotated so that the distal surface is displaced labially and the mesial surface lingually (Figure 1a). In contrast, “counter-winging” is also explained by Dahlberg (1958, 1963)⁵ as the position of incisors when the mesial surface is displaced labially and the distal surface lingually. (Figure 1b)

Dental morphological characteristics including “winging”

since primeval times have been instrumental in providing valuable evidence in palaeontology studies, as teeth are one of the best-preserved materials in ancient remains. The

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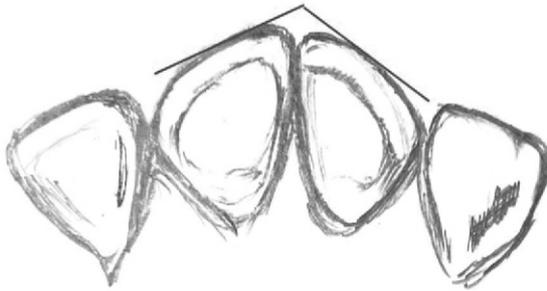


Figure 1a

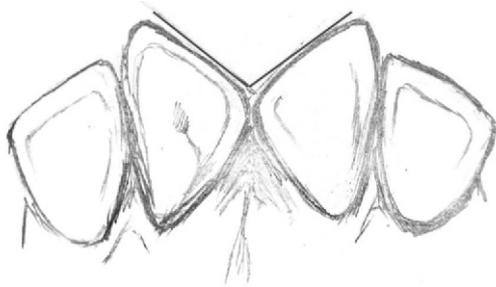


Figure 1b

heterogeneity in dental morphology amongst different populations is useful in understanding the variation in evolution, food habits, phenotype, and alignment characteristics of human dentition owing to the ethnic diversity in as well as progression to modern civilizations.^{6,7}

There are various systems to classify the dental morphological variations, of which ASUDAS (Arizona state university dental anthropology system) is the most extensively used. It has several advantages of being comprehensive with detailed illustrations and relevance in current times due to user-friendly software application.^{7,8}

The frequency trend of ASUDAS traits has been explored in several ethnic populations worldwide and most recently, 20 ASUDAS traits have been studied in Delhi, NCR population in India by Chowdhry et al, 2023.⁹ Further, recent study by Irish et al, 2020 has explored these ASUDAS traits for the genetic affinity using single nucleotide polymorphisms (SNPs) among African and global samples and found close association of ASUDAS/SNP for dental and genetic traits. Thus, it is imperative that these traits be explored in various skeletal and dental arrangements of teeth and jaws which¹⁰ are governed by genetic or epigenetic environmental influences. As an overtone, a recent study by Ashoori et al, 2022¹¹ also studied the association of 46 non-metric traits/shape-number-size anomalies with sex and skeletal malocclusions.

However, the mode of inheritance of individual traits is not well understood in association with dental and skeletal

arrangement of teeth and jaws. Of these, “winging” presents forensic, anthropological, and clinical implications having specific concerns during orthodontic alignment and retention due to its clinical presentation. Although, “winging” is a dental trait extremely important for individual identification in forensics, the current scoping review focuses on its association with malocclusion for its clinical arrangement as well as management.

Material and methods: The research question addressed in the current scoping review was “Is winging a malocclusion trait with special concerns in presentation, management, and retention?”. A thorough literature search was conducted in June 2023 in different databases, “PubMed”, “Scopus” and “Web of Science” with MeSH and free text terms, “winging”, AND “orthodontics” in combination with Boolean terminology. Variable study designs were included i.e clinical trials, case series, and case reports with no limitation of date and language. Reviews and systematic reviews, opinions were excluded. Preferred reporting items for systematic reviews and meta analyses (PRISMA) was followed for record identification, screening, eligibility, and exclusion.(Figure 2) Initial search was done with a predetermined search strategy (“winging”, AND “orthodontics”) followed by duplicate removal, further exclusion by strict inclusion and exclusion criteria (Table 1), and full text retrieval of final included records.

Results: Initial search revealed 47 records on application of predetermined search strategy on databases based on the research question. Duplicate removal excluded two records followed by further exclusion of 41 records following strict inclusion and exclusion criteria (Table 1). Final inclusion of 4 articles was done where orthodontic intervention had been

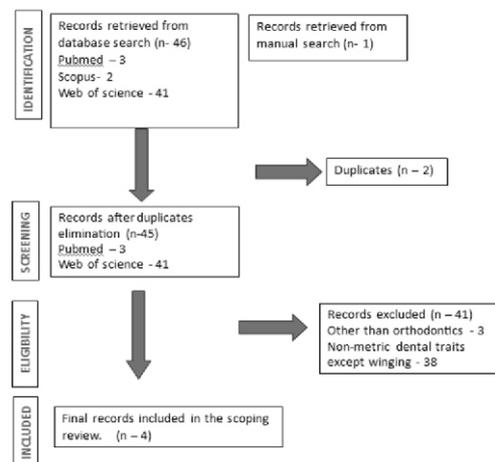


Figure 2: Preferred Reporting Items for Systematic Reviews and Meta-Analyses



Table 1: Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
Non-metric dental traits of winging	Studies in nonmetric dental traits not in the orthodontic domain
Studies involving orthodontic treatment	Nonmetric dental traits except winging

attempted for correction of winged maxillary incisors.(Figure 2) The search was performed by two investigators independently (SM, MA) and in case of discordance, was referred by two investigators (PK, AC) until the consensus was achieved. These three included records underwent data extraction by SM, MA independently.

Data extraction: The data extraction (Table 2) of three included studies¹²⁻¹⁵ revealed different approaches for correction of winged maxillary incisors to change in interlabial angle, and correction of rotation and tip of incisors followed by retention. Of these, two studies^{13,15} mentioned correction of incisor alignment with sectional edgewise appliance bonded to the bilateral central incisors for alignment, with OX2 twin bracket appliance and an 0.018-inch NiTi wire used in one of the studies.¹⁵ The third study however retrospectively studied incisor correction performed by contemporary Invisalign treatment using Clincheck technology comparing the accuracy of predicted outcome with the achieved outcome, and suggested use of linear equations to overcorrect such incisors.¹² In addition, one case-report showed winging and unusual morphology of incisors as one of the dental traits in patient with Bloch-Sulzberger Syndrome with cleft Lip and palate along with many other dental anomalies.¹³ Thus, it is paramount to check genetic association of such nonmetric dental traits with the syndromes of growth abnormalities as they may act as proxy to occurrence of such conditions. Besides, one case report in a young patient mentioned a history of fall two years prior to presentation of patient in the clinic.¹⁵ There was no way to ascertain that winging was consequent to the fall, but ascertains that such history could be relevant to the clinical presentation of “winging” in future. One case report mentioned retention by crowns and fixed prosthesis for esthetics,¹³ while the other mentioned retaining the appliance for 12 weeks prior to root completion.¹⁵

Discussion: The current scoping review focuses on the importance of winging as a malocclusion trait, its identifying features (showing significance in forensic identification), associated anomalies, orthodontic management and retention.

The term “winging” for incisors has been used in dental

anthropology, dental anatomy, forensic odontology¹⁶ primarily for referring to peculiar teeth arrangement but has not been separately used till now as a malocclusion trait. However, the classification of winging as given in ASUDAS can show clear clinical representation in orthodontic malocclusions. Table 3 gives a clinical and pictorial representation of each class of winging as given in ASUDAS system.

These classes of winging have been discussed with respect to ethnicity determination by Oshima S et al¹⁷ on a sample of 750 study casts and 500 dry skulls among Chinese males, with 4.4% and 5.3% rotation of the left and right maxillary central incisors respectively. He also found 3% bilateral winging of maxillary central incisors among Chicago Whites and 22% to 38% among Pima Indians. Enoki and Nakamura(3) reported 9.64% of bilateral winging among 1,089 Japanese school children, with females having a higher frequency (12%) than males (7%) whereas Rothammer¹⁸ measured mesio palatal rotations of central incisors relative to the sagittal line of the maxilla with no sex difference found in the Chilean Indian population. V.Kaul and S.Prakash¹⁹ reported maxillary central incisor winging in Jat children ranging in age from 6-16 year with males having higher frequency of winging than females in deciduous dentition while no significant winging was seen in permanent dentition.

As observed in clinical pictures and the studies included in scoping review, winging and reverse winging is found in association with other dental and skeletal anomalies including high narrow arched palate and also in syndromes with cleft lip and palate.¹³ This condition is found to exist in both crowded and uncrowded dentitions. The arch form and the palatal vault height may influence the position of teeth and pedigree studies show a consistent similarity of this trait in families, which suggests a genetic exploration for this trait, as shown in an earlier study showing ASUDAS/SNP association.¹⁰ Further, winged teeth have often been found to be accompanied by other dental morphology, number, and eruption anomalies such as adjacent teeth malposition, dilacerations, supernumerary and retained deciduous teeth, and abnormal morphology of several teeth in the same patient.¹⁵ Thus, the clinic assessment of associated anomalies is imperative on presentation of winging.

Regarding management and retention, the cases included



Table 2: Summary of the findings of the studies included in the present scoping review.

STUDY	STUDY PARTICIPANTS	AGE/ SEX	DENTAL PARAMETERS WITH RELEVANT HISTORY	TREATMENT	METHOD OF ASSESSMENT	RESULTS
Maree A et al, 2022(12)	30	Adults >18 years	Winged maxillary central incisors	Invisalign appliance was used for rotation and tip movements of winged maxillary incisors. The superimposition with respect to interlabial angle (ILA) and tip was measured between Clincheck predicted and achieved tip and ILA at three time points, using Geomagic Control X software (3D Systems, Rock Hill, SC) was used	Stereolithography files	No statistically significant difference in ILA due to measurements for rotation and change in individual incisor rotation using conventional measurement method and superimposition method was observed. reported. The Invisalign programmed upper incisor rotation and uprighting usually shows undercorrection and requires close monitoring with the help of regression equations for overcorrection.
Nojima K et al, 2017(13)	1	8 years 4 months/ Female	bilateral cleft lip, alveolus, and palate; a Class II molar relationship; winging of both maxillary central incisors; and spacing in the mandibular anterior tooth arches. Anterior crossbite	Sectional edgewise appliance for incisors alignment.	Photographs, OPG Lateral Cephalogram	Orthodontic correction, fitted prostheses, restorative treatment for occlusal stability. Retention period of 6 years with regular follow up
Dali et al, 2013(14)	1	6 years	Early mixed dentition patient with unilateral winging of 11	Begg's bracket bonded on labial and palatal aspect of 11 which was derotated with the help of two cross elastics (3M Unitek, California, USA) and anchorage from molars banded with Nance palatal arch.	Photographs, clinical examination	Orthodontic correction, composite ribbon fiber as retainer on palatal aspect of 11 and 21, follow-up every 3 weeks
Prasad VN et al, 2005(15)	1	8 years 6 months / Male	Winged maxillary central incisors H/O Trauma by fall at 4 years 6 months	0×2 twin bracket appliance with anterior sectional wire, 0.018 inch NiTi initially, replaced by 0.0175×0.025 inch Stainless wire after 4 weeks.	Photographs, IOPAR OPG	Derotation of incisors was achieved, 12 weeks retention, 12 months follow up revealed no relapse



in the scoping review mention different approaches, including sectional edgewise appliance, use of cross-elastics, and newer techniques of aligner therapy. While two studies mentioned sectional edgewise appliance for correction of winging,^{13,15} one mentioned correction of unilateral winging by buccal and palatal bonding of winged incisors and correction by cross-elastics and Nance palatal arch.¹⁴ This suggests early interception of winging in young early mixed dentition stage for better derotation and retention. Few studies also mention correction of associated abnormal morphology by reshaping, followed by crown or fixed prosthesis. This suggests inter-disciplinary management of winging and regular follow-up at an interval of 3-6 months in case of early interception of winging.

Newer treatment therapies including aligner therapy has also been explored for derotation for improving the inter-incisal angle of winged incisors.¹² It has been suggested that linear regression equations should be incorporated in ClinCheck or other aligner software for over-correction and maintenance of correction.

Limitations:

- Variable study designs were included
- Quality assessment not done
- No randomised trial was found for best treatment strategy for correction of winged incisors

Future scope

Table 3: Classification of “winging” with clinical and pictorial representation

Class	Interpretation	Clinical photograph	Diagrammatic representation
1A	Bilateral winging (Greater than 20 degrees)		
1B	Bilateral winging (less than 20 degrees)		
2	Unilateral winging		
3	Straight		
4	Counter-winging		

- Winging can be proposed as a malocclusion trait with proper treatment and management strategies for different stages of dentition.
- It should be a part of dental record proforma to aid individual identification for forensic purposes, if required in future.

Conclusion

Winging, a non-metric dental trait, usually assessed for ethnicity determination, is a potent malocclusion entity which requires interception at early stages for timely management and better retention of correction. The current scoping review suggests sectional fixed orthodontics and use of cross elastics with anchorage savers in early interception as conventional approach and newer aligner therapies for correction of winging in adults. Future studies should focus on clinical trials with standard therapies for generating good primary literature and also considering winging as a separate malocclusion entity.

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