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Shovel Shaped Incisors: A Non-Metric Dental Trait in Local Population of Punjab, Pakistan

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ABSTRACT

Maxillary Incisors being the anterior teeth hold great importance for function and esthetics. Different morphological traits can affect the shape of incisors. Shoveling is a non-metric morphological trait predominantly seen in maxillary incisors and is characterized by prominent mesial and distal ridges enclosing a central fossa on the lingual surface of incisors. **Objective:** To determine the frequency of shovel shaped Incisors and its distribution according to gender in a local population of Punjab, Pakistan. **Methods:** The study was a cross-sectional study carried out on 176 students of age between 17-23 years. Probability, stratified random sampling technique was employed and the study was conducted from March, 2023 to November, 2023. The participants taken for the study were carefully examined clinically to diagnose the presence or absence of this trait. **Results:** Out of total population of 176, only 55 (31.2%) individuals were positive for shoveling trait. Among the positive individuals, no gender predilection of this trait was observed. **Conclusion:** Non-metric dental traits can be assessed to identify ethnic groups, forensic odontology and inform clinical management in various dental procedures.

INTRODUCTION

Odontogenesis is a complex yet well-regulated process. It is a highly diverse phenomenon which involves molecular factors that interact throughout prenatal and postnatal development. Tooth crown features are a result of this diverse process and is controlled by interaction of chemical signals between neighboring and distant cells. Hence the variation in the normal morphology of a tooth is a result of simultaneously acting genetic as well as environmental factors [1]. The study of dental traits and its relation with human development by linking it to the past and present population is called Dental Anthropology [2]. Trait is defined as a characteristic feature that distinguish an individual and its frequency of occurrence varies in different populations [3]. Study of dental morphology in relation to dental anthropology requires to understand the way in which frequency, sexual dimorphism and symmetrical distribution of tooth crown morphological traits (TMCT) vary in permanent teeth in different populations [4]. Dental traits are broadly classified as metric and non-metric traits. Metric traits are those which can be readily quantified for example, crown height, length and width. While non-metric traits are those which show variation in normal anatomy. These may be present or absent, with a variable frequency in different population in certain period of time. Examples of such traits include labial curvature, Shovel-shaped incisors and Carabelli's

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cusp [5]. The non-metric dental traits are heritable features that express morphological variation within one population and among different populations as well. Hence, they can be used in comparing the culture, history and biological progress of early and modern humans [6]. These traits are particularly useful in clinical dentistry, oral pathology, tooth morphology, dental anthropology and forensics [7]. Non-metric dental features provide unique insights into the evolutionary history and genetic makeup of the human population [8]. Teeth are having the strongest structure due to its highest mineral content and can serve as excellent source of study material in forensic and genetic as they remain preserved after any disaster or explosion. Due to this, the non-metric dental traits can be used by forensic odontologist to help identify a person or differentiate between races [9, 10]. Among the non-metric traits incisor shoveling has attained high attention for the forensic odontologists and anthropologists [11]. Incisors, being the anterior group of teeth, hold an important position in oral cavity both esthetically and functionally. According to studies incisors have a high tendency of acquiring multiple morphological variations that can be influenced genetically or environmentally. This includes peg shaped incisors, shoveled incisors, dens invaginatus, barrel shaped or cone shaped incisors [12]. Shoveling is a characteristic predominantly seen in maxillary incisors and occasionally in mandibular incisors. It is defined by prominent mesial and distal ridges enclosing a central fossa on the lingual surface of incisors [13]. The prevalence of this feature varies among different population and ethnic groups. Incisors shoveling was reported in 1920 by Hrdlicka and he proposed it as a trait of Mongoloid dentition. High prevalence has been reported in Eskimos, Pima Indians, North American Indians, and Aleuts [3]. Shoveling of teeth has been previously classified in different grades in 1963 by Hanihara and later in 1998 by Sciulli. Following is the grading criteria:

Grade 0: No shovel-shape, lingual surface smooth.
Grade 1: Semi shovel-shape, slight elevation of marginal ridges.
Grade 2: Shovel, marginal ridges easily seen.
Grade 3: Strong or marked shovel when marginal ridges are broad and high [14].

Understanding the prevalence of this morphological trait is essential for dental practitioners to identify and manage it effectively [15]. Pakistan is a diverse nation with a rich blend of ethnic groups. However, data on the prevalence of shovel-shaped incisors within the country remains limited. This study aimed to explore the prevalence of shoveling in a local population from Punjab, Pakistan.

METHODS

The study was designed as a cross-sectional quantitative investigation. The current study was conducted at FMH College of Medicine and Dentistry after taking approval from Institutional Review Board (Ref No. FMH-01-2020-IRB-715-M), Lahore conducted from March, 2023 to November, 2023. The sample size was calculated by the following formula using 6% margin of error and on based of finite population 478.

$$n = \frac{N}{1+Ne^2} \qquad n = 176$$

A total of 176 undergraduate dental students were included in the study after taking their informed consent. Probability Stratified Random sampling was employed to gather participants from the BDS program, encompassing students from the 1st to the final year. The study included Maxillary Incisors in male and female students in the 1st through 4th years of the BDS program, while those with or missing Maxillary Incisors were excluded. Data were collected through visual observations using dental examination sets, following approval by the institutional review board and obtaining informed consent from the students. Participants were briefed on the procedure and assured of sterilization and confidentiality. Observations were made according to the criteria by Sciulli as mentioned above. At least two investigators observed and recorded on the proforma containing a section of gender, age, presence/absence of trait and if present, grades of shovel-shaped Maxillary Incisors. The statistical analysis was done using SPSS version 23.0. Descriptive statistics was applied to have frequency and percentage and Chi-square was applied to compare between two genders. P-value of ≥0.05 was considered statistically significant.

RESULTS

In this study a total sample of n=176 was selected for the estimation of frequency of shovel-shaped incisors out of which 54 were males and 122 were females. The data for number of individuals observed positive for this trait is provided in the Table- 1. Out of total population of 176, only 55 (31.2%) cases were found to be having shovel shaped incisors. Among the 54 males, only 17 (31.4%) had shoveled incisors of varying grades and out of 122 females, 38 (31.1%) had shoveled incisor of varying grades. The results showed almost equal predilection of this trait in both the genders (p=1.000).

Table 1: Number of Individuals for Shovel-Shaped Incisors

Gender	Number of Individual	Frequency of Trait Frequency (%)
Male	54	17 (31.4%)
Female	122	38 (31.1%)
Total	176	55 (31.2%)

*p-value was found to be 1.000

The grades of shoveling were recorded according to the

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previously published data. The results are shown in the table-2.

Table 2: Frequency of Shovel Grades

Grades	Frequency (%)
Grade 0	122 (69.3%)
Grade 1	19 (10.8%)
Grade 2	30 (17%)
Grade 3	5 (2.8%)
Total	176

Grade 0: No shovel-shape, lingual surface smooth.
Grade 1: Semi shovel-shape, slight elevation of marginal ridges.
Grade 2: Shovel: marginal ridges easily seen.
Grade 3: Strong or marked shovel when marginal ridges are broad and high.

In the study population, grade 2 shoveling was observed with the highest percentage of 17% (figure1). The percentage of grade 1 shoveling was 10.8% while only 2.8% cases showed grade 3 shoveling.

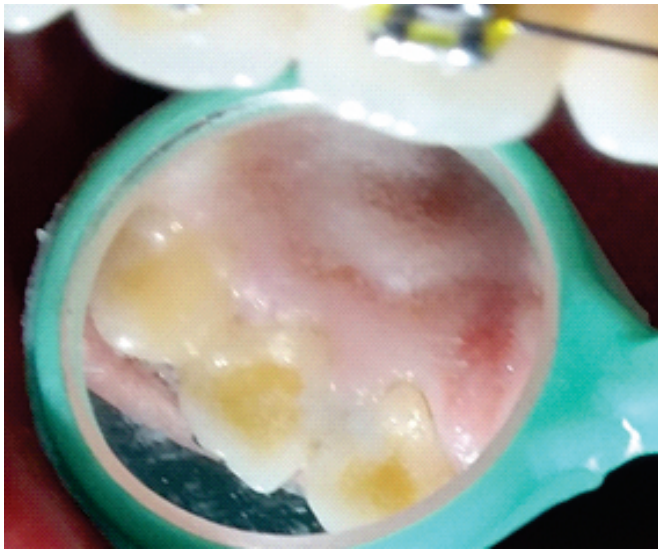

Figure 1: Grade 2 Shovel on Maxillary Left Central Incisor: Elevated and Thick Marginal Ridges with Deep Lingual Fossa

DISCUSSION

Genetics greatly influences the morphology of a tooth, highlighting the importance of studying dental morphology for understanding demographic connections and evolutionary ties. Identification of specific morphological features and bite patterns not only provide valuable insights into dental history but also help dentists in planning optimal treatment for the best outcomes. As due to presence of shoveling, such incisors may develop a room for caries to develop. Very few studies are done in Pakistan to explore such traits as comparative study of different morphological traits provides distinction among populations and may also aid the forensic odontologists to explore specific features in different people to help their identification [16]. Therefore, our study was designed to investigate the frequency of shoveling in a sub population in Punjab, Pakistan. Frequency of shoveling has been investigated in different populations and according to data it was found that this trait is most commonly seen in North American, South American and north Asian populations [5]. The current study showed that only 31% of the sample population had varying grades of shovel-shaped incisors. According to a study in Native Americans some percentage of shoveling is seen in almost every individual [1]. In a local study conducted in Abbottabad among different ethnic groups a lower frequency of shoveling was found [17]. In another study in Odisha and Kerala states of India, a low frequency of shoveling (15%) was found [18]. Contrary to this, another study done in Vidarbha subpopulation showed that 88% of Maxillary Incisors had shoveling that is much higher as compared to the results of present study [9]. Although shoveling do not exhibit sexual dimorphism yet many studies showed a higher female tendency as compared to males. Our findings also indicated no gender predilection regarding the shovel shaped incisors. Contrary to it, a study conducted in Nepal among the Newari children of Bhaktapur, a slightly higher male predilection of shoveling was seen than females. They reported 45.5% shoveling in males and 40.6% in females [19]. Another study of school children from Gujrat state, India also showed more shoveling in males than females [5]. In a previous study conducted in Brazil, shoveling was found to be more prevalent in females (66.7%) than in males (33.3%) in another study conducted among Asian population, females had higher incidence of shoveling as compared to men [20, 21]. These results are contrary to our study where only 31.1% females were found to be positive for this trait as compared to men which were 31.4%. The variation in results may be due to difference in population and area involved along with the genetic factors involved.

CONCLUSIONS

Non-metric morphological traits help in identification of a population and an individual belonging to different ethnicity. In our study shoveling was found in 31.2% of the studied individuals with no gender predilection. As the data regarding this trait in Pakistani population is limited, it should be explored further in detail among more population groups and in other provinces of Pakistan.

Authors Contribution

Conceptualization: SB
Methodology: GH
Formal analysis: SB, RZ, MJ
Writing, review and editing: SB, RSN, RZ, AY

All authors have read and agreed to the published version of the manuscript

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Conflicts of Interest

The authors declare no conflict of interest.

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