Regional variation in incisor shoveling in Indian population

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Abstract

Background: The forensic odontologists play a very important role in assisting the Forensic team in the identification of corpuses found in natural disasters and homicides. Since tooth is a calcified structure and is resistant to high or low temperatures and is adequately strong to resist trauma, the teeth may be the only structure left behind intact in most of the cases. The resemblance of incisors to a shovel results from the combination of a concave lingual surface and elevated marginal ridges of the incisor teeth. Previous researches had proved that different population shows different shoveling pattern, which may be useful for identification of individuals in a mass disaster like natural or human created.

Aims and Objectives: The present study was framed for the identification of different shoveling pattern in incisors in different parts of India.

Materials and Methods: 400 patients were selected for the study which consisted of an equal number of individuals from different parts of India such as East, West, North, and South. The Hrdlicka’s subjective scale was used to categorize the degree of shovel-shaped incisors.

Results: Our study showed that shoveling pattern of incisors were more pronounced in the Western part of India than other areas such as East and North and was very minimal in the Southern part of India.

Clinical Significance: The present study on the shoveling pattern of incisors may be a useful aid for personal identification in forensic dentistry.

Introduction

The forensic odontology is a branch of dentistry that primarily deals with the identification based on the recognition of unique features present in individual’s dental structures. It includes the application of dental knowledge in criminal cases, mass disasters, and anthropological analysis that are enforced by the investigative agencies in the criminal justice system and ministry.¹² They assist the investigative agencies to identify the recovered human remains and also help in identification of whole or fragmented bodies. The dental enamel is the hardest tissue in the body, and would thus withstand pre- and post-mortem damages. The forensic odontologists also help in determining the age, sex, race, and characteristic features of the dentition of the culprit.³⁵

“Shoveling” is a morphological variation of incisors which helps the forensic odontologist team in the identification process. The resemblance of to a shovel results from the combination of a concave lingual surface and elevated mesial, distal and incisal marginal ridges of the upper anterior teeth. The term “shovel-shape” was first introduced by Mihlreiter in Germany, 1870. Shovel-shaped incisors usually occur bilaterally in the maxillary incisors but can occasionally be seen on the mandibular incisors.⁶⁷ Few literature data had mentioned that Mongoloid populations differ from Caucasoid by having a higher preponderance of shovel feature and a lower preponderance of Carabelli’s feature.⁸ Dental identification has been regarded as one of the primary identifiers in the Interpol disaster victim identification protocol.¹³ Sometimes, it may prove to be the only method that can be used to make or disprove identification. The identification of a large number of casualties in mass disasters is complex and fraught with hazards, both physically and emotionally. The ultimate aim...
of disaster victim identification is to establish every victim by comparing and matching accurate antemortem and post-mortem data. However, this not practically possible in developing countries such as India, Iran, and Bangladesh. In such cases, shoveling pattern can help to identify victim origin and reduced burden of post- and post-mortem data matching. A few western literature data had mentioned that shoveling pattern in the bitemark’s on the victim’s body were also very useful in identification. So, the present study was framed for identification of different shoveling pattern of incisors in a different part of India.

**Materials and Methods**

The study population was divided into four groups viz., North zone (individuals from Himachal Pradesh, Delhi, Jammu and Kashmir, Haryana, and Punjab), South zone (individuals from Kerala, Tamil Nadu, Andhra Pradesh, and Karnataka), West zone (individuals from Gujarat, Rajasthan, Maharashtra, and Goa), and East zone (individuals from West Bengal, Assam, Mizoram, Manipur, and Sikkim). An equal number of individuals from each group participated in the study and the total sample was 400.

**Inclusion criteria**

Individuals with fully erupted maxillary central incisors without any developmental anomalies and individuals with at least one intact incisor tooth were included in the study.

**Exclusion criteria**

Candidates with developmental anomalies of incisors, prosthesis, deep bite, erosion, and attrition were excluded from the study. Candidates who had trauma and fractured incisor tooth were also excluded from the study.

A brief case history was taken to know the exact geographic location of the individual. Next step was a clinical evaluation of the morphology of maxillary central incisors by light illumination and Orban’s probe. Palatal surface of incisors was examined and categorized based on the shoveling pattern. Hrdlicka’s subjective scale was used for grading the degree of shovel-shaped incisors as a shovel, semi-shovel, trace shovel, and no shovel.

Once incisors were categorized clinically based on Hrdlicka’s subjective scale, photographs of the palatal surface of maxillary central incisors were captured by a digital camera for further confirmation using the Picasa software. After taking the photographs, it was transferred into Picasa image software to crop and change the pictorial effect. The final step was to invert the color. During this step shoveling fossa appear as dark navy blue and shovel margin appear as light in color as shown in Figure 1. This is due to the optical phenomenon. If shovel (concavity) is present, the light reflecting from these areas will be retarded and recorded and Picasa inverting picture effect will clearly identify the shoveling pattern. So, using this software, we reduced the bias in the study.

**Results**

Total of 400 individuals were selected for the study (237 males and 163 females). Results of the study showed that individuals of different parts of India had a different type of shoveling pattern. Among 100 South Indians participated in the study, none of the participants showed shovel-shaped incisors. Nine of them showed a trace type of shoveling pattern and all these were females as shown in Table 1. Among the North Indians, only one participant showed shovel-shaped incisor, 2% had semi shovel pattern, 91% showed trace type, 6% did not show shoveling as shown in Table 1. Among the East Indians, 81% showed semi shoveled incisors, 9% had shovel type, 7% had trace type, and 3% had none type as shown in Table 1. Among the West Indians, 85% had shovelled incisors, 10% had semi shovel type, 4% trace type, and 1% none type as shown in Table 1. Among 237 females and 163 males participated in the study, 94 individuals showed shovel-shaped incisors (65 males and 29 females), 93 individuals had semi shovel type (51 males, 42 females), 102 individuals showed trace type of shoveling (73 males and 38 females), and

![Figure 1: Picture effect after using Picasa software](image-url)
remaining 101 patients did not show shoveling (72 females and 29 males) as shown in Table 2.

Discussion

Shovel trait frequently occurs in all Mongoloid groups, including Bunun aborigines, Chinese, Eskimos, and American Indians (Dahlberg and Mikkelsen, 1947; Hanihara et al., 1974). Genetic and environmental factors have been reported as the manifestation of shoveling pattern. It is likely that in addition to the environment, genes play a major role in the association between Carabelli’s and shovel traits. Nevertheless, this assumption needs to be verified with family studies.

In the present study, Indian population was divided into different zones such as North, South, East, and West. Results of the study showed that individuals of a different part of India had a different type of shoveling pattern. In this study, Northern part of Indian population had maximum “trace type” of the shoveling pattern followed by “semi shovel” and “prominent type.” However, the southern part of the Indian population showed a majority of “none type” of shoveling pattern and very rarely showed “trace type.” In the Eastern part of Indian population, “semi shovel type” was more common followed by “prominent shovel” and “trace type” of the pattern. In the western part of the Indian population, shovel type of shoveling pattern was more common than “trace” or “semi shovel” pattern.

The Indian population is genetically and environmentally different by birth. Previous reviews had proved that shoveling and Carrabelle trait of teeth are dependent on these factors. The present study demonstrated that different population in India showed a different type of shoveling pattern of incisors with a prominent type in the Western population. The Picasa software used for identification of shoveling of incisors can be a useful aid for personal identification.

Conclusion

The shoveling pattern of incisors is different in different parts of India. In this study, we found that shoveling pattern of incisors was more in the Western region of India and was least in the Southern part of India. So, shoveling pattern may be a useful aid for forensic personal identification.

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