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Original communication

Pilot study to establish a nasal tip prediction method from unknown human skeletal remains for facial reconstruction and skull photo superimposition as applied to a Japanese male populations

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ABSTRACT

Skull-photo superimposition is a technique used to identify the relationship between the skull and a photograph of a target person: and facial reconstruction reproduces antemortem facial features from an unknown human skull, or identifies the facial features of unknown human skeletal remains. These techniques are based on soft tissue thickness and the relationships between soft tissue and the skull, i.e., the position of the ear and external acoustic meatus, pupil and orbit, nose and nasal aperture, and lips and teeth. However, the ear and nose region are relatively difficult to identify because of their structure, as the soft tissues of these regions are lined with cartilage.

We attempted to establish a more accurate method to determine the position of the nasal tip from the skull. We measured the height of the maxilla and mid-lower facial region in 55 Japanese men and generated a regression equation from the collected data. We obtained a result that was 2.0 ± 0.99 mm (mean ± SD) distant from the true nasal tip, when applied to a validation set consisting of another 12 Japanese men.

1. Introduction

Craniofacial reconstruction (CFR) and skull photo superimposition (SPS) are techniques that use information obtained from unknown human skeletal remains. CFR reconstructs the antemortem face from a skull, and SPS compares a skull and photograph of a target person. When an unknown skull is found, the sex, age, and ancestry must be investigated. SPS is then carried out to match information between a target person and a skull. CFR is carried out if there is no match or target individual. Both techniques require mean facial soft tissue thickness values from individuals with a matched ancestry. The next step is to investigate or predict the region that is not lined by hard tissue, i.e., the position of the ear/external acoustic meatus, pupil/orbit, nose/nasal aperture, and lips/teeth. These regions are relatively difficult to identify.[1–7]

The nasal region is highly variable, however, people recognize the others by the variability, e.g. the nose, ear, and eyelid. i.e. The accurate nasal tip prediction means increasing positive identification. Many reports on this region discussed methods for prediction of the nasal tip from a skull. However, there were few positive identification or matched results applied recent methods nevertheless indicated positive on laboratory level. Then human skeletal remains were found, will be able to obtain positive results if investigate it by researchers of recent prediction studies.

Recent studies of nasal tip prediction used cephalometric X-ray images[8–11] or computed tomography (CT).[12–14,17] Most of these studies generated regression models from morphological measurements and their results indicated a high correlation. Although

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these methods were highly reliable and showed good correlation, some are complicated and difficult to apply to CFR. Although accuracy is important, that the method can be used by a range of professionals such as investigators, anthropologists, and forensic artists is also necessary. Rynn and Wilkinson compared 6 prediction methods and found that Gerasimov's method was the most accurate.[15] Gerasimov's method is a two-tangent application and is also the most simple of the 6 methods that were assessed. It involves setting 2 lines and deciding the location of the nasal tip based on their intersection on a photograph or on a duplicated skull. However, Gerasimove recently reported about his methodology because of the discrepancy between the original issue and the translated version. Ulrich and Stephan reported the repeatability of Gerasimove's method,[16] and Lapointe et al.[17] reported new CT guidelines in comparison with Gerasimove's method. A measurement study of the mid-facial region in an Asian population has also been described.[18] However, the study described above cannot be compared to the present study due to the difference in focused measurement points. Recently, two prediction methods for Caucasoid skulls were reported,[10,12] and these were compared by Mala et al.[19] Based on the results of Mala's study and the similarity of measurement points, the author compared with Rynn and Wilkinson's Caucasian study.[12]

In this study, we attempted to establish the simplest possible method for nasal tip prediction. We reports the observed and measured nasal regions in a Japanese male population, and describe a simple and accurate method.

2. Materials and methods

2.1. Measurements

This study was approved by the Ethics Committee of the Matsumoto Dental University (No. 0171). Measurements were made using diagnostic cephalometric X-ray films (lateral view) obtained from 55 Japanese men (aged 20–40 years-old) who visited the

Table 1
Definition of plotted landmark.

#	Name	Definition
①: N	Nasion	Midpoint of suture between frontal and nasal bone on sagittal plane.
②: Rhi	Rhinion	Most inferior end of suture between left and right nasal bone.
③: Prn	Pronasale	Most anterior end of the nose where the perpendicular line from FHP attaches to nasal tip.
④: ANS	Anterior Nasal Spine	Most anterior end of maxilla.
⑤: A	Point A	Deepest point where perpendicular line from the line between ④ and ⑥.
⑥: Pr	Prosthion	Most inferior point of alveolar process of maxilla between left and right central incisor.
⑦: Gn	Gnathion	Most inferior point of mandible on midsagittal plane.

FHP: Frankfort Horizontal Plane.

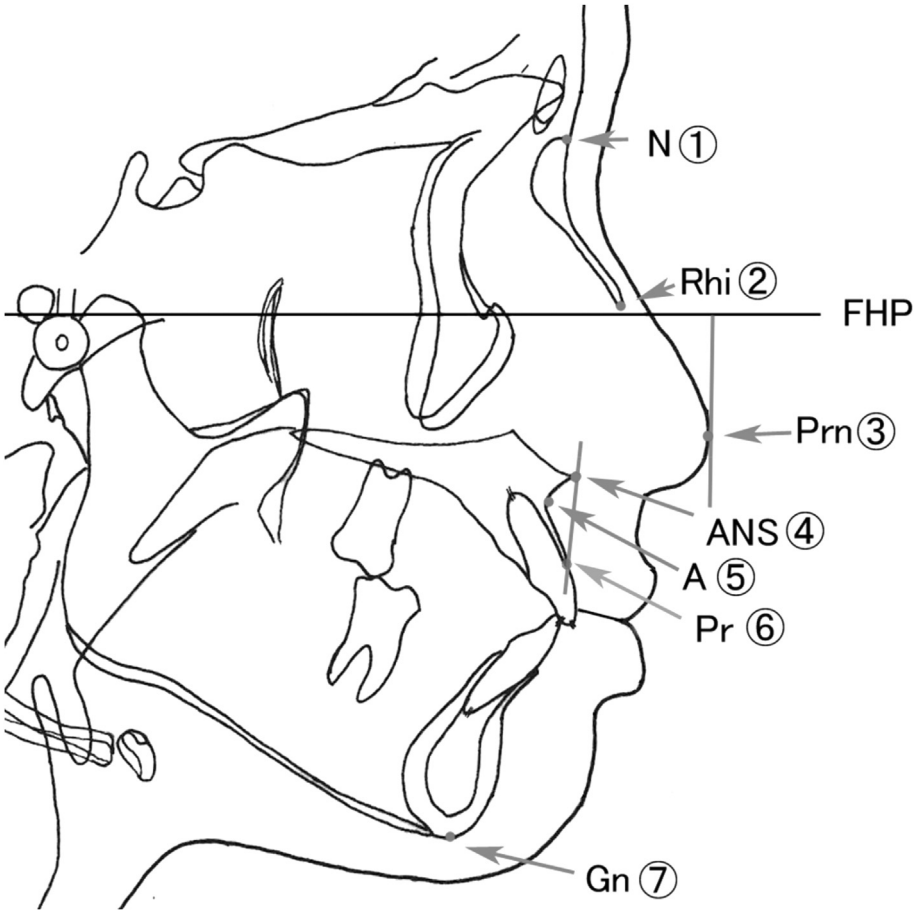

Fig. 1. Plotted anthropological landmarks on a cephalogram.