Original article

Sex determination from metopic suture and supraorbital ridge in Thai population

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Objectives This study was carried out on metopic suture and supraorbital ridge for sexing in a Thai population.

Materials and methods This study included 300 human adult skulls, which were obtained from the Forensic Osteology Research Center, Faculty of Medicine, Chiang Mai University. The metopic suture and supraorbital ridge were observed macroscopically. The degree of supraorbital ridge was classified into 4 levels. The 1st level had a massive prominence, the 2nd showed fair prominence, the 3rd indicated slight prominence and the 4th revealed no prominence. Descriptive statistics were analyzed by the SPSS program.

Results The metopic suture can be divided into three groups: 1) normal skulls without metopic suture, of which 12.9% were male and 87.1% female, 2) skulls with complete metopic suture in 75% male and 25% female, and 3) skulls with incomplete metopic suture with 68.9% male and 31.1% female. Furthermore, sex determination from study of the supraorbital ridge showed major percentages in the male skull of 94.5% and 93.9% at the 1st and 2nd level, respectively. Female skulls showed major percentages of 76% and 92% at the 3rd and 4th level, respectively.

Conclusion Metopic suture and supraorbital ridge could be bony landmarks for sex determination and biological identification in a Thai population. **Chiang Mai Medical Journal 2014;53(4):181-6**.

Keywords: sex determination, metopic suture, supraorbital ridge

Introduction

Sex determination is an important step in forensic anthropology, as is biological identification in forensic science. They eliminate approximately 50% of the missing person population from further consideration[1,2]. Generally, there are two major methods used to determine the sex of an individual: the metric and morphological techniques. The metric method has high reproducibility, but it needs well preserved bones and well defined measurements for landmarks and

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techniques. On the other hand, the morphological method is a simple technique, in which the pelvis is the best part for determining the sex (95% accuracy), followed by the skull (92% accuracy)[3-5]. However, a complete pelvis is not found in most situations. Little is known about sex determination from metopic suture and supraorbital ridge, which are prominent bony landmarks of the skull. Therefore, this study was carried out on metopic suture and supraorbital ridge for sexing in a Thai population.

Methods

This protocol was approved by the Ethics Committee of the Faculty of Medicine, Chiang Mai University. The study included 300 human adult skulls, which were obtained from the Forensic Osteology Research Center, Faculty of Medicine, Chiang Mai University. These subjects consisted of 155 male skulls and 145 female ones with ages ranging from 31 to 94 years (mean age 67.27 years). The mean age of the male and female samples was 67.29 years (36-94) and 64.24 years (31-93), respectively. The metopic suture and supraorbital ridge were observed macroscopically. The degree of supraorbital ridge was classified into 4 levels. The 1st level had massive prominence, the 2nd showed fair prominence, the 3rd indicated slight prominence and the 4th revealed no prominence (Figure 1). Descriptive statistics were analyzed by the SPSS program.

Results

Sex determination from the metopic suture

A total of 300 skulls comprised 155 (51.6%) male skulls and 145 (48.4%) female ones, aged from 31 to 94 years (mean age 67.27 years). The metopic suture was divided into three groups: 1) normal skulls without any metopic suture, of which 12 (12.9%) were male and 81 (87.1%) female, 2) skulls with complete metopic suture found in 3 male (75%) and one female (25%), and 3) skulls with incomplete metopic suture found in 140 male (68.9%) and 63 female (31.1%). The incomplete metopic types were grouped according to their shape; namely zig-zag, linear type, double linear type, U-shape, H-shape and V-shape (Figure 2). In zig-zag, linear, double linear, U-shape, H-shape and V-shape type, there were 122 (74.4%) male and 42 (25.6%) female skulls; 4 (16.7%) male and 20 (83.3%) female ones: 5 (100%) male ones only; 4 (80%) male ones and 1 (20%) female; 3 (100%) male ones only and 2 (100%) male ones only, respectively (Table 1).

Figure 1. The degree of supraorbital ridge was classified into 4 levels. A) the 1st level had massive prominence, B) the 2nd showed prominence, C) the 3rd indicated slight prominence, and D) the 4th revealed no prominence.

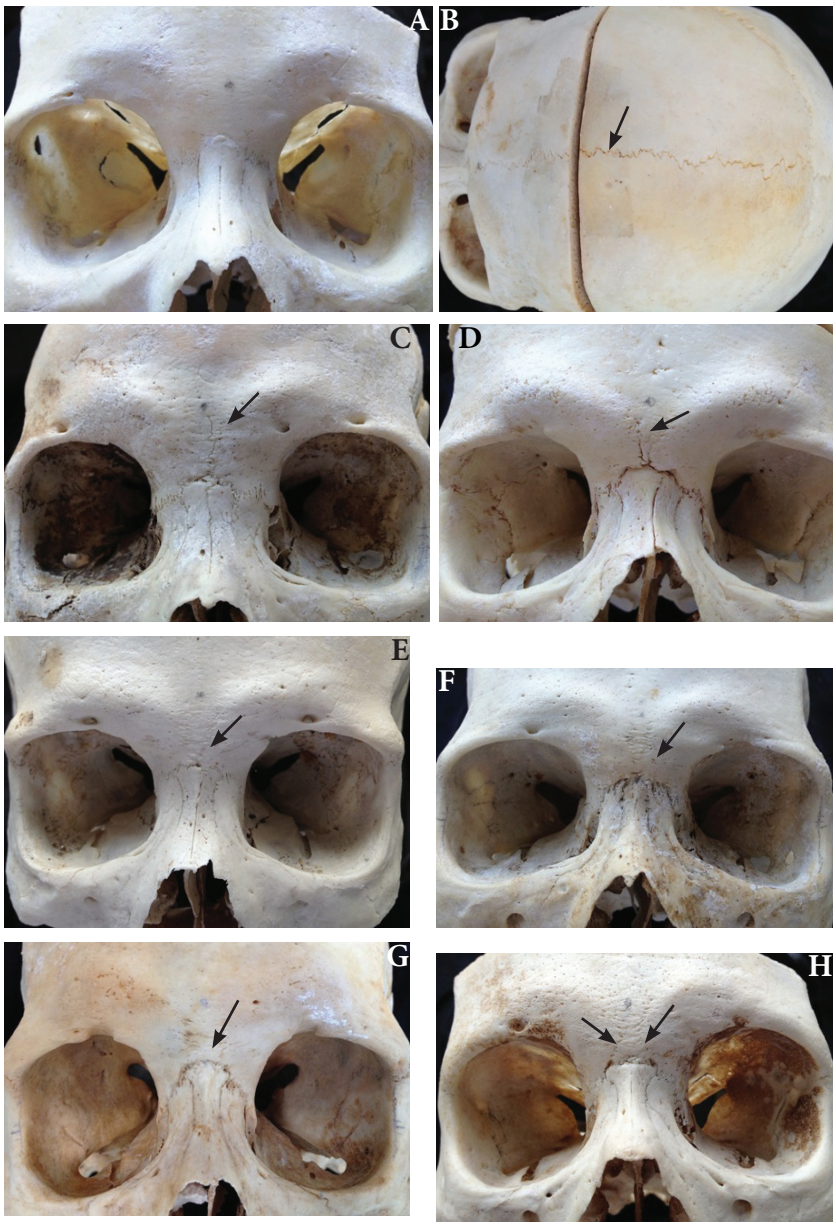

Figure 2. Types of metopic suture; A) absent, B) complete metopic suture, C) linear type, D) V-shape, E) U-shape, F) zig-zag, G) H-shape, H) double linear type.

Sex determination from the supraorbital ridge

The degree of supraorbital ridge was classified into 4 levels. The 1st level comprised 52 (94.5%) male skulls and 3 (5.5%) female ones. The 2nd level consisted of 78 (93.9%) male skulls and 5 (6.1%) female ones. The 3rd level included 18 (24%) male skulls and 57 (76%) female ones; and the 4th level had 7 (8%) male skulls and 80 (92%) female ones (Table 2).

Discussion

Metopic suture is the kind of medline suture[6] that runs between the frontal bones of the fetus and infant, from the anterior fontanelle to nasion. During the fetal period, the two frontal bones are separated by the sutural space, which consists of mesenchymal cells and fibrous tissue. Normally, the metopic suture closes between the ages of 1-2 years, but it can remain patent for up to the seven years[7]. Vu *et al*[8] stated from their radiological

Table 1. Number and percentage of metopic suture types in each sex

Types of metopic suture	Number (%)	Number of male skulls (%)	Number of female skulls (%)
Complete metopic suture	4 (1.3)	3 (75.0)	1 (25.0)
Incomplete metopic suture	203 (67.7)	140 (68.9)	63(31.1)
- Zig-zag	164 (54.7)	122 (74.4)	42 (25.6)
- Linear type	24 (8.0)	4 (16.7)	20 (83.3)
- U-shape	5 (1.7)	4 (80.0)	1 (20.0)
- Double linear type	5 (1.7)	5 (100.0)	-
- H-shape	3 (1.0)	3 (100.0)	-
- V-shape	2 (0.7)	2 (100.0)	-
Absent	93 (31.0)	12 (12.9)	81 (87.1)
Total	300 (100.0)	155 (51.6)	145 (48.4)

Table 2. Number and percentage of cases for the degree of supraorbital ridge in each sex

Degree of supraorbital ridge	Number	Number of male (%)	Number of female (%)
1st Level	55	52 (94.5)	3 (5.5)
2nd Level	83	78 (93.9)	5 (6.1)
3rd Level	75	18 (24.0)	57 (76.0)
4th Level	87	7 (8.0)	80 (92.0)
Total	300	155 (51.6)	145 (48.4)

study that metopic fusion may occur as early as 3 months of age, with complete fusion occurring by 9 months. Furthermore, they explained that metopic suture persists as an incomplete or complete type, extending from the nasion to bregma, and this condition is called metopism. In this study, the incidence of complete metopic suture was found to be 1.33%, which is higher than that reported in Africans by Breathnach (1%)[9]. However, the incidence of complete metopic suture varies between different ethnic groups (1-10%)[7]. In addition, complete and incomplete metopic sutures were observed in 207 of the 300 (69%) skulls, with 143 (69%) being male and 64 (31%) female. Similar male predominance of metopic sutures was observed by Baaten *et al*[10]. The metopic suture is a part of the supranasal region, and has a number of facial expression muscles such as the procerus, corrugators supercilii and depressor supercilii as well as the frontal belly of the occipitofrontalis. These muscles are responsible for forehead movement and formation of vertical and horizontal wrinkles. The result of this study showed that the smooth surface of the supranasal region (absent of metopic suture) is associated with females, thus suggesting that some of these structures are responsible for variation of smoothness in the supranasal region, which was demonstrated by Schiwy-Bochat[11]. The differences in soft tissue thickness between the sexes in the supranasal region have been documented. Therefore, it is possible that the muscles of facial expression, as well as aponeurosis, may create roughness (metopic suture) in males.

The supraorbital ridge is a crest of bone situated on the frontal bone of the skull, forming the separation between the forehead and roof of the eye orbits. Part of the frontal bone has been used to determine sex, for example, the frontal eminence, supraorbital margin, and especially supraorbital ridge. This study showed that the

1st and 2nd levels (massive and fair prominence) and 3rd and 4th levels (slight and no prominence) of the supraorbital ridge were specific mostly to male and female skulls, respectively. Russell[12] stated that the supraorbital region had been considered as a beam supporting the robust masticatory process in males. Similarly, Osman *et al*[13] reported that the robust nature of the male skull is one of the most obvious features. For example, the shape and size of the nuchal crest and mastoid process were larger in males than the females. Additionally, a review on well-known forensic osteology and anthropology texts stated that size of the supraorbital ridge is the trait recommended most commonly for sex determination[14-16].

Therefore, morphological knowledge of the metopic suture and supraorbital ridge of the skull are important for forensic physicians, anthropologists and osteologists when using skulls for sex determination. The authors believe that this study provides important data that may be applied for sex determination and biological identification in a Thai population.

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การระบุเพศจากรอยประสาน metopic และสันนูนเหนือเบ้าตา ในกลุ่มประชากรไทย

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วัตถุประสงค์ เพื่อศึกษาการระบุเพศจากรอยประสาน metopic และสันนูนเหนือเบ้าตาในกลุ่มประชากรไทย

วิธีการ ศึกษากะโหลกคนไทยจำนวน 300 โครง จากศูนย์วิจัยนิติกระดูกวิทยา คณะแพทยศาสตร์ มหาวิทยาลัยเชียงใหม่ โดยสังเกตรอยประสาน metopic และสันนูนเหนือเบ้าตาจากกะโหลกด้วยตาเปล่า โดยแบ่งระดับของสันนูนเหนือเบ้าตาออกเป็น 4 ระดับ ได้แก่ ระดับ 1 นูนมาก ระดับ 2 นูนปานกลาง ระดับ 3 นูนน้อย และระดับ 4 เรียบแบน จากนั้นจะนำข้อมูลที่ได้ไปวิเคราะห์ทางสถิติเชิงพรรณา ด้วยโปรแกรมสถิติสำเร็จรูป SPSS

ผลการศึกษา พบรอยประสาน metopic 3 รูปแบบคือกลุ่มกะโหลกที่ไม่พบรอยประสาน metopic ในเพศชายพบร้อยละ 12.9 เพศหญิงพบร้อยละ 87.1 กลุ่มกะโหลกที่พบรอยประสาน metopic แบบสมบูรณ์ ในเพศชายพบร้อยละ 75 เพศหญิงพบร้อยละ 25 และกลุ่มกะโหลกศีรษะที่พบรอยประสาน metopic แบบไม่สมบูรณ์ ในเพศชายพบร้อยละ 68.9 เพศหญิงพบร้อยละ 31.1 นอกจากนี้การศึกษาการระบุเพศจากสันนูนเหนือเบ้าตา พบว่าในเพศชายจำนวนมากในระดับ 1 และ 2 พบร้อยละ 94.5 และ 93.9 ส่วนในเพศหญิงจำนวนมากในระดับ 3 และ 4 พบร้อยละ 76 และ 92 ตามลำดับ

สรุปผลการศึกษา รอยประสาน metopic และสันนูนเหนือเบ้าตา ซึ่งเป็นส่วนของกะโหลกศีรษะ น่าจะนำมาใช้ในการระบุเพศในคนไทยในการพิสูจน์เอกลักษณ์บุคคล **เชียงใหม่เวชสาร 2557;53(4):181-6.**

คำสำคัญ: การระบุเพศ รอยประสาน metopic สันนูนเหนือเบ้าตา