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Accuracy of the Greater Sciatic Notch in sex assessment in Algerian population sample

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***Abstract*— This study explores the sexual dimorphism of the Greater Sciatic Notch (GSN) and its accuracy in sex assessment in a contemporary Algerian adult sample. A total of 123 left virtual innominates from 62 males and 61 females, aged between 18 and 86 years, were used with local ethics committee approval and full anonymization of the sample. Bones were derived from clinical CT-scans performed in 2018 in an Algerian hospital. Sex assessment was carried out according to the Walker (2005) visual method. Results show that scores 1 and 2 were predominantly feminine (84.2%), while scores 3 to 5 were predominantly masculine (80.3%). Sex probability was proportional to the score. Male probability increased with higher scores, while female probability decreased. A global correct sex classification rate of 82.1% was obtained in the Algerian sample. Intra- and inter-observer tests showed fair to perfect agreement. The GSN appears to be a useful tool for sex assessment in the Algerian population in a forensic context. Further studies are required to confirm the present results.**

***Keywords*— Forensic anthropology, sex estimation, greater sciatic notch, visual method, Algerian population.**

I. INTRODUCTION

Sex assessment is a key element of the biological profile in forensic anthropology [1,2]. Many other questions, such as age at death, stature, and ancestry, depend on it [3,4]. Among all the bones of the human skeleton, the innominate is considered the most reliable indicator of sex [2,5].

When using the innominate, the pubic bone is the best region for sex assessment [3]; however, it is fragile to taphonomic effects [6,7]. When this segment is damaged, the greater sciatic notch (GSN) is used given its high sexual dimorphism and greater resistance to damage [8,9]. Morphological and metric approaches have been used to assess sex from the GSN. Visual methods are simple but subjective, while metrical methods are more objective but are usually limited by the frequent damage of the GSN anatomical landmarks [8].

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Morphologically, the shape of the GSN varies significantly between sexes. It tends to be wider in women, whereas it is narrower and more closed in men [5,8] (see Fig. 1).

Walker (2005) proposed morphological diagrams for assessing sex from the GSN, resulting in correct sex classification rates ranging from 80 to 89% [8], while also noting a significant variation between the samples studied and age-related changes in GSN morphology [8]. In a recent study, DesMarais et al. (2024) revealed a relationship between age and notch morphology, with some disparities between the GSN score frequencies of the Australian sample and Walker's sample [10]. Others studies suggest that these differences are related to population variations [11,12]. This variation of the sexual dimorphism between populations is regularly debated in the literature [1,6,8], calling into question the efficiency of a method derived from one population when applied to other distant populations. Such population-related disparities underscore the need for regionally validated methods.

To this end, this study was carried out to assess the morphological sexual dimorphism of the GSN in an Algerian population sample and its accuracy in sex identification.

II. MATERIAL AND METHODS

A total of 123 left innominates were examined in this study. They were derived from clinical computed tomography (CT) scans of Algerian adult individuals (born between 1932 and 2000), performed in an Algerian hospital. The sample included 62 males [age: 22-76 years (mean age: 34.2 ± 9.9 years)] and 61 females [age: 18-86 years (mean age: 41.9 ± 14.9 years)]. All scans were anonymized, and ethical approval were granted by the Local ethics committee.

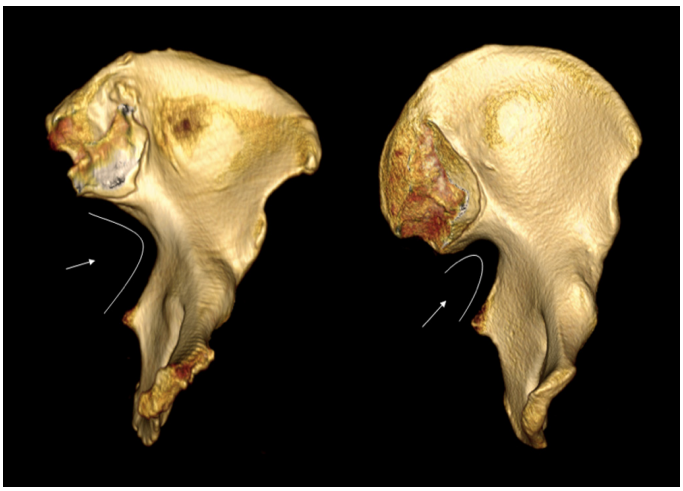


Fig.1. Sexual dimorphism of the GSN on 3D CT bones. Male shape on the right image and female shape on the left one.

CT-scans were performed on a 16-slice CT scanner, with a slice thickness ranging from 1 to 2 mm. The virtual bones were reconstructed in three-dimensional (3D) models using 3D post-processing station.

The Walker method is based on a visual examination of the GSN. Scores from 1 to 5 are assigned with reference to a diagram proposed by the author [8]. Scoring of the blinded data was carried out according to the principles of the method [8], by aligning the anterior portion of the GSN of the virtual bone with the corresponding figures in the diagram, illustrated on a transparent sheet.

All statistical analysis was performed using R software and Microsoft Excel 2013. Score frequencies of the GSN by sex were calculated, and the Mann-Whitney U test was used to assess differences between sexes. The Chi-square ($\chi 2$) test was also used to assess the relationship between GSN morphology and sex. Correct sex classification rates were assessed using the probability of being male or female at a given score [8].

Intra-observer and inter-observer tests were carried out to assess the reliability of the method. Two observers (O1 and O2) re-assessed 20 virtual bones from the sample after an interval of one week. The second observer had no prior experience with the method. Intra- and inter-observer agreements were calculated using Cohen's Kappa (K) coefficient [13] and interpreted according to Landis and Koch (1977) system [14].

III. RESULTS

Table I shows the results of intra- and inter-observer tests. For intra-observer tests, a perfect agreement (K = 0.871) was noted for the first observer and a fair agreement for the second observer (K = 0.226). As for the inter-observer test, a substantial agreement was recorded (K = 0.684).

Table I.
Intra- and inter-observer tests results.

Observer	Kappa	p
O1-O1	0.871	<0.001
O2-O2	0.226	0.048
O1-O2	0.684	<0.001

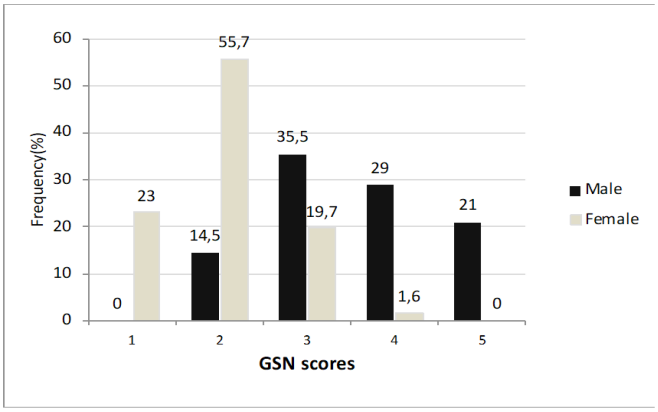


Fig.2.Scores frequencies of the GSN by sex in the Algerian sample.

Score frequencies for both sexes are presented in Table II and Figure 2. Scores 1 and 2 were predominant in females (84.2%, n = 48/57), while scores 4 to 5 were predominant in males (96.7%, n = 31/32). Score 3 was predominantly a male feature, with a rate of 64.7% (n = 22/34). Table 2 shows that the probability of being male increases proportionally with higher GSN score, while it decreases for females.

Regarding differences between sexes, the average score for males was 3.56 compared with 2 for females. There was a significant difference between the male and female GSN means ($p<0.0001$), with a strong relationship between the shape of the GSN and biological sex ($p<0.001$).

Based on the sex probabilities for each score, an overall correct sex assignment of 82.1% was obtained, with 85.5% for males and 78.7% for females.

IV. DISCUSSION

The present study evaluates the morphological sexual dimorphism of the GSN and its effectiveness in sex assessment in an Algerian sample. The accuracy of sex assessment methods must be established before applying them to a target population, especially in a forensic context [2].

Results show a high morphological sexual dimorphism of the GSN in the Algerian sample, with a significant difference between the male and female sample means. A wider notch was more indicative of female sex, whereas a narrower notch was essentially indicative of male sex, which is consistent with several studies [8,10,12,15-17]. However, a difference was noted in the sectioning score between sexes compared to Walker's study. In the latter, male probabilities dominated from score 2 onwards [8], whereas in the Algerian sample male probabilities predominated from score 3 onwards, with a female majority at score 2. The GSN score distribution by sex in the Algerian sample was comparable to other studies, with a predominance of scores 1 and 2 for females and scores 3 to 5 for males [10,16,17]. These findings suggest a similar overall pattern of GSN sexual dimorphism, with some disparities in its degree of expression.

The overall correct sex classification rate was 82.1%, which is close to the results of Walker (2005) and Bonczarowska et al. (2019), who reported 80% and 81.9% overall correct sex classification in their study samples, respectively [8,15]. Higher accuracies were noted in other morphological studies [9,10,16]. In another recent metrical study carried in an Algerian sample, Rafai et al. (2026) recorded a correct sex classification rate of 87,8% using the angle of the GSN [18]. The present correct classification rate is in line with the accepted accuracy threshold in sex assessment [19].

Regarding the reliability of the method, a perfect agreement was noted for the first observer and a fair agreement for the second observer. The lower agreement of the second observer could be related to inexperience in GSN scoring. Training and experience are known to play an important role in the repeatability of the results [9,20]. The use of digital material may also have influenced the scoring results; in particular, adapting the 3D model size to the diagram size appears to affect score assignment. Nevertheless, inter-observer agreement was substantial, which represents acceptable reproducibility.

Furthermore, 3D-CT bones have allowed a morphological assessment comparable to the conventional method, which is consistent with findings in the literature supporting the usefulness of CT bones in morphological sex evaluation [2,21,22]. Virtual bones provide an alternative solution for the lack of local skeletal collections necessary for validating existing methods applied in forensic casework and developing bio-anthropological databases from the current populations [2,23].

Table II.
Score frequencies of GSN by sex and sex probabilities.

		GSN score					
Sex		1	2	2	4	5	Total
Male	n	0	9	22	18	13	62
	%	0	14,5	35,5	29	21	100
Probability of being male		**0**	**20,9**	**64,7**	**94,7**	**100**	
Female	n	14	34	12	1	0	61
	%	23	55,7	19,7	1,6	0	100
Probability of being female		**100**	**79,1**	**35,3**	**5,7**	**0**	

V. CONCLUSION

The morphology of the GSN seems to be a good indicator of sex in the Algerian population, particularly for the extreme scores. Score 3 should be interpreted with caution. The use of additional anatomical regions of the innominate is recommended to consolidate the assessment. Finally, the use of medical imaging tools offers promising prospects for developing population-specific standards in forensic anthropology for the Algerian population.

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