Intercondylar Spanning: An Artifice for Sexual Dimorphism

Kuruganti Sireesha, Ananthaneni Anuradha, Eali Simon Neal Jedhidiah, Horatti Kuberappa Puneeth

1-3Post Graduate Student, 3Professor, 4Assistant Professor
St. Joseph Dental College

ABSTRACT

BACKGROUND: Disaster victim identification is a forensic procedure which includes identification of human body or remains after death. Gendering the recovered human remains is a fundamental part of the identification process. Intercondylar distance can be used for gender determination as it remains intact even in segmented decomposition. Computed tomography (CT) provides an excellent method for examining intercondylar distance.

OBJECTIVE: To identify the gender of an individual by measuring the intercondylar distance.

MATERIALS AND METHODS: CT images were used to measure the intercondylar distance in 40 patients (20 males and 20 females) for forensic identification. The results were tabulated and analyzed using unpaired t-test.

RESULTS: A statistically significant (P < 0.05) difference was found in the intercondylar distance between males and females. Results showed significantly larger dimensions of intercondylar distance in males (117.79±4.63) when compared to females (111.37±3.85). Our method was able to predict the gender with an accuracy of 85.0% in males and 80.0% in females, with an overall accuracy rate of 82.5%.

CONCLUSION: Among many methods that have been used to predict the gender of an individual in a massive disaster, the intercondylar distance could be used for gender determination when the whole skeleton is not available.

KEYWORDS: Forensic Sciences, Computed tomography, Gender identity, Intercondylar distance.

INTRODUCTION

Disaster is a natural catastrophe or serious disruption occurring in relatively short period of time causing great damage and widespread human, material, economic and environmental loss, which can be natural or human instigated hazards. Immediately following the onset of a disaster, it is essential for national, regional, or local authorities to concentrate their actions and resources on three basic activities: first, the rescue and treatment of survivors; second, the repair and maintenance of basic services; and, finally, the recovery and management of bodies [1]. The identity of a human being should be preserved even after death, as there are consequences, often financial, that lead to the court of law, which demands that the identity of the deceased be established before a verdict is passed. Forensic science based evidence is accepted in a judicial setting by the court and plays a major role in the identification of individuals who cannot be identified visually or by other simple means. Postmortem identification is a forensic procedure [2]. However, it is difficult to perform after marked postmortem changes such as decomposition and skeletonization have taken place due to environmental factors such as humidity, temperature, and exposure to microorganisms.[3,4] Nevertheless, a postmortem is obligatory in terms of the law and social norms.

Disaster victim identification is a forensic process of identifying victim in a mass disaster which involves anthropological analysis for gendering skeletal material, which provides relatively fast and accurate data that help the investigators to narrow down his field of search to a limited geographic area or within a gender. Gender identification has been determined from pelvis, skull, long bones and also with assessment of epiphysis and metaphysis in unknown skeletons [2]. The foramen magnum, the sphenoidal sinus, the sella turcica, and the frontal and maxillary sinuses have also been used recently for gender determination in unknown remains [5]. However, in cases where intact skull is not found, mandible may play a vital role in sex determination as it is the most dimorphic, largest and strongest bone of skull. Mandibular condyle and ramus, in particular, are generally the most sexually dimorphic as they are the sites associated with the greatest morphological changes and remodeling during growth [6]. The measurements of intercondylar distances tend to show sexual dimorphism and the difference between genders is more marked in them.

Computed tomography (CT) provides an excellent method for examining intercondylar distances. As the image represents a contiguous series of crosssections and three-dimensional information and the machine is available in most of the hospitals, CT has been applied in the study of fossil skulls [7]. CT scan can be used for determination of gender by measurement of intercondylar distances when other methods are inconclusive, though this method is not errorfree. Therefore, our study aimed to identify the gender of an individual by measuring the intercondylar distance.
MATERIALS AND METHODS

Study Design: The study included 40 patients of which 20 were male and 20 were female. Intercondylar distance of each individual was measured using CT scan.

Selection Criteria:
Inclusion criteria: Patients with intact mandibular condyles without any pathological, physiological, or surgical deformity. Forty patients with age ranging between 30 and 60 years were included in the study.

Exclusion criteria: Patients with a history of extraction, surgery, mandibular fracture, and any other severe developmental disturbances leading to variation in the size of mandible were excluded from the study.

The measurements of intercondylar distances were made when the condyles were in their widest position, with the help of on-screen linear measurement tool on CT work station. The linear distance between two condyles was annotated on the screen when their first appearance was noted in sequential coronal CT sections. The entire procedure was repeated for every patient.

STATISTICAL ANALYSIS

Mean values of intercondylar distances in both the genders were analysed using statistical software SPSS version 17. The unpaired t-test was applied, results were tabulated and analyzed with statistical package. The data was expressed as mean and in the entire tests P (probability) value ≤ 0.05 was taken to be statistically significant.

RESULTS

Results showed significantly larger dimensions of intercondylar distance in males (117.79±4.63) when compared to females (111.37±3.85). A statistically significant (P < 0.05) difference was found in the intercondylar distance between males and females. [Table 1] [Graph 1].

Sex was accurately determined in 17 cases out of twenty male intercondylar distance measurements with prediction accuracy rate of 85%, and sex was accurately determined in 16 cases out of twenty female intercondylar distance measurements with an accuracy rate of 80% with an overall accuracy rate of 82.5%. [Table 2].

Table 1: Mean and standard deviation values of intercondylar distances in both genders.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Males Mean±SD</th>
<th>Females Mean±SD</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercondylar distance</td>
<td>117.79±4.63</td>
<td>111.37±3.85</td>
<td>&lt;0.0001S*</td>
</tr>
</tbody>
</table>

S*: Significant

Table 2: Prediction accuracy

<table>
<thead>
<tr>
<th>Gender</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>Accuracy (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>17</td>
<td>3</td>
<td>20</td>
<td>85</td>
</tr>
<tr>
<td>Female</td>
<td>4</td>
<td>16</td>
<td>20</td>
<td>80</td>
</tr>
</tbody>
</table>

Graph 1: Mean and standard deviation values of intercondylar distances in both genders.

DISCUSSION

Following mass disaster, identification of individual victims by hard tissue means is one of the most reliable methods. In severe burn situations and/or following severe disintegration, visual recognition of facial features and fingerprints is often impossible due to extensive soft tissue destruction; this situation often necessitates the use of hard (calcified) tissue such as human dentition and jaw bones for human identification. Persons who have been diseased for some time prior to discovery and those found in water also present unpleasant and difficult visual identification [8]. It has been reported that 100% accuracy can be achieved in
gender determination from skeleton, 98.0% from both pelvis and skull, 95.0% from pelvis only or the pelvis and long bones, 90.0–95.0% from both the skull and the long bones, and 80.0–90.0% from the long bones only. Skull is the most dimorphic and easily remarked portion of skeleton after pelvis. The circumference and area of the foramen magnum were used to differentiate the gender with an accuracy of 67.0% and 69.3%, respectively [2].

Nascimento Correia Lima et al., in their study of the linear measurement of palatal bone and skull base showed significant sexual dimorphism, with reliability rates of 63.0% and 65.0%, respectively. However, in cases where intact skull is not found, mandible may play a vital role in sex determination as it is the most dimorphic, largest and strongest bone of skull [9]. Humphrey et al. emphasized that almost any site of mandibular bone deposition, or resorption, or remodeling for that matter, seems to have a potential for becoming sexually dimorphic [10]. Hence, mandibular condyle and ramus, in particular, are generally the most sexually dimorphic as they are the sites associated with the greatest morphological changes in size and remodeling during growth [6].

Boddu Naveen Kumar et al conducted study to determine gender using various measurements on mandible using digital Orthopantomography (OPG). Of all the parameters the Bi-condylar width showed highest sex differentiation in its measurements. But the OPG technique has disadvantage where unequal magnification and geometric distortion may cause many problems. These distortions are the result of the horizontal movement of the film and X-ray source [9]. Therefore the present study was intended to employ CT work station to measure intercondylar distances since CT provides an excellent method for examining intercondylar distance. The measurements of intercondylar distances tend to show sexual dimorphism and the difference between genders is more marked in them. The results in our study showed significantly larger dimensions of intercondylar distance in males (117.79±4.63) when compared to females (111.37±3.85). A statistically significant (P < 0.05) difference was found in the intercondylar distance between males and females. Consistent with the above mentioned studies [6][9], the results in our study supported the concept of intercondylar distances exhibiting sexual dimorphism.

Improvising on the CT based studies, which did not include the measurements of intercondylar distances, our study measured the distance between the condyles to predict the gender of an individual. In our study, using intercondylar distance measurements, gender was determined with accuracy rate of 85% and 80% for male and female respectively and overall prediction accuracy rate was 82.5% in both the genders. Therefore it seems likely that intercondylar distance could be used as an artifice for gender determination when the whole skeleton is not available as it remains intact even in segmented decomposition.

CONCLUSION

Among many methods that have been used to predict the gender of an individual in a massive disaster, the intercondylar distance could be used for gender determination when the whole skeleton is not available as it remains intact even in segmented decomposition with an added advantage of CT scan which provides an excellent method for examining intercondylar distance.

REFERENCES