# **ORIGINAL ARTICLE**

# Value of Maxillary sinus morphology in Identification of male gender by using digital radiography

YOUNAS KHAN<sup>1</sup>, SADIA SYED<sup>2</sup>, RUBINA SALMA<sup>3</sup>, RIZWAN-UL-HAQ<sup>4</sup>, FAHAD IQBAL<sup>5</sup>, ANWAR-UL-HAQ<sup>6</sup> <sup>1,5</sup>Postgraduate Trainees. <sup>3,4</sup>Associate Professors, Department of Forensic Medicine & Toxicology, Peshawar Medical College, Peshawar <sup>2</sup>Senior Lecturer, Al-Nafees Medical College, Islamabad <sup>6</sup>Associate Professor, Khyber Girls Medical College, Peshawar Correspondence to: Dr. Younas Khan email: unee4u@hotmail.com Cell 0335-9439250

# ABSTRACT

**Aim:** To determine gender from the morphology of maxillary sinus through digital radiography. **Study Design:** Descriptive study

**Place and Duration of Study:** Kuwait Teaching Hospital and Khyber Teaching Hospital Peshawar from 1<sup>st</sup> January 2020 to 30<sup>th</sup> June 2020.

**Methodology:** Radiographs (AP view) of 64 male subjects were used and morphometric parameters of maxillary sinus were analyzed

**Results**: The mean height and width of right maxillary sinus in males was 28.15mm and 25.04mm. Results were found statistically highly significant. Similarly, the mean height and width of left maxillary sinus in males was 28.91 mm and 25.33 mm.

**Conclusion:** It is possible to determine male gender from the height and width of maxillary sinuses with the help of anteroposterior (AP) view of digital radiographs.

Keywords: Forensic radiography, Maxillary sinus, Sexual dimorphism, Mass disaster

# INTRODUCTION

Identification of a human being is essential for many reasons such as for family members, humanitarian, emotional reasons and for the court of law before passing verdict.<sup>1,2</sup> Identification is required both in a living and dead body. The positive identification of an unknown human remains is among the most important part of any medicolegal investigation for both the judicial and ethical reasons.<sup>3</sup> Forensic radiology consists of performance, interpretation and then the reporting of the radiological examinations and procedures which concerns the law/ or courts.<sup>4</sup> Gender is determined radiologically by the help of bones such as pelvis, skull and femur. However, these bones are disfigured badly in incineration, and therefore the maxillary sinuses are used for identification in such cases.5 Radiography has the advantages of its general availability, comparatively low cast and low radiation doses as compared to three dimensional (3D) cone beam computed tomography.<sup>6</sup> The use of radiographs has been traced back to early 1900's for identification of unknown human remains.7 Radiological examination is frequently used for this purpose, thus making the radiologist as a key for the identification procedure.8 For identification in routine and mass disasters, the radiographs are being used since long effectively, swiftly and easily.<sup>9</sup> Furthermore, nowadays, forensic pathologist are getting trained in collecting and reading radiological data by working in close collaboration with radiologists.<sup>10</sup> The features taken into account for the identification in dead persons include age, sex, fingerprints and footprints, general development including stature, complexion, religion, teeth, superimposition, DNA fingerprinting, anthropometric measurements and personal belongings.<sup>11</sup> Two of the accurate applied methods of identification are finger printing which becomes impossible sometimes such as in incinerated, fragmented or decomposed human bodies and DNA finger printing. another accurate method of identity, which requires advance laboratory facilities and time but sometimes

become impossible, especially if the body remains are degraded badly.<sup>12</sup>

In forensic medicine, anthropometric characteristics have fundamental importance in solving problems of identification.<sup>13</sup> Identification of sex is one of the most important parameters of personal identity.<sup>14</sup> Gender identification is done through various body parts, mainly through pelvis skull and long bones.<sup>15</sup> It is necessary to compare the antemortem record with the post mortem record to identify the dead body. However, identity is difficult to establish with routinely used forensic procedures after development of marked postmortem changes.<sup>16</sup> In warfare, explosions, incinerated, decomposed bodies and other mass disasters like aircraft crashes, all the bones get badly disfigured while maxillary sinuses remain intact, therefore they can be used for identification.<sup>17</sup>

Maxillary sinuses are two air filled cavities present in maxillary bone, are the largest of all paranasal sinuses is the first paranasal sinus to develop at the age of 10 weeks in utero.<sup>15</sup> There are two stages of development of paranasal sinuses. The first stage is prenatal phase also known as primary pneumatization and second stage of secondary pneumatization which continues from prenatal stage through adulthood.<sup>18</sup> Its development is continued till 3<sup>rd</sup> decade in males and 2<sup>nd</sup> decade in females.<sup>19</sup> It has been reported that genetic diseases, post-infections and environmental factors can affect the sizes of maxillary sinuses.<sup>16</sup>

Sexual dimorphism is a term used to describe the systemic difference in either the shape or size between the individuals of different sexes in the same species. Sexual dimorphism is exhibited by maxillary sinuses of various species.<sup>17</sup> The characteristics of maxillary sinus makes its utility as an important sinus for forensic identification.<sup>20</sup> Analysis of the maxillary sinus may be helpful in the field of forensic medicine.<sup>21</sup> Gender identification through morphology of the maxillary sinus with help of digital radiography is thus helpful to provide easy, less expensive way of gender identity.<sup>17</sup> In developing countries, like

Pakistan X-ray facility is commonly available, as compared to computed topography (CT) scan which is expensive, unaffordable and more technical. Therefore, further research is needed to evaluate the usefulness of digital radiography for estimation of gender and identity through maxillary sinu.<sup>20</sup>

#### PATIENTS AND METHODS

This descriptive study was conducted at Kuwait Teaching Hospital and Khyber Teaching Hospital Peshawar from 1st January 2020 to 30th June 2020 and comprised 64 male patients for their ENT related problems and were advised X-ray (AP view showing maxillary sinuses). Patients age between 25-40 years, eruption of all permanent teeth and the included radiographs showing completely formed left and right maxillary sinuses with clarity, adequate density and contrast were included. Patients of images with errors in radiograph processing and artifacts and images with pathologies or malformations of maxillary sinuses were excluded. An image processing programmer microdicom is used for measuring dimensions of height and width of all radiograph samples. This programmer was fed with a sample radiograph showing left and right maxillary sinuses and height and width is measured in the mid-line along yaxis and x-axis of radiographs under the guidance of a radiologist (Fig. 1). The data was entered and analyzed through SPSS-20.



Fig.1: Radiograph showing measurement of height and width of maxillary sinuses in millimeters

## RESULTS

The means of height of right maxillary sinus in was 28.15 mm, width of right maxillary sinus was 25.04 mm, height of left maxillary sinus was 28.91 mm and width of left maxillary sinus was 25.33 mm. Statistically the difference was significant (P<0.05) (Table 1, Fig. 2).

					<i>·</i> · ·
Table 1:	Height and	l width of	maxillary	sinus	(mm)

Variable	Mean±SD	
Age	29.81±5.97	
Height right maxillary sinus	28.15±5.14	
Width right maxillary sinus	25.04±4.53	
Height left maxillary sinus	28.91±4.0	
Width left maxillary sinus	25.33±5.59	



Younas Khan, Sadia Syed, Rubina Salma et al

Height of right mailliary Width of right mailliary Height of left mailliary sinus si

## DISCUSSION

Identification is the determination of the individuality of a person. Sex determination becomes medicolegally important in cases of divorce, marriage, impotence, legitimacy, heirship and rape.<sup>11</sup> Establishing Identity from the human skeletal's remains is an important forensic procedure. Determination of a gender and age is an integral part of identification. It has been reported about accuracy rate of gender determination that it is 100% from a complete skeleton, 98% from both the skull and the pelvis, 95% from pelvis only or the pelvis and long bones, 90-95% from the skull and long bones and 80-90% from long bones only.<sup>16</sup> Recent literature shows that Computed Tomography has excellent diagnostic accuracy due to its high special resolution and broad availability. There is more literature available on the analysis of facial sinuses by means of computed tomography. It is a highly effective technique because it provides tridimensional information, diminishes the overlapping of structures through sectional images, thus allowing satisfactory assessment of anatomy of sinuses and their variations. When complete human skeleton is not available then the height and width of maxillary sinuses can be used to determine sex along with other bones.22

In this present study, 64 radiographs were used to measure the height and width of maxillary sinuses. Cristhiane et al<sup>22</sup> who conducted their study on panoramic radiographs of maxillary sinuses in Brazil noted that the mean height for the right maxillary sinuses in males was 30.74±3.59mm as compared to 27.71±3.92mm for females' right maxillary sinuses height. They noted that the mean width for the right maxillary sinuses in males was 48.57±4.49mm as compared to 45.18±2.83mm for females. Similarly, the mean height and width for left maxillary sinuses were 30.99±3.38mm and 48.77±4.24mm respectively for males and for females, these values were 28.78±3.39mm and 44.61±4.62mm respectively. This study also shows that maxillary sinuses are higher and wider in males as compared to females.

Thais et al<sup>12</sup> conducted research over articles which were published in Brazil between 2003 and 2014 about determination of sex and identification from maxillary and frontal sinuses radiography and computed tomography. The articles showed that there was marked difference between male and female maxillary sinuses dimensions both on radiographs and computed tomography and hence maxillary sinuses can be reliably used for gender determination as compared to frontal sinuses.

Similar results were also noted by Teke et al<sup>16</sup> who used computed tomography to determine sex through the size of maxillary sinuses who found that the size of maxillary sinuses of females were smaller than the males. Ruhi et al<sup>15</sup> conducted a study for gender estimation from maxillary sinuses by lateral radiography on 50 subjects (25 males and 25 females) free of maxillary sinuses diseases, by taking lateral radiographs and then the area and perimeter of maxillary sinus was showed that the perimeter and mean area of maxillary sinus in males was 5.2885 cm and 1.7261 cm<sup>2</sup> and in females, it was 4.3901 cm and 1.3424cm<sup>2</sup>. They concluded that gender can be identified from measuring dimensions of maxillary sinuses through radiography.

## CONCLUSION

The male gender can be determined from the height and width of maxillary sinuses with the help of anteroposterior view of digital radiographs.

## REFERENCES

- 1. Kunigal SP, Charan G, Ganganna K, Jayadev S, Shubha K, Suchetha DN. Gender differentiation using maxillary sinus. Int J Oral Care Res 2017; 5(1):19-22.
- Prabhat M, Shalu R, Mandeep K, Kanika P, Puneet B, Sapna P. Computed tomography based forensic gender determination by measuring the size and volume of the maxillary sinuses. J Forensic Dent Sci 2016; 8(1), 40-46.
- Ciaffi R, Gibelli D, Cattaneo C. Forensic radiology and personal identification of unidentified bodies: a review. Radiol Med 2011;116:960-8.
- 4. Brogdon BG. The scope of Forensic Radiology. Clin Lab Med 1998; 18(2):203-40.
- Asmaa TU, Natheer HA, Ahmed SA, Jalal FA. Evaluation of Maxillary Sinus Dimensions in Gender Determination Using Helical CT Scanning. J Forensic Sci 2011; 56(2): 403-8.
- Malina-Altzinger S, George D, Klause WG, Bernd S. Evaluation of maxillary sinus in panoramic radiography-a comparative study. Int J Implant Dent 2015; 1:17.
- 7. Besana JL, Rogers TL. Personal identification using frontal sinus. J Forensic Sci 2010; 55(3):584-9.
- 8. Ruder TD, Markus K, Walther FG, Mathier S, Lars CE, Michail JT, Gary MH. Radiologic identification of disaster

victims: a simple and reliable method using CT of the paranasal sinuses. Eur J Radiol 2012; 81:e132-8.

- 9. Kahana T, Hiss J. Identification of human remains: Forensic radiology. J Clin Forensic Med 1997; 4:7-15.
- Grabherr S, Uldin T, Dedouit F. Radiodiagnostic and molecular innovation in personal identification. P5 Med Justice 2017; 427-36.
- Dixit PC. Textbook of Forensic Medicine and Toxicology. 2<sup>nd</sup> ed. New Delhi, India: Peepee Publishers. 2013.
- Thais AX, Andrea SSD, Ricardo HADS. Forensic application of the frontal and maxillary sinuses: a literature review. J Forensic Radiol Imaging 2015; (3):105-10.
- 13. Rainio J, Lalu K, Ranta H, Pentilla A. Radiology in forensic operations. Leg Med 2001; 3(1):34-43.
- Tanya K, Arpita K, Uday G, Ritika J. Cephalometric analysis for gender determination using maxillary sinus index: A novel dimension in personal identification. Int J Dent 2017; 2017: 7026796.
- Ruhi S, Sunira C, Parvathi D, Neeraj T, Kunal S, Navdeep K. Forensic importance of maxillary sinus in gender determination: A morphometric analysis from Western Uttar Pradesh, India. Eur J General Dent 2014; 3(1):53-6.
- Teke SD, Nergis C, Gurol C. Determination of gender by measuring the size of the maxillary sinuses in computerized tomography scans. Surg Radiol Anat 2006; 29:9-13.
- Kanthem D, Venkateswara RG, Sivaranjani Y, Geeta K. Sex determination using maxillary sinus. J Forensic Dent Sci 2015; 7(2):163-7.
- Pifferi A, Caramella D, Cicco MZ, Chinellato I, Macchiav P, Boner AL. Agenesis of paranasal sinuses and nasal nitric oxide in primary ciliary dyskinesia. Eur Respiratory J 2011; 37(3):566-71.
- 19. Akkurt A, Dogru M, Hekimoglu S, Karadede I. Three dimensional comparison of maxillary sinus volume in patients with and without posterior crossbite maxillary sinus volume. Int Arch Med Res 2013; 5(1):1-8.
- 20. Mousse JO, Marques JAM, Olibeira RN. Contribution of the maxillary sinus analysis for human identification. Health Ethics Justice 2009; 14(2): 65-76.
- 21. Fernandes CL. Forensic ethnic identification of crania: the role of the maxillary sinus. Am J Forensic Med Pathol 2004; 25:302-13.
- 22. Christiane LDQ, Andrea SSDT, Thais UD, Lais GDA, Rodigro G, Christiano O. Sex determination of adult human maxillary sinuses on panoramic radiographs. Acta Stomatol Croatia 2016; 50(3):215-21.