The study of sexing of second metacarpal bone from Saurashtra region

Jatin A. Chudasama, Mital M. Patel, Chintan J. Lakhani, Mayank D. Javia, Daksha Dixit, T. C. Singel, Assistant Professor, Professor, 3rd year Resident, Professor & Head, Department of Anatomy, M.P. Shah Medical College, Jamnagar, Gujarat. Professor & Head, Department of Anatomy, J. N. Medical College, Belgaum, Karnataka.

Abstract

Aim: The aim of the present study is to provide parameters of 2nd metacarpal bones for sex determination from Saurashtra populations. Material and method: Forty two pairs of 2nd metacarpal bones were measured and their dimensions were compared with the dimensions of Spanish and American white population. The mean, SD, t value and p value were calculated, and demarcating point method for sexual dimorphism was employed. Result: Mean interarticular length of 2nd metacarpal was higher in male as compared to female for both sides (right and left) and the difference was statistically highly significant. Mean anteroposterior width at base of 2nd metacarpal was higher in male as compared to female for both sides (right and left), but the difference was statistically insignificant for right side and statistically significant for left side. Conclusion: The present study showed that interarticular length and anteroposterior width at base of 2nd metacarpal are effective parameters for sex determination.

Keywords: interarticular length, anteroposterior width of base, Demarcating point

Introduction

Determination of sex is one of the most important steps during forensic and archeological analyses of human skeletal remains. Presence of both skull and pelvis may provide the most accurate sex determination potential. However, both of these components may not be present in every instance, necessitating the use of other skeletal remains. Very few studies were carried out on metacarpals for sex determination. The aim of this study is to determine the sex of unknown individual from metacarpal bone.

According to Lazenby, the second metacarpal has also contributed to methodology in forensic anthropology with regard to stature estimation and sex identification.

According to Lazenby, appreciation of population variation in skeletal asymmetry, strength, and lateral hand dominance owes much to bone mass data from the second metacarpal.

In metacarpals II and V, unilateral notches often represent an unequal widening and modeling of the proximal end of the shaft.

Plato et al. found that the second metacarpal was longest in both adult Guamanian and American white males than in females.

Materials and methods

Material of study consisted of 84 normal human 2nd metacarpal bones obtained from Anatomy Department M.P. Shah Medical College, Jamnagar. Out of 84 bones, 72 bones (36 right, 36 left) were of male and 12 bones (6 right, 6 left) were of female.

Following methods as described by Falsetti were used:

1) Interarticular length

It is length measured between midline of head to the midline of base of metacarpal using Vernier caliper. (Fig.1)

2) Anteroposterior width of base

It is width measured in the anteroposterior plane at base of metacarpal bone using Vernier caliper. (Fig.2)

Mean, standard deviation, demarcating point range (mean±3SD) of above measurements were calculated. The t-test was applied on data to test the significance of difference between the means of male & female parameters. Statistical results are shown in table no. 1 and 2.
Sexing of second metacarpal: Chudastama et al.

Interarticular length >70.46 mm can be accurately classified as male and right 2nd metacarpal with interarticular length <60.30 mm can be accurately classified as female. However, when the interarticular length of bone was between 60.30 mm and 70.46 mm sexing was not possible due to overlapping. Demarcating point analysis identified sex of 9 right male bones out of 36 (25%) and 3 right female bones out of 6 (50%).

For left male 2nd metacarpal, mean interarticular length was 68.44 mm with a range of 64-75 mm and S.D. of 2.71 mm and for left female 2nd metacarpal, mean interarticular length was 60.50 mm with a range of 55-65 mm and S.D. of 3.08 mm. Mean interarticular length of left 2nd metacarpal was higher in male as compared to female. Calculated t-value and p-value showed that this difference was statistically highly significant with p<0.01. Mean ± 3 S.D. values gave range for Demarcating point (D.P.). With the help of these demarcating points, left 2nd metacarpal with interarticular length >69.74 mm can be accurately classified as male and left 2nd metacarpal with interarticular length <60.31 mm can be accurately classified as a female. However, when the interarticular length of bone was between 60.31 mm and 69.74 mm sexing was not possible due to overlapping. Demarcating point analysis identified sex of 14 left male bones out of 36 (38.88%) and 4 left female bone out of 6 (66.66%) and the difference was statistically highly significant.

Results

1. Interarticular length

For right male 2nd metacarpal, mean interarticular length was 68.52 mm with a range of 64-75 mm and S.D. of 2.74 mm and for right female 2nd metacarpal, mean interarticular length was 60.83 mm with a range of 55-65 mm and S.D. of 3.21 mm. Mean interarticular length of right 2nd metacarpal was higher in male as compared to female. Calculated t-value and p-value showed that this difference was statistically highly significant with p<0.01. Mean ± 3 S.D. values gave range for Demarcating point (D.P.). With the help of these demarcating points, right 2nd metacarpal with interarticular length >70.46 mm can be accurately classified as male and right 2nd metacarpal with interarticular length <60.30 mm can be accurately classified as female. However, when the interarticular length of bone was between 60.30 mm and 70.46 mm sexing was not possible due to overlapping. Demarcating point analysis identified sex of 9 right male bones out of 36 (25%) and 3 right female bones out of 6 (50%).

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2. Anteroposterior width of base

For right male 2nd metacarpal, mean anteroposterior width of base was 15.27 mm with a range of 13-18 mm and S.D. of 1.09 mm and for right female 2nd metacarpal, mean anteroposterior width of base was 13.50 mm with a range of 13-14 mm and S.D. of 0.51 mm. Mean anteroposterior width at base of right 2nd metacarpal was higher in male as compared to female. Calculated t-value and p-value showed that this difference was statistically insignificant with p>0.05. Mean ± 3 S.D. values gave range for Demarcating point.
Sexing of second metacarpal - Chudasama et al.

Table 1: Range, mean and standard deviation of interarticular length and anteroposterior width at base of 2nd metacarpal

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sex</th>
<th>Side</th>
<th>n</th>
<th>Range (mm)</th>
<th>Mean (mm)</th>
<th>S.D. (mm)</th>
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<tr>
<td>Interarticular length</td>
<td>Male</td>
<td>Right</td>
<td>36</td>
<td>64-75</td>
<td>68.52</td>
<td>2.74</td>
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<td></td>
<td></td>
<td>Left</td>
<td>36</td>
<td>64-75</td>
<td>68.44</td>
<td>2.71</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>Right</td>
<td>6</td>
<td>55-65</td>
<td>60.83</td>
<td>3.21</td>
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<tr>
<td></td>
<td></td>
<td>Left</td>
<td>6</td>
<td>55-65</td>
<td>60.50</td>
<td>3.08</td>
</tr>
<tr>
<td>Anteroposterior width at the base</td>
<td>Male</td>
<td>Right</td>
<td>36</td>
<td>13-18</td>
<td>15.27</td>
<td>1.09</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Left</td>
<td>36</td>
<td>13-18</td>
<td>15.36</td>
<td>0.88</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>Right</td>
<td>6</td>
<td>13-14</td>
<td>13.50</td>
<td>0.51</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Left</td>
<td>6</td>
<td>13-14</td>
<td>13.16</td>
<td>0.91</td>
</tr>
</tbody>
</table>

Table 2: Sexual dimorphism of different parameters of 2nd metacarpal

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Side</th>
<th>Male (n=36)</th>
<th>Female (n=6)</th>
<th>r' value</th>
<th>r'' value</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTERARTICULAR LENGTH</td>
<td>R</td>
<td>60.30-76.74</td>
<td>&gt;70.46</td>
<td>25.00%</td>
<td>50% (3)</td>
</tr>
<tr>
<td></td>
<td>L</td>
<td>60.31-76.57</td>
<td>&gt;69.74</td>
<td>38.88%</td>
<td>66.66% (4)</td>
</tr>
<tr>
<td>ANTEROPosterior WIDTH OF BASE</td>
<td>R</td>
<td>12.00-18.54</td>
<td>&gt;15.03</td>
<td>36.11% (13)</td>
<td>&lt;12.00</td>
</tr>
<tr>
<td></td>
<td>L</td>
<td>12.72-18.00</td>
<td>&gt;15.89</td>
<td>33.33% (12)</td>
<td>&lt;12.72</td>
</tr>
</tbody>
</table>

(D.P.). With the help of these demarcating points, right 2nd metacarpal with anteroposterior width of base >15.03 mm can be correctly classified as male and right 2nd metacarpal with anteroposterior width of base <12 mm can be correctly classified as a female. However if the anteroposterior width of base of bone is between 12 mm and 15.03 mm sexing was not possible due to overlapping. Demarcating point analysis identified sex of 13 right male bones out of 36 (36.11%) and but could not identify any right female bones out of 6 bones.

For left male 2nd metacarpal, mean anteroposterior width of base was 15.36 mm with a range of 13-18 mm and S.D. of 0.88 mm and for left female 2nd metacarpal, mean anteroposterior width of base was 13.16 mm with a range of 13-14 mm and S.D. of 0.91 mm. Mean anteroposterior width at base of left 2nd metacarpal was higher in male as compared to female. Calculated t-value and p-value showed that this difference was statistically significant with p<0.05. Mean ± 3S.D. values gave range for Demarcating point (D.P.). With the help of these demarcating points, left 2nd metacarpal with anteroposterior width of base >15.89 mm can be correctly classified as male and left 2nd metacarpal with anteroposterior width of base <12.72 mm can be correctly classified as a female. However if the anteroposterior width of base of bone is between 12.72 mm and 15.89 mm sexing was not possible due to overlapping. Demarcating point analysis identified sex of 12 left male bones out of 36 (33.33%) and 2 left female bone out of 6 (33.33%).
Table 3: Comparison of present study with other studies

<table>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mean</td>
<td>S.D.</td>
<td>Mean</td>
<td>S.D.</td>
</tr>
<tr>
<td>INTERARTICULAR LENGTH</td>
<td>Male</td>
<td>R</td>
<td>67.73</td>
<td>3.29</td>
<td>65.24</td>
<td>4.99</td>
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<tr>
<td></td>
<td></td>
<td>L</td>
<td>67.55</td>
<td>3.12</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>R</td>
<td>61.86</td>
<td>2.91</td>
<td>62.79</td>
<td>5.02</td>
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<tr>
<td></td>
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<td>L</td>
<td>61.67</td>
<td>2.78</td>
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<tr>
<td>ANTEROPOSTERIOR WIDTH AT BASE OF METACARPAL</td>
<td>Male</td>
<td>R</td>
<td>18.19</td>
<td>1.24</td>
<td>16.45</td>
<td>2.30</td>
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<tr>
<td></td>
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<td>L</td>
<td>17.65</td>
<td>1.27</td>
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<tr>
<td></td>
<td>Female</td>
<td>R</td>
<td>16.29</td>
<td>0.94</td>
<td>15.44</td>
<td>1.42</td>
</tr>
<tr>
<td></td>
<td></td>
<td>L</td>
<td>15.76</td>
<td>0.87</td>
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</tbody>
</table>

Discussion

Present study deals with the observations of two parameters of 2nd metacarpal in the Saurashtra region. Similar studies have been carried out by a number of workers in other regions. The findings of the present series are compared with those of the other series and are presented below.

Interarticular Length

(A) Male

Comparison for interarticular length of male 2nd metacarpal between present study and other studies has been shown in Table No.3. Mean value of Interarticular length of 2nd metacarpal of male in present study was 68.52 mm (right) & 68.44 mm (left). In other studies done by Barrio et al., Burrows et al. and Scheuer & Elkington, it varied from 65.24 mm to 68.02 mm.

Interarticular length of 2nd metacarpal in Saurashtra region was near to American white and was higher than the British white population and Spanish population.

(B) Female

Comparison for interarticular length of female 2nd metacarpal between present study and other studies has been shown in Table No.3. Mean value of Interarticular length of 2nd metacarpal of female in present study was 60.83 mm (right) & 60.50 mm (left). In other studies, it varied from 61.67 mm to 64.64 mm.

Interarticular length in 2nd metacarpal in Saurashtra region was lower than the British white, Spanish population and American white.

Anteroposterior width at base

(A) Male

Comparison of anteroposterior width at base of male in 2nd metacarpal between present study and other studies has been shown in Table No.3. Mean anteroposterior width at base of metacarpal of male in present study was 15.27 mm (right) & 15.36 mm (left). In other study it varied from 16.45 mm to 18.19 mm.

Anteroposterior width at base in metacarpal-II in Saurashtra region was lower than the British white population, Spanish population and American white.

(B) Female

Comparison of anteroposterior width at base of female in metacarpal-II between present study and other studies has been shown in Table No.3. Mean value of anteroposterior width at base of metacarpal of female in present study was 13.50 mm (right) & 13.16 mm (left). In other study it varied from 15.44 mm to 16.29 mm.

Anteroposterior width at base in metacarpal-II in Saurashtra region was lower than the British white, Spanish population and American white.
Sexing of second metacarpal · Chudasama et al.

**Conclusion**

In the absence of cranial and pelvic bones the metacarpals can provide a base for classification by sex and population groups.

Thus, by demarcating point method, the effective parameters for sexing of 2nd metacarpal from Saurashtra region are-interarticular length and anteroposterior width at base. Interarticular length of 2nd metacarpal can identify 25% of right male bones, 38.88% of left male bones, 50% of right female metacarpals and 66.66% of left female bones. Anteroposterior width at base of 2nd metacarpal can identify 36.11% of right male bones, 33.33% of left male bones and 33.33% of left female bones.

These two parameters of 2nd metacarpal could be used in construction of plastic models for teaching purpose in Anatomy.

**References**


Address for communication:

Dr. Jatin A. Chudasama  
Assistant Professor of Anatomy,  
M. P. Shah Medical College, Jamnagar, Gujarat.  
e-mail ID : chudasama_jatin@yahoo.co.in  
Mobile : 09033866762

National Journal of Clinical Anatomy  
Vol.-2, (3) Pg. 145 - 149 (2013)