Correlation between the forearm plus little finger length and the femoral length

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ABSTRACT

Purpose. To assess the correlation between the forearm plus little finger length and the femoral length in 100 volunteers.

Methods. The forearm plus little finger length and the ipsilateral femoral length of 68 male and 32 female volunteers aged 19 to 55 (mean, 35.8) years were measured using a measuring tape. The forearm plus litter finger length was measured from the tip of the olecranon to the tip of the little finger, whereas the femoral length was measured from the tip of the greater trochanter to the level of proximal pole of the patella over the outer aspect of thigh. Two observers made the measurements on 2 separate occasions. Intra- and inter-observer variations were calculated. A value of ≥0.75 indicated excellent agreement.

Results. The mean forearm plus little finger length and femoral length were 39.87 (SD, 2.73) and 39.85 (SD, 2.44) cm, respectively. The mean difference between these 2 measurements was 0.028 (95% CI, –0.109 to 0.165) cm. The correlation between these 2 measurements was 0.861 (p<0.001). Patient age, sex, and body mass index did not affect this correlation. The intra- and inter-observer reliability was excellent.

Conclusion. The forearm plus little finger length correlated with the femoral length. This method is simple, radiation-free, and can be applied in day-to-day practice.

Key words: anthropometry; bone nails; femoral fractures; forearm; fracture fixation, intramedullary

INTRODUCTION

Intramedullary nailing is the most common procedure for adult diaphyseal femoral fractures.1,2 Proper preoperative assessment of the fracture pattern, comminution, fracture extension, femoral length, and morphology is necessary.1–3 Several direct and indirect methods of estimating the femoral nail length have been described.1,4–9 Direct measurement of the intact femur (from the tip of the greater trochanter to the proximal pole patella) on the opposite side can serve as a rough guide,1 but may be inaccurate
in obese patients. The use of radiographs can solve this problem, but involves radiation exposure, and radiological magnification may lead to inaccuracy.\(^4\)\(^8\) Other methods include the use of a nail template, radio-opaque ruler, or Kuntscher ossimeter.\(^7\)\(^9\) All these methods require an intact contralateral femur. In bilateral comminuted fractures, measurement is made on the less-committed side.\(^1\)\(^4\)

Measurement of the forearm plus little finger length (from the tip of the olecranon to the tip of the little finger) is an alternative means to determine the femoral length.\(^3\) This study assessed the correlation between the forearm plus little finger length and the femoral length in 100 volunteers.

**MATERIALS AND METHODS**

The forearm plus little finger length and the ipsilateral femoral length of 68 male and 32 female volunteers aged 19 to 55 (mean, 35.8; standard deviation [SD], 9.2) years were measured using a measuring tape. They had no congenital or traumatic deformity of the limbs. Of them, 40 were of normal weight (body mass index [BMI], 19–24.9 kg/m\(^2\)), 40 were overweight (BMI, 25–29.9 kg/m\(^2\)), and 20 were obese (BMI, ≥30 kg/m\(^2\)). Informed consent was obtained from each participant.

The forearm plus little finger length was measured from the tip of the olecranon to the tip of the little finger. The elbow was flexed to 90° and the wrist and fingers were in a neutral position (Fig. 1). The femoral length was measured from the tip of the greater trochanter to the level of proximal pole of the patella over the outer aspect of thigh. The thigh was slightly flexed and adducted to make the greater trochanter more prominent (Fig. 1).

Two observers made the measurements on 2 separate occasions. Intraclass correlation coefficients (ICC) were calculated for intra- and inter-observer variations. An ICC of ≥0.75 indicated excellent agreement. Student’s \(t\) test was used to compare the 2 measurements by each observer. The association between the 2 measurements was studied using the Pearson correlation coefficient. A \(p\) value (two-sided) of <0.05 was considered statistically significant.

**RESULTS**

The mean forearm plus little finger length and femoral length were 39.87 (SD, 2.73) and 39.85 (SD, 2.44) cm, respectively (Table 1).

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Mean±SD forearm plus little finger length (cm)</th>
<th>Mean±SD femoral length (cm)</th>
<th>Mean difference (95% CI)</th>
<th>(p) Value</th>
<th>Correlation</th>
<th>(p) Value (Student’s (t)-test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observer 1</td>
<td>1st 39.74±2.76</td>
<td>39.71±2.44</td>
<td>0.033 (-0.247 to 0.313)</td>
<td>0.816</td>
<td>0.859</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>2nd 39.86±2.78</td>
<td>39.77±2.44</td>
<td>0.085 (-0.186 to 0.356)</td>
<td>0.537</td>
<td>0.871</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Observer 2</td>
<td>1st 39.86±2.79</td>
<td>39.88±2.46</td>
<td>-0.020 (-0.314 to 0.274)</td>
<td>0.893</td>
<td>0.838</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>2nd 40.04±2.65</td>
<td>40.03±2.45</td>
<td>0.014 (-0.250 to 0.278)</td>
<td>0.917</td>
<td>0.875</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

**Figure 1** Measurement of (a) the forearm plus little finger length and (b) the femoral length.

**Table 1** Correlations between the forearm plus little finger length and the femoral length.
The correlation between these 2 measurements was 0.028 (95% CI, –0.109 to 0.165) cm. The correlation between these 2 measurements was 0.861 (p<0.001, Student’s t test, Table 1, Fig. 2). Patient age, sex, and BMI did not affect this correlation (Table 2).

The intra-observer reliability for measuring the forearm plus little finger length and the femoral length were 0.984 and 0.982 for observer 1 and 0.978 and 0.983 for observer 2, respectively, which were excellent (Table 3). The inter-observer reliability was also excellent (Table 3).

**DISCUSSION**

Restoration of the femoral length is one of the treatment goals for femoral diaphyseal fractures.1 Shorter nails may result in inadequate stability or stress fracture at the distal tip, whereas longer nails may protrude to the proximal femur causing bursitis and movement restriction. Preoperative estimation of the femoral nail length using other body parts has been described.4–7 The contralateral femoral length is considered the standard measurement for the femoral nail length.1,5 The sum of the fibular length and the transverse femoral head diameter correlates to the femoral medullary length.4 This radiographic measurement requires that both the femoral head and the fibula be intact. The use of the forearm length as a reference has been reported.5,6 It can be easily applied in clinical practice. Correlation was strong (r=1) between the 2 measurements, with a mean difference of 0.16 mm.6 In the present study, the correlation between the 2 measurements was 0.86 (p<0.001), and was not affected by age, sex, and BMI. The forearm plus little finger length represents the maximum femoral nail length. This method is simple, radiation-free, and can be applied in day-to-day practice.

**DISCLOSURE**

No conflicts of interest were declared by the authors.

**REFERENCES**