

Correlation Between the Forearm Plus Little Finger Length and The Actual Femoral Length in Orthopedic Patients Presenting with Femoral Shaft Fractures

¹Ghias Ud Din Jan, ²Fazal Mahmood, ³Saeed Ullah

Author's Affiliation

¹Assistant professor, Department of Orthopedics surgery and trauma, Pakistan institute of medical sciences, Islamabad.

^{2,3}Postgraduate resident, Department of Orthopedics surgery and trauma, Pakistan institute of medical sciences, Islamabad.

Author's Contribution

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²Active participation in methodology, interpretation and discussion, writing of manuscript,

³Data collection, data entries, review of literature and data analysis.

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Address of Correspondence

Dr. Ghias Ud Din Jan
ghiasjan16@gmail.com

ABSTRACT

Objective: To determine the correlation between the forearm plus little finger length and the actual femoral length in orthopedic patients presenting with femoral shaft fractures at a teaching hospital in Islamabad.

Methodology: This study was conducted at Department of Orthopedics, Pakistan Institute of Medical Sciences, Islamabad. Study design was descriptive cross-sectional study and the duration of study was one year (12-7-2015 to 12-7-2016), in which a total of 30 cases was observed. Ppatients of both genders aged between 18-70 years presenting with femoral shaft fractures. All the patients who met the inclusion criteria were enrolled into this study. A single resident measured forearm plus little finger length pre-operatively. Actual femoral length in centimeter was measured during operative procedure using a measuring tape. Patient's demographic details and forearm plus little finger length and actual femoral lengths were recorded into the attached proforma.

Results: The age of the patients ranged from 26 years to 59 years with a mean of 42.10 ± 9.79 years. There were 27(90%) male and 3(10%) female patients in the study group. The forearm plus little finger length ranged from 38 cm to 44 cm with a mean of 40.97 ± 2.28 cm. The actual femoral length ranged from 38 cm to 45 cm with a mean of 40.93 ± 2.29 cm. There was significantly strong correlation between forearm plus little finger length and actual femoral length ($r=.970$; $p=.000$). When stratified, there was significantly strong correlation between forearm plus little finger length and actual femoral length across various age groups 26-36 years ($r=.981$, $p=.000$), 37-47 years ($r=.946$, $p=.000$), 48-59 years ($r=.993$, $p=.000$) and genders; male ($r=.976$, $p=.000$), female ($r=.986$, $p=.000$).

Conclusion: There was significantly strong correlation between forearm plus little finger length and actual femoral length ($r=.970$; $p=.000$) regardless of patient age and gender.

Key words: Femur Shaft Fracture, Intramedullary Nail Length Determination, Forearm plus Little Finger Length, Actual Femoral Length, Correlation.

Introduction

Most common surgical option adopted in diaphyseal femoral fractures in adults is the intramedullary nailing.¹ It offers the benefits of indirect reduction with less stripping of periosteal blood supply and preservation of soft tissues

and the fracture hematoma with its bone-forming cells and factors thus enabling early mobilization, excellent fracture healing and decreased risk of infection.^{1,2}

It however requires proper preoperative evaluation of the fracture pattern, morphology, fracture comminution, extension and femoral length. Numerous direct and indirect methods for the estimation of femoral nail length have been described³. Direct measurement of the intact femur (from the tip of the greater trochanter to the proximal pole patella) on the opposite side can function as a rough guide but may be inaccurate in obese patients. The use of radiographs can resolve this issue, but implicates radiation exposure, and radiological magnification may lead to inaccuracy. Other methods comprise the use of a nail template, radio-opaque ruler, or Kuntscher ossimeter. All these methods necessitate an intact contralateral femur^{3,4}

Lakhey et al⁵ in described the use of pre-operative forearm plus little finger length measurement as reference for per-operative femoral length. Naik et al⁷.showed that the mean forearm plus little finger length was 39.87 ± 2.73 cm while the mean actual femoral length which was measured from the tip of the greater trochanter to the level of proximal pole of the patella over the outer aspect of thigh was 39.85 ± 2.44 cm. The forearm plus little finger length correlated well (mean difference=0.028; $r=0.861$) with the actual femoral length. Similar correlation was observed previously by Nazir et al.⁶ in (mean difference=0.16; $r=1$)

This method of pre-operative femoral length estimation is simple, radiation free, and can be applied in day-to-day practice. However, the above evidence is limited (only 2 international papers) and there is no study in local population. Considering the limited evidence and skeletal differences among various populations^{8,9}, the purpose of the current study is to determine how strongly the forearm plus little finger length correlates with the actual femoral length in local population. The results of this study may thus provide a simple, easy to perform and safe method for pre-operative determination of femoral length in future patients requiring intramedullary nail fixation for femur shaft fractures.

Methodology

This study was conducted at Department of Orthopedics, Pakistan Institute of Medical Sciences, Islamabad. Study design was descriptive cross-sectional study and the duration of study was one year (12-7-2015 to 12-7-

2016), in which a total of 30 cases was calculated with 80% power of test, 5% significance level and expected correlation between the forearm plus little finger length and the actual femoral length to be $r=0.8616$. More over patients were selected by non-probability consecutive sampling was used for sample collection. Patients of both genders aged between 18-70 years presenting with femoral shaft fractures. While patients with congenital or acquired deformity of the limbs (as per history and clinical examination), patients with comminuted fractures where loss of bone length was suspected (on x-ray and direct inspection during surgery) and foreign nationals were excluded from the study. All the patients who met the inclusion criteria were enrolled into this study. Patient's demographic details were noted. Written informed consent was taken from each patient to participate in this study. A single resident measured forearm plus little finger length pre-operatively. Actual femoral length in centimeter was measured during operative procedure using a measuring tape. Patient's demographic details and forearm plus little finger length and actual femoral lengths were recorded into the attached proforma. All the data was analyzed in SPSS version 10. Mean and SD were computed for continuous variables like age, forearm plus little finger length and the actual femoral length. Frequency and percentages were calculated for categorical variables like gender. Pearson co-efficient of correlation (r) was determined for forearm plus little finger length and the actual femoral length by taking $p \leq 0.05$ as significant. Data has been stratified for age and gender and post-stratification independent sample T-Test has been applied taking p value ≤ 0.05 as significant.

Results

The age of the patients ranged from 26 years to 59 years with a mean of 42.10 ± 9.79 years. There were 27(90%) male and 3(10%) female patients. (Table I, II).

Table I: Descriptive Statistics for Age (Years)

	N	Minimum	Maximum	Mean	Std. Deviation
Age	30	26	59	42.10	9.792

Table II: Frequency Table for Gender

	Gender	Frequency	Percent
	Male	27	90.0
	Female	3	10.0

Gender	Frequency	Percent
Male	27	90.0
Female	3	10.0
Total	30	100.0

The forearm plus little finger length ranged from 38 cm to 44 cm with a mean of 40.97 ± 2.28 cm. (Table III, VIII.).

	n	Minimum	Maximum	Mean	Std. Deviation
Forearm + Little Finger Length (cm)	30	38	44	40.97	2.282

	n	Minimum	Maximum	Mean	Std. Deviation
Actual Femoral Length (cm)	30	38	45	40.93	2.288

The actual femoral length ranged from 38 cm to 45 cm with a mean of 40.93 ± 2.29 cm. Table IV. There was significantly strong correlation between forearm plus little finger length and actual femoral length ($r = .970$, $p = .000$). (Table V).

	Mean \pm Std. Deviation	Pearson Correlation Coefficient (r)	P value
Forearm + Little Finger Length (cm)	40.97 ± 2.282	.970	.000
Actual Femoral Length (cm)	40.93 ± 2.288		

When stratified, there was significantly strong correlation between forearm plus little finger length and actual femoral length across various age groups 26-36 years ($r = .981$, $p = .000$), 37-47 years ($r = .946$, $p = .000$), 48-59 years ($r = .993$, $p = .000$) and genders; male ($r = .976$, $p = .000$), female ($r = .986$, $p = .000$). (Tables VI, VII)

Age Groups	Mean \pm Std. Deviation	r	P value
26-36 Years	Forearm + Little Finger Length (cm)	.981	.000
	Actual Femoral Length (cm)		
37-47 Years	Forearm + Little Finger Length (cm)	.946	.000

	Actual Femoral Length (cm)	Mean \pm Std. Deviation	r	P value
48-59 Years	Forearm + Little Finger Length (cm)	41.50 ± 2.928	.993	.000
	Actual Femoral Length (cm)	41.38 ± 2.825		

Gender	Mean \pm Std. Deviation	r	P value	
Male	Forearm + Little Finger Length (cm)	41.11 ± 2.293	.976	.000
	Actual Femoral Length (cm)	41.00 ± 2.304		
Female	Forearm + Little Finger Length (cm)	39.67 ± 2.082	.986	.000
	Actual Femoral Length (cm)	40.33 ± 2.517		

Discussion

Most common surgical option adopted in diaphyseal femoral fractures in adults is the intramedullary nailing¹ It however requires proper preoperative evaluation of the fracture pattern, morphology, fracture comminution, extension and femoral length.³ A failure to determine nail length accurately can result in either a shorter or longer nail than required. A short nail can lead to delayed union or non-union while a longer nail can impinge into the skin and can cause bursitis and pressure necrosis¹⁰. Both of these can lead to leg length discrepancy, particularly in comminuted fracture.¹¹

Numerous direct and indirect methods for the estimation of femoral nail length have been described.³ Direct measurement of the intact femur (from the tip of the greater trochanter to the proximal pole patella) on the opposite side can function as a rough guide but may be inaccurate in obese patients. The use of radiographs can resolve this issue, but implicates radiation exposure, and radiological magnification may lead to inaccuracy. Other methods comprise the use of a nail template, radio-opaque ruler, or Kuntscher ossimeter. All these methods necessitate an intact contralateral femur.^{3,4}

Lakhey et al⁵ described the use of pre-operative forearm plus little finger length measurement as reference for pre-operative femoral length. This method of pre-operative femoral length estimation is simple, radiation free, and can be applied in day-to-day practice. It also doesn't

require an intact contralateral femur. However, due to limited evidence, need for the present study was realized to determine how strongly forearm plus little finger length correlated with the actual femoral length.

The age of the patients ranged from 26 years to 59 years with a mean of 42.10 ± 9.79 years. There were 27 (90%) male and 3 (10%) female patients in the study group giving a male: female ratio of 9:1. A high male: female ratio can be due to underlying cause of femoral shaft fractures i.e. motor vehicle accidents being common in male drivers⁶. Naik et al.⁷ observed mean age to be 35.8 ± 9.2 years with a male: female ratio of 2:1 in India.

Forearm plus Little Finger Length was measured in centimeters from the tip of the olecranon to the tip of the little finger while the elbow was flexed to 90° and the wrist and fingers were in a neutral position. The forearm plus little finger length ranged from 38 cm to 44 cm with a mean of 40.97 ± 2.28 cm. Naik et al.⁷ observed it to be 39.87 ± 2.73 in Indian population.

Actual Femoral Length was measured in centimeters from the tip of the greater trochanter to the level of proximal pole of the patella over the outer aspect of thigh while the thigh was slightly flexed and adducted to make the greater trochanter more prominent. The actual femoral length ranged from 38 cm to 45 cm with a mean of 40.93 ± 2.29 cm while Naik et al.⁷ observed it to be 39.85 ± 2.44 cm.

There was significantly strong correlation between forearm plus little finger length and actual femoral length ($r = .970$; $p = .000$). Our results closely match with those of Naik et al.⁷. ($r = 0.86$; $p < .001$) and Nazir et al.⁶ ($r = 1$). When stratified, there was significantly strong correlation between forearm plus little finger length and actual femoral length across various age groups 26-36 years ($r = .981$, $p = .000$), 37-47 years ($r = .946$, $p = .000$), 48-59 years ($r = .993$, $p = .000$) and genders; male ($r = .976$, $p = .000$), female ($r = .986$, $p = .000$). Thus, correlation between forearm plus little finger length and actual femoral length was independent of patient's age and gender. Naik et al.⁷ also observed insignificant difference across various age groups ($p = .09$) and genders ($p = .054$).

In the light of this observation, forearm plus little finger length can thus be used pre-operatively to determine

required nail length in patients with femur shaft fractures. This method is simple, radiation free, and can be applied in day-to-day practice. It also doesn't require an intact contralateral femur. However, a very important limitation to our study was the limited sample size of 30 cases. There is need to repeat this study with larger sample size to further confirm the results.

Disclosure: this article is based from CPSP thesis submitted in CPSP in 2016

Conclusion

There was significantly strong correlation between forearm plus little finger length and actual femoral length ($r = .970$; $p = .000$) regardless of patient age and gender.

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