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CORRELATION BETWEEN FUNCTIONAL OUTCOME AND ANATOMICAL OUTCOME IN DISTAL RADIUS FRACTURES TREATED WITH CLOSED REDUCTION

Original Research

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ABSTRACT

Objective: To determine the correlation between functional outcome score and anatomical outcome score in distal radius fracture after close reduction.

Methodology: A cross-sectional study was conducted at the Department of Orthopedics, Lady Reading Hospital, Peshawar from 23-April-2024 to 23-October-2024. Two hundred and seventy one patients aged 20–60 years with extra-articular distal radius fractures (Frykman types I–II) were included. Closed reduction under local anesthesia was performed which was followed by dorsoradial splint immobilization. Functional outcomes were evaluated at four months using the Gartland and Werley scoring system while anatomical outcomes were assessed via the Bunger scoring system. Correlation between both scoring systems were assessed.

Results: Mean age was 51.18 ± 10.008 years. The mean functional outcome score was 10.01 ± 0.82 while the mean anatomical score was 6.00 ± 1.38. Correlation analysis exhibited a weak non-significant relationship between functional and anatomical outcomes ($r = 0.06$; $p = 0.31$).

Conclusion: A non-significant weak correlation was found between functional outcome and anatomical outcome in distal radius fractures treated with closed reduction.

Keywords: Distal radius fracture, closed reduction, functional outcome, anatomical outcome, Gartland and Werley score, Bunger score.

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INTRODUCTION

The Emergency Department as well as primary care clinics are often tasked with the evaluation of orthopaedic grievances. It is crucial for majority of providers to possess confidence in management of basic orthopaedic issues. Fractures that take place in distal radius of forearm are prevalent. [1] The occurrence for radial fractures is on rise due to a growing lifespan, resulting in an increasing amount of patients susceptible to these injuries. [1-3] Distal radius fractures (DRFs) primarily occur in paediatric as well as adolescent populations, as well as in older people. Fracture, management strategies, as well as complications vary across these age groups. Providers have to understand these distinctions to identify and this fracture patterns are emergent and make sure timely referral for additional treatment. [4] A 2017 study reported a yearly rise of 2.0% in DRFs among men as well as a 3.4% increase among women aged 50-59 during period 1999 -2010. The findings of this study suggested significant rises within age group of 17 to 64 years. [5]

Non-displaced fractures are usually treated conservatively using a plaster cast, avoiding need for surgical intervention. Unstable fractures, due to their healing in a detrimental anatomical position, can often be treated through surgical intervention. Surgical as well as nonsurgical management options for patients with distal radius fractures involve closed reduction and percutaneous K-wire fixation, bridge plating, or use of an external fixator.[6-8]The optimal treatment decision is conditioned upon characteristics of fracture; however, there exists a limited amount of quality evidence to substantiate this. The American Academy of Orthopaedic Surgeons issued 29 recommendations in its clinical practice guidelines regarding DRFs; however, none of these suggestions received a satisfactory grade related to inadequate quality of evidence. [6-8]

The Dutch guidelines for DRFs suggest carrying out closed reduction for displaced DR fractures in emergency department prior to surgery. This approach might offer post-reduction pain relief, as well as successful reduction might support conservative treatment. [9] The techniques used for closed reduction of DRFs include manual traction as well as finger-trap traction. [10]A study reported functional outcome score was not correlated to anatomical outcome in DRFs following closed reduction with pearson correlation coefficient (r)= 0.029. [11]

Distal radius fractures are highly prevalent, yet the relationship between functional outcomes and anatomical outcomes after closed reduction remains unclear, with no local studies conducted to date. Understanding this correlation is crucial as it may guide treatment decision-making, patient counseling, and the development of comprehensive outcome assessment protocols. A strong correlation could support using anatomical outcomes as a surrogate for functional outcomes, streamlining follow-ups. Conversely, a weak correlation may necessitate additional interventions beyond anatomical restoration for optimal functional recovery. By investigating this topic in our local population. We can generate relevant data to improve patient care, optimize treatment strategies, and contribute to the broader understanding of distal radius fracture outcomes, ultimately enhancing evidence-based practice within our healthcare system.

METHODOLOGY:

We conducted this cross sectional study in the Department of Orthopedics at Lady Reading Hospital (LRH) Peshawar which dated from 23-April-2024 to 23-October-2024. The study was initiated after taking ethical approval from our hospital. Two hundred and seventy one patients were enrolled using non-probability consecutive sampling. The sample was selected using a correlation-based calculation of 90% power, 95% confidence level and an estimated correlation coefficient of 0.029[11] derived from previous research.

Participants aged 20–60 years with extra-articular distal radius fractures (Frykman types I or II) presenting within three weeks of injury were included. Patients with fractures with severe intra-articular comminution of bone loss exceeding five fragments, multiple fractures, osteoporosis or diabetes were not included. After taking patients' consent we proceeded with gathering the baseline demographic data like age, gender, BMI, socioeconomic status, education level, residential status and profession. The American Society of Anesthesiologists (ASA) physical status classification (I or II) was used to assess preoperative risk.

Closed reduction was performed under local anesthesia (4 mL) using manual traction and dorsoradial splint immobilization in palmar flexion and ulnar deviation. Post-reduction radiographs confirmed the alignment. Follow-up assessments were conducted at one, two and three months with final outcomes evaluated at four months. Functional outcomes were measured using the Gartland and Werley

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scoring system which incorporated subjective pain reports, range of motion, grip strength and residual deformity. Anatomical outcomes were assessed via the Bunger scoring system evaluating dorsal angulation, radial shortening and radial inclination. Scores of 0–8 and 0–3 denoted satisfactory functional and anatomical outcomes respectively.

Data analysis was performed with SPSS 24. Age, BMI and outcome scores were assessed as mean ± standard deviation Gender, socioeconomic status, residence, education level, profession and ASA status were evaluated as frequencies and percentages. Pearson's correlation analysis examined the relationship between functional and anatomical scores, stratification with demographic parameters were performed. A p-value ≤0.05 indicated statistical significance.

RESULTS:

Our study included 271 patients. The mean age was 51.18 ± 10.008 years. The mean BMI of the patients was 26.28 ± 1.77 kg/m².

Majority of patients were male 161 (59.4%) while females 110 (40.6%). Rest of the demographic variables can be seen at table no 1.

The functional outcome score averaged around 10.01 ± 0.82 while the anatomical outcome score had a mean of 6.00 ± 1.38. We observed a weak correlation (r = 0.06) between functional and anatomical outcome scores which was not statistically significant (p = 0.31) (Table 2). Table 3 to table 10 present the stratification of correlation between functional and anatomical outcomes with various demographics parameters.

Figure 1: Age distribution (Years)

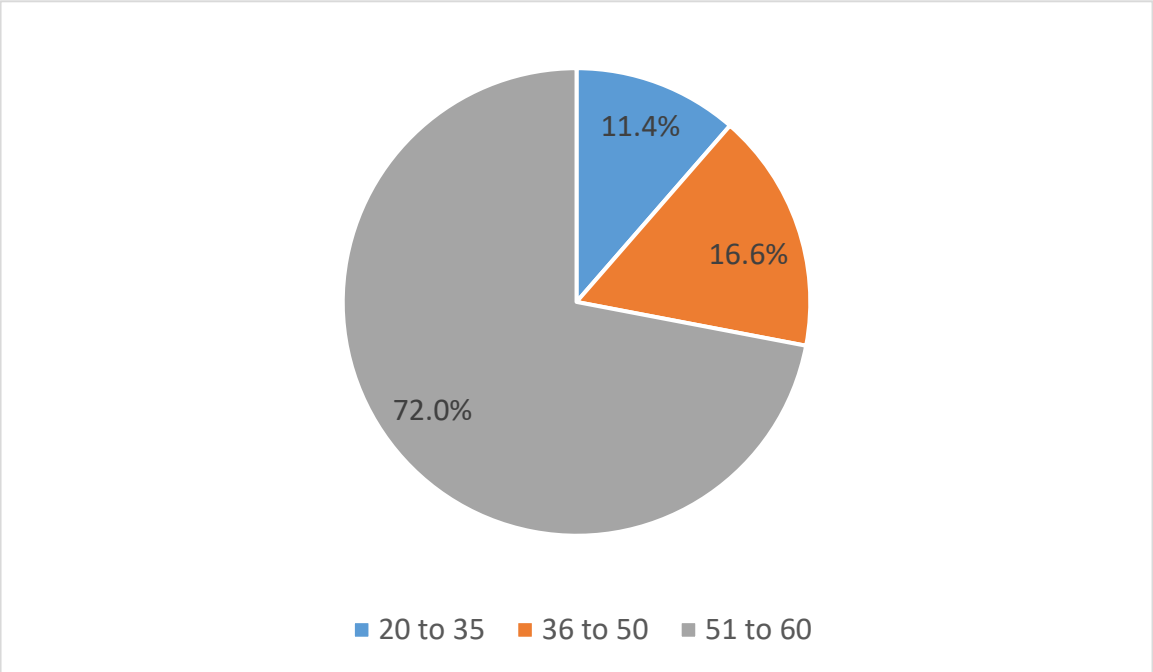

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Table 1: Demographics

Demographics		N	%
Gender	Male	161	59.4%
	Female	110	40.6%
Socioeconomic status	Poor	67	24.7%
	Middle	173	63.8%
	Rich	31	11.4%
Education level	Uneducated	59	21.8%
	Primary	90	33.2%
	Secondary	83	30.6%
	Higher	39	14.4%
Residential status	Rural	153	56.5%
	Urban	118	43.5%
Profession	Job	95	35.1%
	Jobless	127	46.9%
	Business	49	18.1%
ASA grade	ASA I	128	47.2%
	ASA II	143	52.8%

Table 2: Correlation between functional and anatomical outcome

Parameters	Mean	Std. Deviation	N	r	P value
Functional outcome score	10.01	.825	271	0.06	0.31
Anatomical outcome score	6.00	1.380	271		

Table 3: Stratification of correlation between functional and anatomical outcome with age

Age distribution (Years)		Mean	Std. Deviation	N	r	P value
20 to 35	Functional outcome score	9.84	.820	31	-0.22	0.23
	Anatomical outcome score	3.48	1.947	31		
36 to 50	Functional outcome score	10.04	.824	45	0.36	0.01
	Anatomical outcome score	6.36	.933	45		
51 to 60	Functional outcome score	10.04	.827	195	0.01	0.85
	Anatomical outcome score	6.32	.850	195		

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Table 4: Stratification of correlation between functional and anatomical outcome with gender

Gender		Mean	Std. Deviation	N	r	P value
Male	Functional outcome score	9.91	.812	161	0.01	0.81
	Anatomical outcome score	5.91	1.461	161		
Female	Functional outcome score	10.17	.822	110	0.10	0.28
	Anatomical outcome score	6.14	1.245	110		

Table 5: Stratification of correlation between functional and anatomical outcome with socioeconomic status

Socioeconomic status		Mean	Std. Deviation	N	r	P value
Poor	Functional outcome score	10.01	.807	67	0.28	0.01
	Anatomical outcome score	5.99	1.430	67		
Middle	Functional outcome score	10.03	.824	173	-0.04	0.51
	Anatomical outcome score	6.00	1.431	173		
Rich	Functional outcome score	9.94	.892	31	0.27	0.12
	Anatomical outcome score	6.03	.948	31		

Table 6: Stratification of correlation between functional and anatomical outcome with education level

Education level		Mean	Std. Deviation	N	r	P value
Uneducated	Functional outcome score	10.03	.850	59	0.09	0.47
	Anatomical outcome score	6.15	1.215	59		
Primary	Functional outcome score	10.10	.794	90	0.21	0.04
	Anatomical outcome score	6.06	1.275	90		
Secondary	Functional outcome score	9.98	.855	83	-0.03	0.72
	Anatomical outcome score	5.82	1.594	83		
Higher	Functional outcome score	9.87	.801	39	-0.06	0.67
	Anatomical outcome score	6.03	1.367	39		

Table 7: Stratification of correlation between functional and anatomical outcome with residence status

Residential status		Mean	Std. Deviation	N	r	P value
Rural	Functional outcome score	10.02	.815	153	0.12	0.11
	Anatomical outcome score	5.97	1.442	153		
Urban	Functional outcome score	10.01	.842	118	-0.03	0.73
	Anatomical outcome score	6.03	1.300	118		

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Table 8: Stratification of correlation between functional and anatomical outcome with profession

Profession		Mean	Std. Deviation	N	r	P value
Job	Functional outcome score	9.95	.830	95	0.05	0.58
	Anatomical outcome score	5.91	1.474	95		
Jobless	Functional outcome score	9.94	.843	127	0.05	0.52
	Anatomical outcome score	6.08	1.270	127		
Business	Functional outcome score	10.35	.694	49	0.10	0.45
	Anatomical outcome score	5.98	1.479	49		

Table 9: Stratification of correlation between functional and anatomical outcome with BMI

BMI (Kg/m2)		Mean	Std. Deviation	N	r	P value
18 to 24.9	Functional outcome score	10.04	.844	78	-0.04	0.73
	Anatomical outcome score	5.94	1.480	78		
> 24.9	Functional outcome score	10.01	.820	193	0.10	0.13
	Anatomical outcome score	6.03	1.340	193		

Table 10: Stratification of correlation between functional and anatomical outcome with ASA grade

ASA grade		Mean	Std. Deviation	N	r	P value
ASA I	Functional outcome score	9.95	.831	128	0.04	0.65
	Anatomical outcome score	6.05	1.254	128		
ASA II	Functional outcome score	10.07	.819	143	0.08	0.32
	Anatomical outcome score	5.96	1.486	143		

DISCUSSION:

The correlation between functional and anatomical outcomes in distal radius fractures treated with closed reduction remains a topic of substantial debate, as evidenced by the varying results across multiple studies.

Our study, which evaluated 271 patients revealed that while anatomical outcomes were often suboptimal, the functional recovery was notably better. The mean functional outcome score was 10.01 ± 0.82 compared to the anatomical outcome score of 6.00 ± 1.38 indicating a disparity between radiographic alignment and clinical performance. This suggests that patients can achieve satisfactory wrist function even when anatomical parameters are not fully restored.

Our findings align with several studies that have examined similar variables. One study carried out by Arshad et al reported excellent functional outcomes in 33.6% patients despite only moderate anatomical restoration reinforcing the idea that functional adaptation often compensates for imperfect alignment.[12] Likewise Jamil et al found that 58% of patients achieved excellent functional results while only 16.5% had excellent anatomical outcomes mirroring our observations.[13] These studies collectively suggest that conservative management can yield good functional results even when radiological parameters are not ideal.

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The weak correlation (r = 0.06; p = 0.31) observed between functional and anatomical outcomes in our study is consistent with research by Gutiérrez-Monclus et al who found no notable correlation between radiological alignment and functional scores in elderly patients.[11] Their study like ours highlights that anatomical perfection is not always necessary for functional recovery particularly in older individuals with lower physical demands. However younger patients in our cohort exhibited better functional outcomes when anatomical parameters were closer to normal suggesting that age and activity level influence the relationship between alignment and function, although we could not reach to a positive correlation, however we did observe that patients aged 20 to 35 years had better anatomical and functional scores than patients above 35 years.

Young et al reported that after the follow up period of thirty four months, they did not observe a notable link between the functional outcome or return to daily routine with radiological outcome.[14] Similarly Chang et al found no relation among radiological and functional outcome after twenty months assessment of their patients.[15] Jaremko et al's study concluded that DASH score had no relation with acceptable reduction of DRF.[16] Aligned with our findings, Grewal et al after follow up at one year could not related poor alignment with poor functional outcomes in their study.[17]

Shetty et al noted potential correlation between radiological and functional outcomes in fractures which were operatively treated.[18] Their results infer that surgical fixation may enhance the anatomical restoration, thereby it lead to improvement in functional results.

Interestingly our anatomical outcomes were assessed using the Bunger scoring system which emphasizes radial height inclination and volar tilt, these parameters have been identified as critical for functional recovery by Rehman et al.[19]

CONCLUSION:

In conclusion, we found a non-significant weak correlation between functional outcome and anatomical outcome in distal radius fractures treated with closed reduction, we recommend further additional intervention for obtaining better functional and anatomical results which may correlate.

AUTHOR CONTRIBUTION

Author	Contribution
Sufyan Ali Shah	Data Entry, Data Collection, Data Analysis, Manuscript Writing, and Manuscript Revision
Muhammad Inam*	Critical Input, Conception of Study Design, Final Approval of Draft

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