Project Title

Predicting functional outcomes in conservatively managed proximal humerus fractures with radiographic evaluation

Project Lead and Members

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Organisation(s) Involved

Tan Tock Seng Hospital, Woodlands Health Campus

Healthcare Family Group Involved in this Project

Medical, Allied Health, Healthcare Administration

Specialty or Discipline

Orthopaedics, Medical & Laboratory Technology, Medical Statistician

Project Period

Start date: Jan 2017

Completed date: Dec 2020

Aims

1. Studying the utility of radiographic parameters in predicting functional outcomes

2. Obtaining a cut off for poor functional outcomes

3. Assess the intra and interrater reliability of these radiographic measurements

Background

See poster appended / below

Curated by CHI Faculty: Prof Loo Shi, Senior Consultant, Surgery, TTSH

Methods

See poster appended / below

Results

See poster appended / below

Conclusion

See poster appended / below

Additional Information

Singapore Health & Biomedical Congress (SHBC) 2021: Singapore Clinician Investigator Award – Bronze Award

Project Category

Applied/ Translational Research, Quantitative Research

Keywords

Proximal Humerus Fracture, Radiographic Parameters, Reliability, Functional Outcomes

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Predicting functional outcomes in conservatively managed proximal humerus fractures with radiographic evaluation

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Introduction

Background

- Treatment of proximal humerus fractures remains controversial
- Multiple factors can determine functional outcomes
- Predicting functional outcomes for conservatively managed fractures with radiographic parameters has not been studied extensively
- Most studies have looked at the utility of anteroposterior (AP) angles (1)
- Few studies have looked at the validity of the Y-scapular angles in predicting functional outcomes (2)
- The intra and interrater reliability of the radiographic measurement also remains conflicted (2, 3)

Aims

1. Studying the utility of radiographic parameters in predicting functional outcomes
2. Obtaining a cut off for poor functional outcomes
3. Assess the intra and interrater reliability of these radiographic measurements

Methods

- **Radiographic parameters** Caput-collum-diaphyseal (CCD), Y-scapular angle, and humeral head height (HHH) for 114 patients were measured by 2 observers
- **Functional outcome scores** including quick Disability of the Shoulder, Arm and Hand (DASH), Oxford Shoulder Score (OSS), and Constant Shoulder Score (CSS) were measured at presentation and at the 1-year mark
- Patients were split into varus/ valgus alignment and anteversion/ retroversion based on their initial fracture configuration
- **Intra and interrater reliability** was measured with the **intraclass correlation coefficient** (ICC)
- **Correlation** between radiographic parameters and functional outcome scores were measured with **linear regression models**
- **Receiver operator curve (ROC)** analysis and logistic regression analysis were used to obtain a cut off angle
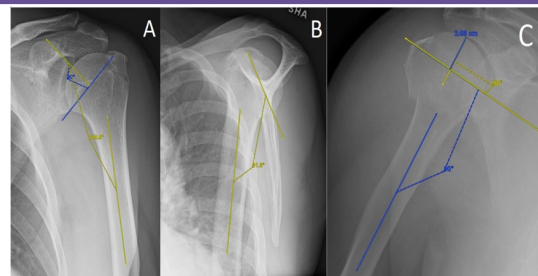
Results

Outcome measure and functional evaluation

- Mean follow up was 7 months (1-14 months)
- Mean quick DASH, OSS, and CSS at 1 year were 7.1 (11.0), 44.6 (5.9), and 67.8 (8.7) respectively

Intra and interrater reliability

- The lowest intrarater reliability for both raters was ICC 0.938 for Y-scapula angle in rater 1
- Interrater reliability was excellent for both raters, with the best interrater reliability occurring for final CCD angle at 0.986

Radiographic evaluation

- Mean initial CCD (Standard Deviation) for the varus group was 119° (18) and 153° (12) for valgus
- At final follow up, CCD for the varus group was 112° (17) and 140° (17) for the valgus group
- Mean initial Y-scapula angle for retroverted group was 28° (23) and 70° (8) for the anteverted group
- Mean final Y-scapula angle for retroverted group was 27° (23) and 40° (8) for the anteverted group

Correlation of functional outcome with radiographic assessment

- There was no significant correlation between quick DASH and radiographic parameters
- There was a significant correlation between CSS and initial HHH but this was not strong enough to derive a cut off point
- However, there was a **significant correlation between OSS and final Y-scapular angle**
- Based on the relationship between OSS and final Y-scapular angle, a cut off of ≥40 was used to identify the optimum sensitivity and specificity to obtain a **cut off of 25°**. The area under ROC (AUROC) was 0.611
- Significant correlations in radiographic parameters for:
1. Initial valgus CCD angle and change in CCD angle
2. Initial retroverted Y-scapular angle and change in Y-scapular angle
3. Initial HHH and change in HHH

Figure 1: Radiographic parameters measured. A, CCD angle; B, Y-scapular angle; C, HHH

	Coeff	95% CI	P value	Adj Coeff	95% CI	P value
CCD angle						
Varus	0.103	-0.057, 0.262	0.2	0.065	-0.112, 0.242	0.455
Valgus	-0.026	-0.085, 0.033	0.385	-0.019	-0.071, 0.034	0.48
Y-scapula						
Retroversion	0.058	0.008, 0.109	**0.025***	0.056	0.008, 0.104	**0.022***
Anteversion	0.08	-0.364, 0.380	0.959	-	-	-
HHH	0.156	-0.060, 0.373	0.155	0.028	-0.194, 0.251	0

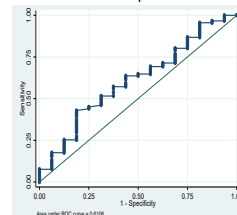Table 1: Relationship between final radiographic measurements and OSS

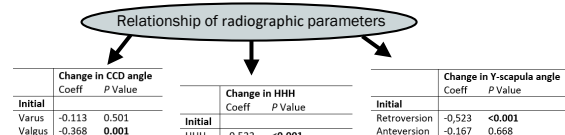Figure 2: AUC for final Y-scapula angle with OSS cut-off 40

Relationship of radiographic parameters

	Change in CCD angle	
	Coeff	P Value
Initial		
Varus	-0.113	0.501
Valgus	-0.368	**0.001**

	Change in HHH	
	Coeff	P Value
Initial		
HHH	-0.523	**<0.001**

	Change in Y-scapula angle	
	Coeff	P Value
Initial		
Retroversion	-0,523	**<0.001**
Anteversion	-0.167	0.668

Figure 3: Relationship between initial radiographic parameters and change in corresponding angles

Conclusion

Retroversion as a predictor of poor function

- Court Brown et al (1) showed that the degree of translation on initial AP radiographs was related to function outcome scores at 1 year
- Keene et al (4) showed that healing in 55° or less on AP views and less then 1.5mm displacement predicted good outcomes
- Poeze et al (2) were the first to describe the initial Y-scapular angle in predicting function, their cut off was 55° angulation
- Our paper shows a cut off of 25° and below on final Y-scapular retroversion predicted poor outcome

Predicting displacement

- The more displaced the fracture was in valgus and retroversion initially, the more likely the fracture was to displace further
- Displacement can be due to multiple reasons like alcohol intake and osteoporosis (5)

Intra and interrater reliability

- The intra and interrater reliability was excellent in this study

These findings may aid surgeons in the future with planning for surgical intervention

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