

# ความน่าเชื่อถือภายในและระหว่างบุคคลของการวัดระยะห่างของปุ่มกระดูก coracoid กับกระดูกไหปลาร้าในภาวะ ข้อต่อ Acromioclavicular เคลื่อนหลุด และการเสนอวิธีการวัดแบบใหม่

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## Intraobserver and Interobserver Reliability of the Measurement of the Coracoclavicular Distance in Acromioclavicular Dislocation and A new Technique of Measurement

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**หลักการและเหตุผล:** การวินิจฉัยการบาดเจ็บข้อต่อ acromioclavicular (AC) ขึ้นอยู่กับการตรวจร่างกายและการตรวจทางรังสีวิทยา การถ่ายภาพรังสีของข้อต่อ AC พร้อมกันสองข้างก็นำมาวัดเปรียบเทียบระยะห่างข้อต่อทั้งสองข้าง โดยทั่วไปนิยมวัดระยะห่างของปุ่มกระดูก coracoid กับกระดูกไหปลาร้า (coracoclavicular, CC) และระยะการยกตัวขึ้นของปลายกระดูกไหปลาร้ากับกระดูก acromion ค่าต่าง ๆ เหล่านี้จะนำมาใช้พิจารณาการผ่าตัดรักษา เนื่องจากการวัดมีความแปรปรวนอาจจะก่อให้เกิดปัญหาในการตัดสินใจการรักษาและการประเมินผลหลังการรักษา และยังไม่มีการศึกษาตรวจสอบความน่าเชื่อถือของการวัดเช่นนี้มาก่อน

**วัตถุประสงค์:** เพื่อวัด ความน่าเชื่อถือภายในและระหว่างบุคคลของการวัดระยะห่างของ ปุ่มกระดูก coracoid กับกระดูกไหปลาร้าแบบที่ใช้กันอยู่ในปัจจุบันในภาวะ ข้อต่อ Acromioclavicular เคลื่อนหลุด และการเสนอวิธีการวัดแบบใหม่

**รูปแบบการศึกษา:** การศึกษาเชิงบรรยาย

**สถานที่ทำการศึกษา:** ภาควิชาออร์โธปิดิกส์ คณะแพทยศาสตร์ มหาวิทยาลัยขอนแก่น

**กลุ่มตัวอย่าง:** ภาพถ่ายรังสีข้อต่อ AC ตามวิธีของ Zanca จำนวน 20 ภาพ เป็นภาพถ่ายรังสีของผู้ป่วยชาย 15 คน หญิง 5 คน อายุเฉลี่ย  $25 \pm 6$  ปี (ช่วงอายุระหว่าง 20-48 ปี) ผู้ป่วย 13 คนได้รับบาดเจ็บที่ไหล่ขวา ให้ผู้ตรวจวัดสองคนโดยทั้งสองคนจะใช้วิธีการวัดแบบปัจจุบันและวิธีใหม่ โดยใช้ แผ่นใส Mose วัดภาพถ่ายรังสีเดียวกันแต่คนละเวลาและโอกาส

**Background:** The diagnosis of acromioclavicular (AC) joint injury depends upon primary physical and radiological examinations. Simultaneous views of both AC joints are obtained and measurements compared between injured and uninjured sides. Most commonly, the severity of injury is determined by the relative differences between the widths of the AC joint space, the coracoclavicular (CC) distance, and degree of elevation of the clavicle above the acromion. These parameters are usually used to decide on surgical or conservative treatments. The measurement's variation can change the treatment options.

**Objectives:** To evaluate the reliability of the current method for measuring the CC distance and introducing the new method of measuring the width of CC distance by using a Mose's template.

**Design:** Descriptive study

**Setting:** Department of Orthopedic, faculty of Medicine, Khon Kaen University.

**Subjects:** The anteroposterior radiograph of both acromioclavicular joints with Zanca technique were used in this study. Twenty radiographs were selected based on the quality of the radiograph. There were 15 male and female patients. The average age of the patients was  $25 \pm 6$  years old (range 20-48 years). Thirteen patients had right and seven had left AC joint injuries. Two observers were included in this study to evaluate the reliability of the

**ผลการศึกษา:** ความน่าเชื่อถือระหว่างบุคคลโดยวิธีใหม่ให้ผลสอดคล้องกัน 32 ใน 40 คู่ของภาพถ่ายรังสี (80%, ช่วงความเชื่อมั่นร้อยละ 95 เท่ากับ 67.61%-92.39%) ในขณะที่วิธีปัจจุบันได้ผลความสอดคล้องกัน 3 ใน 40 คู่ของภาพถ่ายรังสี (7.5%, ช่วงความเชื่อมั่นร้อยละ 95 เท่ากับ 7.2%-7.8%)

ความน่าเชื่อถือภายในบุคคลสำหรับวิธีใหม่ของผู้ตรวจวัดที่ 1 และที่ 2 ได้ผลตามลำดับดังนี้ ความสอดคล้อง 8 ใน 10 ภาพถ่ายรังสี (80%, ช่วงความเชื่อมั่นร้อยละ 95 เท่ากับ 55%-100%) และความสอดคล้อง 6 ใน 10 ภาพถ่ายรังสี (60%, ช่วงความเชื่อมั่นร้อยละ 95 เท่ากับ 30%-90%) ในขณะที่วิธีปัจจุบันได้ผลความสอดคล้องกันในผู้ตรวจวัดคนที่ 1 ได้ผลความสอดคล้อง 2 ใน 10 ภาพถ่ายรังสี (20% ช่วงความเชื่อมั่นร้อยละ 95 เท่ากับ 0-45%) และผู้ตรวจวัดคนที่ 2 ได้ผลความสอดคล้องเพียง 1 ใน 10 ภาพถ่ายรังสี (10% ช่วงความเชื่อมั่นร้อยละ 95 เท่ากับ 0-29%)

**สรุป:** วิธีปัจจุบันที่ใช้วัดระยะ CC ในกรณีข้อต่อ AC เคลื่อนหลุดนั้นยังมีความน่าเชื่อถือทั้งชนิดภายในและระหว่างบุคคลน้อยกว่าวิธีใหม่ที่ใช้แผ่นใส Mose

current and new methods.

**Results:** There were thirty-two of 40 pairs (32/40, 80%, 95% confidence interval 67.61%-92.39%) of measurement by two observers (interobserver reliability) using Mose's template had the same results. However, the current technique used by two observers had the same results only three of 40 pairs (3/40, 7.5%, 95% confidence interval 7.2%-7.8%) of measurements.

The intraobserver reliability, for the Mose's template of the observer I and II, there were 8 of 10 (8/10, 80%, 95% confidence interval 30%-90%) and 6 of 10 pairs (6/10, 60%, 95% confidence interval 30%-90%) of measurements had the same results respectively. For the current technique, however, there were only two of 10 pairs (2/10, 20%, 95% confidence interval 0-45%) and one of 10 pairs (1/10, 10%, 95% confidence interval 1%-29%) of measurements of the observer I and II had the same results respectively.

**Conclusion:** The Mose's template technique is a more reliable method of measurement the CC distance in the AC joint injury.

Acute acromioclavicular (AC) joint injury is a common traumatic problem usually resulting from a fall on the point of the shoulder. The diagnosis of acromioclavicular joint injury depends upon primary physical and radiologic examinations. Simultaneous views of both AC joints are obtained and measurements compared between injured and uninjured sides. Most commonly, the severity of the injury is determined by the relative differences between the widths of the AC joint space, the coracoclavicular (CC) distance, and the degree of elevation of the clavicle above the acromion<sup>1-3</sup>. Those parameters are usually used for deciding on surgical or conservative treatments. The difference of CC distance is more than 50% over the normal side signifies complete dislocation<sup>4</sup>, moreover, some authors document complete dislocation with as little as a 25% increase in the coracoclavicular distance<sup>2</sup>. Normally, the range of coracoclavicular distance is 1.1-1.3 centimeters by radiograph<sup>4</sup> or 1.76-1.87 cm by ultrasound<sup>5</sup>. Therefore, the difference of 50% distance from normal should be 0.65 cm if normal is 1.3 cm. However, the variation of measurement of the CC distance by ultrasound is 0.686 cm (two standard deviation)<sup>5</sup>. The measurement's variation can change the treatment options. This study, therefore, aims to evaluate the reliability of current method for measuring the CC distance and introducing the new method of measuring the width of CC distance by using Mose template<sup>6</sup>.

### Material and Method

The anteroposterior radiograph of both acromioclavicular joints with Zanca technique<sup>7</sup> were used in this study. This included sixty radiographs of 60 cases with unilateral AC joint injuries. Only 20 radiographs were selected based on the quality of the radiograph. There were 15 male and 5 female patients. The average age of the patients was  $25 \pm 6$  years old (range 20-48 years). Thirteen patients had right and seven patients had left AC joint injuries. Two observers were presented to evaluate the reliability of the current and the new methods; one had a ten years' experience in orthopedic trauma and the other was a third year orthopedic resident. Both observers were informed and practiced both methods of measuring the CC distance. Due to the circular like shadow of the coracoid process on the radiograph, the Mose's template was used. The middle circle of the template was chosen according to the size of the circle and the size of coracoid process. Then the Mose's template was placed over the marginal curve of the coracoid process on the radiograph (figure 1). The first circular line of the Mose's template which touched the lower cortex of

clavicle was selected and recorded. The CC distance of the current method is the length of the perpendicular line from the curve of the coracoid process up to the lower cortex of clavicle. All of the radiographs for each patient were placed in a numbered folder and arranged in random order and were rearranged for the second viewing. All identifying data on the radiographs were obscured. Both observers independently measured the CC distance by viewing the radiograph. The current method was used first, followed by the Mose's template method. The data were recorded in the first and second recorded forms respectively. One week later, the ten sets of the radiographs had been viewed, were randomly selected again and each observer repeated measurement with both techniques and the same sequence.

### Statistical Analysis

The main data of this study were continuous data, therefore, the limits of agreement method is the most appropriate method of analysis<sup>8,9</sup>. A plot of difference between the measuring techniques and the mean is given of both observers and techniques.

### Results

The inter-observer reliability of two observers who measured the coracoclavicular distance of the injured and normal acromioclavicular joints by using the current and Mose's techniques were presented in the table I. Thirty pair (30/40, 75%, 95% confidence interval was 61.6%-88.4%) of measurements by of two observers using the Mose's technique had the same results. Five pairs of measurement had different results on each of the right and left sides. The current technique used by two observers, however, had the same results in only three pairs (3/40, 7.5%, 95% confidence interval was 7.2%-7.8%) of measurement. Thirty seven pairs (37/40, 92.5%) of measurement had different results on both the right and left sides.

The intra-observer reliability of each observer who measured the coracoclavicular distance of the injured and normal acromioclavicular joints two times by using the current and Mose's techniques were presented in the table II. For the Mose' technique observer I had eight pairs (8/10,80%, the 95% confidence interval was 55%-100%) and observer II had six pairs (6/10, 60%, the 95% confidence interval was 45%-75%) of measurement with the same results. For the current technique, however, observer I had two pairs (2/10, 20%, the 95% confidence interval was 0%-45%) and observer II had one pair (1/10, 10%, the 95% confidence interval was 1%-29%) of measurement with the same results.

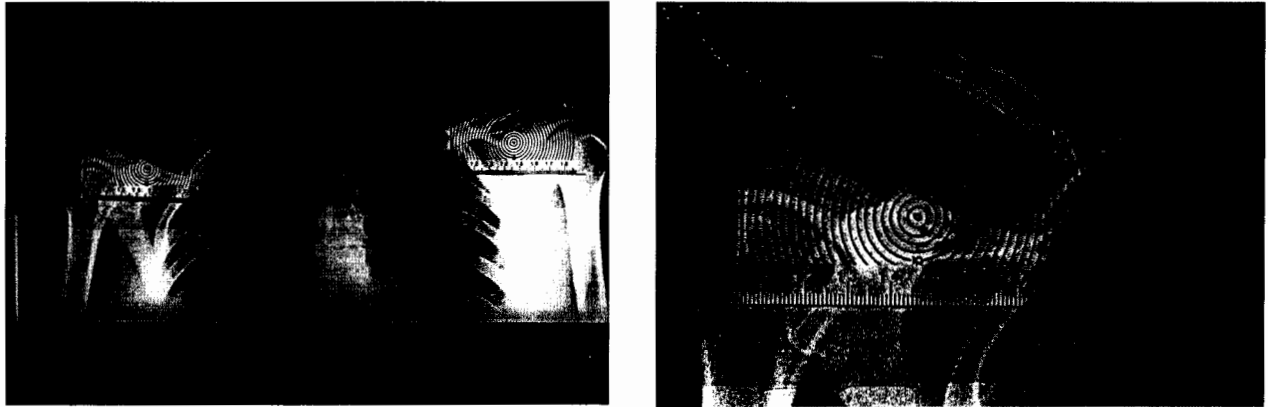


Figure I. The radiograph of both AC joints and technique using Mose's template to measure the CC distances.

Table I. Coracoclavicular distance (in millimeters) of the injured and normal acromioclavicular joints were measured by the two observers with the current and Mose's template techniques.

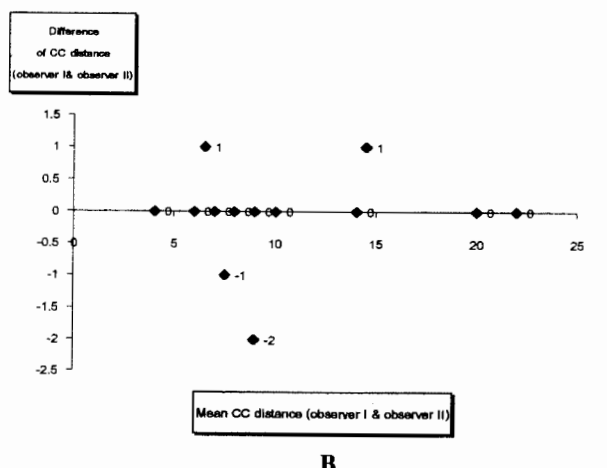
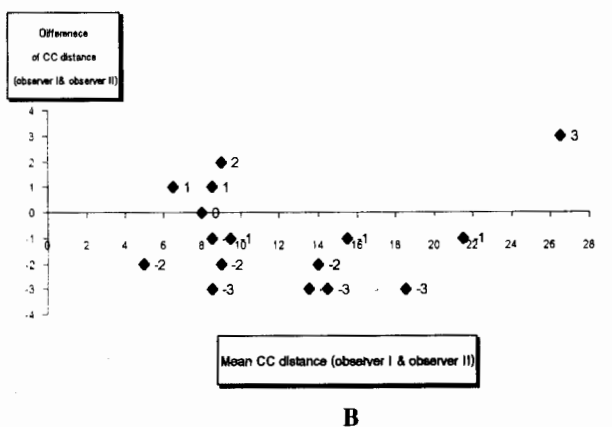
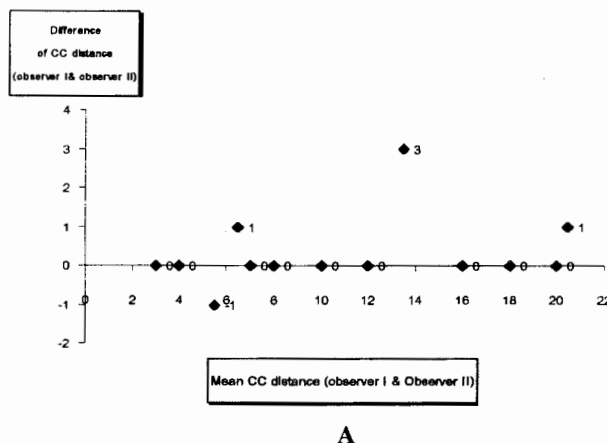
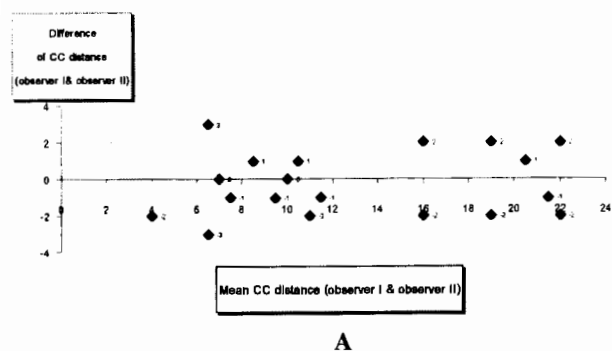
Case number	Observer I				Observer II			
	Right side		Left side		Right side		Left side	
	Current method	Mose's technique	Current method	Mose's technique	Current method	Mose's technique	Current method	Mose's technique
1	15*	12	8	8	17	12	9	8
2	5	4	15*	14	8	4	16	14
3	21*	18	7	6	20	18	6	6
4	11*	10	4	4	12	10	6	4
5	20*	20	9	10	18	20	8	10
6	10	10	10	10	10	10	8	10
7	11	8	28*	22	10	8	25	22
8	10	7	13	10	12	7	16	10
9	21*	18	8	7	22	18	10	8
10	9	10	8	8	10	10	10	10
11	17*	15	9	9	15	12	8	9
12	8	8	12*	10	5	8	15	10
13	18*	16	9	8	20	16	10	8
14	7	5	13*	10	7	6	15	10
15	18*	16	9	8	20	16	10	8
16	3	3	7	7	5	3	10	6
17	7	7	17*	15	8	6	20	14
18	9	8	21*	20	10	8	22	20
19	23*	21	8	8	21	20	8	8
20	21*	18	8	7	23	18	10	7

\*=injured side

**Table II** The coracoclavicular distance (in millimeters) of the coracromioclavicular joints were repeated measurement two times by both observers with the current and Mose's template techniques.

Case NO.	Current technique				Mose's technique			
	Observer I		Observer II		Observer I		Observer II	
	First time	Second time	First time	Second time	First time	Second time	First time	Second time
1	17	18	15	15	12	12	12	10
2	5	8	5	6	4	4	4	4
3	22	20	21	20	18	18	18	16
4	12	14	11	12	10	10	10	12
5	22	22	20	22	20	22	20	20
6	10	10	10	10	10	10	10	10
7	11	12	11	12	8	8	8	8
8	7	8	10	12	7	8	8	8
9	19	20	21	20	18	18	18	16
10	10	12	9	10	10	10	10	10

The limits of agreement for CC distance measured with the current and Mose's techniques by the two observers were presented in figure II and III.



**Figure II** Presenting the limits agreement of CC distance measured by Mose's technique. A Right side, B Left side. The y axis is the difference of CC distances measuring by observer I and II. The x axis is the mean of CC distance measured by both observers

**Figure III** Presenting the limits agreement of CC distance measured by the current technique. A Right side, B Left side. The y axis is the difference of CC distance measuring by observer I and II. The x axis is the mean of CC distance measured by both observers

## Discussion

Reliability of measurement in orthopedics has been reported<sup>10-12</sup>. This means human error can be found in any measurements in clinical practice. Clinical decisions making depends upon clinical classification. The results of Mose' technique of measurement of both intra-observer and inter-observer agreement were higher than the current technique. This may due to the variation of defining the point at the circularlike shadow of the coracoid process of each individual observer and it is difficult to draw the perpendicular line from upper margin of the coracoid process to the inferior border of the clavicle. Therefore, the line which draw from the coracoid process to the conoid tubercle or inferior border of the clavicle will be varies in length from individual to individual. Due to the circular-like shadow of coracoid process on the radiograph, therefore, it makes sense to apply the Moses's template. The tangential line of the circle usually perpendiculates to the center of the circle and the perpendicular line is the shortest one. It is very easy and reproducible to place the Mose's template over the marginal curve of the coracoid process, therefore, the reproducibility of measurement of each individual can be obtained.

The data analysis of this study used the most appropriate method to present the percentage of data had the same results. The intraclass-correlation coefficients is not appropriate because the coefficient tell us only the relationship of the pairs of data, however, it does not tell us about the results are the same or not the same<sup>6,9</sup>. The graphic presentations of agreement of two observers were clearly demonstrated in Mose's technique which most of the results were in the zero line (figure II and III).

This new method of measurement the CC distance has a higher reproducibility than the current technique. This technique should be used for deciding on the treatment for the patient with AC dislocation and also be used for the post operative follow up period.

In conclusion, this new technique using Mose's template

is more reliable than the current method to measure the CC distance in patient with the AC joint dislocation. This technique is simple and easy to perform.

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