Assessment of Approximate Glenoid Size in Thai People

Pason Phonphok MD*,
Nattha Kulkamthorn MD*

** Division of Sports Medicine, Department of Orthopedics, Phramongkutklao Hospital and College of Medicine, Bangkok Thailand*

Background: *The loosening of the glenoid baseplate component is one of the most common complications after reverse total shoulder arthroplasty. The mismatch between size of baseplate and glenoid in Thai People may result in improper baseplate screw fixation and lead to early loosening of the glenoid component. Knowing of the glenoid size will guide the surgeon in placing or choosing the proper size glenoid baseplate to improve screw fixation strength.*
Objective: *Study the size of glenoid in Thai people and compare with previous studies.*
Material and Method: *The authors measured the glenoid size in anteroposterior and superoinferior directions, the data were recorded in term of mean and standard deviation. The present data were then compared with the previous glenoid studies to identify the differences in size between Thai people and others.*
Results: *Among 160 patients with the mean age of 58.2±14.2 years, the overall glenoid size for the entire study group were 32.3±3.2 mm and 24.4±3.2 mm in superoinferior (SI) and anteroposterior (AP) directions, respectively. The male glenoid size were 35.6±2.6 mm and 26.7±2.5 mm in SI and AP directions, respectively. The female glenoid SI diameter were 31.0±1.9 mm and in AP diameter were 22.0±1.7 mm. The glenoid size in Thai people was significantly smaller than the glenoid size from previous studies in Caucasians.*
Conclusion: *The overall glenoid size in Thai people was significantly smaller than the previous studies in Caucasians. The female glenoid was also smaller than with the male. These findings alert surgeons to choose the proper glenoid baseplate design to avoid an overhang problem and improve screw fixation, especially in Thai female patients.*

Keywords: *Glenoid, Reverse total shoulder arthroplasty, Thai glenoid size*

J Med Assoc Thai 2014; 97 (Suppl. 2): S14-S18
Full text. e-Journal: *http://www.jmatonline.com*

Reverse total shoulder arthroplasty (RTSA) was initially used to manage massive rotator cuff tear and rotator cuff tear arthropathy. The indications have been expanded to more complex shoulder problem such as failed shoulder arthroplasty and proximal humeral fracture sequelae.

The rising in number of RTSA may lead to complications unique to the procedure. The mechanical glenoid baseplate failure is one of the common problems after RTSA. The loosening of glenoid component can be prevented by placing the baseplate at the lower part of glenoid bone so that the inferior screw will achieve the strongest pull-out strength, enough to resist the pull-out force of the glenoid component[1]. The glenoid component from western manufacturers may cause an overhang on the glenoid in Thai patients, and then lead to screw misplacement and result in the early loosening of the component.

Correspondence to:
Phonphok P, Department of Orthopedics, Phramongkutklao Hospital, Bangkok 10400 Thailand.
Phone: 0-2354-7600 Fax: 0-2354-9084
E-mail: omnpason@hotmail.com

Knowing the glenoid size in Thai patients will aid the surgeon in placing the glenoid baseplate more properly to improve the fixation strength and better choose the proper size of the glenoid baseplate to avoid the overhang of the component.

Moreover, these average "normal" glenoid size can be used as a reference data in calculate the percentage of glenoid bone loss in patients with recurrent shoulder dislocation and glenoid bone loss in arthritic shoulder patient that may result in changing the treatment plan in these groups of patients.

To date, there are no data about the average glenoid size of Thai people and no comparative studies between Thai glenoid size and others. The hypothesis of the presence study is that average glenoid sizes in Thai people are smaller than those of Caucasians.

Material and Method

The authors collected the data from the patients who had undergone chest or shoulder computer tomographic imaging at the Department of Radiology, Phramongkutklao Hospital between March and July 2012. The CT images then had been

reconstructed into 3D image. The authors rotated the reconstruct glenoid to the so-called En face view. The bare spot was used as a reference for centering the imagine circle. The circle was then drawn at the same time trying to keep the circumference of the circle parallel with the inferior edge of glenoid as possible. Then the glenoid was measured in both anteroposterior and superoinferior directions in millimeters by using the landmark from the bare spot of the glenoid as a reference[2] (Fig. 1).

Patients with the history of glenoid fracture, shoulder instability or osteoarthritis were excluded from the study.

The sample size was calculated according to a study by Churchill RD et al[3], the present study was to enroll at least 73 patients to provide statistically significance. In the present study, the authors enrolled 160 patients divided equally into both genders.

The baseline characteristics such as gender, age, underlying diseases were recorded in the registration forms. The measurement of the glenoid size in anteroposterior and superoinferior directions in millimeters were also collected and were presented as mean and standard deviation to be compared with the previous international studies by independent t-test using the SPSS statistical software (release 20.0). A *p*-value less than 0.05 was considered statistically significant. All measurements were carried out by the same observer for two periods and then repeated after at least 2 weeks.

Results

Among 160 patients (age 22-88 years) with the mean age of 58.2±14.2 years, were 80 male and 80 female. The overall glenoid size for the entire study group were 32.3±3.2 mm and 24.4±3.2 mm in superoinferior and anteroposterior directions respectively. The average male glenoid size were 35.6±2.6 mm and 26.7±2.5 mm in superoinferior and anteroposterior directions respectively. The female glenoid size in superoinferior was 31.0±1.9 mm and in anteroposterior were 22.0±1.7 mm (Table 1).

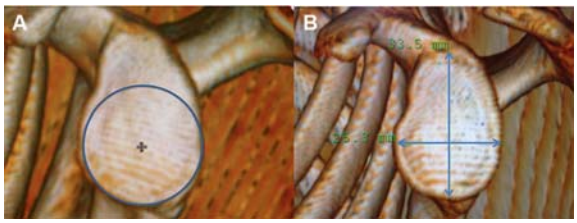


Fig. 1 Computed tomographic imaging of the glenoid. (A) The bare spot was identified and used as a reference for the center of circle. Try to keep the circumference of circle parallel to inferior part of glenoid as posible. (B) The glenoid was measured in both anteroposterior and superoinferior directions by used the landmark from the bare spot as a reference.

The average glenoid size in Thai people then had been compared to the previous studies[4-6] and the comparing data between genders also performed as shown in Table 2.

Von Schroeder et al and Iannotti et al found the overall glenoid sizes in Thai statistically smaller than the previous glenoid studies. Moreover, when comparing between gender, the average Thai male and female glenoid sizes were also significantly smaller than previous study of Caucasians[3] (Table 2).

However, when comparing with the Korean glenoid size[6] (Table 2), there was no significantly difference in both superoinferior and anteroposterior directions (*p*-value = 0.11 and *p*-value = 0.01, respectively).

Discussion

One of the most common complications after reverse total shoulder arthroplasty is loosening of glenoid baseplate; the sizes of glenoid baseplates from western manufacturers were claimed to be larger than in Asian or Thai glenoid patients.

These mismatches between sizes may have been caused by inappropriate purchases of glenoid baseplate screws and could lead to early loosening of the component.

The average AP glenoid diameter in Thai people is 24.4±3.2 mm and the mean SI diameter is 32.3±3.2 mm. These present data show the overall glenoid size in Thai people were significantly smaller than the previous studies in Caucasians[35] (*p*-value <0.01).

Interestingly, the subgroup analysis comparing gender, the glenoid size of Thai male were statistically larger than Thai female. The mean AP diameter in male and female were 26.7±2.5 mm and 22.0±1.7 mm (*p*-value <0.01), respectively. The mean SI diameter of male and female were 35.6±2.6 mm and 31.0±1.9 mm, which also show statistical difference (*p*-value <0.01). These findings correspond with the previous Korean[6] and Caucasian[3] studies that the male glenoid is bigger than female. This data will alert the surgeon when dealing with Thai-female glenoid.

When compared with Korean glenoid[6], the overall glenoid diameters are not statistical different

Table 1. Demographic data and average glenoid size of 160 patients

Characteristic	Total (n = 160)	Male (n = 80)	Female (n = 80)
Age (years), mean ± SD (range)	58.2±14.2 (22.0-88.0)	58.8±15.2 (22.0-87.0)	55.7±13.1 (25.0-88.0)
Average glenoid size			
SI diameter, mean ± SD (range)	32.3±3.2 (26.6-42.5)	35.6±2.6 (30.6-42.5)	31.0±1.9 (26.6-36.1)
AP diameter, mean ± SD (range)	24.4±3.2 (19.2-34.3)	26.7±2.5 (21.7-34.3)	22.0±1.7 (19.2-29.1)

SI = superoinferior; AP = anteroposterior

Table 2. Comparison of the average glenoid size between Caucasian and Asian

A) Comparison according to diameter

Studies	n	AP	*p*-value*	SI	*p*-value*
The present data (CT) Thailand, 2012	160	24.4±3.2		32.3±3.2	
von Schroeder, et al 2001 (cadaveric)	15	29.0±3.0	<0.01	36.0±4.0	<0.01
Iannotti, et al 1992 (cadaveric + MRI)	120	29.0±3.2	<0.01	39.0±3.5	<0.01
Moon, et al 2006 (CT)	25	26.1±2.4	0.01	31.2±2.3	0.11

B) Comparison according to diameter and gender

Studies	n		AP	*p*-value*		SI	*p*-value*
The present data (CT)	160	Male	26.7±2.5		Male	35.6±2.6	
Thailand, 2012		Female	22.0±1.7		Female	31.0±1.9	
Churchill RD, et al 2001	344	Male	28.8±1.6	<0.01	Male	37.5±2.2	<0.01
(cadaveric)		Female	23.6±1.5	<0.01	Female	32.6±1.8	<0.01

SI = superoinferior; AP = anteroposterior; CT = computed tomography; MRI = magnetic resonance imaging
**p*-value were compared with the present study

with both also smaller than the Caucasian glenoid. These findings also confirm that race and gender have an effect on glenoid diameter.

For clinical application, the data of average glenoid size can be used to improve the RTSA surgical outcome and also being used as a reference number for calculation of percent of glenoid bone loss in recurrent shoulder instability patients.

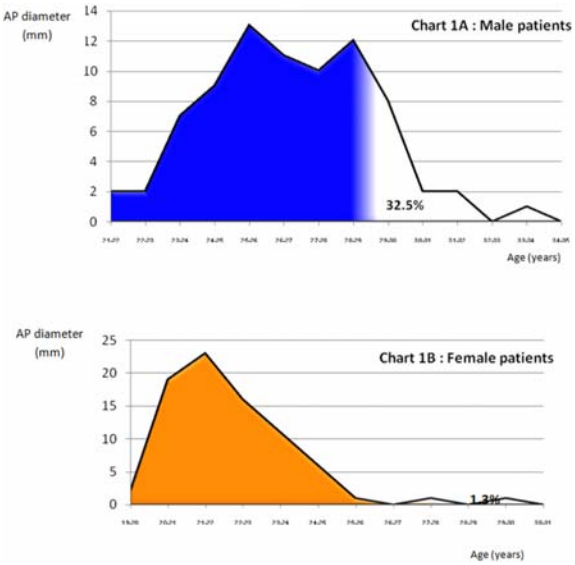
The glenoid baseplate that we use in RTSA have just only one size[8] (28.0 mm in diameter). Therefore, to avoid overhanging of the glenoid baseplate, the patient with the glenoid size larger than 28.0 mm in the AP direction will be considered safe for this type of glenoid baseplate that were designed for the western people.

The present study found that only 26 persons or 32.5 percent of male are considered suitable for this size of baseplate. Hence, more obviously in the female group, just only 1 person or 1.3 percent of female group are proper for the western design glenoid baseplate as shown in Fig. 2. The glenoid AP diameter that smaller than 28.0 mm can cause overhanging and effect the screw purchase that could lead to loosening later.

For the patients with recurrent shoulder dislocation, thirty percent of glenoid bone loss is the consensus number among surgeons for changing from arthroscopic treatment to open coracoid or bone graft transfer. According to the present data, the loss of glenoid bone in the anteroposterior direction about 8.0 mm in male and 6.6 mm in female would correspond to 30.0 percent. On the other hand, if we found an 18.7 millimeter glenoid bone left in male and 15.4 millimeters left in female will alert the surgeon to change treatment plan to open bone graft or coracoid transfer.

Conclusion

The overall glenoid size in Thai people was found significantly smaller than the previous studies



SI = superoinferior; AP = anteroposterior; mm = millimeter

Fig 2. The average AP glenoid diameter and number of patients. A, B) The graph between the AP diameter of the glenoid and number of patients in male and female. Only 32.5 percent in male population and 1.3 percent in female population (white area under the curve) were suitable for the glenoid baseplate.

in Caucasian. The female glenoid was also found to be smaller than that of the male. These findings alert surgeons to choose the proper glenoid base plate design to avoid an overhang problem and improve screw fixation especially in Thai female patients.

Potential conflicts of interest

None.

References

1. Matsen FA 3rd, Boileau P, Walch G, Gerber C, Bicknell RT. The reverse total shoulder arthroplasty. J Bone Joint Surg Am 2007; 89: 660-7.
2. Hoenecke HR Jr, Hermida JC, Flores-Hernandez C, D'Lima DD. Accuracy of CT-based measurements of glenoid version for total shoulder arthroplasty. J Shoulder Elbow Surg 2010; 19: 166-71.
3. Churchill RS, Brems JJ, Kotschi H. Glenoid size, inclination, and version: an anatomic study. J Shoulder Elbow Surg 2001; 10: 327-32.
4. von Schroeder HP, Kuiper SD, Botte MJ. Osseous anatomy of the scapula. Clin Orthop Relat Res 2001; (383): 131-9.
5. Iannotti JP, Gabriel JP, Schneck SL, Evans BG, Misra S. The normal glenohumeral relationships. An anatomical study of one hundred and forty shoulders. J Bone Joint Surg Am 1992; 74: 491-500.
6. Moon YL, Lee HE, Noh KH. Normal glenoid size of the Korean in 7th and 8th decades. J Korean Shoulder Elbow Soc 2008; 11: 37-40.
7. Disabled World. Disabled world-disability news and information [Internet]. 2012 [cited 2012 Jul 19]. Avialable from: http://www.disabled-world.com
8. Strauss EJ, Roche C, Flurin PH, Wright T, Zuckerman JD. The glenoid in shoulder arthroplasty. J Shoulder Elbow Surg 2009; 18: 819-33.

การศึกษาหาขนาดเบ้ากระดูกสะบักในคนไทย

พาสรรค์ ผลโภค, ณัฏฐา กุลกำมธร

ภูมิหลัง: ปัจจุบันการผ่าตัด Reverse total shoulder arthroplasty ในผู้ป่วยที่มีภาวะข้อไหล่อักเสบหรือข้อไหล่ไม่มั่นคง ร่วมกับกล้ามเนื้อหุ้มไหล่ฉีกขาดที่ซ่อมแซมไม่ได้ เป็นการผ่าตัดที่พบภาวะแทรกซ้อนในอัตราที่สูงโดยในส่วนของข้อเทียม บริเวณกระดูกสะบักหลวมเป็นหนึ่งในภาวะแทรกซ้อนที่พบได้และสามารถลดความเสี่ยงได้หากทราบถึงขนาดเบ้ากระดูกสะบัก เพราะจะสามารถเลือกขนาดอุปกรณ์ที่เหมาะสมและนำไปสู่การวางข้อเทียมส่วนสะบักไว้ส่วนล่างของกระดูก และสามารถยึดสกรูที่ข้อเทียมไว้ได้อย่างมั่นคง ปัจจุบันยังไม่มีข้อมูลที่แน่ชัดถึงขนาดเบ้ากระดูกสะบักในคนไทยและความแตกต่างระหว่างคนไทยเทียบกับประชากรชนชาติอื่น

วัตถุประสงค์: เพื่อศึกษาหาขนาดเบ้ากระดูกสะบักในคนไทยและความแตกต่างระหว่างคนไทยเทียบกับประชากรชนชาติอื่น

วัสดุและวิธีการ: การศึกษาโดยนำภาพเอ็กเรย์คอมพิวเตอร์สามมิติที่บริเวณหัวไหล่หรือทรวงอกในผู้ป่วยจำนวน 160 ราย เป็นเพศชาย 80 รายและเพศหญิง 80 ราย ทำการวัดขนาดเบ้ากระดูกสะบักในแนวขอบบนถึงขอบล่าง (superoinferior directions) และในแนวขอบหน้าถึงขอบหลัง (anteroposterior directions) นำค่าที่ได้มาคำนวณหาค่าเฉลี่ยและส่วนเบี่ยงเบนมาตรฐาน ทั้งค่าเฉลี่ยรวมและแยกตามเพศ ข้อมูลที่ได้นำไปเปรียบเทียบกับขนาดเบ้ากระดูกของประชากรต่างชาติเพื่อหาความแตกต่างทางสถิติโดยใช้ independent t-test

ผลการศึกษา: จากภาพเอกซเรย์คอมพิวเตอร์สามมิติพบว่าค่าเฉลี่ยขนาดเบ้ากระดูกสะบักของกลุ่มตัวอย่างทั้งหมด ในแนวขอบบนถึงขอบล่างและในแนวขอบหน้าถึงขอบหลังเท่ากับ 32.3±3.2 มิลลิเมตรและ 24.4±3.2 มิลลิเมตรตามลำดับ เมื่อแยกตามเพศพบว่าเพศชายมีค่าเฉลี่ยในแนวขอบบนถึงขอบล่าง และในแนวขอบหน้าถึงขอบหลังเท่ากับ 35.6±2.6 มิลลิเมตรและ 26.7±2.5 มิลลิเมตรตามลำดับและในเพศหญิงจะมีขนาดค่าเฉลี่ยขนาดในแนวขอบบนถึงขอบล่างและในแนวขอบหน้าถึงขอบหลังเท่ากับ 31.0±1.9 มิลลิเมตรและ 22.0±1.7 มิลลิเมตรตามลำดับ นำข้อมูลที่ได้จากการศึกษานี้ทั้งค่าเฉลี่ยโดยรวมและแยกตามเพศเปรียบเทียบกับขนาดเบ้ากระดูกของประชากรต่างชาติ พบว่ามีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติ (p-value <0.01)

สรุป: ค่าเฉลี่ยขนาดเบ้ากระดูกสะบักในคนไทยเมื่อวัดในแนวขอบบนถึงขอบล่างและขอบหน้าถึงขอบหลังมีค่าเท่ากับ 32.3±3.2 มิลลิเมตร และ 24.4±3.2 มิลลิเมตรตามลำดับ ซึ่งมีค่าแตกต่างเมื่อนำมาเปรียบเทียบกับการศึกษาที่ทำในประชากรต่างชาติพบว่ามีขนาดเล็กกว่าอย่างมีนัยสำคัญทางสถิติ