Original Article

Is the Bare Spot a Good Landmark for Arthroscopic Evaluation of Anterior Glenoid Bone Loss?

Chusak Kijkunasathian MD[1], Chalermchai Limitlaohaphan MD[1], Nadphorn Saengpetch MD[1], Porncharn Saitongdee MD[2], Krai Meemon PhD[2], Chinnawut Suriyonplengsaeng MD[2]

[1] Department of Orthopaedics, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Bangkok, Thailand
[2] Department of Anatomy, Faculty of Science, Mahidol University, Bangkok, Thailand

Objective: Glenoid defect is an important factor of consideration in determining appropriate surgical treatment for anterior shoulder instability, so precise assessment is necessary. The glenoid fossa bare spot has been reported to be a useful landmark during arthroscopic examination, although there are some controversies. The objective of the present study is to determine whether the bare spot is located in the center of the glenoid and thus the extent to which it can be used as a landmark.

Materials and Methods: The distance from the center of the bare spot to the anterior, posterior, superior, and inferior rim of the glenoid were measured in 40 male and 26 female specimens.

Results: The average glenoid length was 36.1 mm superoinferiorly and 27.2 mm anteroposteriorly. However, both the vertical and horizontal length of the glenoid was significantly smaller in females than in males (p-value <0.01). The average anterior and posterior glenoid length was 13.2 mm in females versus 13.5 mm. The anterior glenoid length was significantly shorter than the posterior length in females (p-value = 0.02), but there was no significant difference in males (p-value = 0.22).

Conclusion: The anterior glenoid length is shorter than the posterior in females. The posterior glenoid length may be a useful reference in evaluating bone loss of the anterior glenoid rim in males, but may not be useful in females.

Keywords: Anterior glenoid defect, Bare spot, Arthroscopic evaluation

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One important factor in determine the need for surgery for anterior shoulder instability is the severity of the anterior glenoid bone loss. The glenoid bone loss is known to be associated with a higher failure rate in arthroscopic Bankart repair for anterior shoulder instability[1-4]. Itoi et al. found that an anterior inferior bony glenoid defect equal to 21% of the glenoid length significantly reduced the translation force required for dislocation and that stability decreased progressively as the size of the osseous defect increased[4]. This indicates that accurate evaluation of the size of the glenoid bone loss is crucial in determining the surgical indication.

Correspondence to:
Kijkunasthian C, Department of Orthopaedics, Faculty of Medicine Ramathibodi Hospital, Mahidol University, Bangkok 10400, Thailand.
Phone: +66-2-2011589, **Fax:** +66-2-2011599
E-mail: chusak.kij@mahidol.ac.th, hong3101@gmail.com

Magnetic resonance imaging [MRI] is used to evaluate patients with anterior shoulder instability. The articular cartilage and capsulolabral complex are clearly visualized, but the anterior glenoid bone loss may be underestimated with MRI[5]. A three dimensional (3-D) CT scan is recommended to evaluate anterior glenoid bone loss, but that requires special technique and expertise to achieve an accurate evaluation[6-8].

Arthroscopic evaluation of glenoid bone loss has been described by Burkhart et al. They suggest that the glenoid bare spot can be used as a consistent landmark in measuring bone loss[3,9]. The center of the bare spot is equidistant from the anterior, posterior, and inferior glenoid margins. It has been reported that anterior glenoid bone loss can be calculated by comparing the distances from the glenoid bare spot to the anterior and posterior rims[10]. However, that calculation method is based on the hypothesis that the anterior and posterior glenoid are of equal length.

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Anterior-inferior glenoid bone loss greater than 25% is considered to be an indication for bone grafting.

Kralinger and et al[11] published a paper about imaging the bare spot of the glenoid using a three dimensional (3-D) CT scan. They concluded that the bare spot does not exhibit anatomical consistency. They reported that anterior, posterior, and inferior glenoid rims are not equidistant from the center of the bare spot. A limitation of that study was the small sample size. In addition, information on patient gender and age was not provided in this study. The upshot is that the accuracy of using the bare spot to evaluate anterior glenoid bone loss is still controversial. The objective of this study was to determine whether the bare spot is consistently at the center of the glenoid.

Materials and Methods

Seventy-eight formalin-fixed cadaveric shoulders were obtained from the Department of Anatomy, Faculty of Science, Mahidol University. Twelve shoulder specimens with deformity, previous surgery, loss of anterior labrum, osteoarthritis, or an undefined bare spot were excluded, leaving 40 male and 26 female specimens with an average age of 71.3 years (range 17 to 95 years). The shoulders were dissected and all the muscles attached to the glenoid bone were removed. The glenoid labrum was removed from the glenoid rim after identifying the position of the biceps anchor and the bare spot. A vertical line of the glenoid was drawn from the center of the biceps anchor through the center of the bare spot (Figure 1, Line A). A horizontal line was drawn perpendicular to the vertical line and also passing through the center of the bare spot (Figure 1, Line B+C). The distances from the center of the bare spot to the superior and inferior rims of the glenoid were measured along the vertical line. The vertical length of the glenoid was defined as the distance from the superior rim to the inferior glenoid rim. The distances from the center of the bare spot to the anterior and posterior rims of the glenoid were measured along the horizontal line. The horizontal length was defined as the distance from the anterior to the posterior glenoid rim. The anterior (Figure 1, Line C) and posterior glenoid length (Figure 1, Line B) were defined as the distance from anterior rim to the center of the bare spot and from the posterior rim to the center of the bare spot, respectively. The length of the glenoid was recorded in millimeters. A significant difference between the anterior glenoid length and the posterior glenoid length was defined as a difference of two millimeters or more. The ratio of the difference between the anterior and the posterior glenoid is expressed as a percentage

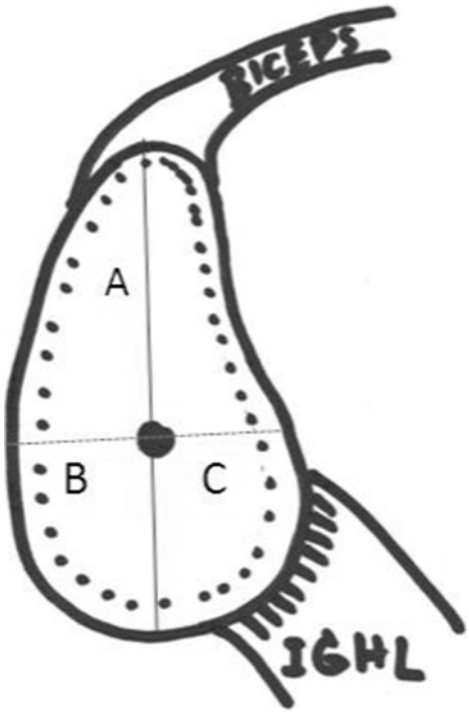

Figure 1. The vertical line of the glenoid was drawn between the center of the biceps anchor and the center of the bare spot (Line A). The horizontal line was drawn perpendicular to the vertical line and passing through the center of the bare spot (Line B+C). (A = vertical length, B = posterior glenoid length, C = anterior glenoid length, B+C = horizontal length).

Statistical analysis

The horizontal length, vertical length, anterior glenoid length and posterior glenoid length are reported as mean ± standard deviation. We used the Student's t-test to compare means between groups and the paired t-test to compare means within groups. The differences between the anterior and posterior glenoid were compared using Pearson's Chi-square test. All analyses were performed using STATA 10.0 (StataCorp., College Station, Texas, USA), and *p*-values <0.05 were considered statistically significant.

Results

The average vertical and horizontal lengths of the glenoid were 36.1±3.9 mm and 27.2±4.8 mm, respectively (Table 1). Those lengths were significantly

Table 1. Glenoid size

Glenoid dimensions	Total mean (SD) mm	Male mean (SD) mm	Female mean (SD) mm	*p*-value
Vertical length	36.1 (3.9)	37.4 (3.9)	34.0 (3.1)	>0.01
Horizontal length	27.2 (4.8)	29.0 (5.1)	24.3 (2.3)	>0.01

Table 2. Anterior and posterior glenoid length

	Anterior glenoid length mean (SD) mm	Posterior glenoid length mean (SD) mm	*p*-value
Total	13.2 (2.3)	13.5 (1.6)	0.22
Male	14.2 (2.2)	14.2 (1.3)	0.93
Female	11.8 (1.4)	12.6 (1.5)	0.02

different between the genders (*p*-value <0.01), with both the vertical and horizontal lengths larger in male than in female specimens. The average anterior and posterior glenoid lengths for males and females were 13.2±2.3 mm and 13.5±1.6 mm, respectively. The anterior and posterior glenoid lengths were not significantly different in males (*p*-value = 0.93), whereas the female specimens showed a significant difference (*p*-value = 0.02) (Table 2). The average anterior glenoid length in males was equal to the posterior glenoid length, but the average anterior glenoid length in females was shorter than the average posterior glenoid length (Figure 2). The proportion of specimens that had a difference between the anterior and posterior glenoid length >2 mm was 30.00% in males and 57.69% in females, a statistically significant difference (*p*-value = 0.02) (Table 3).

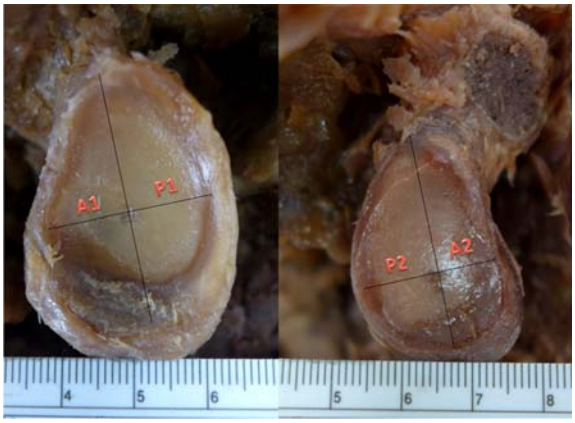

Figure 2. The anterior glenoid length in males (A1) was equal to the posterior glenoid length (P1), whereas the anterior glenoid length in females (A2) was shorter than the posterior glenoid length (P2).

Discussion

Glenoid bone loss is one of the important factors affecting surgical outcomes in arthroscopic treatment of anterior shoulder instability[12,13]. Bony procedure is recommended for patients who have anterior glenoid bone loss greater than 25% of the anterior-posterior diameter of the glenoid[3,4].

Arthroscopic evaluation of the anterior glenoid bone loss is an alternative method that is commonly used. Burkhart et al recommended using the glenoid bare spot as a central reference point to quantify the percentage bone loss[3]. Their calculation method is based on the hypothesis that the anterior and posterior glenoid lengths from the bare spot were equal. However, a two millimeter difference between the anterior and posterior glenoid length causes a 6% to 8% error in the calculation of the anterior glenoid bone loss for a horizontal glenoid length of 27 millimeters. An error of that magnitude can affect the plan of treatment.

Barcia et al[14] provided an arthroscopic characterization of the bare area. They found that the bare spot was at the center in only 37% of cases. Miyatake et al[15] reported on the validity of arthroscopic measurement of glenoid bone loss using the bare spot. They found the anterior glenoid length was shorter than the posterior glenoid length, but that the difference was not statistically significant. Eighteen percent of

Table 3. Proportion of specimens with a difference ≥2 millimeters between anterior and posterior glenoid length by gender

	Male (%)	Female (%)	*p*-value
Proportion with ≥2 mm difference	30.00 (12/40)	57.69 (15/26)	0.02

their specimens showed a difference ≥2 mm. They concluded that the bare spot was not consistently located at the center of the inferior glenoid. Huysmans et al[16] described a study of the shape of the glenoid in cadaveric specimens, concluding that the bare spot was not in center of the inferior glenoid, but that the differences in the distance to the anterior, inferior and posterior rims were small (1.16 to 2.41 mm). No previous study has investigated the effect of gender on the anterior and posterior glenoid length.

The present study found a difference in size of the glenoid between the genders: females have a smaller glenoid than the males. The anterior glenoid length was significantly shorter than the posterior glenoid length in females, but the lengths were equal in males. Fifty-seven percent of the female specimens had a difference of two millimeters or more between anterior and posterior glenoid length. This finding indicates that arthroscopic evaluation of anterior glenoid bone loss using the bare spot as a reference may be inaccurate in females. The reason for the significant difference in the females but not in the males is not known.

There are several limitations in the present study. First, the sample size may not have been large enough to detect a significant difference between anterior and posterior glenoid lengths. Second, we did not perform inter- or intra-observer reliability tests. Third, we used the biceps anchor as a landmark; this soft tissue landmark is commonly used in arthroscopic surgery, but we found some variation in the location of that landmark.

Conclusion

The location of the glenoid bare spot is different in males and females. The anterior glenoid length is significantly shorter than the posterior in females, but the lengths are equal in males. The posterior glenoid length may be a useful reference for evaluating bone loss of the anterior glenoid rim in males, but it may not be useful in females.

What is already known on this topic?

The glenoid bare spot is an important anatomical bony landmark in evaluation of anterior glenoid bone loss. The bare spot is generally located at the center of the glenoid, but there is individual variation in its location.

What this study adds?

The anterior glenoid length was found to be significantly shorter than the posterior glenoid length in females. The posterior glenoid length may be a useful reference for evaluating the extent of bone loss of the anterior glenoid rim in males, but it may not be useful in females.

Potential conflicts of interest

The authors declare no conflict of interest.

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