TO COMPARE THE BONY PARAMETERS OF HIP AND SHOULDER JOINTS FOR UNDERSTANDING THEIR ROLE IN DISLOCATION

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ABSTRACT

Objective: The purpose of this study is to compare the bone of shoulder with that of hip joint for any structural change-pertaining to variation in stability of these joints due to trauma or pathological processes.

Material and Methods: This study work was carried out on bones collected from cadavers in Anatomy department of KGMC Peshawar from January 2012 to December 2014. A total number of 11 pairs of humeri, 12pairs femurs, 10 pairs of scapulae and 14 pairs of hip bones were included in this study. The measurement of different part of bone were performed with help of vernier caliper and recorded on observation sheet. For measurement of weight the electronic scale, equipped with a high precision sensor system, was used.

Results: The mean diameter of right glenoid cavity was less as compared to left glenoid cavity but the depth of right glenoid cavity was more than that of left glenoid cavity. Both diameter and depth of right acetabulum were less as compared to left acetabulum.The mean diameter of humeral head and thickness of articular surface were less on right sidewhich were not significant. The diameter of right humeral neck was significantly less as compared to left side.

The mean diameter of right femoral head and neck were more as compared to left side but the thickness of femoral head was less on right side which was not significant. All bony parameters were significantly different in shoulder joint as compared to hip joint.

Conclusion: A significant asymmetry exists in parameters of shoulder and hip joint which can be a factor affecting their mobility and stability. The difference noted in right and left sides were not significant.All these findings may have implication for regional prosthetic design and implantations.

Keywords: Hip Joint, Shoulder Joint, Ball and Socket Joints, Vernier Caliper.

INTRODUCTION:

The shoulder and hip joint are good examples of ball and socket joints. Apart from other factors the stability of a joint depends on the shape, size, and arrangement of the articular surfaces.The ball-and-socket arrangement of the hip joint is a good example of how bone plays an important role in joint stability. It has also been observedin certain surgical procedure, like hip arthroplasty,that the use of a larger femoral head had sufficiently contributed to lower the incidence of post-operative dislocation where otherwise dislocation was the most common complication of such procedures[1].

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In shoulder joint the articulation occurs between the rounded head of the humerus and the shallow, pear-shaped glenoid cavity of the scapula.As in shoulder joint much of the stability has been sacrificed to permit a wide range of movementthat is why this joint is considered to be an unstable joint[2].

The depth of glenoid cavity is remarkably lesser in anterior as well as posterior direction which is associated with the larger area of articular surface of humerus, about four times the area of the glenoid cavity. This may be contributing to the unstable nature of shoulderjoint[3].

The purpose of this study is to compare the shoulder and hip joints for any structural properties pertaining to variations in stability of these two joints. A commonly encountered entity in orthopaedic practice is the anterior shoulder instability[4]. In present study the bones of right shoulder and hip joints would also be compared with those of left side to see any structural differences.

The important factors to consider here is not only the degree of proportion of articulating surfaces but also non-articular parts like the diameter of neck of humerus as compared to that of femur. In this study the main comparisonoptions would be headand neck of humerus and femur with that of glenoid and acetabular cavities. This

will be helpful in understanding the normal anatomy of joint in local population which would certainly be useful in understanding the nature of injuries or other pathological processes (osteoporosis etc.) Involving bones or joints, and designing of prosthesis, replicating the normal joint suitable for the people of KPK Peshawar.

MATERIAL AND METHODS:

This study work was carried out on bones collected from cadavers at Anatomy department of KGMC Peshawar from January 2012 to December 2014. A total number of 11 right humeri, 11 left humeri, 12 right femora and 12 left femora, 10 pairs of scapulae and 14 pairs of hip bones were included in this study. The damaged bones were excluded from this study while all other remaining available bones were included in this study. After numbering these bones, the weight and length of different parts of bone were recorded on observation sheet.

Glenoid cavity: The average diameter of glenoid cavity was calculated from maximum vertical and horizontal diameters. The average depth of glenoid cavity was also calculated from average of maximum vertical depth and maximum horizontal depth.

Acetabulum: The average diameter of acetabulum was calculated from maximum vertical and horizontal diameters. The average depth of acetabulum was also calculated from maximum vertical depth and maximum horizontal depths.

Head and neck of humerus: The average diameter of head of humerus is calculated from maximum vertical and horizontal diameters. The average articular surface thickness is calculated from heights in all four quadrants of humeral head. The average diameter of neck of humerus is calculated from horizontal and vertical diameters. The RSI(Right shoulder index) and LSI(Left shoulder index)was calculated with the help of following formula:-

RSI or LSI = 100 X Head diameter x Articular surface thickness / Socket diameter x Depth

Head and neck of femur:

The average diameter of head of femur was calculated from maximum vertical and horizontal diameters. The average articular surface thickness was calculated from heights in all four quadrants of femoral head. The average diameter of neck of femur was calculated from horizontal and vertical diameters.Right hip index (RHI) and Left hip index (LHI) wascalculated with the help of following formula which may be used as parameter for comparing and designing the prosthesis.

RHI or LHI = 100 X Head diameter x Articular surface thickness / Socket diameter x Depth

Total data was entered in SPSS version 20. All the data were assessed through Student's t-test to test any significant difference in mean of head and neck diameters of humerus, femur and diameters and depth of glenoid and acetabular cavities bilaterally. The findings observed in shoulder and hip joints were compared and analyzed for conclusion.Student's t-test was applied for all quantitative data. A p-value of ≤ 0.05 was taken significant.

RESULTS:

Glenoid cavity: The mean diameter of right glenoid cavity was 32.15±0.68 mm and the mean diameter of left glenoid cavity was 32.67±0.62mm. The mean depth of right glenoid cavity were 3.56±0.17mm andthe mean depth of left glenoid cavity were 3.07±0.25mm(Table 1). Significant difference was noted when glenoid and acetabular cavities were compared bilaterally (Table 2).

Acetabulum: The mean diameter of right acetabular cavity was 51.14±0.74 mm and the mean diameter of left acetabular cavity was 52.89±0.73mm. The mean depth of right acetabular cavity was 24.89±0.77mm and the mean depth of left acetabular cavity was 26.71±0.43 mm (Table 1).

Head and neck of humerus: The mean diameter of right humeral head was 41.88±0.6 mm and the mean diameter of left humeral head was 43.04±0.95 mm. The meanarticular surface thickness of right humerus was12.12±0.29 mm and the mean articular surface thickness of left humerus was 12.72±0.46 mm.The mean diameter of right humeral neck was 42.81±0.59 mm and the mean diameter of left humeral neck was 44.25±0.67 mm (Table 1). Bilateral significant difference noted when similar parameters of humeri were compared with femora(Table 4).

RSI or LSI = 100 X Head diameter x Articular surface thickness / Socket diameter x Depth

RSI = 100 X41.88 x 12.12 / 32.15 x 3.56 = 443.48

LSI = 100 X43.04 x 12.72 / 32.67x 3.07 = 545.84

Head and neck of femur: The mean diameter of right femoral head was 46.12±0.59 mm and the mean diameter of left femoral head was 44.20±1.26 mm. The mean articular surface thickness of right femur was 27.64±0.58 mm and the mean articular surface thickness of left femur was 27.89±0.72 mm. The mean diameter of right femoral neck was 31.16±0.61 mm and the mean diameter of left femoral neck was 29.50±0.83 mm (Table 1).

RHI or LHI= 100 X Head diameter x Articular surface thickness / Socket diameter x Depth

RHI = 100 X 46.12 x 27.64 / 51.14 x 24.89 = 100

LHI = 100 X 44.20 x27.89 / 52.89 x 26.71 = 87.2

DISCUSSION:

Glenoid cavity: The mean diameter of right glenoid cavity was 32.15 mm which was less when compared with that of left glenoid cavity 32.67mm but this difference was insignificant (p=0.643).Similar to this study it has been reported by Jung et al[5] that the overall mean height of the glenoid was 37.67 mm. In another study 39 mm dimension has been reported in the superior-inferior direction of glenoid cavity by Iannotti[6].

Statistically significant difference (p=0.00)

Table No: 1 Comparison of Bones of Shoulder and Hip Joint

S. No	Bone	Parameters	Right	Left	P. value
			MEAN ± S	MEAN ± SE	
1	Glenoid	Diameter	32.15±0.7	32.7±0.6	0.643
		Depth	3.6±0.2	3.1±0.25	0.63
		N	10	10	
2	Acetabulum	Diameter	51.1±0.7	52.9±0.7	0.13
		Depth	24.9±0.8	26.7±0.4	0.06
		N	14	14	
3	Humerus	Diameter Head	41.9±0.6	43.0±0.95	0.228
		Articular surface thickness	12.1±0.3	12.7±0.5	0.353
		Diameter Neck	42.8±0.6	44.25±0.7	0.017*
		N	11	11	
4	Femur	Diameter Head	46.1±0.6	44.20±1.3	0.204
		Articular surface thickness	27.6±0.6	27.9±0.7	0.772
		Diameter Neck	31.2±0.6	29.50±0.8	0.199
		N	12	12	

KEY: N = Number of specimens SE = Standard error of mean

* = Statistically significant

Table No: 2 Comparison of Glenoid and Acetabular Cavities

S. No	Parameter	N	Side	Glenoid cavity	Acetabular cavity	P. value
				Mean ± Se	Mean ± Se	
1	Diameter	10	Right	32.15±0.7	50.85±1.0	0.000*
			Left	32.7±0.6	52.95±1.0	0.000*
2	Depth	10	Right	3.6±0.2	25.20±1.0	0.000*
			Left	3.1±0.25	26.70±0.6	0.000*

KEY: N = Number of specimens SE= Standard error of mean

* = Statistically significant

Table No: 3 Comparison of Humerus and Femur

S. No	Parameter	N	Side	Humerus	Femur	P. value
				Mean ± SE	Mean ± SE	
1	Diameter of head	11	Right	41.9±0.60	46.40±0.6	0.001*
			Left	43.0±0.95	44.2±1.4	0.567
2	Articular surface thickness	11	Right	12.1±0.3	27.6±0.6	0.000*
			Left	12.7±0.5	28.0±0.8	0.000*
	Diameter of Neck	11	Right	42.8±0.6	30.90±0.60	0.000*
			Left	44.25±0.7	29.7±0.9	0.000*

KEY: N = Number of specimens SE= Standard error of mean

* = Statistically significant

was noted when diameter of right glenoid cavity was compared with the diameter of right acetabular cavity. Similarly the left glenoid diameter were significantly less as compared to left acetabular cavity (p=0.00) which could be oneof the important factor in shoulder joint dislocation, being more common than hip joint dislocation in cases of injuries.

The mean depth of right glenoid cavity (3.6mm) was more than that of left glenoid cavity (3 mm) but this difference was not significant(p=0.063)but there was a significant difference(p=0.00)when compared with corresponding acetabular cavity (25 mm)the difference noted were highly significant(p=0.00).This is an accordance with result of study of Howell[7], reporting that the glenoid articular surface create a socket that is approximately 4.5 mm deep in the superoinferior direction and 2.5 mm deep in the anteroposterior direction[7] which could be related to the relatively unstable nature of shoulder joint leading to an easy dislocation.

Acetabulum:The mean diameter of right acetabular cavity (51 mm) was insignificantly (p=0.13) less than the mean diameter of left acetabulum (53mm) but this finding is consistent with the finding of Varodompun et al, who noted that the average acetabular diameter was 51.8 mm[8] as larger diameter of acetabulum (62mm) is also associated with increased rate of dislocation[9].

There was no significant (p=0.063) difference between the mean depths of right acetabular cavity which was 25mm and the mean depth of left acetabular cavity was 26.7mm but difference in depth was significant (p=0.00) when right acetabular cavity was compared with right glenoid cavity. The greater depth of acetabular cavity is the key factor for stability of hip joint which is less common dislocation as compared to shoulder joint in injuries. It has also been reported that proper sizing and depth of the acetabular cavity are most important factors required for hip stability[10].

Head and neck of humerus:No significant difference was noted between mean diameters of right (42 mm) and left (43mm) humeral heads(p=0.35). The larger diameter of left humeral head is important to be noted for ideally fitting prosthesis. This study is also in accordance with the result of a study, reporting that the across diameter of right humeral head (40.5 mm) and left(40.7 mm) and vertical diameter of right humeral head (43.4 mm) and left (44.5 mm)[11].The diameter of right humeral head (42 mm) was significantly (p=0.001) less thanthe diameter of right femoral head (46.4 mm) which parallels with greater diameter of the acetabulum making the hip a stable joint than the shoulder joint.

The mean articular surface thickness of right humerus was less (12 mm) than that of left humerus (13 mm) and this difference was not significant (p=0.35). This study was not in accordance with the result of a study conducted by Iannotti et al. reporting that the average thickness of the humeral head was 19 mm[6]. A significant difference (p=0.00) was noted when the articular thickness of right humerus (12mm) was compared with that of right femur (28 mm). The mean diameter of right humeral neck (43 mm) was less than that of left humeral neck(44 mm) and this difference was significant(p=0.01). It was interesting to note that right (presumed dominant) humeral neck diameter was rather less than the left (presumed non-dominant) humeral neck diameter. Apart from this a significant (p=0.00) difference was noted when diameters of right humeral neck (43 mm) and right femoral neck(31mm).

Right and left Shoulder Index was 443 and 545 respectively which highlight the asymmetry present in right and left side of the body.

Head and neck of femur:The mean diameter of right femoral head (46 mm) was more than that of mean diameter of left femoral head (44mm) but this difference was not significant (p=0.204). It was consistent with the findings of Chauhan et al who reported the average diameter of right and left femoral head were 45.44 mm and 45.84 mm respectively[12].

It is noticed that the average diameter of femoral head is smaller than the average diameter of acetabulum in people of this region which give rise to proper fitting of femoral head into the acetabular cavity. It was consistent with the findings of Chauhan et al who reported that snugly fitting of femoral head into acetabulumis associated with decreasing incidence of osteoarthrosis of hip joint[12] and it may also decrease incidence of hip joint dislocation.

The mean articular surface thickness of right femur and left femur were similar (28 mm) but larger than humeral head which has been reported to enhance stability owing to the increasing range of motion before impingement[1].

The mean right and left femoral neck diameter was 31 mm and 30 mm respectively which was significantly less than that of humeral neck (43mm). Similarly our results are not consistent with the findings of Saengnipanthkul and Techasatien who reported larger (40 mm) femoral neck diameter in male. This difference observed may be considered a good point for designing a more stable hip prosthesis to suit requirement of local population[13].

RHI and LHI was 100 and 87 respectively which can be used as guideline for prosthetic design regarding total joint replacements or other surgical procedures and also highlights the asymmetry present in right and left side of the body along with low incidence of hip dislocation as compared to shoulder joint which can very easily dislocate[14].Apart from this other factors like capsular laxity[15,16]and weak muscles are also involved in shoulder dislocation.

CONCLUSION:

A significant asymmetry exists in parameters of shoulder and hip joints as reduced depth of socket as compared to larger head size, in case of shoulder joint may affect its stability at the cost of mobility leading to an easy dislocation in case of fall or other assaults. The difference noted in right and left sides were not significant but it can play a vital role in regional prosthetic design for hip or shoulder arthroplasty.

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