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Does Humeral Retrotorsion And Rotational Range Of Motion Change With Experience Of Playing In Professional Volleyball Players?

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Faculty Disclosure Information

- Nothing to disclosure

PURPOSE / OBJECTIVES

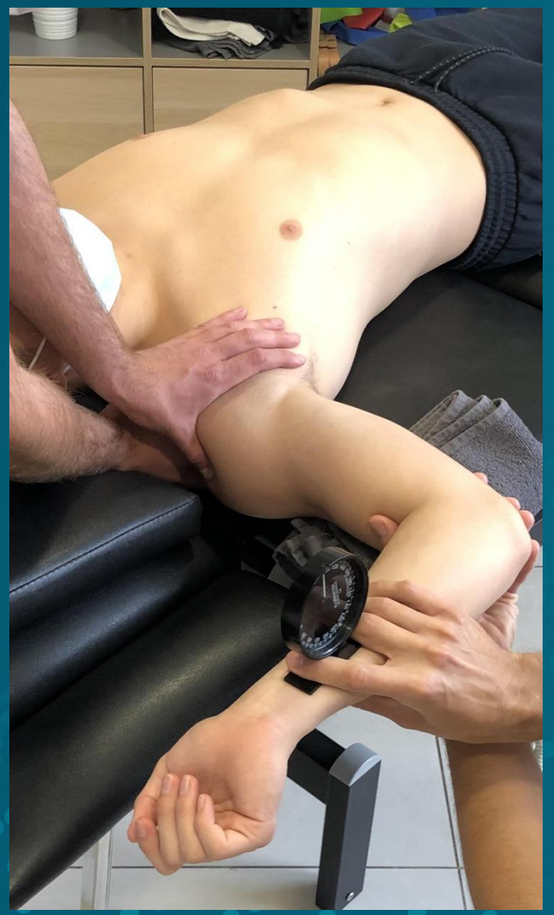
Overhead athletes demonstrate adaptive changes in rotation motion of glenohumeral joint. This motion shift depend on adaptive changes in the soft tissue, but also on the degree of humeral retrotorsion. The aim of this study was to determine how retrotorsion affects the range of rotation motion and how these parameters change with the duration of volleyball training.

MATERIAL & METHODS

It was a prospective cross-sectional study. Authors have examined 99 professional male players, aged 13-41, who have been practicing volleyball for at least 2 years and not less than 5 times a week. The mean age of the subjects was 19.67, and the standard deviation SD = 6.9 years. The mean value of volleyball playing experience was 8.4 years, and standard deviation SD = 6.2 years. Humeral retrotorsion (HR) was measured using diagnostic ultrasound and Rippstein plurimeter, while the range of external rotation (ER) and internal rotation (IR) was measured by plurimeter. One-way analysis of variance for dependent variables was used to compare the mean of the tested parameters for left and right side. Univariate linear regression models was used to assess the dependence of the studied variables on the degree of humeral retrotorsion and playing experience. Student's t-test was used for comparing regression coefficients in linear regression models

Measurements

Humeral retrotorsion



Rotation in back lying

Rotation in side lying

RESULTS

Dependence of the humeral head retrotorsion on the length of playing experience

parameter	side	B_0	SE B_0	B_1	SE B_1	P value (B_1)	P value of the equality
HH (playing experience)	ndom	40,470	2,201	- 0,644	0,211	0,003	0,481
	dom	31,447	2,098	- 0,630	0,201	0,002	

Dependence of the parameters of the range of motion on the length of playing experience

parameter	side	B_0	SE B_0	B_1	SE B_1	P value (B_1)	P value of the equality
BL IR	ndom	68,876	1,942	- 0,032	0,186	0,863	
	dom	60,527	1,996	- 0,089	0,191	0,642	
BL RE	ndom	136,652	2,200	- 1,276	0,211	< 0,0005	0,116
	dom	144,632	2,215	- 1,635	0,212	< 0,0005	
TROM BL	ndom	205,510	2,986	- 1,307	0,286	< 0,0005	0,166
	dom	205,119	2,953	- 1,721	0,283	< 0,0005	
SL IR	ndom	42,573	2,446	0,964	0,234	< 0,0005	0,486
	dom	33,726	2,520	0,976	0,241	< 0,0005	
SL RE	ndom	130,009	2,500	- 1,161	0,239	< 0,0005	0,322
	dom	134,918	2,526	- 1,318	0,242	< 0,0005	
TROM SL	ndom	172,861	2,809	- 0,219	0,269	0,418	
	dom	168,705	2,910	- 0,361	0,279	0,198	

RESULTS

- Humeral retrotorsion depends on the lenght of playing ($p<0,05$). It enhances with the increase of playing experience in dominant and nondominant side

- Except IR measured in supine and TROM measure in side lying, all other parameters of the range of motion proved to be correlate with the experience of playing ($p<0,05$). On both sides, ER and TROM measured supine decreases with the length of playing, whilst measured in side lying, ER decreases and IR increases.

SUMMARY / CONCLUSION

- In professional volleyball players, the degree of retrotorsion is significantly greater on the dominant side and enhances with the increase of playing experience
- On the dominant side, there is a significantly increased ER range and decreased IR range and TROM.
- ER range and TROM measured supine decreases with the length of playing
- In side lying ER range decreases and IR range increases with the length of playing

REFERENCES

- Achenbach L, Clément AC, Hufsky L, Greiner S, Zeman F, Walter SS. The throwing shoulder in youth elite handball: soft-tissue adaptations but not humeral retrotorsion differ between the two sexes. Knee Surgery, Sports Traumatology, Arthroscopy. 2019 Dec; 27(12):3937-3943.
- Almeida GP, Silveira PF, Rosseto NP, Barbosa G, Ejnisman B, Cohen M. Glenohumeral range of motion in handball players with and without throwing related shoulder pain. J Shoulder Elbow Surg. 2013; 22:602-607.
- Andersson SH, Bahr R, Clarsen B, Grethe Myklebust G. Risk factors for overuse shoulder injuries in a mixedsex cohort of 329 elite handball players: previous findings could not be confirmed. Br J Sports Med. 2018 Sep; 52(18):1191-1198.
- Camp CL, Zajac JM, Pearson DB, Sinatro AM, Andrea AM, Werner BC, et al. Decreased shoulder external rotation and flexion are greater predictors of injury than internal rotation deficits: analysis of 132 Pitcher-Seasons in professional baseball. Arthroscopy. 2017; 33:1629–36.
- Chant CB, Litchfield R, Griffin S, Thain LM. Humeral head retroversion in competitive baseball players and its relationship to glenohumeral rotation range of motion. J Orthop Sports Phys Ther. 2007; 37:514-520.
- Clarsen B, Bahr R, Andersson SH, Munk R, Myklebust G. Reduced glenohumeral rotation, external rotation weakness and scapular dyskinesis are risk factors for shoulder injuries among elite male handball players: a prospective cohort study. Br J Sports Med. 2014; 48:1327–1333.
- Donaldson MJ, McCurdy K, Thomas ST, Myers NL. Does humeral torsion play a role in shoulder and elbow injury profiles of overhead athletes: a systematic review. J Shoulder Elbow Surg. 2020 Aug; 29(8):1712-1725.
- Edelson G. The development of humeral head retroversion. J Shoulder Elbow Surg. 2000; 9:316-318.
- Forthomme B, Wieczorek V, Frisch A, Crielaard JM, Croisier JL. Shoulder pain among high-level volleyball players and preseason features. Med Sci Sports Exerc. 2013; 45:1852–60.
- Greenberg EM, Lawrence JTR, Fernandez-Fernandez A, McClure P. Humeral Retrotorsion and Glenohumeral Motion in Youth Baseball Players Compared With AgeMatched Nonthrowing Athletes. Am J Sports Med. 2017 Feb; 45(2):454-461.
- Greenberg EM, Lawrence JTR, Fernandez-Fernandez A, Shah K, McKenna C, Rowan ML, et al. Physical and functional differences in youth baseball players with and without throwing-related pain. Orthop J Sports Med. 2017 Nov 22; 5(11):1-7.
- Hannah DC, Scibek JS, Carcia CR, Phelps AL. Junior and Collegiate Tennis Players Display Similar Bilateral Asymmetries of Humeral Retroversion. J Athl Train. 2021 Apr; 13:1-20
- Helmkamp JK, Bullock GS, Rao A, Shanley E, Thigpen C, Garrigues GE. The Relationship Between Humeral Torsion and Arm Injury in Baseball Players: A Systematic Review and Meta-analysis. Sports Health. 2020 Mar/Apr; 12(2):132-138.
- Hibberd EE, Oyama S, Myers JB. Increase in humeral retrotorsion accounts for agerelated increase in glenohumeral internal rotation deficit in youth and adolescent baseball players. Am J Sports Med. 2014; 42:851-858.
- Keller RA, De Giacomo AF, Neumann JA, Limpisvasti O, Tibone JE. Glenohumeral Internal Rotation Deficit and Risk of Upper Extremity Injury in Overhead Athletes: A Meta-Analysis and Systematic Review. Sports Health. 2018 Mar/Apr; 10(2):125-132.
- Meyer CJ, Garrison JC, Conway JE. Baseball players with an ulnar collateral ligament tear display increased nondominant arm humeral torsion compared with healthy baseball players. Am J Sports Med. 2017; 45:144-9.
- Moreno-Perez V, Moreside J, Barbado D, Vera-Garcia FJ. Comparison of shoulder rotation range of motion in professional tennis players with and without history of shoulder pain. Man Ther. 2015; 20: 313-318.
- Mullaney MJ, McHugh MP, Johnson CP, Tyler TF. Reliability of shoulder range of motion comparing a goniometer to a digital level. Physiother Theory Pract. 2010 Jul; 26(5):327-33.
- Myers JB, Oyama S, Rucinski TJ, Creighton RA. Humeral retrotorsion in collegiate baseball pitchers with throwing-related upper extremity injury history. Sports Health 2011; 3:383-389.
- Noonan TJ, Shanley E, Bailey LB, Wyland DJ, Kissenberth MJ, Hawkins RJ, et al. Professional pitchers with glenohumeral internal rotation deficit (GIRD) display greater humeral retrotorsion than pitchers without GIRD. Am J Sports Med. 2015; 43:1448-1454.
- Noonan TJ, Thigpen CA, Bailey LB, Wyland DJ, Kissenberth M, Hawkins RJ, et al. Humeral torsion as a risk factor for shoulder and elbow injury in professional baseball pitchers. Am J Sports Med 2016; 44:2214-9.

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- Nutt C, Mirkovic M, Hill R, Ranson C, Cooper SM. Reference values for glenohumeral joint rotational range of motion in elite tenis players. The International Journal of Sports Physical Therapy. 2018 Jun; 13(3):501-510.
- Oyama S, Hibberd EE, Myers JB. Preseason screening of shoulder range of motion and humeral retrotorsion does not predict injury in high school baseball players. J Shoulder Elbow Surg 2017; 26:1182–9.
- Polster JM, Bullen J, Obuchowski NA, Bryan JA, Soloff L, Schickendantz MS. Relationship between humeral torsion and injury in professional baseball pitchers. Am J Sports Med. 2013; 41:2015-2021.
- Pozzi F, Plummer HA, Shanley E, Thigpen CA , Bauer C, Wilson ML, et al. Preseason shoulder range of motion screening and in-season risk of shoulder and elbow injuries in overhead athletes: systematic review and meta-analysis. Br J Sports Med. 2020; 54:1019–1027.
- Reeser JC, Fleisig GS, Bolt B, Ruan M. Upper limb biomechanics during the volleyball serve and spike. Sports Health. 2010; 2(5):368-374. 189.
- Reeser JC, Joy EA, Porucznik CA, Berg RL, Colliver EB, Willick SE. Risk factors for volleyball-related shoulder pain and dysfunction. Physical Medicine & Rehabilitation. 2010 Jan; 2(1):27-36.
- Sabick MB, Kim YK, Torry MR, Keirns MA, Hawkins RJ. Biomechanics of the shoulder in youth baseball pitchers: implications for the development of proximal humeral epiphysiolysis and humeral retrotorsion. Am J Sports Med. 2005; 33:1716-1722.
- Saccol MF, Almeida GPL, de Souza VL. Anatomical glenohumeral internal rotation deficit and symmetric rotational strength in male and female young beach volleyball players. Journal of Electromyography & Kinesiology. 2015; 29, 121–125.
- Schwab LM, Blanch P. Humeral torsion and passive shoulder range in elite volleyball players. Physical Therapy in Sport. 2009 May; 10(2):51-6.
- Shanley E, Kissenberth MJ, Thigpen CA, Bailey LB, Hawkins RJ, Michener LA, et al. Preseason shoulder range of motion screening as a predictor of injury among youth and adolescent baseball pitchers. J Shoulder Elbow Surg. 2015; 24(7):1005-1013.
- Shanley E, Rauh MJ, Michener LA, Ellenbecker TS, Garrison JC, Thigpen CA. Shoulder range of motion measures as risk factors for shoulder and elbow injuries in high school softball and baseball players. Am J Sports Med. 2011; 39:1997-2006.
- Shanley E, Thigpen CA, Clark JC, Wyland DJ, Hawkins RJ, Noonan TJ, et al. Changes in passive range of motion and development of glenohumeral internal rotation deficit (GIRD) in the professional pitching shoulder between spring training in two consecutive years. J Shoulder Elbow Surg. 2012; 21(11):1605-1612.
- Shitara H, Kobayashi T, Yamamoto A, Shimoyama D, Ichinose T, Tajika T, et al. Prospective multifactorial analysis of preseason risk factors for shoulder and elbow injuries in high school baseball pitchers. Knee Surg Sports Traumatol Arthrosc 2017 Oct; 25(10):3303–10.
- Thomas SJ, Swanik CB, Kaminski TW, Higginson JS, Swanik KA, Bartolozzi AR, et al. Humeral retroversion and its association with posterior capsule thickness in collegiate baseball players. J Shoulder Elbow Surg. 2012; 21:910-916.
- Tonin K, Strazˇarb K, Burgera H and Vidmara G. Adaptive changes in the dominant shoulders of female professional overhead athletes: mutual association and relation to shoulder injury. International Journal of Rehabilitation Research. 2013 Sep; 36(3):228-35.
- Tyler TF, Mullaney MJ, Mirabella MR, Nicholas SJ, McHugh MP. Risk factors for shoulder and elbow injuries in high school baseball Pitchers: the role of Preseason strength and range of motion. Am J Sports Med. 2014 Aug; 42(8):1993–9.
- Whiteley RJ, Adams RD, Nicholson LL, Ginn KA. Reduced humerał torsion predicts throwing-related injury in adolescent baseballers. J Sci Med Sport. 2010; 13:392-6.
- Wilk KE, Macrina LC, Fleisig GS, Porterfield R, Simpson 2nd CD, Harker P, et al. Correlation of glenohumeral internal rotation deficit and total rotational motion to shoulder injuries in professional baseball pitchers. Am J Sports Med. 2011 Feb; 39(2):329–35.
- Wilk KE, Macrina LC, Fleisig GS, Aune KT, Porterfield RA, Harker P, et al. Deficits in Glenohumeral passive range of motion increase risk of shoulder injury in professional baseball Pitchers: a prospective study. Am J Sports Med. 2015 Oct; 43(10):2379–85.
- Winkelmann MT, Walter SS, Laver L, Zemanc F, Fehske K, Achenbach L. Increased posterior shoulder capsule thickness in youth elite handball players: a sonographic investigation. J Shoulder Elbow Surg. 2021 Jan; 30(1):194-199.
- Yamamoto N, Itoi E, Minagawa H, Urayama M, Saito H, Seki N, et al. Why is the humeral retroversion of throwing athletes greater in dominant shoulders than in nondominant shoulders? J Shoulder Elbow Surg. 2006; 15(5):571-575.