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Research Article

The relationship between physical mechanics and upper limb injuries in professional badminton players

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Abstract

Background: Badminton booklet is a high-risk sport in the field of upper limb injuries. The aim of the present study was to investigate the relationship between physical mechanics and upper limb injuries in professional badminton players.

Materials and Methods: 20 professional open badminton players from the national badminton league with a history of shoulder injuries with age (28.41 1 1.12 years), weight (71.23 7 7.22 kg), height (36 5 5.88) / 175 m), playing history (4.6 ± 1.5 years), as well as 20 healthy open badminton players with age (27.63 2 2.3 years), weight (68.88 6 6.20 kg), height (20.4 ± 177 meters), games (2.3 / 2.5 years), participated in this study. The subjects' shoulder kinematic indices were evaluated. Data were analyzed by chi-square and logistic regression.

Results: According to the results of the study, the relationship between physical mechanics and shoulder injuries was observed in both healthy and injured groups (P = 0.003) Conclusion: Based on the results of this study, the anatomical factors of cinema are exposed to injury and athletes are considered to be related to anomalies and minor injuries, and because kinematic indicators are among the factors that have been damaged in predicting injury. , Can be considered.

Conclusion: Based on the results of this study, the anatomical factors of cinema are exposed to injury and athletes are considered to be related to anomalies and minor injuries, and because kinematic indicators are among the factors that have been damaged in predicting injury Can be considered. by badminton coaches.

Keywords:
body mechanics, upper limbs, badminton

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1. Introduction

Badminton is an international sport and its outcome is determined by various performance factors. Badminton injuries are reported at 9.2 per player per 1000 hours of play. These injuries, in addition to performing incorrect blow techniques and not warming up the body, are mostly due to excessive training in this game. This sport requires a lot of power in rapid changes of the wrist, jumps, jumps and changes of direction, and these repeated actions can cause injury. (1) The most injuries in badminton (32% to 58%) Is related to the upper limb, also shows 13% to 16% of all injuries. (2) Shoulder pain due to frequent shoulder strains in badminton can occur in badminton players, especially in overhead throws, such as dice or its name. Rotator cuff muscles are small muscles around the shoulder joint that can be damaged during a game of badminton. Typically, damage to these muscles begins during inflammation (tendonitis) caused by small but persistent stimuli. (1) If the cause of the inflammation is not known and persists over a long period of time, a minor rupture may eventually lead to a complete rupture. 9 cases per 1000 hours of exercise, for badminton, reported that these injuries can cause many limitations for athletes. Badminton players. This lesion, which can be acute or chronic, is relatively common due to the specific anatomy of this area. (4) The main mechanism of this rupture is that the rotator cuff tendon becomes trapped in the shoulder area between the biceps, one is the humerus and the other is the acromion appendage (which is part of the scapula or scapula and is located above the head of the humerus). When a person tries to raise his hand above his head, these two bones come closer to each other.

However, if the two bones are too close together, the rotator cuff joint tendon may become trapped and compressed. If this compression is too severe, it can cause a sudden tendon rupture. This condition is more common in young people who engage in strenuous physical activity. (5) Faton et al. (2013), stated Due to the role of the racket in this sport, upper limb injuries such as rotator cuff injuries (shoulder injuries) are common badminton injuries. (6) John et al. (2014) stated in a study that the most commonly reported injury (60%) occurred when jumping its name and lateral movements. They also reported that special attention should be paid to the effects of shoes and the characteristics of the abutment surface on the biomechanics of badminton players. (2) Mohammad Sharif et al. (2009) stated in a study that the most injuries of racquet sports players include an important relationship between how they perform movement and training program strategies. (7) Save et al. (2013) reported that unprofessional athletes hit during a greater range of motion and were more likely to be injured. The results showed a small distance between the center of mass and the center of pressure in the injured players and also the lower speed as the maximum speed when hitting the backhand. (8) Examining and recognizing the ambiguous aspects of biomechanics, performing movements and diagnosing the causes of injuries, in addition to preventing their occurrence, can help improve the professional performance of badminton players. (6)

On the other hand, due to the limited studies on upper limb injuries and its relationship with trunk kinematics in professional badminton players, the present study attempts to investigate the relationship between physical mechanics and the occurrence of upper limb injuries in professional badminton players.

2. Materials and Methods

Subjects

The present study is descriptive-cross-sectional in nature and post-event type. The statistical sample of this study was 20 athletes and players of the national badminton league (preserving the name) who had a history of common sports injuries including rotator cuff (shoulder injury) and 20 healthy athletes in terms of gender, age and membership in the homogeneous sport. And were selected as subjects of this study. In this study, the time of injury of the subjects was collected according to the information contained in their medical records. By completing the consent form, the subjects announced their readiness to participate in this research and the necessary information about the purpose and manner of performing the tests was provided to the subjects in written and oral form.

Figure 1. Bilateral shoulder elution test 2. Thoracic extension test The test was performed in such a way that the person was one step away from the wall with a bent knee attached to the wall and the sacrum, upper back and occipital areas were in contact with the wall. The person performed posterior tilt and chin vines for lumbar, thoracic, and cervical smoothness, respectively. The purpose of this test was to evaluate the ability of the person in the upper flexion of the cervical region and to evaluate the ability of the person to smooth the thoracic and lumbar region during the movement of the chin-like movement

Tests related to the evaluation of shoulder kinematic indices:

1. Bilateral shoulder elution test The test was performed by first spreading the legs shoulder-width apart and elucidating the shoulders on the scapula. In this position, the elbow was fully extended and the palms were facing the midline. The purpose of this test is to evaluate the spine, scapular thoracic joint, glenohumeral joint in both frontal and sagittal planes. If there was any increase in the arch in the areas of the spine and asymmetry between the two sides, the test would be positive and the person would get a score of zero.(9)

Figure 1: Bilateral shoulder elution test

2. Thoracic extension test The test was performed in such a way that the person was one step away from the wall with a bent knee attached to the wall and the sacrum, upper back and occipital areas were in contact with the wall. The person performed posterior tilt and chin vines for lumbar, thoracic, and cervical smoothness, respectively.

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Figure 2: Thoracic extension test

3. Pectoralis minor muscle length assessment test According to Figure 3-8, the method of performing the test is that the person was lying in an open arch, with the arms next to the body and the palms facing down. The purpose of this test was to evaluate the distance between the outer edge of the scapula and the table, which according to the athlete's anthropometry, the usual distance should not be more than two inches. If more than this amount is violated, the person will get a score of zero.

Figure 4: Scapular dyskinesia evaluation

Figure 3: Pectoralis Minor Muscle Length Test

5. Lettimus dorsi muscle length assessment test The test was performed in such a way that the person was placed on the bed in an open arch with the knee bent, then the posterior tilt of the pelvis with shoulder flexion on the sagittal plate with a flat elbow with the palms facing the midline. , Did. The purpose of this test was a person's ability to perform 180-degree shoulder flexion, which would give a score of zero if the range of motion was reduced.

4. Evaluation test of elitovascular scapular muscle The test was performed in such a way that the person performed the movement of lowering the shoulder from the elution position of the head with the palms facing the wall. The purpose of this test was to assess the normal status of the scapula, which was positive in case of low angle protrusion and high shoulder depression and the person received a score of zero.

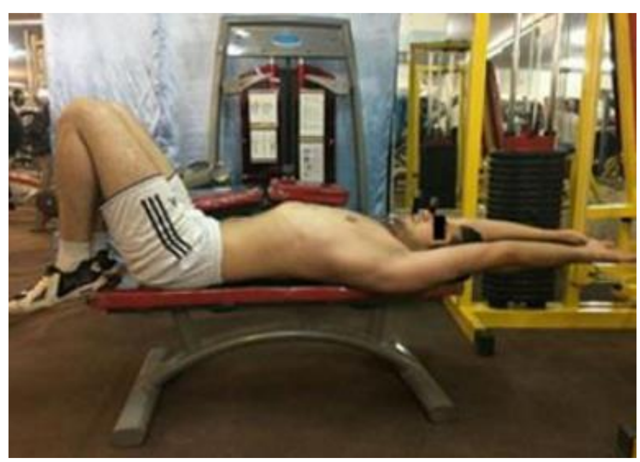

Figure 5: Dorsal latissimus muscle length assessment test

6.Posterior reticulum muscle length test This test was performed in two ways. According to Figure 3-11, in the first method, the person was placed in an open arch with the... 6.performed 90-degree abduction of the shoulder while the shoulder was completely retracted (by the examiner). . If the person's elbow with the floor could not make a 90 degree angle, the person would get a score of zero. In the second way, the person was placed on the bed in an open arch with his knees bent. The examiner then performed a 90-degree abduction of the shoulder with the internal rotation of the shoulder. If the person's elbow was not parallel to the floor, the person would score zero. (9)

Figure 6: Posterior reticulum muscle length assessment test

In general, the scoring method was such that the person did the move correctly, one point, and if the move was done incorrectly, he was given a score of zero. 7. Assess the angle of the head and shoulders forward In order to evaluate the amount of head and shoulders forward in the present study, the method of photographing the profile of the body was used. This method has high reproducibility and has been used in numerous studies. To measure the angles of the head and shoulders forward using the above method, first the three anatomical signs of the tragus of the ear and the protrusion of the right acromion as well as the spinal appendage of the C7 vertebra were identified and marked with a landmark. The subject was then asked to stand at a designated location next to the wall (at a distance of 32 cm) with his left arm facing the wall. The tripod, on which the digital camera was also mounted, was then placed 265 cm from the wall and its height was adjusted to the level of the subject's right shoulder. In such a situation, the subject was asked to lean forward three times and raise his arms three times, then to stand completely comfortably and naturally and look at a hypothetical point on the opposite wall (eye In the direction of the horizon). Then, after a five-second pause, the examiner took three consecutive shots of the half view. Finally, the mentioned photos were transferred to the computer and using AutoCAD software, the angle of the tragus line and C7 with the vertical line and the angle of the C7 line and the acromion appendage with the vertical line (shoulder forward angle) were measured. Then the average of three angles The obtained for each anomaly was recorded as the desired angle for the head and shoulders forward.

Data analysis method:

Descriptive and inferential statistics were used to examine and analyze the obtained information. To determine the normal distribution of data from Kolmogorov-Smirnov test, to compare variables in healthy and injured groups independent of t-test and to investigate the relationship between lower and upper limb orientation in the above variables and history of shoulder injuries, from the test. Chi-square and logistic regression were used.

Statistical analysis

Descriptive and inferential statistics were used to examine and analyze the obtained information. To determine the normal distribution of data from Kolmogorov-Smirnov test, to compare variables in healthy and injured groups independent of t-test and to investigate the relationship between lower and upper limb orientation in the above variables and history of shoulder injuries, from the test. Chi-square and logistic regression were used.

mean, standard deviation that the relevant results are presented in Table 1. Then to investigate the natural distribution of variables, the Kolmograph-Smirinov test was used (Table2). Also all statistical analyzes were performed at the significance level of 0.05 and using IBM STATISTICS SPSS 25 statistical software.

3. Results

Table 1 presents descriptive characteristics such as mean and standard deviation of individual characteristics scores of the studied subjects in both injured and healthy groups.

Table 1: Individual characteristics of the studied subjects

Row	variable	Internal reliability coefficient	Average standard error
1	Two-sided shoulder elixir	0/89	0/68
2	Thoracic extension	0/90	1/65
3	Minor pectorals muscle length	0/86	0/59
4	Alveolar scapular muscle length	0/93	0/73
	The length of the latissimus	0/83	0/63
6	Posterior retinal cuff muscle length	0/90	0/66
7	Head and shoulder angle forward	0/87	0/75

Table 2: Internal reliability coefficient and standard estimation error of kinematic indices

Row	variable	Internal reliability coefficient	Average standard error
1	Two-sided shoulder elixir	0/89	0/68
2	Thoracic extension	0/90	1/65
3	Minor pectorals muscle length	0/86	0/59
4	Alveolar scapular muscle length	0/93	0/73
	The length of the latissimus	0/83	0/63
6	Posterior retinal cuff muscle length	0/90	0/66
7	Head and shoulder angle forward	0/87	0/75

Table 3: Results of independent t-test in comparison of variables of shoulder kinematic indices

variable	Affected group	The value of	Healthy group	Significance level
Two-sided shoulder elixir	3/23+10/52	1/114	3/63+9/02	0/004
Thoracic extension	3/88+12/06	-2/254	5/81+14/62	0/256
Minor pectoralis muscle length	3/54+15/30	-5/412	3/12+15/21	0/452
Alveolar scapular muscle length	2/86+15/45	0/546	3/26+13/63	0/315
The length of the latissimus dorsi muscle	4/74+34/87	0/850	4/09+32/16	0/349
Posterior retinal cuff muscle length	2/46+8/11	2/246	5/73+9/22	0/032
Head and shoulder angle forward	4/85+6/89	3/238	4/02+8/32	0/001

p < 0/05 *

Table 3. The results of independent t-test in comparing the variables of shoulder kinematic indices between the two groups of injured and healthy groups are shown. According to the table above, according to the test results of indices in both healthy and injured groups, the level of significance of bilateral shoulder elution indices (p = 0.004), head and shoulder angle forward (p = 0.001) in healthy group And the rest of the indicators are less damaged and based on this, it can be said that 95% of the injuries have a non-collision mechanism and 5% of them have a collision mechanism.

Table 4: Results of independent chi-square test in examining the relationship between lower limb and kinematic shoulder injuries

variable	The amount of chi_square	Degrees of freedom	Significance level
Two-sided shoulder elixir	6/654	1	0/001
Thoracic extension	8/741	1	0/004
Minor pectoralis muscle length	1/012	1	0/003
Alveolar scapular muscle length	0/985	1	0/410
The length of the latissimus dorsi muscle	0/000	1	1/000
Posterior retinal cuff muscle length	5/875	1	0/002
Head and shoulder angle forward	3/547	1	0/001

According to Table 4, it can be seen that there is a difference between bilateral shoulder ligation (p = 0.001), thoracic extension (p = 0.004), elitorascapolar muscle length (p = 0.410), and head-to-shoulder angle (P = 0.001), there is a significant relationship with kinematic shoulder injury (p <0.05).

But there is no significant relationship between pectoralis minor muscle length, latissimus dorsi muscle length and posterior reticulum muscle.

Table 5: Prediction coefficients of each of the variables of the first hypothesis in the logistic regression model

Predictive variables	Significance level	Degrees of freedom	Parent test	Average standard error	Prediction coefficients	Change per unit
Two-sided shoulder elixir	0/003	1	1/003	0/411	-2/009	0/352
Thoracic extension	0/006	1	1/812	0/363	-1/503	1/526
Minor pectoralis muscle length	0/741	1	0/273	0/245	-0/893	0/416
Alveolar scapular muscle length	0/001	1	1/582	0/129	0/099	1/603
The length of the latissimus dorsi muscle	0/580	1	3/149	2/321	-3/362	1/162
Posterior retinal cuff muscle length	0/309	1	0/150	0/741	0/152	0/125
Head and shoulder angle forward	0/639	1	2/044	4/987	-3/468	0/054

Table 5 shows the model coefficients and their effect on the model. As can be seen from the table above, bilateral shoulder movement, thoracic extension, elitorascapular muscle length and head-shoulder angle are directly related to shoulder kinematic injury and other variables are inversely related to the level of significance. Bilateral shoulder elution (0.003), thoracic extension (0.006), elitorascapular muscle length (0.001) and head-to-shoulder angle (0.639) are significant coefficients for predicting kinematic injury injuries. They are considered shoulders.

Table 6: Classification of injured people based on standard sizes of shoulder kinematic indices

variable	Normal(n)		Less than normal (n)		More than normal (n)	
	healthy	hurt	Healthy	hurt	healthy	hurt
Bilateral shoulder elixir (cm)	13	5	4	3	6	11
Thoracic extension (grade)	8	9	4	2	11	6
Pectoralis minor muscle length (cm)	14	3	7	4	9	4
Alveolar scapular muscle length(cm)	8	7	6	3	14	3
Latitude of the latissimus dorsi muscle (cm)	15	2	5	1	9	8
Posterior reticulum muscle length (cm)	12	4	-	-	3	15
Head and shoulder angle forward (degree)	9	3	-	1	6	12

Table 6 shows the classification of affected people based on standard variables. As can be seen, bilateral shoulder elution had 3 subjects in the range less than normal (0> 3), 5 subjects in the normal range (0> 5) and 11 subjects in the range more than normal (0 <7). Also, the length of the latissimus dorsi muscle was 1 person in the range less than normal, 5 people in the normal range and 8 people in the range more than normal. Therefore, all injuries are evident in the variables related to shoulder kinematic indices.

4. Discussion

This study investigated the relationship between physical mechanics and the occurrence of upper limb injuries in professional badminton players. According to the information provided about the kinematic indices of the shoulder and its relationship with the body mechanics of professional badminton players, and considering the research conducted on the characteristics and kinematic indices of the upper limbs and body mechanics, it can be inferred that There is a significant relationship between physical mechanics and the occurrence of upper limb injuries in professional badminton players. In addition, the results showed that in the healthy group, shoulder kinematic indices such as bilateral shoulder elution, thoracic extension, elitorascapular muscle length and head and shoulder angle were significant. This group neglects the condition of upper torso movement due to only lower body exercises and is more prone to upper limb injuries, especially shoulders. (11) Athletes in various sports such as badminton in order to achieve any progress, must enter long programs. Exercise duration. Depending on the prevailing condition of each sport, the orientation of the body and the amount of arches in the spine of athletes may be affected. (12) The results of this study are consistent with the results of Daneshmandi (1396), Aliabadi et al. (1396). It is also said that during certain exercises, especially in young athletes, the body adapts to a slight postural deviation that is appropriate for the sport. [13] (14) The results of this study are consistent with the research of Fattahi et al. (2012) who stated that there is a significant relationship between athletes' sports history and their postural disorder (15) .In contrast, it has an inverse relationship with the results of Sadeghi and Malek Hosseini (2009).

Various studies have suggested the mechanism of action of thoracic kyphosis on the shoulder, which in a general conclusion can be said that kyphosis causes more anterior and downward deviation and reduces the space under the extremities. 16) In addition to the hypotheses It is emphasized that the curvature of the spine may affect the shoulder girdle and the actual muscle joints, altering the relationship between the length and tension of the muscles attached to the scapula. In various studies, a significant relationship has been found between the curvature of the spine in the sagittal plate and the type of exercise. (17,14.20) Among the champions of sprint, endurance and semi-endurance and weightlifting, the amount of thoracic curvature has been reported more. Thoracic curvature is reported to be low among soccer players, rugby players, swimmers and passive people (13). Gumina et al. Reported that patients with thoracic kyphosis, during shoulder flexion, the large bulge of the shoulder collides with the last appendage ahead of time and causes shoulder implantation. [18] Compared to the anatomical standing position of the body, the badminton player's spine adapts to the often bent upper body position when moving the racket during training and competition. As a result, this condition has a double effect on the natural posture of the spine and is the most important factor associated with increased chest kyphosis in badminton players. (2)

In a study conducted by Aliabadi et al. (2017), they acknowledged that patients with thoracic kyphosis, during shoulder flexion, a large bulge of the shoulder collides with the last appendage prematurely and causes shoulder impingement. Et al. (2017) also reported that patients with forward head disorder, round shoulder and increased chest kyphosis, changed the position of the scapula (forward scapular rotation) and reduced the space under the extremities and displacement of the glenoid cavity. (14) Another result of this study was that abnormal function in the scapula is associated with the mechanism of damage in the shoulder girdle. Functional dysfunction in one joint affects the function of other joints. Kinematic abnormalities in The shoulder girdle is easily recognizable in overweight exercises, so screening the upper quarter before the training season can be a good guide for the trainer in diagnosing and correcting athlete's movement disorders. Et al. (1396), Sadeghi (2008) and Haji Hosseini (2016) and Ladwig (2000) are in the same direction., 22,21) (9 also It seems that the increase in head-forward complication among tall people is due to their greater tendency to kyphosis and bending forward, which is followed by head protrusion. On the other hand, people who use their shoulders more in performing movements, more than others, show a forward head position, which was contrary to the results of the present study. Ladwig (2000) and Daneshmandi (2017) Another reason for the increase in head-forward angle in athletes was the use of more shoulders and muscles in this area in competitions and exercises, which was contrary to the results of the present study.

5. Conclusion

Using the results of the present study and the findings of previous researchers on the susceptibility of badminton players's shoulder vulnerability, especially in disciplines with landing, acceleration and successive rotations of the shoulder and foot, as well as its relationship with biomechanical abnormalities of the upper limbs and with According to some previous research, specific screenings of badminton players by coaches seem necessary. Many of these abnormalities can be identified, corrected, and corrected by non-invasive methods of sports coaches and practitioners. Acknowledgments The present research is taken from Mr. Karim Refahi's master's thesis. They also include the subjects and subjects of the research subjects who conducted the study.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval

Informed consent Informed consent was obtained from all participants.

Author contributions

Conceptualization: A.D.; Methodology: A.D., S.K.M.; Software: K.R., F.P.; Validation: K.R., F.P.; Formal analysis: K.R., F.P.; Investigation: A.D., S.K.M.; Resources: A.D., S.K.M., ; Data curation: K.R.; Writing - original draft: A.D.; Writing - review & editing: A.D.; Visualization: A.D.; Supervision: A.D., S.K.M.; Project administration: A.D.; Funding acquisition: K.R., F.P.

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