Biomechanical Ankle Joint Work as a Basis for the Development of Exercises to Prevent Injury (Torsion) in Some Olympic Sports

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Introduction and Research Problem:

The human body is a mechanic moving according to the mechanical laws, so some of the prior knowledge of these laws and the foundations that help those interested in competitions and sports competitions to improve the performance of athletes (67: 4.)

Arthur T. Johnson (8) (2007) and Albert I. King (10) (2016) point out that a thorough knowledge of the human, anatomical, and physiological movement of the human body is an essential ingredient in success and development, as well as preventing or prohibit injury and rehabilitation.

Adel Abdul Basir (4) (2007) and Eman Shaker (2) (2014) agreed that one of the objectives of the study of biomechanics in the field of sports is to prevent or prohibit injury and then contribute to the rehabilitation processes after

The study and analysis lead to a deeper understanding of the trainers, players, and practitioners in the details of the movements and ways and methods of education and performance and how to develop them, and thus can be eroded errors leading to many injuries associated with some competitions and sports activities.

In addition to contributing to the development of preventive training of infection for each type of Types of motor activities such as exercises such as preventive exercises for some joints of the body, and also contribute to identify the causes and conditions that

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lead to the occurrence of infection (35: 5)

Et Fong DT1, Ha SC (19) (2012) points out that biomechanics can provide us with the basis to modify or change the techniques, tools, exercises, prevention or prevention of injury, as well as subsequent rehabilitation processes.

The principles governing the anatomical structure of the human body determine the general form of performance. There are principles related to the structural and functional aspects of joints where the motor range of the joint is determined by the elasticity of the ligaments and tissues surrounding the joint, as well as the elasticity of the muscles surrounding the joint.

Related to the lack of a thorough understanding of the principles and the foundations of mobility may be associated with a lack of physical requirements such as weakness of strength in a specific muscle group and lack of flexibility of a joint, which requires
Perform exercises to treat this deficiency and to prevent injuries that may occur to the joint (89: 3)

Reference references - JeremyR. (2007) and Emad Eldin Odeh (2007) that ankle sprains accounted for 85% of torsion cases. Several studies, such as BradleyJ.Monteleone (2012), Long B, Milner CE (2012) Total injuries for all parts of the body.

Mohammed Jabir Barka and his charity Ibrahim Al-Sukari (2012) include biomechanics that include a precise description of human movement and study the causes of human movement. The study of biomechanics is relevant to professional practice in many disciplines of motion science.

The physical educator or the instructor who studies the technique of movement and the sports coach or physiotherapy treatment of the injury of biomechanics to analyze the movement completely.

Some studies agree on the diagnosis and treatment of injuries. Consequently, the field of biomechanics is a wonderful bridge between the two, and the study of biomechanics enables us to

work with individuals in an attempt to explain the mechanisms of injury. It is assumed that the definition of these mechanisms can lead to a reduction and possibly even a strengthening of treatment outcomes. (292: 18)

With the tremendous development in all the sciences and the continuous race in the programs of kinetic analysis to identify all the negatives that can contribute to the occurrence of sports injuries to players and away from the team for a period of time not short, which deprives his team to benefit from it in sports competitions and thus contribute to the treatment to prevent players from any Injury (78: 7)

Arthur Adams (9) (2015) states that movement safety, or injury prevention and rehabilitation, is a key area and goal of biomechanics that can be applied. Injury researchers have studied injury data to try to identify potential causes of disease or injury. A strong ally in the pursuit of sports medicine to prevent and treat injury.

The concept of injury in the context of skeletal musculoskeletal mechanics is the damage to body tissue in response to the forces applied through physical trauma (80: 7)

Biomechanics Analysis of Injuries Biological biopsies are usually useful if it is not clear whether the injury is related to an event, or if the severity of the injury appears to be inconsistent with performance. (381: 23)

The studies of Gehring et et (15) (2013) and BradleyJ.Montel (13) (2012) indicate that the ankle joint functions as a rheumatoid joint. But it is more than just a sphincter. The ankle is actually composed of several important structures with a unique design that makes it very stable to carry 1.5 times the body weight when walking and up to eight times the weight of the body when walking easily and effortlessly. The whole of the body.

In the case of an injury to the ankle ligaments and insufficient recovery, the player may end up with instability in the ankle and this can cause more problems of the ankle joint if the ligaments did not heal the ankle sufficiently after the ankle sprain.

Treatments are likely to begin to help restore a common set of motion, strength, and joint stability. As well as retraining sensory points in the ankle as they help stabilize the ankle joint and protect it from ankle sprawl again. Many people who have ankle instability have impaired sphincter muscles. (90:14)

The study of Einor Andersen (17) (2004) is a realistic study of the causes of injury in order to develop methods of prevention but did not address the extent of the association of other joints of the body to the occurrence of this injury and with the advancement of mechanical sports technology, there have been several ways to quantify the infection so the researchers tried to talk to The relationship between the other joints and ankle joint and the extent of their contribution to the injury to contribute to finding more in-depth solutions to prevent the incidence of sprain injury with the ankle joint in the light of some of the biomechanical variables in preparation for the design of training exercises for the joint.

Search Goal:

The aim of this research is to conduct an analytical study of the mechanics of ankle joint injury by identifying the following:

1-Identify some mechanical variables that may affect ankle sprain in some Olympic sports.

2-Design of some exercises in light of the variables under study to prevent ankle injury in some Olympic sports.

Research hypotheses:

Through the research objective, the researchers formulated their hypotheses through the following questions:

1- Is there a relationship between the variables (angular velocity-angular change) and ankle sprain؟

2- Is there a relationship between the speed of the center of the body weight and ankle sprain؟

Research Plan and Procedures:

Research Methodology:

According to the nature of the problem of research and to achieve its objectives and test for the terms of the researchers used the descriptive method, using the analysis of the movement because of its relevance to the nature of the study. .

Research community:

A total of 30 videos of ankle injuries were collected in the English Premier League,

the 2016 World Basketball, Tennis and Gymnastics Championships and the French Handball Championship, with 40 players injured.

The research sample:

The researchers selected the research sample in a deliberate way through the video sections that are suitable for analysis. Five videos represent five players for "tennis, basketball, football, handball and gymnastics."

Table (1)
Characterization of the Sample

Weight	Height	Sport	Player name	Serial no.
83	191	Football	Martin Scletterl	1
90	2.02	Handball	Luca Karapatic	2
100	2.08	Basketball	Callian Tilly	3
72	1.75	Tennis	Serena Williams	4
75	1.77	Gymnastics	Samir White Said	5

Data collection methods:

First: Arab and foreign references: The two researchers reviewed the specialized scientific references as well as previous studies related to the field of research to benefit from them when conducting this research.

Second: Scientific instruments and tools:

Due to the difficulty of portraying cases in a laboratory and illogical imaging the incidence of injury to a player such as imaging skill performance was collected 30 video clips of ankle injuries only

AVI1-Video recordings have been converted from their original format to a finished image format

Through Adobe (Premiere)

Adobe 2 - Image sequences were synchronized and displayed in 1 Hz video sequences by Adobe Photoshop (Photoshop)

3-The skeletal match was matched with a shank slide and then partially matched with the KineMan 3D Human foot and frame parts using the MaxTRAQ()

Figure (3) shows the stages of preparing videos and utilities

4- Using the kinetic analysis program, the mechanical variables in question were extracted:

1- Angular velocity of the joint "pelvic-knee-ankle"

2- Angular change of the joint "pelvis - knee – ankle"

3- speed center lower body moment of ankle sprain

4- The injury time was set to 0.08 seconds

5-Number of cadres of the total stage 4 cadres

Survey Study:

The researchers conducted the survey on 2/1/2017 to confirm the validity of the videos, the programs of the hacking, as well as the ability to watch the player and the signs on the video processing unit (Monitor.)

Basic Study:

The researcher conducted the basic study on 8/1/2017 and selected the best picture of the infection (ankle sprain) under consideration and the number of five cases were identified in the players of football, tennis, basketball, gymnastics and handball.

Third: Statistical treatments used in research:

The researchers prepared the data, tabulated and analyzed statistically with the extraction of results and interpretation of each of the following statistical methods:

The arithmetic mean - the standard deviation - and the Pearson correlation coefficient

In light of the biomechanical variables, the following exercises were designed:

First: The requirements that must be taken into account when applying the training exercises:

1-Training the muscles of the correct member (s) during the rest period.

2-Do not neglect the educational requirements during exercises, for example the sense of pain as well as not to neglect the player interest in prolongation with the help of sports qualification whenever possible.

3-taking into account changing the angles of muscular pregnancy until all muscle fibers are developed and thus the muscle can function fully.

4 -taking into account gradation in pregnancy

Second: The objectives of the training exercises:

1-Restoring the main functions of the affected ankle joint

(return of the normal motor range of the affected joint - not feeling the loss of balance in the ankle joint)

2-restore the normal functions of the muscles working around the injured ankle joint

III: Specifications of training exercises, size, density, frequency and stages (Annex 1)

Fourth: Specification of motor training exercises. (Annex 2)

Fifth: To divide the stages of rehabilitation exercises according to the biomechanical indicators and the degree of injury (Annex 3)

View and discuss results:

Table (2)

The arithmetic mean, standard deviation and torsion coefficient of mechanical variables are shown The torsion time for the first player is n = 4

Serial no.	Mechanical variables	SMA	standard deviation	Torsion coefficient	Time
		S-	+E		
1	The angular speed of the pelvis / w	141.68	32.74	-1.592	0.08-0.02
2	Angle of the pelvis	132.25	6.842	-.516	0.08-0.02
3	The angle of the knee	224.86	5.10	.217	0.08-0.02
4	Knee angle	132.52	3.11	.928	0.08-0.02
5	Speed of center of gravity (m / s)	-.11	.007	-.193	0.08-0.02
6	Angle of ankle sprain moment	15.52	.43493	-1.504	0.08-0.02
7	Angular velocity of the ankle	1701	2.75	.323	0.08-0.02

**n = number of injury cadres

Table (2) shows the angular velocity of the basin joint with an average of 141.68 ° C and the standard deviation of 32.74 ° C and the pelvic angle of 132.25 mm and the mean of 6.842. The knee angle is 224.86 ° C and the standard

deviation 5 . The knee angle was 1.32.52 and the standard deviation was 3.11. The center of gravity was -1.0.112 m / s and the standard deviation was -0.077 m / s. The ankle angle was 15.52 degrees and the standard deviation was 0.43. S and the standard deviation was 2.75

Table (3)

The arithmetic mean, standard deviation and torsion coefficient of mechanical variables are shownThe torsion time for the second player is n = 4

Serial no.	Mechanical variables	SMA	standard deviation	Torsion coefficient	Time
		S -	+E		
1	The angular speed of the pelvis / w	129.46	23.44	-.570	0.08-0.02
2	Angle of the pelvis	131.13	2.68	-.719	0.08-0.02
3	The angle of the knee	340.01	20.67	.043	0.08-0.02
4	Knee angle	136.24	.570	-.441	0.08-0.02
5	Speed of center of gravity (m / s)	-.13	.013	.810	0.08-0.02
6	Angle of ankle sprain moment	16.92	.098	-.804	0.08-0.02
7	Angular velocity of the ankle	1688	8.10	.631	0.08-0.02

The horizontal velocity of the basin joint is 129.4675 (d / s) and the standard deviation is 23.44 ° C and the pelvic angle is 131.13 and the deviation is 2.68527. The corner speed of the knee is 340.01 ° C and the standard deviation is 20.67391. The knee angle was 136.24, the standard deviation was 570 and the center of gravity was -1.3 m / s. The standard deviation was 1013. The ankle angle was 16.92 and the standard deviation was .9845. The average angular velocity of the ankle was 1688 ° / s and the standard deviation was 8.10.

Table (4)
The arithmetic mean, standard deviation and torsion coefficient of mechanical variables are shown The torsion time for the third player is n = 4

Serial no,	Mechanical variables	SMA	standard deviation	Torsion coefficient	Time
		S -	±E		
1	The angular speed of the pelvis / w	170.47	10.51	-1.241	0.08-0.02
2	Angle of the pelvis	126.97	3.44	-.492	0.08-0.02
3	The angle of the knee	201.28	14.27	.771	0.08-0.02
4	Knee angle	124.98	4.14	-.517	0.08-0.02
5	Speed of center of gravity (m / s)	-.0603	.02	-.085	0.08-0.02
6	Angle of ankle sprain moment	18.57	.457	-1.811	0.08-0.02
7	Angular velocity of the ankle	1478	10.43	-.660	0.08-0.02

Table (4) shows the angular velocity of the basin joint with an average of 170.47 ° C and the standard deviation of 10.51 ° C and the pelvic angle of 126.97 and the deviation and standard of 3.44. The knee angle of 201.28 ° C and the standard deviation 14.27 The mean angle of the knee was 124.98 and the standard deviation was 4.14. The center of gravity was -0.06 m / s and the standard deviation was 0.21 m / s. The ankle angle was 18.57 and the standard deviation was .457. The average angular velocity of the ankle was 1478 ° / s and the standard deviation was 10.43.

Table (5)
The arithmetic mean, standard deviation and torsion coefficient of mechanical variables are shown The torsion time for the fourth player is n = 4

Serial no,	Mechanical variables	SMA	standard deviation	Torsion coefficient	Time
		S -	±E		
1	The angular speed of the pelvis / w	163.06	12.209	-1.902	0.08-0.02
2	Angle of the pelvis	130.98	1.692	-.380	0.08-0.02
3	The angle of the knee	333.17	7.458	-.938	0.08-0.02
4	Knee angle	134.61	2.533	.123	0.08-0.02
5	Speed of center of gravity (m / s)	-.1585	.02364	-.598	0.08-0.02
6	Angle of ankle sprain moment	21.20	.5972	.373	0.08-0.02
7	Angular velocity of the ankle	1488.25	7.675	.496	0.08-0.02

Table (5) shows the angle velocity of the basin joint with an average of 163.06 ° C and the standard deviation of 12.209 ° C and the pelvic angle of 130.98 and the deviation and the standard of 1.692. The knee angle of 333.17 ° / The knee angle was 134.61 and the standard deviation was 2.533 and the center of gravity was 15.1585 m / s and the standard deviation was reached. .2364 m / s as the ankle angle reached 21.20 degrees and the standard deviation was 5,972. The average angular velocity of the ankle was 1488 degrees / w and the standard deviation was 7.675

Table (6)
The arithmetic mean, standard deviation and torsion coefficient of mechanical variables are shown And torsion time for the fifth player n = 4

Serial no,	Mechanical variables	SMA	standard deviation	Torsion coefficient	Time
		S -	+E		
1	The angular speed of the pelvis / w	159.77	11.80	-.642	0.08-0.02
2	Angle of the pelvis	124.32	4.13	.808	0.08-0.02
3	The angle of the knee	247.42	28.54	1.806	0.08-0.02
4	Knee angle	129.74	3.45	1.435	0.08-0.02
5	Speed of center of gravity (m / s)	-.229	.019	-1.199	0.08-0.02
6	Angle of ankle sprain moment	22.27	.518	.457	0.08-0.02
7	Angular velocity of the ankle	1744.	29.98	-1.814	0.08-0.02

The mean velocity of the basin joint is 159.77 ° C, the standard deviation is 11.80 ° C, the basin angle is 124.32, the deviation is 4.13 and the angle of the knee is 247.42 ° / 28.54 and the knee angle was 129.74 and the standard deviation was 3.45 and the center of gravity reached -2.29 m / s. .019 m / s also reached the angle of the ankle 22.27 degrees and the standard deviation reached. . The average angular velocity of the ankle was 1744 ° / s and the standard deviation was 29.98

Discussion of results:

To investigate the biomechanical variables and their relation to ankle sprain:

First: Variable "angular velocity of the pelvic joint at the moment of torsion"

Tables (2-3-4-5-6) show that the angular velocity of the basin joint is an average of 141.68, 163.06, 170.47, 129.46 and 159.77 degrees / d for players (1-5), respectively. The

values of the velocity variable in which the wrench interprets the moment of torsion correspond to that of BradleyJ. Monteleone Eamonn Delahunt. Before the ground contact stage, The pelvis was significantly skewed and the pelvis was generally less rotated internally in a thrust forward direction and the thigh was moving downward.

Fong DT1 et et al. Also agree that the ankle sprain begins much earlier than the ankle contact to the ground, which is from the pelvic joint, and some references "Einor Andersen, Rould Bahe" "Long B, Milner" CE, Zhang S and the stem and pelvis are the starting point of ankle sprain.

Second: variable "angular change of the pelvic joint moment of twisting"

Tables (2-3-4-5-6) show that the angle of the basin joint is 132.25, 131.13, 126.97, 130.98 and 124.32 degrees for players (1-5) respectively. The values of the angular variable show the difference between the angles. The extension of the joint to a large extent contributed to the torsion of the inability of the muscles of the thigh to balance with the movement of the ankle point of the ground and confirms both "P. Grimshaw" and Lars Konradsen that the weakness of the thigh muscles contribute to the injury of ankle joint sprains

Third: Variable "angular velocity of the knee"

Tables (2-3-4-5-6) show that the angular velocity of the knee joint is 224.86, 340.01, 201.28, 333.17 and 247.42 degrees / second for the players (1-5) respectively

That controlling the angular velocity of the knee and thigh muscles is vital to maintain control when the ankle falls. "Einor Andersen, Rould Baher states that the players tried to avoid injury to the ankle by flexing the knee as it increased its speed and rotated outward to avoid placing the weight on the ankle joint. They tried to avoid an ankle injury by flexing the knee and externally rotating the thigh to avoid placing the weight on the ankle joint, however, when they could no longer compensate the players they had to put the weight on the ankle and there was injury.

Fourth: Variable "angular change of the knee joint moment of twisting"

Tables 2-6 show that knee joint angles averaged 132.52, 136.24, 124.98, 134.61 and 129.74 degrees for players (1-5), respectively. The height of the angles of the players and their exposure to the injury. "Eamonn Delahunt indicated that the degrees of bending in motion the outer circular angle is 30-40 degrees. The bending in the inner circular movement 20-30 degrees Lars Konradsen confirmed that there are four ligaments that provide the joint stability in the mechanical movement, two connected within the joint securing the bending movement, two outside the joint, one of the inner side and one of the outer side, securing the extension,

Stability of the moment of landing, avoiding sprains. JeremyR Dicus agrees that the work of the knee joint to bring the equilibrium point between the body and the ground before the sprain is important and also the circular movement in the space of the ball player especially where this joint plays an important role in the economy of the circular movement of the players which helps to absorb shocks during landing

On the ankle and that the internal and external light rotation of the knee also helps to ease the sprain of the ankle.

Fifth: "variable speed center of body weight"

Table (2-6) shows that the weight center of the body, averaged 0.11, 0.13, 0.6, 0.15 and 0.22 m / s for the players (1-5), showed that the center of gravity and its speed contributed negatively to injury.

The body on the pelvic joint and the knee joint greatly to ensure stability and balance and stability during movement may occur as a result of the rush of the player to the side as in the injury of the tennis player may move the center of the weight of the body and the distance of excess speed, which increases the load on the knee and thus on the ankle and the sprain of the ankle joint has been confirmed " ArthurT. Johnson "The weight of the body is a great pressure on the ankle joint, which contributes to the high incidence.

Sixth: "Angular change of the ankle joint"

Table 2-6 shows the angular variable of the ankle joint at an average of 15.52, 16.92, 18.57, 21.20 and 22.27 for the players (1-5). All the studies under study agreed that the angle of ankle sprain ranged from 20-22 degrees,

"The inner side of the ankle joint is firmer than the outer side because the outer leg ligaments are longer and less powerful than the inner ligaments, which reduces the external side stiffness, which causes the torsion to occur easily. Before ankle contact with the ground, attention must be paid to the mechanics of the whole body. Much earlier ankle contact with the ground and ankle sprain Is an injury related to the incorrect places of the foot before and in the first contact during the landing of the jump or walk. Moreover, the delayed reaction of the sliver muscle may also contribute to injury.

The ankle sprain is an injury related to incorrect places of the foot before and during the descent of the jump as in the case of the gymnast. Brian W.Fullem, Weldon Johnson, pointed out that "the delayed reaction of the slit muscle may also contribute to the injury and can help the player correct the foot position before Transferring weight to the ankle by increasing neuronal and muscular control through training and rehabilitation exercises to strengthen internal ligaments.

Seventh: "Variable angular velocity of the ankle joint"

Table 2-6 shows the angular velocity values of the ankle joint, averaging 1701, 1688, 1478, 1488 and 1744 degrees / second for players (1-5) respectively. Talha Hossam et al. And FrançoisFourche agree where there is a change in the angle with the torsion time and to optimize the angle speed by reducing Hemispheres of the hip joint and the moving knee during the movement of the ankle to move the body during the movement before the moment of twisting the ankle and the shape of an arch, as the angular velocity of the ankle sprain depends on the angle of the knee and pelvis.

During the movement of the player it was observed that the direction of the ankle movement is directly to the

center of the circle, which makes us expect that the path to the circumference of the circle will be small and coincides with this event a significant transition in the knee path than expected injury.

Conclusions:

The angle of the basin joint is 141.68, 129.46, 170.47 and 163.06, 159, 77 degrees / second for players

The angle of the basin joint is 132.25, 131.13, 126.97, 130.98 and 124.32 degrees for the players

3-The angular velocity of the knee joint is 224.86, 340.01, 201.28, 333.17 and 247.42 degrees / second.

4-The knee joint angles averaged 132.52, 136.24, 124.98, 134.61 and 129.74 degrees for the players.

5-The values of the center of the weight of the body and averaged 0.11 and 0.13 and 0.6 and 0.15 and 0.22 m / s of the players.

6-Angular change of the ankle joint averaged 15.52, 16.92, 18.57, 21.20 and 22.27 players.

-The angular velocity of the ankle joint was 1701, 1688, 1478, 1488 and 1744 degrees / w.

8-Time ankle twisting 0.08 seconds.

Recommendations:

In light of the results of the research, it was found that:

1-Taking into account the work of exercises include the muscles of the trunk to control the basin joint.

2- Focus on strengthening the muscles of the leg.

3-The work of similar studies dealing with the electrical activity of the muscles with mechanical analysis to see the role of the moment of sprain muscles

4- We recommend tennis players who do a lot of lateral movements to do their best to descend with the direction of the ankle neutral, and to maintain their position of the pressure of the material that turns to the side , in order to prevent the foot from turning on the edge to cause a twisting ankle twisting.

5-Gymnasts at the moment of landing not to accelerate the transfer of weight on the ankle.

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