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The Effects of Changes of Volleyball Official Game Rules on Sports Injuries: A Comparison between Pre-and Post-2016 Period at the Elite Level

Eren ULUÖZ*
*Cukurova University School of Physical Education and Sports, Adana, Turkey
Email: proferde@hotmail.com

Abstract

The aim of this study is to determine the relationship between two different versions of the file contact rule applied before and after 2016 in sports volleyball in volleyball. In this study, causal comparative method is applied. In this study, a total of 400 super league matches were analyzed. 200 of these matches are women's super league matches (before the rule change in 2016: 100 matches, after the rule change in 2016: 100 matches). 200 matches were analyzed from the men's super league (before the rule change in 2016: 100 matches, after the rule change in 2016: 100 matches). There is no statistically significant difference between the pre-rule period and the post-rule period in terms of the number of injury ($p>0.05$). There was no statistically significant difference in the severity of the injuries compared to before and after the rule change in the Women's Super League ($X2 = 0,072$; $df = 1$; $p> 0.05$). Similarly, there was no statistically significant difference in the severity of the injuries compared to before and after the rule change in the Men's Super League ($X2=0,019$; $df=1$; $p>0,05$). In conclusion, it was observed that the rule change related to the net had no effect on the number and the severity of sports injuries. It can be thought that sports injuries show similar features before and after the rule.

Keywords: Volleyball; injuries; rule changes; net contact

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1. Introduction

Volleyball sport was invented in 1895 by physical education teacher William Morgan, inspired by basketball and tennis sports. It is a popular sport that has been growing day by day in the 120 years since its birth (FIVB Web Page, 2014). Nowadays, it is a very popular sport that is played by millions of people in the world on elite and amateur levels (Reeser and Bahr, 2017; Verhagen et al., 2004; Uluöz, 2019). As in all sports branches, sports injuries are frequently encountered in volleyball sport (Baugh et al., 2018; Cuñado-González et al., 2018; Bavlı & Kucuk, 2013; Sole, Kavanaugh & Stone, 2017; UIuöz, 2016). Sports injuries occur in all kinds of sports because of different types and different reasons. Sports injuries may occur during a match or training. Although many factors cause sports injuries, inadequate physical fitness, inadequate warming/cooling, technical inadequacies, traumas due to external forces and inappropriate field conditions have been reported as the most common causes of injury (Bavlı & Kozanoğlu, 2008; Bere et al., 2015; Guishen & Wenjie, 2018; Skazalski, Khan & Bahr, 2017; Uluöz, 2016 [a,b]). Volleyball is played in a separated two equal playing areas by a net (FIBV Web Page, 2018). Due to this structure, there is no physical contact between competing players except for some exceptional positions in front of the net. However, volleyball sport is a sport which sports injuries occur frequently (Bere et al., 2015; Cuñado-González et al., 2018; Reeser and Bahr, 2017; Verhagen et al., 2004; Uluöz, 2016 [c,d]). In the literature, many different classifications have been made about sport injuries in volleyball. As in many sports branches, sports injuries are encountered in volleyball sport due to different reasons. Volleyball sport involves many techniques and positions that can lead to acute and chronic sports injuries due to its fast, power-based and challenging structure (Bhat & Balamurugan, 2017; Crema & Murakami, 2016; Kılıç et al., 2017; Uluöz, 2017). When the literature related to sports injuries encountered in volleyball sport is examined, it is seen that different characteristics related to injuries are examined. The area of occurrence of the injury in the body, which area of the injury in the playing area, the causes of injury, the acute and chronic injuries and the relationship between the game location and the injury are seen as the subjects examined in the literature related to the injuries encountered in volleyball sport in the literature. Uluöz (2007) performed an investigation on female volleyball players' injuries and reported that 53.50% of injuries were during the match, while 46.70% of injuries were during training. Augustsson et al (2006) reported that 47% of the injuries they examined were during training. In the study performed in Turkey, it was found that 71.7% of the 60 sports injuries encountered by athletes were caused by acute injuries caused by a sudden trauma, and 28.3% were caused by repeated micro trauma and 61.4% of the acute injuries occurred during the matches (Uluöz, 2007). Verhagen et al. (2004) reported that 75% of all injuries that occurred in the study were acute injuries, and the risk of acute injury was higher than that of training. In addition, they found that the middle players were the most injured in the study by 40% in the study. These players are fallowed by corner spikers with 30-35% and setters with 15-20% rate. In a study performed on women volleyball players in Turkey show that middle players had 35-40% rate, 4 number players had 15-20% injury rate and 2 numbers players had 15-20% injury rate. In his study, Uluöz (2007), it is possible to say that the middle players are almost twice more injured than the players playing in other positions. It can be considered that the players who play in the middle

position have such a high ratio in total number of injuries and their duties and positions in the game. Especially in block positions, middle players may be considered more at risk than other players. For players in block positions, the greatest risk is to contact opposite players or their teammates. Especially after the block jumping, the ankle injuries are caused by the contact of the feet on the ground. The findings obtained in this study support these thoughts. According to the information obtained from the literature, sports injuries encountered in volleyball sport, the risk of injury in athletes, the rate of acute injury is high, the rate of lower extremity disability is markedly increased, especially in the middle players are seen to carry more risk of injury than other players. The majority of volleyball sport injuries have been reported as acute traumatic injuries resulting from contact with the opponent or his / her team-mate during the net-front struggles. In the light of this information, a new discussion has emerged in the recent years that there may be a relationship between the changes in volleyball sport and the changes in rules related to the contact of the net. Until 2016, the FIVB was implementing the rule that freed contact from outside the net band. However, since 2016, the rule that prohibits contact with all points of the net has been started. Among people involved in volleyball, there is a serious discussion that these changes made in recent years in the rules of official rules of play have increased sports injuries. Particularly in the discussions over social media, some people claim that by contacting the sections outside the upper band of the net prior to 2016, the disability has increased and more serious injuries have occurred. On the other hand, some people claim that unnecessary pauses in the game have been reduced with the release of contact to the net. According to these individuals, injuries are always occurring and there has not increased or decrease in the number of injuries. When the literature related to the studies on this subject is examined, it is seen that there are few studies. Previously, many rule changes in volleyball sport increased the continuity and quality of the game. The main purpose of the rule changes mentioned in this study is to accelerate the game, to prevent unnecessary stopping and to improve the quality of play. However, in the literature search, it was seen that volleyball sport required a lot of vertical jumps during the perform of the techniques especially in front of the net and most of the injuries were caused by contact with competing players in the fall following the jumps (Aggustonss, 2006; Uluöz, 2007; Verhagen, 2004). The modification of the file rule mentioned in this study provides the player with freedom of contact to the player at any point of the net except the net of the net during the performing of the spike and block technique, and it is thought that this may increase the risk of injury to the ground more in the fall phase and therefore the risk of injury due to contact with the opponent players in the fall. It is thought that it is important to do a research on this issue. In this study, it is thought that the results of the researches which are planned to be carried out in this study can give an idea about the effects of the change of rules on injuries, and it is thought that the scientific studies to be done in this way may contribute to the regulations to be made in the future. In this context, the aim of this study is to determine the relationship between two different versions of the file contact rule applied before and after 2016 in sports volleyball in volleyball.

2. Method

In this section, the method of the research, defining the research variables, defining the sources of the data obtained in the research, the data collection tools used in the research, the sample of the research, the performing processes of the research and data collection procedures, analysis of the data and detailed explanations about the statistical methods used are included.

Research Design: In this study, causal comparative method is applied. The causal comparison method often looks for the answer to the question of why an event or situation has occurred. It is defined as a type of research that aims to compare the groups that differ according to a given variable or variables in an event or in a situation that arises, and to determine the different variables that affect these causes (Fraenkel, 2006).

Sample of the research: In this study, a total of 400 super league matches were analyzed. Two hundred of these matches are women's super league matches (before the rule change in 2016: 100 matches, after the rule change in 2016: 100 matches). Two hundred matches were analyzed from the men's super league (before the rule change in 2016: 100 matches, after the rule change in 2016: 100 matches). In the sample selection, Volleyball-TV archives published by TVF (Turkish Volleyball Federation) were selected by randomized drawing for each category.

Defining Research Variables: This section contains information about the variables used in the research. It is thought that the definition of research variables as clearly as possible will facilitate readers and researchers who will investigate on similar subjects.

Match duration: The total time from the start to the end of the match.

Date of matches: Before or after the rule change in 2016.

Number of injuries: The number of injuries occurring during the competitions.

Minor injuries (temporary): Non-serious injuries that do not prevent the player from continuing to play.

Serious injuries: Serious injuries to the level that will prevent the player from continuing the match.

Injury area: Injuries to the lower extremities or injuries to the upper body.

Action with Injury: Spike, block, defense and others game actions

Analysis Procedure of Match Records: In the analysis of match records, a match analysis observation form was used. The video recordings of the matches in the study were monitored through a video player program with stopping, slowing, and speeding, fast forwarding and cutting functions. The same records were monitored simultaneously by a second volleyball expert, but analyses performed independently from each other. The researcher and volleyball expert who performed the video analysis recorded the results of the match analysis as the number of temporary injuries, the number of serious injuries, the number of total injuries, the body part occurring injuries, the severity of injuries and the technic related to the injuries. The researcher and volleyball expert repeated this measurements again after 6 months and checked whether there were any measurement differences by matching the two measurements obtained in a row to the row line in the Microsoft Office Excel (Microsoft, 2010) Program. There were no differences between the measurements.

3. Findings

In this section, data obtained as a result of video records analysis are presented with descriptive statistics, tables and relational statistical methods.

A general overview of findings without considering gender:

Table 1 shows the findings of the injuries of the all athletes in the body. Injuries were determined in the lower extremities and in the upper extremities.

Table 1. Findings of male athletes' injuries in terms of the body part

Injury area in the body	Number of injuries			%
	Male	Female	Total	
Lower extremity	8	18	26	56,52
Upper extremity and upper body	8	12	20	43,48
Total	16	30	46	100

As seen in Table 1, when injuries are examined, it is seen that 26 (56.52%) of 46 injuries occurred in the lower extremities. On the other hand, 20 of 46 (43.48%) injury cases were seen in upper extremity and the other body areas. Table 2 shows the findings of the technique in which the athletes were injured during the match. The techniques in which the injuries occurred were examined as spiking technique, block technique, defensive and other techniques.

Table 2. Findings of the technique in which the injuries were experienced

Injury area in the body	Number of injury			%
	Male	Female	total	
Spiking technique	5	4	9	19.56
Block technique	4	17	21	45.65
Defense and other techniques	7	9	16	34.79
Total	16	30	46	100

Table 2 shows that it was observed that 9 (19.56%) of 46 injuries occurred during the spiking technique and 21 (45.65%) occurred during the block technique. On the other hand, 16 (34.79%) of 46 sports injuries occurred during the defense and other techniques.Table 3 shows the findings of general comparison of injury incidence of rule periods without in terms of gender.

Table 3. The findings of general comparison of injury incidence of rule periods without in terms of gender

Variable	Period	Mean	df	t	p
Number of Injuries	**Before 2016** (contact with net except for upper band was free)	0.117±0.024	398	0.88	0.151
	After 2016 (contact with net completely was free)	0.112±0.021			

As seen in Table 3, there is no statistically significant difference between the pre-rule period and the post-rule period in terms of the number of injuries ($p>0.05$).

The Results of Women's Super League

Table 4 shows the incidence of injuries experienced by female athletes in the matches. Injury frequency is given as how many minutes of injury occurred.

Table 4. Findings on the Frequency of Injuries in the Women's Super League

Rule change period	Total match duration	Number of injuries	Frequency of injury
Before 2016 (contact with net except for upper band was free)	9986 min.	12	Per 832,16 min.
After 2016 (contact with net completely was free)	13487 min.	18	Per 749,27 min.
Total	23.473 min.	30	Per 782,43 min.

Table 4 shows that the total playing time is 23.473 min. As a result of video analysis, it was observed that 12 injuries occurred in total 9986 minutes before the rule change. Accordingly, it is found that every 832.16 minutes there is an injury. After the rule change, a total of 18 injuries were observed in the total 13.487 minutes during the matches. According to these findings, it is seen that every 749.27 minutes after the rule change an injury occurred. Table 5 presents the findings of the number of injuries per match.

Table 5. Comparing the number of injuries of female athletes in terms of rule changes periods

Rule change period	Number of injuries)	%	Number of matches	Number of injuries per match	t	df	p
Before 2016 (contact with net except for upper band was free)	12	33,33	100	0,12			
After 2016 (contact with net completely was free)	18	66,66	100	0,18	-1,14	198	0,255
Total	30	100	200	0,30			

As seen in Table 5, there were 12 injuries in 100 games and 0.12 injuries per game, while in the 100 competitions after the rule change analyzed; there were 18 injuries and 0.18 injuries per game. The difference between the two groups was not statistically significant (p> 0.05). Table 6 shows the severity of the injuries experienced by the athletes before and after the rule change. The concept of seriousness of injury is determined by the criteria of being able to continue the game or not.

Table 6. The Comparison of Findings Regarding the Severity of the Injuries of the female Athletes in terms of rule changes periods

Rule change period	Severity of the Injuries	Number of injuries	%	Number of injuries per match
Before 2016 (contact with net except for upper band was free)	Minor Temporary injuries	13	43,33	0,13
	Serious injury	7	23,33	0,07
After 2016 (contact with net completely was free)	Minor Temporary injuries	6	20,00	0,06
	Serious injury	4	13,33	0,04
	Total	30	100	0,15

X^2=0,072; df=1; p>0.05

As analyzed in Table 6, it is seen that 20 of the 30 injuries occurred in the game before the rule change, and 13 (43.33%) of these injuries are minor temporary injuries which do not cause the continuation of the game. On the other hand, 7 (23.33%) out of 20 injuries were serious. After the rule change, a total of 10 injuries are observed. Six of these 10 injuries (20.00%) were minor temporary injuries, while 4 of them (13.33%) were serious injuries which would prevent the game. There was no statistically significant difference in the severity of the injuries compared to before and after the rule change ($X^2 = 0.072$; df = 1; $p > 0.05$).

The Results of Men's Super League

In this section, the data obtained as a result of video analysis in the Men's Super League are presented as descriptive statistics, tables and findings by using relational statistical methods.

Table 9. Findings on the Frequency of Injuries in Men's Super League

Rule change period	Total match duration	Number of injuries	Frequency of injury
Before 2016 (contact with net except for upper band was free)	8.221 min.	10	per 821,10 min.
After 2016 (contact with net completely was free)	12.091 min.	6	per 2.015,16 min.
Total	20.312 min.	16	per 1.269,50 min.

As shown in Table 9, the total playing time is 20.312 min. As a result of video analysis, it was observed that 10 injuries occurred in total 8.221 minutes before the rule change. Accordingly, it is observed that there is an injury every 821.10 minutes. After the rule change, a total of 6 injuries were observed in the total 12.091 minutes during the matches. According to these findings, it is seen that every 2.015,16 minutes after the rule change, an injury occurred. Table 10 presents the findings of the number of injuries per match.

Table 10. Comparing the number of injuries of male athletes in terms of rule changes periods

Rule change period	Number of injuries)	%	Number of matches	Number of injuries per match	t	df	p
Before 2016 (contact with net except for upper band was free)	10	62,50	87	0,10	1,601	198	0,111
After 2016 (contact with net completely was free)	6	37,50	113	0,06			
Total	16	100	200	0,08			

As can be seen in Table 10, there were 10 injuries in 100 games and 0.10 injuries per game, while in the 100 competitions analyzed, there were 6 injuries and 0.06 injuries per game. The difference between the two groups was not statistically significant (p> 0.05). Table 11 shows the severity of the injuries experienced by the male athletes before and after the rule change. The concept of seriousness of injury is determined by the criteria of being able to continue the game or not.

Table 11. The Comparison of the injury severity of the male athletes in terms of rule changes periods

Rule change period	Severity of the Injuries	Number of injuries	%	Number of injuries per match
Before 2016 (contact with net except for upper band was free)	Minor Temporary injuries	7	43,80	0,08
	Serious injury	3	18,80	0,03
After 2016 (contact with net completely)	Minor Temporary injuries	4	25,00	0,03
	Serious injury	2	12,50	0,01
Total		16	100	0,08

X^2=0,019; df=1; p>0,05

As analyzed in Table 11, it is seen that 10 of the 16 injuries occurred in the game before the rule change, and 7 (43.80%) of these injuries are minor temporary injuries which do not cause the continuation of the game. On the other hand, 3 (18.80%) out of 10 injuries were serious. After the rule change, a total of 6 injuries are observed. 4 of these 6 injuries (25.00%) were minor temporary injuries, while 2 of them (12.50%) were serious injuries which would prevent the game. There was no statistically significant difference in the severity of the injuries compared to before and after the rule change ($X2=0.019$; $df=1$; $p>0.05$).

4. Discussion

When the findings are examined in this study, it is seen that 26 (56.52%) of 46 injuries occurred in the lower extremities. On the other hand, 20 of 46 (43.48%) injury cases were seen in upper extremity and the other body areas. In addition the findings, it was observed that 9 (19.56%) of 46 injuries occurred during the spiking technique and 21 (45.65%) occurred during the block technique. On the other hand, 16 (34.79%) of 46 sports injuries occurred during the defense and other techniques. When the previous research findings related to injuries in volleyball sport are examined; similar findings are seen to ours. Augustsson et al. found that 30% of injuries occurred during block and spike positions. In the study performed by Uluöz (2007), 56.7% of all injuries were found to occur during block and spike movements, and almost all of the acute injuries investigated in this study were experienced by the attackers and blockers on the net and most injuries were reported to be occurred in the ankle and wrist / hand fingers. Verhagen et al. (2004) reported that 61% of ankle injuries occurred in front of the net, and 25-30% of these injuries were caused by contact with their team-mate during block and attack movements, while 30% were competing during block and attack movements. It is reported that they were formed as a result of contact with the players. In a study performed in Turkey, ratio in all injuries of ankle injury 40%, the rate of knee 7.16%, the ratio of the waist, 13.3% and shoulder area ratio was found to be 8.3%, and was found to be lower extremity injuries of about 57.6% of all injuries examined (Uluöz, 2007). In the study performed by Knobloch et al. (2004), 71.3% of all injuries occurred in the upper extremity, 21.5% in the lower extremity and 4.3% in the head region, and 53% of all upper extremity injuries occurred in the wrist and fingers. Reeser et al. (2006) reported that ankle injuries accounted for approximately 50% of total injuries in their study on volleyball players in the Norwegian League 2 and 3. In addition, approximately 10% injury occurred in each of the knees, shoulders, fingers and other areas, and approximately 60% of the injuries were seen in the lower extremity. In a study performed by Verhagen et al. (2004) during a season on volleyball players, 100 sports injuries were examined. It was reported that 41% of these injuries occurred in the ankle area, 12% in the knee area and 21% in the other parts of the lower extremity. However, 10% of the injuries were reported in the waist / back area, 9% in the shoulder area and 7% in the other parts of the upper extremity. According to this, approximately 74% of all injuries

occur in the lower extremity. In a research conducted by Augustsson et al. (2006) in the Swiss volleyball leagues, 121 sports injuries were examined. They found that 23% of all sports injuries occurred in the ankle, 18% in the knee area and 15% in the waist. It has been reported that approximately 41% of total injuries occur in the lower extremity. The results we found in this study and the results in the literature show that the rule change does not affect the general characteristics of sports injuries. It is clear that both the injury areas in the body and the techniques in which the injuries occur are similar to most of studies in the literature which published pre-rule and post-rule change periods.

When the findings obtained in this study were examined, it was seen that there was no statistically significant difference between the number of injuries occurring before the rule and the number of injuries that occurred after the change of rule ($p > 0.05$). Uluöz (2015) compared the pre and post period with the change in the net rule change made in 2009 in his study on the same subject. He reported that there were no significant statistical differences between before and after the rule changes (in 2009) related to net contact in all gender and league categories ($p<0.05$). On the other hand, the number of temporary injury numbers showed a statistically significant higher the after the rule change in Turkish Super Men's League ($p>0.05$). In contrast, the number of temporary injuries in Turkey Women Super League has been reported that there was not significant difference statistically significant ($p > 0.05$). In all other categories, it was observed that there was a numerical increase, although not statistically significant ($p>0.05$). When we look at the number of temporary injuries in terms of match, it was found that there was a statistically significant increase in all categories and in all categories of men's leagues. In contrast, Turkey Women Super League has been shown to decrease numerically although not statistically significant ($p > 0.05$). In all other categories, it was observed that there was a numerical increase, although not statistically significant ($p>0.05$). In the evaluation made on the set basis of all Men's Super-Leagues, it was observed that serious injuries increased numerically despite the fact that they were not statistically significant after the rule. In all the other categories, it was observed that serious injuries showed a numerical decrease although not statistically significant. After the rules change the serious injured in Turkey Men's Super League and the all categories of leagues have seen an increase numerically although not statistically significant. Although the findings of the study performed by Uluöz (2015) differed at some points, it was seen that there was no statistically significant difference between the rule change and the increase in number of injuries in both studies. In this study, it is seen that there are different results in the lower leagues. In our study, the study was performed at the super league level. It is normal for athletes at the elite level to be more powerful and technically better, although the number of injuries does not increase despite the rule changes.

5. Conclusion

In conclusion, in contrast to the arguments regarding the increase of sports injuries in volleyball, the results of the research show that the injuries occurring in volleyball sport are similar rate and have similar structure in all official game rule modifications related to the net contact. On the other hand significant injury risks are involved in different types of injuries at various severity levels in volleyball. Especially, the athletes playing in the front of the net are at greater risk than other players. Lots of previous research reported that the injury rates for lower body are significantly higher than the injury rate of upper body. In addition, net actions, especially block technique, are the most risky positions for sports injuries in volleyball. Though volleyball is a non-contact sport, intensive repetitive actions performed in front of the net might increase the risk in all injures in volleyball. In order to reduce the risk of sport injuries, preventive precaution might be implemented. For example, "using preventive knee and ankle equipment", "receiving a post-injury medical treatment that ensures complete recovery", "performing correct specific jumping and landing practices" and "issuing written and/or practical injury prevention programs to players". These implementations may reduce the risk of injuries in volleyball. It has also been suggested that there may be a relationship between the injuries and game rules related to net contact and middle line. Future studies should address the relationship between injuries and official game rules, especially middle line.

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