Lesions in Shotokan Karate and Jiu-Jitsu – Direct Trauma Versus Indirect

LOCOMOTOR APPARATUS IN EXERCISE AND SPORTS

ORIGINAL ARTICLE

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ABSTRACT

Introduction: Karate and Jiu-Jitsu are martial arts sharing a common origin but showing distinct movement biomechanics. The main features of Shotokan Karate are the impact blows, whereas Jiu-Jitsu utilizes projections, strangulations, torsions and immobilizations. These differences can provoke different sites of lesion. Objective: To verify the frequency of lesions in Karate and Jiu-Jitsu and confront their respective lesions between the two studied groups. Methods: Ninety-four athletes from three different competitive levels (international, national and state) were transversally evaluated through an open-closed-question questionnaire. Data regarding starting age and period of training were also assessed. The T-Student test and Chi-Square test were applied for the group comparison. Statistically significant differences were considered when p<0,05. Results: 148 lesions were reported from a sample of 53 karate players, and 160 lesions from 41 Jiu-Jitsu athletes. The most frequency site of lesion in karate was the hands and fingers (15.5%) and, in Jiu- Jitsu, the knees (16.3%). The places which presented significant differences between the two groups were: legs (p=0.042), mouth and teeth (p=0,028), neck (p=0,038), shoulder (p=0,000), elbow (p=0,001), and ear (p=0,000). Conclusion: Karate and Jiu-Jitsu show differences as regards frequency and incidence of lesion sites. These findings contribute to the elaboration of specific preventive and therapeutic measures for each sport.

Keywords: lesion, martial arts, sport, rehabilitation.

INTRODUCTION

Different kinds of martial arts had their origin from the technique named *Shaolin-su-kempo,* developed by the Indian Buddhist monk Bodhidharma who initially spread the technique in China and it was subsequently taken to Japan, where it has gone through countless transformations which resulted in different techniques, out of which we highlight Shotokan Karate and Jiu-Jitsu[1].

Shotokan Karate is the mostly well-known martial art in the world, having as main characteristic impact strikes, with no use of any weapon, since the word *Karate* means 'empty hands'. The dynamics of a Shotokan Karate competition is composed of blocks and a myriad of strikes, through punches and kicks, performed with upper and lower limbs, which reach the opponent's trunk and head regions[1,2].

Jiu-Jitsu, as Shotokan Karate, has its origin in Japan; however, it is different from Karate in movement technique and mechanics. The word *Jiu-Jitsu* means suave art. In Jiu-Jitsu, the intention is to defeat the opponent through projections, strangulations, torsions and immobilizations resulted from tensional force on the joints[3].

Despite the similar origin of the two martial arts, it is clear that the movement dynamics of the two modalities is opposite [4]. These specific characteristics can determine important differences in the type and frequency of injuries, which are crucial information to prevention and treatment.

The numerous competitions, as well as the expressive number of practitioners in the two modalities, justify the performance of this study.

OBJECTIVE

To verify the frequency of injuries of Shotokan Karate practitioners comparing them with Jiu-Jitsu practitioners.

CAUSES AND METHODS

This work is a transversal research investigation carried out through an open and closed questionnaire. 94 questionnaires were assessed, where 41 were answered by Jiu-Jitsu fighters and 53 by Shotokan Karate practitioners. Athletes from three competition levels were asked, following this distribution: international level, national level and state level.

The questionnaire was composed of the following items: name, date of birth, weight age at the beginning of sports practice, time of practice with no interval, current belt, dominant side, if he is a competitor, level of competition, number of weekly trainings, number of hours per training and site of injury during sports practice (skull, neck, shoulder, arm, elbow, forearm, wrist, hand/fingers, hip, thigh knee, leg, ankle, foot/toes, spine, chest/back, mouth/teeth, nose, ear).

The data are presented in percentage, means and standard deviations and presented in charts and tables.

Data were analyzed through descriptive statistics. *Student's* t test was applied for comparison of normalized data.Chi-square test was used to verify the difference in percentage of injury between groups. The program used was the SPSS,11.5/*Windows*. The differences between groups were considered significant when $p < 0.05$.

RESULTS

This study was approved by the Ethics and Research Committee of the University of Santo Amaro.

The studied sample was composed of 94 individuals (table 1), all from the male sex, divided in 53 karate fighters (56.3%) and 41 Jiu-Jitsu practitioners (43.7%). Age mean among Karate practitioners was of 22.4 years and in Jiu-Jitsu it was of 22.1 years. Concerning weight, a significant difference was observed (p = 0.002) between groups, since the weight mean in Karate was 68.6kg and in Jiu-Jitsu, 76.6kg. In the age at the beginning variable, a significant difference was found (p = 0.006) between groups, in which the karate fighters began their training with mean age of 14.4 years and Jiu-Jitsu practitioners with 17.7years. The time of practice was also different (p = 0.001); karate fighters present longer time of practice of 6.3 years, against 3.7 years of the Jiu-Jitsu practitioners. The number of weekly trainings and of hours per training, both specific to the sport and complementary, also presented difference (p = 0.008) and (p = 0.002), where in Shotokan Karate, 3.7 days per week and 111 minutes per day and in Jiu-Jitsu, 4.6 days per week and 144 minutes per day.

308 injuries were reported; 160 in the Jiu-Jitsu practitioners and 148 in the Karate fighters.

Regarding the Shotokan Karate practitioners (table 2), it was observed that 88.6% presented any kind of sport injury. The sites which presented the highest incidence were (figure 1): hand/fingers in 23 practitioners (15.5%), followed by foot/toes with 19 practitioners (12.8%) and leg with 14 practitioners (9.5%). While in the Jiu-Jitsu practitioners (table 3), an impressive prevalence of 97.5% of sport injuries was observed, with most of them having been reported in (figure 2): knee in 26 practitioners (16.3%), shoulder in 23 practitioners (14.4%) and ear in 21 practitioners (13.3%).

Comparing the sites of injury between Jiu-Jitsu practitioners *versus* Karate fighters (table 4) it was observed that hand/fingers and foot/toes were the most frequent injuries in Shotokan Karate; however, they did not present significant differences when compared with the Jiu-Jitsu practitioners. The leg was the third most frequent site of injury in Shotokan Karate and presented significantly higher incidence (p = 0.042) when compared with the Jiu-Jitsu practitioners; that is to say, from the total of injuries on the le, 77.8% were in Shotokan Karate versus 22.2% in Jiu-Jitsu. Comparing the site of injury in the Jiu-Jitsu practitioners, significantly higher incidence was observed on the knee, shoulder and ear, presenting p = 0.000 for the three sites. Out of the total of knee injuries, 72.2% occurred in Jiu-Jitsu and 27.8% in Shotokan Karate; while on the shoulder, the prevalence was of 76.7% in Jiu-Jitsu and 23.3% in Shotokan Karate; and on the ear, the difference was shocking, being 95.2% in Jiu-Jitsu and 4.8% in Shotokan Karate.

Table 1. Sample characterization.

Variables	Shotokan Karate	Jiu Jitsu	Sig * (p<0,05)
N	53	41	
Age (years)	22.4 ± 8.4	22.1 ± 3.9	0.878
Weight (kg)	68.6 ± 11.9	76.7 ± 12.1	0.002*
Age beginning (years)	14.4 ± 7	17.7 ± 4.7	0.006*
Time (years)	6.3 ± 4.3	3.7 ± 3.1	0.001*
Training/week (day)	3.7 ± 1.5	4.6 ± 1.7	0.008*
Time/training (min)	111± 45.7	144 ± 57.4	0.002*

Note: Variables represented by Mean ± Standard deviation. Result of the statistical analysis through the Student's t tes

Table 2. Frequency of injuries per body segment in Shotokan Karate.

Site	Frequency number	Percentage %
Skull	9	6.1%
Neck	3	2.0%
Shoulder	7	4.7%
Arm	8	5.4%
Elbow	2	1.4%
Forearm	5	3.4%
Wrist	4	2.7%
Hand/fingers	23	15.5%
Hip	4	2.7%
Thigh	6	4.1%
Knee	10	6.8%
Leg	14	9.5%
Ankle	6	4.1%
Foot/toes	19	12.8%
Spine	3	2.0%
Chest/back	1	0.7%
Mouth/teeth	13	8.8%
Nose	10	6.8%
Ear	1	0.7%
Total	148	100%

Nota: Frequência e percentual.

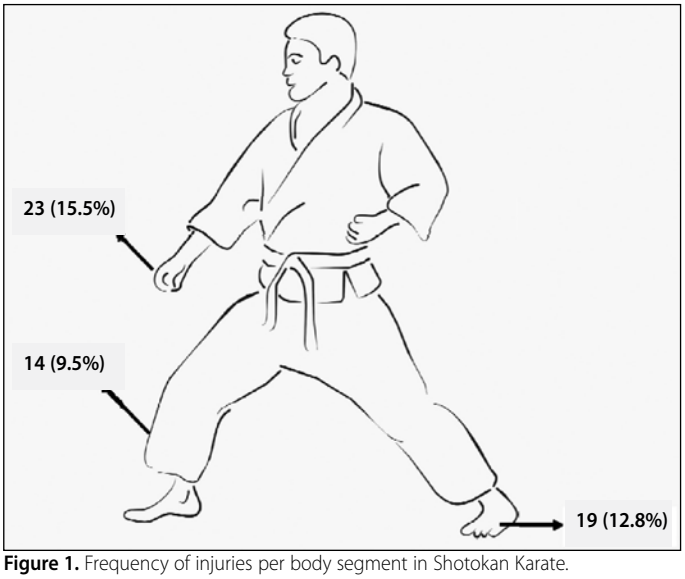

Figure 1. Frequency of injuries per body segment in Shotokan Karate.
Note: Three main sites of injury in Shotokan Karate (Frequency and percentage).

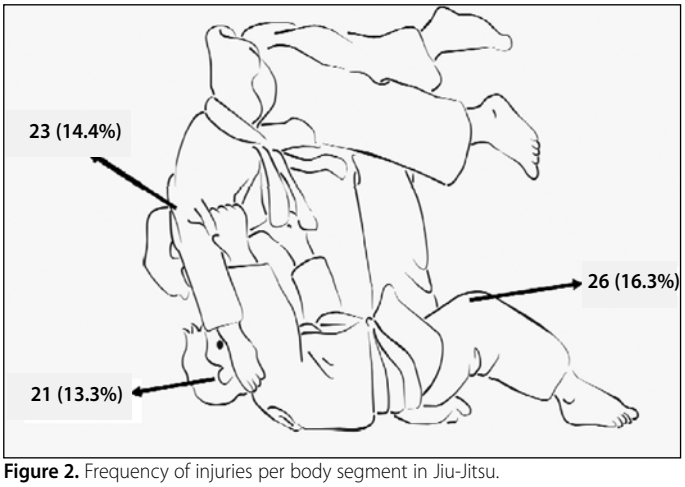

Figure 2. Frequency of injuries per body segment in Jiu-Jitsu.
Note: Three main sites of injury in Jiu-Jitsu (Frequency and percentage).

Table 3. Frequency of injuries per body segment Jiu-Jitsu.

Site	Frequency number	Percentage %
Skull	2	1,3%
Neck	8	5.0%
Shoulder	23	14.4%
Arm	10	6.3%
Elbow	11	6.9%
Forearm	3	1.9%
Wrist	5	3.1%
Hand/fingers	13	8.1%
Hip	0	0%
Thigh	2	1.3%
Knee	26	16.3%
Leg	4	2.5%
Ankle	14	8.8%
Foor/toes	7	4.4%
Spine	4	2.5%
Chest/back	2	1.3%
Mouth/teeth	3	1.9%
Nose	2	1.3%
Ear	21	13.3%
Total	160	100%

Note: Frequency and percentage.

Table 4. Frequency of injuries per body segment comparing Shotokan Karate *versus* Jiu-Jitsu.

Injury site	Shotokan Karate (53)	Jiu Jitsu (41)	Sig * (p<0,05)
Skull — n (%)	9 (81.1%)	2 (18.2%)	0.070
Neck — n (%)	3 (27.3%)	8 (72.7%)	0.038*
Shoulder — n (%)	7 (23.3%)	23 (76.7%)	0.000*
Arm- n (%)	8 (44.4%)	10 (55.6%)	0.256
Elbow — n (%)	2 (15.4%)	11 (88.4%)	0.001*
Forearm — n (%)	5 (62.5%)	3 (37.5%)	0.715
Wrist — n (%)	4 (44.4%)	5 (55.6%)	0.448
Hand and fingers — n (%)	23 (65.7%)	12 (34.3%)	0.160
Hip — n (%)	4 (100%)	0 (0%)	0.072
Thigh — n (%)	6 (75%)	2 (25%)	0.267
Knee — n (%)	10 (27.8%)	26 (72.2%)	0.000*
Leg — n (%)	14 (77.8%)	4 (22.2%)	0.042*
Ankle — n (%)	6 (31.6%)	13 (68.4%)	0.015*
Foot and toes — n (%)	19 (70.4%)	8 (29.6%)	0.083
Spine — n (%)	3 (42.9%)	4 (57.1%)	0.453
Chest and back — n (%)	1 (33.3%)	2 (66.7%)	0.413
Mouth and teeth — n (%)	13 (81.3%)	3 (18.7%)	0.028*
Nose — n (%)	10 (83.3%)	2 (16.7%)	0.044*
Ear — n (%)	1 (4.8%)	20 (95.2%)	0.000*

Note: Frequency and percentage of injuries in the studied groups. Result of the statistical analysis through the *Chi-square* test.

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DISCUSSION

The present study assessed only male individuals so that influence of the anatomic differences on the injury incidence could be avoided.

The understanding on the importance as well as sites where injuries occur in specific sports modalities and the movement biomechanics is crucial to identify the trauma mechanisms and hence perform a more efficient prevention and rehabilitation work.

This research shows that Shotokan Karate and Jiu-Jitsu athletes start their activities when still young; however, this starting time is even earlier in Shotokan Karate, being it an aggravation issue, since the bone resistance below 16 years of age is not similar to in an adult[5]. Additionally, the interaction between age and years of experience significantly contributes to the reduction of injury risk[6].

The most interesting aspect of this study is the comparison between two martial arts with different styles. In Shotokan Karate there is partial contact with strikes and blocks, while in Jiu-Jitsu physical contact is total. However, contrary to Shotokan Karate, it does not present punches and blocks, but projections to the ground and joint torsions [1,3].

The incidence of injuries observed in Shotokan Karate in the present study is similar to what is observed in the literature. A study which assessed 186 karate fighters found that the main sites for injuries were feet, hands and head, with 35%, 28.9% and 26.5%, respectively[7]. Safety was also evaluated in 114 athletes in which the authors concluded that training load lower than or equal to three hours per week presented low injury incidence, corroborating that training can be harmful when excessively performed[8].

The injuries on the hands and fingers were the main in Shotokan Karate. A study reports that these injuries are frequent in many sports. The authors mention that the joint amplitude of different sports activities and *overuse* are the main factors for

these injuries[9]. However, in Shotokan Karate there is not demand for wide joint amplitudes on the wrists, hands and fingers. Thus, these injuries could be justified by direct trauma, since it was observed in a study significant reduction of these injuries with introduction of hand and foot guards. It is important to highlight that the guards did not limit the joint amplitude, however, they protected against direct trauma[10]. One study assessed the impact force of boxers during a direct strike with the wrists and found for the 4.7m/s velocity an impact force of 2.45kg, which is an impact sufficient to cause serious injuries [11]. These physical characteristics are even more striking, since a wrist strike and a kick reach velocities of 9.8m/s and 14.4m/s, respectively, in Shotokan Karate athletes[12].

The joint torsion techniques present in Jiu-Jitsu explain the high incidence of knee and shoulder injuries. A study which compared *Aikido* – a martial art characterized by projections and torsions as well – with other martial arts, observed high incidence of injuries on the upper and lower limbs[13].

Despite the low incidence of injuries in the neck region in both martial arts, these were significantly higher ($p = 0.038$) in the Jiu-Jitsu practitioners. Injuries in the neck region are always of great concern due to the common motor incapacity and death associated with these regions. The kinematic evaluation of four different strikes of different martial arts concluded that the possibility of cervical injury through these strikes was significant [14].

A factor which should be considered is the possibility that some athletes have omitted or underestimated their injuries due to the fear of being excluded from some competition or training. This behavior was verified in a previous study which also assessed the frequency of injuries[15].

Jiu-Jitsu is a martial art with a large number of practitioners around the world, especially in countries such as Brazil, Japan and United States; however, the research related to injuries is limited. Until the present date, only two articles related to injury were found in the PubMed database, which were published in 1955 and 1957, extremely outdated[16,17].

In one article it was observed that the main injuries in Judo occurred on the upper limbs, resulting from projections to the ground. This study is similar to ours, since the second main site of injury observed were the shoulders. Concomitantly, the authors did not observe high incidence of knee injuries as in the present study. Such fact is probably due to the freedom of strikes application on the lower limbs present in Jiu-Jitsu but not in Judo[18]. Interestingly, among the few injuries reported on the lower limbs in Judo, the most common was the knee injury, as observed in 9,936 individuals/year[19], which agrees with the present study.

CONCLUSION

Based on the data obtained with the studied sample it was concluded that the main sites of injury observed in Shotokan Karate were hand and fingers and in Jiu-Jitsu, the knee. Such behavior is probably due to the biomechanical differences between the two martial arts.

All authors have declared there is not any potential conflict of interests concerning this article.

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