Martial Art Athletes' Injury Detection, Recovery and Avoidance

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Abstract
In order to improve the validity of sports injury detection for athletes, a method of extracting motion details based on three-dimensional sensor tracking is proposed. Three-dimensional sensor tracking and recognition method is used for image acquisition of motion damage action, key feature points reflecting the details of motion damage are extracted, edge contour detection and corner detection are carried out on the collected three-dimensional image, and statistical information feature extraction and damage degree evaluation of motion damage action are realized by deformation displacement estimation method of damage location, combined with block segmentation square of image. The method is used to extract motion details of sports injuries. Experiments show that this method has a good effect on athletes' injury detection. It is analyzed that the injury factors of athletes are potential factors and direct factors. This paper probes into the preventive measures for athletes, which include strengthening physical training, improving physical reserve, arranging sports volume scientifically, paying attention to the scientific of training methods, mastering correct technical movements in an all-round way, making full preparations, strengthening the protection of vulnerable parts, paying attention to the recovery measures after training, strengthening the medical supervision of athletes and enhancing their self-protection consciousness. Strengthen the martial arts morality education of athletes and other eight aspects to prevent, so as to reduce the probability of sports injury of martial arts athletes.

Key words: Athletes, Damage Detection, Three-Dimensional Sensor Tracking, Preventive Measures

Detección, recuperación y evitación de lesiones de atletas de artes marciales

Resumen
Con el fin de mejorar la validez de la detección de lesiones deportivas para los atletas, se propone un método para extraer detalles de movimientos basados en el seguimiento de sensores tridimensionales. El método de seguimiento y reconocimiento de sensores tridimensionales se utiliza para la adquisición de imágenes de acción de daño de movimiento, se extraen puntos de características clave que reflejan los detalles de daño de movimiento, la detección de contorno de bordes y la detección de esquinas se realizan en la imagen tridimensional recopilada e información estadística la extracción de características y la evaluación del grado de daño de la acción de daño por movimiento se realizan mediante el método de estimación de desplazamiento de la deformación de la ubicación del daño, combinado con el bloquecuadrado de segmentación de la imagen. El método se utiliza para extraer detalles de movimiento de lesiones deportivas. Los experimentos muestran que este método tiene un buen efecto en la detección de lesiones de los atletas. Se analiza que los factores de lesión de los atletas son factores potenciales y factores directos. Este documento investiga las medidas preventivas para los atletas, que incluyen el fortalecimiento del entrenamiento físico, la mejora de la reservafísica, la organizacioncientífica del volumendeportivo, la atención a la cientificidad de los métodos de entrenamiento, el dominio de los movimientos correctos de forma integral, la preparacióncompleta, el fortalecimiento la protección de las partes vulnerables, prestando atención a las medidas de recuperación después del entrenamiento, fortaleciendo la supervisión médica de los atletas y mejorando su conciencia de autoprotección. Fortalecer la educación de los atletassobre la moralidad de las artes marciales y otros aspectos para prevenir, a fin de reducir la probabilidad de lesiones deportivas de los atletas de artes marciales.

Palabras clave: Atletas, detección de daños, seguimiento tridimensional del sensor, medidaspreventivas
1. **Introduction**

With the popularization and promotion of martial art and the increasing number of competitions, the field of martial art has made rapid progress in competition rules, teaching competitions, technical and tactical training, market operation mode and psychological research, but the research on martial art sports injury is still rare [1]. Because martial art is a competitive sport with kicking, beating and wrestling as its main content and fighting between the two sides as its form. Therefore, in the process of special training and competition, sports injuries will easily occur, which will frustrate the enthusiasm of athletes in training, hinder the improvement of athletes' professional skills, and seriously shorten the exercise life of practitioners [2-4]. Thus, it causes serious losses to the overall development of martial art sports. Therefore, how to prevent and reduce the probability of martial art sports injury is a problem we must face and need to solve at present. It provides scientific and reasonable theoretical basis for guiding teaching and improving training level, optimizing curriculum system, and successfully holding various competitions. The impact of sports injury is serious. It will not only cause motor dysfunction, but also affect the working ability of muscles and the quality of motion of the whole body, even if the fine organic tissue changes in joints. And it will affect the physical health of athletes, disrupt the systematization of sports training, reduce the enthusiasm of athletes, affect the improvement of professional performance, reduce the competitive age of athletes, and eventually have to regretfully end their sports career ahead of time, seriously or even cause disability, bringing great physical and psychological pain to athletes [7].

Sports injury refers to the destruction of human tissues or organs and physiological confusion in sports. Some sports injuries are closely related to sports training, with the characteristics of sports specialty and technical movements. The occurrence of sports injuries brings many inconveniences to the learning, training and life of athletes, and serious life-long disasters [8-10]. The analysis and Research on the occurrence of sports injuries will help prevent sports injuries, minimize sports injuries and help coaches to complete training plans and tasks on time and in quantity, improve athletes' technical and tactical level and promote the development of this project. The degree of sports injury can be divided into three categories according to the loss of motor ability: normal training according to the training plan after injury, and not aggravating the injury to a moderate degree. Within a week after injury, training can not be carried out according to the teaching and training plan, and local activities need to be stopped or reduced. After injury, two weeks or more, there is no exercise at all, and rest treatment is needed [11-14]. The degree of injury can be divided into acute injury and chronic injury according to the nature of injury. Acute injury is a sudden injury, often in training or competition when doing a certain action suddenly injured. It also has various acute symptoms such as red, swelling, fever and pain. Chronic injury is caused by the accumulation of multiple minor injuries, with local symptoms of acid, anesthesia, swelling and pain [15].

Therefore, this paper studies the detection of athletes' injuries, and analyses the factors and characteristics of martial art athletes' sports injuries. At the same time, it puts forward the treatment methods of acute sports injuries, chronic sports injuries and post-recovery training, aiming at strengthening the treatment efficiency of martial art athletes' sports injuries, and supporting the scientific adjustment of recovery training, so as to provide martial art athletes with injuries. The treatment method provides theoretical reference [16-18]. With the development of image processing technology, image feature analysis and extraction methods are widely used in the treatment and analysis of sports injury. Combined with three-dimensional image reconstruction and three-dimensional sensor tracking method, CT imaging technology is used to extract the image of the sports injury site and analyze the sports injury site, which can effectively realize the diagnosis of sports injury. The basis of pathological analysis and diagnosis of sports injury is to extract the details of sports injury action [19-22]. At present, the main methods of extracting motion details are gray level detection, corner matching and block segmentation, which can accurately calibrate and segment the contour and edge feature points of the motion-damaged image, mark the active contour of the image, and extract the motion details of the motion-damaged image. However, the above methods have poor convergence and anti-interference ability. Not strong and other issues [23-24]. For this reason, this paper proposes a method of extracting the details of motion damage action based on three-dimensional sensor tracking. The method of estimating the deformation displacement of the damaged part is used to extract the statistical information features of motion damage action and evaluate the degree of damage. It has a good application effect [25].

2. **Proposed method**

2.1 **Damage detection**

1. Mixed Gauss Model. Mixture Gauss Modeling (GMM) can be used to model video with complex background to detect moving objects in video. According to the Mixture Gauss Model, the probability density of the sample value of the pixels in a frame in a certain period of time is calculated, and then the background content of each pixel is determined according to the common principle of statistical difference. When reading a
new video frame, first update the model according to the current frame, then traverse each pixel in the frame to be processed to determine whether it is a background point. After processing each pixel of the frame, the frame background model can be obtained, and then the frame foreground can be obtained according to the background. Gauss mixture model can well model the background of complex video.

2. SIFT feature SIFT (scale invariant feature transform) The feature point is a stable local feature. The representative points on the surface of an object are selected to describe the object. These points are usually called interest points, such as the points with higher brightness in darker areas, the points with lower brightness in bright areas, and the special points on the edge of the object. Interest points will not change greatly because of image scaling or rotation, and they are robust to light changes and noise interference.

3. Perceptual hash image. Perceptual hashing technology, also known as digital fingerprint, is a summary of multimedia information. Perceptual hashing is a kind of one-way mapping from multimedia representation to hash value. Each image has its corresponding fingerprint. The perceptual hashing algorithm first removes the details of the image, ignores the size and scale differences of the image, and only retains the basic information such as structure and shadow. Then the discrete cosine transform (DCT) coefficient matrix of each frame gray image is calculated, and only the 8*8 matrix of the upper left corner is preserved. Compute the gray mean of all the pixels, compare the size of each pixel and the mean value of the matrix, and mark it as "1" if it is greater than or equal to the mean value, otherwise mark it as "0", and finally generate the frame fingerprint. The Hamming distance is calculated according to the frame fingerprint, and the frame similarity is judged.

4. Canny Operator Canny operator [6-7] is an algorithm proposed by combining image processing algorithm with optimization idea. It has high peak signal-to-noise ratio (PSNR) and detection accuracy, so it is widely used. The three criteria for evaluating the performance of Canny operator are as follows: 1) the signal-to-noise ratio is the best, that is, the probability of distinguishing the real edge as a false edge or a false edge as a real edge is as small as possible in image recognition; 2) the location of the detected edge point is the closest to the actual edge point; 3) the single edge response, that is, the response of a single edge point is only one time, and the response of the false edge is the smallest. It should be suppressed. The edge detection using Canny operator mainly includes smooth image of Gauss function, calculation of gradient magnitude and direction, non-maximum suppression of gradient magnitude, double threshold detection and connection. 1) Gauss function smoothing image. The image is smoothed by using the first derivative of the two-dimensional Gauss function. The two-dimensional Gauss function is as follows:

$$G(x,y) = \frac{1}{2\pi\sigma^2} \exp\left(-\frac{x^2 + y^2}{2\sigma^2}\right)$$ (1)

$\sigma$ for standard deviation, edge positioning accuracy and signal-to-noise ratio will change with the change of standard deviation. The bigger the standard deviation, the bigger the signal-to-noise ratio, and the lower the positioning accuracy, so it plays a key role in image smoothness. 2) Gradient amplitude and direction calculation. The first-order finite difference in the 2*2 neighborhood is used to calculate the gradient amplitude $M(x,y)$ and the gradient direction $\theta(x,y)$ of the Gaussian smoothed image $I(x,y)$,

$$M(x,y) = \sqrt{P_x^2(x,y) + P_y^2(x,y)}$$ (2)

$$\theta(x,y) = \arctan\left(\frac{P_y(x,y)}{P_x(x,y)}\right)$$ (3)

Non-maximum suppression of gradient amplitude. The gradient magnitude of all $M(x,y)$ pixels is interpolated along the gradient direction in the 3*3 neighborhood. The central pixel points are compared with two adjacent interpolation points along the gradient direction. If they are larger, they are edge points, otherwise they are non-edge points. 4) Double threshold detection and connection. Canny operator detects the gradient magnitude of the image after non-maximum suppression, and then connects the detected images. Among them, the determination of high and low thresholds needs to be set artificially. The ratio of high and low thresholds is generally 1:0.4.

2.2. 3-D Sensor Tracking

Firstly, three-dimensional sensor tracking acquisition method is used to collect the original motion damage image, and three-dimensional sensor tracking method is used to acquire the contour length of the motion damage image as follows:
In the formula: the neighborhood value of the pixel for image edge detection; the number of superimposed templates for piecewise linear fitting of the image. The edge contour features of motion damage action images are extracted by template superposition method, and the box filter model of motion damage action images is constructed as follows:

\[ L(\phi) = \int_{\Omega} \delta(\phi) | \nabla \phi | \, dx \]  

(5)

Three-dimensional sensor tracking and recognition is carried out by using 3*3 pixel block region segmentation method. The fused image information is expressed as a set of statistical features, which are defined as:

\[ P(\phi) = \frac{1}{2} \int (| \nabla \phi | -1)^2 \, dx \]  

(6)

For the statistical feature information of key information points, it is a local gradient energy item, and the pixels of motion damage action feature collected by three-dimensional sensor follow the normal distribution N (0,1).

2.3. Preventive measures

1. To follow the automatic training system of sports training. The level of sports technical level has different degree of injury. With the increase of technical level, there is a process of formation and reduction of injury. That is to say, in the early stage of training, we strictly follow the automatic training system in sports training, and constantly run in the coordination of movement technology and physical quality. This is a good way to reduce injury. At the same time, in the early stage of training, using the existing research results of traditional Chinese medicine, drawing lessons from the traditional Chinese boxing practice of fighting power skills and medication methods, and accompanied by athletes in training competitions.

2. According to the nature of damage degree. Because the athletes use the extreme strength and speed to produce the resultant force of the body and transmit the force to the fist,sole and instep to attack each other, so as to achieve the goal of success in attack and defense. Therefore, the proportion of acute damage caused by these points and surfaces is very large. So strengthening the flexibility and strength of ankle and wrist joints and improving the motion specifications accord with the force principle of sports biomechanics. It is a very shortcut and effective way to reduce the injury of ankle and wrist joints. It is a good countermeasure to reduce injuries to strengthen the ability to fight against the lower leg and arm of the defensive part, and to strengthen the practice of fighting against the scoring part by means of non-contact defensive methods or by means of strength.

3. According to the time of injury. The coaches should list the causes of injury according to the actual situation of the team or the characteristics of athletes' technical training, personality psychology and other factors, dissect them one by one, find out the commonness and individuality of sports injury, and use different countermeasures to eliminate the injury one by one to reduce the occurrence of injury, so as to improve the efficiency of training and competition. Athletes training should not be too monotonous, such as: always technical training or competition, forming a single training method is not desirable, should be based on different periods of training. Develop in the direction of scientific regularity.

4. According to the injured parts and types of athletes, we can draw lessons from Thai boxing and boxing to reduce the injuries by touching oil on the face in competition training. This should be advocated, which can avoid injuries and do not violate the rules. The injury factors of the same part of the injured athletes are different. Coaches and team doctors should list in time what parts of the injured athletes have experienced. Studying the prevention and treatment of these injuries is also a good way to improve the performance of athletes. Focus on strengthening the head and face defensive exercises, such as: focusing on strengthening the contact defensive techniques of blocking, patting, blocking exercises, in order to improve the defensive techniques of boxing and high-leg offensive defensive exercises, enhance the resistance of the arm. Strengthen the practice of non-contact defense, use evasive techniques, and try to avoid using the method of positive attack. Attention should be paid to the strictness of defense, so as to reduce the possibility of injury caused by direct hit by the other side. Coaches and athletes should be familiar with the referee's rules and try to drill in the blanks of the rules, such as: rendering the atmosphere when scoring or creating false impressions when approximating the score to confuse the referee, etc. At the same time, athletes should not play hard, not to mention the scoring effect. Understand the law enforcement criteria of different referees, keep in mind
5. Make full preparations to strengthen the protection of vulnerable parts. The injury caused by inadequate preparatory activities before training accounted for 58.62% of the total number of injuries, ranking first (Figure 8). It can be seen that it is necessary to make adequate preparatory activities before training and competition. Full preparation not only can improve the excitement of the central nervous system, overcome the physiological inertia of the body's functional activities, and prepare for formal training and competition, but also can increase the number of capillaries in the muscles of the body, improve the function of the muscles of various parts, increase the extensibility of the joint ligaments, and prevent the injury of the major joint muscles and ligaments of wrist, knee and ankle. The principle of sports physiology tells us that we should make full preparations to accelerate blood circulation, weaken the viscosity between muscles and ligaments, fully mobilize the activity of visceral organs, and improve the ability of exercise stress. Sanda belongs to the direct physical antagonism sport. From the beginning of the competition, it is required to enter its best state and exert its extreme physical fitness, skills and tactics. It is not allowed to have a short compensation period as a transition. Therefore, the quality of preparatory activities directly affects the results of athletes' competitions, which is more important. In addition, head, hand, elbow, shoulder, hip, knee and foot are the main contact points of fall. Attention should be paid to strengthening the training of landing techniques, improving the rationality of the training of landing techniques, and making them have a certain ability to fight, which plays an important role in reducing injury.

6. Attaching importance to the recovery measures after training has been widely used in martial art Sanda training. Athletes who have exceeded the level required by the competition in physical and technical ability are called physical reserves. The whole process of martial art Sanda training should include load-fatigue-eliminating fatigue-recovery and improvement. Therefore, it will get twice the result with half the effort to master the training load scientifically and make the body recover scientifically. Martial art Sanda belongs to the direct physical antagonism sport, and its technology is complex and changeable. Martial art Sanda athletes will accumulate fatigue if they do not take effective measures to recover after training with high intensity and large amount of exercise, which will lead to excessive fatigue and increase of some local coincidence, thus causing the occurrence of sports injury. Martial art Sanda athletes should pay special attention to physical recovery and nutritional supplement; ensure adequate sleep; increase the supplement of trace elements and minerals, you can eat more fresh vegetables and fruits, which is conducive to eliminating the accumulation of acid products in the process of exercise. In addition, martial art Sanda athletes can also massage, sauna and relax according to the conditions, which can not only accelerate the recovery of fatigue and prevent injury, but also improve the guarantee for future training and competition.

7. Strengthening medical supervision and improving self-protection consciousness in Sanda competition, because the head and trunk are the main scoring parts, have become the main target, so it is necessary and strict medical supervision. In addition to the monitoring of the whole process of combat on the spot, the team members should be regularly inspected to find problems, prevent and treat them early, and avoid injury as much as possible. Therefore, we must do the following: first, strengthen the supervision and inspection of athletes' physical changes, there should be a special person to observe, register and carefully maintain the injuries of athletes in different periods, and give education and guidance to athletes who do not listen to the requirements. Secondly, according to the athletes with different injuries, they should arrange some rehabilitation exercises with a positive and serious attitude, and should not rest purely. Especially the athletes with injuries in the vulnerable joints should strengthen the small strength exercises of the injured muscles appropriately. Thirdly, when athletes go out to train or compete, they should arrange their daily activities reasonably and supervise carefully and patiently step by step. Fourth, the injured athletes who are not fully recovered can not participate in training and competition, and can gradually recover and improve until they are fully recovered. Fifth, keep the training and competition venues clean and tidy, so that no hard blocks appear in boxing sets, foot targets and sand bags; no loosening gap appears in the protective mat on the ground; for the phenomenon of sweat or drinking water falling on the training and competition venues in sports, it should be dealt with in time. Sixth, in training competition, coaches, team doctors and athletes should coordinate and cooperate, and the injured precursors found should be properly handled. It is wrong to practice heavy boxing without armor or wrist bandage. For over-emphasizing hardness training and adopting the method of killing tactics, we should arrange the training scientifically and appropriately. Improve the technical training when falling down actively or passively, develop the habit of reasonable falling down method, and reduce the occurrence of injury.

8. To improve the psychological endurance ability before, during and after training competitions, we should take active measures to protect ourselves and not leave traces of injuries in our hearts. Establish the psychological state of training and competition safety, reduce the excessive anxiety and fear before the competition, and concentrate on the task of each lesson in training and competition. It is wrong to be emotionally unstable and not calm in actual combat confrontation.

9. Strengthen the martial arts morality education of athletes. There has always been the saying of "advocating martial arts and morality", requiring practitioners to "take martial arts as the foundation" and "morality as the guide". As a moral code of conduct for martial arts practitioners, the aim of martial art Sanda is to make it develop healthily as a sports event. Those who do not respect civilized morality, deliberately strike the
forbidden parts, bully the weak and deliberately cause the other party's disability should be abandoned. Under the guidance of the concept of building a harmonious society, martial art Sanda should continuously popularize and promote the development of this project on the premise of "friendship first, competition second". Athletes themselves are full of "martial arts", so they should pay more attention to their words and deeds in the process of communicating with others.

3. Experiments

In this paper, the damage detection part is simulated based on the image processing tool of matlab. In the experiment, motion damage action image acquisition is realized by three-dimensional sensor tracking and recognition method. The acquisition place is orthopaedic department of a large hospital. The template size of detail action feature of motion damage image is 200 *200, the range of gray standard deviation is (0.25,2). The time step of image tracking and recognition by three-dimensional sensor is t=0.1s, and the total gray level is 280.

The first-hand materials used in this paper are mainly obtained through the author's questionnaires and consulting related works. More than 79 relevant research works, papers and materials were consulted, which provided a theoretical basis for this study. A total of 191 pieces of information about teaching, training and sports injuries in martial art were retrieved. Among them, there are 8 studies on sport injury of martial art Sanda athletes. Through the processing and processing of these documents, this paper studies and reveals the current situation of sport injury of martial art Sanda athletes. According to the needs of this study, we visited some experts in martial art Sanda training and sports medicine. Listen to their valuable opinions and suggestions to inspire thinking, validate ideas, enrich knowledge and test research results. In this study, two sets of questionnaires were issued: the athletes' questionnaire and the expert validity evaluation questionnaire. The validity of the athletes' questionnaire was evaluated by the expert validity evaluation questionnaire. Athletes' questionnaires were pre-issued before issuance, and they were issued in the form of face-to-face issuance and recovery. In this study, 110 athletes' questionnaires were distributed and 105 were recovered, with a recovery rate of 95.45%. Four invalid questionnaires were excluded and 101 effective questionnaires were actually sent out, with an effective recovery rate of 96.19%. 17 questionnaires were collected and the recovery rate was 100%. According to Babbitt's point of view, recovery of more than 50% is appropriate, more than 60% is better, and more than 70% is very good. Therefore, the questionnaire can meet the research needs. In order to test the reliability and validity of the questionnaire, the reliability part of the respondents was re-tested by retest method, and the correlation coefficient of the two tests was calculated as a = 0.886, P<0.01, which showed that the results of the survey had high reliability.

\[
\text{Table 1. Athlete Questionnaire Retest Reliability Table}
\]

<table>
<thead>
<tr>
<th>Retest population</th>
<th>Two intervals</th>
<th>correlation coefficient</th>
<th>Table lookup value</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 day</td>
<td>0.886</td>
<td>P&lt;0.01</td>
<td></td>
</tr>
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The validity test adopts the method of qualitative and quantitative evaluation of the contents of the questionnaire. Experts are asked to evaluate the contents of the questionnaire according to five grades: A is very suitable (8-10 points) B is more suitable (6-8 points) C is general (4-6 points) D is not suitable (2-4 points) E is not suitable (0-2 points). The questionnaire designed has high validity. This study used sports statistics knowledge to make statistics and analysis of the data. Using logical analysis method, all kinds of data and information collected are summarized and analyzed in depth. Guided by the theories of sports training, sports medicine, sports anatomy and pedagogy, and combined with the special training theory of Sanda, this study demonstrates the relevant viewpoints and data of this paper through the logical thinking process of concept, judgment and reasoning, and summarizes the viewpoints which have certain guidance and reference value.

4. Discussion

According to the above simulation environment, motion damage action image analysis and detailed action feature extraction simulation are carried out, and the original image acquisition results of the two groups of images are shown in the first half of Fig. 1. In the first half of Fig. 1, the image acquisition results are used to detect the edge contour and corner points of the collected three-dimensional images, extract the action features that reflect the details of motion damage, and obtain the details feature extraction results as shown in the second half of Fig. 1. Based on the extracted detailed features of sports injuries, the statistical information features of sports injuries are extracted and the degree of injuries is evaluated to realize the judgment and treatment of injuries.
In order to quantitatively analyze the application performance of this method, the accurate judgment rate of the damage point is used as the test index, and different judgment methods are used to obtain the comparison results as shown in Figure 2. The analysis shows that this method is more accurate in judging and treating sports injury.
The results show that the injuries caused by "designated action" exercises are serious, mainly for two reasons. Firstly, there are deviations between the practical operation of "designated action" and the development direction of "high, difficult, beautiful and new", which overemphasizes the "difficult" degree component and artificially formulates a continuous combination of jumping and turning in the air to connect static balance, which is very inconsistent with the joint function of the human body. Martial art emphasizes the connotation of contradiction transformation, such as "moving fast, quiet and steady". It aims at the type of action without external binding force. It requires the cooperation between human body segments and segments, emphasizes the way of muscle strength as a whole, and pursues the internal training of muscles. Although jumping, turning and balancing movements from the external performance of the movement, more intuitive performance of the movement of ups and downs, staggered, but many people do not realize that this is contrary to the essential requirements of martial arts. Jumping and landing impact action produces a strong external binding force. If the lower limb muscle contraction strength of athletes cannot resist this external impact force, lower limb sports injury is inevitable, and more common in the weakest link of lower limbs - knee joint. Secondly, with the transformation from traditional martial art to competitive martial art, coaches' ideas still remain in the traditional martial art training system. Because of the guiding role of competition rules, many coaches are eager to achieve results. In the case of unclear technical concept of "designated action", they follow the traditional experience of "practicing a thousand times and taking care of themselves", requiring athletes to practice repeatedly and explore in practice, which can only achieve half the result with twice the effort. As far as physiological function is concerned, repeated exercises can only precisely locate the sense of time and space rhythm of the movements that have been mastered. The fundamental motive force to complete jumping movements is to improve the take-off strength of athletes' lower limbs, and at the same time, it is also the fundamental means to prevent sports injury. In order to develop lower limb muscle strength, attention should be paid to the characteristics of muscle activity of double joint muscles. Statistics show that knee ligaments are most vulnerable to injury, and ligament injury is mainly caused by joint muscle dysfunction. Compared with the data reported by other scholars, there is a gap in the relative value of peak moment of slow flexion and extensor of martial art athletes, which is lower than that of other athletes (such as football, wrestling, bicycle). Although this is related to the characteristics of martial art events, with the increasing competitive degree of martial art, we should realize that the strength function is completing difficult movements and anticipating. It plays an important role in preventing sports injury. Regarding the balance of muscle strength of left and right limbs, Morris thinks that the difference of extensor strength between two sides is 9%, flexor strength is 8%, while Gleim thinks that the difference of muscle strength between two knees of elite athletes should be less than 5%, otherwise it is easy to cause weak side injury. The results show that the balance of flexor strength of both knees of martial art athletes is good, there is no significant difference, but the maximum isometric extensor strength, left knee and right knee have significant difference (p < 0.05), left knee (93.4Nm) is lower than right knee (102.8Nm). This suggests that in order to maintain balance, the strong contraction of the extensor knee against the impact force of landing at the moment of landing, if both feet landing, due to the imbalance of the extensor strength on both sides, resulting in weak side injury; if one foot landing, it will be damaged due to the weaker strength of the largest isometric extensor of the left knee. Compared with other studies, the flexor-extensor ratio of martial art athletes is higher than that reported by domestic athletes. Under the three angular speeds, 60.1%, 73.3% and 72.4% respectively. Compared with the ratio standard recommended by Davies, GJ for knee flexors and extensors, there is a big gap at 240 degrees/s (should be more than 80%). In the movement of lower limbs, knee flexor is the antagonist of extensor muscle. During rapid movement, this part of muscle contracts and tenses appropriately, and brakes or delays the movement speed of the link, so as to avoid the injury of soft tissue around the joint. Relevant studies have shown that flexors endure more intensive stretching force than extensors during fast exercise. Reflexity causes stronger centripetal contraction of muscles. If the ratio of flexors to extensors is low, technical movement deformation will easily occur during exercise, resulting in flexors' pulling injury or knee joint injury, affecting the exercise ability. Therefore, it is necessary to pay attention to the strength training of knee flexors to prevent sports injury. After exercising according to the method proposed in this paper, the number of martial art athletes with severe injury and moderate injury decreased significantly, as shown in Figure 3.
5. Conclusions

In this paper, a method of extracting motion details based on three-dimensional sensor tracking is proposed and compared with experiments. The research shows that this method can extract the details of motion injuries and recognize the motion injuries by three-dimensional sensor tracking. It can express the features of motion injuries better and lay a foundation for visual pathological diagnosis and treatment of motion injuries. The injured parts of high-level martial art athletes mainly distribute in ankle, knee, waist and other joints. In order to avoid excessive sports injuries of high-level athletes, scientific selection should be made in training methods. At the same time, the training intensity, load, duration and frequency of each training method should be quantified, and specific and optimized training implementation plan should be formulated. To strengthen the training of vulnerable and relatively weak parts, team doctors should regularly review athletes with sports injury history, formulate short, medium and long-term rehabilitation goals, and deal with various sports injuries in a timely and effective manner; athletes should strengthen self-supervision, timely and active feedback of physical condition, pay attention to the regulation of physiological and psychological state, so as to reduce the occurrence of sports injuries.

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References