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Treatment of Acromioclavicular Dislocation of Rugby Player RockwoodⅢ

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Abstract: In this article, the clavicle trimming of the research object was carried out, and the acromioclavicular ligament and the coracoclavicular ligament were completely retained. The modified acromioclavicular joints were randomly divided into groups according to the random allocation principle. A multifunctional strength machine was used as the experimental equipment and the load was 100mm / min. Speed, the tensile mechanics of the ligaments of the subject was measured, and the fracture strength and deformation of each ligament were recorded in detail on a computer connected to a biomechanical testing machine. When the ligament of group A was stretched at 100mm / min, the average breaking strength was 645.99N. When the ligaments of group B were stretched at 100mm / min, the average fracture strength was 551.33N, indicating that the strength of the coracoclavicular ligament is far less than that of the acromioclavicular ligament, but it has a little stabilizing effect in maintaining the stability of the clavicle. The experiments in this paper show that by comparing the tension between the acromioclavicular ligament and the coracoclavicular ligament, the results show that the acromioclavicular ligament can significantly maintain the stability of the acromioclavicular joint.

1. Introduction

1.1. Research Background and Significance

Rugby is one of the most popular sports in the world. It is a comprehensive sport that combines strength, speed, calmness, wisdom, dexterity, coordination and coordination. It not only requires athletes to have strong physique, tenacious will quality, fast running ability, but also requires the ability to complete technical actions and tactics coordination with fierce physical contact with the opponent, has a high degree of viewing and fun. In modern rugby games, there are always many wonderful shots that make the audience happy. When the offensive player runs the ball at high speeds and breaks through the opponent's multiple obstacles, he finally scores a touch of the ball in the run; the defender rises up. Catches straight and throws at an opponent who is about to reach in a high-speed run. To complete these difficult and difficult technical and tactical actions, athletes not only need to have fast speed, sufficient strength and high sensitivity, but also to show the athlete's spirit of individual heroism who dares to take risks, disregards himself and moves forward.

However, among all ball games developed by universities, football players have the most frequent physical contact, the most intense confrontation, and a variety of technical actions, including hits, flashes, rushes, block, flutter, kicks, etc. To a certain extent, it leads to a high rate of sports injuries for rugby players [1]. It has been pointed out that of the 15 college sports, football has the highest number of serious sports injuries (eg, anterior cruciate ligament injury, concussion) [2]. It has been found that the estimated cost of each rugby sports injury increased by about 20% from 1977 to 1986 [3]. Injured athletes may also experience psychological trauma, such as fear of re-injury or surgery. In 1998, the practice of limiting the number of player trainings first appeared in spring rugby training in an attempt to reduce the injury rate, but the result was contrary to expectations. The spring injury rate was twice as high as the fall [4]. Research investigating the injuries of rugby players helps to suppress the high injury rate of rugby. Therefore, this paper investigates and analyzes the types of sports injuries that occur in football players during training and competition, focusing on the type of injury, the location of the injury, the vulnerable position on the field, and the degree of injury and rehabilitation. On this basis, the suggestions for the prevention and treatment of sports injuries in rugby players are put forward, which provides a reference for the more targeted training of athletes and the prevention of injuries.

1.2. Related Work

M. Faggiani believed that acromioclavicular joint dislocation is a common sports injury. He analyzed the clinical data of 31 patients with acute acromioclavicular dislocation who were treated between 2012 and 2015, excluding subjects with chronic dislocation or other injuries. He selected 16 patients (mean age 37 years). Half of the sample patients underwent minor open surgery with the MINAR® system, and the other half underwent canine bone arthroscopy. The normal shoulder joint score, Oxford shoulder joint score, simple shoulder joint test and patient's subjective motion recovery score were used to evaluate the shoulder joint function recovery after treatment. Based on the results of exercise scores, he showed that patients treated with the MINAR® system had a significantly higher probability of returning to exercise ($p < 0.001$) [5]. The objective parameters of the constant table for arthroscopic surgery were statistically significant ($p < 0.05$); $p < 0.001$). Conclusion ACJ anatomic reduction is the key to successful surgery. The surgical technique should be personalized. Minimally invasive surgery and arthroscopic surgery are effective. However, according to exercise scores, patients who underwent small incision surgery had less pain and performed better after resuming exercise compared to the other group [6]. Diogo Lino Moura described the clinical and functional results obtained in a group of patients. This is a retrospective observational study that included 153 patients with acute acromioclavicular joint dislocation. The operation time was from 1999 to 2015. His clinical assessment included the following results: continued functional score, development of complications, time to resume previous work / exercise activity, and satisfaction index. He used a contrasting side (uninjured) shoulder as a comparison of subjective results. To monitor loss of reduction, joint degenerative changes, and signs of coracoclav calcification, a radiological assessment was performed. The surgical technique he described is the best choice for the treatment of Rockwood grade III to v acute acromioclavicular joint dislocation, which is also confirmed by its excellent clinical and functional results and low incidence of complications [7]. Guolong Tang studied the effects of surgery and conservative treatment on the dislocation of Rockwood's acromioclavicular joint. There is no consensus in general orthopedic practice. He compared the clinical results of patients with type Ⅲ acromioclavicular (AC) dislocation surgery and conservative treatment, and pooled patient data using standard meta-analysis. For continuous variables, the weighted mean difference method is used. For binary data, odds ratios were calculated. The current analysis includes 10 trials on this topic, and his results show that in pain, weakness, tenderness, post-traumatic arthritis, limited strength, poor function and scores (Constant, UCLA, Imatani, SST, DASH, Larsen), There is no significant difference between surgical treatment and conservative treatment [8].

In this article, the human body is used as an experimental object to try to make up for the deficiencies in the previous research and provide strong support for the treatment of acromioclavicular joint dislocation. In addition, the acromioclavicular ligament and the coracoclavicular ligament were measured by biomechanical experiments, and the stability of the acromioclavicular joint was compared. The results of the study proved that the acromioclavicular ligament can significantly maintain the stability of the acromioclavicular joint. At the same time, the clavicle hook plate coincides with the concept of moment of inertia, which forms a lever force for the clavicle to create a stable tension-free environment. Therefore, the authors believe that no special repair of the complex coracoclavicular ligament is needed, especially in patients with fresh dislocations.

2. Proposed Method

2.1. Acromioclavicular Joint

The stability of the acromioclavicular joint is maintained by three parts: the joint capsule and the acromioclavicular ligament; the coracoclavicular ligament: the conic ligament and the trapezoid ligament; the tendon attached to the deltoid and trapezius. If a single acromioclavicular ligament is broken, acromioclavicular joint dislocation will occur; while the acromioclavicular ligament and coracoclavicular ligament will break at the same time, it will cause a total dislocation of the acromioclavicular joint. Rupture also causes total dislocation of the acromioclavicular joint [9]. Therefore, the complete coracoclavicular ligament is very important for the function of the acromioclavicular joint. Classic trauma mechanisms are forces from above the shoulders, such as falling from a high place or colliding in motion. This force can cause simultaneous tearing of the acromioclavicular ligament and the coracoclavicular ligament. Of the resulting shoulder joint injuries, 18% of patients can have type III to V acromioclavicular joint dislocations. Shoulder pain with swelling of local soft tissue and prominent clavicle. Due to pain, shoulder movements are limited, and patients' daily activities and sports activities are significantly restricted. Chronic instability of the acromioclavicular joint can lead to huge impairments of shoulder function: including muscle fatigue, limited scapular motion, feeling heavy with injured upper limbs, and horizontal adduction of upper limbs in pain [10].

Medical history and physical examination can provide a basis for diagnosis. The patient had a history of trauma in the fall or collision of the shoulder, and the pain was limited to the acromioclavicular joint, usually near the trapezius, and accompanied by shoulder swelling. Examine the patient while standing or sitting and see the prominent clavicle when compared to the uninjured side. The acromioclavicular joint has marked tenderness. Due to the acute phase of pain, the range of motion of the shoulders is reduced and muscle strength is reduced. The examiner should check the stability of the acromioclavicular joint in the up-down and front-back directions. For Type III-V, the joint feels unstable when the clavicle is pressed down ("piano key" sign).

Shoulder X-rays, including front view, scapular Y lateral view, axillary position (or Velpeau if the arm cannot be abducted), and Zanca position of the acromioclavicular joint (X-ray beam performed by tilt (10° to 35° towards the head side and using only 50% of the standard shoulder back and forth penetration strength) [11,12]. It may be useful to obtain radiographs on the opposite side for comparison. The bilateral Zanca film can see the ipsilateral and contralateral acromioclavicular joints on an X-ray box while maintaining the same beam direction. In addition, by assessing the degree of overlap of the clavicle and acromion, plain radiographs can distinguish between stable and unstable acromioclavicular joints. However, it is necessary to use the stress slice for pulling the upper arm distally by weight. Suspected to have other side injuries, more accurate imaging techniques such as CT or MRI are needed.

2.2. Treatment of Acromioclavicular Joint Dislocation

In all cases, type I and type II injuries were treated nonsurgically, but the true prognosis was found not to be as satisfactory as predicted, and types IV, V, and VI required surgery. In the past few decades, the treatment of type III acromioclavicular joint dislocation has been very controversial. In the past, patients with type III acromioclavicular joint dislocation were treated by surgery. However, after a long-term follow-up comparison, it was found that conservative treatment after surgery did not show a significant superior effect. Type III surgery is sometimes considered suitable for high-demand workers and sports patients. Most surgeons now generally believe that patients with type III injuries can initially be treated with non-surgical treatment; if conservative treatment is not effective, surgical methods to reconstruct the acromioclavicular joint and coracoclavicular ligament are adopted [13].

2.2.1. Non-surgical Treatment

Non-surgical treatment is suitable for type I and type II acromioclavicular joint dislocations, and can be suspended for 1 to 3 weeks with a temporary fixation band or a triangular towel. Encourage early moderate exercise for rehabilitation training. To the extent that pain allows, daily rehabilitation activities can gradually increase. Heavy lifting and contact exercise are prohibited for 6 weeks. The unsatisfactory effect of conservative treatment is mostly due to the failure of corrective and continuous rehabilitation training.

2.2.2. Surgical Treatment of Acromioclavicular Joint Dislocation

For the open operation of acromioclavicular joint dislocation, many surgical repair or reconstruction surgery methods have been published. These surgical methods can be basically divided into four categories: fixation of the acromioclavicular joint with internal fixation (including screws and Kirschner wire, shoulder lock hook steel plate) and / or

Repair of coracoclavicular ligament; dynamic muscle transfer with or without distal clavicle resection; reconstruction of coracoclavicular ligament with biological materials; reconstruction of coracoclavicular ligament with autograft or allograft tendon [14,15].Regardless of the surgical method, the biological healing process will take a long time.

1) Kirschner wire tension band fixation: A long time ago, temporary transarticular Kirschner wire fixation of the acromioclavicular joint has been used in combination with direct ligament repair. However, this technique has led to unsatisfactory results, including Kirschner wire loosening, breakage, migration, and loss of reset. Similarly, cerclage of the coracoclavicular ligament or screw fixation (such as Bosworth screws) can also lead to an unacceptable risk of rupture of the internal

fixation. Some people remove the internal fixation after 6 to 8 weeks to avoid this complication. But even with sufficient screw positioning, internal fixation breaks and forced screw removal have reduced the popularity of this technology. These surgical methods have been eliminated.

2) Shoulder lock hook steel plate fixation: This is the most commonly used surgical method in clinical practice. The acromioclavicular plate is a metal device that restores and maintains the acromioclavicular joint in its original position by hooking its tip under the acromion and fixing its steel plate to the clavicle with screws. It can be used alone or in combination with other ligament repair methods. Locate the acromioclavicular hook plate to reduce joint space, or insert the hook plate under the structure behind the acromion, and then push the steel plate segment to the distal end of the clavicle shaft, so that the clavicle is pulled downward, and the acromioclavicular joint is reset by lever force. In most cases, a 4-hole (shortest) hook plate can be used. The hook can be adjusted below the acromion, or the steel plate can be adjusted to the distal clavicle.

The advantage of this surgical approach is that it provides a strong and stable construction. It has been reported that the surgical method of fixing the shoulder lock hook steel plate has obtained good results. However, the disadvantage is that the hook steel plate occupies the space structure under the acromion, squeezing the acromion, causing impact under the acromion, rotator cuff injury, and even stress fracture of the acromion caused by the hook. The hook steel plate is in close contact with the lower surface of the acromion, which may explain why more various complications usually occur after the hook steel plate is fixed. Due to the strong internal fixation stress concentration, it can cause long-term joint pain or discomfort, cause muscle strength decline, shoulder joint dysfunction, and affect patients' daily activities. For these reasons, it is generally necessary to remove the hook plate after 3-4 months, and this requires secondary surgery, causing secondary damage.

3) The coracoclavicular ligament reconstruction with looped steel plate fixation: anatomic reconstruction of the coracoclavicular ligament was performed with looped steel plate as an alternative to simple suture fixation. These devices consist of two titanium plates of metal buttons connected by non-absorbable sutures. The titanium plate is locked behind the clavicle and coracoid bore, and the suture ACTS as the coracoclavicular ligament. Biomechanical studies have shown that the looped steel plate has considerable biomechanical strength compared with the natural ligament. This surgical method has the advantages of minimally invasive, more consistent with biology and long-term maintenance of acromioclavicular joint stability. However, single looped button titanium plate fixation of the single coracoclavicular ligament appears to be biomechanically inferior to the natural coracoclavicular ligament in vivo. The failure rate of single looping titanium plate fixation is high due to slip of the suture line, fracture of the suture line, displacement of the button titanium plate, secondary fractures, enlarged or mispositioned drilling, and failure to properly treat the acromioclavicular joint capsule, which leads to traumatic arthritis. Because of the high failure rate of single looped titanium plate fixation, it is now recommended to use multiple looped plates to reconstruct and restore the conical and trapezoidal ligaments (to improve horizontal and vertical instability) and to reduce the risk of failure.

4) Reconstruction of the coracoclavicular ligament with tendon transplantation: The natural coracoclavicular ligament (CA) was used to reconstruct the coracoclavicular ligament to treat acromioclavicular joint dislocation. The technique involves the distal clavicle resection combined with the transfer and fixation of the coracoid shoulder ligament from the acromion to the distal clavicle to try to restore the stability of the acromioclavicular joint. This surgical method has been widely adopted, and compared with intact coracoclavicular ligaments, it has demonstrated a failure rate of up to 30% and a biomechanical strength of only about 25%. After improved surgery, direct coracoclavicular ligament suture or acromioclavicular plate was used to supplement ligament transfer. Some studies have reported that compared with the coracoclavicular ligament

reconstruction technique using autogenous semitendinosus muscle transplantation, the clinical effect of modified surgery is poor.

3. Experiments

3.1. Selection of Experimental Materials

3.1.1. Main Operating Instruments and Instruments

Scalpels, bone knives, pliers, tissue shears, wire shears, hammers, toothed forceps, non-toothed forceps , No. 15 and 23 surgical blades, LYF-201B multi-function powerful machine, Surgical magnifier, surgical microscope (XTS-4A), MDF-3820 ultra-low temperature refrigerator.

3.1.2. Main Reagents

4% formalin solution

3.1.3. Specimen

1) Specimen trimming

Sixteen acromioclavicular joints of adult male corpses were selected. All specimens were similar in size and weight. All specimens were radiographed. There were no anatomical changes caused by tuberculosis, rheumatoid rheumatism, malignant tumors and other diseases. There were no dislocations and deformities. After inspection, all specimens met the requirements of this research experiment.

2) Save

Preserved in 4% formalin solution.

3) Remove the specimen

Remove the soaked specimen.

3.2. Experimental Design

3.2.1. Exposing Acromioclavicular Ligament and Coracoclavicular Ligament

Clean up the skin and subcutaneous tissue, completely remove the trapezius muscle, coracoid brachialis muscle, deltoid muscle, subscapularis muscle, superior scapulae, etc., and use a bone knife wire saw to keep the clavicle end of the acromioclavicular joint to about 5 cm. The glenoid was removed from the scapula, and the ligaments around the acromioclavicular joint were separated under a high-power microscope. It was observed that the acromioclavicular ligament was the acromioclavicular joint capsule and its thickened part; the coracoclavicular ligament was separated and it was observed that the coracoclavicular mainly consists of two ligaments ligament. The adipose tissue was peeled off from around the ligament, and the acromioclavicular and yokelock ligaments remained intact.

3.2.2. Biomechanical Measurement of Acromioclavicular Ligament and Coracoclavicular Ligament

At present, the methods for measuring the ligament fracture strength and its anatomical data are cumbersome and trivial. In addition, the current measurement methods have certain shortcomings and cannot provide a widely recognized and effective measurement method. In this study, LYF-201B is used as the experimental equipment. When the specimen is fixed by a special fixture, the tensile test can be performed in the vertical direction under the specified load strength and speed. Due to the limited experimental conditions, it is not possible to use a professional biomechanical testing machine for operation, but because the LYF-201B multifunctional strength machine can measure the tensile strength of the job, it is pulled with the ligament in terms of operating principles, accuracy, and errors. The extension test is similar. After constant analysis and actual measurement of these controllable variables, it is found that the instrument basically meets the requirements of this experiment, so it is used. In view of practical considerations such as the purpose of this anatomical experiment, the design process, the limitations of materials, and the lack of instruments, this experiment is more suitable for invasive measurement.

Based on the principle of random allocation, the experimental specimens after preliminary trimming were randomly divided into two groups, A and B. Group A retained the complete acromioclavicular ligament and coracoclavicular ligament; Group B retained only the acromioclavicular ligament. The bone structure at both ends of the specimen was fixed with a specific clamp. The tensile strength of two groups of ligaments was measured using a multi-functional strength machine with a load speed set to 100 mm / min, and recorded by a computer connected to a biomechanical testing machine. Fracture strength and fracture deformation of each ligament.

3.2.3. Material Collection and Specimen Preservation

Some scholars believe that biomechanical experiments on ligaments are performed immediately after obtaining specimens, but it is difficult to complete the experiment in a short period of time due to the actual experimental conditions; while others are well preserved in low temperature culture medium The obtained specimens shall be subjected to biomechanical experiments after the experimental conditions are mature or perfect. At this stage, most of the tensile mechanical experiments of ligaments tend to use the latter method for preservation. The specimens used in this experiment were sealed and wrapped in plastic bags and several layers of dressings before the experiment, and stored in a warm freezer for freezing. If experiments are needed, remove them in advance.

3.3. Data Processing

Data processing in this paper uses SPSS 17.0. The data were compared in pairs using t test.

4. Discussion

4.1. Analysis of Patient Sex Ratio

Through follow-up of patients, the intraoperative bleeding volume, surgical incision length, complications, internal fixation removal, and 12-month postoperative curative effect were recorded in the three groups of patients, and the follow-up deadline was June 30, 2016. The evaluation of curative effect was based on Karlsson The evaluation criteria were that the shoulder joint had no abnormal appearance, normal movement, no tenderness, throbbing symptoms, and normal muscle strength. The X-ray showed that the acromioclavicular joint space was less than 5mm, and those with no traumatic arthritis were superior. As shown in Figure 1, there is no obvious deformity of the shoulder joint, and the range of motion is 90°-180°. Slight pain can occur after exertion, and the muscle strength is moderate. Inflammation is good; shoulder deformity is obvious, the range of motion is less than 90 °, tenderness and throbbing symptoms are obvious, muscle strength is poor, X-ray shows that the acromioclavicular joint space is blurred, and severe traumatic arthritis is poor.

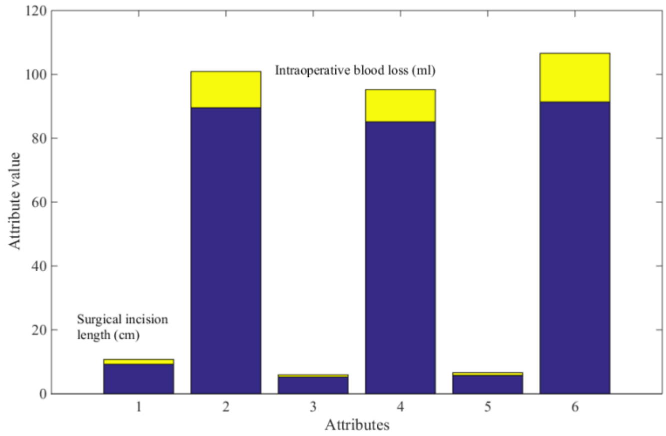

Figure 1. Surgical incision length and intraoperative blood loss of 3 groups

As shown in Tables 1 and 2, there was no statistical difference in the sex composition ratio of the patients, and there was no statistical difference in the age distribution (F = 1.638, P = 0.251> 0.05). In the three groups, the intraoperative blood loss and 12 postoperative There was no statistical difference in monthly efficacy (P> 0.05).

Table 1. The sex ratio of patients

Group	Number of cases	Sex	
		Men	Women
Clavicle hook plate	34	26(76.47%)	8(23.53%)
Double strip anchor	33	26(78.79%)	7(21.21%)
Endobutton group	31	25(80.65%)	6(19.35%)

Table 2. The average of patients

Group	Number of cases	Average age
Clavicle hook plate	34	35.47 ±4.69
Double strip anchor	33	34.22 ±4.07
Endobutton group	31	36.33 ±4.71
F value		1.638
P value		0.251

4.2. Analysis of Postoperative Efficacy

The data of the three groups of patients were collected, and all patients were followed up for more than 12 months. The intraoperative blood loss, incision length, complications, internal fixation removal, and effect of 12 months after operation were recorded. SPSS statistical software was used to analyze the data. Counting data such as gender composition ratio and 12-month postoperative curative effect were expressed as percentages. Chi-square test was used for comparison between groups; intraoperative blood loss and other measurement data were used (mean ± standard

Difference) means that the comparison between groups was performed by one-way analysis of variance and q test, and the standard of statistical difference was P <0.05.

As shown in Figure 2, the length of the surgical incision, the clavicle hook plate group is longer than the double-strip line anchor group and the Endobutton plate group (q = 7.428, P = 0.002; q = 6.835, P = 0.002). There was no statistical difference in the Endobutton steel plate group (q = 1.728, P = 0.118> 0.05). Six cases of repeated shoulder pain occurred in the clavicle hook plate group, which were cured after removal of the internal fixation. The internal fixation was not removed at the end of follow-up in 5 cases, and the remaining two groups had no repeated shoulder pain and no internal plant removal.

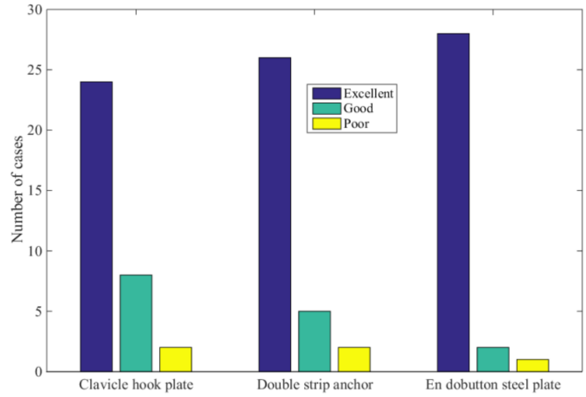

Figure 2. The curative effect of 12 months after surgery in 3 groups

4.3. Analysis of Ligament Pull Test Results of Common Ligaments

Table 3. The ligament pull test result of normal ligaments

Observation item	200N	600N	1000N	1400N	1600N
Strain value (constant)	28.87±2.15	56.29±5.87	87.69±8.08	128.27±11.87	
Displacement (mm)	1.95±0.23	2.84±0.21	3.56±0.33		

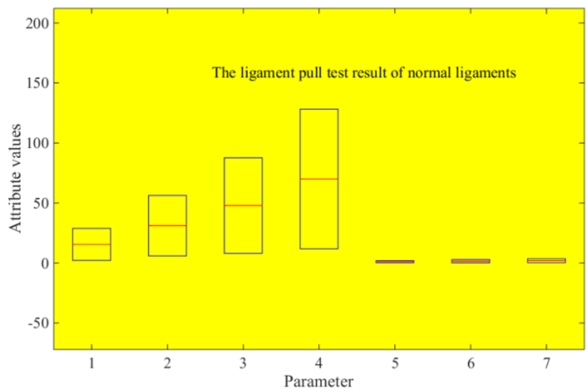

Figure 3. The ligament pull test result of normal ligaments

The acromioclavicular joint is a micro-movement joint, which basically consists of the acromioclavicular surface of the scapula and the acromioclavicular surface of the clavicle. It is connected by the joint capsule, acromioclavicular ligament, and coracoclavicular ligament. Although the range of motion is small, it is synergistic. On human upper limbs. The mechanical properties of the ligaments are related to the tissue structure, the arrangement order of the fiber bundles, and the influence of the surrounding matrix. According to autopsy studies, there are three factors that can cause acromioclavicular joint dislocation related to external forces on the shoulder or traction of the shoulder: Acromioclavicular joint dislocation can be affected: the angle between the acromioclavicular joint and the sagittal plane is different; the movement of the joint There are variations in the degree and joint space; the position of the clavicle.

As shown in Table 3 and Figure 3, the linear load of the normal coracoclavicular ligament is (601.34 ± 61.39) N, the maximum load is (1353.25 ± 146.47) N, the linear displacement is (2.80 ± 0.27) mm, and the maximum displacement is (4.19 ± 0.42) Mm. The final ligament tear occurred at the junction with the clavicle.

4.4. Analysis of Ligament Tension Test Results of Suture Anchors

Table 4. The ligament pull test result of suture anchor

Observation item	200N	600N	1000N	1400N	1600N
Strain value (constant)	21.86 ±2.18	63.04 ±5.05	98.42 ±8.76	118.05 ±12.07	142.38 ±15.17
Displacement (mm)	1.82 ±0.09	2.51 ±0.25	3.48 ±0.35	4.25 ±0.42	4.50 ±0.48

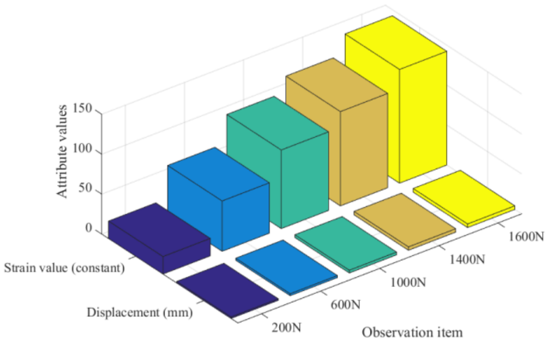

Figure 4. The ligament pull test result of suture anchor

As shown in Table 4 and Figure 4, the linear load of the double strip anchor is (804.16 ± 92.21) N, the maximum load is (1694.24 ± 200.29) N, the linear displacement is (3.35 ± 0.32) mm, and the maximum displacement is (4.93 ± 0.47) Mm. The results of the Endobutton group were similar to those of the double-strip line anchor group, but when the load increased to the extreme value, the reconstructed ligament was torn, mostly in the middle. The clavicle hook plate group had a linear load of (610.28 ± 58.31) N, a maximum load of (1380.31 ± 120.29) N, a linear displacement of (2.76 ± 0.14) mm, and a maximum displacement of (4.29 ± 0.38) mm. When the clavicle hook plate fails, it is caused by the deformation of the hook end.

There was a statistical difference in the data line displacement between the 4 groups (F = 89.460, P <0.05). Compared with the other 3 groups (q = 1.282, P = 0.337; q = 4.568, P = 0.019; q = 4.376, P = 0.021), indicating that the biomechanical properties of the clavicle hook plate during normal loading are similar to normal ligament tissue, but worse than the double-strip line anchor and Endobutton. The ratio of the clavicle hook plate to the double-strip line anchor and Endobutton is statistically different (q = 5.335, P = 0.011; q = 5.276, P = 0.012) It indicates that the biomechanical performance of the double-strip anchor and Endobutton is better than that of the clavicle hook plate under uniform loading. There is no difference between the double-strip anchor and the Endobutton group; the maximum load of the four groups of data There is a statistically significant difference ($F = 100.690$, $P < 0.05$). Compared with the other three groups ($q = 1.323$, $P = 0.295$; $q = 4.392$, $P = 0.020$; $q = 4.539$, $P = 0.018$) When loaded to the maximum load, the maximum tensile capacity of the clavicle hook plate is similar to that of the normal ligament, which is less effective than the double-strip anchor and Endobutton steel plate. Compared with the double-strip anchor and Endobutton steel plate ($q = 4.224$, $P = 0.025$; $q = 4.367$, $P = 0.020$), which shows that the maximum tensile capacity of the clavicle hook plate is worse than that of the other two groups. Double-strip anchors and Endobutt There is no statistical difference in performance.

The maximum displacement of the four groups of data was statistically different ($F = 78.34$, $P < 0.05$). Compared with the other three groups ($q = 1.327$, $P = 0.243$; $q = 4.313$, $P = 0.020$; $q = 4.254$, $P = 0.025$), indicating that the normal ligament tissue and the clavicle hook plate have similar fixation strength to the acromioclavicular joint, but inferior to the double band line anchor and Endobutton; the clavicle hook plate is compared with the double band line anchor and Endobutton ($q = 4.852$, $P = 0.013$; $q = 4.368$, $P = 0.020$), which indicates that the deformation of the clavicle hook steel plate is worse than that of the other two types when the internal fixation load of the three groups is ineffective. There is no statistical difference between the double-strip anchor and the Endobutton. From the chart, it can be calculated that the strength of the normal ligament is (625.27 ± 61.35) MPa, the strength of the clavicle hook steel plate is (620.54 ± 63.24) MPa, the strength of the double-strip anchor is (795.84 ± 77.28) MPa, and the strength of the Endobutton steel plate is (801.94 ± 56.57) MPa. Comparing the three groups with normal ligaments, there was a statistically significant difference between the double band line anchor and the normal ligament ($F = 13.523$, $P < 0.05$). The ratio of the Endobutton steel plate to the normal ligament was significantly different ($F = 14.571$, $P < 0.05$), There was no difference between the hook steel plate and the normal ligament, and there was no difference between the double band line anchor and the Endobutton steel plate.

5. Conclusion

The sports injuries of American college football players are mainly acute injuries. The prevention of sports injuries is a top priority, and athletes must be fully prepared before formal training and competitions. The conclusions of this article are as follows: The internal fixation of the clavicle hook plate is the main treatment for Rockwood III acromioclavicular joint dislocation. The anatomical design of the plate is consistent with the moment of inertia of the human shoulder joint. This study compared the biomechanics of the complete acromioclavicular ligament, the coracoclavicular ligament, and the acromioclavicular ligament, and found that the acromioclavicular ligament significantly maintained the stability of the acromioclavicular joint. Based on this, the author analyzes that in the treatment of type III acromioclavicular joint dislocation, the repair of the acromioclavicular ligament is necessary, and the coracoclavicular ligament does not need special repair. In this way, the adverse effects of time-consuming, labor-intensive, easy to re-traumatic and the like caused by simultaneous repair of the coracoclavicular ligament can be avoided, and the ideal effect of high efficiency, energy saving and easy repair can be achieved.

In terms of biological strength, all three types of internal fixation can reach or exceed the normal ligament strength, but the mechanical properties of the clavicle hook plate are slightly inferior. Double-strand anchors and Endobutton steel plates are superior to clavicle hook steel plates in terms of strength, stiffness, and elastic modulus. They can provide a stable healing environment for the repair of damaged ligaments, provide conditions for patients' early functional exercises, and prevent shoulder joint stiffness. . The clavicle hook plate is relatively mature in technology, with many steel plate materials, models, and manufacturers, and relatively low cost. It is a good choice for patients with limited economic conditions and low shoulder function requirements, but the surgical incision is large and the tissue is stripped during the operation. Many, the defect of high postoperative complication rate cannot be compensated.

Rockwood Ⅲ acromioclavicular joint dislocation can achieve anatomical reconstruction treatment, can achieve acromioclavicular joint reset and firm fixation, and can maintain its position for a long time; it can reduce the impact under the acromion and the interference with the soft tissue around the acromioclavicular joint, reducing postoperative appearance The probability of shoulder pain; the micro-movement characteristics of the acromioclavicular joint are retained, which is in line with the concept of biological fixation; the tightening amplitude of the self-locking cable can be controlled to accurately reset, and its unidirectional tightening characteristics make the acromioclavicular joint The risk of re-dislocation and loss of reduction is reduced; the operation is convenient, the operation time is short, and it is convenient for popularization; internal fixation does not need to be removed by secondary surgery.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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