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FUNCTIONAL RECOVERY OF POST-TRAUMATIC SHOULDER INSTABILITY: A CASE STUDY

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Abstract

Aim. Shoulder instability, particularly post-traumatic, is a significant issue in sports medicine. This study investigates the functional recovery of an unstable shoulder following a surgical intervention for labrum glenoid reconstruction.

The aim of this study is to evaluate the effectiveness of a comprehensive rehabilitation program that includes physiotherapy, electrotherapy, hydrotherapy, and kinesiotaping in restoring shoulder function and reducing pain in a post-traumatic shoulder instability case.

Methods. The study followed a 21-year-old male athlete who had experienced multiple shoulder subluxations, culminating in surgery. The rehabilitation program was conducted over six months at the Fisiokinlab private clinic in Oradea. Various assessments were conducted, including mobility, muscle strength, flexibility, pain, and instability tests.

Results. Significant improvements were observed in shoulder mobility, with flexion increasing from 60° to 160°, extension from 24° to 40°, abduction from 77° to 176°, and external rotation from 6° to 29°. Muscle strength evaluations showed progress from F3- to F5 across different movements. Pain levels decreased notably, with daytime pain reducing from 6 to 2, exercise pain from 8 to 6, and nighttime pain from 5 to 1. Instability tests also showed marked improvements.

Conclusions. The comprehensive rehabilitation program was effective in significantly improving the functional capabilities and reducing the pain and instability of the shoulder. The integration of multiple therapeutic approaches played a critical role in the patient's recovery, suggesting the value of a multidisciplinary rehabilitation strategy for similar cases.

Keywords: Post-traumatic shoulder instability, physiotherapy, pain management.

Introduction

The shoulder joint is one of the most complex and mobile structures in the human body, allowing a wide range of movements. However, this high mobility makes the shoulder particularly vulnerable to injuries and instability, which can be exacerbated by activities that impose repetitive loads, such as overhead sports (Sheehan et al., 2013).

Instability in the shoulder is frequently encountered among overhead athletes, with common causes encompassing traumatic events related to shoulder instability, ongoing overuse, and microtrauma. The repeated motion and substantial forces exerted on the shoulder joint by overhead athletes during their developmental years may gradually alter the structure and function of the joint's anatomical stabilizers. This 'normal adaptation' can evolve into pathological dysfunction in several forms, including glenohumeral internal rotation deficit, internal impingement from tightening of the posterior capsuloligamentous structures, a comparative loosening of the anterior structures, SLAP, injuries to the biceps tendon, and tendinopathy or tears of the rotator cuff (Arguello, 2022).

SLAP lesions can be caused by a variety of injury mechanisms, ranging from single traumatic events to repetitive microtraumatic injuries. Traumatic events, such as falling on an outstretched arm or abrupt stopping during a car accident, can cause SLAP lesions due to the compression of the superior articular surfaces combined with subluxation of the humeral head. This is known as the "pinch" injury mechanism according to Snyder. Other traumatic injury mechanisms include direct blows, falls on the shoulder point, and traction injuries of the upper limb.

Repetitive overhead activities, such as hyperextension in goalkeeper saves in soccer, are another common injury mechanism that often leads to SLAP lesions. Andrews et al. (1985) first hypothesized that SLAP pathology in athletes performing overhead movements stemmed from the high eccentric activity of the biceps brachialis during the deceleration and follow-through phases of the movement. During an arthroscopic evaluation, the authors observed that the contraction of the biceps lifted the labrum from the glenoid rim, simulating the hypothesized mechanism.

Burkhart and Morgan (1998) hypothesized a "peel-back" mechanism that produces SLAP lesions in athletes performing overhead movements. They suggest that when the shoulder is in a position of abduction and maximum

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external rotation, the rotation generates a twist at the base of the biceps, transmitting a torsional force to the anchor. Also, Ejnisman et. al. (2016), describe this mechanism for the goalkeepers injuries, due to their pitch role.

In the Fifa 11+ program is described a list of preventing exercises to reduce the appearance of injury in the goalkeeper, but without any relevance statistics. In cases of SLAP (Superior Labral from Anterior to Posterior) lesions, particularly type II and type IV which involve detachment of the biceps tendon and the labrum, surgical intervention is often the preferred method to restore shoulder stability and function, especially for athletes. This is due to the poor outcomes associated with non-surgical management of these unstable lesions. The surgical approach generally involves the reattachment of the superior labrum to the glenoid using suture anchors or a bioabsorbable tack, with the specific technique adapted based on the extent of the biceps involvement. If the biceps tear is substantial, a procedure such as biceps tenodesis may be performed instead of direct repair to maintain biceps function and prevent further instability (Wilk et al., 2005). Postoperative rehabilitation of these injuries is often complicated and lengthy, significantly impacting an athlete's ability to return to pre-injury levels. This process can be further complicated by the presence of kinesiophobia – the fear of moving the injured shoulder – which can delay recovery and return to play as Popchak (2017) and Wang (2022) describes in their articles.

The aim of this study is to evaluate the effectiveness of a comprehensive multidisciplinary rehabilitation for a 20-year-old soccer goalkeeper who has suffered repeated shoulder dislocations and was subsequently operated on for a SLAP lesion. Through this approach, we aim to explore effective strategies for managing the complex dynamics of postoperative recovery in these specific cases.

Objectives

The main objective of this study is to demonstrate the effects of the union of tecartherapy, kinesitherapy and kinesiotaping in Functional Recovery of Post-Traumatic Shoulder Instability.

Secondary objectives: reduce posttraumatic shoulders pain, increase shoulder s ROM, muscle strength.

Methods

This study is designed as a single-subject case study conducted at the Fisiokinlab private clinic in Oradea, during 6 months. The participant is a 21-year-old male goalkeeper who experienced multiple shoulder subluxations, which eventually led to a SLAP lesion requiring surgical intervention. Throughout his career, the subject experienced multiple subluxations of the shoulder joint, all of which were reducible except for the last one, which required surgical intervention. The anamnesis reveals that the traumatic events occurred following an external rotation movement. The first subluxation occurred in September 2019 and was treated with electrotherapy and kinesiotherapy aimed at developing muscle mass around the scapulohumeral joint. Subsequent subluxations were recorded in October and November 2021, with the latter being treated with acupuncture for two months and kinesiotherapy. Another subluxation occurred in July 2022, again treated with acupuncture and kinesiotherapy. In August 2023, the subject suffered another subluxation, which led to surgical intervention. That same month, they underwent surgery at the "Hermann-Josef-Krankenhaus" clinic in Erkelenz (Cologne, Germany) for the reconstruction of the glenoid labrum.

The participant was selected based on specific criteria, including being a high-level athlete with a post-surgical SLAP lesion. The inclusion criteria were high-level athletes aged 18 to 25 with post-surgical SLAP lesions, while exclusion criteria included the presence of other significant shoulder injuries or conditions, inability to participate fully in the rehabilitation program, and contraindications to the therapeutic interventions used. The materials utilized in this study included physiotherapy equipment for range of motion and strength exercises, an electrotherapy device, a hydrotherapy pool, kinesiotape, and a tecartherapy device.

The rehabilitation program included various therapeutic interventions such as physiotherapy, electrotherapy, hydrotherapy, kinesiotaping, and tecartherapy. Physiotherapy focused on restoring the range of motion, strength, and functional stability of the shoulder. Electrotherapy was used to reduce pain and inflammation and promote tissue healing. Hydrotherapy provided to enhance mobility and strength, while kinesiotaping supported the shoulder joint, improved circulation, and reduced pain. Tecartherapy, using capacitive and resistive energy transfer, was employed to promote healing and to reduce muscles stiffness. Throughout the rehabilitation program, various assessments were conducted to monitor the participant's progress. These included measurements of shoulder mobility using a goniometer, muscle strength evaluated through manual muscle testing (Oxford), flexibility assessed via stretching tests (Tarcau, 2011), pain levels measured using a visual analog scale (VAS), instability evaluated through Apprehension test, fulcrum test and relocation test.

For the Apprehension Test, the patient is seated with the upper limb abducted 90° and the elbow flexed at 90°. The examiner, positioned behind the patient, grips the forearm in the distal third, while supporting the arm in the proximal third. The examiner then performs slow external rotation while applying light pressure forward on the humeral head with the hand placed on the patient's shoulder. This maneuver will elicit apprehension in a patient with anterior shoulder instability, shown through facial expressions or words (the patient will indicate that the shoulder "comes out").

In the fulcrum Test the patient lies supine with the upper limb abducted and externally rotated 90°. The examiner places a fist under the shoulder for support while using the other hand to apply downward pressure on the patient's elbow. This maneuver, through anterior translation of the humeral head on the glenoid, will trigger apprehension in the patient, similar to the previously described test.

For the Relocation Test if the previous tests are positive, the fulcrum test will be repeated with the patient lying supine, using the edge of the bed as a support. However, in this case, the pressure will be applied both forwards and backwards, allowing for a greater degree of external rotation. In this position, the patient's apprehension will be reduced. (Lo et al., 2004).

The postural assessments were conducted using photographic analysis with Kinovea software, already succesufull used by Elrahim (2016) and Yazdani (2022) in their studies. The intervention lasted six months, with sessions initially conducted three times a week and adjusted based on progress. Each session lasted approximately one hour and included a combination of physiotherapy, electrotherapy, hydrotherapy, and kinesiotaping, all supervised by a licensed physiotherapist experienced in sports rehabilitation.

Descriptive statistics were used to summarize the data, with comparison from the initial, middle and final testing.

Results

The rehabilitation program for the 21-year-old male goalkeeper was conducted over six months, focusing on restoring shoulder function, reducing pain, and improving stability. The following sections present the detailed results of the various assessments conducted throughout the program.

Flexion

Progress in flexion movement was satisfactory. The most significant progress was recorded between the initial testing and intermediate testing 1, and between intermediate testing 2 and the final testing. The progress achieved in the first month of treatment was 35°, between the second and third month 11°, and between the third and sixth month 54°. The total progress was 100°, with the initial ROM being 60° and the final one 160°.

Table 1. Results of the flexion evaluation

No.	*Parameters*	*Values*
1.	Initial flexion evaluation	60°
2.	Intermediary 1 flexion evaluation	95°
3.	Intermediary 2 flexion evaluation	106°
4.	Final flexion evaluation	160°

Extension

In extension movement, there were no significant problems. The most significant progress was recorded between the November-December and December-March testing, 6° and 7° respectively. The progress achieved in the first month of treatment was 3°. The total progress was 16°, with the initial ROM being 24° and the final one 40°, achieving complete functionality according to some authors.

Table 2. Results of the extension evaluation

No.	*Parameters*	*Values*
1.	Initial extension evaluation	24°
2.	Intermediary 1 extension evaluation	27°
3.	Intermediary 2 extension evaluation	33°
4.	Final extension evaluation	40°

Abduction

For abduction movement, the following progress was recorded: The most significant progress was recorded between the initial and intermediate 1 testing, obtaining an increase of 59°. The progress achieved between the second and third month was 32°, and between the third and sixth month was 8°. The total progress was 99°, with the initial ROM being 77° and the final one 176°.

Table 3. Results of the abduction evaluation

No.	*Parameters*	*Values*
1.	Initial Abduction evaluation	77°
2.	Intermediary 1 Abduction evaluation	136°
3.	Intermediary 2 Abduction evaluation	168°
4.	Final Abduction evaluation	176°

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Internal Rotation

Initial evaluation for internal rotation was not possible due to blocking and stiffness at the scapulohumeral joint. The second testing gave a value of 10°, the third 21° (gain of 11°), and in the final testing a value of 37° (gain of 16°). The ROM value at the end of the recovery program was 37°.

Table 4. Results of the internal rotation evaluation

No.	*Parameters*	*Values*
1.	Initial internal rotation evaluation	0°
2.	Intermediary 1 internal rotation evaluation	10°
3.	Intermediary 2 internal rotation evaluation	21°
4.	Final internal rotation evaluation	37°

External Rotation

Like internal rotation, the initial evaluation for external rotation was not possible. The second testing gave a value of 6°, the third 15° (gain of 13°), and in the final testing a value of 42° (gain of 27°). The ROM value at the end of the recovery program was 42°.

Table 5. Results of the external rotation evaluation

No.	*Parameters*	*Values*
1.	Initial external rotation evaluation	0°
2.	Intermediary 1 external rotation evaluation	6°
3.	Intermediary 2 external rotation evaluation	15°
4.	Final external rotation evaluation	42°

Pain

In pain evaluation using the visual analog scale, it was found that the highest and most constant pain was during treatment sessions. The second highest pain sensation was felt during the day, decreasing by two points after the first month of treatment, remaining constant until the third month of recovery, and decreasing again in the final testing with a 2-point difference between the initial and final testing, being 4 points. Night pain recorded values of 5 in the initial testing, 4 in the two intermediate testings, and 2 points in the final testing.

Table 6. Results of the pain evaluation

No.	*Evaluation*	*Daytime Pain*	*Exercise Pain*	*Night Pain*
1.	Initial	6	9	5
2.	Intermediary 1	4	7	4
3.	Intermediary 2	4	8	3
4.	Final	2	6	1

Shoulder Instability

As shown in the table, in the first two months, the three tests resulted positive. This indicates that from the moment the apprehension test was negative (December), it coincided with emphasizing rotation movements. In the final testing, the results were negative, and the subject gained some confidence in the stability of the joint.

Table 7. Results of the shoulder instability evaluation

No.	*Evaluation*	*Apprehention Test*	*Fulcrum Test*	*Relocation Test*
1	Initial	Positive	Positive	Positive
2	Intermediary 1	Positive	Positive	Positive
3	Intermediary 2	Negative	Positive	Negative
4	Final	Negative	Negative	Negative

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Postural Evaluation

In the initial evaluation in October, the angles obtained were 87° for the acromion and 85° for the left inferior scapular angle. Regarding the left inferior scapular angle, there was a gain of 1° in November 86°, 2° in December 88°, and in March still 88°. For the acromion, the first three tests were 87°, and the one in March was 88°.

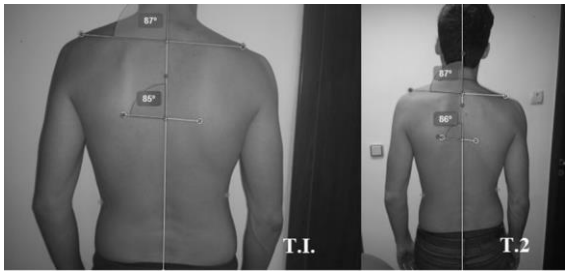

Figure 1. Postural Evaluation Initial-Intermediary I

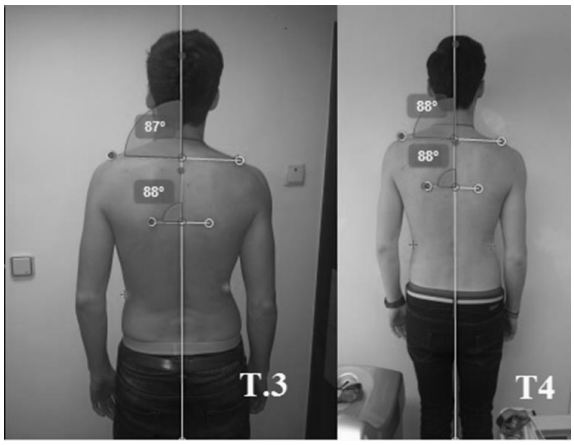

Figure 2. Postural Evaluation Intermediary II- Final

Flexibility Evaluation

As it was impossible to perform internal/external rotation movements, the first two tests could not be carried out, but considering the importance of flexibility in the shoulder girdle, this objective was considered from the beginning. As we gained in ABD, FLX, and rotation movements, we gradually introduced exercises to increase the flexibility of the shoulder girdle and the cervico-lumbar spine. In December, we were able to perform the test, obtaining a result of -12 cm, while in the final test in March, the value was 0, the subject managing to touch the tips of the index fingers.

Table 8. Results of the flexibility evaluation

No.	*Evaluation*	*Value Obtained*
1.	Initial flexibility evaluation	N/A
2.	Intermediary 1 flexibility evaluation	N/A
3.	Intermediary 2 flexibility evaluation	-12 cm
4.	Final	0 cm

Muscle Strength Evaluation

For the muscle strength evaluation, we used the Oxford Test (Hermans, 2014).

Table 9. Muscle Grading Scores

No.	*Muscle Grading Scores*
0	
1	No detectable muscle contraction (visible or palpation)
2	Detectable contraction (visible or palpation), but no movement achieved
3	Limb movement achieved, but unable to move against gravity
4	Limb movement against resistance or gravity
5	Limb movement against gravity and external resistance
	Normal strength

In the initial testing, due to the limitations of joint ROM, the muscle strength testing gave a result of F3- in all tested movements. As recovery progressed, the tests showed which movements were emphasized: flexion, extension, and abduction, moving from F3- to F3, while in rotation movements, the muscle strength testing did not show improvements. The same pattern was observed in the second intermediate test in December, with a progress from F3 to F3+, while rotation movements remained stable at F3-. In the final test, there was a general improvement: flexion, extension, and abduction reached F5, while external rotation and internal rotation reached F3+.

Table 10. Results of the muscle strength evaluation

No.	*Parameters*	*FlexionValue*	*Extension Value*	*Abduction (ABD) value*	*External Rotation (ER) Value*	*Internal Rotation (IR) value*
1.	Initial strength evaluation	F3-	F3-	F3-	F3-	F3-
2.	Intermediary 1 strength evaluation	F3	F3	F3	F3-	F3-
3.	Intermediary 2 strength evaluation	F3+	F3+	F3+	F3-	F3-
4.	Final strength evaluation	F5	F5	F5	F3+	F3+

Discussions

The results of this study demonstrated significant improvements in shoulder mobility, muscle strength, pain reduction, flexibility, and stability following the multidisciplinary rehabilitation program. These findings align with previous studies that have shown the effectiveness of combined therapeutic interventions in managing post-surgical SLAP lesions. The improvements in shoulder mobility, as indicated by the increased range of motion in flexion, extension, abduction, and rotation, suggest that the integration of physiotherapy, electrotherapy, hydrotherapy, and kinesiotaping effectively addresses the biomechanical demands of the shoulder joint. This comprehensive approach likely facilitated the reduction of joint stiffness and promoted better muscle coordination and joint function.

Our study identifies common findings that validate our arguments regarding the effectiveness of kinesitherapy combined with tecartherapy in reducing pain and improving the range of motion, as demonstrated in various articles (Szabo et al., 2020 and Raeisi, M. 2023). Similarly, the beneficial effects of kinesiotape are supported by several studies, which confirm that its application, combined with joint mobilization, leads to an improvement in symptoms (Singh, A. 2023).

As also discussed by Popchak et al. in 2017 and by Wang et al. in 2022, kinesiophobia—the fear of movement following injury—significantly affects the quality and success of rehabilitation. It is a factor that must always be considered and addressed throughout the rehabilitation process.

The observed muscle strength gains, evaluated using manual muscle testing (MMT), underscore the importance of targeted strength training in rehabilitation programs for athletes. The significant increase in muscle strength across all measured movements indicates that the rehabilitation program successfully restored the functional capacity of the shoulder, essential for the participant's return to high-level athletic performance. This finding is consistent with existing literature that emphasizes the role of resistance training in enhancing muscle strength and functional outcomes in shoulder rehabilitation. Pain reduction, as measured by the visual analog scale (VAS), further supports the effectiveness of the rehabilitation program. The marked decrease in pain levels during daytime activities, exercises, and nighttime rest highlights the program's success in alleviating discomfort and improving the participant's quality of life. These results are in line with studies that have reported significant pain relief following multidisciplinary rehabilitation interventions for shoulder injuries.

Instability and flexibility assessments revealed substantial improvements, suggesting that the rehabilitation program enhanced joint stability and flexibility. The reduction in positive instability tests and the improvement in flexibility scores indicate that the program effectively addressed the underlying issues contributing to shoulder instability and limited range of motion. These findings are supported by research that highlights the benefits of proprioceptive training and flexibility exercises in managing shoulder instability and enhancing joint function.

The postural assessment using photographic analysis with Kinovea software showed improvements in shoulder posture and alignment. This finding is crucial, as proper posture and alignment are essential for preventing re-injury

and ensuring optimal shoulder mechanics. The observed improvements suggest that the rehabilitation program not only addressed the immediate symptoms of the SLAP lesion but also contributed to the long-term health and stability of the shoulder joint.

Conclusions

This study provides valuable insights into the effectiveness of a multidisciplinary rehabilitation program for managing post-surgical SLAP lesions in overhead-athletes. The significant improvements in shoulder mobility, muscle strength, pain reduction, flexibility, and stability underscore the importance of integrating various therapeutic interventions to achieve optimal rehabilitation outcomes. By addressing the unique biomechanical demands and injury mechanisms associated with the goalkeeper position, the rehabilitation program facilitated the participant's return to high-level athletic performance.

Despite the positive outcomes, this study has several limitations. As a single-subject case study, the findings may not be generalizable to a broader population. Further research involving larger sample sizes and diverse athletic populations is needed to validate the effectiveness of the rehabilitation program. Additionally, the study's reliance on subjective measures, such as the visual analog scale for pain assessment, may introduce bias. Objective measures, such as electromyography and advanced imaging techniques, could provide more comprehensive insights into the rehabilitation outcomes.

The implications of this study could be significant for clinicians and researchers in sports rehabilitation. The demonstrated effectiveness of a multidisciplinary approach can inform the development of evidence-based rehabilitation protocols for athletes with post-surgical SLAP lesions. The study also underscores the importance of individualized rehabilitation programs tailored to the specific needs and demands of the athlete's sport. Future research should explore the long-term outcomes of such rehabilitation programs and their impact on athletic performance and re-injury prevention.

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