Archives of Current Medical Research
Arch Curr Med Res 2024;5(1):1-6

Received: 29 October 2023
Revised: 1 January 2024
Acccepted: 24 January 2024
DOI: 10.47482/acmr.1413317

REVIEW ARTICLE

Subscapularis tendon tears: A narrative review

İlhan Çelik[1] Tacettin Ayanoğlu[2] Günbay Noyan Dirlik[1] Mustafa Odluyurt[3] Abdurrahman Vural[4] Fatih İlker Can[5] Mustafa Yasin Hatipoğlu[6] Semih Yaş[7] Batuhan Bahadır[8]

1 Alanya Education and Training Hospital, Department of Orthopedics and Traumatology, Alanya, Antalya, Turkey
2 Bolu Abant Izzet Baysal University Medical Faculty, Department of Orthopedics and Traumatology, Bolu, Turkey
3 Çaycuma State Hospital, Department of Orthopedics and Traumatology, Zonguldak, Turkey
4 Başakşehir Çam and Sakura City Hospital, Department of Orthopedics and Traumatology, Istanbul, Turkey
5 Muğla Education and Training Hospital,Department of Orthopedics and Traumatology, Muğla, Turkey
6 Hand and Upper Extremity Surgeon, Private Clinic, Ankara, Turkey
7 Gazi University, Faculty of Medicine, Department of Orthopedics and Traumatology, Ankara, Turkey
8 Ankara Bilkent City Hospital, Department of Orthopedics and Traumatology, Ankara, Turkey

Abstract

The subscapularis muscle, which is the strongest muscle of the rotator cuff, plays important roles in shoulder biomechanics and stability. The emergence of a significant percentage of subscapular tendon tears in rotator cuff tears with advancing arthroscopic techniques has brought the importance of subscapular repair to the agenda along with different dynamics to the arthroscopic perspective. Patient training will reduce postoperative patient morbidity in addition to physical examination, imaging, and medical and surgical approaches to the treatment.

Keywords: M. Subscapularis Tendon, Shoulder, Arthroscopic Repair.

Cite this article as: *Çelik İ, Ayanoğlu T, Dirlik Noyan G, Odluyurt M, Vural A, Can Fİ, Hatipoğlu MY, Yaş S, Bahadır B. Subscapularis tendon tears: A narrative review. Arch Curr Med Res. 2024;5(1):1-6*

Corresponding Author:
İlhan Çelik, Alanya Education and Training Hospital, Department of Orthopedics and Traumatology, Alanya, Antalya, Turkey
E-Mail: drilhanc@gmail.com

INTRODUCTION

The shoulder is a complex joint that has a complex network of bones, ligaments, muscles, and neurovascular anatomy along with a wide range of motion and functional requirements (1). The subscapularis muscle, which is the largest and strongest muscle of the rotator cuff, plays important roles in shoulder stability and function (2).

The subscapular muscle fills the subscapular fossa providing 50% of the total strength of the rotator cuff. It also plays roles with its triangular shape in balancing the force couples of the glenohumeral joint and in internal rotation and abduction of the shoulder (3). Its upper two-thirds attaches to the minor tuberosity as a tendon after passing under the coracoid, and its lower third attaches to the metaphysis of the proximal humerus as a muscle (4). The superolateral part of the subscapularis is in close relationship with the superior glenohumeral and coracohumeral ligament (5). The nerve subscapular innervates the subscapular muscle (6).

Subscapular tears are frequently detected in forced external rotation with abduction or forced extension (7). Subscapularis tears are more frequent than expected with the development of modern arthroscopic techniques and greatly affect the quality of life (8). Although isolated subscapular tears are frequent in the young population (4%) (9), subscapular tears are detected in 40% of shoulder cuff tears (4). In the present study, the clinical characteristics, diagnostic methods, treatment options, and rehabilitation procedures of subscapularis muscle tears, which affect the comfort of life significantly, are explained comprehensively.

Subscapularis Tears and Classification

Classifying the subscapular tendon tears is of prognostic importance for preoperative preparation and planning appropriate treatment. Many suggestions were offered in the past for the classification of subscapular tendon tears, but no strong decision has been reached yet. Some of these classifications are diagnostic in physical examination, some in ultrasonography, and some in CT arthrography. Yoo and Rhee, Fox and Romeo's, Martetschlager, Lyon, Toussaint, Dierckman classifications are the classifications used in the repair of subscapular tendon tears (10). According to a survey that was conducted among elbow and shoulder surgeons in America in 2023, it was reported that the Lafosse Classification is more appropriate for the most appropriate diagnosis and treatment (11).

Table 1. Classification of Lafosse et al. regarding subscapular tendon tears (12)

Type 1	Partial tear and erosion on the superior third of the subscapularis
Type 2	Complete detachment of the superior third of the subscapularis
Type 3	Complete detachment of the superior two-thirds of the subscapularis without involvement of the inferior one-third muscular part (limited tendon retraction)
Type 4	Complete subscapularis tear from the humeral insertion (well-centered humeral head and fatty infiltration involving less than or equal to grade 3 tear)
Type 5	Complete subscapularis tear from the humeral insertion with humeral head anterosuperior subluxation and contact with the coracoid (associated with fatty infiltration)
Plug	Isolated deep layer SC tendon tear (for visualization it is required to elevate the subscapularis tendon by the probe)

The Etiology of Subscapular Tendon Tears

Many subscapular tears occur as a result of a strong contraction in sudden accidents and traumas (13). Partial or complete tears might occur as a result of repetitive chronic overuse, especially in manual workers and athletes (14). Non-traumatic tears might occur as a result of decreased elasticity in muscle tissue with advancing age (15). Biomechanical abnormalities (16) and inadequate body alignment (17) cause potential tears over time and genetic predisposition (18) plays important roles in this respect. In the shoulder joint, inflammatory conditions (e.g., tendinitis and bursitis) can weaken the subscapular tendon and cause ruptures if not managed well (19).

Another approach is that the subscapularis tendon increases the tensile loads on the joint surface, causing tension undersurface fiber failure at the subscapularis insertion. Subcoracoid stenosis and subcoracoid impingement contribute to the pathogenesis of subscapularis tendon tears by causing a "roller-wringer effect" on the subscapularis tendon (20).

The Symptoms of Subscapular Tendon Tears

The presence of pain increasing with internal rotation or overhead exercises is a characteristic indicator of

subscapularis tears (21). Subscapularis injuries might result in a limited range of motion in the abduction and internal rotation. Patients might also face difficulties in raising their arms above their heads or feel discomfort while doing certain actions. Determining the degree of mobility restriction facilitates determining the extent of the tear (13). Patients might encounter pain within a defined range of movement, commonly during the middle phase of moving the limb away from the body and rotating it outward. Identifying the specific range of movement that causes discomfort helps to determine the damaged structures and direct additional diagnostic investigations (22). Some persons experiencing subscapularis tears might have a perception of catching or clicking in the shoulder joint when performing specific movements. These sensations might suggest the presence of structural problems and can help direct additional diagnostic tests (23). Commonly, clinical examinations reveal tenderness in the anterior shoulder region, particularly localized over the subscapularis muscle. By palpating this region, the clinician can pinpoint the origin of pain and discomfort, hence enhancing the precision of the diagnosis (21). An indicative indication is the exacerbation of pain during nighttime, especially when reclining on the afflicted shoulder. Nocturnal pain can greatly affect the quality of sleep and is frequently an indication of an underlying subscapularis disease (24). Subscapularis rips can lead to muscular atrophy in circumstances that are persistent or severe. Measurable alterations in muscle size, specifically in the front region of the shoulder, can suggest the presence of long-lasting or significant injuries (25).

Physical Examination Findings and Imaging Techniques

Detailed anamnesis, physical examination, and imaging make up the pillars of diagnosis in patients presenting with shoulder complaints. Physical examination and imaging are a whole. It is argued that only imaging without physical examination might not be compatible with the actual treatment and might cause unnecessary and excessive treatment modalities to be applied (26). The functionality of the subscapularis is evaluated with the Dynamic Lift-Off Test, bear-hug test, and Belly Press Test performed during the physical examination (27). Among these tests, the bear-hug test can be considered the most likely clinical test to detect a tear in the upper part of the subscapularis tendon. Performing all subscapularis physical examination tests at the same visit is useful in estimating the size of the tear (28). Long biceps head tendon sheath effusion >2 mm on USI (29), subscapularis tendon tear from the lesser tuberosity in the axial plane on Magnetic Resonance Imaging (MRI), Long Head of the Biceps (LHB) tendon subluxation, subscapularis muscle belly atrophy in the sagittal plane, torn subscapularis fibers and bare lesser tuberosity are important findings in subscapular tendon ruptures (11). Bone marrow edema, cysts, and fat atrophy in the tuberculum minor are the symptoms of chronic tears (30). In addition, although no subscapular tear is seen in the MRI findings of patients whose surgery is planned due to rotator cuff tear, the presence of subcoracoid effusion should bring to mind intraoperative subscapular evaluation (31).

No doubt, the best imaging is Shoulder Arthroscopy, which serves both diagnosis and treatment simultaneously (32). When the Comma Sign is in the upward retraction of the superior glenohumeral ligament and coracohumeral ligament, it is an important symptom in full-thickness subscapular tears in arthroscopy (33).

Artificial intelligence and machine learning algorithms have attracted great attention in recent years as a promising, innovative approach to diagnosis (34). According to a machine learning study conducted for the diagnosis of subscapular tendon tears, it was found that MRI alone was successful in predicting subscapularis tears in 85% of patients, and this machine learning increased the accuracy and sensitivity in diagnosis (35). However, advanced and large-scale studies on machine learning are still needed.

Treatments

Less active, older patients with smaller atraumatic tears should first enter a conservative treatment plan consisting of physical therapy, anti-inflammatories, and activity modifications (36). Shoulder joint strengthening exercises and electrical stimulation help increase range of motion and NSAIDs can provide both physiopathological and symptomatological relief for inflammation (37, 38). The patient must be shown which movements to avoid (21). Corticosteroid injections might be utilized because of their anti-inflammatory characteristics. Injected directly into the subacromial region or shoulder joint, these injections offer brief alleviation of discomfort and inflammation. It should be kept in mind that there may be atrophy in the muscle, and it should not be forgotten that it may pave the way for new tears in the tendon (39, 40). Platelet-Rich Plasma (PRP) and Stem Cell Therapy are widely

preferred in biological interventions today. PRP injections entail the utilization of concentrated platelets from the patient's own blood to promote the process of healing. This regenerative method has the potential to enhance tissue healing in instances of subscapularis rips (41, 42). Stem cell therapy investigates the regenerative capacity of stem cells to assist in the restoration of damaged tissues. Ongoing research in this field shows promise for treating subscapularis injuries (43, 44). While symptomatic relief is observed in conservative treatments, it should be kept in mind that complete recovery may not occur and the patient should be informed about this. In addition, conservative treatments have a lower success rate and are not cost effective compared to the surgical approach (45).

Patients unresponsive to conservative treatment may be candidates for surgical intervention. Early surgical intervention in patients with traumatic tears will likely yield better outcomes (46). Arthroscopic repair is performed in the surgical approach by suturing the subscapular tear under the guidance of an arthroscope (44). Open repair can be performed for specific anatomical factors with a large incision, but postoperative recovery time might be prolonged (47). In artroscopic repair, the typical posterior portal is necessary in addition to the anterosuperior and anterior portals for arthroscopic surgery to repair the subscapularis. First, a portal is established on the anterolateral side. The ideal position and alignment of the portal should be parallel to the subscapularis fibers at a certain angle, enabling access to the tuberculum minus of the humerus for suturing purposes (48). Through examination of the biceps tendon is necessary during surgery. If it is determined to be required, pathological tendons can be treated with either total tenotomy or tenodesis. Medial subluxation should be assessed in non-pathological tendons (49). Due to the subscapularis tendon's attachment site providing anterior support to the biceps long head groove, dislocation of the biceps long head tendon can exert pressure on the subscapularis tendon, resulting in repair failure. If faced with such a circumstance, biceps tenotomy or tenodesis may be suitable options (50).

The coracoid prominence is readily identifiable since it is positioned just at the center of the anterior portal entry and directly above the subscapularis tendon (51). The axillary artery and vein, long thoracic nerve, and brachial plexus are located nearby (52). Furthermore, one may see the presence of compound tendons originating from the short head of the biceps and coracobrachialis, together with the attachment of the pectoralis minor muscle (53). Burkhart suggests that in cases of partial tear of the subscapularis muscle, coracoplasty can be performed by establishing a window in the rotator interval. It is important to maintain the integrity of the biceps' medial tether and the superior glenohumeral ligament (SGHL) throughout this treatment (54).

The objective of coracoplasty is to establish a coracohumeral spacing of 7-10 mm, hence reducing friction during the subscapularis healing process (55). Following complete tears, the subscapularis muscle will progressively retract over a period of time. In instances of severe retraction, it is possible for it to have shifted medially to the extent of the glenoid labrum (21). This adds complexity to the process of selecting the allocation for tenodesis during subscapularis repair. In such instances, the "comma sign," as elucidated (32). The comma sign denotes the superolateral surface where the subscapularis tendon is distinguished from the humeral head. In essence, it is a leftover part of the middle connection of the biceps muscle (56).

Postoperative physical rehabilitation must be planned according to the type of the subscapularis tear and individual characteristics for the regeneration of strength, flexibility, and functional movements (57). For proactive prevention in physical rehabilitation, shoulder conditioning, effective preparatory exercises and flexibility training, and gradual progressive activities will improve shoulder multifaceted function (58). Periodic checks along with pain management will optimize patient outcomes.

Declarations

The authors have no conflicts of interest to declare. The authors declared that this study has received no financial support. Ethics committee approval is not required

REFERENCES

1. Bakhsh W, Nicandri G. Anatomy and physical examination of the shoulder. Sports Med Arthrosc Rev. 2018 ;26(3):e10-e22.
2. Longo UG, Berton A, Marinozzi A, Maffulli N, Denaro V. Subscapularis tears. Med Sport Sci. 2012;57:114-121.
3. Keating JF, Waterworth P, Shaw-Dunn J, Crossan J: The relative strengths of the rotator cuff muscles. A cadaver study. J Bone Joint Surg Br 1993;75:137– 140.
4. Arai R, Sugaya H, Mochizuki T, Nimura A, Moriishi J, Akita K: Subscapularis tendon tear: an anatomic and clinical investigation. Arthroscopy 2008;24:997– 1004.

5. Richards DP, Burkhart SS, Tehrany AM, Wirth MA: The subscapularis footprint: an anatomic descrip- tion of its insertion site. Arthroscopy 2007;23:251– 254.
6. Siwetz M, Hammer N, Ondruschka B, Kieser DC. Variations in subscapularis muscle innervation-a report on case series. Medicina (Kaunas). 2020;56(10):532.
7. Gerber C, Hersche O, Farron A. Isolated rupture of the subscapularis tendon. Results of operative repair. J Bone Joint Surg 1996;78:1015-23.
8. Lee J, Shukla DR, Sánchez-Sotelo J. Subscapularis tears: hidden and forgotten no more. JSES Open Access. 2018;2(1):74-83.
9. Edwards TB, Bradley Edwards T, Walch G, Nove-Josserand L, Boulahia A, Neyton L, et al. Arthroscopic debridement in the treatment of patients with isolated tears of the subscapularis. Arthroscopy 2006;22:941-6.
10. Saremi H, Seifrabiei M. Subscapularis tendon tear classification and diagnosis: A systemic review and meta-analysis. Front Surg. 2023;10:916694.
11. Ghasemi SA, McCahon JAS, Yoo JC, Toussaint B, McFarland EG, Bartolozzi AR, Raphael JS, Kelly JD. Subscapularis tear classification implications regarding treatment and outcomes: consensus decision-making. JSES Rev Rep Tech. 2023;3(2):201-208.
12. Lafosse L, Lanz U, Saintmard B, Campens C. Arthroscopic repair of subscapularis tear: surgical technique and results. Orthop Traumatol Surg Res 2010;96:S99- 108.
13. Clark RJ, Marchessault J, Sizer PS Jr, Slauterbeck J. Isolated traumatic rupture of the subscapularis tendon. J Am Board Fam Pract. 2002;15(4):304-8.
14. Gerber C, Krushell RJ. Isolated rupture of the tendon of the subscapularis muscle. Clinical features in 16 cases. J Bone Joint Surg Br. 1991;73(3):389-94.
15. Balke M, Banerjee M, Greshake O, Hoeher J, Bouillon B, Liem D. The coracohumeral distance in shoulders with traumatic and degenerative subscapularis tendon tears. Am J Sports Med. 2016;44(1):198-201.
16. Lo IK, Burkhart SS. The etiology and assessment of subscapularis tendon tears: a case for subcoracoid impingement, the roller-wringer effect, and TUFF lesions of the subscapularis. Arthroscopy. 2003;19(10):1142-50.
17. Houglum PA. Rehabilitation for subacromial impingement starts at the scapula. J Orthop Trauma Rehabil. 2013;17:54-60.
18. Plachel F, Moroder P, Gehwolf R, Tempfer H, Wagner A, Auffarth A, et al, risk factors for rotator cuff disease: An experimental study on intact human subscapularis tendons. J Orthop Res. 2020;38(1):182-191.
19. Park HB, Gwark JY, Na JB. Risk factors of chronic subscapularis tendon tear. Clin Shoulder Elb. 2022;25(4):257-264.
20. Lo IK, Burkhart SS. The etiology and assessment of subscapularis tendon tears: a case for subcoracoid impingement, the roller-wringer effect, and TUFF lesions of the subscapularis. Arthroscopy. 2003;19(10):1142-50.
21. Goldberg DB, Tamate TM, Hasegawa M, Kane TJK 4th, You JS, Crawford SN. Literature review of subscapularis tear, associated injuries, and the available treatment options. Hawaii J Health Soc Welf. 2022;81(3 Suppl 1):2-7.
22. Rigsby R, Sitler M, Kelly JD. Subscapularis tendon integrity: an examination of shoulder index tests. J Athl Train. 2010;45(4):404-6.
23. Bak K. The practical management of swimmer's painful shoulder: etiology, diagnosis, and treatment. Clin J Sport Med. 2010;20(5):386-90.
24. Mengi A, Akif Guler M. Nocturnal pain in patients with rotator cuff related shoulder pain: A prospective study. Musculoskelet Sci Pract. 2022;59:102536.
25. Seppel G, Voss A, Henderson DJH, Waldt S, Haller B, Forkel P, et al. Atrophy patterns in isolated subscapularis lesions. BMC Musculoskelet Disord. 2021;22(1):378.
26. Günay C. Investigation of clinical effectiveness of specific shoulder examination tests, Osmangazi Journal of Medicine, 2020;42(6):670-681
27. Wahezi SE, Duarte R, Kim C, Sehgal N, Argoff C, Michaud K, et al. An algorithmic approach to the physical exam for the pain medicine practitioner: A review of the literature with multidisciplinary consensus. Pain Med. 2022;23(9):1489-1528.
28. Barth JR, Burkhart SS, De Beer JF. The bear-hug test: a new and sensitive test for diagnosing a subscapularis tear. Arthroscopy. 2006;22(10):1076-84.
29. Lee J, Shukla DR, Sánchez-Sotelo J. Subscapularis tears: hidden and forgotten no more. JSES Open Access. 2018; 2(1):74-83.
30. Wang Q, Zhao J, Zhou S, Lv Y, Liu X, Yang H. Quantitative MRI indicators and features for partial subscapularis tendon tears on conventional shoulder MRI. Insights Imaging. 2022;13(1):168.
31. Sarıkaya B, Bahadır B, Kaya İ, Oklaz B, Bekin Sarıkaya PZ, Kanatlı U. Can subcoracoid effusion be a more specific finding for subscapularis tear among rotator cuff pathologies on magnetic resonance imaging? J Shoulder Elbow Surg. 2023;32(1):17-23.
32. Bhatnagar A, Bhonsle S, Mehta S. Correlation between MRI and arthroscopy in diagnosis of shoulder pathology. J Clin Diagn Res. 2016;10(2):RC18-21.
33. Aiken AJ, Field LD. Techniques and tips for identification of comma tissue in subscapularis tears. Arthrosc Tech. 2020 ;9(7):e859-e862.
34. Rodriguez HC, Rust B, Hansen PY, Maffulli N, Gupta M, Potty AG, et al. Artificial intelligence and machine learning in rotator cuff tears. Sports Med Arthrosc Rev. 2023;31(3):67-72.
35. Oeding JF, Pareek A, Nieboer MJ, Rhodes NG, Tiegs-Heiden CA, Camp CL, et al. A machine learning model demonstrates excellent performance in predicting subscapularis tears based on pre-operative imaging parameters alone. Arthroscopy. 2023;S0749-8063(23)00766-1.
36. Sewick A, Kelly J, Leggin B. Subscapularis tears: diagnosis and treatment. Univ Pa Orthop J. 2011;21:25-30.
37. Brusalis CM, Chan JJ, Jackson GR, Khan ZA, Kaplan DJ, Allahabadi S, et al. Advanced subscapularis repair techniques. Oper Tech Sports Med. 2023;31(1); 150981.
38. Boudreault J, Desmeules F, Roy JS, Dionne C, Frémont P, Macdermid JC. The efficacy of oral non-steroidal anti-inflammatory drugs for rotator cuff tendinopathy: a systematic review and meta-analysis. J Rehabil Med. 2014;46(4):294-306.
39. Gruson KI, Ruchelsman DE, Zuckerman JD. Subacromial corticosteroid injections. J Shoulder Elbow Surg. 2008;17(1 Suppl):118S-130S.
40. Sengodan VC, Kurian S, Ramasamy R. Treatment of partial rotator cuff tear with ultrasound-guided platelet-rich plasma. J Clin Imaging Sci. 2017;7:32.
41. Harrison A, Shatsky J, Parsons B, Flatow E, Outcomes of open and arthroscopic subscapularis repairs (SS-18). Arthroscopy, 27(5), 2011; e38-e39.
42. Hernigou P, Flouzat Lachaniette CH, Delambre J, Zilber S, Duffiet P, Chevallier N, et al. Biologic augmentation of rotator cuff repair with mesenchymal stem cells during arthroscopy improves healing and prevents further tears: a case-controlled study. Int Orthop. 2014:1811-8.
43. Oh JH, Chung SW, Kim SH, Chung JY, Kim JY. 2013 Neer Award: Effect of the adipose-derived stem cell for the improvement of fatty degeneration and rotator cuff healing in rabbit model. J Shoulder Elbow Surg. 2014 :445-55.
44. Burkhart SS, Tehrany AM. Arthroscopic subscapularis tendon repair: Technique and preliminary results. Arthroscopy. 2002 18(5):454-63.

45. Edwards P, Ebert J, Joss B, Bhabra G, Ackland T, Wang A. Exercise rehabilitation in the non-operative management of rotator cuff tears: A review of the literature. Int J Sports Phys Ther. 2016;11(2):279-301.
46. Warner JJ, Higgins L, etal. Diagnosis and treatmen to fanterosu periorro tato rcufftears. J Shoulder Elbow Surg. 2001;10:37-46.
47. Adams CR, Schoolfield JD, Burkhart SS. The results of arthroscopic subscapularis tendon repairs. Arthroscopy. 2008 24(12):1381-9.
48. Barlow JD, Everhart JS. Arthroscopic subscapularis repair through a single anterior portal. Arthrosc Tech. 2017;6(5):e1593-e1598.
49. Lalehzarian SP, Agarwalla A, Liu JN. Management of proximal biceps tendon pathology. World J Orthop. 2022;13(1):36-57.
50. Vopat ML, Yang SY, Gregor CM, Kallail KJ, Saunders BM. Medial dislocation of the long head of the biceps without concomitant subscapularis tear: A case report. J Orthop Case Rep. 2020;9(6):6-10.
51. Valenti P, Maroun C, Schoch B, Arango SO, Werthel JD. Arthroscopic trillat coracoid transfer procedure using a cortical button for chronic anterior shoulder instability. Arthrosc Tech. 2019;8(2):e199-e204.
52. Ahmed AS, Lafosse T, Graf AR, Karzon AL, Gottschalk MB, Wagner ER. Modern treatment of neurogenic thoracic outlet syndrome: Pathoanatomy, diagnosis, and arthroscopic surgical technique. J Hand Surg Glob Online. 2023;5(4):561-576.
53. Zielinska N, Tubbs RS, Podgórski M, Konschake M, Aragonés P, Grzelecki D, et al. Relationships among coracobrachialis, biceps brachii, and pectoralis minor muscles and their correlation with bifurcated coracoid process. biomed res int. 2022;2022:8939359.
54. Burkhart S.S., Brady P.C. Arthroscopic subscapularis repair: surgical tips and pearls A to Z. Arthroscopy. 2006;22:1014–1027.
55. Pearce SS, Ruzbarsky JJ, Ernat JJ, Rakowski DR, Hanson JA, Millett PJ. Arthroscopic subcoracoid decompression, coracoplasty, and subscapularis repair for subscapularis tears in the Setting of Subcoracoid impingement. Arthrosc Tech. 2022;11(3):e333-e338.
56. Dilisio MF, Neyton L. Comma sign-directed repair of anterosuperior rotator cuff tears. Arthrosc Tech. 2014;3(6):e695-8.
57. Altintas B, Bradley H, Logan C, Delvecchio B, Anderson N, Millett PJ. Rehabilitation following subscapularis tendon repair. Int J Sports Phys Ther. 2019;14(2):318-332.
58. Miranda H, Viikari-Juntura E, Martikainen R, Takala EP, Riihimäki H. A prospective study of work related factors and physical exercise as predictors of shoulder pain. Occup Environ Med. 2001a;58(8):528-34.