# Current Clinical Concepts: Nonoperative Management of Shoulder Instability

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# Current Clinical Concepts: Nonoperative Management of Shoulder Instability

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Nonoperative management after shoulder dislocation or subluxation remains a challenging and complex task. Accurate diagnosis of the condition and shared decision-making regarding operative and nonoperative management and timing of return to play is required. In this Current Clinical Concepts paper, we introduce a shoulder instability framework that addresses these fundamental clinical dilemmas. Valid clinical prognostic tools that can be used to predict recurrent shoulder instability are reviewed. The process of shared decision-making in the realm of shoulder instability is presented. Finally, a framework for progressive rehabilitation that addresses deficits in motor control, strength, and endurance in scapular and shoulder musculature is provided to guide patients from an initial instability event through to return to play.

*Shoulder instability* is defined as the inability to maintain the humeral head within the glenoid fossa.[1] Traditionally, researchers have focused on both the assessment and outcomes of operative management of shoulder instability.[2,3] Even though authors of individual studies have reported recurrence rates as high as 75% to 100%,[2,3] evidence from 2 systematic reviews indicated a much lower recurrence rate of 21% to 39% across all populations.[4,5] Therefore, many patients would likely benefit from and be appropriate for nonoperative management. Unfortunately, literature detailing specific nonoperative interventions is limited.[6,7] In addition, some patients with chronic shoulder microinstability are misdiagnosed and may not have responded to traditional shoulder rehabilitation programs. Ultimately, direct-access or first-contact clinicians face at least 3 clinical decisions: (1) determining the patient's correct diagnosis; (2) identifying if the patient should be managed operatively or nonoperatively (incorporating multiple biopsychosocial factors); and (3) if the patient chooses nonoperative intervention, deciding which interventions should be provided to maximize the outcome. The purpose of this clinical concepts paper is to share a framework for managing shoulder instability that addresses these 3 fundamental concerns.

## SHOULDER INSTABILITY FRAMEWORK

### What Is the Diagnosis?

Patients with shoulder instability present with a spectrum of symptoms ranging from intermittent pain with activities because of microinstability to severe pain associated with complete or frequent shoulder dislocation. A traumatic dislocation may be relatively simple to identify from observation and palpation. However, in patients with instability but without obvious deformity, a thorough subjective history and examination for signs of abnormalities in range of motion (ROM), strength, and scapular control and provocative special tests are required to determine the direction of the instability and the potential for nonoperative management. Detailed information on examination procedures and provocative tests has been well supplied in the literature.[8,9] This assessment is important to differentiate shoulder pain from other sources, such as cervical, scapular, or neurologic origins. From this examination, shoulder instabilities are typically classified by the frequency (single or multiple instability episodes), cause (traumatic or atraumatic), direction (anterior, posterior, or multidirectional), and severity (microinstability, subluxation, or dislocation).[10,11] Physical impairments of motor control and strength in the anterior and posterior rotator cuff and scapular musculature are commonly identified through the physical examination (Figure 1). In addition, shoulder mobility limitations such as posterior shoulder tightness may be observed in overhead athletes. After the diagnosis is made and impairments are identified, patients and clinicians together can decide on the appropriate management.

### Clinical Decision-Making on Management

Deciding between operative and nonoperative management of shoulder instability is challenging. Historically, physically active male patients aged <25 years have been considered good candidates for surgery to reduce the redislocation risk,[12] but relying on these factors can result in unnecessary surgery.[13] Recent prognostic research can help guide clinicians on the prognosis after anterior shoulder instability events.[14,15] The key point of both prognostic factors[14,15] is that items in addition to sex and age after a first traumatic anterior dislocation should be considered when advising the patient on the likelihood of reinjury after an initial anterior shoulder instability event. Olds et al[14] published a predictive model that discussed 6 factors that together predicted recurrent shoulder instability:

(1) Presence of a bony Bankart lesion,
(2) Age 16 to 25 years,

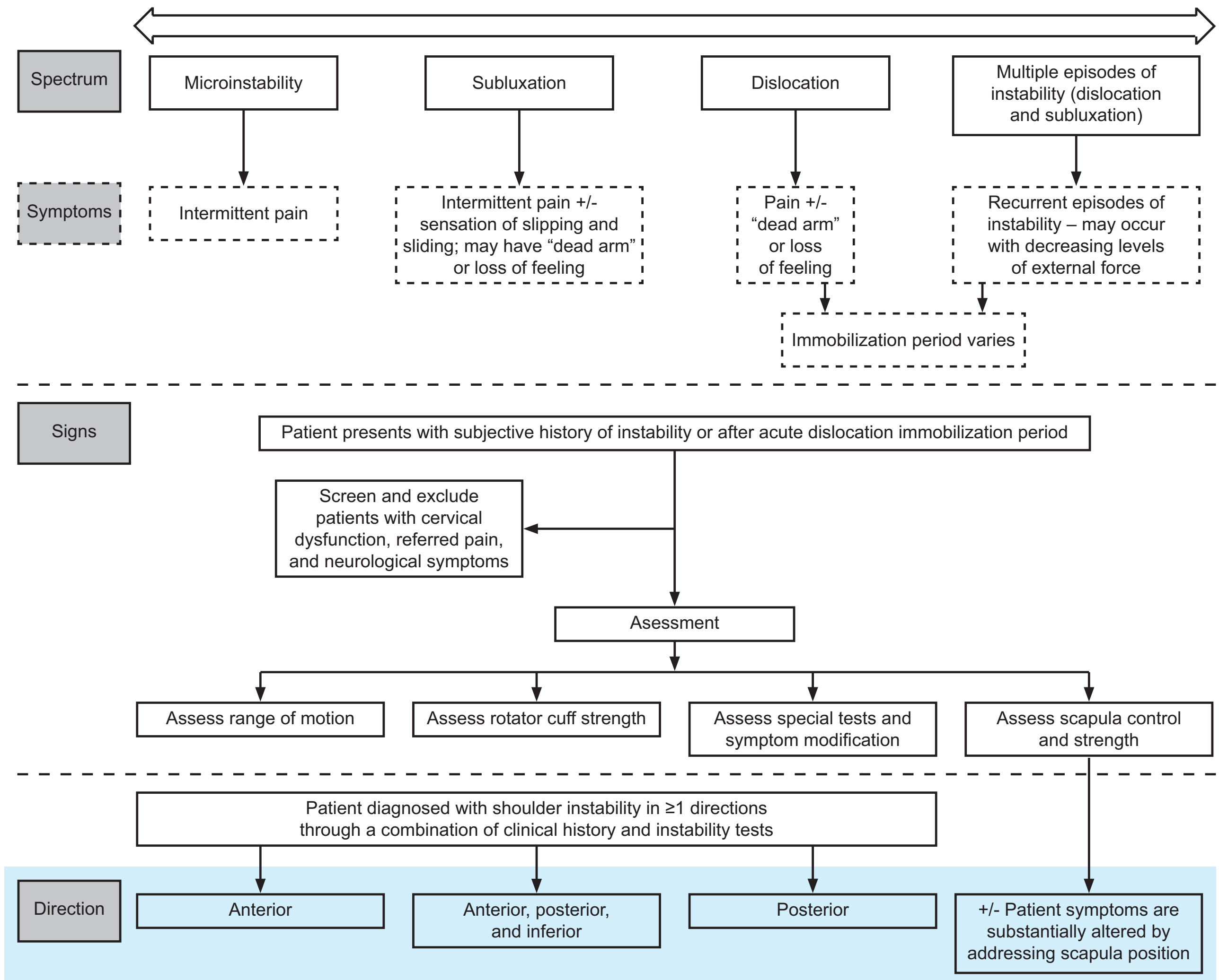


**Figure 1. Spectrum, symptoms, and assessment of shoulder instability.**

(3) Dominant-shoulder involvement,
(4) Elevated Tampa Scale of Kinesiophobia score,
(5) Elevated Shoulder Pain and Disability Index score, indicating more pain and dysfunction, and
(6) Lack of immobilization.

Clinicians can enter individual patient data into a free online calculator (www.margieolds.com/pris) to help determine their patient's risk of recurrence.

Tokish et al[15] also identified 6 factors that can be used to predict recurrent shoulder instability and created the Nonoperative Instability Severity Index Score (NISIS). This tool was originally developed to guide decision-making regarding operative or nonoperative treatment after a primary traumatic anterior shoulder dislocation in primarily high school athletes[15] but has also been used to predict recurrent shoulder instability.[16] The authors weighted the 6 factors, and patients deemed *low risk* (NISIS score $<$ 7) were managed successfully with nonoperative treatment 97% of the time.[15] Patients classified as *high risk* (NISIS score $>$ 7) were more likely to have unsuccessful nonoperative management (60.3%) than those classified as low risk (48.9%; $P = .03$).[16] The 6 factors and weights are as follows:

(1) Collision sport = 3, not a collision sport = 0;
(2) Age $>$ 15 years = 2, age $\leq$ 15 years = 0;
(3) Bone loss detectable on radiograph = 2, no bone loss on radiograph = 0;
(4) Dislocation = 1, subluxation = 0;
(5) Dominant-arm involved = 1, nondominant-arm involved = 0; and
(6) Male = 1, female = 0.

Patients presenting with a first-time anterior dislocation should be classified using either tool along with other contextual considerations that should be incorporated into the shared decision-making process regarding operative versus nonoperative management (Figure 2). Shared decision-making consists of providing an explanation of the shoulder instability; outlining the natural history; discussing the potential benefits and harms of operative and nonoperative management; and establishing the patient's values, preferences, and expectations. This process assists patients in reaching an informed decision about the management of their condition.[17] Management of subsequent subluxations or dislocations in the literature is controversial, and clinicians are encouraged to share all relevant research so

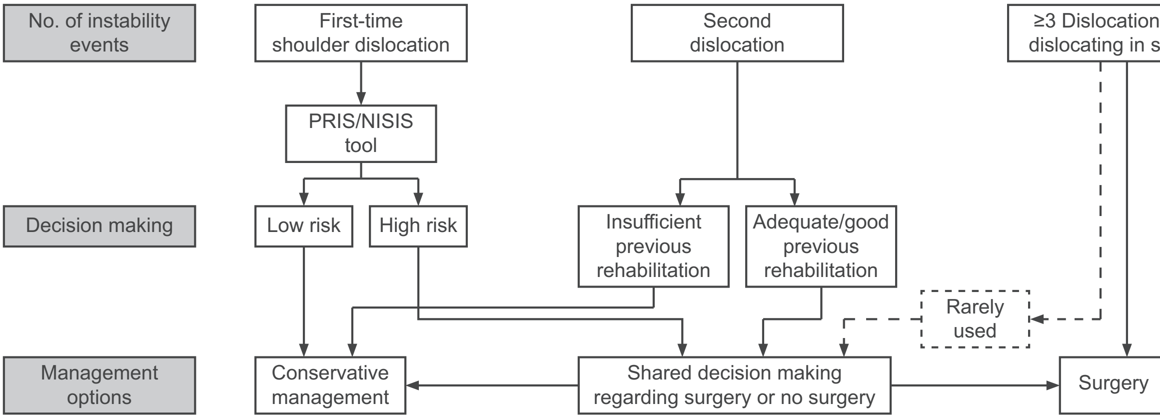


**Figure 2. Decision-making regarding operative versus nonoperative management after a shoulder dislocation. Abbreviations: NISIS, Nonoperative Instability Severity Index Score; PRIS, Predicting Recurrent Instability of the Shoulder.**

patients can make decisions regarding their treatment. Recurrent shoulder instability may also be a consequence of *inadequate previous rehabilitation*, which occurs when patients have not regained strength, endurance, and ROM within 10% of the unaffected side (accounting for a 10% strength effect of dominance).[18–21]

## Nonoperative Management of Shoulder Instability

When patients have decided to proceed with nonoperative management, deficits that were identified in the clinical assessment (Figure 1) are incorporated into treatment in a staged, progressive manner. Our perspective of rehabilitation intervention is based on the direction of the instability, mobility limitations, and common muscular deficiencies found with shoulder instabilities, which is the primary focus of this article (Figure 3).

## ACUTE SHOULDER INSTABILITY

First-time acute anterior shoulder subluxation or dislocation requires specific management within the initial 6 weeks after an injury to maximize patient outcomes. After reduction, the shoulder should be immobilized for a length of time that depends on the symptoms.[22] Regarding an anterior dislocation,

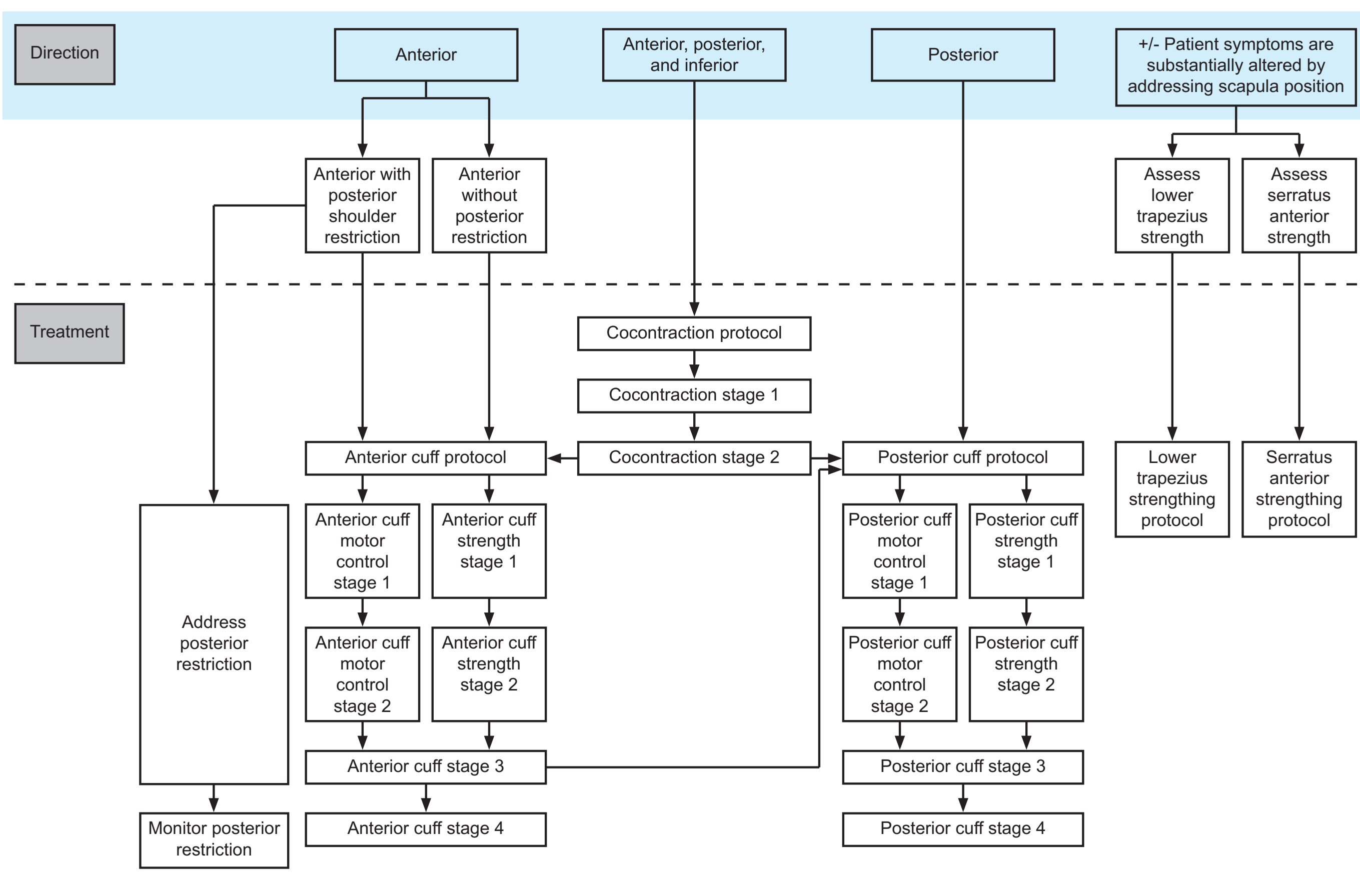


**Figure 3. Progressive rehabilitation intervention from subacute to end stage, based on the direction of instability, mobility limitations, and common muscular deficiencies.**

Table 1. Criteria to Progress for Each Phase

| Stage | Protocol: Anterior Rotator Cuff | Protocol: Posterior Rotator Cuff | Protocol: Cocontraction |
|---|---|---|---|
| 1 | Motor control: Patients demonstrate good motor control by activating and relaxing the subscapularis isometrically 15× without difficulty.<br>Strength: Patients sustain 3 × 30-s isometric contractions in prone lift-off position. | Motor control: Prone patients can hold the upper extremity in 90° of abduction and 90° of external rotation × 30 s with no weight and minimal scapular movement.<br>Strength: Patients hold 1 kg in 45° of flexion for 30 s × 3 reps. | Progression from stage 1 can occur when side-lying patients can hold their shoulder in 90° of abduction in × 3 sets of 30 s. |
| 2 | Motor control: Patients demonstrate smooth eccentric and concentric movement from 0°–90° with the upper extremity abducted to 90° in supine with 1–1.5-kg (2–3-lb) load × 15 repetitions with continuous palpable subscapularis contraction.<br>Strength: Patients lift and hold their hand away from their spine (1–2 in [2.54–5.08 cm]) using a 1-m heavy resistance band (blue or black) for 30 s without losing control and without pain. | Motor control: Prone patients perform 30 reps from 0°–90° with 1-kg weight. Scapula must remain relatively still, and humeral head motion must be differentiated from scapular compensation.<br>Strength: Patients hold 1 kg at 90° of flexion × 3 sets of 30 s. | Patients hold 5 kg × 3 sets of 30 s and control clockwise and counterclockwise circles with scapula protracted. |
| 3 | Patients perform elastic resistance of concentric and eccentric internal rotation × 30 s before increasing speed. Speed of movement can usually increase every 5–7 d or every few visits based on level of function and motor control. | Patients perform elastic resistance of concentric and eccentric external rotation × 30 s before increasing speed. Speed of movement can usually increase every 5–7 d or every few visits based on level of function and motor control. | Patients perform side hold on hand and hips × 3 sets of 30 s with body weight supported on hand. |
| 4 | Patients can withstand 1 min of perturbations without pain before attempting return-to-sport testing. | Patients can withstand 1 min of perturbations without pain before attempting return-to-sport testing. | |

Abbreviation: rep, repetition.

evidence for whether immobilization should be in external or internal rotation is inconsistent.[23] Although no evidence showed that immobilization for >1 week reduced the risk of recurrent shoulder instability,[23] we advise immobilizing the shoulder for pain and symptoms as needed but not beyond 3 weeks. The shoulders of people with recurrent instability should be immobilized as symptoms require. No data are available regarding the appropriate length of immobilization in the population with recurrent instability, and clinicians should use symptoms and presentation to guide their management. People with microinstability seldom require immobilization. Indeed, they commonly present with restricted movement in the posterior shoulder and require stretching or mobilization of these structures. The shoulders of individuals with acute traumatic posterior instability may be immobilized, but few researchers have examined outcomes, position, or the length of immobilization in this population. Patients with multidirectional instability tend to have less hemarthrosis and joint damage and may benefit from a short period of immobilization (1–3 days) if they have symptoms. Again, rigorous evidence for immobilization in people with multidirectional instability is limited.

Clinicians should focus on early resolution of strength impairments as acute symptoms allow.[24] Low-level isometric contractions can often be performed in pain-free positions in multiple directions to facilitate shoulder neuromuscular control. Patients should then slowly regain their active ROM. Early resolution of full shoulder ROM after a traumatic subluxation or dislocation is not thought to be clinically advantageous. The symptoms and impairments experienced after an episode of shoulder instability vary greatly. Therefore, a criterion-based progression uses functional milestones with specific endurance- and strength-based criteria (Table 1) instead of more time-based protocols. A general consideration for posterior instability is that patients initially tolerate mobility exercises in the frontal or scapular plane, whereas those with anterior instability initially tolerate mobility exercise in the sagittal or scapular plane. Regardless of the specific direction of the instability, patients, family, and other interested parties often have several questions. Therefore, patients and stakeholders should be educated on the pathoanatomy, risk of recurrence, return to activity, and treatment options. Kinetic chain deficits may contribute to shoulder instability through alterations in muscle activity; thus, the positioning of the scapula and trunk (eg, with decreased contralateral gluteal or trunk-rotation strength or both) should be assessed, and any deficits should be treated.

## SUBACUTE AND END-STAGE REHABILITATION: DIRECTION-SPECIFIC INTERVENTIONS

A direction-specific approach is required in the rehabilitation of a patient with instability, as the injury and impairments (eg, strength and ROM) differ depending on the direction of the instability. Treatment in the subacute stages follows a staged progression based on the primary direction of the instability, using the anterior rotator cuff, posterior rotator cuff, and cocontraction protocols outlined in Figure 3. Rehabilitation consists of re-establishing motor control and strength of the key shoulder musculature (stages 1 and 2). Then dynamic exercises are added to facilitate the position, amplitude, load, and speed (PALS) of movement (stage 3). Finally, internal and external perturbations and unexpected movements (stage 4) are integrated, and then readiness to return to sport is examined. Each stage has a direction-specific focus to facilitate specific muscle activation, and treatment for anterior and posterior

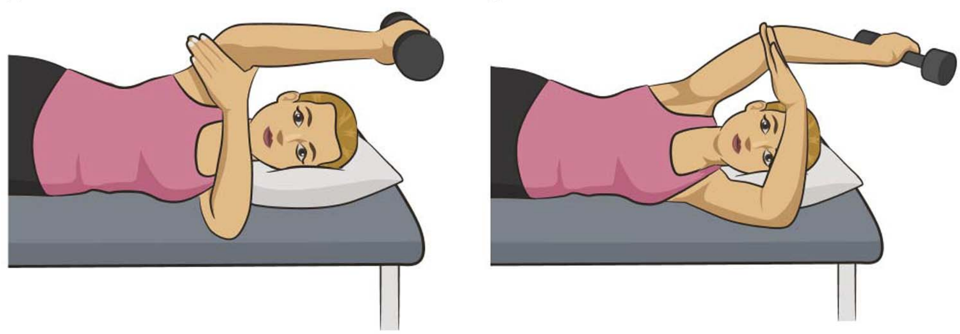


**Figure 4. Isometric external-rotation strengthening at 90° and 135° of flexion.**

instability may or may not include both the anterior and posterior directions, depending on the deficits found in each patient. All criteria to progress for each protocol are summarized in Table 1. Scapular muscle strengthening is outlined in the Appendix and can begin when patients are able to perform exercises without pain. Discussions and possible referral to an appropriate health care provider may be needed for patients with fear of reinjury or decreased confidence.

## Anterior Rotator Cuff Protocol

The anterior rotator cuff protocol is primarily used for anterior instability and principally develops motor control and strength of the subscapularis muscle (Figure 3). This muscle blends with the anterior shoulder capsule and is an important dynamic anterior stabilizer of the glenohumeral joint.[25] Clinicians should initially incorporate motor-control training to differentiate subscapularis activity from that of the often-compensating latissimus dorsi and pectoralis major muscles and can palpate subscapularis activity at the base of the axilla to determine the level of activation.[26] Furthermore, forces created by the pectoralis major and the latissimus dorsi muscles may increase anterior translation of the humeral head on the glenoid.[27] If patients with anterior instability also present with posterior rotator cuff impairment, clinicians should address this deficit using the posterior rotator cuff protocol after stages 1 and 2 of the anterior protocol have been completed.

Some patients with microinstability in the anterior direction present with restrictions of passive ROM in horizontal flexion, internal rotation at 90° of abduction, or end-range elevation. Several treatment approaches[28,29] can be used to normalize ROM of the posterior shoulder, including but not limited to the sleeper stretch, cross-body stretching, massage, contract-relax, and mobilization. When posterior shoulder restriction is identified, it should be addressed in the early stages and throughout rehabilitation of the anterior rotator cuff protocol to ensure full mobility and function are restored (Figure 3).

**Stage 1. Anterior Rotator Cuff Motor Control and Strengthening.** In stage 1, we advocate for the use of exercises that bias the activation of the subscapularis over the pectoralis major and latissimus dorsi muscles. These exercises are performed in supine position with the upper extremity abducted comfortably to allow the clinician to palpate the subscapularis. Patients are instructed to "draw the shoulder into its socket" or internally rotate the humerus without humeral adduction or horizontal flexion and without activating the other internal rotators (Supplemental Video 1, available online at https://dx.doi.org/10.4085/1062-6050-0468.22.S1).[30] Light distraction of the humeral head from the glenoid can facilitate subscapularis activation. Clinicians can use gentle isometric shoulder abduction or horizontal extension to reciprocally inhibit the adductors (predominantly the latissimus dorsi) and horizontal flexors (predominantly the pectoralis major). This allows patients to contract the subscapularis with decreased contributions from other muscles.[31] Clinicians instruct patients to palpate the subscapularis during this exercise to facilitate motor-control feedback (Supplemental Video 1).

The strength-based approach to increase the strength and activation of the subscapularis uses a prone lift-off position to decrease the contribution of the latissimus dorsi and the pectoralis major because of their anatomic constraints. Patients lie prone with their wrist over L4, lift the hand from the back (no more than 1 in [2.54 cm]), and hold this position for 30 seconds. If this exercise is painful, it can be modified by moving the hand down to over the buttock or using a belly-press exercise. As they are able, patients should progress toward the prone lift-off L4 position. The exercise is performed to promote subscapularis fatigue and should not be painful (Figure 4). Ideally, both motor-control and strength criteria will be achieved before moving to stage 2, but the strength-based goal must be achieved (Table 1).

**Stage 2. Anterior Rotator Cuff Motor Control and Strengthening.** After patients can activate the subscapularis more independently, the focus of rehabilitation is concentric and eccentric subscapularis control through ROM. Stage 2 exercises can be performed supine with the upper extremity abducted so that the clinician or patient is able to palpate the subscapularis (Supplemental Video 2, available online at https://dx.doi.org/10.4085/1062-6050-0468.22.S2). If this position is painful, the upper extremity should be moved to the scapular plane with a towel placed under the distal humerus and the range limited to pain-free movement.[27] Light weights or elastic bands should be used for daily home exercises to increase patient control of the subscapularis through ROM.

Progression of the strength-based approach is achieved by using a 1-m-long resistance band fixed to the wall in front of patients who stand 1 m away. The band is passed around the unaffected side of the body, so patients grasp with the hand of their affected shoulder behind their back. They then lift their hand 1 to 2 in (2.54 to 5.08 cm) away from their back to perform a 10-second isometric hold 3 times. They progress the exercise up to 30 seconds and the level of resistance until the goal is achieved in order to advance. Clinicians should instruct patients to maintain the load through internal rotation without pain and not compensate with shoulder extension or wrist flexion. Patients with anterior instability often also need posterior rotator cuff strengthening after they have established subscapularis control to balance the glenohumeral joint.

**Stage 3. Anterior Rotator Cuff PALS.** Stage 3 is the dynamic stage during which rehabilitation is tailored to the individual's sport or job demands by altering the PALS of the exercise. This protocol has similarities across all 3 directions of instability, although the focus should remain on the specific direction of the instability. After patients with anterior instability have progressed through anterior rotator cuff motor control and strengthening stages 1 and 2, clinicians should assess them for any deficits in posterior rotator cuff motor control and strength. Any such deficits should now be addressed by adding posterior rotator cuff stages 1 and 2 to the rehabilitation protocol.

Patients who are required to lift heavy loads should focus on increasing the loads in the relevant ROM. Those who need to return to quick movements should focus on increasing the speed of the movement in positions, amplitudes, and loads that replicate their requirements. A metronome provides external pacing and monitoring of the progression. Initially, patients start exercises with no pace to allow for proper execution. We recommend beginning at 30 beats/min, progressing to 120 beats/min for 30 seconds in 20-beats/min steps. Assuming a 90° arc of motion is covered, patients would progress speed from 45°/s to 180°/s. The key is humeral head movement without scapular or trunk movement and a maintained pace without substitution before progression. The anterior rotator cuff protocol focuses on internal-rotation strength after the stage 2 criteria are met.

Patients should begin shoulder internal-rotation strengthening with the upper extremity at the side, going through a full arc of internal rotation of the humerus using an elastic-resistance band and without scapular substitution. They often have muscle weakness and difficulty near end range due to decreased muscular control in this part of the range. Therefore, exercises should be modified to focus on the specific arc with stability deficits until patients have enough strength to move through the entire arc of motion. When patients can demonstrate smooth control of concentric and eccentric motion using the elastic-resistance band through the full arc for 30 seconds, they can begin to keep pace with a metronome (beginning at 30 beats/min). Typically, as patients demonstrate the third level in the progression (approximately 70 beats/min) without scapular or trunk movement, a more challenging rotation exercise with additional upper extremity elevation can be initiated. Patients advance toward performing exercises with the upper extremity abducted to 90° in the scapular plane and then the frontal plane. Speed and resistance should be based on patients' physical activity requirements. A typical progression for both the anterior and posterior rotator cuff muscle protocols is provided in Table 1. Pain-free weight-room activities are typically started in this stage but may require limitations in arcs of motions (eg, bench press from the floor to limit horizontal extension).

**Stage 4. Motor-Pattern Integration and Perturbation Training.** After patients can activate specific musculature and have acquired the appropriate speed and endurance of the subscapularis, further overload of the shoulder is required. Stage 4 should include expected and unexpected directional perturbations, beginning with expected motions (eyes open) and progressing to unexpected activities (eyes closed). Patients can start by receiving a perturbation of a light weight (0.5 kg) dropped into their hand while lying supine, with the arm in abduction and external rotation and their eyes open, eventually progressing to receiving the perturbation in this position with their eyes closed. They can then move to an upright position and receive perturbations from the clinician into external rotation or horizontal extension in a position of abduction and external rotation with the instruction "don't let me move you." Further progressions include moving from a stable to an unstable surface (eg, kneeling on a Swiss ball) and the use of elastic-resistance bands or straps to increase the force applied.

Weight-room exercises should be advanced, incorporating training multiple movement patterns that simulate patients' sport or work involving the entire kinetic chain. Targeted gymnasium strengthening for the shoulder can progress with supine flies or the bench press and prone rollouts. At the end of this stage, patients should demonstrate movement through the ROM without pain, with added visual (movement in peripheral vision), aural (distracting noise), and tactile (altered surface) disturbances in the absence of opponents or other players. Clinicians should limit oral and visual feedback during this stage to encourage patients' cognitive processing and problem solving.[32] This is the final stage to prepare patients for criterion-based return-to-sport testing.

Criteria for return-to-sport testing are both rotator cuff and scapular strength. Patients should also have progressed through scapular rehabilitation so they can perform pain-free push-ups and side planks on an extended upper extremity for 3 repetitions of 30 seconds (Appendix). They should be able to withstand 1 minute of perturbations in abduction and external rotation with no pain before attempting return-to-sport testing.

## Posterior Rotator Cuff Protocol

The key to rehabilitation of the posterior rotator cuff is activating the external rotators without excessive compensatory scapular motion. Clinical experience indicates that the emerging pattern of compensatory movement is excessive posterior scapular tilt and retraction of the scapula in the absence of isolated external rotation of the humerus, particularly when the infraspinatus is short in terminal external rotation. This protocol is the mainstay of treatment for people with posterior shoulder instability. It can also be added after stage 2 for patients with anterior and multidirectional instability when strength or motor control of the external rotators is lacking.

**Stage 1. Posterior Rotator Cuff Motor Control and Strengthening.** The crucial factor in stage 1 is establishing whether patients can externally rotate the humerus without scapular posterior tilt or retraction. Patients are evaluated and treated in prone position with a folded towel placed under the anterior proximal humerus (Supplemental Video 3, available online at https://dx.doi.org/10.4085/1062-6050-0468.22.S3). They perform 1 repetition of external rotation to 90° without pain or scapular substitution. If patients cannot externally rotate to 90° without scapular movement, they are instructed to perform an isometric external-rotation hold at the limit of external rotation before scapular movement. Isometric contractions should be held for 30 seconds for 3 repetitions. Clinicians should provide oral, visual, and tactile feedback so that scapular movement is minimal in this stage.[33,34] This position can be modified initially into scaption if pain is present.

Table 2. Progression of Concentric and Eccentric Internal and External Rotation

| Protocol | Progression[a–e] (beats/min) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Anterior rotator cuff | | | | | | | | | | | | |
| Internal rotation at side through pain-free arc | Self-paced | 30 | 50 | 70 | 90 | 120 | | | | | | |
| Internal rotation in scapular plane from 0° to 90° | | | | Self-paced[d] | 30 | 50 | 70 | 90 | 120 | | | |
| Internal rotation in frontal plane from 0° to 90° | | | | | | | Self-paced[d] | 30 | 50 | 70 | 90 | 120 |
| Posterior rotator cuff | | | | | | | | | | | | |
| External rotation at side through pain-free arc | 30-s holds[d] | 30 | 50 | 70 | 90 | 120 | | | | | | |
| External rotation in frontal plane at 90° of abduction from 0° to 90° | | | | 30-s holds[d,e] | 30 | 50 | 70 | 90 | 120 | | | |
| External rotation in frontal plane at 135° of abduction from 0° to 90° | | | | | | | 30-s holds[d,e] | 30 | 50 | 70 | 90 | 120 |

[a] Patients perform exercise for 30 s on pace with proper form and no substitutions before moving to the next speed or level.
[b] Assuming a 90° arc of motion, 30 beats/min = 45°/s, 90 beats/min = 135°/s, and 120 beats/min = 180°/s.
[c] Blank cells indicate exercise is not performed.
[d] When progressing positions, continue to perform only 3 sets for 30 s, but for 1 set of 30 s in the new position and incrementally move to the more challenging positions and pace as tolerated while maintaining the 3 × 30 s volume.
[e] Holds performed with an elastic-resistance band (green/blue) in the described position.

The strength-based approach to increase infraspinatus strength is initiated with patients in side-lying position with the elbow supported on a towel and bent to 90°. Patients should hold a 1-kg weight isometrically and parallel to the floor for 30 seconds for 3 repetitions. Then patients should support the distal humerus at 45° of flexion with the opposite hand and repeat the isometric exercise without scapular substitution; this promotes infraspinatus endurance and should not be painful. Ideally, both motor-control and strength criteria will be achieved before moving to stage 2, but the strength-based goal must be achieved (Table 1).

**Stage 2. Posterior Rotator Cuff Motor Control and Strengthening.** The goal of stage 2 is to facilitate motor control of external rotators through the ROM, both concentrically and eccentrically. Patients move through a 90° arc of motion in side-lying position and then progress to lying prone with manual resistance or light resistance (0.5–1 kg) without symptoms and scapular compensation. To continue isometric strengthening, upper extremity elevation is advanced to 90° and 135° if needed, with the load and exercise variables as presented in stage 1 (Figure 4).

**Stage 3. Posterior Rotator Cuff PALS.** Stage 3 is similar to stage 3 of the anterior rotator cuff protocol but progressively loads the posterior rotator cuff. Patients with posterior instability can start external rotation with the upper extremity at the side and proceed to more elevated upper extremity positions after they can hold the resistance in the end range of external rotation for 30 seconds (Table 2). Typical progressions move the upper extremity into more elevation in the frontal plane and then the sagittal plane and overhead. A common error is to start this stage too early, without adequate strength and isolation of humeral external rotation on a stable scapula.

**Stage 4. Motor-Pattern Integration and Perturbation Training.** Stage 4 also has similarities to stage 4 of the anterior rotator cuff protocol, although again, the direction of the load is reversed. Patients lie prone and perform drop catches using a light weight with the shoulder positioned in 90°/90° to eccentrically load the posterior rotator cuff. Perturbations from clinicians include pushing the hand to move the arm into internal rotation in this position or moving the arm into a more sagittal-plane position to prepare patients for functional activities. The complexity of the tasks can be increased, as in stage 4 of the anterior rotator cuff protocol, by incorporating multiple stimuli, such as distraction or noise, altering surfaces for enhanced stability, and incorporating opponents. The exercise interventions are detailed in stage 4 of the anterior rotator cuff protocol and follow similar criteria to progress.

## Cocontraction Protocol

Patients with multidirectional instability may not respond to a direction-specific muscular protocol due to increased generalized capsular laxity. An imbalance in the transverse force couple of the subscapularis and infraspinatus, which dynamically centers the humeral head on the glenoid during work, sport, or activities of daily living, can create the instability.[35,36] The cocontraction protocol can also be used if loading either the anterior or posterior shoulder is painful or ineffective. This principle uses the axial compressive load through the humerus to facilitate joint stability by placing the patient in a position that centers the humeral head on the glenoid. With the humeral

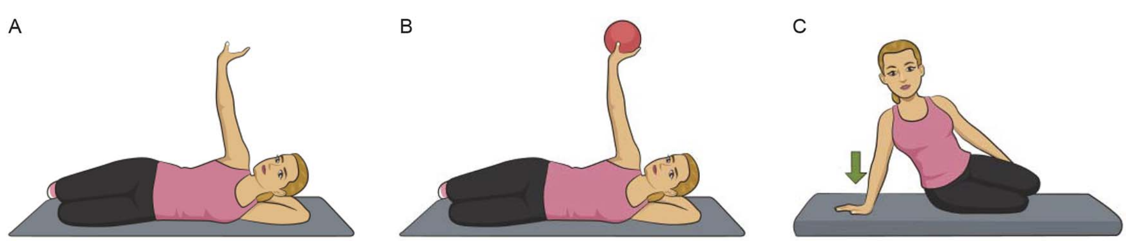


**Figure 5. Side-hold progressions that keep the humeral head centered in the glenoid among patients with multidirectional shoulder instability.**

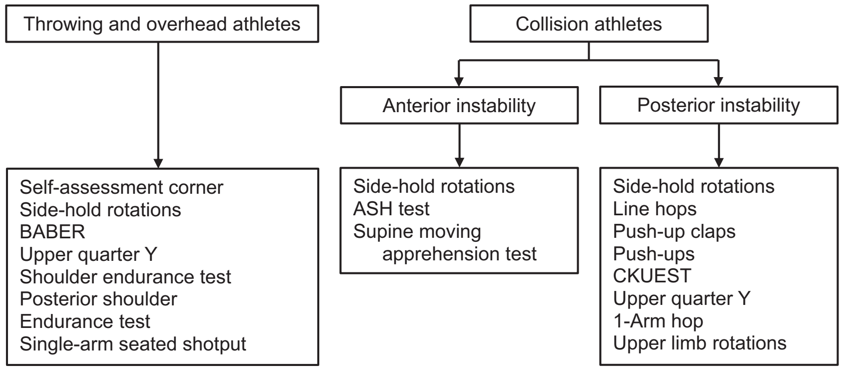


**Figure 6. Return-to-sport tests by sport and injury. Abbreviations: ASH, Athletic Shoulder test; BABER, ball abduction external rotation; CKUEST, closed kinetic chain upper extremity stability test.**

head centered, cocontraction of the anterior and posterior rotator cuff can be used to stabilize it as opposed to using these muscles to affect the rotation of the humerus on the glenoid.

**Stage 1.** Patients begin stage 1 lying on their side with the affected upper extremity at approximately 90° using no weight. They are instructed to hold the upper extremity in neutral position. The initial hold may be for 10 seconds for 10 repetitions and then advances to 30 seconds for 3 repetitions. Conceptually, patients are centering the humeral head on the glenoid (Figure 5A).

**Stage 2.** For stage 2, patients perform small circles within the pain-free ROM in either direction. In electromyography research, investigators demonstrated that creating a circular motion facilitated activity of both prime movers (eg, the pectoralis major and deltoid) and the rotator cuff to stabilize the humeral head.[37] The exercise is followed by loading the humerus axially with a 3-kg and then a 5-kg load for 30 seconds (Figure 5B). To activate the scapular musculature, patients can be encouraged to reach for the ceiling as glenohumeral stability and strength increase.

Once patients with multidirectional instability can support the upper torso body weight in a closed chain position of 1 hand or elbow and hips (Figure 5C), they should be reassessed for their primary direction of instability and treated as per the protocols described earlier. Scapular strengthening should start after patients can adopt positions without pain and continue throughout rehabilitation (Appendix).

## Return-to-Sport Clinical Tests

In stage 4, activities are incorporated to prepare athletes to return to sport. In this current clinical concepts paper, we have identified criteria at the end of each stage to progress to the next stage; returning to sport is the final criterion. Before transitioning back to full sport activities, the athlete must be psychologically ready and demonstrate appropriate physical performance based on the direction of instability, sporting demand, and endurance needed. Clinicians are advised against attempting return-to-sport testing until the patient has met the previous rehabilitation milestones.

As the "2016 Consensus statement on return to sport from the First World Congress in Sports Physical Therapy" indicated, assessment tests for the upper extremity are limited.[38] Several conceptual models for returning an athlete to sport have clearly identified multiple factors that must be considered before return to sport.[39,40] Some components that should be incorporated are pain, mobility, strength, physical performance, time of season, level of competition, and psychological readiness. The Shoulder Instability-Return to Sport after Injury is a valid scale for measuring psychological readiness in patients after shoulder-instability events.[41,42] This scale successfully discriminated between those who were and those who were not likely ready to return, with a cut point of 55.[43]

Several reliable physical performance tests have been described for use after a shoulder injury (eg, Athletic Shoulder test, upper limb rotation test, line hops, and push-ups).[20,30,44] Conceptually, many of the physical performance tests are progressions from rehabilitation. Unfortunately, these physical performance tests for assessing readiness to return to sport lack predictive validity. Physical performance readiness must entail the classic measures of impairment, such as ROM, pain, and strength measured objectively with an isometric or isokinetic dynamometer. Physical performance tests should be selected based on sport demand and the direction of instability.[19] Nearly all physical performance tests were found to be reliable, but the decision of which to use depends on the tissues being challenged and the loads that must be controlled during sport performance. In biomechanical studies examining muscle activity, forces, and moments around the shoulder, researchers have shown that the closed kinetic chain upper extremity stability test,[45] push-ups,[30] side-hold rotations,[32] and line hops[32] activated the serratus anterior and infraspinatus maximally while primarily placing posterior translation forces on the shoulder for posterior instability assessment. Tests that stress the anterior stabilizers, including the Athletic Shoulder test,[46] upper limb rotation test,[44] and side-hold rotation test,[32] should be considered for athletes requiring anterior stabilization to return to sport. In those players returning to overhead sport who have endurance requirements of the posterior shoulder, clinicians should consider including the posterior shoulder endurance test[47] and the shoulder endurance test.[48] No single test is likely to evaluate all the demands on a particular athlete. Therefore, a battery of tests should be based on the patient's physical demands. Each athlete and sport demand is different, so the testing battery will likely differ; we offer suggested test batteries in Figure 6. These return-to-sport decisions ultimately lie with the athletes, but they will seek multiple inputs from family, coaches, and their sports medicine team. Shared decision-making to ensure patients are empowered for successful short- and long-term decisions regarding return to sport is optimal.

## CONCLUSIONS

Treatment of shoulder instability has advanced considerably in recent years, and in this clinical commentary, we highlighted our current opinion of rehabilitation across the continuum of acute instability to return-to-sport decision-making, including incorporation of psychosocial and personal factors. Clinicians should remain abreast of developments in operative and nonoperative decision-making and should include motor control and motor programming in their rehabilitation programs. Future investigators should examine the clinical outcomes of patients using this motor-control and motor-programming approach. Successful rehabilitation can return many patients to their previous level of activity without operative intervention, and clinicians should maximize patient outcomes and reduce the risk of recurrent shoulder instability using contemporary rehabilitation practices.

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## SUPPLEMENTAL MATERIAL

**Supplemental Video 1.** Anterior rotator cuff motor control stage 1. Activation of the subscapularis with minimal pectoralis major or latissimus dorsi activation.

Found at DOI: https://dx.doi.org/10.4085/1062-6050-0468.22.S1

**Supplemental Video 2.** Anterior rotator cuff motor control stage 2. Eccentric and concentric subscapularis contraction through range of motion with clinician and home exercises.

Found at DOI: https://dx.doi.org/10.4085/1062-6050-0468.22.S2

**Supplemental Video 3.** Posterior rotator cuff stages 1 and 2. Humeral external rotation without scapular movement.

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## Appendix. Scapular Rehabilitation

The targeted muscles are the trapezius and serratus anterior, which are often dysfunctional in shoulder instability.[1–3] Typically, motor control, strength, and endurance deficits are found. Isometric holds for up to 30 seconds for 3 repetitions during the outlined program provide criteria to progress.

The lower trapezius has multiple roles in scapular dynamics, including stabilizing the scapula during elevation and creating upward rotation with the serratus anterior.[4] Clinicians should check for substitution from the upper trapezius, the latissimus dorsi, or both, through these progressions. The key to this progression is maintaining posterior tilt of the scapula for increased middle and lower trapezius activity.

The prone scapular posterior tilt exercise progresses as follows:

- Place hands on the table in forearm pronation (palms up; isometric),
- Abduct upper extremities to 45° with elbows straight and palms facing the floor (isometric), and
- Move from a starting position of upper extremities abducted and externally rotated to 90° with elbows bent and palms facing the floor (W position) to an ending position of arms abducted to 135° with elbows straight and palms facing the floor (Y position; Appendix Figure 1).

The serratus anterior functions to posteriorly tilt and upwardly and externally rotate the scapula in addition to the classic role of scapular protraction.[5] Poor control and decreased serratus anterior activity have been documented in patients with shoulder instability.[6,7] The serratus anterior exercise progression is illustrated in Appendix Figure 2. It typically starts with a supine (Appendix Figure 2A) or side-lying punch (Appendix Figure 2B) to establish good motor control during both concentric and eccentric control around the thoracic cage. After patients can demonstrate smooth and controlled concentric and eccentric contractions for 30 repetitions, those who function in a closed chain or weight-bearing position (offensive lineman) can progress to endurance-strengthening exercises that use 10-second isometric holds for 10 repetitions, progressing to 30-second holds for 3 repetitions before advancing to the next exercise.

Patients typically start in the quadruped position with approximately 10% body weight through the injured upper extremity, progressing to 50% through both arms (Appendix Figure 2C). However, this may be difficult, or the patient may be fearful due to the history of injury. One modification we have used is a side-sitting position with weight through the upper extremity in a more abducted position, advancing to side plank through the knees (Appendix Figure 2F). Ultimately, patients need to develop endurance strength and confidence in accepting loads with a forward-flexed shoulder. Progressing this by altering positions (Appendix Figure 2D) or lifting the lower extremities (Appendix Figure 2E) will increase muscle activation of the infraspinatus as loads increase (Appendix Figure 2).[8] Clinicians should be aware of substitution of the latissimus dorsi and upper trapezius during closed chain exercises, which produces scapular anterior tilt and downward rotation.[9] They should instruct patients to elongate and retract the cervical spine to minimize upper trapezius activity and to facilitate increased serratus anterior activation by protraction, resulting in the medial scapular border staying flush with the thoracic cage.

## Stages 3–5

In stages 3 through 5, patients can perform closed chain exercises in a side-support position (stage 3), side-lying planks from the knees (stage 4), and then side planks from the hand or elbow to the feet (stage 5; Appendix Figure 2F–H).

## Criteria for Progressions Between Stages 3–5

When patients can hold the side-support position for 30 seconds for 3 repetitions, they can advance to isometric holds from their knees and then feet. This progression increases the loads using body weight stabilization as depicted in Appendix Figure 2F. After patients can perform body-weight side holds from their knees, the subscapularis and infraspinatus/teres protocol can usually be incorporated without pain. In these patients, both sides of the force couple must be addressed throughout the rehabilitation process.

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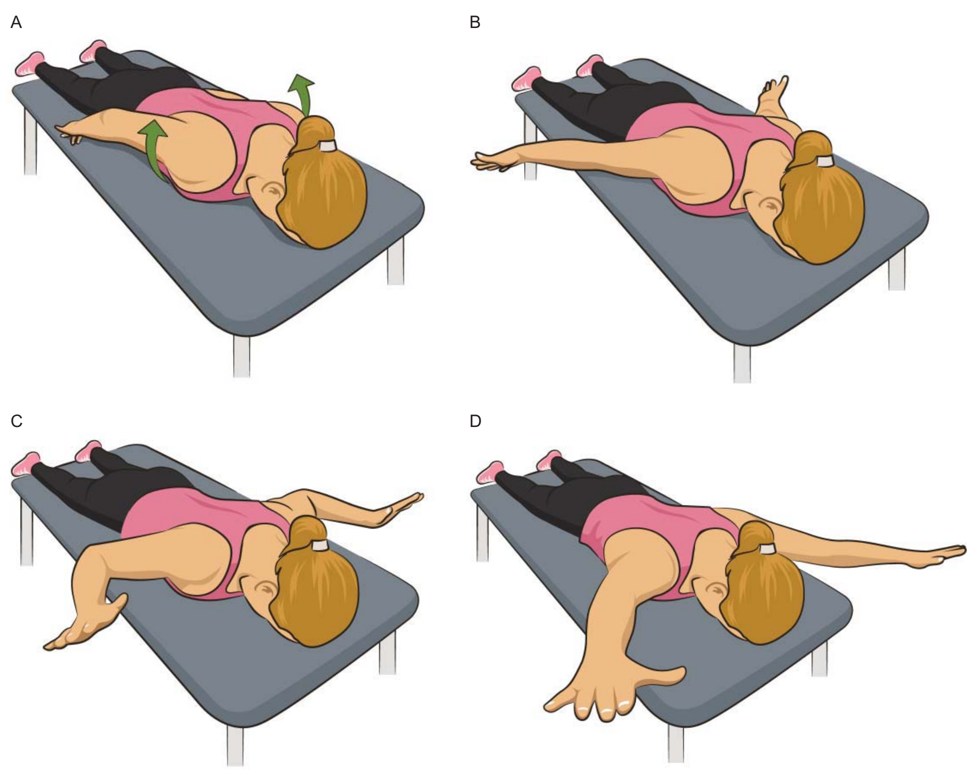
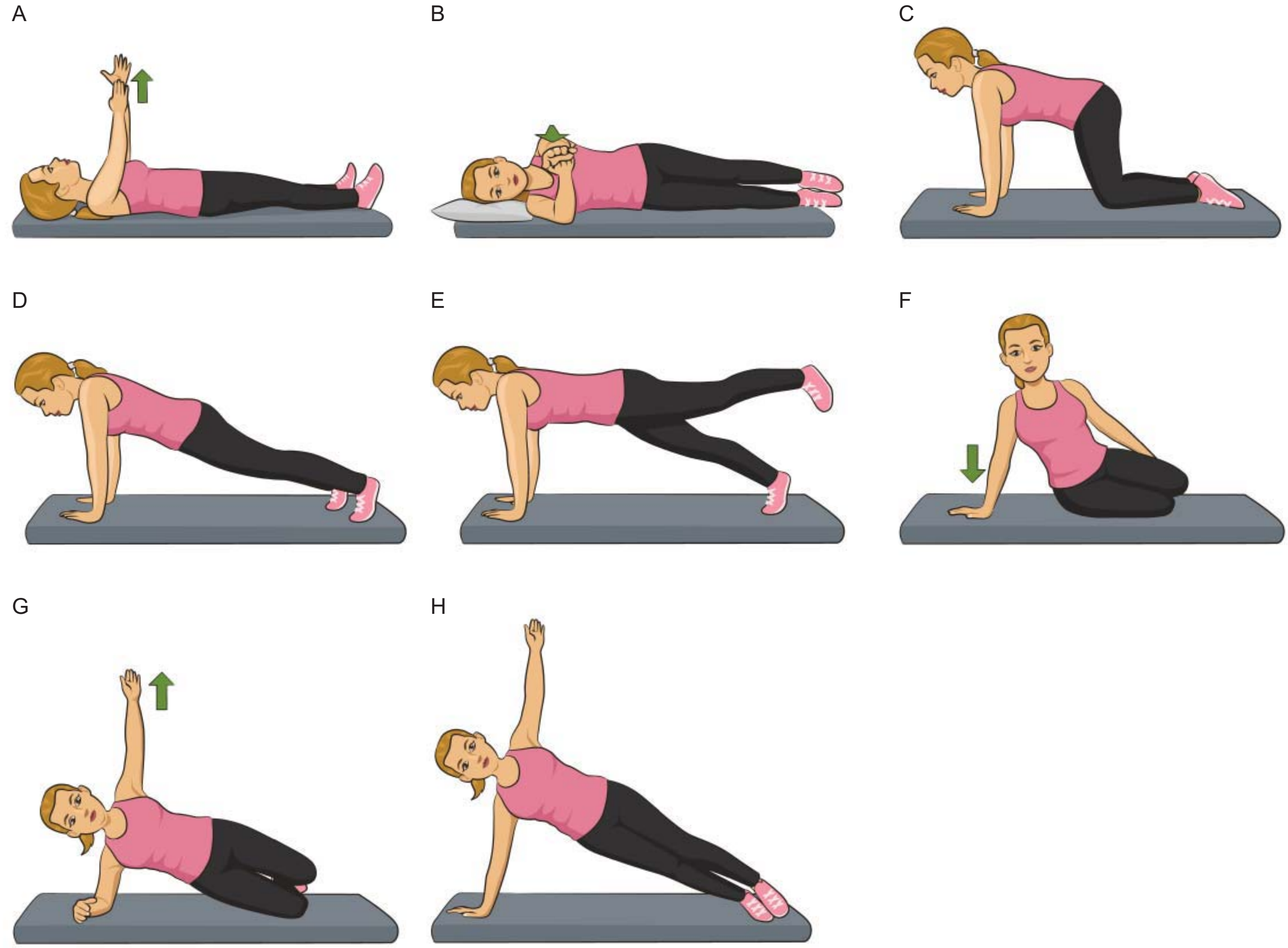



**Appendix Figure 1. A–D, Lower trapezius exercise progression.**




**Appendix Figure 2. Progressive loading of the serratus anterior in the A–E, frontal and F–H, sagittal planes. A, Supine punch; B, side-lying punch; C, 4-point kneeling; D, plank feet; E, plank with leg lift; F, side support; G, side-plank knees; and H, side-plank feet.**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