The Flexibility and Rehab Tips column provides practical information on the role of rehabilitation and flexibility on both performance and the modification of injury risk.

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The Upright Row: Implications for Preventing Subacromial Impingement

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SUMMARY

TRAINING PROGRAMS ARE OFTEN INCLUSIVE OF EXERCISES DESIGNED TO ACHIEVE STRENGTH AND HYPERTROPHY OF THE MIDDLE DELTOIDS AND UPPER TRAPEZIUS. THE "UPRIGHT ROW" IS ONE OF THE MORE COMMON EXERCISES PERFORMED; HOWEVER, ITS EXECUTION IS NOT WITHOUT RISK, PARTICULARLY IN THE POPULATION WITH DOCUMENTED SHOULDER DISORDERS, SUCH AS SUBACROMIAL IMPINGEMENT. IMPLICATIONS SPECIFIC TO THE UPRIGHT ROW EXERCISE ARE DISCUSSED IN THIS COLUMN AS WELL AS MODIFICATIONS APPLICABLE TO BOTH THE SYMPTOMATIC AND THE ASYMPTOMATIC POPULATIONS.

INTRODUCTION AND EPIDEMIOLOGY

The health and fitness benefits ascribed to weight training (WT) are well known (1,2,8,12). However, when considering the shoulder complex, these benefits are not obtained without risk. A survey of 110 recreational WT participants revealed that 61% had reported shoulder pain during the course of WT in the past year, whereas 33% had pain during WT in the past 3 days (10). Moreover, research indicates that up to 36% of WT-related injuries and disorders occur at the shoulder complex (13,17,18). Of the more common disorders that may be attributed to WT, anterior instability, rotator cuff (RTC) pathology, and subacromial impingement are most often described in the literature (6,16,26,29).

Pathology of the RTC comprises a considerable proportion of shoulder disorders in both the general and the athletic population (23,24,29). Although the etiology of RTC pathology is multifactorial, subacromial impingement is often implicated (5,7,22). Factors contributing to subacromial impingement (impingement of soft tissues, namely the RTC, between the bony structures of the shoulder during arm elevation) include RTC weakness, age-related degeneration of the musculoskeletal anatomy, a congenitally narrowed subacromial space, and precipitating activities, such as exercises, that lend to aberrant biomechanics. From a WT perspective, impingement has been postulated to occur from exercises that require elevation of the arm (raising the arm away from the body out to the side or to the front) overhead without proper mechanics (11,21).

The upright row is a popular exercise often employed both by athletes as well as by the general public to target the middle deltoid and upper trapezius musculature. In addition to recruiting the middle deltoids and upper trapezius, the upright row has been advocated for strengthening the scapular stabilizers (19) and is integral to the sport of weight lifting, where it is a component of the high pull portion of the clean.

Despite the intrinsic benefits associated with the upright row, performance of the exercise as traditionally described has been postulated to place individuals at risk for subacromial impingement (9,11). Specifically, performance of

the upright row requires the arms to be elevated (raised away from the body) above shoulder height while in an internally rotated position (Figure 1). Performing this exercise in the aforementioned manner leads to aberrant biomechanics because normal shoulder elevation requires the arms to externally rotate to prevent subacromial impingement (20). Essentially, when elevating the arm overhead, normal biomechanics dictates that the shoulder should externally rotate to avoid subacromial impingement. Thus, elevating the arm overhead with internal rotation as done with the upright row may directly cause subacromial impingement or perpetuate the existing impingement. Effective and safe performance of the traditional upright row exercise requires modifications that are inclusive of both anatomical and biomechanical factors. This column presents modifications for the upright row exercise that respect normal biomechanics while maintaining the exercise's intended purpose of improving upper trapezius and middle deltoid muscle performance.

BIOMECHANICAL CONSIDERATIONS

The upright row is a multijoint exercise, with movement taking place at the shoulder complex and elbow joints. Electromyographic studies indicate that the upright row elicits considerable activation of the upper trapezius and middle deltoid at 85 ± 5% and 78 ± 6% maximum voluntary contraction, respectively (3). Activation of the upper trapezius approaches that of the shrug but with the use of lighter loads, potentially making it a suitable alternative for those with chronic neck pain (3).

Performance of the upright row requires elevation of the arm at an angle that is slightly anterior to the coronal plane (bringing the arm straight out to the side). The traditionally prescribed technique for executing the lift requires individuals to internally rotate their shoulder during elevation as a means of targeting the middle deltoid (3,4). Furthermore, traditional technique (Figure 1) often dictates that individuals elevate their arms to bring their elbows into a position above shoulder height (90°) while maintaining an internally rotated position of the arms. Elevating the arms above the shoulder height while internally rotated violates normal biomechanics because the shoulder should externally rotate as a means of preventing impingement of the subacromial structures.

External rotation may begin at 60° of elevation; however, it is most critical between 90° and 120° to avoid impingement (20). Researchers using magnetic resonance imaging and surgical exploration have reported the greatest degree of subacromial impingement to occur from 70° to 90° when raising the arm overhead without external rotation (14,15,25). The upright row exercise as traditionally prescribed requires individuals to raise their arms into elevation at angles beyond 90° while maintaining internal rotation, thus placing individuals at risk for subacromial impingement (7,20,25). In our experience, individuals with previously diagnosed RTC pathology or subacromial impingement may report symptoms (pain or an ache) during this exercise, with the severity of reports often correlating to the height of arm elevation. Mitigating this risk involves modifying the exercise to respect normal biomechanics; however, suitable modifications must maintain the exercises intended purpose in regards to adequate muscle recruitment.

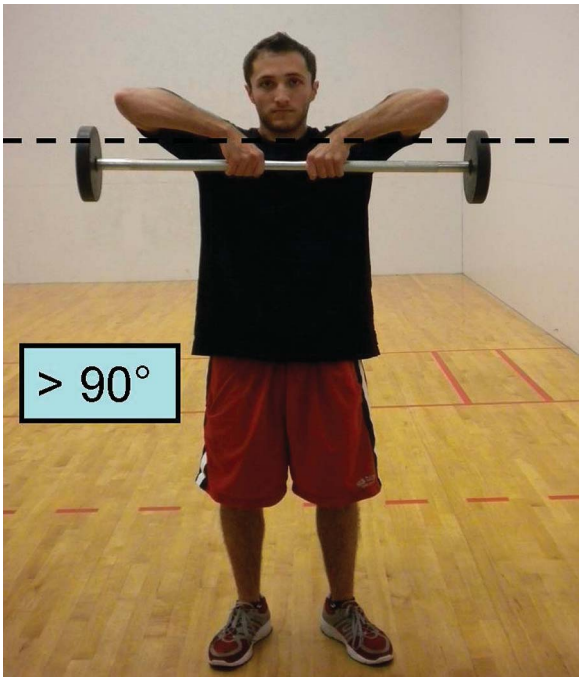

Figure 1. Illustration of traditional upright row with arms elevated above 90°. Dashed line indicates the 90° angle.

MODIFICATIONS TO TECHNIQUE

The upright row can be a safe and effective exercise, provided proper precautions are followed. Performance must take into account both individual genetics and pathophysiology of the shoulder complex. As a general rule, the bar should be pulled as close to the body as possible throughout the movement so as to maintain optimal stress on the middle deltoid. In addition, it is important to pull through the elbows, not the wrist, so as to maximize muscle activity at the shoulder.

What constitutes a safe degree of shoulder elevation during upright row performance remains a topic of controversy. As previously noted, studies indicate that impingement typically peaks between 70° and 120° of

glenohumeral elevation (7,14,15,20,25), thus the authors recommend that asymptomatic individuals elevate their arms during the upright row to just below 90° (shoulder height) (Figure 2). Similar recommendations have been put forth by other authors (21), who suggest limiting shoulder abduction to approximately parallel with the floor. This can serve as a general guideline as long as no pain is sensed during or immediately after exercise performance. Those individuals with previously diagnosed subacromial impingement or who may report pain with the exercise should decrease the angle of elevation to a height that does not provoke symptoms.

The upright row is sometimes used to maximize power production. This is particularly true when performing variations of the clean (e.g., hang clean and power clean). During the clean, a lifter's focus is on generating explosive upward movement of the bar during the high pull portion of the exercise (27). Impingement generally is not an issue here because elevation of the upper arm should not exceed 60°, assuming the lift is performed properly. Those new to the lift, however, often tend to pull the bar beyond a safe range. Not only does this bring about impingement but, given the high rate of acceleration during performance, creates forces at the shoulder joint that are exceedingly high, thereby heightening the extent of soft tissue damage. Beginners are therefore advised to practice the clean at a reduced speed with light weights until basic technique is developed. Once a modicum of proficiency is attained, part practice may be beneficial in mastering the skill. This is best accomplished by the use of segmentation, whereby the high pull is practiced separately from other aspects of the lift (28). Such a strategy can help to solidify neuromuscular control and thus ensure that impingement does not occur during performance.

In regards to training volume and load, considerable variability may exist among the injured versus asymptomatic population. Among the asymptomatic population, it is suggested that if the individual's activity-specific demands require endurance, a volume assignment of 2–3 sets of 12–20 repetitions is prescribed at a load of less than 67% of the 1-repetition maximum (1RM). To achieve the shared goals of both strength and hypertrophy, the exercise is performed for 3–6 sets of 6–12 repetitions at 67–85% of the individual's 1RM with rest periods of 60–90 seconds between sets. Individuals with a predisposition to shoulder injuries–such as overhead athletes–may be best advised to begin in the lower end of this range and then gradually move into higher ranges. Moreover, the threshold for advancement should not be independent of pain because premature progression of load and/or volume may lead to delays in healing among the injured population. In cases where a 1RM is not appropriate, such as in the rehabilitation setting, an estimated 1RM may be obtained using higher repetitions and a prediction equation. Readers are advised to consult the text *Essentials of Strength Training and Conditioning*, third edition, by Baechle and Earle (4), for details regarding prediction of the 1RM from the multiple repetition maximum. For those rehabilitating injury, it also is advisable to consult with a physician, athletic trainer, and/or physical therapist to ensure safe and effective prescription.

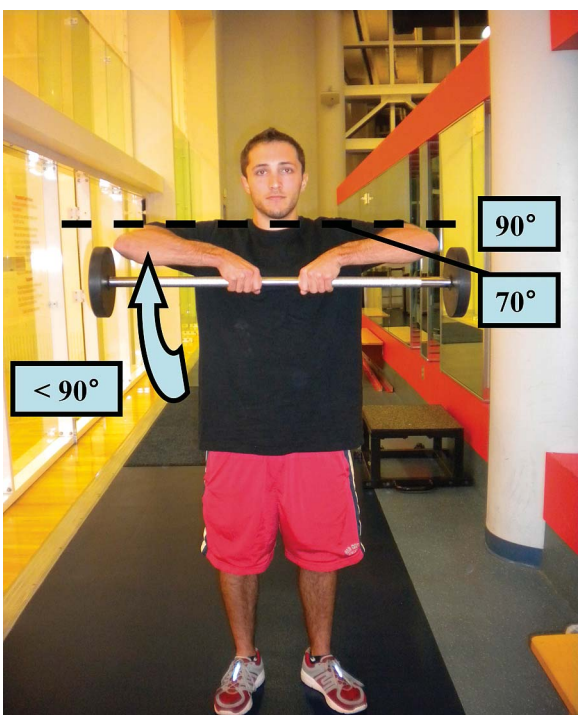

Figure 2. Illustration of modified upright row with arms elevated below 90°. Dashed line indicates the 90° angle.

CONCLUSION

One of the main advantages of the upright row is that it is perhaps the only open chain multijoint movement that targets the middle deltoid, making it a desirable exercise for many lifters. Although the exercise has known benefits, execution is not without risk as a result of the exercise's propensity to produce subacromial impingement. This risk may be mitigated through instruction of the individual to avoid elevation of the elbows above the shoulder height. Those with existing subacromial impingement who have pain during performance of the upright row are advised to elevate to an angle below the shoulder height that does not provoke symptoms or to avoid the exercise altogether.

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