

Detailed Analysis of The Pull-Up Exercise

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INTRODUCTION

The pull-up exercise has been used as a performance measure to assess physical fitness and muscular strength and endurance of the major muscles in the upper limb. The ability to successfully perform multiple repetitions of a pull-up is dependent upon a performer’s body mass, muscle strength, and movement style.

Traditionally, the pull-up has been used to assess the degree of physical fitness in adolescents and in men or women who attend the US military service academies, like for example in The Presidential Fitness Test where it was tested accompanied by other exercises like the sit-ups, shuttle runs, standing broad jump, 50-yard dash and softball throw for distance (1958).

Rehabilitation or fitness professionals are concerned with the level of balance between upper body pressing and pulling performance. Excessive emphasis on pressing movements in upper extremity resistance training may increase the likelihood of shoulder complex trauma such as rotator cuff injury or strain. By periodically assessing the ratio of press-to-pull, rehabilitation professionals or coaches, can monitor an athlete’s physical training to help preserve a more balanced shoulder complex and prevent injury.

The purpose of this work is to analyze and show the different stages of a pull-up, looking specifically at the muscles involved in each stage and how they work in the three different contractions we can find during the movement: isometric, concentric and eccentric. In addition, in accordance to the literature, I will demonstrate how the different joints works and which muscles are the primary movers or stabilizers in the different stages.

STARTING POSITION



According to Antinori F., Chandler T., Floyd RT., and colleagues “Initial static stability in the starting position: middle trapezius, lower trapezius, rhomboids, pectoralis minor, pectoralis major, posterior deltoid, infraspinatus, latissimus dorsi, teres major, subscapularis, biceps brachii, brachialis, brachioradialis, flexor carpi radialis, flexor carpi ulnaris, palmaris longus, flexor digitorum profundus, flexor digitorum superficialis, and flexor pollicis longus, external oblique, and erector spinae act statically.

Static contractions of muscles described in the previous (muscles involved) section facilitate the shoulder girdle’s stability with the scapula in a relative position of elevation, abduction, and upward rotation and the glenohumeral (shoulder) joint in a position of relative abduction.

The elbow joint is in extension and the hand and wrist are in flexion. The trunk maintains an upright neutral position between flexion and extension

ASCENDING POSITION



According to Floyd RT., La Chance PF., Hortobagyi T., Ricci B., and colleagues in the ascending position “while maintaining a vertical trunk position, the scapulae are forcibly depressed, retracted, and rotated in a downward position by concentric actions of the rhomboids, middle and lower trapezius, and pectoralis minor.

The glenohumeral (shoulder) joint is adducted by concentric actions of the pectoralis major, infraspinatus, posterior deltoid, teres major, subscapularis, and latissimus dorsi.

The elbow, wrist/hand joints are flexed by concentric actions of muscles discussed in the previous section. The body is pulled upright in a linear path until the underside of the chin is level with or above the top surface of the horizontal bar. The performer is encouraged to avoid all swinging, kicking, and twisting motions and to pause momentarily to allow the chin to pass over the top of the horizontal bar.”

DESCENDING POSITION



According to Floyd RT., LaChance PF and Hortobagyi T., in the descending position “While maintaining shoulder girdle and glenohumeral (shoulder) joint fixation and stabilization, the performer lowers the entire body to the original starting/ static hanging position.

Eccentric actions of muscles discussed in the previous sections (all the muscles previously described in the starting position) help the body to follow a linear and controlled downward path and help to prevent excessive scapular (shoulder girdle) elevation, glenohumeral (shoulder) flexion, elbow extension and trunk flexion, and/or extension. “

CONCLUSIONS

In conclusion, as demonstrated by Youdas, Amundson and colleagues the seven muscles that works the most during a pull-up are: ”latissimus dorsi (117– 130%), biceps brachii (78–96%), infraspinatus (71–79%), lower trapezius (45– 56%), pectoralis major (44–57%), erector spinae (39–41%), and external oblique (31–35%. ” According to the detailed analysis by Ronai P., and Scibek E., during the starting position these muscles all work statically maintaining the body still.

When the body starts to go up in the ascending phase all these muscles work concentrically and the shoulder joint is adducted by to the concentric contraction of all these muscles. And also, the elbow/wrist and hand joints flex thanks to the same contraction.

Instead, in the third phase, the descending one, eccentric actions of muscles discussed in the previous section help the body to follow a linear and controlled downward path and help to prevent excessive scapular (shoulder girdle) elevation, glenohumeral (shoulder) flexion, elbow extension and trunk flexion, and/or extension.

Additionally, according to Ball, TE., Ricci, B., and colleagues (1988-1993) “Previous electromyography (EMG) analysis of the pull-up has shown that the major portion of the work is accomplished by the shoulder musculature (2,24). The muscles active during the early phase of the movement are the teres major, upper portion of the pectoralis major, biceps brachii, infraspinatus, and latissimus dorsi (24). In the later phase of the movement, the latissimus dorsi, infraspinatus, and teres major are the major muscles active (24).” So, in conclusion, exercises, such as the PU, should be implemented into resistance training programs to enhance the strength, and perhaps, stability of the shoulder complex.

REFERENCES

Amundson, C. L., Cicero K. S., Hahn J. J., Harezlak D. T., Youdas J. W., (2010). Surface electromyographic activation patterns and elbow joint motion during a pull-up, chin-up, or perfect-pullup” rotational exercise. *J Strength Cond Res.* 24(12), 3404-14. doi: 10.1519/JSC.0b013e3181f1598c

Johnson, D., Lynch, J., Nash, K., Cygan, J., Mayhew, J. L., (2009). Relationship of Lat-pull Repetitions and Pull-ups to Maximal Lat-pull and Pull-up Strength in Men and Women. *Journal of Strength and Conditioning Research.* 23(3), 1022-4. DOI:10.1519/JSC.0b013e3181a2d7f5

LaChance P. F., Hortobagyi, T. (1994). Influence of Cadence on Muscular Performance During Push-ups and Pull-up Exercise. *Journal of Strength and Conditioning Research.* 8(2) 76-79

Negrete J. R., Hamney W. J., Pabian P., Kolber M. J. (2013). Upper Body Push and Pull Strength Ratio In Recreationally Active Adults. *Int J Sports Phys Ther.* 8(2), 138-144

Ronai, P., Scibek, E. (2014). The Pull-up. *Strength and Conditioning Journal.* 36(3), 88-90. doi: 10.1519/SSC.0000000000000052

Sas-Nowosielski K. J. (2022). Comparison of power, force, velocity and one repetition maximum of pull-ups performed by climbers on portable holds and a fingerboard. *TRENDS in Sport Sciences.* 29(1), 13-17 DOI: 10.23829/TSS.2022.29.1-2