OPTIMIZING POSITION OF THE HORIZONTAL BENCH PRESS USING SURFACE ELECTROMYOGRAPHY

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INTRODUCTION

Poor technique of the horizontal bench press (HBP) can lead to under developed pectoral muscles and chronic shoulder pain. Not controlling the weight during the eccentric and concentric phases of the lift and bouncing the bar off the chest is common poor practice. Many bench pressers use a variety of hand and body positions in hope that muscle fibers of the pectoralis major will be maximally recruited. Some of these positions have resulted in muscle imbalance and injuries.

An examination into the effect of glenohumeral (GH) joint angle, scapula and lower-back position on electromyographic (EMG) activity of the prime movers (upper clavicular and lower sternocostal heads of the pectoralis major (UCPM and LSPM), anterior deltoid (AD) and the long head of the triceps brachii (TB)) of the HBP can give insight into maximizing pectoral development and minimizing injuries. The optimum range of width of grip (WG) that produced maximum EMG activity in both the upper clavicular and lower sternocostal heads of the pectoralis major expressed as a percentage of biacromial width (BW) was found to be from 165 -190% for the HBP [1].

This study seeks to determine the optimum hand and body position for maximizing recruitment of the pectoralis major muscle using surface EMG (SEMG). It was hypothesized that a specific glenohumeral (GH) joint angle, scapula and lower back position would yield maximum EMG activity in the pectoralis major during the concentric phase of the HBP.

METHODS

Nine experienced (minimum of 2 yrs) male weight trainers were recruited and all signed consent forms prior to testing. EMG activity was recorded from the UCPM, LSPM, AD and the TB for six predetermined positions. Three GH joint angles (GHJAs) of 50º, 70º, and 90º with lower back naturally arched (LBNA) and scapula rotated (SR), one GHJA of 70º with scapula neutral (SN) and LBNA, and two positions of lower back arched (LBA) and flat (LBF) with 50º GHJA and SR. GHJA was kept consistent by use of two vertical wooden poles placed medially of the upper arm. Rolled towels maintained the SR and LBA positions. Feet were placed on a high box to produce the flat back position. On the day of testing subjects easily grasped the form for each position. Subjects produced maximum voluntary isometric contractions (MVICs) of the UCPM, LSPM, AD and TB by lying supine on the bench, holding an un-weighted bar stationary in their customary bench press position at approximately mid length of ascent while a spotter gradually applied increasing downward force symmetrically on the bar until the subject indicated that the contraction was maximum and the force maintained then EMG activity was recorded for 3 secs. Three trials for each position were then performed with 3 minutes rest intervals. WG was standardized to165% BW.

EMG activity was detected by pairs of 1cm disc Ag/AgCl electrodes with inter-electrode distance of 2cm. Bipolar centers were placed on the surface of the skin over the muscle bellies offset 2cm from the mid-length of the muscles to avoid innervation zones. Two ML865 Power Lab 4/25T, data acquisition systems coupled by a common trigger recorded EMG activity. Signals were sampled at 1000 Hz, filtered at 10 Hz (high pass) and 500 Hz (low pass), full-wave rectified, integrated, time normalized, found as %MVIC and expressed as a percentage of maximum %MVIC for each muscle. Recordings were processed for the concentric phase (from the lowest position to soft elbow lock out) and represented total energy of the lift. Processing EMG activity for the whole concentric phase helped to eliminate variance in readings by containing overall change in EMG activity, due to movement of electrodes for individual trials, constant.

RESULTS AND DISCUSSION

Effect of GH Joint Angle: Tukey post-hoc test showed that there was no significant difference in mean %MVIC for the UCPM, LSPM and TB muscles for changes in GHJA. However, direct comparisons showed that for the UCPM the 50º and 70º GHJAs produced greater mean %MVIC than the 90º GHJA (Fig. 1). There was significant difference in mean %MVIC of the AD between the 50º and 90º GHJAs.

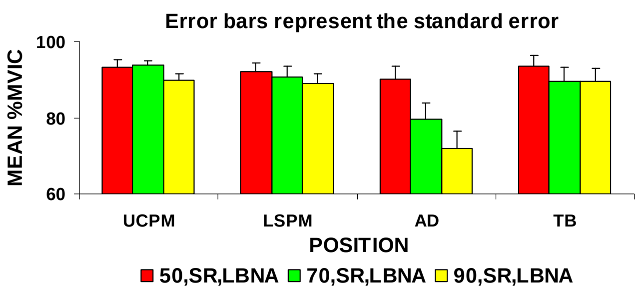

Figure 1: Mean %MVIC in UCPM, LCPM, AD and TB for the 50º, 70º and 90º GHJAs.

It is common belief that to target the pectoral muscles, the HBP should be performed with a close to 90º GHJA. The results show that this is not the case and that the 50º or 70º GHJA can be used to work the pectoral muscles effectively. Furthermore the 90º JA has been shown to increase the risk of shoulder injury, instability, atraumatic osteolysis of distal clavicle and pectoralis major rupture [2].

Effect of Scapula Position: The correct anatomical position for the scapula is back and rotated downwards. In this position greater stability of the GH joint is achieved. During the eccentric and concentric phases of the HBP the scapulae retracts and protracts however, a flat bench surface does not allow free movement of the scapulae and increases risk of shoulder injury. For this reason the rolled towel was used to create space between the scapulae and bench surface to allow free retraction and protraction. Independent samples t-test revealed that there was no significant difference in mean %MVIC in the UCPM, LCPM, AD and TB between rotated and neutral scapula positions. Therefore muscle recruitment would not be compromised when the technique of rotating the scapula backwards is utilized during the HBP. More importantly the GH joint would be less prone to injury.

Effecct of Lower back Position: Some bench pressers experience discomfort in the lower back during the HBP due to excessive curvature of the lower lumbar region. To relieve stress, the flat back position can be used without affecting the benefits of the horizontal bench press. There was significant difference in mean %MVIC for the AD and TB between the LBA and LBF position. Direct comparisons of mean %MVIC for the UCPM, LSPM, AD and TB showed greatest EMG activity for the LBF position (Fig. 2).

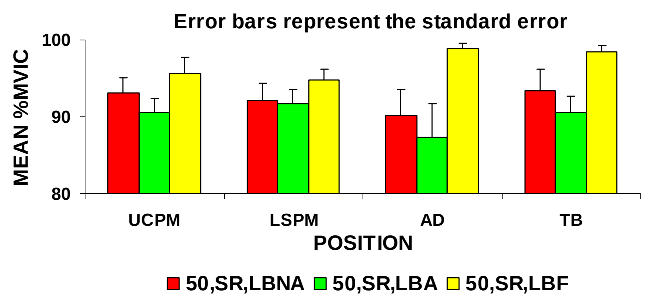

Figure 2: Mean %MVIC in UCPM, LCPM, AD and TB for LBNA, LBA and LBF positions.

Recommendations: To minimize shoulder injury and maintain recruitment of the UCPM, LSPM, AD and TB muscles, the HBP should be performed with a 50-70º GHJA with SR for free movement and either the LBF or LBNA position. Bench design can help maintain optimum position. We can be 95% assured that a specific body position does not yield maximum EMG activity in the pectoralis major.

REFERENCES

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2. Green CM, and P Comfort. *Strength and Conditioning Journal*. **5**, 10-14, 2007.

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