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AN OVERVIEW, EFFECT OF BENCH PRESS ON UPPER EXTREMITY MUSCLES

[1]Abdulrhman Saad Alzhrani, [2]Adel Abdullah Alshehri, [3]Mohammed Abdulrahman Alnghaimesh, [4]Muteb Oqab Alanazi, [5]Abdulaziz Hassan Alsybiani, [6]Faisal Nasser Albasri

[1]Aliman General Hospital, Physiotherapist
[2]Aliman General Hospital, Senior Physical Therapist
[3]Aliman General Hospital, Physical Therapist
[4]Al-Iman General Hospital, Physiotherapist
[5]Al-Iman General Hospital, Physical therapy technician
[6]Al-Iman General Hospital, Physical therapy technician

Abstract:

Bench-press workouts are widely utilized as a prevalent training modality for enhancing upper extremity muscle strength and endurance, resulting in significant improvements in these physiological parameters. We narratively review the literature, throughout several databases, including PubMed, and Embase, for all relevant data published up to the middle of 2022. The existing body of literature encompasses a range of studies examining the impact of different bench-press postures on the level of muscular activation. Nevertheless, there remains a lack of comprehensive understanding of the complete impact of fatigue on both the muscle performance and kinetics specifically pertaining to the elbow joint.

Corresponding author:

Abdulrhman Saad Alzhrani,
Aliman General Hospital, Physiotherapist

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INTRODUCTION:

The utilization of bench-press exercises is prevalent among health-conscious persons and athletes due to their convenience, ease of acquisition, and adaptability to different levels of complexity. These exercises primarily aim to enhance the strength of the upper extremity muscles [1]. The stability of joints during upper extremity movements is maintained by both the surrounding tissue, such as ligaments and capsules, as well as the strength of muscular contractions. Hence, it is imperative to prioritize the maintenance and enhancement of muscle strength as a means to improve performance capacity and mitigate the risk of movement-related injuries [1].

Bench-press exercises are widely utilized as a prevalent upper extremity training modality due to their demonstrated efficacy in enhancing both muscular strength and muscle endurance. The existing body of literature encompasses a range of studies examining the impact of different bench-press postures on the level of muscular activation. As an illustration, it has been observed that assuming a narrow base posture leads to a greater level of electromyographic activity in the pectoralis major and triceps brachii muscle groups compared to assuming a broad base position [2].

The upper extremities are consistently engaged in routine athletic endeavors, such as pushing and participating in throwing events. The primary muscles engaged in these movements include the pectoralis major, the anterior deltoid, and the triceps brachii. The pectoralis major muscle is a substantial muscular structure comprised of three distinct sections, namely the clavicular, sternal, and costal portions. In its entirety, this particular muscle functions as a robust medial rotator and adductor of the upper limb. The anterior deltoid muscle provides assistance to the pectoralis major in shoulder flexion, whereas the triceps brachii serves as the principal extensor of the elbow [2].

Resistance training is widely recognized as the predominant approach employed by athletes and recreational lifters to enhance their upper body strength. The bench press is widely recognized as one of the most commonly performed exercises in resistance training programs. The bench press has a dual purpose as an assessment tool for evaluating upper body strength and as one of the three primary exercises in the discipline of powerlifting. Consequently, numerous athletes prioritize the bench press in their training regimen with the aim of enhancing their upper body strength. The bench press, because to its widespread popularity, encompasses several variations that are integrated into diverse training regimens. These variations include adjustments in the inclination of the bench, utilization of machines [3,4], as well as the incorporation of chains and bands. An alternative approach involves the utilization of an unstable surface that serves the dual purpose of enhancing muscular strength and promoting trunk stabilization during the exercise [5].

Due to its widespread appeal, prior scholarly investigations have been conducted to explore the impacts of various bench press variations and their potential advantages. The utilization of a Swiss ball bench press in practical settings has prompted several researchers to investigate the impact of unstable surfaces on muscle activation and maximal force generation [5,6,7].

The bench press exercise is widely utilized in upper-body resistance training by athletes and leisure trainers alike, either to enhance performance or as an indicator of upper-body strength [8]. In addition, competitive athletes specializing in bench press employ a variety of bench press variations to specifically target and train the muscles of the shoulder girdle, thereby making a substantial contribution to their overall performance. Indeed, the barbell bench press is widely regarded as the most effective exercise for the development of the pectoral muscles. The manipulation of bench inclination is a commonly employed variable for altering muscle activation levels during the bench press exercise. According to previous research, adjusting the angle of the bench during the bench press exercise can result in optimal muscle activation of either the upper or lower pectoralis major [9].

Multiple studies have been conducted to assess the electromyographic (EMG) activity of the pectoralis major muscle through manipulation of the bench press inclination, specifically incline and decline bench press exercises [10,11]. The study conducted by Barnett et al. (2012) examined the impact of different bench inclinations and hand spacing on the electromyographic (EMG) activity of five muscles involved in shoulder joint movement. The researchers discovered that the sternocostal head of the pectoralis major exhibited more activation during the execution of the horizontal bench press compared to the incline bench press. Nevertheless, the authors of this study regarded the sternal and costal segments of the pectoralis major muscle as a unified entity. Furthermore, the authors of this study conducted a comparison of three different inclinations of the bench press over the horizontal plane, namely the horizontal position, an inclination of 40° above horizontal, and the vertical position known as the "military press" [12].

DISCUSSION:

The selection of exercises is an essential aspect of a resistance training program, as it aligns with the idea of specificity by inducing varying levels of muscle activation. The activation of muscles has significance within a workout regimen, as research has demonstrated its crucial role in stimulating the enhancement of muscle strength and size [13]. The bench press exercise is frequently recommended for enhancing upper-body strength, with a specific focus on the pectoralis major muscle [12]. When the two heads of the pectoralis major operate together, their primary movements include horizontal adduction and medial rotation of the humerus. Nevertheless, when operating independently, the superior head assists in shoulder flexion, while the inferior head assists in shoulder extension from a flexed state. In light of these observed actions and the inherent capacity of the shoulder joint to exhibit a broad spectrum of motion, numerous adaptations have been implemented with regards to the inclination of the bench during bench press exercises, with the aim of enhancing the activation of the distinct heads of the pectoralis major [12,14]. Hence, acquiring a deeper comprehension of the impact of bench angle on muscle activation will contribute to the development of efficacious upper extremity workout protocols.

The study conducted by Barnett, Kippers, and Turner [12] investigated the muscular activation patterns of the upper and lower heads of the pectoralis major during bench press exercises executed at different bench angles. The researchers discovered that performing horizontal bench (0°) exercise led to the highest level of activation in the lower pectoralis major muscle. However, they did not see any difference in upper pectoralis activation between horizontal bench and 40° exercises [12].

In a more recent study, Trebs et al. [11] discovered that when comparing the horizontal bench press to bench angles of 44° and 56°, there was a notable increase in upper pectoralis activation. Nevertheless, no significant disparity in upper pectoralis activation was discovered between the 28° inclined bench and the horizontal bench. This finding aligns with the observations made by Barnett et al. [12], who also noted the greatest activation of the lower pectoralis during the horizontal bench press [11]. Despite modest variations in methodological approaches, such as bench angles and equipment, individuals were consistently subjected to the same relative resistance load across all bench settings. The activation of muscles can be influenced by changes in the absolute resistance load, irrespective of alterations in bench angle and/or body position. This is a significant factor to consider, as adjustments in the bench angle during bench press exercises are commonly employed to maximize muscle activation in either the upper or lower pectoralis major [11,12].

In their study, Glass and Armstrong (year) conducted a comparison of the electromyographic (EMG) activity between the upper pectoral (clavicular portion) and lower pectoral (costal portion) muscles. This comparison was carried out under two different bench press inclinations, specifically at +30° and −15° from the horizontal position. The findings of their study demonstrated a notable increase in lower pectoral muscle activation when doing a decline bench press exercise, but comparable levels of upper pectoral muscle activation were observed during both incline and decline bench press exercises. Nevertheless, the researchers did not assess the electromyographic (EMG) activity of the additional muscles involved in the bench press exercise, such as the sternal part of the middle pectoral, anterior deltoid, or triceps brachii. Furthermore, they did not examine any other inclinations of the bench press. In their study, Trebs et al. (2011) conducted a comparative analysis of the activation levels of the clavicular head and sternocostal head of the pectoralis major, as well as the anterior deltoid, during the execution of the bench press exercise. The researchers examined the effects of doing the exercise at various angles above the horizontal plane, specifically at 0°, 28°, 44°, and 56°, while utilizing a workload equivalent to 70% of the participant's one-repetition maximum (1RM) for each respective angle. The researchers discovered that there was an increase in muscle activation in the clavicular heads of the pectoralis major and the anterior deltoid as the inclination of the bench press was elevated. However, similar to the study conducted by Barnett et al. [12], the authors of this study also treated the sternal and costal segments of the pectoralis major as a unified entity and did not assess additional synergistic muscles such the triceps brachii. In a study conducted by Lauver et al. (reference 14), a comparison was made between the muscle activation of the upper and lower pectoralis major, anterior deltoid, and triceps brachii during a free-weight barbell bench press. This exercise was performed at various bench angles, specifically -15°, 0°, 30°, and 45°. According to their findings, the utilization of the horizontal bench press has the potential to elicit muscle activation in both the upper and lower heads of the pectoralis. Nevertheless, the central section of the pectoralis major was not subjected to analysis by these authors. In a more recent study, Saeterbakken et al. (4) conducted a comparison of electromyography (EMG) activity during the execution of a 6-repetition maximum (6RM) bench press using three different bench angles: flat (0°), incline (+25°), and decline (-25°). The findings of the study indicated that there were no statistically significant variations in activation among the three bench positions, save for a decreased activation of the triceps brachii and an increased activation of the biceps brachii observed during the incline bench press in comparison to the horizontal and decline bench press. In addition to examining the electromyographic (EMG) activity in relation to grip widths for bench press inclinations, the authors of the study solely conducted measurements at a singular bench press inclination angle, namely at a +25° angle from the horizontal.

Nevertheless, using an unstable surface is not the sole method employed by individuals to introduce diversity into resistance training with the aim of enhancing upper-body strength. One technique that has had a surge in popularity in recent years involves the utilization of an unstable load (UL), colloquially referred to as the chaos bench press, for the purposes of enhancing strength and facilitating shoulder rehabilitation. A recent study examined the effects of an unstable load (UL) on squat performance. The findings revealed a notable increase in muscle activation of the rectus abdominus, external oblique, and soleus muscles, along with a modest reduction in vertical ground response force, as compared to a stable load (SL) condition [15]. Nevertheless, the impact of these factors on muscle activation during the bench press remains unclear.

While research has demonstrated that use a Swiss ball can enhance the activation of trunk stabilizer and anterior deltoid muscles, its impact on maximum force output remains inconclusive. Nevertheless, there is a scarcity of studies investigating the long-term consequences of integrating an unstable surface into a resistance training regimen. The utilization of chains and bands has demonstrated a favorable impact on strength improvements during short-term training sessions, although limited knowledge exists regarding the long-term effects. Based on prior research indicating that an unstable surface leads to increased muscle activation, the incorporation of an unstable load (UL) in conjunction with an existing unstable barbell during a bench press exercise may have potential in enhancing muscle activation and subsequently improving upper-body strength [16].

Prior research has indicated that the decline bench press elicits activation in the lower pectoralis major muscle [10,16], whereas the flat bench press primarily engages the sternocostal portion of the pectoralis major muscle, and the incline bench press predominantly stimulates the upper pectoralis major muscle [17]. Due to this rationale, there is a prevailing belief that the horizontal bench press exercise is efficacious in eliciting activation in the central region of the pectoralis major. Additionally, when the bench press is inclined beyond the horizontal plane, there is an observed increase in electromyographic (EMG) activity within the upper region of the pectoralis major. Despite the apparent simplicity of the aforementioned assertions, it has been documented by Glass and Armstrong [10] that there are no statistically significant disparities observed in the upper pectoralis major muscle activation when comparing the incline and decline bench press exercises. According to the findings of Lauver et al. (14), it was determined that a decrease or a 45° slope of the bench would yield minimal to no further advantages in terms of enhancing muscle strength and promoting the development of the pectoralis major. Furthermore, there is a lack of research examining the electromyographic (EMG) activity of the three portions of the pectoralis major muscle in relation to the inclination angle of the bench press exercise. Specifically, there is a dearth of studies investigating the inclination angle that elicits higher EMG activity in the upper portion of the pectoralis major, as well as the point at which the anterior deltoid muscle becomes highly activated in conjunction with the triceps brachii muscle during these bench inclinations. In a recent study conducted by Muyor et al. (2013), an analysis was performed on various muscles including the three segments of the pectoralis major, the anterior deltoid, and the triceps brachii, during the execution of the bench press exercise. Nevertheless, the aforementioned authors solely conducted a comparison of electromyographic (EMG) activity during the horizontal bench press exercise, specifically when the athletes maintained their feet grounded and engaged in active hip flexion. However, they did not explore variations in bench press inclinations.

In accordance with the guidelines provided by the Surface Electromyography for the Non-invasive Assessment of Muscles (SENIAM) recommendations [14], the electrodes were positioned on the dominant side of each participant and securely affixed using adhesive tape to minimize the potential for displacement during the exercise regimen. The placement of the electrodes in this study was as follows: on the clavicular portion of the pectoralis major upper portion (referred to as PMUP), specifically at the midclavicular line over the second intercostal space [15]; on the sternal portion of the pectoralis major middle portion (referred to as PMMP), located horizontally to the rising muscle mass (approximately 2 cm from the axillary fold) [15]; on the costal portion of the pectoralis major lower portion (referred to as PMLP), positioned at the midclavicular line over the fifth intercostal space [7]; on the anterior deltoid (referred to as AD), placed 1.5 cm distal and anterior to the acromion [1]; and on the medial head of the triceps brachii (referred to as TB), positioned at the midpoint between the posterior aspect of the acromion and the olecranon processes [16]. The provided diagram (Figure 1) is presented for reference. Following the placement of electrodes, the maximal voluntary isometric contraction (MVIC) of each muscle was measured in order to standardize the electromyography (EMG) values obtained during each bench press inclination. In order to accomplish this, two trials of maximum voluntary isometric contractions (MVICs) lasting 3 seconds each were conducted for every muscle in a randomized fashion. A rest interval of roughly 10 seconds was provided between each contraction, and a 2-minute break was given between the MVIC measurements of each muscle [17]. The maximum voluntary isometric contraction (MVIC) was calculated by averaging the amplitude of the highest rectified electromyography (EMG) signals, using the root-mean-square (RMS) method, during a one-second timeframe. This calculation was performed with a 100 ms window, as described in [18,19].

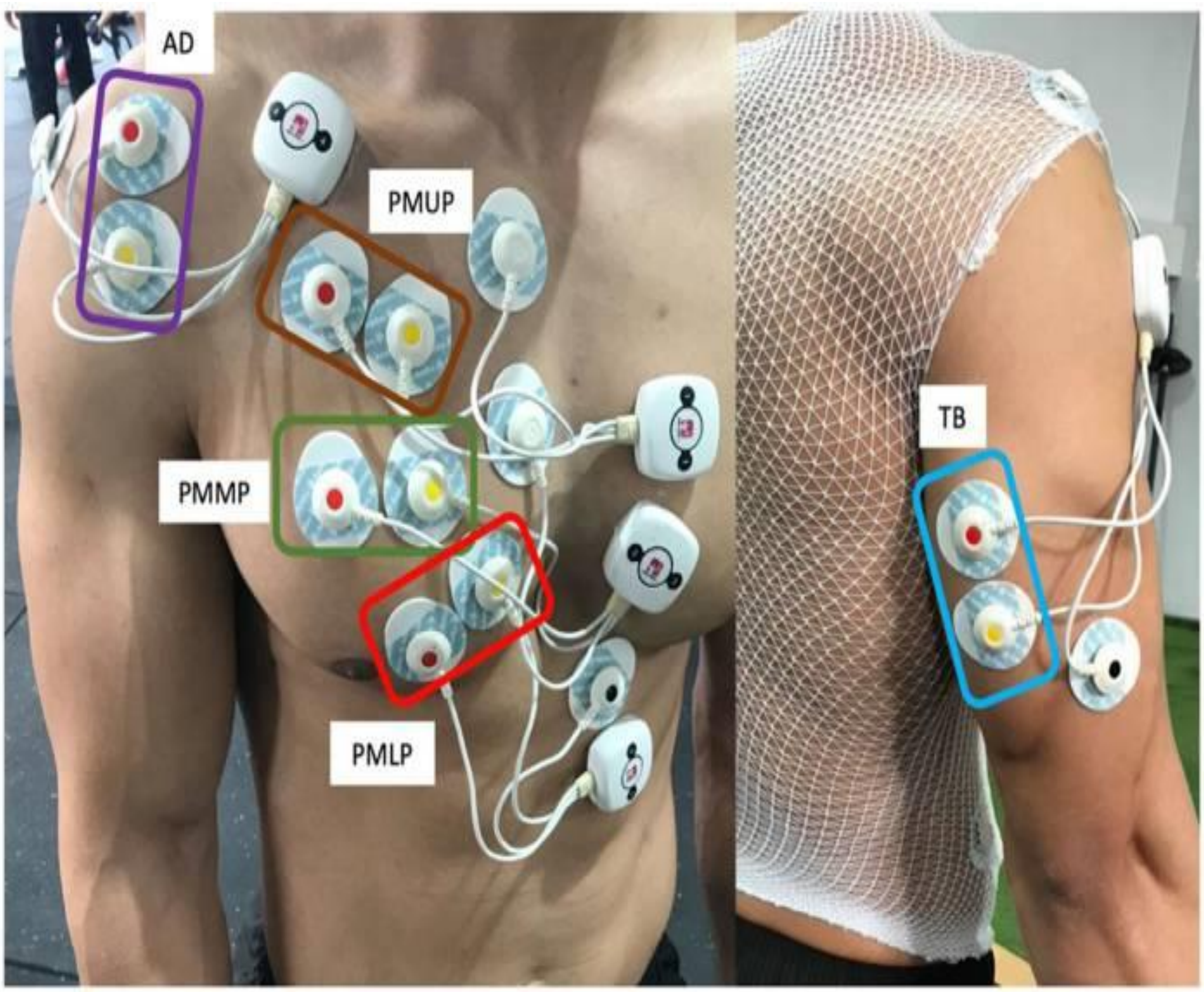

Figure 1: Electrode placement diagram for recording electromyographic (EMG) activity. AD: anterior deltoid; PMUP: pectoralis major upper portion, clavicular portion; PMMP: pectoralis major middle portion, sternal portion; PMLP: pectoralis major lower portion, costal portion; TB: triceps brachii, medial head.

CONCLUCION:

Various bench press variations have the potential to elicit improvements in both strength and hypertrophy of the elbow extensors, shoulder flexors, and horizontal adductors. Nevertheless, it is plausible to anticipate more significant adaptations in the elbow extensors and shoulder flexors with narrower grip widths, while larger grip widths may lead to stronger adaptations in the shoulder horizontal adductors. The majority of studies have examined the impact of fatigue on the kinetics and myodynamics of the elbow joint. These findings serve as a valuable resource for developing bench-press strategies in the context of general athletic training and recovery. Significantly, the findings of their study indicate that engaging in bench-press training until reaching a state of tiredness heightens the susceptibility to injury in the elbow joint and upper extremity. Hence, it is imperative for doctors to exercise meticulous control over the maximum number of repetitions when devising bench-press workout regimens.

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