

Bench press exercise the greatest functionally and biomechanically drill.

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Introduction Approach:

Weight training is a popular activity offering many physical and psychological benefits and the bench press is one of the most popular weight training exercises among both competitive and recreational lifters. The purpose of this article was to increase the body of knowledge concerning the biomechanics and functions of the bench press as performed by novice lifters. Muscular activity and the kinematics of the lifter, as well as the kinematics and kinetics of the bar, were assessed during different variations of the exercise [8] [19] [20] [21]. Bench pressing is an exercise that can give a strong upper body with benefits reaching into all areas of life [34]. The bench press exercise is one of the most used for training and for evaluating upper-body strength. In strength training, the bench press exercise is a standard part of anyone's resistance training program and is often used to assess upper body strength as

well. The bench press (also known as the chest press) targets the large pectoral muscles that help perform the pushing motion. This exercise is typically performed with free weights such as a barbell or dumbbells [28].

By the nature of bench pressing, it is utilizing the chest muscles and shoulder blades to lift the weight up and hold it in place. The more muscle mass on the upper body, the more weight you will be able to lift. This can help increase strength in other exercises as well (like push-ups). Improving posture: Bench pressing creates these big muscles that hold up so much weight. This helps keep the back straight and shoulders pulled back when doing other activities such as carrying groceries or lifting children [3] [4] [27]. The bench press and push up with Thera-Band resistance produced similar levels of pectoralis major activation (39% maximum contraction) [28].

Figure (1). Thera-Band Resistance



Having large muscles also makes our bodies produce more testosterone. This means stronger bones, improved cardiovascular health, plus many other benefits. While there are many benefits to bench pressing, the best part is that it's easy to do. Anyone can learn how to bench press, regardless of age or fitness level. The key is to start out light and perfect the form before adding weight. The barbell bench press is one of the universal gauges of strength lifters use to establish the weight room hierarchy. The more plates you can pile onto each side of the barbell and successfully

push off your chest, the higher you are in the pecking order [1] [2] [20] [27] [34].

The bench press is a compound exercise that works the chest and shoulders, as well as the triceps. It's considered one of the best exercises for building muscle and increasing strength, making it an important part of most workouts [11]. A conventional bench press uses the pectoralis major, front deltoids and triceps brachia to horizontally adduct the shoulder. While flat bench pressing, the pectoralis major and pectoralis minor muscles are activated [3]. The exercise also

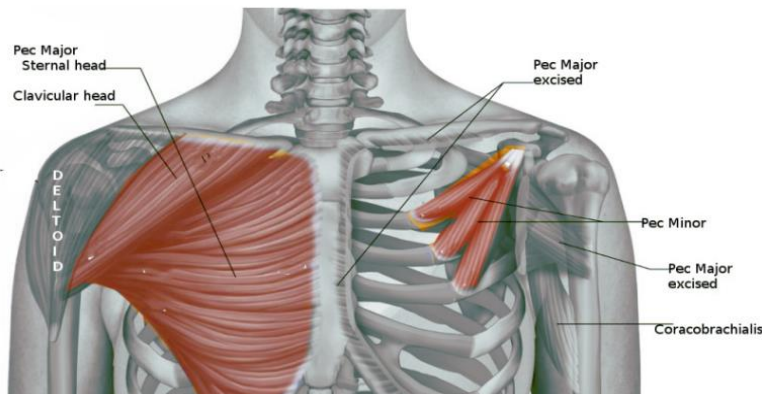
uses the triceps and anconeus muscle to extend the elbows. The bench press is an exercise that can be used to strengthen the muscles of the upper body, including the pectorals, arms, and shoulders. Depending on specific goals, there are different variations of bench presses that work slightly different muscles, too [4] [31] [32] [34].

The biomechanical principles relevant to the bench press are Balance, Coordination Continuum, Force–Time, and Range of Motion. When training for strength, resistance is high, the athlete must have good control of the weight (Balance), and coordination during the lift will be simultaneous [8] [21]. The force–time profile of strength training attempts to maintain large forces applied to the bar through as much of the range of motion as possible. The Stretch Shorting Cycle (SSC) nature of the movement should be minimized. This keeps the movement slow and force output near the weight of the bar. High initial forces applied to the bar results in lower forces applied to the bar later in the range of motion [9]. The principle of Range of Motion in strength training tends toward one of two extremes. First, minimize the range of motion of joints that do not contribute to the movement and of those that allow other muscles to contribute to the movement. Second, the range of motion for joint movements or muscles that are

targeted by the exercise should be maximized [33]. The primary joint actions that occur during the bench press include Eccentric (lowering) Phase, Horizontal shoulder abduction, Elbow flexion, Concentric (lifting) Phase, Horizontal shoulder adduction, Elbow extension [33] [34]. The two principles most strongly related to exercise safety in the bench press are Balance and Range of Motion. Athletes must always control the weight of the bar, and a lack of control will affect the range of motion used in the exercise. Since the athlete is struggling to “make weight,” the difference in strength between the sides of the body manifests as uneven motion of the bar and poor balance. The athlete also hyper extended his lumbar spine in straining to lift the weight [10] [11]. The biomechanics of the bench press can be analyzed in terms of joint angles, muscle activation, and force production. Joint angles are critical in determining the biomechanics of the bench press. During the exercise, the shoulder, elbow, and wrist joints are all involved in moving the barbell [27].

The studies showed that all bench press variations achieved high elbow and shoulder muscular efforts. A decrease in grip width induced larger elbow NJMs, and larger EMG activity of the lateral head of the triceps brachii, anterior deltoid, and clavicular head of the pectorals major [22].

Figure (2). Pectoralis Muscles



Another study aimed at evaluate the electromyographic (EMG) activity levels of the pectoralis major (PM) in its three portions (upper portion, PMUP, middle portion, PMMP, and lower portion, PMLP), the anterior deltoid (AD), and the triceps brachii (TB) medial head during the bench press exercise at five bench angles (0°, 15°, 30°, 45°, and 60°). The EMG activity of the muscles was recorded at the aforementioned inclinations at 60% of one-repetition maximum (1RM). The results showed that the maximal EMG activity for PMUP occurred at a bench inclination of 30°. PMMP and PMLP showed higher EMG activity at a 0° bench inclination. AD had the highest EMG activity at 60°. TB showed similar EMG activities at all bench inclinations. In conclusion, the horizontal bench press produces similar electromyographic activities for the pector [6]. In

another study by Elliot et al., the results showed that electromyograms produced by the prime mover muscles (sternal portion of pectoralis major, anterior deltoid, long head of triceps brachii) achieved maximal activation at the commencement of the ascent phase of the lift and maintained this level essentially unchanged throughout the upward movement of the bar [11].

All bench press variations may stimulate strength gains and hypertrophy of the elbow extensors and shoulder flexors and horizontal adductors. However, greater adaptations of the elbow extensors and shoulder flexors may be expected when selecting narrower grip widths, whereas wider grip widths may induce greater adaptations of the shoulder horizontal adductors [21] [22] [23].

Figure (3). Inclined bench Press.



The comparison between a recreational and powerlifting bench press shows vast differences, maybe more so than the comparison between a weightlifting and powerlifting squat. The aims are very different (muscular hypertrophy, aesthetics, sports / everyday life performance compared to strength increase power output, weight lifted etc.). While bodybuilders / recreational lifters may want their muscles to be 'felt' working, powerlifters generally try to move the weight by manipulating joint positions and maximizing bio-mechanical advantages – reducing moment arms and keeping the weight close to the fulcrum [16].

The concentric phase of bench press from an athlete is struggling to make a weight goal. Risk of immediate and future injury: lateral strength imbalance, poor control of bar motion and hyperextension of the lumbar spine. Since the athlete is “maxing-out,” some of these weaknesses can be expected, but safety is the greatest concern. Hyperextension of the lumbar spine under loading is dangerous because of uneven pressures on the intervertebral disks and greater load bearing on the facet joint [14]. Here the immediate risk of injury is more important than balance, skill in exercise, or passing a screening test. The Relative Bench Press Test is an upper body muscular strength endurance test. Participants perform the maximum number of bench presses at a set % of their body weight. The NHL Bench Press Test had a similar test using 70-80 % of bodyweight performed at a set cadence [24]. This is an upper body muscular strength endurance test.

The bench press is great exercise because it hits the entire upper body and incorporates more stabilizer muscles than any other weightlifting movement. It's also a compound exercise, meaning that it works several different muscle groups at once. That makes the bench press one of the best exercises for strengthening the chest and shoulders. It's also great for helping to improve posture and building up your triceps and back muscles (often referred to as “the lats muscles”; The lats have 3 main divisions, the lumbar division (middle lat), the iliac division (lower lat) and the thoracic division (upper lat) and it's possible to bias each division based on your set up, shoulder position and arm path. The bench press requires coordination so you can use these smaller

muscles to stabilize the body while pressing weight overhead [11] [12].

This exercise involves several muscle groups. It's also a complex exercise. It requires a lot of stabilizer muscles to work in concert to help stabilize the body. Stabilizer muscles are smaller muscles that work together with the larger muscle groups to keep balance and stable. They're important for posture, balance and injury prevention and they come into play when lifting heavy weights. The bench press uses these smaller stabilizing muscles because it requires the entire upper body to move as one unit. This is especially true when lifting a heavy weight from the chest up. This can be especially important for people with an existing shoulder issue or those who want to avoid injury [11][21] [32].

Regarding the core, it strengthens the core and improves the posture. There's a reason it's included in many workout routines. It requires using the core muscles to stabilize the body. This means that this exercise will help strengthen the muscles around the spine. Since these muscles are so important for supporting good posture, improving their strength can help prevent back pain. Everyone does not have to use a barbell or even lie down on the ground to get the benefits of the bench press. It can also be done while lying on a stability ball or while standing on a Bosu ball [1] [2] [3][11]. The bench press targets the pectorals/chest to a greater extent than the floor press simply because the longer range of motion of the press increases the stretch and loading place upon the chest. In contrast, the floor press can increase chest strength and mass as well, there's generally more chest involvement in the standard bench press than the floor press [7].

There are a few formulas useful for calculating the approximate max weight for any lift. The one is usually use is the Epley formula. It is popular in the fitness industry and for my body seems to be relatively close to accurate. Anyone can even perform the calculation in his head in some circumstances [13] [15] [25].

Take the weight that used, multiply by the number of reps can achieve, divide by 30 and add the weight that used. So, as a practical example, say you benched 120 kg for 5 reps to failure. Epley max = $120 * 5 / 30 + 120 = 140$ kg. So, in theory you might be able to grind out a 140 kg rep. This is only an approximation though so

never take this number as an absolute truth. You will find that many programs you can download from the Internet work on a "Training max" such as the Wendler 5/3/1 program. This is often calculated as 90% of your one rep max. In many of the spreadsheets, this 1 RM and subsequent training max is calculated by using the Epley formula [15] [25].

One-repetition maximum (one-rep max or 1RM) in weight training is the maximum amount of weight that a person can possibly lift for one repetition. It may also be considered as the maximum amount of force that can be generated in one maximal contraction. One repetitions maximum can be used for determining an individual's maximum strength and is the method for determining the winner in events such as powerlifting and weightlifting competitions [18] [25].

One repetition maximum can also be used as an upper limit, in order to determine the desired "load" for an exercise (as a percentage of the 1RM). Weight training protocols often use 1RM when programming to ensure the exerciser reaches resistance overload, especially when the exercise objective is muscular strength, endurance or hypertrophy. By understanding the maximal potential of the muscle, it is possible to reach resistance overload by increasing the number of repetitions for an exercise [25]. Power is the product of both force and velocity, and correlates with increases in athletic performances [18] [26] [29].

The bench press, or chest press, is a weight training exercise where a person presses a weight upwards while lying horizontally on a weight training bench. Although the bench press is a compound movement, the muscles primarily used are the pectoralis major, the anterior deltoids, and the triceps, among other stabilizing muscles. A barbell is generally used to hold the weight, but a pair of dumbbells can also be used [1] [2] [3] [4]. In strength training, the bench press exercise is a standard part of anyone's resistance training program, and is often used to assess upper body strength as well. The bench press (also known as the chest press) targets the large pectoral muscles that help perform the pushing

motion [4] [6] [14]. An effective way to build explosive power that directly transfers into the bench press is by lifting sub maximal weights with maximal force [5].

The barbell bench press is one of three lifts in the sport of powerlifting alongside the deadlift and the squat. These are the only lifts in the sport of Paralympic powerlifting. The barbell bench press is one of the universal gauges of strength lifters use to establish the weight room hierarchy [27].

The bench press is also extensively used in weight training, bodybuilding, and other types of training to develop the chest muscles. Bench press strength is important in combat sports as it closely correlates to punching power. To improve upper body strength, power, and endurance for athletic, occupational, and functional performance as well as muscle development, the barbell bench press is frequently used [3] [12] [28]. It is a cure to competitive weightlifters that were having difficulty mastering the quick lifts found that they could utilize their strength much more readily by doing less dynamic lifts: bench press, deadlift and back squat [34]. An effective way to build explosive power that directly transfers into the bench press is by lifting sub maximal weights with maximal force [5].

In Powerlifting The position is taking by lying on a flat bench with body weight resting on buttocks and upper traps, an arched back, and feet driven into the floor. Movement requires the weight to be taken at full arm's length, lowered to upper torso, paused, and then lifted to starting position. Optimizing performance for powerlifting entails the powerlifter following and practicing certain techniques, such as arching, inhaling deeply, and actively pressing their feet into the floor to utilize all body parts in the lift and ensure weight distribution through the back and legs and into the floor. [1] [2] [6] [7] [13] [16] [19] [26] [27]. It must first note that the Bench Press (as performed in the sport of powerlifting), is relatively safe if executed correctly. Most injuries that occur are the result of technical breakdown caused by fatigue, or simply not knowing how to bench properly [31].

Figure (4). Powerlifting Style Bench Press (Maximal Strength).



Bodybuilding Style Bench Press (Maximal Chest Stimulation): While this method can be used for more chest stimulation, it can carry a higher risk of injury. Heavy weights are not recommended with this style. Here are some common tweaks:

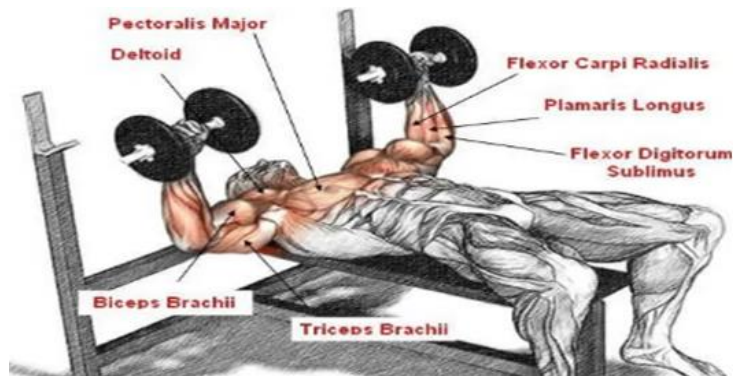
More Elbow Flare; Instead of the elbows tucked inward toward the torso, they are flared out to the sides. Partial Reps; Stopping before lockout, and above the chest allows the tension to remain mostly on the chest instead of other muscles [3] [4] [34].

Performing the bench press can contribute to multiple types of injuries as, Torn ligaments / tendons in shoulders, Injuries to the trapezius muscle, elbow / wrist strains, cracked or broken ribs, usually the result of bouncing the bar off of the chest to add momentum to the lift, or a loss of strength causing the bar to fall onto the chest, besides, distal clavicular osteolysis where bone is spurring or erosion at the end of the clavicle. Athletes suffering from this condition should avoid doing bench presses [17]. Also, torn or damaged rotator cuff, Pectoral muscle tear, cervical discopathy or, in extreme cases, spinal cord injury. While the mechanism

is not clear, lifting the neck or arching the back and leaning on the lower neck while pressing the weight could stress the area death by asphyxiation by being trapped under the bar (several each year subclavian vein thrombosis [14] [20] [30] [33].

Many of these possible injuries can be avoided by using dumbbells instead of a barbell since dumbbells can be dropped without hitting the chest or neck, while also allowing greater external rotation of the shoulder which can help prevent shoulder injuries. Studies have also shown dumbbell bench press activates the pectorals more, which can lead to increased muscle growth. When a muscle is forcefully lengthened, the muscle spindles engage a stretch-reflex response to prevent overlengthening and limit the possibility of injury [10] [12] [14] [29] [30] [31][32] [33]. Tendinopathies of the rotator cuff muscles, biceps tendon and pectoralis major muscle are common causes of shoulder pain in athletes. Overuse insertion tendinopathy of pectoralis minor is a previously undescribed cause of shoulder pain in weightlifters/sportsmen [4].

Figure (5). Muscles of dumbbell bench press exercise



Variations of the bench press involve different groups of muscles or involve the same muscles in different ways: The flat bench press involves both portions of the pectoralis major muscle but focuses on the lower (sternal) head as well as the anterior deltoid muscle. The

term 'bench press' on its own is assumed to refer to a flat bench press. The flat bench press allows athlete to use his body weight as resistance, this is a good way to perfect your form and build up some strength while staying safe [34].

Figure (6). Flat Bench Press Exercise



There were data suggests that an acute bout of low-volume, explosive-force upper body movements performed 30 seconds before a 1RM attempt might enhance bench-press performance in athletic men. [35]. It is important to keep the back straight and feet planted on the floor throughout the entire movement [34]. It mustn't let them rest in between reps or during breaks in between sets [11] [25]. Where in incline bench press; an incline elevates the shoulders and lowers the pelvis as if reclining in a chair; this variation emphasizes anterior deltoids with little emphasis on the upper (clavicular) head of the pectoralis major. This variation is called the incline bench press. A decline bench press elevates the pelvis and lowers the head and emphasizes the lower portion of the pectoralis major whilst incorporating shoulders and triceps [2] [3] [4] [10] [12] [13] [16] [19] [26] [28] [34].

In the dumbbell bench press, the dumbbell is going to allow athlete to get a little bit larger range of motion, because he can lower them below his chest, "It's also going to force a bit more stability as he is holding the two dumbbells separately, going to have to work a bit more on stabilizing each. Furthermore, when a muscle is forcefully lengthened, the Golgi tendon organs (GTO) engage an opposite stretch-reflex response to the muscle spindles. Their role is to inhibit the excitation of the muscle spindles during forceful over-lengthening to prevent the possibility of injury one [34] [37]. Considering ligament structures could be related to their physiologic functions [16]. Flexibility is the capacity of a joint to move through its entire ROM [17].

Bench pressing is an exercise that can give athlete a strong upper body with benefits reaching into all areas of life. By the nature of bench pressing, athlete is utilizing his chest muscles and shoulder blades to lift the weight up and hold it in place. The more muscle mass he has on his upper body, the more weight he will be able to lift. This can help increase strength in other exercises as well (like push-ups). Bench pressing creates these big muscles that hold up so much weight. [1] [2] [3]. This helps keep the back straight and shoulders pulled back when doing other activities. Having large muscles also makes our bodies produce more testosterone [29]. This means stronger bones, improved cardiovascular health, plus much other benefit as helping red blood cell production through the bone marrow. Low testosterone levels are linked to a variety of cardiovascular risks [3] [4] [6] [7] [8] [9] [29] [34]. The biceps serve as Occupational safety and health administration for explosive bench [30].

The main difference between chest press and weights bench press is that doing a chest press on a machine, and use a barbell or free weights to do a bench press.[13]. The chest press will typically be lighter because the maximum weight is often dictated by what is available on the machine. The bench press has no limit to the amount of weight that can be used. One of the most important elements of setting up the bench press is the breathing and bracing process. The two main reasons for

this are: breathing and bracing correctly enables to keep athlete to be stable during the execution and, it helps to minimize the chest from deflating [5].

Also, both exercises of the Floor Press and, Bench Press they are bench press variations, with the key difference being that the bench press is done on a workout bench and the floor press is done with the lifter lying on the ground [7]. It's not surprising that the bench press is such a popular move. Once athletes have mastered the basic movement pattern and the bench press form, they will see rapid progress in how strong they are, as well as size gains to three major muscle groups: the chest, the front shoulders and the triceps [33]. There is another research project has shown that performing the bench press with a wider grip is more efficient than a narrow grip [8].

There are many benefits to bench pressing, but the best part is that it's easy to do. Anyone can learn how to bench press, regardless of age or fitness level. The key is to start out light and perfect your form before adding weight. Once the athlete gets comfortable with this exercise and get stronger over time, you'll be on your way toward a stronger upper body [7] [8] [11] [28] [32]. In regard to the dumbbell it is going to allow athlete to get a little bit larger range of motion, because the athlete can lower them below his chest," "It's also going to force a bit more stability as he is holding the two dumbbells separately, so he is going to have to work a bit more on stabilizing each one.[34] [36].

Conclusion:

- In conclusion, the biomechanics of the bench press are critical in maximizing the effectiveness of this exercise while minimizing the risk of injury. Understanding joint angles, muscle activation, and force production can help athletes and gym-goers achieve their training goals and optimize their performance. By focusing on proper technique and incorporating these biomechanical principles into their training, athletes can take their bench press to the next level and achieve their strength and power goals. One of the most critical aspects of the biomechanics of the bench press is proper technique. Proper technique involves using the correct joint angles, muscle activation, and force production to maximize the effectiveness of the exercise while minimizing the risk of injury.

- These data discussion suggested that an acute bout of low-volume, explosive-force upper body movements performed 30 seconds before a 1RM attempt might enhance bench-press performance in athletic men [37].

- Need prospective study:

As, contrary to popular opinion among many on social media, arching in the bench press will not cause the spine to "explode", nor will it put you at a greater risk of injury as opposed to "flat back benching" [31]. These data suggest that an acute bout of low-volume, explosive-force upper body movements performed 30 seconds before a 1RM attempt might enhance bench-press performance in athletic men [37].

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