

# Comparison among the EMG Activity of the Anterior Deltoid and Medial Deltoid During Two Variations of Dumbbell Shoulder Press Exercise

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## ABSTRACT

**Objective:** To analyze the muscle activation of anterior and medial deltoid muscles while performing two different grip variations of dumbbell shoulder press.

**Methodology:** Ten healthy male participants (age =  $20.9 \pm 1.449$  years, height =  $1.71 \pm .038$  m, weight =  $69.65 \pm 2.92$  kg) from Lakshmi Bai National Institute of Physical Education (Gwalior, M.P, India) were recruited as a sample of the study. The participants performed 5 repetitions of two different grip variations of dumbbell shoulder press. The exercises were Arnold Dumbbell Press (ADP) and Overhead Dumbbell Press (ODP). Surface Electromyography (SEMG) was used to record the muscle activation and for measuring muscle electrical activity that occurs during muscle contraction.

**Results:** Paired t-test was used to detect mean differences between the two variations of dumbbell shoulder press. It was found that Anterior and Medial Deltoid muscles were more active while performing ADP (AD-1346.4292.495; MD – 827.5 146.426) as compared to ODP (AD - 1043.4 141.299; MD – 725.4 100.4). Also while performing both the exercises, the muscle activation of anterior deltoid was found to be much higher than Medial Deltoid.

**Conclusions:** Arnold dumbbell press was more effective exercise for the activation of Anterior and Medial deltoid muscles as compared to the Overhead Dumbbell Press. Anterior deltoid acts as primary muscle while performing both the exercises, as the muscle activation is much higher as compared to medial deltoid.

**Keywords:** Anterior Deltoid, Dumbbell shoulder press, Electromyography, Medial Deltoid and Muscle activation

## INTRODUCTION

The shoulders are used in many daily life activities and it's a key to many full-bodied movements. The shoulder muscles always come into play while throwing, pushing, pulling or lifting<sup>1</sup>.

Deltoids are the most important muscles of the shoulders to produce shoulder joint movements. Anatomically deltoids are divided into three different portions: anterior, medial and posterior. For developing its strength, each portion can be worked separately. Each of these portions has a different role of play. The anterior deltoids plays dominant role in lifting the arms forward, similarly the middle deltoids lift the arms sideways and the posterior deltoids lift the arms backward.

Symmetrical development of each portion of the deltoids can be assured by the use of individual exercises that can be accomplished with the use of dumbbells. The strength, protection against shoulder injury, and a powerful upper body for participation in sports are some of the benefits of well-developed deltoid<sup>2</sup>.

The dumbbell shoulder press is one of the popular exercises for the shoulders. While doing vertical press, dumbbells are the perfect tool for a several reasons. In dumbbell shoulder press the weight is pressed upwards, it allows the Gleno-humeral joint to follow a natural path, which is well suited to the anatomy of the shoulder. As compare to dumbbell press, in barbell Press the movement of the shoulder is limited by that of the other shoulder and the placement of the bar<sup>3</sup>. The dumbbell

shoulder press is also more effective for producing shoulder muscles hypertrophy. Dumbbells allow more freedom as compare to barbells but it also requires coordination. As compare to barbell, during the last phase of the press, dumbbells allow the arms to come closer that result in greater range of motion<sup>4</sup>. A twisting variation of the overhead dumbbell shoulder press (also known as basic shoulder press) is the Arnold dumbbell press. During this press, the range of motion increases at the starting position of the dumbbells, without altering the target muscles. The target muscles for both i.e. overhead shoulder press and the Arnold press are the front and side shoulder muscles<sup>5</sup>. Choosing the best exercise for developing the shoulder becomes really difficult due to the different portions of the shoulder muscles. One way to determine this is by checking the level of muscle activation associated with a particular exercise, through the use of electromyography (EMG).

Electromyography measures the electrical activity of the muscles tissues during muscle contraction and relaxation cycles. Apart from rehabilitation it is also used in many sports techniques and is an essential tool in physiological, biomechanical and biomedical assessments for performance enhancement in sports<sup>6,7,8,9</sup>.

The purpose of the study was to analyze the muscle activity of anterior and medial deltoid during two different grip variations of dumbbell shoulder press.

## METHODOLOGY

**Subjects:** Ten healthy male participants (age =  $20.9 \pm 1.449$  years, height =  $1.71 \pm .038$  m, weight =  $69.65 \pm 2.92$  kg) from Lakshmi Bai National Institute of Physical Education (Gwalior, M.P, India) were recruited as a sample to be included in the study. More specifically, each subject met our stringent requirement of at least 1 year of experience in their regular (i.e. at least thrice a week) weight training programs. Simple Random Sampling technique was used for the selection of the subjects. All subjects were free from injuries which would have limited their ability to perform the technique correctly. Each subject provided informed consent prior to participation in any testing procedures.

**Experimental Approach to the Problem:** To compare the EMG response between the two variation of Dumbbell Shoulder Press (DSP), subjects performed 5 repetition of Arnold Dumbbell Press (ADP) and Overhead Dumbbell Press (ODP), with surface electrodes positioned over the

2 muscle (i.e. Anterior Deltoid; AD and Medial Deltoid; MD). A familiarization session was carried out 2 weeks before testing for knowing 10 RM of the subjects. At the beginning of the session, the subjects were asked to warm up (jogging) for 3–5 minutes. Their 10 repetition maximum (10RM) was determined by having the subjects lift approximately three to five sets of each exercise at increasing loads until they reach their maximum load for 10 repetitions. They were allowed to rest for 5 minutes between the sets, or until they felt sufficiently rested, and then they were asked to repeat the above steps (after two days) for determining 10 RM, this time performing the other variation. Surface ElectroMyoGraphy (SEMG) was used for measuring muscle electrical activity that occurs during muscle contraction and relaxation cycles. The SEMG signal generated by the muscle fibers is captured by the electrodes, then amplified and filtered by the sensor before being converted to a digital signal by the encoder. It is then sent (by optical fiber) to the computer to be processed, displayed and recorded by the Infiniti software. The MyoScan-Pro sensor's active range is from 20 to 500 Hz. It can record SEMG signals of up to 1600 microvolts ( $\mu\text{V}$ ), RMS. A/D Converter (Encoder; ProComp Infiniti) has 2 channels (C and D) sampling at 256 samples per second.

**Data collection:** Biograph infinity version 5.0 was used to record muscle activation of Anterior and Medial Deltoid. Before placing the electrodes on the target muscles, an abrasive cream was applied to the electrodes. Then the EMG electrodes were placed parallel to the muscle fiber on two locations (i.e. channel C for Anterior Deltoid and channel D for Medial Deltoid). A 15 foot optic fiber wire was used for recording the muscles activation (Raw EMG signals), which is directly connected to A/C encoder. A 20 mega pixels extended video camera was synchronized with the EMG software (Biograph infinity version 5.0), to find out the muscle activation value of the selected muscles at the time of performing the exercises. Myoscan-pro sensor with triode electrode was used. The participants performed 5 repetitions (of 10RM) of each variation of dumbbell shoulder press one by one. To know the differences between the muscles activation in the Arnold dumbbell press and overhead dumbbell press, the amount of weight for the both the exercises was kept same. Sufficient recovery time was provided to the participants after completing each exercise. The mean value of 5 repetitions was recorded as a final score for each subject.

**Statistics:** For testing the assumption of normality and to know the nature of data different descriptive statistics

such as mean, standard deviation, skewness, kurtosis, normal probability plots and Shapiro–Wilk’s test were used. All data are presented as mean with standard deviations. Paired t – test was used to detect mean differences between the two variations of dumbbell shoulder press. For this purpose Statistical Package for Social Science (SPSS) version 21 was used. The level of significance was set at 0.05.

**RESULTS AND DISCUSSION**

A deviation from symmetry can be indicated, if a skewness value is more than twice its standard error. As none of the variables’ skewness is greater than twice its standard error, hence all the variables are symmetrically distributed. Similarly, the value of kurtosis for the data to be normal of any of the variable is not more than twice its standard error of kurtosis hence none of the kurtosis values are significant. In other words, the distribution of all the variables is meso-kurtic.

Further for testing the normality Shapiro–Wilks test was used. It compares the scores in the sample to a normally distributed set of scores with the same mean and standard deviation. If the test is non – significant ( $p>.05$ ) it tells that the distribution of the sample is not significantly different from a normal distribution (i.e. it is probably normal) and vice-versa. Here from table-1 we can see that none of the variables’ p – value is less than .05, hence the data is normally distributed.

**Table 1: Descriptive Statistics and Test of Normality**

Exercise	Arnold Dumbbell Press		Vertical Dumbbell Press	
	Anterior Deltoid	Medial Deltoid	Anterior Deltoid	Medial Deltoid
<b>Mean</b>	1346.40	827.50	1043.40	725.40

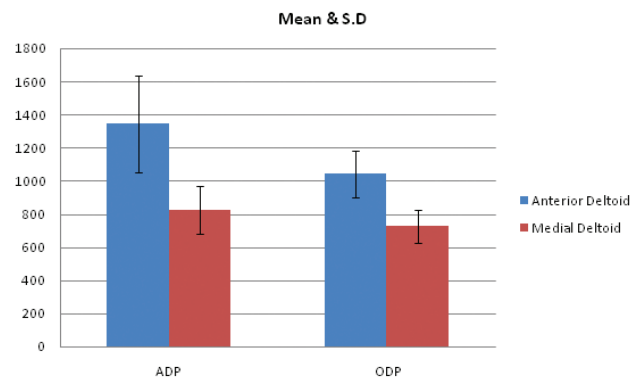
**Table 2: A summary of the paired t - test**

Muscles Pair		Paired Differences			t	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean		
<b>AD</b>	ADP - ODP	303	296.5854	93.78853	3.231	0.01
<b>MD</b>	ADP- ODP	102.1	105.5256	33.37013	3.06	0.014
<b>ADP</b>	AD - MD	518.90	276.98795	87.59128	5.924	.000
<b>ODP</b>	AD - MD	318.00	197.72427	62.52591	5.086	.001

\*Significant at 0.05 level

Arnold dumbbell press found to be better exercise than overhead dumbbell press as significant differences shows higher muscles activation in both the muscles i.e. anterior and medial deltoid. In case of pairwise comparison between Anterior and Medial Deltoid muscle activation for each of the two exercises (i.e. ADP

<b>Std. Error of Mean</b>	92.495	46.304	44.682	31.751
<b>Std. Deviation</b>	292.495	146.426	141.299	100.407
<b>Skewness</b>	.597	-.581	.223	.194
<b>Std. Error of Skewness</b>	.687	.687	.687	.687
<b>Kurtosis</b>	-.884	-1.295	-1.932	-.636
<b>Std. Error of Kurtosis</b>	1.334	1.334	1.334	1.334
<b>Shapiro – Wilk (p-value)</b>	.402	.103	.086	.872



**Figure 1: Mean and S.D value of muscles activation (Anterior Deltoid and Medial Deltoid) in Two Variations of Dumbbell Shoulder Press.**

The above figure shows that the muscles activation of Anterior Deltoid and Medial Deltoid muscles in both the exercises were not similar. Arnold Dumbbell Press shows greater muscle activation in both Anterior and Medial Deltoid as compared to Overhead Dumbbell Press. To see whether these differences are significant paired t – test was used.

Degree of freedom= 9 & ODP); significant differences were found in anterior deltoid muscle. This indicates that while performing ADP and ODP, anterior deltoid acts as primary muscle for both the exercises, as the muscle activation is much higher as compared to medial deltoid.

In the initial position of Arnold dumbbell press the elbows drop in front of the body, activates the anterior deltoid muscles to a great extent as compared to overhead dumbbell press. And as the dumbbell moves upward, the medial delts become increasingly engaged but not until the anterior deltoid initiate most of the movements<sup>10</sup>. Due to different movement patterns or the path, the Arnold dumbbell press is more effective for producing shoulder muscle (AD and MD) hypertrophy as compared to Overhead Dumbbell Press.

### CONCLUSION

The purpose of the study was to analyze the muscle activity of anterior and medial deltoid during two different grip variations of dumbbell shoulder press. Due to greater range of motion Arnold dumbbell press was more effective exercise for the activation of Anterior and Medial deltoid muscles as compared to the Overhead Dumbbell Press. While performing both the exercises it has been concluded that anterior deltoid muscle acts as a primary muscle as the muscles activation is significantly higher than the medial deltoid, which means both the exercises are more effective for developing anterior deltoid than medial deltoid.

**Ethical clearance:** No need

**Source of funding:** Self

**Conflict of Interest:** Nil

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