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Original Article

Can the craniocervical position modulate trunk muscle activation during a deadlift? A preliminary electromyographical analysis comparing conventional and sumo variations

MIGUEL GARCÍA-JAÉN[1], GEMA SANCHIS-SOLER[2], MARC CASANOVA-JULIÁ[3], SERGIO SEBASTIA-AMAT[4]*, JUAN MANUEL CORTELL-TORMO[5]
[1,2,4,5]Area of Physical Education and Sports, Department of General and Specific Didactics, Faculty of Education, University of Alicante, SPAIN
[3] University of Alicante, SPAIN

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Abstract:
To prevent back pain and injuries, it is essential to select appropriate strength training exercises and to ensure their correct technical execution. The deadlift exercise and its variations seem to be highly effective at activating the posterior body kinetic chain. This exercise is therefore recommended, when is properly performed, for injury and back pain prevention in both athletes and inactive people. Therefore, a more comprehensive understanding of the deadlift exercise is still necessary. The aim of this study was to compare trunk muscle activity in conventional and sumo deadlift variations performed in various craniocervical positions. Similar submaximal loads were used across all experimental conditions. Three participants with strength training experience (age: 21.67±1.15 years, height: 169±10 cm, body mass: 75.13 ± 7.00 kg and body fat percentage: 9.87±2.49 %) performed the conventional and sumo deadlift variations in different craniocervical positions: neutral, extension and flexion. Participants followed a familiarization session applying the same submaximal load, number of repetitions, lifting velocity and exercise variations than in the posterior testing session. Trunk muscle activation was quantified via surface electromyography (EMG). Participants presented greater latissimus dorsi activation in the neutral condition, and this activation level was higher during the conventional deadlift variation. The greatest EMG response was found in the erector spinae muscles in the extension position, especially in the conventional variation. Finally, the greatest trapezium musculature activation was found in the flexion condition. During the sumo performance, the highest trapezium activity was detected in the middle trapezium fibers whereas during the conventional performance, the highest value was recorded in the superior trapezium fibers. Deadlift variations and craniocervical positions thus did trigger different levels of myoelectric activation in the analyzed musculature, showing how the craniocervical position influences the activity of posterior trunk musculature.
Keywords*:* strength training, back musculature, core, EMG, powerlifting.

Introduction

Muscular strength, as essential component of physical fitness, is a physical quality necessary for the care of personal health (Westcott, 2012). In fact, proper muscle conditioning is critical to maintain or enhance functional mobility, well-being, and quality of life (Haraldstad et al., 2017; Lauersen et al., 2018; Steele et al., 2017). Thus, adequate strength training seems to contribute in reducing the risk of developing cardiovascular, metabolic, bone, psychological and cognitive diseases (Westcott, 2009; Westcott, 2012). Moreover, muscular training is an effective therapy for people with chronic low back pain (McGill, 2015), knee osteoarthritis, chronic tendinopathies (Escamilla et al., 2000; Escamilla et al., 2002). It also represents an excellent strategy to recover from, or to prevent, a musculoskeletal injury (Kristensen & Franklyn-Miller, 2012). From a sports performance standpoint, resistance training is a key component to athletic improvement and injury prevention, especially for young strength athletes, such as powerlifters (Faigenbaum & Myer, 2010; Escamilla et al., 2002).

Body ergonomics and appropriate technical execution of strength exercises are essential principles to ensure resistance training benefits and to avoid potential injuries (Faigenbaum & Myer, 2010; Gabbett, 2016; McGill, 2010). Although the scientific evidence related to the efficacy and safety of strength exercises has shown their benefits when the resistance training program is well designed and the strength exercises are supervised and properly executed following evidence-base criteria (Lauersen et al., 2018; McGill, 2010; McGill, 2015; Westcott, 2012), a high percentage of the population continues to ignore the evidence and execute the exercises incorrectly (Ilaria et al., 2019). Such behaviors can potentially increase the risk of musculoskeletal pain, joint disorders and injuries, due to excessive tension derived to the osteoarticular structures, especially in the knee, shoulder and the trunk region (Ilaria et al., 2019; Schmidt & Kohlmann, 2005). In fact, over 60% of the population, both sedentary and active people, present back pain during their lifetime, being common trigger

Corresponding Author: SERGIO SEBASTIA-AMAT, E-mail: sergio.sebastia@gcloud.ua.es

factors the incorrect maintained postures, inappropriate body movements and exercises performed incorrectly (Ilaria et al., 2019; Teichtahl et al., 2015). With regards to athletes, back pain fluctuates depending on the type of sport, load and tension supported by the lower back, as well as on the amount of hinge movement produced during sport-specific actions or during the exercise execution (Stuber et al., 2014). Moreover, ergonomics and correct technical execution are essential to avoid injuries during training (Faigenbaum & Myer, 2010; Gabbett, 2016; McGill, 2010). Therefore, a more comprehensive understanding about the appropriate technical execution and the muscle activity when performing strength exercises is necessary from an efficacy and safety standpoint (Lauersen et al., 2018; McGill, 2010).

In recent years, therapeutic and preventive studies have been conducted to determine the best exercises for trunk strength development and back pain prevention (Bird & Barrington-Higgs, 2010). Among these exercises, the barbell deadlift exercise and its variations are among the most studied for their ability to develop large muscle groups in overall trunk region and lower limbs (Piper & Waller, 2001; Escamilla et al., 2002). Additionally, effects on athletic performance have been demonstrated since the exercise is highly effective at activating the posterior chain, strengthening the hip, thigh, and lower back and increasing muscle power (Bird & Barrington-Higgs, 2010). The proper technical execution of the deadlift implies starting the movement with the lifter in a squat position, with the arms straight and pointing down to the barbell. This exercise is usually performed using an alternating or prone hand grip (Escamilla et al., 2000). Then, the barbell is lifted upward during concentric phase preserving a continuous motion by extending the knees and hips until the lifter is standing erect with knees extended and the shoulders thrust back, with scapulae retracted. During the eccentric phase, the barbell is slowly lowered back to the ground by flexing the knees and hips (Escamilla et al., 2002). The deadlift exercise is usually executed using either a conventional or sumo variations (Piper & Waller, 2001). The main differences between these two variants are the feet position, further apart and turned out more in the sumo deadlift, and the arm position, inside the knees for the sumo variation and outside the knees for the conventional style (Escamilla 2002).

Several kinematic (Gadomski et al., 2018; Hales et al., 2009), electromyographic and biomechanical analyses (Escamilla et al., 2000; Escamilla et al., 2002) of conventional and sumo deadlifts have been performed (Andersen et al., 2019; Escamilla et al., 2002; Lee et al., 2018). In addition, muscle activation of the trunk and shoulder musculature has been examined across different pull exercises and variations (Fenwick et al., 2009; García-Jaén et al., 2021). Yet, as far as we were able to verify, few studies have analyzed upper body or back muscle activation during the barbell deadlift, since almost all have focused on the lower body muscle activity. On the other hand, the craniocervical position has been observed to modify trunk muscle electromyography (EMG) (Su et al., 2016). In the same way, the craniocervical position may have an effect on certain back muscles given its aponeurotic connection with this craniocervical segment. Despite this, to the best of our knowledge, the subject remains unaddressed for the deadlift. Therefore, a more comprehensive understanding of this exercise is still necessary to provide a more effective and ergonomic execution of the deadlift.

Thus, the objective of this preliminary study was thus twofold: (1) to evaluate the electromyography activation of upper body posterior muscles in different craniocervical positions - neutral, flexion and extension - during conventional and sumo deadlifts; and (2), to analyze the differences between the deadlift styles. The initial hypotheses focused on the fact that: (1), a series of specific muscular responses will be produced depending on the craniocervical position; and (2), the levels of activation of the back muscles will be greater in the conventional deadlift than in the sumo deadlift across all experimental conditions.

Material & methods

Participants

As preliminary study, the sample consisted of three male undergraduate students enrolled in the Sports Sciences degree (age: 21.83±1.11 years, height: 169.04±10.02 cm, body mass: 75.13±7.00 kg and percentage of body fat: 9.87±2.49%). The requirement to participate was to report at least three years of experience in resistance training and to perform the deadlift variations using an appropriate technique. Participants were also required to present a repetition maximum above 120kg in both deadlift variations. The exclusion criteria were as follow: a body fat percentage above 20%; a skinfold thickness in the electrode placement area greater than 20 mm (García-Jaén et al., 2020); and pain or surgery in the back region. Participants were requested to abstain from consuming caffeine and alcohol and to avoid any high intensity training 48h before the testing. All participants gave their written consent after having been informed of the project, which was previously approved by the research Ethics Committee of the University of Alicante (UA-2018-11-16), in accordance with the Declaration of Helsinki.

Experimental Design

A cross-sectional study of repeated measures was designed to compare the EMG activation levels of five muscles located in the back region (upper trapezius -UT-, middle trapezius -MT-, latissimus dorsi -LD-, lumbar erector spinae -LES- and thoracic erector spinae -TES-) during the execution of conventional and sumo deadlift variations. Moreover, the total intensity value (TI), considered as the sum of the normalized EMG value of all five muscles, was also recorded. Each deadlift variation was performed in three craniocervical positions:

neutral (the ear tragus and acromion were bisected by a plumb line); maximal flexion (chin glued to the height of the trachea); and maximal extension (maximum range of movement in extension). Anthropometric measurements were collected by an expert anthropometrist. After familiarization with the instruments and protocols, the EMG activation of back musculature was evaluated under the following test conditions: conventional deadlift (neutral, extension and flexion craniocervical positions) and sumo deadlift (neutral, extension and flexion craniocervical positions).

Instruments and Data Collection Procedures

The electromiographic data were obtained using an 8-channel portable microcomputer, with a high-resolution surface of the Megaelectronics LTD Wireless logger system (Muscle Tester MegaWin Wireless Bio Amplifier, Kuopio, Finland), with its specific software (MegaWin Software 700046 version 3.0), and with a 14 bit A / D conversion, a Common-Mode Rejection Ratio of 60dB and a 12-450 Hz band filter. The sampling frequency for EMG measurements was 1000 Hz. The 10 s average root-mean-square (RMS) value for each muscle was calculated and registered using the LabVIEW software (National Instruments, Austin, TX, USA). During data collection, the signal produced by the wireless sensors was collected by telemetry signal receivers and then pre-amplified using an analogue amplitude differential. This analogue signal was converted to a digital signal via an A/D converter (National Instruments NIUSM-6210, New South Wales, Australia). The surface electrodes used were pre-gelled Ag/AgCl. Electrodes not exceeding 20mm wide and 20mm long were used. The inter-electrode distance, that is, the distance between the centre of the conductive areas of two bipolar electrodes did not exceed 20mm. Electrodes were placed on the right side of the trunk (Figure 1), in accordance with accepted international guidelines of Surface EMG for Non-Invasive Assessment of Muscles (SENIAM) project, with an interelectrode separation of 20mm (Hermens et al., 2000). Subsequently, the participants performed different movements to test the quality of the EMG signal. The electrodes and the wireless sensors were fixed with adhesive tape to avoid movements.

A tape measure was used to measure the grip and support distances and an adhesive tape was used to mark the bar grip and feet floor positions to avoid movements between craniocervical positions which could affect the EMG results (Figure 1). The descriptive data for feet width (the distance between the medial parts of the posterior surface of the heel) and grip width (the distance between the two thumbs) were 36.63 ± 18.61cm and 42.17 ± 3.69 cm for the conventional deadlift and 63.00 ± 22.70cm and 17.17 ± 14.63cm for the sumo deadlift, respectively. Based on previous research criteria (Ekstrom et al., 2003), the authors decided to control the execution velocity using the Soundbrenner metronome, downloaded from the App Store (https://apps.apple.com/es/app/el-metr%C3%B3nomo-por-soundbrenner/id1048954353), an important consideration to correctly evaluate the EMG. The metronome was configured at 57 beats per minute (moderate execution rhythm) to control the concentric, isometric and eccentric phase of deadlift execution. Worthy of note, EMG recordings can vary due to changes in muscle lengths and contraction velocity. This is always a concern when performing EMG to evaluate exercises. However, it has been shown that, when the contraction velocity is kept constant, the relationship between force production and EMG recording with concentric or eccentric contractions is almost linear (Bigland & Lippold, 1954; Komi, 1973). Anthropometric measurements were conducted by the same evaluator, certified anthropometrist Level 3 by the International Society for the Advancement of Kinanthropometry (ISAK). The technical measurement error was within the recommended ranges. A Cescorf tape measure (to the nearest 1mm), a Cescorf plicometer (to the nearest 1mm), a wall height rod (to the nearest 1mm), and a balance beam scale (to the nearest 100g) were used for this purpose.

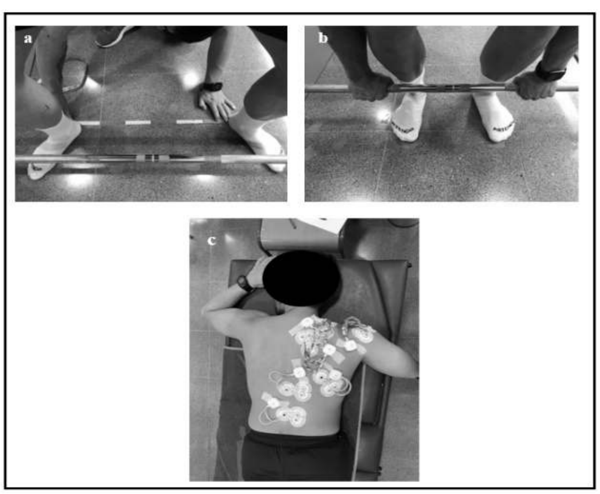

Fig. 1. a) Sumo deadlift; b) conventional deadlift c) Bipolar Surface electromyographic electrode and wireless sensor placement

Procedure

Participants conducted a familiarization session 72 hours before the testing session. The MVC tests were first explained in a theoretical-practical way to prepare for subsequent habituation as these tests are complex to follow without previous knowledge. The familiarization session lasted approximately sixty minutes, and the evaluators ensured that participants understood the entire protocol and performed all deadlift variations correctly. The EMG wireless sensors were placed on the participants prior to the data collection.

This procedure included skin preparation by shaving the hair on the skin, mild abrasion, and cleaning with isopropyl alcohol. First, a general warm-up was conducted that included joint mobility and dynamic stretches with elastic bands. Second, participants performed a specific warm-up that consisted of two sets of 12 repetitions with the bar weight (20kg), one set for each deadlift variation, and 4 repetitions in each craniocervical position. Once the warm-up was completed, MVC tests were performed to normalize the EMG data. They consisted of two trials lasting 5 seconds for each muscle with a 2-minute rest between trials. Following the guidelines of Peterson-Kendall et al. (2005), the MCIV testing order was as follows: upper trapezius, latissimus dorsi, middle trapezius, thoracic erector spinae, and lumbar erector spinae.

Data collection consisted of 3 repetitions at 50% RM for each deadlift variation in the three craniocervical positions. The testing order was randomized. The concentric phase of the second repetition was used for statistical analyses. Three minutes of rest were given between deadlift variations. The load lifted by each participant was calculated based on the one-repetition maximum (RM) load, approximately 50% RM. This 1 RM percentage was previously calculated during the familiarization session. Participants used the same load under all test conditions and the use of belts or straps was not allowed.

Statistical analyses

MegaWin Software 700046 version 3.0. was used to examine the EMG signal. Statistical analyses of the data were performed using SPSS 24.0 software (SPSS Inc. Chicago, IL, USA). Considering the small sample size, non-parametric statistics (Friedman and pairwise Wilcoxon test) were performed to compare the EMG responses for each experimental condition. Statistical significance was set at $p \leq 0.05$. All variables are reported as mean ± SD.

Results

First, in the case of the conventional deadlift variation, non-significant differences among craniocervical positions were observed. In all cases, the greatest activation occurred in the LES and the activation percentage was greater in the extended position for this muscle group. Greatest LD activation was found in the neutral position. For the UT and MT, the most pronounced response was recorded in the flexed position and for the TES, in the extended position. Table 1 shows the mean and SD values of the normalized EMG muscle activity and the results of the Friedman test for LD, UT, MT, LES and TES during the conventional deadlift according to the three craniocervical positions.

Table 1. Friedman test results for conventional deadlift. Mean and SD values of the normalized EMG.

Conventional Deadlift Exercise				
	Neutral Position	Extension Position	Flexion Position	
Musculature	Mean ± SD	Mean ± SD	Mean ± SD	k
Latissimus Dorsi	43.28 ± 34.72	36.20 ± 17.81	37.70 ± 24.26	0.717
Upper Trapezius	15.88 ± 3.59	18.97 ± 8.33	22.93 ± 8.29	0.097
Middle Trapezius	23.99 ± 9.69	22.81 ± 7.23	30.08 ± 14.85	0.264
Lumbar Erector Spinae	86.63 ± 44.15	92.81 ± 42.55	83.85 ± 40.12	0.264
Thoracic Erector Spinae	48.89 ± 10.52	57.32 ± 19.61	50.87 ± 13.06	0.529

SD: standard deviation

Second, in the case of the sumo deadlift variation, the LES and MT presented the greatest activation in the flexion position. The most pronounced LD activation occurred in the neutral position, and for the UT and TES, in the extension position. Table 2 shows the mean and SD values of the normalized EMG muscle activity and the results of the Friedman test for LD, UT, MT, LES and TES in the sumo deadlift position according to the three craniocervical positions (neutral, extension and flexion position).

Table 2. Friedman test results for the sumo deadlift. Mean and SD values of the normalized EMG.

Sumo Deadlift Exercise				
	Neutral Position	Extension Position	Flexion Position	
Musculature	Mean ± SD	Mean ± SD	Mean ± SD	k
Latissimus Dorsi	33.34 ± 19.17	28.11 ± 12.45	30.40 ± 23.79	0.368
Upper Trapezius	13.96 ± 1.72	18.51 ± 8.30	15.73 ± 1.44	0.264
Middle Trapezius	17.90 ± 7.71	18.06 ± 3.66	38.05 ± 37.43	0.717
Lumbar Erector Spinae	72.47 ± 29.01	85.65 ± 33.23	88.17 ± 28.56	0.097
Thoracic Erector Spinae	49.12 ± 11.98	56.18 ± 18.20	52.89 ± 21.10	0.264

SD: standard deviation

In general, the results in both the conventional (39.08 ± 6.99) and sumo (34.27 ± 9.34) deadlifts showed a greater activation of the LES compared to the rest of the analyzed muscles. Although non-significant differences were detected, the activation for this muscle group was greater in the extension position for the conventional deadlift and in the flexion position for the sumo deadlift.

Finally, TI showed that the craniocervical flexion was the condition that triggered the greatest activation in both deadlift variations. Considering the three positions, a greater activation was observed in the conventional deadlift compared to the sumo deadlift, although the difference was non-significant (Figure 2).

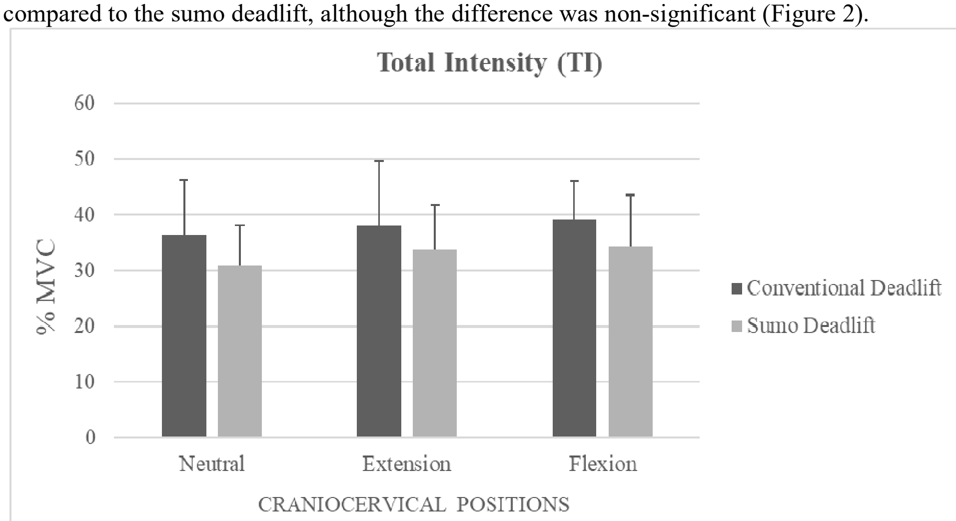

Figure 2. Total intensity expressed as a percentage. Wilcoxon test results for the conventional deadlift vs the sumo deadlift.

Discussion

The purpose of this preliminary study was to examine the potential effect of the craniocervical position on EMG activity of the main upper and lower back muscles involved in performing the conventional and sumo deadlift variations. The results generally supported our hypotheses: each specific craniocervical position caused a specific response regarding myoelectric activation of the muscle groups analyzed in both exercise variations. The conventional deadlift elicited a greater activation in the overall back musculature compared to the sumo deadlift variation. In both variations, the upper back EMG response – measured in the middle and upper trapezius muscles – was greater in the flexion condition. By contrast, the lower back EMG responses – measured in the lumbar and thoracic portions of the ES – were greatest in both deadlift variations in the extension position. For its part, the neutral position triggered the greatest LD musculature activation both in the conventional and in the sumo deadlift variations. These findings demonstrate how a specific craniocervical position can influence and modulate EMG activity of the upper and lower back musculature across both deadlift exercise variations.

To the best of our knowledge, no previous study has hitherto analyzed the effects of the craniocervical segment on the posterior trunk musculature in the conventional and sumo variations of the deadlift exercise presented in this study. Our results show that when these common variations are performed maintaining an active craniocervical flexion, the EMG response is greater in the upper back muscles. Conversely, when these exercise variations are conducted preserving an active craniocervical extension, the EMG activity is greater in the lower back muscles. However, no statistical differences were found, probably due to the small sample size and therefore the limited statistical power of this preliminary study. For this reason, these preliminary outcomes should be interpreted with caution and be used solely as preliminary hypotheses requiring confirmation in future studies with larger sample sizes.

Latissimus Dorsi EMG muscle activation

LD activity was greater during the conventional deadlift than during the sumo deadlift across all experimental conditions. Edington et al. (2018) had already showed greater LD activation when the deadlift was performed conventionally due to increased lever arm – that is, with the bar remaining far from the center of gravity compared to the sumo bar position. This fact was already mentioned by Escamilla et al. (2000), who stated that a sumo deadlift presented a 20-25% smaller range of motion than a conventional deadlift. The reason could be that the LD is responsible for shoulder extension, medial rotation, and arm adduction (Valerius et al., 2013). In another study, Escamilla et al. (2002) observed an approximately three times greater knee moment during the sumo deadlift compared to the conventional deadlift. This caused greater EMG activation in the quadriceps, probably due to the trunk being more vertical in the sumo variation, allowing the bar to remain closer to the body throughout the movement. In contrast, during the conventional variation, the trunk remains in a more inclined position and the LD requires greater activation to keep the bar close to the body. Thus, a shoulder extension and scapular adduction would also be necessary to maintain this closer bar position, causing a 3-5% reduction in the activation demands of the lumbar and hip extensor muscles (Belcher, 2017; Ronai, 2020).

Hancock et al. (2012) also studied this phenomenon, analyzing the bar trajectory during the conventional deadlift in intermediate weightlifters. At the beginning of the pull phase, when the shoulders were in extension and the bar against the ankle, there was 43-44% less front-to-back bar movement compared to when the bar started to be pulled in a straight line from the glenohumeral joint. This way, the role of LD is to bring the bar closer to the ankles and shins keeping it close to the body throughout the movement.

Therefore, LD activation may be greater when performing a conventional deadlift for two main reasons. First, because the shoulder extension is less pronounced than in the sumo deadlift. Consequently, it should generate greater LD activation to bring the bar closer. Indeed, in the sumo deadlift, the bar is already at shoulder level (Escamilla et al., 2002). Second, a scapular retraction should be performed to avoid flexing the upper part of the back because the trunk is more inclined in the conventional variation and the pull phase starts with a more pronounced lever arm (Hancock et al., 2012). Another explanatory hypothesis is that the grip width may influence LD activation. Andersen et al. (2014) analyzed LD activation according to the grip amplitude in vertical pulls and observed greater EMG activation with an open or medium grip compared to a close grip.

Finally, comparing EMG activity across the different craniocervical positions, greater LD activation was found in the neutral position, both during the conventional and in the sumo deadlifts. In contrast, in the case of a craniocervical flexion, the participant's trunk is above the bar at a greater floor distance than when in the neutral position. This fact may reduce LD activation, as the shoulder must automatically be extended to maintain the bar close to the body and the trapezius activity increases due to a scapular upward rotation, as explained further below. On the other hand, the LD presented less activation in the craniocervical extension position, since a spine extension was automatically performed, along with an automatic small scapular retraction. This leads to extending the shoulder and bringing the bar closer to the body without forcing this shoulder extension, as opposed to the neutral position, where an active shoulder extension is necessary to perform the exercise correctly.

Erector Spinae EMG muscle activation

In line with Cholewicki et al. (1991), the results showed that the lumbar portion of the erector spinae presented approximately 10% greater activation during the conventional deadlift compared to the sumo deadlift. The reason may be because the torso is inclined further forward at the start of the pull phase, requiring greater LES activity to keep the back extended when the bar is lifted off the ground. In this sense, Swinton et al. (2011) observed a more vertical torso in the hexagonal deadlift variation, similarly to the sumo variation. This position would decrease the lever arm, and probably the force and tension generated in the lumbar spine portion.

In contrast, there were barely any activity differences in the thoracic portion of the erector spinae between the conventional and sumo deadlifts, as similarly reported in a previous study (Escamilla et al., 2002). This implies that the sumo deadlift may be as effective as the conventional deadlift at recruiting paraspinal muscles at the T12 level, but not at the L3 level.

Maximum LES and TES activation occurred in the conventional deadlift in the craniocervical extension position more than in the flexed position. This fact seems plausible from an anatomical and biomechanical perspective: spinal erectors can generate more force and maintain the lumbar lordosis when a neck extension is performed (Hales et al., 2009). This has been observed in weightlifters when they perform a very heavy lift, rounding their back, seeking a greater mechanical advantage in the lift (Siewe et al., 2011). Finally, in a neutral craniocervical neutral position, LES activation was less intense during the sumo deadlift and TES activation was less pronounced during the conventional deadlift. The reason is that this position has a lesser impact on low back activity and because core and hip muscle activation is greater to preserve the low back in a neutral position (Escamilla et al., 2002).

Trapezius EMG muscle activation

In line with Escamilla et al. (2002), MT activation was greater during the sumo deadlift in the craniocervical flexion position. On the other hand, maximum UT activation occurred during the conventional deadlift in a craniocervical flexion position, with this upper portion presenting higher activation in all the craniocervical positions during the conventional performance.

Consequently, trapezius activation was observed to peak in a flexed position in both variations and this may be due to the ascending scapular rotation. Trapezius spinal fibers cause an elevation and anterior scapular tilt by performing a traction of the upper scapula to the spine. By contrast, the trapezius showed less activation in the craniocervical extension position. The reason could be the scapulae retraction and depression resulting from this extended position (Turgut et al., 2016). Finally, the neutral craniocervical position triggered a lower EMG response, probably because the neutral position function could be to maintain the scapular retraction and to support the bar weight in a more upward phase of the movement. All these hypotheses, however, need to be tested in future studies.

Practical applications

A strong posterior trunk musculature is essential to support compressive loads in the spine (Fredericson & Moore, 2005). Back muscles should be ready to provide stability, to support posture, and to generate maximum force (McGill, 2015; McGill et al., 2003). Moreover, the choice of exercise is key in strength training design, and the selected exercises should recruit the desired muscles and provide an adequate biomechanical stimulus when combined with appropriate variables (Swinton et al., 2011). In this sense, the deadlift should be recommended as a strengthening exercise due to its benefits for back and trunk musculature (Ronai, 2020).

The results of the present study show how the biomechanical stimulus of conventional and sumo deadlifts can be altered by using different craniocervical positions during the exercise. Thus, the correct choice of deadlift variation in a strength training session will depend on the stimulus that practitioners need to generate. If the training goal of the deadlift is to recruit the erector spinae muscles to the maximum, the conventional or sumo deadlift should be performed in a craniocervical extension position, a greater activation being obtained in the conventional variation. On the other hand, if the objective is to specifically recruit the trapezius muscle, the deadlift should be performed in a craniocervical flexion position. Middle fibers were activated the most in the sumo deadlift, whereas the upper fibers were the most activated in the conventional variation. Finally, if a greater LD activation is required, the craniocervical position should be neutral, this effect being greater in the conventional variation than in the sumo one. Generally, if practitioners seek a greater activation of overall back musculature, the conventional exercise could be preferred to the sumo variation.

In summary, this investigation suggests that the craniocervical position in each deadlift variation can influence the activation of different back muscles. These preliminary results – if they are confirmed in future research – could help strength and condition specialists as well as physical therapists to develop deadlift technique modifications and adjust exercise programs, seeking an optimal activation of the posterior trunk musculature. Nevertheless, this preliminary study presented a limited sample size and therefore insufficient statistical power. Consequently, the findings of this preliminary study cannot be generalized.

As a possible study limitation, the 1RM percentages had been calculated earlier in the familiarization session. The 1RM percentage of the data collection session probably differed from that of the previous session. In this sense, using a linear encoder could have made it easier to calculate this 1RM during each deadlift variation in a simple and practical way. Future related studies should consider using this instrument to objectively control the concentric, isometric and eccentric phases of the deadlift exercise.

Conclusions

This study explored the effects of specific craniocervical positions on the electromyographic activation of the posterior trunk musculature during conventional and sumo deadlift styles. EMG results showed that the conventional deadlift was more effective than the sumo deadlift for recruiting the LD, LES, TES, and UT, whereas the sumo deadlift was more effective for the MT. These findings demonstrate how specific craniocervical positions influence posterior trunk muscle activity. The neutral position enhanced LD activation, while the extension position increased spinal erectors activity. Finally, the craniocervical flexion position accentuated the UT and MT muscular response, generating greater EMG activation. These preliminary results – if they are confirmed in future studies – could add new insights about the optimal strategy to perform the deadlift, providing a more comprehensive understanding of this exercise. These findings could help strength and condition specialists as well as physical therapists to develop deadlift technique modifications, controlling the specific craniocervical position to seek for an optimal activation of the posterior trunk musculature and providing a more effective and ergonomic execution of the barbell deadlift exercise, both in conventional and sumo styles.

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