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Biomechanical analysis of some variables and EMG of the muscles during the performance of the snatch lift in weightlifting

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Abstract
The research aims to identify the relationship between some indicators of the electrical activity of the muscles (EMG peak) recording over skin (sEMG) . This research is an important experiment in the field of producing high physical strength with perfect body performance for weightlifters as a final result of physical work characterized by strength and accurate performance. The research subject was eight of best regional and national weightlifters (21years ±0.63),(79 kg ±2.3) for record their experimental data with descriptive way. The researchers using the four-channel wireless device produced by the Canadian company (Noraxon) for EMG, The research targeted the muscles (quadriceps femoris left and right) and (large dorsal muscle left and right). Also used high speed video recording (210 f/s) Exillime Japanese camera for movement analyze. Force platform was used, Germany Zebris product, for recording the force transfer from foot to ground during the lift phases. The results showed significant symmetry relations between force and dorsal muscle. Also, the amount of force product is directly proportional with quadriceps EMG (left and right) and correspondingly with back dorsal muscle. The results showed that the increase in the speed of the lift (the end of the acceleration phase) is offset by a decrease in the amount of force on the ground and EMG of quadriceps. At the last phase (braking and fixation phase) the force and EMG came at the highest level.

Keywords: Biomechanical, EMG, weightlifting

Itroduction
The interconnection among different mathematical sciences, such as sports learning and training, and physiology is one of the scientific fields that have entered into the development of sporting achievements for various games, which help researchers and show them the importance of these sciences with a view to developing levels of motor performance and achievements for different sporting events.
From here, the correlation among theoretical sciences and the level of performance in sporting activities was closely linked, and thus technology and modern equipment had a large space in revealing many details of work topics from movement analysis or laboratory tests or direct and field measuring devices(Ammar et al., 2018), and from these modern technologies is a technique Record the electrical activity of skeletal muscles on the surface of the skin sEMG(Ismaeel, n.d.).
Since the work of the muscles during the performance of exercises or movements is associated with a type of electrical activity for that muscle group(Wu et al., 2020), which reflects the level of activity of this muscle group, which is often an indication of muscle strength. In addition to the use of force platform or a foot scanner, it can provide a real and more accurate reading of the amounts of productive and interacting power (force) interactively on the ground to take advantage of its physical principles as a response to the raised weight and thus the amount of force on the ground is in fact an expression of the resultant range The strength on the one hand and the amount of power distribution on the other hand during the elevation phases.
From here emerged the importance of research, which intends to mix between modern technologies, which give accurate results with the approved and traditional methods and to identify their values as a diagnostic method for the performance of weightlifters or can be used to evaluate the course of the individual training process for weightlifters , especially when a suitable sample of research is available.

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Weightlifting sport is characterized by individualism in terms of training and performance(Kipp et al., 2012), because of what each weightlifter possesses both body compostion and physical specifications, it is possible to determine the type and form of his performance, but the overall process requires that there be a clear, scientific and concrete identification of the training path and evaluation of the.
The research subject was eight of best regional and national weightlifters (21years ±0.63),(79 kg ±2.3).
The research aims:
1- Knowing the values of some biomechanical variables and EMG during the phases of performing the snatch lift.
2- Knowing the magnitude of the distribution of the forces seized on the ground during the phases of snatch lift.
3- Knowing the relationship among the values of some biomechanical variables, EMG and the force projected on the ground during the phases of snatch lift.

Hypothesis of the research

There is relation of statistical significance between the values of some biomechanical variables and electromyography of lifter's muscles and the force falling onto the ground during the performance of snatch lift.

METHODS

The descriptive method was adopted in this research by finding the correlational relationships of the research variables in the case study of the weight lifter for lifting the snatch and using special devices and applications for that. The materials and software were:
- MYo Trace400 quadrupole electrical activity recording device produced by the Canadian company noraxon (1.07.41)(Gao et al., 2020).
- A German foot scanner.
- Fast video camera (210 f / sec), of Japanese origin, type Exilim.
- Dell laptop
- Electrodes supported by Noraxon.
- Applications of video analysis and statistics software.

Subject
. The research subject was eight of best regional and national weightlifters (21years ±0.63),(79 kg ±2.3) for record their experimental data with descriptive way.

Identify research variables:

1- Lift phases:

A- 1st pull phase: this phase began from weight start moving until the bar being on the knee.
B- 2nd pull phase: also called (the maximum accelerate phase) began from the knee until full body extension.
C- 3rd pull phase: began from drop down the weight with fixation and stability.

2- Biomechanical variables:

- Force on the ground (fig.2).

$$force\ platform$$

- Vertical and horizontal barbell speed (fig.1).

$$distance/_{time}$$

- Vertical and horizontal weight Momentum (fig.1).

$$mass.speed$$

3- EMG variables:

Peak of amplitude relied, using myotrace technique (fig.3).

4- Muscle groupe determine:

- Right and left quadriceps muscle (fig.3).
- Right and left Great dorsal muscle (fig.3).

Statistical analysis:
Correlation method was depended (person) among biomechanical and EMG variables during snatch lift phases, and relied:
- Mean
- S.D.
- Simple correlate (person).

Results:

DISCUSSION & IMPLICATIONS

As a results came in table (2), values of correlation coefficients came with varying values and according to the phase requirements or the necessity and effectiveness of the variable, and we find that the moral value achieved statistically, which achieved values of error levels less than (0.05) is the peak of EMG of the right quadriceps muscle with the horizontal velocity and we find that explained by the fact that the weightlifter depends On one of his legs more than the other and this is what we find clear in the layout of the foot scanner and therefore this difference in the amount of power shed led to a large occurrence in the horizontal distance of the raised weight and appeared clearly in the close link between it and the horizontal speed and this represents the emergence of a force on one end of the body more From others, and thus a visible apparent effect occurs as an inevitable result where "the effect of force varies from one body to another and changes its kinetic state. This effect may be represented by tension, pressure or others, which is a clear explanation of Newton's laws in the effect of the strength of a body on another body."(Takei et al., 2020) Also, through the above results, it becomes clear to us that the quadruple depends more on the muscles of the back than the muscles of the two legs in the hijack height, and we notice this through the correlation of the peak of the electrical activity of the right and left back muscles with the output of the dominant force at one time and with the horizontal momentum at another time, which is an indication that the performance pattern The kinetic here is dependent on this muscle group. Perhaps the nature of the performance of the quadrilateral and its adoption of this approach or method in the hijacking height, especially as we know that the line lift requires that the lifted weight gain more speed than the 2nd lift (clean&jerk) because its long path taken is relatively longer(Králová et al., 2020).

In table (3) shown to us that weightlifter was performing a normal kinematic behavior, i.e. very close to the mechanism, and we notice this clearly through the acceptability of many interrelationships even if no statistical significance was recorded. To enter under it and receive it at the most appropriate time where we find that the force variable recorded a significant correlation with the horizontal speed and that this constitutes an error that must be dealt with, since the force was supposed to achieve a correlation with the vertical speed in order to avoid any injury and to invest all the effort exerted, but the reason for that is due to this phase is characterized by the presence of a large curve path(Sandau & Granacher, 2020), and therefore the resultant force here is concentrated in a large proportion among the phase to the horizontal component, which enhances the appearance of the large hook path of the lifter, and this is a form of balance of strength, especially in lifting weights and in snatch lift in particular.

As a results came in table (4), weightlifter data has achieved significant correlation coefficients for the performance variables of the stabilization phase under the barbell. Because the weightlifter has good physical strength, the muscle balance between the two most important muscle groups in the quadrants, which is the back and the leg, we find simultaneous at work at the moment of stabilization and the fall under the weight as it represents the absorption phase of the moving gravity momentum We find that it is morally related to each other and here it should be noted that this phase is its specificity in curbing the movement of the drop under weight due to weight and that the individual performance of this quadrant is characterized by a high level, and that this moral relationship is evidence of the power of the weightlifter in the success of the lift, where "mechanical work is the process of transferring energy, and it is the product of hitting the force on an object in the distance that it has traveled towards that force"(González-Martínez, 2019). Mechanical work does not occur without a change in this location on the one hand, on the other hand, mechanical work is in two forms, positive and negative. Positive work is the same amount of work done to land the same number of stairs, but negatively. "Here we find that the mechanical work performed by the weightlifter is to convert a form of The kinetic energy forms into potential by absorbing it by strong fixation(Vigotsky et al., 2019). In this table, confirmation is that the snatch lift has greater specificity through the hooked arc generated in the second phase, as we find here that the amount of gravity movement descending underneath the bonding relationship is close with the top of the electrical activity of the muscles of the legs,: The resistance represented by the depth of the deviation externally forced the quadrilateral to withdraw the weight toward it again, which gained opposite momentum from the stabilization phase and thus required the muscles of the two legs to fall under the barbell of stopping this great resistance. This confirms the vertical momentum of the drop down, as it recorded an acceptable value of association with the top of the dorsal muscle activity, which is the achievement of a natural result of a distinct performance of the quadrants in electing the most appropriate muscles in the appropriate motor duty. The final momentum of the full extension is the one that affects the pull force as the bar of gravity moves at the fastest possible speed(Enoka, 1979), this speed pushes the barbell to move upward at the end of the second drawing phase and here we get the maximum momentum(Fleisig, 2010), and the more momentum we get At a higher height for the bar, which in turn will have a corresponding effect in the landing and stabilization phase.

Conclusions

1- It was found through the results of the research that the weightlifter depended on one of his legs more than the other to generate the force necessary to lift the weight, and by this the exercises had to be codified to develop the other leg.
2- The high level of the weight lifter enables it to adopt the principle of levers in the technical recruitment of the snatch lift, as it needs a higher speed than the net.

3- The presence of functional synergy for the muscles of greatest importance in achieving an important motor duty, which is stabilizing the weight.
4- The natural growth that the weightlifter is going through is forcing him to follow a new weight path of through the amounts of horizontal movement that express the existence of new paths at the same previous speed.
5- The quadrilateral still has a large power supply represented by the performance of the levers with a high kinematic harmony between the parts of the body.

References:

Ammar, A., Riemann, B. L., Masmoudi, L., Blaumann, M., Abdelkarim, O., & Hökelmann, A. (2018). Kinetic and kinematic patterns during high intensity clean movement: searching for optimal load. Journal of Sports Sciences, 36(12), 1319–1330. https://doi.org/10.1080/02640414.2017.1376521

Enoka, R. M. (1979). The pull in olympic weightlifting. Medicine and Science in Sports, 11(2).

Fleisig, G. (2010). XXVIII International Symposium of Biomechanics in Sports July 2010. Biomechanics, July.

Gao, T., Zhang, X., & Xu, W. (2020). Research on the balance adjustment mechanism of single leg stance in aged people before and after visual deprivation. Chinese Journal of Rehabilitation Medicine, 35(4). https://doi.org/10.3969/j.issn.1001-1242.2020.04.008

González-Martínez, A. (2019). Determinación de propiedades aerodinámicas de la jabalina mediante dinámica de fluidos computacional. [Determination of aerodynamic properties of javelin by means of computational fluid dynamics]. RICYDE. Revista Internacional de Ciencias Del Deporte, 15(56). https://doi.org/10.5232/ricyde2019.05602

Ismaeel, S. (n.d.). Differences in biomechanics and EMG variables at jump vs land phase during spike in volleyball.

Kipp, K., Redden, J., Sabick, M., & Harris, C. (2012). Kinematic and Kinetic Synergies of the Lower Extremities During the Pull in Olympic Weightlifting. Journal of Applied Biomechanics, 28(3), 271–278. https://doi.org/10.1123/jab.28.3.271

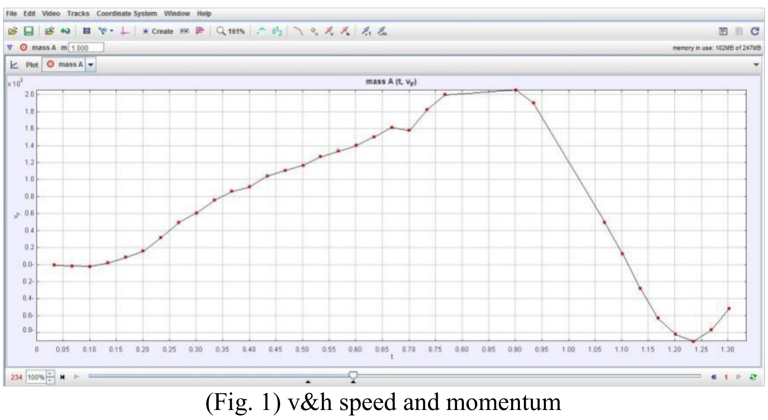
Králová, T., Gasior, J., Vanderka, M., Cacek, J., Vencúrik, T., Bokůvka, D., & Hammerová, T. (2020). CORRELATION ANALYSIS OF OLYMPIC-STYLE WEIGHTLIFTING EXERCISES AND VERTICAL JUMPS. Studia Sportiva, 13(2). https://doi.org/10.5817/sts2019-2-3

Sandau, I., & Granacher, U. (2020). Effects of the Barbell Load on the Acceleration Phase during the Snatch in Elite Olympic Weightlifting. Sports, 8(5). https://doi.org/10.3390/sports8050059

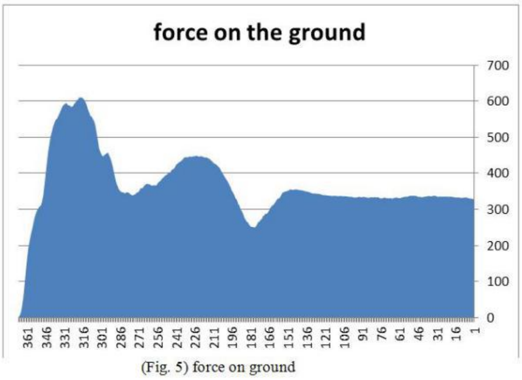
Takei, S., Hirayama, K., & Okada, J. (2020). Is the optimal load for maximal power output during hang power cleans submaximal? International Journal of Sports Physiology and Performance, 15(1), 18–24. https://doi.org/10.1123/ijspp.2018-0894

Vigotsky, A. D., Zelik, K. E., Lake, J., & Hinrichs, R. N. (2019). Mechanical misconceptions: Have we lost the “mechanics” in “sports biomechanics”? In Journal of Biomechanics (Vol. 93). https://doi.org/10.1016/j.jbiomech.2019.07.005

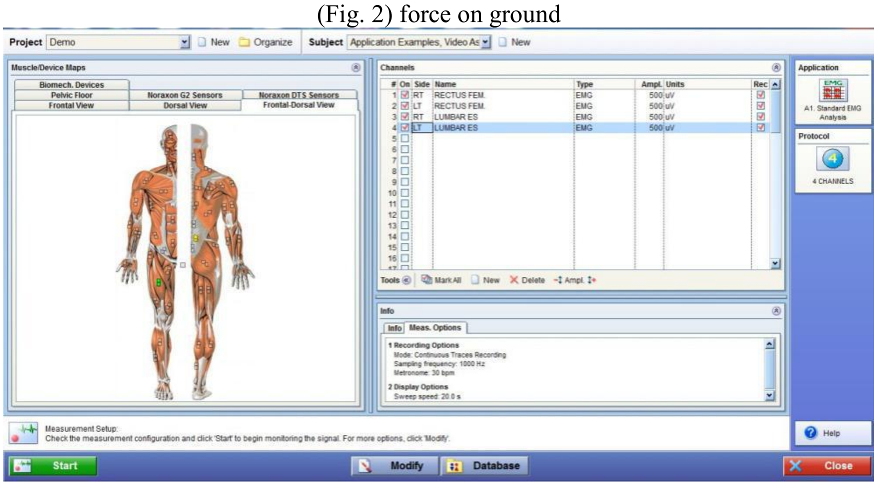
Wu, C., Yan, Y., Cao, Q., Fei, F., Yang, D., Lu, X., Xu, B., Zeng, H., & Song, A. (2020). SEMG Measurement Position and Feature Optimization Strategy for Gesture Recognition Based on ANOVA and Neural Networks. IEEE Access, 8. https://doi.org/10.1109/ACCESS.2020.2982405



(Fig. 1) v&h speed and momentum



(Fig. 2) force on ground



(fig.3) muscle groups & EMG variables

(table 1) Biomechanical and EMG variables during snatch lift phases.

variables	1st phase		2nd phase		3rd phase	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Force on ground	1303.75	27.69815	1186.41	25.205	1350.3	38.71
V. speed	0.9175	0.01479	1.23	0.019	1.101	0.017
H. speed	0.02	0.007071	0.027	0.009	0.0202	0.007
V. momentum	94.5	2.692582	121.905	3.473	108.6	3.096
H. momentum	12	0.474	14.4	0.569	18	0.711
R. Q. peak	492.5	29.68	349.325	26.420	588.75	44.52
L. Q. peak	502.5	16.77	366.275	15.26116	563.5	23.47
R. G. peak	432.5	42.204	312.3	52.33	415.625	52.75
L. G. peak	428.5	59.491	323.62	78.528	693.792	125.64

(Table 2) the correlate relation among biomechanical and EMG variables during 1st phase snatch lift

		Force	V. speed	H. speed	V.M	H. M	R. Q.	L. Q.	R.G.	L. G.
Force	Pearson	1								
	Sig									
V. speed	Pearson	.847	1							
	Sig	.153								
H. speed	Pearson	.634	.560	1						
	Sig	.366	.440							
V. M.	Pearson	.885	.663	.890	1					
	Sig	.115	.337	.110						
H. M.	Pearson	.138	-.404	-.073	.216	1				
	Sig	.862	.596	.927	.784					
R. Q.	Pearson	-.615	-.407	-.967-*	-.909	-.177	1			
	Sig	.385	.593	.033	.091	.823				
L. Q.	Pearson	.367	.662	.766	.501	-.696	-.582	1		
	Sig	.633	.338	.234	.499	.304	.418			
R. G.	Pearson	.988*	.887	.537	.807	.062	-.495	.346	1	
	Sig	.012	.113	.463	.193	.938	.505	.654		
L. G.	Pearson	-.066	.447	.250	-.071	-.982-*	-.005	.812	-.015	1
	Sig	.934	.553	.750	.929	.018	.995	.188	.985	

(Table 3) the correlate relation among biomechanical and EMG variables during 2nd phase snatch lift

		Force	V. speed	H. speed	V.M	H. M	R. Q.	L. Q.	R.G	L. G.
Force	Pearson Correlation	1								
	Sig. (2-tailed)									
V. speed	Pearson Correlation	.572	1							
	Sig. (2-tailed)	.428								
H. speed	Pearson Correlation	.957*	.478	1						
	Sig. (2-tailed)	.043	.522							
V. M.	Pearson Correlation	.746	.847	.788	1					
	Sig. (2-tailed)	.254	.153	.212						
H. M.	Pearson Correlation	.656	.499	.820	.881	1				
	Sig. (2-tailed)	.344	.501	.180	.119					
R. Q.	Pearson Correlation	.734	.384	.893	.813	.976*	1			
	Sig. (2-tailed)	.266	.616	.107	.187	.024				

L. Q.	Pearson Correlation	-.262	-.832	-.316	-.830	-.660	-.490	1		
	Sig. (2-tailed)	.738	.168	.684	.170	.340	.510			
R. G.	Pearson Correlation	.944	.811	.880	.880	.681	.688	-.530	1	
	Sig. (2-tailed)	.056	.189	.120	.120	.319	.312	.470		
L. G.	Pearson Correlation	.092	.766	.149	.721	.550	.360	.985	.382	1
	Sig. (2-tailed)	.908	.234	.851	.279	.450	.640	.015	.618	

(Table 4) the correlate relation among biomechanical and EMG variables during 3rd phase snatch lift

		Force	V. speed	H. speed	V.M	H. M	R. Q.	L. Q.	R.G.	L. G.
Force	Pearson Correlation	1								
	Sig. (2-tailed)									
V. speed	Pearson Correlation	-.146	1							
	Sig. (2-tailed)	.854								
H. speed	Pearson Correlation	.442	.478	1						
	Sig. (2-tailed)	.558	.522							
V. M.	Pearson Correlation	.373	.847	.788	1					
	Sig. (2-tailed)	.627	.153	.212						
H. M.	Pearson Correlation	.760	.499	.820	.881	1				
	Sig. (2-tailed)	.240	.501	.180	.119					
R. Q.	Pearson Correlation	.772	.384	.893	.813	.976*	1			
	Sig. (2-tailed)	.228	.616	.107	.187	.024				
L. Q.	Pearson Correlation	-.262	-.832	-.316	-.830	-.660	-.490	1		
	Sig. (2-tailed)	.738	.168	.684	.170	.340	.510			
R. G.	Pearson Correlation	.073	.811	.880	.880	.681	.688	-.530	1	
	Sig. (2-tailed)	.927	.189	.120	.120	.319	.312	.470		
L. G.	Pearson Correlation	.218	.766	.149	.721	.550	.360	.985-*	.382	1
	Sig. (2-tailed)	.782	.234	.851	.279	.450	.640	.015	.618	