EFFECT OF EXTERNAL APPLICATION OF SEMICONDUCTORS ON MOTOR PERFORMANCE: CASE STUDIES

Spiros Prassas
Colorado State University, Fort Collins, CO 80523, USA

INTRODUCTION AND PURPOSE

In order to enhance motor performance, humans have utilized a variety of agents and/or techniques. External application of semiconductors has been currently advertised as a stimulus and as an enhancer of muscle performance. If the claim is correct, one could hypothesize that external application of semiconductors, such as germanium, may positively enhance motor performance. Discovery of a non-invasive, effective and safe performance enhancer will be of definite value. Thus, the purpose of this study was to investigate the effects of external application of germanium on motor performance.

METHODS

Two motor tasks, vertical jumping and kicking, were investigated. An experienced kicker (mass: 75 kg) and a student participant in a University activity class (mass: 60 Kg) participated in the kicking and jumping tasks, respectively. A NAC 400 High Speed Video Recording System was utilized to record ten kicks performed by the subject. For the first 5 kicks, the subject was wearing germanium imbedded cloth knee wraps (Goode Wraps, Reno, Nevada, USA). For the next 5 kicks, the subject was wearing cloth knee wraps without germanium imbedded in them. Prior to videotaping each group of kicks, the subject sat quietly for 20 minutes and then exercised at the same level of intensity on a stationary bicycle ergometer for a period of five minutes. The same protocol was utilized during vertical jump data collection with the addition of a Kistler force plate to simultaneously collect force data (sampling rate: 500 Hz) and with the subject wearing ankle wraps and (Stromgren) shorts imbedded with germanium in addition to knee joint wraps. Jumping heights were calculated utilizing force plate data. All kicks and the best trial from each group of jumps (based on jump height) were digitized (at 100 Hz) utilizing an Ariel Performance Analysis System (APAS). The raw (position) data were smoothed with cubic splines, or with digital filtering with a cut-off frequency of 5 Hz before being submitted to further analysis. Dempster's (1955) data as presented by Plagenhoef (1971) was utilized to predict the segmental and total body anthropometric parameters necessary to solve the mechanical equations.

RESULTS AND DISCUSSION

Kicking

Table 1. Ball and Lower Extremity Kinematics.

Variable	Germanium	Control	t-score
Ball Velocity(m/sec)	26.25 1	25,684	2.359
Knee Joint Angular Velocity(deg/sec)	801.500	784.750	0.352
Thigh Angular Velocity (deg/sec)	381.500	344.250	-1.546
Shank Angular Velocity (deg/sec)	1182.500	1129.750	0.999

Table 1 presents maximum ball velocity, angular knee joint velocity at contact and thigh and shank angular velocities at contact for the experimental and control conditions. Mean values for the germanium trials were larger than in the control trials for all measured variables indicating that a positive effect of germanium on motor performance may exist. Paired t-tests, however, showed that the differences between the two conditions were not significant ($p<.05$).

Vertical Jumping

Average kinetic and kinematic results for the germanium and control jumps are presented in Table 2. The average jump height, vertical take-off velocity and vertical push-off impulse (the quantity that dictates take-off velocity and, ultimately, jump height) were larger in the germanium jumps.

Table 2. Average Kinetic and Kinematic Parameters

Variable	Germanium	Control	t-score
Height jumped (meters)	0.38	0.36	0.43 1
Vertical take-off velocity (nlsec)	2.75	2.70	0.432
Vertical push-off impulse (N.s)	164.00	162.00	0.429

Paired t-tests, however, showed that the differences between the two conditions were not significant ($p<.05$). Comparison of the best germanium and best control jumps (Table 3) revealed larger vertical impulse-resulting in larger vertical take-off velocity and jump height for the germanium. Comparison, however, of hip, knee, and ankle joint maximum angular velocities showed higher values for the germanium hip and ankle joint maximum angular velocities, but not for the knee. Maximum shank angular velocity was also higher in the germanium trial, but the thigh angular velocity was not.

Table 3. Selected Kinematic and Kinetic Parameters of the Best Germanium and Control Jumps

Variable	Germanium	Control
Height jumped (meters)	0.41	0.39
Vertical take-off velocity (m /sec)	2.84	2.73
Vertical push-off impulse (N.s)	170.4	163.8
Maximum hip joint angular velocity (deglsec)	649.0	606.0
Maximum knee joint angular velocity (deglsec)	783.0	800.0
Maximum ankle joint angular velocity (deglsec)	545.0	498.0
Maximum thigh angular velocity (deglsec)	447.0	464.0
Maximum shank angular velocity (deglsec)	342.0	335.0

CONCLUSION

The results of the study are not conclusive: in both activities studied, no significant differences between germanium and control trials were found. However, a clear trend indicating a positive effect of germanium on performance was seen. In jumping for example, average vertical impulse and the resulting jumped heights were higher in the germanium trials. And in kicking, ball velocity and knee joint and thigh and shank segment angular velocities at contact were also higher when germanium was used. In light of the limitations of the single subject design in this report, it is recommended that a study with a larger number of subjects be undertaken to further investigate the effects of semiconductors such as germanium on motor performance.

REFERENCES

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