Measurement of Characteristic Change using MyotonPRO in Low Back Muscles during a Long-term Driving; Pilot Study

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Abstract
Background: Sedentary behavior is characterized by physical inactivity and is associated with several health risks[1]. Especially car drivers complain of a low back pain under long-term driving[2]. Previous studies try to measurement of low back muscle fatigue using EMG (electromyography) in a long-term driving. However results show there are no significant correlation between muscle fatigue and back pain. Method: One subject volunteered to participate in this pilot study. In this study, experiment was consisted of pre-test and long-term driving test. Pre-test was designed to compare EMG and MyotonPRO results by evoked muscle fatigue at biceps. Before the long-term driving test, we selected 32 points of subject’s back and measurement muscle characteristic using MyotonPRO. After driving test, we measured muscle characteristic using MyotonPRO. Results: Long-term driving test result shows that Frequency and Stiffness increased at right side of low back. Decrement, Creep and Relaxation was increased at left side of low back. Conclusion: These result shows that long-term driving evoked muscle’s blood supply at right side of low-back and evoked a pain or overload. Application: Low back muscle characteristic change evoked by long-term driving would be measured using by MyotonPRO.

Keywords: Low back muscle characteristic, Long-term driving, MyotonPRO

Introduction
Sedentary behavior is characterized by physical inactivity and is associated with several health risks[1]. Especially car drivers complain of a low back pain under long-term driving[2].

Previous studies try to measurement of low back pain using EMG (electromyography) in a long-term driving[3, 4]. However results show there are no significant correlation between muscle fatigue and back pain[5].

MyotonPRO(Myoton AS, Tallinn, Estonia) is a system that evaluating a muscle biomechanical characteristic non-invasively. Previous study show that MyotonPRO revealed rigidity-related stiffness in resting skeletal muscles in Parkinson's disease patients when they doing rehabilitation[6-8]. In case of normal, muscle characteristic change when they carried out stretching[9, 10], also office workers who felt low back pain when they got off were changed low back muscle characteristic during the office hours[11].

In this study, measuring driver’s low back muscle characteristic in long-term driving using MyotonPRO.

Methods
One subject (176cm, 65kg) who had been in possession of a driver’s license for at least 3 years was included in this study. Participant received written and oral information about the study and provided a written consent to participate.

MyotonPRO measured 5 parameters of muscle characteristic and it can be evaluate 4 indexes of biomechanical characteristic. The 4 indexes were Ton(Natural oscillation frequency), Stiffness(Dynamic stiffness), Elasticity(Logarithmic Decrement of natural oscillation), Viscoelastic properties(creep and relaxation time).

Fig 1: MyotonPRO

Tone(Shown as Frequency in MyotonPRO) is the mechanical tension in a relaxed muscle. Increased tone is relatable to pain, athletic underachievement, overload and other phenomena. Low tone may indicate lowered achievement and weak muscles.

Stiffness(Shown as Stiffness in MyotonPRO) is a muscle’s ability to resist a force deforming the muscle. In terms of athletic performance, it is related to the resistance of the antagonist muscles during movement. Asymmetry of stiffness between body sides (disbalance) can disturb the rhythm of the movements.

Elasticity(Shown as Decrement in MyotonPRO) is a muscle’s ability to restore its initial shape. Decreased elasticity brings on quicker muscle fatigue and the speed of a movement is limited if the muscle is less elastic.

Viscoelastic properties(creep and relaxation time)
are a muscle’s recovery time of its initial state to con-
traction or deformation.

Fig 2: Diagram of the measuring process

Experiment was consisted of pre-test and long-
term driving test. Pre-test was designed to compare
EMG and MyotonPRO results by evoked muscle fa-
tigue at biceps. The long-term driving test was designed
two hours driving test. Before the long-term driving test,
we selected 32 points of subject’s back and measure-
ment muscle characteristic using MyotonPRO(fig. 3).
After driving test, we measured muscle characteristic
using MyotonPRO again.

Fig 3: 32 points of subject’s back

Results

Pre-test results show that median-frequency of sub-
ject’s left biceps brachii EMG data down after work out
so we assured muscle fatigue evoked. And we checked
muscle characteristic change at belly of biceps muscle.

Long-term driving test results show that frequency
value was decreased 1.2% average of 32points at back
before and after driving. Especially (3, 3) and (3, 4)
point increase about 1.8% and (3, 2) point decrease
about 3.6% before and after driving(fig. 4).

Case of stiffness, the results show that stiffness
value was decreased 2.3% average of 32points at back
before and after driving. Especially (3, 3) and (3, 4)
point increase about 0.1% and (3, 2) point decrease
about 0.3% before and after driving(fig. 5).

Case of decrement, the results show that decrement
value was increased 2.1 % average of 32points at back
before and after driving. Especially (4, 2) point increase
about 15.0% and (4, 3) and (4, 4) point decrease each
15.2%, 8.2% frequency before and after driving(fig. 6).

Case of creep, the results show that creep value
was increased 0.8% average of 32points at back before
and after driving. Especially (5, 2) and (3, 2) point in-
crease each 15.2%, 8.2% and (2, 3) and (2, 4) point decrease each 0.8%, 10.0% before and after driving(fig. 7)

Case of relaxation, the results show that relaxation value was increased 1.1% average of 32points at back before and after driving. Especially (5, 2) and (7, 4) point increase each 4.4%, 4.0% and (6, 2) and (2, 3) point decrease each 0.8%, 10.0% before and after driving(fig. 8)

Discussion

Previous study about low back pain under long-term driving evaluate low back pain various method. However Lee, J, and Reed, M.P. study suggest that significance relation between muscle fatigue and low back pain using EMG. However recently, Ingr Ringheim study results show that there no significance. In these reason, our study use MyotonPRO to measuring drivers low back muscle biomechanical characteristic under before and after long-term driving condition.

Results show that great change of muscle characteristic at Musculus erector spinae under before and after long-term driving condition. Ton value of Musculus erector spinae shows that high value at right side, low value at left side. Stiffness value of Musculus erector spinae shows that high value at right side, low value at left side. Elasticity value of Musculus erector spinae shows that high value at left side, low value at right side. Viscoelastic properties value of Musculus erector spinae shows that late to recovery time at right side. These are the reason that long-term driving was evoked pain and muscle fatigue at right side low back, and left side muscle was weaker than right side. K. Oha study results show that Ton, Elasticity and Stiffness were asymmetry left-right Musculus erector spinae, Ton and Stiffness were high value at right side, Elasticity was high value at left side. For these reason, K. Oha suggest that people suffered low back pain from poor posture. Seung Hee Kim suggests that right side low back pain was evoked by right leg, because of right leg used to floor and brake pedal. These reason, muscle characteristic was effected driver’s posture, driver’s driving habits. In this study suggest that long-term driving might be evoked low back pain, especially Musculus erector spinae pain and most effected factor of muscle characteristic change was driver’s posture.

Conclusion

The MyotonPRO allows the basic indicators of the skeletal muscle condition to be determined. This study data might be possible to find a quantitative relation between change of muscle characteristic and muscle pain. Further study, it should be carry out repeated experiment and composed various subjects.

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