

## Analysis of muscle activity in various performance levels of Ollie jumps in skateboarding: A pilot study

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**Background:** Correct mastering of a basic Ollie jump is essential for development of other jumps in skateboarding. In scientific literature we can find a lack of scientifically proved knowledge that describes the difference in muscular activity on various levels of this jump performance. **Objective:** The aim of this study was to characterize muscular activity in the basic skateboard Ollie jump and to compare this activity with a more difficult modification of the switchstance Ollie jump (the same jump but changed position of limbs). **Methods:** Ten men experienced in skateboarding for several years, aged  $20.0 \pm 4.6$  years participated in the study (height  $1.79 \pm 0.05$  m, body mass  $71.5 \pm 4.1$  kg). All subjects performed 3 measured Ollie jumps and after that 3 switchstance Ollie jumps. In case of the last-mentioned front and back lower limbs are switched. The observation of muscular activity was carried out by the Delsys Trigno electromyography system. The jump was divided (after video records) into four phases: preparatory, take-off, flight-up and landing. Mean amplitude of muscle activity was measured in following muscles: tibialis anterior, gastrocnemius medialis, rectus femoris, semitendinosus and gluteus medius. Comparison of muscle activity during Ollie and switchstance Ollie was performed by the Wilcoxon test in Statistica. **Results:** Significantly greater activity ( $p < .05$ ) was shown by gastrocnemius medialis and rectus femoris on the lower back limb during the preparatory phase of switchstance Ollie and by tibialis anterior and semitendinosus on lower front limb during the landing phase of Ollie. **Conclusion:** Results of our study suggest that in switchstance Ollie is increased muscle activity during preparation period on the back limb and movement control during landing. The skaters in this type of jump should move his/her centre of gravity from the tail to the centre of the skateboard and also he/she would produce adequate muscle activity also during the landing phase.

*Keywords:* electromyography, kinesiology, training, skateboarding

### Introduction

Skateboarding is one of the most popular extreme sports in recent years (Kuleshov, 2010). This sport is a recreational activity, professional sport and for a lot of young people it is a lifestyle as well (Fountain, & Meyers, 1996; Keilani et al., 2010; Rethnam, Yesupalan, & Sinha, 2008).

Mastery of rigorous technique in basic skateboard jumps is a very important aspect of success in this sport (Kane, 1989). In skateboarding, as in relatively young sport, there are currently missing evidence based training recommendations. The scientific literature describes mainly the dynamic characteristics of the

skateboard jumps. Frederick, Determan Whittlesey, and Hamill (2006) describe the ground reaction forces during the Ollie jump, Determan, Frederick, Cox, and Nevitt (2006) during the Kickflip jump. Although the study by Crockett and Jensen (2007) includes monitoring of muscle activity by electromyography (EMG), this study is primarily concerned with the ratio of the number of rebounds and speed of movement and comparison of muscle activity during various skateboard jump performances is missing.

The aim of this study was to compare muscle activity in the basic skateboard jumps, the Ollie and switchstance Ollie.

### Methods

#### Subjects

The experiment involved 10 men without health problems aged  $20.0 \pm 4.6$  years with height  $1.79 \pm 0.05$  m

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and body weight  $71.5 \pm 4.1$  kg. All measured persons had at least four years of experience with skateboarding and good jump technique of Ollie and its modification, the switchstance Ollie.

### The methods and technical equipment

For analysis of muscle activity a wireless surface electromyography system Delsys Trigno (frequency 200 Hz, Delsys, Boston, MA, USA) was used. EMG recording was synchronized with a video recording (frequency 50 Hz, camera Sony DCR-TRV, Sony, Tokyo, Japan).

### The measurement process

The study was approved by the Ethics Committee of the Faculty of Physical Culture, Palacký University, Olomouc. At the beginning of measurement subjects signed informed consent and had a few minutes to test the basic jumps at the place of measurement. Then their skin was shaved and cleaned and the electrodes (parallel-bar shaped) were placed on their lower limbs by an experienced physiotherapist on the muscle bellies of semitendinosus (ST), gastrocnemius medialis (GM), rectus femoris (RF), tibialis anterior (TA) and gluteus medius (GluMed). The electrodes were placed in parallel with the process of muscle fibre using double-sided tape.

For each subject at first rest values of muscle activity during quiet standing was measured following measurements of three jumps Ollie and three jumps switchstance Ollie. All experiments were recorded by a video camera located in front of the obstacle.

The indoor track for jumping was 25 meters long with a cleaned concrete surface. The Ollie jump was performed over 20 cm high and switchstance Ollie over 2 cm high obstacles. The main purpose of the obstacles was that all participants perform the jump in the same place in front of video camera. The instruction was to jump naturally. The switchstance Ollie obstacle was lower because this type of jump is more difficult and all participants were not able to jump over naturally.

### Data processing

For processing the raw EMG recording EMG analysis work program (Delsys, Boston, MA, USA) was used. The record was rectified and smoothed (using RMS with window size 25 ms). The processed signal was exported to MS Excel. Jump phases were selected from the videos and times of beginning and ending were also recorded in MS Excel.

*These events were defined:*

1. the centre of mass at the lowest point;
2. last contact of the front wheel with the ground;
3. last contact of the back wheel with the ground;
4. skateboard at the highest position;

5. first contact of the skateboard with the ground after flight.

*These events define these phases:*

1. preparatory phase;
2. take-off phase;
3. flight-up phase;
4. landing phase.

The degree of muscle activity in each phase was expressed as the integral value (area under the curve) depending on the time. Resting activity represented a normative value, to assess activation of selected muscles during selected jumps. From rest values activation values (AV) for all monitored muscles were calculated ( $AV = \text{average} + 2 * \text{standard deviation}$ ) from the rest values. Monitored parameters were expressed as multiples of activation values. For each muscle we calculated the mean value and standard deviation of 3 monitored attempts.

Independent variables were the type of the jump and the phase of the jump and the dependent variable was the muscular activity of target muscles.

Statistical processing was performed by Statistica (Version 12.0, StatSoft, Tulsa, OK, USA). Normality of data distribution was tested by Kolmogorov-Smirnov test. Due to non-normal data distribution differences in muscle activity between jumping switchstance Ollie and Ollie were assessed by non-parametric paired Wilcoxon test. Differences were considered as significant if the level of statistical significance was  $p < .05$ .

For better understanding, results are presented by the relative difference in muscle activity of Ollie and switchstance Ollie. Muscle activity in Ollie jumps is considered as 100%.

## Results

Values of total muscle activity during the entire movement are shown in Figure 1 and 2. Differences were observed independently on front and back limbs because of different functions of these limbs during skateboard jumps.

In comparing Ollie and switchstance Ollie we found significant differences in the activity of RF ( $p = .022$ ) and GM ( $p = .013$ ) on the back lower limb. In both muscles this activity was significantly higher for switchstance Ollie jump.

**Preparatory phase**

In the preparatory phase RF ( $p = .017$ ) and GM ( $p = .028$ ) muscle activity is significantly higher for switchstance Ollie on back lower limb (Figure 2).

**Take-off phase and flight-up phase**

Although results suggest increased muscle activity during switchstance Ollie than during Ollie, we did not find any significant difference.

**Landing phase**

Compared muscle activity in switchstance Ollie and Ollie at this phase we find two significant differences in TA and ST. In both muscles on the front lower limb

was muscle activity significantly higher (for both muscles  $p = .028$ ) during the Ollie jump (Figure 1).

**Discussion**

Jumps in skateboarding require the involvement of multiple muscle groups and also the optimal timing of their activity. The number of scientific studies of skateboarding is low and therefore the possibility of comparison with the results of other measurements is very limited.

In our study we tried to compare the differences in muscle activity in two basic jumps. Generally it looks that both jumps are the same, but replacing limbs

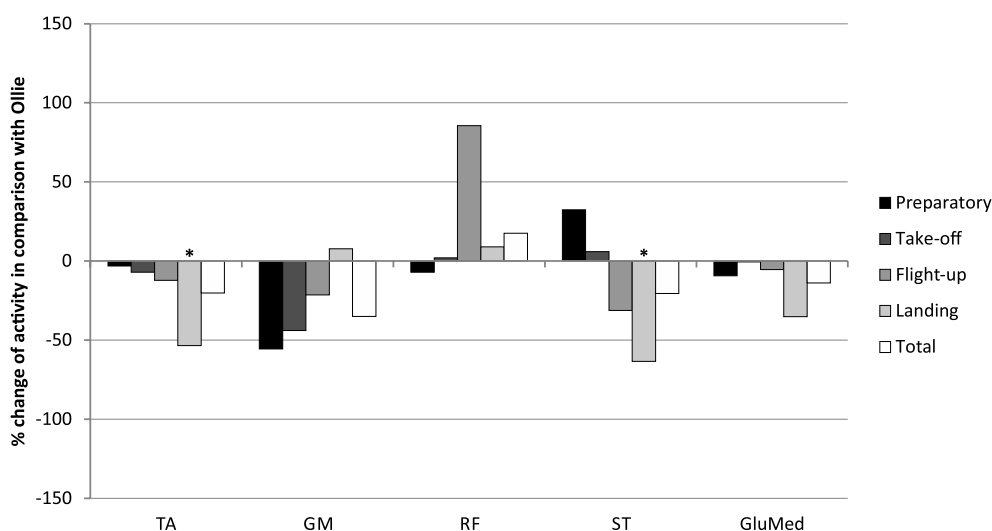


Figure 1. Front lower limb muscle activity during switchstance Ollie in comparison with Ollie. TA = tibialis anterior, GM = gastrocnemius medialis, RF = rectus femoris, ST = semitendinosus, GluMed = gluteus medius. \* $p < .05$

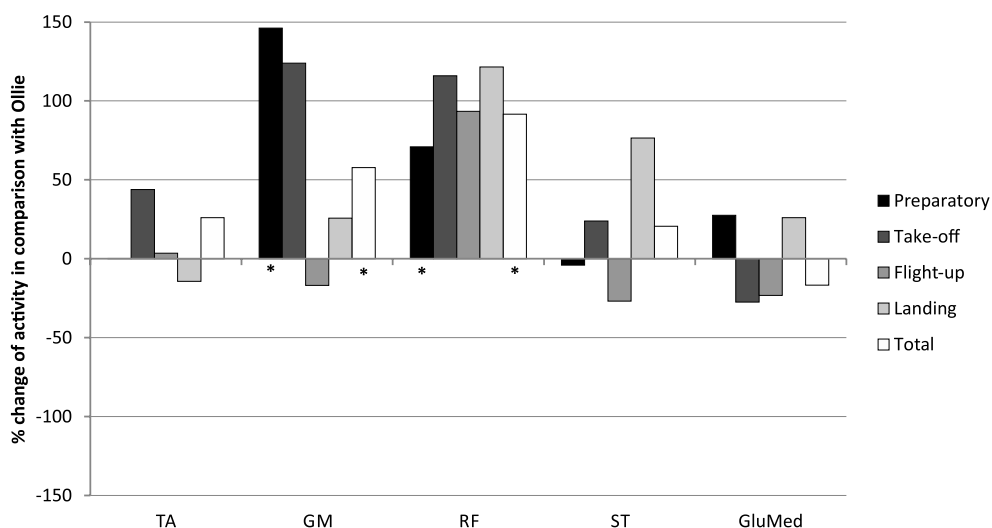


Figure 2. Back lower limb muscle activity during switchstance Ollie in comparison with Ollie. TA = tibialis anterior, GM = gastrocnemius medialis, RF = rectus femoris, ST = semitendinosus, GluMed = gluteus medius. \* $p < .05$

results in different performance. Switchstance Ollie is more demanding in terms of coordination. This type of Ollie can replace Ollie performance of the beginners, because it is rarely trained and movement patterns are not well automatized. Therefore we can expect different muscle activity than in the case of Ollie jump.

Crockett and Jensen (2007) studied involvement of selected muscles during skateboarding. Their results showed major involvement of rectus femoris and tibialis anterior. Our study has not the purpose to describe major involvement muscles, however our results suggest that for optimal jump technique could be useful to observe also other muscles such as gastrocnemius medialis and semitendinosus, because in these muscles we found some difference between easier and more difficult performance of Ollie.

During the preparatory phase of the jump we found increased activity of the gastrocnemius medialis and rectus femoris during switchstance Ollie on the back lower limb. This difference is also significant in the muscle activity across the whole jump. Based on this result, we can conclude that during switchstance Ollie there is excessive muscle activity on the back lower limb. The rider has the focus shifted to the back foot instead of the middle of the skateboard, thus the rider is not able to effectively control muscle force on the back leg. Due to the lack of training and low level of experiences with this very complicated complex motion of the rider is unable to estimate the optimal force acting on the foot during the take-off phase. The tail of skateboard is pressed to the ground with an insufficient or excessive force and the rider cannot dispense adequate muscle activity for this coordination demanding exercise.

Another significant difference was found in the increased muscle activity of the tibialis anterior and semitendinosus at Ollie in front lower limb during the landing phase of jump. Increased activity of the tibialis anterior would be explained by better control of braking by eccentric contraction associated with the plantar flexion and pronation in the ankle. Increased activity of semitendinosus would be associated with increased controlled extension of the knee.

No significant differences were found in muscle activity of the muscles, which is involved in stabilizing of the pelvis (gluteus medius). It seems that during both conditions muscle activity in pelvis is similar.

We also considered limitations of our study. Main limitation is associated the fact that due to lack of the time for measurement, we did not perform a test of maximal voluntary contractions of each muscle.

However some authors presented that mean activation levels obtained during the task under investigation would be also considered as normalization procedure (Halaki & Ginn, 2012).

## Conclusions

A comparison of muscle activity of selected muscles during the various phases of the jump indicates that during switchstance Ollie skateboarders use higher muscle activity on the back limb to maintain knee position. In the front lower limb, results suggest more active jump performance, better control of movement and greater range of motion during the Ollie. The study suggests two training suggestions for the switchstance Ollie results of. The skater should move his or her centre of gravity from the tail to the centre of the skateboard and also he or she would continue with muscle activity during the landing phase.

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