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Robert Ropret

Faculty of Sport and Physical Education, University of Belgrade

THE APPLICATION OF ROLLERBLADES IN ALPINE SKIERS TRAINING

Abstract

Skiing as a seasonal sport has limited abilities of specific training. Therefore it is desirable for "dry" trainings to have a certain degree of similarity of competitive technique movements' simulation. Exercises must be in accordance with the parameters that determine the structure of movement on skis. The subject of this paper is to determine the possibility of including the training on rollerblades as an integral part of „dry" training. By analyzing the previous studies it has been tried to establish the extent to which the basic parameters concur with the elements of ski slalom technique (SL) and rollerblade slalom (ISL): positions and relationships between body segments, activities of current muscle groups (mode, degree of activation) and kinematics of movement (duration of certain phase shifts) and others. The results of previous research indicate coordinative propinquity of reverse-route technique on skis and on rollerblades. Certain differences in speed, intensity of force, load points, as well as similarities in the positions of body segments, the involvement of actual muscle groups, the intensity of muscle tension and others are evident. The knowledge of the similarities and differences can improve the application of rollerblades in training of skiers. Changes in some parameters (slope, speed) can contribute significantly to the positive transfer when the structure of movements in skiing is in question.

Keywords: SKI TECHNIQUE / TRAINING / ROLLERBLADES / SLALOM

INTRODUCTION

An important problem of alpine skiers is a reduced possibility of development and maintaining the technique and motor abilities in the regime of specific training outside of (short) snow season. Usage of imitation or rare specific exercises offer the possibility of fulfilling these demands to a certain extent. The application of imitation exercises, as an alternative method of training, depends largely on the degree of connection of the imitation exercise with the competitive technique. In that case the structure of exercises has to be congruent with the parameters that characterize the structure of movements in competitive technique (Kroll, 2005). Body posture, relation among segments, the motion, and mutual coordination of movement would have to be as similar to the basic exercises as much as possible. Training modalities would have to be based on the same general motor program, which would imply the operation of actual muscle groups in the same regime, the degree of activation, the dynamic, kinematic parameters and others. Also, tuning effects of external and internal forces in terms of maintaining a dynamic balance during moving with constant changes of rhythm are the factors that have to be taken into account when assessing the similarity of the training resources.

Bearing in mind the basic conditions' features and techniques of skiing, the possible alternative exercises are ice skating, skiing on grass (*grass rollers*) or rollerblades (*in-line skates*). Since individual

Correspondence to: Robert Ropret, Faculty of Sport and Physical Education, University of Belgrade
Blagoja Parovića 156, 11030 Belgrade, e-mail: robert.ropret@dif.bg.ac.rs

activities include specific conditions, the only substitute to skiing, in terms of „dry" training is using rollerblades. With the appearance of skis with a pronounced side-port, and thus the mechanism of adaptation to the rotation, the possibility of using rollers in the training process is opened up.

The application of rollerblades in the „dry" training of skiers is based on the assumption that rollers as props can successfully mimic the movement in the snow, bearing in mind that these are movements with similar transitional positions, together with the need for significant manifestation of dynamic equilibrium and similar mechanisms of reverse direction. These mechanisms are based on the effect of rotator of the thigh (a consequence of setting bruised shins and skis / wheels at an angle to the surface) and expressing the effect of the geometry of skis / wheels. On snow surface, skis establish the reverse of direction of the forced change due to motion expressing the effect of geometry and elasticity of the skis (Ilic, Ropret, & Ilic, 2009), and the rollerblades because of the smaller diameter of the side-wheels. Rotations of bruised shins are necessary for the regulation of reverse slippage of back parts of skis / rollerblades. In both cases maintenance of a dynamic balance in the sagittal plane (movements of muscles in the leg and hip joint in the knee and ankle) is manifested as well as in the frontal plane (by movements of inclination and angulations in order to coordinate action of centrifugal and centripetal forces).

In addition to empirical knowledge about these basic elements of the mechanism of changing direction on the skis and rollerblades, research and comparison of the dynamic characteristics of the slalom on skis (SL) and slalom (*in-line skates*) on rollerblades (ISL) were performed in a small number of papers (Roman et al., 2007; Zeglinski et al., 1998, Kroll et al., 2005; Bandalo, 2009) and are presented in this paper.

TECHNIQUE ANALYSIS

Roman et al. (2007) evaluated the impact of knowledge using rollerblades with success in ski training in their study. The experiment was carried out on pupils aged 7-13 years (n-51) without previous knowledge of skiing, which were divided into an experimental group-EG (n-26) and a control group-CG (n-25). The experimental group had 16 days of rollerblading training, and the control group had only regular sports activities (basketball, volleyball, etc.). Both groups had undergone a five-day ski training with evaluation of the degree of mastering techniques. After 7-day break a retest was performed. By evaluating the elements of skiing techniques: posture (body posture, body segment ratio), speed control, keeping control of skis and movements coordination (movement segments of the body alignment, balance) the high correlation of success in skiing in the EG was noticed. In all evaluated elements, the EG achieved significantly better results (higher rates) than CG. The authors believe that these results prove the assumption that knowledge of rollerblading has a positive transfer of learning to ski, i.e. rollerblades usage develop specific motor skills that are characteristic for the technique of skiing on snow.

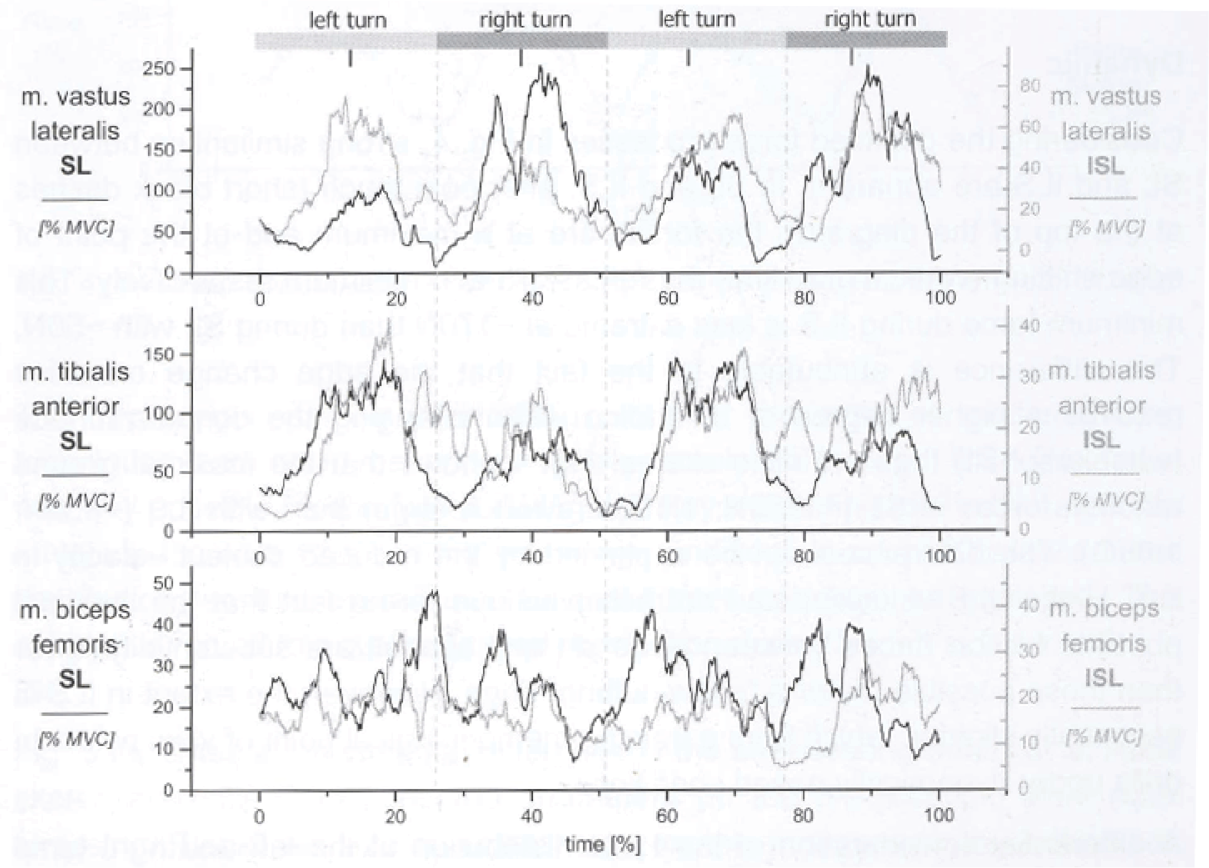
In the work of Kroll et al. (2005) the techniques of slalom runs in the snow (14 gate slalom setting according to the FIS standards on the slope of 17°) and the slalom on the in-line rollerblades (14 gates, asphalt trails, slope of 5.2°) were analyzed. The following parameters were monitored: EMG activity of eight leg muscle groups (the paper provided detailed analysis of *m. tibialis anterior-TA, biceps femoris-BF and vastus lateralis-VL*), the value of their maximum voluntary contraction (MVC), as well as the forces manifested in forefoot and rear foot. The experiment was monitored and video taped. By analyzing video tapes and comparing the certain moments during the ski slalom (SL), rollerblades slalom (ISL), and free rides rollerblades without gates (slIL), at the beginning of a shift in the time of the transfer of loads from one ski to another - the „change of edge," the moment of passing by the gate and at the end of turn, some similarities and differences are found (Figure 1):

1. At the moment of weight transmission, the width of posture in SL is obviously higher than the ISL, while in contact with a gate that difference disappears.
2. Body inclination is significantly higher in the SL at the moment of contact with the gate. The inclination of bruised shins is also greater on skis. There is no significant difference in the posture width.

Figure 1 Body position in the SL, ISL and slIL at the beginning and the end of the turning, and at the moment of passing a gate (Kroll et al., 2005)

The analysis of EMG activity of the right leg in SL and ISL (Figure 2) indicates that there are similarities in the mode of muscle work in terms of matching the beginning, the moment of maximum expression of value and duration of activation of these muscle groups. In both cases the maximum values were recorded immediately after passing the gate, at least in the changing of edge phase, i.e. at the end of turn and at moving to the next. Significant differences are noticed in the degree of muscle activation. In the SL it moves ~ 250% of maximal voluntary contraction (MVC), and in ISL at ~ 80% MVC.

Figure 2 EMG activity of m.VL, TA, BF of the right leg in all three phases of the turn of the SL and ISL (short line at the top of the chart - the moment of crossing gates, dashed line - the ending of turn and passing to a new one) (Kroll et al., 2005)



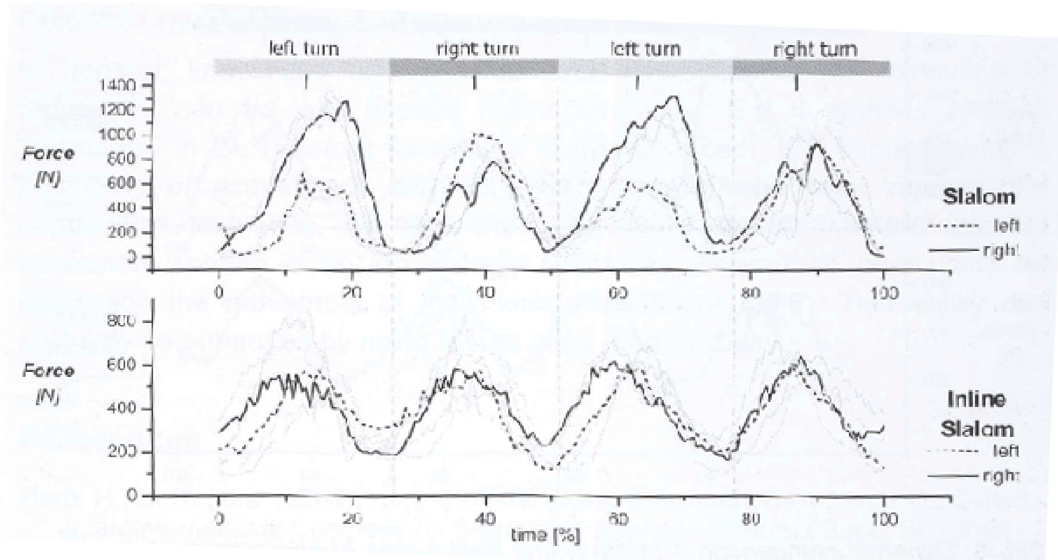
The analysis of dynamic characteristics also shows a significant similarity of muscle activity in SL and ISL. Load distribution on the outer and the inner leg (Figure 3) indicates that the moments of loading and unloading in both cases (SL and ISL) coincides in time, but the intensity of expressed powers is different. The greatest forces are manifested immediately after touching the gate, and they are at SL ~ 1350 N (1.5 G), while at ISL they are significantly lower ~ 830N (1.08 G).

Differences in maximal force values can be explained by lower ability of preventing and dosing skids for ISL. The reason for that is less control of the friction between the surface - asphalt and wheels as opposed to the snow surface where the ability to control dosing skids by carving skis into the surface. Therefore the speed, turning radius and the size of the centrifugal force is smaller for ISL.

Minimum force is manifested during the transition from one to another turn and they are ISL ~ 170 N and ~50 N in SL. The reason is the need to make significant reduce of the load at the change of edge while on skis (SL) than it is necessary in respect with the load transfer to the wheels on the asphalt.

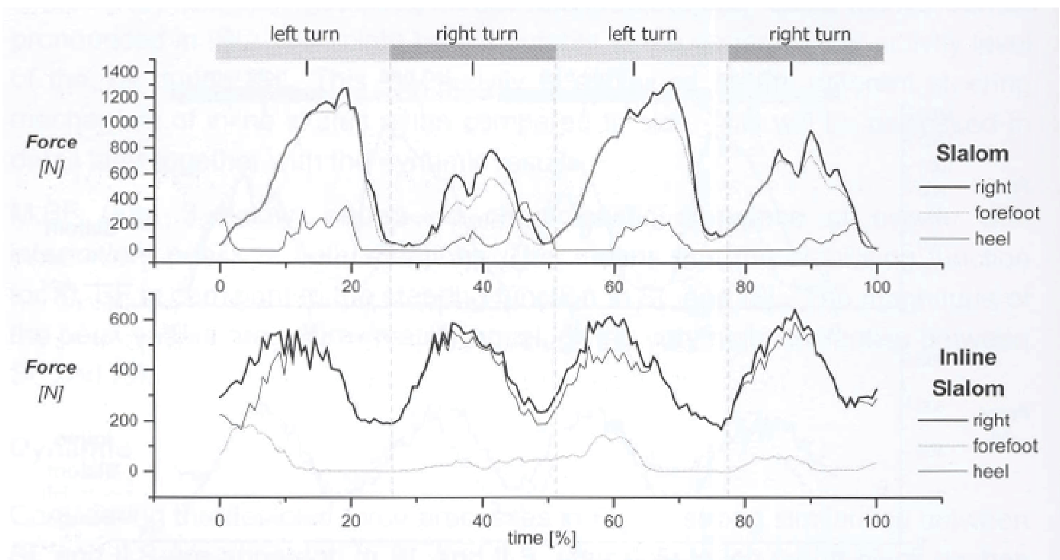
During SL shift it is evident the difference in force values manifested in the outer and the inner leg, i.e. the outer one exhibits significantly greater force than the inner. At ISL there is no significant difference, but the performance of inner and the outer leg is steady. In the modern alpine skiing there is the tendency to load evenly on both feet, so this element can be used for the purpose of learning and developing this element of technique on skis.

Figure 3 Dynamic characteristics - power distribution for the left and right leg during the SL and ISL (short lines at the top of the diagram - the moment of passing the gate, dashed line - the ending of turn and passing to a new one) (Kroll et al., 2005)



In terms of load distribution on the front (toes) and the back (heel) part of the foot, there are certain differences for SL and ISL (Fig. 4). At SL a larger load of the forefoot is dominant, while at ISL the heel is significantly more loaded during turns. The researches of Hintermeister (1995) also indicate the characteristics of forefoot load, who explains such load distribution by the significant effect of *m. Tibialis anterior*-TA in SL. In SL there is a need to load the front of the ski which carves the surface the first and therefore establish a compulsory movement-turn (Ilic, Ropret, & Ilic, 2010). Load transfer is achieved by moving the center of gravity forward, by the influence of the hip extensors, knee extensors, in which TA has an important role as a stabilizer of the ankle joint, thus allowing the effect of the aforementioned kinetic chain.

Figure 4 Dynamic characteristics - power distribution for front (forefoot) and back (heel) foot SL and ISL (short lines at the top of the diagram - the moment of passing the gate, dashed line - the ending of turn and passing to a new one) (Kroll et al., 2005)

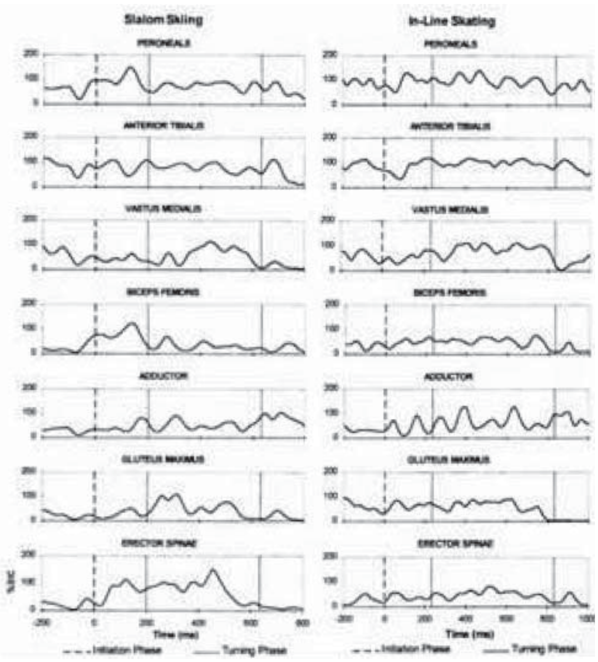


Zieglinski et al. (1998) investigated, on a sample of five competitors, the muscle activity (EMG) of 7 leg muscles and trunk extensors (*m. peroneus-PE; anterior tibbialis-AT; vastus medialis-VM, biceps femoris-BF; adductor-AD; gluteus maximus and erector spinae GM-ES*), and kinematic parameters (duration of individual phases of turning during ski slalom (SL) and the rollerblades slalom (ISL). The intensity of the muscle response was evaluated according to the degree of maximal voluntary muscle contraction (MVC) measured at the beginning and the end of the experiment.

The results showed that the duration of the change of direction phase on the rollerblades was 55% longer than the SL, while the duration of the preparatory phase was the same. The speed on skis was significantly higher (10.2 m/s) than the speed on rollerblades (8.5 m/s). Differences in speeds, and thus the duration of turn phase, can be explained by different conditions, slope, type and quality of the surface. Small slope of the path, greater friction forces between the surface and the wheels cause lower speed and a longer phase change of direction on rollerblades.

The analysis of EMG signals (Figure 5) shows the similarity in average and maximum values of amplitude, in the preparatory phase of SL and ISL, except for *m. erector spinae*, which shows a significantly higher average and maximum value in the SL compared to ISL. Contrary to Zieglinski, the author of this paper believes that the increased activity of the muscle groups is the result of trunk inclination forward maintenance in SL, as a need of front loading of skis, and not the movements of unloading.

Figure 5 EMG activity of muscle groups in SL and ISL (dashed vertical line marks the beginning of preparation, a full line - the beginning and end phase of changing direction) (Zeglinski et al., 1998)



The shown results indicate that there are differences in the intensity of activity of tested muscle groups during skiing SL and ISL, but according to the scheme of functioning, similarity in number and type of muscle groups, the application of rollerblades represents an activity of high similarity with skiing on snow skis. The level of muscle activity in mentioned works is in accordance with similar surveys in the slalom and giant slalom, where the intensity of muscle activity was between 80 and 180% MVC. Muscle activity VM, GM and ES show a significant „phase" activity in SL. This activity is reflected in a sharp increase of EMG amplitude from less than 50% MVC to over 100% MVC for a period of 100 ms and then it rapidly decreases to a level 50% MVC in one cycle. These results are in accordance with other authors (Hintermeister, 1995), in which the important role of isometric and quasi-isometric contractions is indicated, as well as the emphasized activity of the muscles in the eccentric contraction mode.

CONCLUSION

The results of researches of the mentioned authors point to the coordinative closeness of the change of direction technique on skis and on rollerblades and the possibility of application of rollerblades on the "dry" alpine skiers training. The differences in the intensity of force expression between SL and ISL, certain differences in the points of loading can be partially disregarded, bearing in mind that the use of rollerblades has a positive contribution to the adoption of the sense of dynamic balance, a sense of space, time, speed, a similar muscle work mode, as well as that lower intensity of power in the ISL provides better demonstration of techniques for beginners and it is more pronounced in the ISL adoption of uniform load distribution on inner and outer leg. Changes in the rollerblade design, the length of the base with wheels, type and quality of wheels, would allow higher speeds, less slippage, and thus the higher slopes both of legs and a skier, which would make the kinematic and dynamic characteristics of SL and ISL even closer.

The knowledge about the differences and similarities allows better methodological use of rollers in training.

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