

The issue of balance training in cross-country skiing

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ABSTRACT

The basis of correct and efficient implementation of techniques in cross-country skiing is balance. In our article, we focus on the description of balance capabilities and its role in cross-country skiing. We describe the possibility of using modern tools and utensils for its development. We also recommend a methodological procedure to develop balance both in the summer months which we call „Dry“ training, also in the winter snow. Part of the text are also suggestions of exercises and selected exercises suitable for developing balance and individual key skills for school conditions which can rehearse during Physical Education classes before the ski course.

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KEY WORDS:

cross country skiing, balance, training, education, ski course

SOUHRN

Základem správného a účelného provedení techniky v běhu na lyžích je rovnováha. V našem příspěvku se zaměřujeme na popis rovnováhové schopnosti a její úlohy v běhu na lyžích. Popisujeme možnosti využití moderních pomůcek a náčiní pro její rozvoj. Dále doporučujeme metodický postup při rozvoji rovnováhy jak v letních měsících při tzv. „suché“ přípravě, tak i v zimních měsících na sněhu. Součástí textu jsou i návrhy cviků a vybraných cvičení vhodných pro rozvoj rovnováhy a jednotlivých klíčových dovedností pro školní podmínky, které lze nacvičovat při hodinách tělesné výchovy před lyžařským kurzem.

KLÍČOVÁ SLOVA:

běh na lyžích, rovnováha, trénink, nácvik, lyžařský kurz

INTRODUCTION

Cross-country skiing is belongs to the cyclic sports with strength-endurance character and with significant part of coordination skills. When movement it occurs the global burdening of muscles throughout the body and at the same time it is necessary, to give the effort expended and fatigue during prolonged activity, to be the technical level of expression of the locomotive optimal and efficient (Ilavský & Suk, 2005).

In many recent studies dealing with performance in cross country skiing, a key factor is forcefully - endurance abilities (Hoff, Gran & Helgerud, 2002; Holmberg, Lindinger, Stöggel, Eitzlmair, & Müller, 2005; Zory, Vuillerme, Pellegrini, Schena, & Rouard, 2009). But we must not forget that cross-country skiing is also based on two important coordination skills: balance and rhythm. Both of

these coordination skills is needed to be developed especially when skiing and react to changing external conditions (snow and footprints quality, quality of preparation skis etc.).

In addition to this is of course optimal use cross-country skiing, but it is clear that in our climatic conditions this fact limits and defines the current status of snow. Therefore we are forced to use other training tools that will allow us at the time called „Dry“ training“, in the summer and autumn time, optimally develop physical fitness and coordination skills important for cross-country skiing. For this purpose we have the following text focused on balance exercises and imitative field exercises that use new, advanced tools, and enriching the training and education in cross-country skiing.

THEORETICAL OUTCOMES

Balance of the cross country skiing

For cross-country skiing, as mentioned above, it is the basis balance. With a good balance can be used longer slip that helps us to conserve power and increase overall speed and creates better conditions for subsequent take-off. By balance, we mean the ability of body to maintain in or its part in a certain position, both at rest and during ongoing movement (Hirtz, 1985). Balance is divided into static, which ensures position of the body when standing, sitting position and other positions and dynamic, maintaining the position of the body in movement (Korvas, 2004). Balance skills are involved in many very basic skills and their development is needed and automatically runs from the earliest age in connection with the formation of elementary physical skills, eg. sitting, standing, walking, running. On the balance of the body are involved in all analyzers, important are perceptions of visual and vestibular sensations and proprio sensory. For the feedback is important kinesthetic analyzer, which evaluates all the information from coming receptors in the central nervous system (Bernaciková, Kapounková, Novotny et al., 2010). For balance skills is needed the interplay of motor and sensory system, so often used the term sensorimotor balance. When balancing labile positions is thus always applied interplay nervous and muscular system, largely manifested reflexes, which are involved in maintaining the position of the body without the participation of consciousness (Krištofič, 1997).

Therefore, we can develop balance in pre-school age, but sensitive period for the development of equilibrium states 8 to 12 years (Hirtz, 1985). Of course, even in later life it is necessary that the ability to develop and maintain. Balance exercises should be a part of nearly every workout of all cross-country skiers with regard to the age and maturity of the skier. At younger ages, we choose a general workout, at a later age (from 13 years of age) we make it more difficult to exercise, and add special exercises of ski balance. Balance exercises also have a booster effect, especially on the postural muscles. These muscles

help us maintain upright stance, but also ensure the correct position for movement (Liebman, 2015). More with this issue concern for example Chrástková (2015) or Jebavý and Zúmr (2014).

Balance exercise due to the complexity of the central nervous system are carried out after incorporation in the beginning of the training, when the body is rested, and there is no problem to concentrate and finely coordinate movements. At the beginning of training units we can submit a maximum of concentrated power, which is the main prerequisite for the proper technical implementation. At the end of the training session or during it is appropriate to include these exercises unless they are precisely mastered, or if you want to test the skills acquired in fatigue (Valoušek, 2012).

OBJECTIVE

The aim of this article is to present the possibilities of using modern tools in the development of balance during pre-training and training in cross country skiing. Focus on key points in the development of balance abilities and techniques in cross-country skiing. Furthermore assemble a set of exercises using modern tools and then the exercises divide by specialization into individual parts according to the maturity of skier.

METHODOLOGY

At the inception of this article were used theoretical methods, and that is the descriptive and comparative, which were used for comparison between exercises in summer and winter preparation period. Some information were obtained on the basis of three personal structured interviews with national coach in cross country skiing, which provided us valuable, practical advice and the latest information mostly technical in nature. Empirical methods were chosen method of direct participant observation, when we were monitoring cross-country skiers during training of balance exercises using selected exercises. On the basis of these methods was subsequently compiled a set of exercises for different age and performance categories of skiers.

RESULTS

To develop balance, we can use a number of tools and utensils (Table 1).

Table 1: Tools and utensils

Balance ball-shaped sectors	
Balance step	
Balance half-spheres	
Balance lentils	
Overball	
Gymball	

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A) Draft of exercises for developing balance for cross-country skiers

First, we focus on the exercise of a general nature which should be an essential building block in the development of the balance (Table 2). These exercises are suitable for beginning runners called

„mite / squirt team“ and the younger pupils. Initially developing static balance after the technically correct implementation of the exercises we include a dynamic character.

a) General exercises

Table 2: Basic exercise - General exercises to develop balance

Exercise	Description	Time of exercise	Notes
Standing on one leg	Stand on one leg, alternating leg lifts to stretch leg out and bend	Hold for 5 sec	On the mat
Rotation with jump	From standing position make the take off with half-turn, turn	On both sides	On the mat
Dove (weight)	From standing position extend leg backwards and bend forward	Hold for 5 sec	On the mat
Called "Flamingo"	From standing upright stare ahead, lift leg and bend it higher	Hold on in first position at least 10 seconds, then close your eyes and hold for 5 seconds. The same with the other leg	On the mat
Overturnd directions	From standing position, in the same time stretch left arm upwards and extend right leg backwards, straight forward bend	Hold for 5 sec and change sides	On the mat
Walking by the line	At first with open eyes, later with closed eyes	Forward and backward	On the mat by the line
Walking on the rope	Walking bare-foot, walking blindfolded	Forward and backward	Rope placed on the ground
Walking on the bench	At first with open eyes, later with closed eyes	Forward and backward	Bench
Walking on the beam	Standing, walking, turns	Forward and backward, with turn	An inverted bench or a tree trunk may be used

b) Special exercises with balancing tools - static and dynamic form

These exercises take place only after mastering the

general exercise and are suitable for both younger and older pupils and slightly advanced skiers (table 3).

Table 3: Special exercises - static form

Exercise	Description	Time of exercise	Notes
Standing a slight squat 	At first with help, later without help (stretch arms forwards or hands in the back of the head)	Hold for 5 sec	On the balance half-sphere
One-leg standing 	At first with bended leg, later with backward bended leg and with closed eyes	Hold for 5 sec	On the balance half-sphere
Standing a slight squat 	At first with help, later without help	Hold for 5 sec	On the inverted balance half-sphere
Standing and shuffling around 	Standing and shuffling around on one place (with prop, without prop)	Hold for 20 sec	Balance step
Walking with balance step 	At first slow short steps, later fast steps	Hold for 30 sec	Balance step
One-leg standing 	At first with prop, later without prop	Hold for 5 sec	Balance step
Telemark 	Shin on the gymball, foot on the balance half-sphere(with help, without help)	Hold for 5 sec	On the balance half-sphere, Gymball
Wide sit on the gymball	At first with help, later without help	Hold for 10 sec	Gymball
Standing and slight squat 	Standing on the ball with prop on the wall bars, slight squat. Next standing on the ball without prop, slight squat (with help)	Hold for 2 sec	Gymball

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c) Special exercises with balancing tools - dynamic form

These exercises are suitable for adolescents,

adults and advanced skiers, who manage technically correct exercises with static nature (Table 4).

Table 4: Special exercises with balancing tools in dynamic form

Exercise	Description	Time of exercise	Notes
Alternating jumps 	From a slight squat position with leg extended backwards, jumps on one leg	10 times	On the balance half-sphere
Alternating over-jumps with legs together 	From a slight squat position, jumps aside and on the opposite side down-jump	10 times	On the balance half-sphere
Alternating over-jumps on one leg with hold (Metcalfs) 	From a slight squat position, one leg jumps on the balance half-sphere and on the opposite side down-jump	Hold for 2 sec	On the balance half-sphere
Jumps with turn	From a slight squat position, jumps with 180° turns	Hold for 2 sec	On the inverted balance half-sphere
Forward lunges 	From standing position alternating lunges forwards	Hold position for 2 sec	Balance step
Side lunges	From standing position alternating side lunges	Hold position for 2 sec	Balance step
„Metcalfs“	From a slight squat position on one leg, alternating side jumps	At first without stop, later with 1 sec hold	Balance step

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d) Special imitative exercises - dynamic balance
Dynamic balance exercises are designed for

experienced skiers and runners with advanced dynamic balance (Table 5).

Table 5: Special imitative exercises with poles and without poles

Exercise	Description	Time of exercise	Notes
Delivering of the basic stance - classical technique 	On the mat, in the basic stance slightly extend leg backwards and stretch arm forward, head is in the extension of the trunk, look about five to ten meters ahead	Hold for 5 sec	More challenging option: eyes closed or exercise barefoot
Imitation of arm movement and lower limb – classical technique 	In one-prop standing train the movement of arms and free lower limbs, which are alternately dangling. The effort is to carry out in full motion as it is in skiing.	10 times	On the mat, bench, later balance half-sphere or overball
Running with poles 	The effort is to coordinate the movement of arms and lower limbs	For 30 meters	At first on the flat land, later up a gentle slope (higher frequency of movement)
Imitation of up a gentle slope without poles - classical technique			
Ski walking up the hill - classical technique 	We pay attention to the basic principles of classical implementation of techniques!		
Imitation of up a gentle slope with poles - classical technique 	We pay attention to the basic principles of classical implementation of techniques!		
Metcalf - skate 	From a slight squat on one leg, we perform jumps sideways		

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B) Proposed exercises for developing balance for cross-country skiing in the school Physical Education

When practicing first describe and demonstrate to students individual exercises. We explain to students why they do the exercise and motivate

students for lessons and ski course. The very exercise, at first, we include exercises without equipment (Table 6), and later include exercises with short rods that imitate ski poles (Table 7).

Table 6 Exercise without equipment

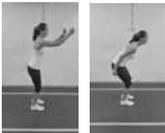
Exercise	Description	Time of exercise
Walk	At every step slide foot lightly over the surface. Arm bend at the elbow are moving as in normal walking	For 30 sec
Imitation classic technique – arm 	Slight wide stance, slightly bend in knees, alternately whip arms forward and backward simultaneously with swung his knees	10 times
Imitation of "kick-double-pole" 	Slight wide stance, both arms at the same time whip from stretch forward higher-pose to stretch backward-pose. simultaneously a slight swing in knees, deep forward bend by the whip of arms backwards. While whipping arms forwards we unbend the trunk.	10 times
Imitation skating 	Alternating overjumps on the right and left leg, the other leg is added to the weighted leg.	10 times

Table 7 Exercising with a short stick

Exercise	Description	Time of exercise
Walk 	Walk with sticks, which simulate the ski poles	For 30 sec
Imitation classic technique 	The basic ski stance: Jumps on the right leg, left arm backwards, left leg, right hand forwards and opposite.	10 times
Imitation classic technique	Squat with leg extended backwards with a prop in the stick – in jump change legs.	10 times
Imitation skating 	Side-jumps from left leg onto right leg with arms stretching forwards and backwards.	10 times

DISCUSSION

Due to the fact that only in a few sectors of endurance sports have technical, coordinational and motor performance that significant impact on overall performance as is the case of cross-country skiing, we have to develop all physical abilities in the training. But we must not forget that exercise regimen should be as similar to cross-country skiing. Climatic conditions in our latitudes do not allow us to spend a lot of time on cross-country skis, so we must seek training funds, which would replace the cross-country skiing.

As already set out above, for limiting the right technical implementation of and thus performance in running can mark a high level balance skills, which we must constantly maintain due to the changing external conditions, thereby preserving the constant position of the body or its parts in various fixed positions, attitudes and movements. It allows us the correct execution of take-off and subsequent rebound longest slide in one-prop position. Interestingly certainly is not evidence that describes the example: Jakl (2014), the traditional Nordic countries, which have historically best athletes in cross-country skiing have at their standard routes and virtually all villages, ski playing areas with man-made obstacles (slopes and rises, ramps, terrain dislocations etc.), where it is possible with children during workouts include many elements of coordination in a relatively small space.

Therefore, we must seek means to develop these skills and improve the technology and our competitors. The key idea is already preparing in the summer and autumn months where we should focus not only on developing fitness skills, but also develop coordination skills and above all balance. It is advisable to start first with the training of static balance, only after the successful completion can smoothly migrate to the training of dynamic balance with the gradual placement of movement in the vertical and horizontal direction and rotational movements (Žák, 2012). It is necessary to observe the conditions for the proper implementation of of exercises to prevent musculoskeletal health problems, especially in the lumbar region.

In practice, proven and highly appropriate means are balancing tools. It is shown that the inclusion of balance aids to training units is to stimulate neuromuscular coordination and effective involvement of the motor units, and improve the kinesthetic feeling and proprioception affecting the strength of deep-seated muscles. Also improving the level of concentration, attention and concentration, it has a positive effect on the human psyche. Finally, a balancing exercise tools are variegation normal training routine. It is also shown that when you exercise to strengthen the deep stabilization system that improves coordination and balance skills. Timely individual then reacts and adapts to changing external conditions, better able to handle unexpected situations on the running track and collisions with rivals in the race with a mass start. Multifunctionality of balance technique enables simultaneous training unit focused on the development of balance and coordination assumptions to synchronize the muscles of the core and the involvement of hip-hip-pelvic complex, thoracic and cervical spine, and simultaneously develops fitness and endurance, power and flexibility requirements.

CONCLUSION

The subject of this paper was to introduce a new, modern equipment and imitative exercises that can be used in developing key motor skills such as balance, both in the field of sports training cross-country skiers, as well as in terms of Physical Education and ski courses. Their inclusion in regular teaching preparation or simply do not develop much-needed balance, but activates the deepest stored muscle systems around the spine. It can be assumed that balance exercises positively affect the deep stabilizing and postural system and coordination, balance and power capabilities. Importance may also have muscle imbalances in the removal of unilateral overload of sports specialization. Based on experience and practical verification We have therefore compiled a set of exercises that can be used both in the preparatory period and in terms of physical education before the ski course.

REFERENCES

1. Bernacíková, M., Kapounová, K., & Novotný, J. (2010). *Fyziologie sportovních disciplín*. 2010. [online] [cit. 2015-06-22] Dostupné z: <http://is.muni.cz/do/rect/el/estud/fsp/ps10/fyziol/web/sport/zima-bez-ky.html>).
2. Hoff, J., Gran, A., & Helgerud, J. (2002). Maximal strenght training improves aerobic endurance performance. *Scand.J.Med.Sci. Sports*, 60(12), pp. 288-295.
3. Holmberg, H.-C., Lindinger, S., Stöggl, T., Eitzlmair, E., & Müller, E. (2005). Biomechanical Analysis of Double Poling in Elite Cross-Country Skiers. *Medicine & Science in Sports & Exercise*, 37 (5), pp. 807-818.
4. Chrástková, M.(2015). Zlepši koordinaci a silový trénink: zařaď balanční cvičení. *Nordicmag*, 6(listopad), pp. 47-49.
5. Ilavský, J., & Suk, A. (2005). *Běh na lyžích - metodický dopis*. Praha: SLČR.
6. Jakl, P. (2014). Nejnovější trendy v lyžařské technice. Jak se učí v Norsku. *Nordicmag*, 5(prosinec), pp. 24-26.
7. Jebavý, R., & Zumr,T. (2014). *Posilování s balančními pomůckami*. Praha: Grada.
8. Korvas, P. (2004). Dynamická rovnováha v běhu na lyžích. *Těl. Vých.Sport Mlád.*,70(8), pp. 14-18.
9. Křištofič, J.(1997). Využití prvků balančního charakteru k rozvoji motorických schopností. *Česká kinantropologie*, 35(2), pp. 45-53.
10. Liebman, H. L. (2015). *Střed těla – core trénink*. Praha: Ikar.
11. Valoušek, Z. (2012). Trénink lyžaře běžce: nácvik rovnováhy. *Ski magazín*, 44(10), pp. 16-18.
12. Zory, R., Vuillermé, N., Pellegrini, B., Schena, F., & Rouard, A. (2009). Effect of fatigue on double pole kinematics in sprint cross-country skiing. *Hum Mov Sci*, 26(2009/1), pp. 85- 98.
13. Žák, J. (2012). Imitace – letní trénink lyžaře. *Nordicmag*, 3(březen), pp.36-38.

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