CAN WE MAKE THE ALPINE SKI LEARNING MORE EFFICIENT BY OMITTING THE SNOW-PLOUGH TECHNIQUE?

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SUMMARY

The aim of our research was to define the most efficient 7-day alpine-ski learning program for the ski-beginners. The research included 126 alpine ski naïve students, randomized into two equally-sized groups, at the study start not differing according to morphological characteristics or motor abilities. Participants of one group were taught alpine skiing by parallel-carving technique exclusively, while the other group learned alpine skiing through traditional parallel and snow-plough techniques. Acquired ski knowledge was tested through demonstration of five ski technique elements, by five independent judges. Participants of the two groups differed significantly in the grades obtained for the elements short turn (2.85 vs. 2.44; p=.01) and parallel turn (3.20 vs. 2.85; p=0.01), where higher grades were achieved by the participants combining parallel and snow-plough techniques. To conclude, according to our observations, in the process of teaching alpine ski beginners how to ski it is more efficient to initially use both parallel and snow-plough alpine ski techniques.

Key words: alpine skiing, learning programs, teaching methods, ski-beginner.

INTRODUCTION

Since the first use of skies as a means of transportation until now, many ski techniques emerged, and often new ones replaced those previously used. The main drive for ski technique evolution was the construction of skies, so not surprisingly carving skies have led to development of yet another, parallel-carving ski technique (Hirano & Tada, 1996; Johanson, et al., 2001; Műller, et al., 2005; Horterer, 2005). Additionally, ski technique utilization is dictated by the level of alpine ski knowledge (thus differing for recreational skiers and competitors) and also by the on-field snow conditions (Lešnik, 2002; Matković, et al., 2004; Supej, 2008.). Alpine ski schools are generally organized on a six or seven days based programs, during which alpine skiers learn or improve their ski technique. The goal of all involved in the learning process (instructors as well as ski beginners) is to find the most efficient method of ski learning. Those learning want to absolve as much of alpine skiing and as fast as possible, while ski instructors want to transfer the greater amount of ski knowledge more efficiently. Due to enormous interest in alpine skiing, Takahaski & Yoneyama (2001) suggest the use of in-line skating in the preseason preparation period as they have proved skating to have a positive effect on alpine ski learning and also on improvement of movements needed during alpine skiing. Other model is based on changing the length of skies every few days during learning process. Learning starts on very short skies of 90 cm, followed by skies of 125 cm and finally ends on skies of varying length, selected

according to the morphological characteristics of the ski beginner. If the latter approach is selected, snow-plough technique is omitted (Murovec, 2006). To our knowledge there are no data in the published English literature which would suggest the better method of ski learning. Thus, the aim of our research was to give answer whether success of alpine ski learning depends upon the technique used, i.e. if the approach using parallel-carving ski technique can achieve better results than the approach based on combined parallel and snow-plough techniques. It emerged from the need to identify the most efficient method of teaching alpine ski beginners how to ski.

METHOD

Study population: The research was conducted on 126 alpine ski naïve participants. Ninety six were male, and thirty of female sex. They were 23.3±1.66 years old, with youngest participant 21 and oldest 28 years old.

Variables: In order to determine motor abilities participants were tested on following tests: 4 meters lateral agility test, 93639 forward-backward agility test, squat jump, counter movement, standing long jump, 3 kg medicine throw test - lying overhead, foot plate tapping test, catting test, sit-ups in 60 seconds, static strength leg test – squat position, sit and reach, lateral tilts on left and right leg, front-back tilts with left and right leg, sprint time over 20 meters and hexagon. Tests were repeated three times, and the best result was selected as final, except in the static strength leg test – squat position, which was performed only once. Measured morphological characteristics included height, weight, percentage of body fat, and right femoral girth. They were measured according to the directions and regulations of International Biological Program (Mišigoj-Duraković et al., 2008).

Study design: Study participants were randomly assigned into two equally-sized groups, differing only in the method used for alpine ski learning. In order to identify the superior way of alpine ski learning, the prerequisite was to have the two homogenous groups, not differing significantly in morphological characteristics or motor abilities at the study beginning. Learning process lasted seven days in the ski resort Sappada, Italy, in identical conditions according to altitude, slopes, equipment, number of participants pro group, hours of learning, repetition of ski elements and exercises. Participants of first, experimental group learned alpine skiing through methods and exercises of parallel-carving ski technique exclusively, and other, control group learned alpine skiing using parallel and snow-plough techniques. Program was based on four hours daily of alpine ski learning with appointed ski instructor according to previously determined protocol. In this study special attention was given to the selection of ski instructors and judges engaged in the grading process. Six instructors were teaching according to one, and six according to the other program. They were all experienced in alpine skiing and teaching. Five judges, also experts in alpine skiing, were chosen to grade the knowledge of alpine skiing according to the previously determined strict criteria. Each judge could give a single grade to a participant on each of the five chosen elements of ski technique. Grades ranged from one (unacceptable performance) to five (superb performance). At the end of seven days, all participants were joined into a single group, in order to ensure the identical grading conditions and to avoid possible bias. Chosen elements of alpine ski technique for the alpine ski knowledge assessment included traversing, uphill turn, basic turn, short turn and parallel turn. Testing (motor abilities and morphological characteristics as well as grading) was performed within three months.

Statistical analysis: Between the groups differences on each variable were tested by ANOVA. Existing differences were determined by Fischer test. Pearson coefficients (r) were calculated between the grades given by each judge on the five chosen elements of ski technique. Factor analysis was used to define the metric characteristics. Number of important factors was determined by (Guttman-Kaiser) GK criterion. Differences between the motor abilities of participants of the two groups were tested by Mann-Whitney test. Bonferroni correction was used to minimize the alfa error. Results were considered significant with $p<.01$.

RESULTS

At the study beginning differences between the participants of the two groups were determined and obtained results enable the assumptions whether the morphological characteristics and/or motor abilities contribute significantly to alpine ski learning process (Table 1). Results show non-significant differences between the groups in the morphological characteristics (Table 1).

According to ANOVA differences between the participants of the two groups in tested motor abilities were non-significant (Table 2). Neither participants of the control nor the participants of the experimental group had advantages/disadvantages when motor abilities, such as agility, explosive strength, frequency, repetitive strength or flexibility were tested.

Distribution of results in the remaining tests for assessment of explosive strength of hands and shoulders, movement frequencies, repetitive strength and balance varied significantly from normal distribution, so for the statistical analysis of between the groups differences nonparametric Mann-Whitney test was used (Table 3). Significant differences were not found in the remaining of seven tests used for assessment of participants' motor abilities (Table 3).

TABLE 1.
Between the groups differences in morphological characteristics

Variable	Control group		Experimental group		ANOVA	
	M	SD	M	SD	F	P
Height	175.42	9.67	176.88	8.04	.85	.36
Body Mass	74.62	12.48	76.68	12.54	.85	.36
% Fat	13.93	4.99	14.62	4.17	.71	.40
Femoral Girth	57.73	3.42	58.50	4.06	1.33	.25

TABLE 2.
Between the groups differences in motor abilities

Test	Control group		Experimental group		ANOVA	
	M	SD	M	SD	F	p
MAGKUS	8.31	.69	8.19	.63	1.06	.31
MAG9NN	8.47	.65	8.44	.61	.09	.77
MESSJ	40.6	5.57	40.12	6.46	.20	.66
MESCM	42.7	6.12	42.91	6.77	.03	.85
MESSDM	226.49	21.06	227.44	22.19	.06	.81
MFRCAT	30.54	2.88	30.37	2.92	.10	.75
MRSPT6	57.12	7.53	58.00	7.6	.42	.52
MFLSAR	13.02	5.53	13.33	5.17	.10	.75
MES20M	3.48	.44	3.47	.28	.00	.95
MAGHEX	11.27	1.18	11.29	1.05	.01	.93

Legend: **MAGKUS** - 4 meters lateral agility test; **MAG9NN** - 93639 forward-backward agility test; **MESSJ** - squat jump; **MESCM** - counter movement jump; **MESSDM** - standing long jump test; **MFRCAT** - cating test; **MRSPT6** - sit up test; **MFLSAR** - sit and reach test; **MES20M** - sprint time over 20 meters; **MAGHEX** - Hexagon test

TABLE 3.
Between the groups differences in motor abilities[1]

Test	Control group		Experimental group		Mann-Whitney	
	M	SD	M	SD	Z	P
MESBML3	75.29	19.26	75.07	17.3	-.04	.97
MFRTAN	22.66	1.82	22.98	1.49	-1.08	.28
MSSIC	94.48	44.65	95.47	57.81	-.44	.66
MRU10L	25.45	21.00	27.1	27.7	-.30	.77
MRU10D	26.11	21.26	26.08	24.05	-.53	.60
MRP10L	7.42	5.59	6.71	5.99	-.82	.41
MRP10D	7.38	4.32	8.31	11.62	-1.08	.28

Legend: **MESBML3** - 3 kg medicine throw test - lying overhead; **MFRTAN** - foot plate tapping test; **MSSIC** - static strength leg test – squat position; **MRU10L** - lateral tilts on left leg; **MRU10D** - lateral tilts on right leg; **MRP10L** - front-back tilts with left leg; **MRP10D** - front-back tilts with right leg

TABLE 4.
Correlation coefficients between the grades given by five judges for each element of alpine ski technique

	traversing	uphill turn	basic turn	short turn	parallel turn
judge 1 & 2	.77**	.80**	.83**	.75**	.81**
judge 1 & 3	.76**	.80**	.77**	.80**	.80**
judge 1 & 4	.69**	.80**	.81**	.77**	.81**
judge 1 & 5	.72**	.81**	.78**	.72**	.83**
judge 2 & 3	.85**	.80**	.86**	.79**	.83**
judge 2 & 4	.85**	.83**	.91**	.79**	.84**
judge 2 & 5	.83**	.86**	.87**	.88**	.85**
judge 3 & 4	.77**	.86**	.87**	.82**	.83**
judge 3 & 5	.79**	.84**	.86**	.82**	.84**
judge 4 & 5	.75**	.84**	.83**	.78**	.83**

* $p<0.05$; ** $p<0.01$

TABLE 5.
Results of first components of judges during grading of participants on five elements of alpine ski technique

Element of ski technique	Components (factors)	Eigenvalue	% variance
traversing	1	4.12	82.31
uphill turn	1	4.30	86.01
basic turn	1	4.35	87.06
short turn	1	4.17	83.38
parallel turn	1	4.31	86.23

[1] In Table 3. arithmetic means and standard deviations are given only to show the direction of orientation while Mann-Whitney is a nonparametric test.

TABLE 6.
Differences between the participants of the two groups in the knowledge of alpine skiing

Element of ski technique	Control group		Experimental group		F	P
	M	SD	M	SD		
traversing	3.46	.72	3.27	.64	2.49	.12
uphill turn	3.24	.74	2.95	.71	5.02	.03
basic turn	2.98	.88	2.70	.75	3.43	.07
short turn	2.85	.83	2.44	.83	7.78	.01
parallel turn	3.20	.76	2.85	.77	6.83	.01

In order to determine judges' objectivity in grading new alpine ski knowledge correlation coefficients between the grades given to each participant on each element of alpine ski technique were calculated. Obtained correlation coefficients showed the accordance of judges in grading elements of alpine ski technique (Table 4), and high levels of correlation point to satisfactory objectivity of all five judges. It can be concluded that grades obtained for the demonstration of elements of alpine ski technique are a reflection of new knowledge and not influence of judges.

Homogeneity of judges was determined by factor analysis, and the results (Table 5) showed that all estimated the same item, i.e. alpine ski knowledge. Beside the presented first components, no other component was statistically significant according to GK (Guttman-Kaiser) criterion.

Results in Table 6 show the better method of learning alpine skiing. Variable that helped in differentiating the better approach was the grade each participant obtained for the demonstration of new knowledge of alpine skiing. Before the ANOVA, Bonferroni correction was used. As this research used five (dependent) variables, according to Bonferroni correction statistical significance was set at ≤ 0.01. The two models of learning alpine skiing did not give significant differences in traversing, uphill turn and basic turn (Table 6). However, participants of the two groups differed significantly in the knowledge of short turn and parallel turn ($p=0.01$). If arithmetic means of grades obtained in the mentioned elements of alpine ski technique are compared between the participants who learned alpine skiing by parallel and snow-plough technique with those achieved by participants using parallel-carving ski technique (Table 6), then better results were achieved by the former group.

DISCUSION

As participants of the two groups did not differ significantly in motor abilities or morphological characteristics at the beginning of this investigation, it can be concluded that their achievement in alpine skiing is attributable to different models used in learning. So, higher grades obtained by the participants pertaining to group taught by elements of parallel and snow-plough techniques are a result of better learned basic ski movements. Participants of the more successful, control group adopted continuous semicircular leg movements much better, which helped them in the end to better demonstrate the new knowledge of alpine skiing, especially to join short turns and parallel turns. Placing modern skies on their side edges, due to constructional characteristics, makes a sharp and clear-cut mark in the snow and also enables marked increase in speed during turn performance. Obtained speed on skies can be controlled by mentioned continuous semicircular leg movements (Hirano, et al., 1996; Kaiser, 1997; Schiefermuller, et al., 2005), which were better acquired by participants with higher grades on short turn and parallel turn. Programs of learning alpine skiing which omitted snow-plough technique in the end proved to be inefficient and not advantageous. It seems that at the beginning of the learning process, elements of snow-plough technique help faster learning, and are not necessarily to be avoided. Moreover, they have the advantage in the basic alpine ski learning

school as they help the beginners to lower the center of gravity and additionally enlarge the area under the skies (Carr, 2004). Moreover, snow-plough technique also helps ski beginners in capturing good balance posture, which in addition to placement of skies on their inner edges, gives complete control of speed (Matković, et al., 2004). Of course, elements of snow-plough technique need not be forced at later stages, when participants of alpine ski school have mastered them, and advanced elements based on parallel ski techniques can be used. As a bridging phase, between snow-plough and parallel ski technique, many use so called wedge shaped ski posture, differing from snow-plough posture by the narrower width of back of the skies (Lešnik, et al., 2002). This posture used either as a methodic exercise or element of alpine ski technique, gradually helps to prepare the ski beginner to fully perform the turn by using solely parallel ski technique. Due to the mentioned, this specific ski technique is used during beginning phases of alpine ski learning. In our investigation, this technique was omitted in one examined group. One program was based exclusively on parallel-carving ski technique. From the early beginning, participants were taught to place skies on their edges, by using the constructional features of carving skies. This program would surely satisfy the demands of modern attendant of alpine ski school for speeding up the learning process, in order to maximize the use of free time during winter holidays. However, faster use of more demanding elements of parallel ski technique, in principle leads to skipping the indispensable phase of alpine ski learning. Desire to faster convey the knowledge of alpine skiing at the end impoverishes recreational alpine skiers for information and ski movements important during later, more advanced phases of learning. Results of this investigation could help alpine ski instructors, in their everyday practice with alpine ski beginners. Newer, modern ways of alpine ski learning need not give better results at the end of the learning process. Only tested novelties, either in alpine ski equipment, or tools used during learning process as well as ways of knowledge transfer are to be safely used in praxis. Important role in learning alpine skiing plays a model i.e. method of alpine ski learning, in addition to capacity and skill of ski beginner and ski surrounding (Lewandowski, 2006). Our investigation proved the importance of exercises and elements of snow-plough and parallel techniques of alpine skiing in achieving better results during beginning phases of alpine skiing.

CONCLUSION

Young motorically capable alpine ski beginners learn alpine skiing better when initially taught by elements of parallel as well as snow-plough technique. Implementation of our results into everyday practice would contribute to greater interest of recreational skiers for this specific motor activity.

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DA LI JE EFIKASNIJI NAČIN PODUČAVANJA ALPSKOGA SKIJANJA BEZ PRIMJENE PLUŽNE SKIJAŠKE TEHNIKE?

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Cilj istraživanja bio je definisati efikasniji sedmodnevni program podučavanja skijaških početnika alpskom skijanju. Istraživanje je sprovedeno na uzorku od 126 ispitanika koji prije samog istraživanja nikada nisu učili ili samostalno probali motoričku aktivnost alpsko skijanje. Prosječna dob ispitanika bila je 23,3±1,66 godina, a unutar uzorka najmlađi ispitanik imao je 21, a najstariji 28 godina. Uzorak je slučajnim odabirom bio podijeljen u dvije, veličinom jednake grupe. Na taj način formirane su dvije grupe ispitanika na kojima se je primijenio različiti tretman. Preduslov za istraživanje bio je da se ispitanici dviju grupa međusobno nisu statistički značajno razlikovali na početku procesa podučavanja s obzirom na morfološke karakteristike i motoričke sposobnosti. Zbog toga su svim ispitanicima bile utvrđene osnovne morfološke karakteristike te procijenjene motoričke sposobnosti. Proces učenja alpskoga skijanja za ispitanike dviju grupa proveden je u skijaškom centru Sappada (Italija). Ispitanici jedne grupe učili su osnove alpskoga skijanja pomoću metodičkih vježbi i elemenata isključivo paralelne-"carving" skijaške tehnike, dok su ispitanici druge grupe učili osnove alpskoga skijanja primjenom metodičkih vježbi i elemenata paralelne, ali i plužne tehnike alpskoga skijanja. Ispitanici su imali identične uslove s obzirom na: boravak na nadmorskoj visini (1250-2000 m), korišćenje skijaške opreme, korišćenje skijaških terena jednakog nagiba prilikom poučavanja određenog skijaškog elementa, broj ispitanika u grupi (10 ispitanika), broj sati učenja (28 sati) i uvježbavanja (12), broj ponavljanja elemenata skijaške tehnike (4-8), broj ponavljanja metodičkih vježbi (1-3). Od izrazite važnosti za istraživanje bio je odabir kvalitetnih učitelja alpskoga skijanja i ispitivača. Odabrano je pet ispitivača, skijaških eksperata s dugogodišnjim iskustvom u procjenjivanju znanja alpskoga skijanja koji su nakon završenog procesa podučavanja procijenili stečeno znanje alpskoga skijanja kod svih ispitanika. Pet nezavisnih ocjenjivača dalo je ocjenu svakom ispitaniku za demonstraciju pet odabranih elemenata skijaške tehnike. Procjena usvojenog nivoa skijaških znanja kod ispitanika valorizovana je ocjenom od jedan do pet. Nakon provedenog procesa podučavanja, a prije ocjenjivanja demonstracije pojedinih elemenata skijaške tehnike ispitanici obje grupe bili su spojeni u jednu, zajedničku grupu te je procjena znanja bila učinjena u isto vrijeme i na istom mjestu za sve ispitanike. Za utvrđivanje nivoa stečenog skijaškog znanja odabrano je ovih pet elementa: spust koso, zavoj k brijegu, osnovni zavoj, vijuganje te paralelni zavoj od brijega. Analiza rezultata istraživanja pokazala je statistički značajnu razliku u ostvarenim ocjenama između ispitanika dviju grupa kod elemenata skijaške tehnike vijuganje (2,85 vs. 2,44; p=0,01) i paralelni zavoj od brijega (3,20 vs. 2,85; p=0,01). Naime, ispitanici grupe koja je podučavana elementima i metodičkim vježbama plužne i paralelne skijaške tehnike ostvarili su prosječno više vrijednosti ocjena u odnosu na ispitanike koji su bili podučavani isključivo elementima i metodičkim vježbama paralelne skijaške tehnike. Ispitanici uspješnije, kontrolne grupe zbog programa po kojem su učili usvojili su kontinuirana polukružna kretanja u zglobovima donjih ekstremiteta na višem nivou, što im je na kraju omogućilo tehnički bolju demonstraciju paralelnih zavoja od brijega i vijuganja. Stoga, moguće je zaključiti kako se efikasnijim modelom učenja alpskoga skijanja pokazao onaj koji je koristio metodičke vježbe i elemente plužne tehnike alpskoga skijanja.

Ključne riječi: alpsko skijanje, usvajanje skijaških znanja, načini učenja, skijaški početnici.