Systematics and correction of skiing technique errors in beginners based on biomechanical analysis

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Annotation:
The result of the training is mastering the skiing technique by the students. It is subject to the instructors’ subjective evaluation. The video analysis and calculation of biomechanical coefficients may supply objective evaluation and specify the errors committed.

Keywords:
3D analysis, skiing technique, errors, centre of gravity, movement analysis

Methodology
The research involved 70 students of Teacher Training College of Revalidation, Resocialization and Physical Education in Białystok, Poland, and 5 instructors (the control group, the standard group) who participated in the winter camp in Juńskie Łąznie, the Czech Republic, in January 2007. the training in the winter camps lasted 7 days. Practical classes were held on the slopes and they were complemented with theoretical knowledge in the form of lectures.

The basic evolutions taught and assessed included the following:
• snowplow turns,
• half-plow turn,
• traverse parallel side-slip

The classes took place in 12-person groups with an instructor. At the beginning of the camp, the participants were divided into groups based on their skiing abilities (2, 4).

The first stage of the research involved collecting the material at the beginning of the camp (2nd day) and at its end (7th day). Two video cameras (Hi-8) recorded the passing of the slope’s fragment following the arc marked by the instructor. During the slide there was a requirement of the half-plow turn technique. The students were to present the most correct technique at the level of their current skills. The camera was placed still on the tripod, and the recording frequency was 25 Hz.

The data regarding the height and body mass of the people under examination was collected along with their skis’ length.

The material collected was subject to a biomechanical analysis. The video recording was converted into AVI files with a multimedia card. Then, by means of Aschenbrenner’s programme (5), the centre of gravity of a skier and their equipment was determined (CoG) and the angles of the respective body parts were measured. The skier’s centre of gravity and the angles were defined in the medium sequence of the turn. The achieved coordinates (CoG) were converted in percentage values in proportion to the length of the lower extremities (l) for further comparison. The forward binding was assumed to be the centre of the reference system. The values obtained at the beginning were compared with the ones obtained at the end of the camp (1, 3).

The position of the centre of mass was assumed to be the correctness criterion. The examined persons were divided into 5 groups, according to the shifts in CoG in the sagittal plane (type of error)
Group A – CoG too much forwards,
Group B – CoG too much backwards
Group C – CoG in the forward-backward axis but too high,
Group D – CoG as above, but too low,
Group E – CoG correct

The force of the error will be evidenced by the CoG distance from the medium standard group in the coordinates system normalized by the standard deviations of the standard group.

The correct position was assumed to the average of the instructors’ group with range 2 standard deviations. Subsequently, the results were correlated with the point-based assessment given by the instructors. The data obtained were subject to the standard statistical and comparative analysis.

Results
The first stage of research described the skiers’ positions by means of measuring the angles and CoG position based on the video recording analysis. Fig. 1 presents the distribution of the results of the skier’s centre of mass coordinates.

Based on the measurements from the camp’s beginning, the study group was divided according to the errors made in keeping the correct position. The most numerous group included people with CoG moped backwards (36%), and then forwards (24%); too high and too low positions (18% and 11% respectively) were also noticed; 11% of

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The students presented the correct position at the very beginning of the classes. The instructors’ group obtained the following geometrical values that determine the position of the body:

- the angle of the shins bending relative to the skis (k1): 77°
- the angle in the knee joint (k2): 133°
- the angle of the trunk bending relative to the skis (k3): 68°
- the angle of the arms’ bending relative to the trunk (k4): 149°
- the angle of the forearms raised relative to the arms (k5): 136°
- the height (from) the whole body mass against the length of the lower extremities (l): 2.41
- the distance (y) between the projection of the centre of the body mass in the sagittal plate (y) in relation to the length of the lower extremities (l): 0.46

Moreover, it was stated that the position of the extremities should be symmetrical. The position of the values examined is illustrated in Fig. 2.

The detailed data that describe the position in the sagittal and frontal plates obtained on the basis of the video recording analysis are included in table 1.

The results describing the students’ positions at the beginning are included in Table 2, and at the end of the camp in table 3.

The group showed much deviation from the values assumed as standard at the beginning; the differences were both excessive and negative. The most frequent terror was bending the shins insufficiently forwards, which accompanied by an excessive bending in the knee joint caused the centre of the body mass shift considerably backwards relative to the skis. The students attempted to compensate for this terror bending their trunks more forwards. As a result their position lost balance and optically deviated from the standard position. Persons whose ankle joint was bent not enough while bending their shins insufficiently forwards had to straighten their trunks in order not to weigh down their skis, and some even bent backwards. Furthermore, many cases of asymmetry in the position of the extremities were noted. The average position of the centre of the body mass in the projection on the skis’ plane appeared much further back from the frontal binding than in case of the standard group.

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Discussion

The errors resulted in shirting the projection of the centre of the body mass to the back of the skis. The vertical coordinate of the centre of the body mass (z) does not differ much, yet, the horizontal one (y) aims at the standards values along with the increased level of training in the study group.

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Table 1.

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The differences in the values are much smaller than at the beginning, which proves the level of the group getting equal. It can be said that the downhill skiing technique has improved during the training. The results obtained at the end of the camp were gained under more difficult weather conditions, which still shows the more advanced level of the students and at the same time proves the training to be effective. The above method of research may be useful in instructing skiing. The instructor, having the standard and student’s error description based on the video analysis at their disposal, can offer the very student unequivocal and precise instructions. It can also be applied for auto-correction when improving one’s own skiing technique.

At the camp one could also additionally notice the positive effects in the form of an increased motivation while being recorded and a greater awareness of one’s own mistakes when watching the recording. Video camera should be one of the fundamental didactic aids during the training process.

Bibliography

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