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Drop Jumping as a Training Method for Jumping Ability

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Summary

Vertical jumping ability is of importance for good performance in sports such as basketball and volleyball. Coaches are in need of exercises that consume only little time and still help to improve their players' jumping ability, without involving a high risk of injury. Drop jumping is assumed to satisfy these requirements. This assumption is supported by a review of results of training studies. However, it appears that regular jumping exercises can be just as helpful. The same holds for exercises with weights, provided the subjects have no weight-training history. In fact, for unskilled jumpers who have no weight-training history, the effects of training programmes utilising these different exercises are additive. The most effective, efficient and safe way for a coach to improve the jumping achievement of his athletes may well be to submit them first to a training programme utilising regular jumps, then to a weight-training programme and finally to a drop jump training programme.

In drop jump training programmes themselves, the improvement in jumping height varies greatly among studies. This variation cannot be explained satisfactorily with the

information available on subjects and training programmes. Given the current state of knowledge, coaches seem to have no other option than to strictly copy a programme which has proved to be very effective. Obviously there is a need for more systematic research of the relationship between design and effect of drop jump training programmes. The most important variable to be controlled is drop jumping technique. From a review of biomechanical studies of drop jumping, it becomes clear that jumping technique strongly affects the mechanical output of muscles. The biomechanics of 2 techniques are discussed. In the bounce drop jump the downward movement after the drop is reversed as soon as possible into an upward push-off, while in the countermovement drop jump this is done more gradually by increasing the amplitude of the downward movement after landing. It is speculated that the bounce drop jump might trigger improvement of the power output capacity of muscles, whereas the repetition of the countermovement drop jump may help to improve coordination. Future training studies are needed to determine whether drop jumping technique really affects the outcome of the training, and if so, which technique should be preferred. Also, further biomechanical research is needed to determine kinematics and kinetics of other drop jumping techniques, and to trace potential dangers. The author urges for a close cooperation between coaches and scientists in future research.

Vertical jumping ability is one of the factors determining performance in a variety of sports, such as basketball and volleyball. Coaches are constantly striving to find new exercises for increasing their athletes' jumping achievement. The exercises not only have to provide greater gains, they also have to be very efficient. The reason is that during the season there is often little time available for training sessions, and the training sessions cannot be fully devoted to improving jumping ability; other abilities (e.g. agility, precision) have to be improved as well, and playing strategies must be rehearsed. A third requirement to be met by the exercises is involvement of only a minimal risk of injuries, and it is so much to the good if the exercises are enjoyed by the athletes. In coaching literature, plyometric exercises are advocated as the ideal solution (Calloway 1978; Costello 1984; Mann 1981; Miller & Power 1981; Moynihan 1983; Thayer 1981; Wilt 1978). During plyometric drills, also known as stretch-shortening cycle drills (Steben & Steben 1981), a movement to an intended direction is performed by starting it with a movement to the opposite direction. One of the most popular plyometric drills is drop jumping. Performing a drop jump, or depth jump (Wilt 1978), involves jumping from a raised platform and, upon landing, immediately performing a vertical jump.

The way drop jumping has become popular is typical of how training methods evolve. It is rumoured that the Russian athlete who won the 100 and 200m dash in the 1972 Olympics, Valery Borzov, utilised plyometric drills as part of his training (Wilt 1978). Coaches of rival athletes became interested and began to search for more information. They found a description of drop jumping in a translated Russian paper by Verhoshanski (1966), adopted the idea, started experimenting and developed their own modifications. These modifications are now incorporated in widespread athletic programmes.

The growth in popularity of drop jumping has been influenced only very little by results of controlled training studies and results of studies into biomechanics of the exercises and possible dangers. Unfortunately, this too is typical of the development of training methods. The main reason seems to be a lack of communication between coaches and scientists. Coaches don't always see the value of experimental research and are reluctant to involve scientists in their work, possibly for fear of losing control over their athletic training programmes. This may slow down the progress in development of new training methods. Scientists all too often fail to explain clearly to coaches how research can be of help, and in planning their re-

search they tend to neglect the experience of coaches. This may cause discrepancies between what is done in the experimental study and procedures followed in actual training, which limits the practical relevance of the results.

The purpose of the present paper is to help coaches who design jump training programmes, and to identify crucial questions that should be addressed in future research. For this purpose, I have attempted to integrate the experience of coaches, the results of studies into the training of jumping ability, and findings of biomechanical research into drop jumping.

1. Why Drop Jumps?

Most of the studies into the training effects of drop jump programmes are inspired either directly or indirectly by the work of Verhoshanski (1966, 1967) who introduced the performance of drop jumps as training exercise for jumpers. Therefore, it may be useful to briefly clarify Verhoshanski's view on how a specialised training programme for jumpers should be designed, and to mention the experience upon which this view is based. Another reason is that this experience can be used to put the results of training studies in perspective. The quotations given below are from an English translation of Verhoshanski's papers, which were originally written in Russian.

Before introducing drop jumps, Verhoshanski (1966) recognised that '. . . on the first stage of sports improvement the usual methods [jump exercises] allow for growth of sports achievement. However, further on, jump exercises serve to increase the sports result to a lesser degree than do exercises with weights. However, in its own turn this latter effect on the highest stages of sports mastery likewise decreases.' To explain this, Verhoshanski refers to what he calls the principle of dynamic correlation or dynamic conformity. According to this principle, '. . . the means of specialized strength preparation should be so chosen that it has maximum conformity with the basic sports exercise [the performance of a jump] in relation to the amount of strength, the time it is displayed and the speed of maximum development, the regime of the work of the muscles, and, finally, the amplitude of the work movement' (Verhoshanski 1967). Apparently, '. . . the training function of weight exercises does not answer those needs which appear in conditions of fulfilling the jump' (Verhoshanski 1966). What then, are these needs? Comparing skilled jumpers ('Masters') with novice sportsmen, Verhoshanski (1967) identifies as one of the differences that 'His [the Master's] muscles more quickly switch from yielding work to overcoming work and more quickly develop maximum dynamic strength, which is also greater than in the beginner. Because of this, we say the reactive ability of the nerve-muscle apparatus in the Master is higher.' In his view, '. . . growth of sports mastery to a significant degree is stipulated by the so-called 'reactive ability' of the muscles' (Verhoshanski 1966). Continuing the discussion of weightlifting exercises, Verhoshanski (1966) states 'it shows up that weightlifting, while stimulating the appearance of significant strength, at the same time slows down the speed of its development and frequently the speed of switching the muscles from yielding work to overcoming work.'

Which methods, then, can help to improve the reactive ability? 'It is obvious that one such method is the basic sports exercise for record for the given jumper's level of achievement. . . . However, for reasons known, this is not always possible to do. Because of this, it is advisable to search for means which by their own dynamic characteristics give adequate ties with the basic sports exercise . . .' (Verhoshanski 1966). This is where the execution of drop jumps comes in: '. . . for development of the reactive ability of the nerve-muscle apparatus, it would be ideal to have such strength training conditions that in the forthcoming work regime the muscles developed maximum dynamic strength corresponding (by its complex characteristics) to the phase of amortization in the jump, and, at the same time, did not slow down the switching of the muscles to overcoming work. Such conditions can be artificially created if, for example, the sportsman takes off (forward-upward or upward) after a

in accordance with the experience of Verhoshanski (1966), that all these exercises have their own place in the training of jumping ability. Thus, the most effective, efficient and safe way for a coach to improve the jumping achievement of his athletes may well be to submit them first to a training programme utilising regular jumps, then to a weight-training programme, and finally to a drop jump training programme.

Focusing on drop jump training programmes themselves, it turned out that the improvement in jumping height varied greatly among studies. This variation could not be explained satisfactorily with the information available on subjects and training programme. Given the current state of knowledge, coaches seem to have no other option than to strictly copy a programme which has proved to be very effective. Obviously there is a need for more systematic research of the relationship between design and effect of drop jump training programmes. Some of the variables which might affect the outcome of the training, and which should therefore be carefully controlled, were mentioned.

The most important variable to be controlled is drop jumping technique. From a review of biomechanical studies of drop jumping, it becomes clear that jumping technique strongly affects the mechanical output of muscles. If subjects reverse the downward movement after the drop as soon as possible into an upward push-off (BDJ), the mechanical output of knee extensors and plantar flexors is greatly enhanced over and above that during a regular countermovement jump (CMJ). Inherent to BDJ, however, is a pattern of segmental rotations and joint kinetics during the push-off which is completely different from that during a CMJ. If, on the other hand, the subjects make a larger downward movement upon landing, the enhancement of mechanical output is less than in BDJ, but at the same time the push-off more closely resembles that of a CMJ. It is speculated that BDJ might be effective in triggering improvement of the power output capacity of muscles, whereas the repetition of CDJs may help to improve coordination. Since drop jumping technique is not specified in the training literature, it is not clear yet whether drop jumping technique really affects the outcome of the training, and, if so, which technique should be preferred. This is to be determined in future training studies. Also, further biomechanical research is needed to study kinematics and kinetics of other drop jumping techniques, and to trace potential dangers. One condition for success of future studies is that a close cooperation can be established between coaches and scientists. This means that coaches will have to understand that scientific research can be of help in the development of training programmes, but cannot replace coaching experience in motivating and guiding athletes in the application of these programmes. Scientists, in turn, have to realise that this very coaching experience is needed to ensure practical relevance of the experimental results.

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