Monitoring of load in young tennis players

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In youth sports it is known that performance improvement is often a combined result of growth and maturation with training effects. Sports training in young athletes has thus to consider that the energy cost, and therewith the stress of effort, is most probably higher than it is in well trained adult top athletes. And if not higher, it has at least to be considered as different from that in adults. Consequently, training planners should be aware that "load", defined as the cumulative training stress for a certain period, needs particular attention. The balance between session contents, session density, session stress and optimal recovery, within and between sessions, needs proper individual follow-up.

Nearly every sport has its own specific performance structure. However, sports mainly rely on general capacities. There is always a merge between technical and physical fitness elements. The quality of most of the sports motor actions depends on the neuromuscular and/or cardiovascular capacities of the athlete. In children and youngsters both capacities are constantly growing, maturing and developing. So it is important that the separate strain on the muscles and the cardiovascular system are well organised within the planning and follow-up of training.

Training planning

Motor development studies show that the acquisition of new skills, and consequently new sports skills, put a high stress on the neuromuscular system. This is mainly due to the energy cost of coordinative adaptations. The coordination of the different intra- and inter-muscular motor units has to economise. The younger the athlete, the more new motor answers have to be installed for the acquisition of a wide range of motor actions and handling. The more novice the athlete, the less economic these motor performances are. Thus it could be expected that the economy of training response depends on calendar age, maturity status, training age, and probably talent.

Pilot study

At the training centre of the Flemish Tennis Federation (Belgium), a pilot study was set up for a better understanding of the individual response on training strain between the youth elite squads. Heart rate monitoring was used to register the individual cardio-respiratory response to a set of standard on-court exercises, each of a well defined duration, and separated by a defined recovery phase.

Subjects

The study groups consisted of 4 girls and 4 boys, subdivided as follows: 2 girls and 2 boys aged 13 years, and 2 boys and 2 girls aged 15 years. All players were members of the national talent squad. Data samplings were done in the spring of 2002. Since this time, 1 girl and 2 boys from this group have been highly ranked on the final world junior rankings in the year that they became 18 years of age.

Data sampling and evaluation method

Prior to the session at which the heart rate response to a defined set of standard on-court exercises was registered, the players underwent, on separate days, 2 incremental running tests to define VO_2 and heart rate dynamics in relation to running speed. These tests were a standard treadmill protocol, and a field shuttle run over 20 meter to exhaustion (Légertest). Afterwards test results were matched to define the individual heart rate zones. A few days later a set of 9 classic tennis training exercises was performed, and at the end a high intensity ball game was played as a control for the maximum attainable heart rate.

Results

Heart rate data was analysed using Intensiogram® software, allowing a visual comparison of the chronological alternation of five individually defined heart rate zones (Figure 1). Due to individual profiles, the heart rate response showed individual intensity alternations per exercise. However the differences were always larger between age groups, and between both sexes, than between the age peers per group. In the major part of the exercises the girls' heart rates tended to be lower at effort, but remained higher during the in-between repetition intervals. The recovery heart rates between the separate exercises showed no visual differences between both sexes. In the exercise sets that combined the need for a higher technical mastering with larger replacement distances, the younger players' heart rates were generally lower. Thus we concluded that there is definitely a different exercise stress per age and between sexes. However, heart rate monitoring can only explain a part of the exercise strain, since muscle activity strain does not always cause reliable heart rate responses.

Discussion

Since there were only 4 players observed per age group, 2 girls and 2 boys, and the characteristics of the players were certainly not average, the findings should be interpreted with caution. It can be expected that less skilled young players show different heart rate answers to the exercise stress. The better the skill, the longer lasting the ball exchanges, and thus, the higher the intermittent intensity efforts.

Conclusions

Heart rate monitoring is a valid method to monitor exercise stress in tennis. Data however has to be interpreted regarding training age, talent, kind of exercise, and most of all in relation to a personal profile. For deeper conclusions, it would be of interest to use heart rate monitoring in combination with movement tracking systems, such as accelerometers, for a better understanding of muscle power output, and eventual energy expenditure per training session. Visual interpretation of heart rate monitoring can contribute to a fast and useful analysis of training load tendency.

About the author

Paul Ponnet, Ph.D., is a specialist in talent development. He advises federations, teams and individual athletes. At the Flemish Tennis Federation he advises the federal coaching staff from the talent groups in the planning and the follow-up of training response.

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Figure 1 Heart rate response in pubertal girls and boys during tennis drills