

Tapering: The Critical Interaction of the Art and science of Coaching.

By: Greg Wells

The taper phase is the critical time of the year for coaches and athletes alike, for it is then that the seasonal planning, training and preparation are all put to the test as coaches make those final adjustments to the year's training that lead to significant improvements in performance. The challenge for coaches is to use their knowledge and experience to help the athletes make that final adaptation and reach their potential, while constantly adjusting for a myriad of factors, such as travel, stress, technique, and physical changes that come with reduced training. This article summarizes the research on tapering with the objective of providing coaches with information so that they can make informed decisions on how to create an optimal taper for their athletes.

Overview

Tapering is a special training period immediately preceding the major competition phase during which the training stimulus is reduced in a systematic non-linear fashion to achieve a peak in performance. Optimal physiology, technique, and psychology are all outcomes of tapering. More scientifically, tapering produces an optimal biological state characterized by perfect health, a quick adaptability to training stimuli, and a superior rate of recovery. The complete definition of taper is "a progressive non-linear reduction in the training load during a variable period of time, in an attempt to reduce the physical and psychological stress of daily training and optimize sports performance" (Mujika 2000).

At the peak of a taper, the athlete has a high state of synergism - the joint action of several factors that act together to increase each other's effectiveness. Tapering has been shown to result in performance improvements of 2%-4% in most studies in laboratory and field performance tests, as well as in competition results.

The Physiological Effects of Tapering

The primary objective of tapering is to decrease the training stress to allow the body to recover and eliminate fatigue. With systematic changes in the training impulse, fatigue decreases more rapidly than fitness, and increased performance results from the increasing difference between the two factors. Thus,

in a well-designed taper, the body becomes rested (with all the associated benefits) and the athlete's fitness level is well maintained. In fact, improvements in performance during taper are significantly correlated with decreases in the negative influences of training (fatigue), but are not correlated with the positive influences of training (fitness) (Mujika et al. 1996). The effects of tapering on the various physiological systems in the body are reviewed below.

Hematological Effects. The effects of a taper on various blood parameters, such as hemoglobin (the oxygen-carrying capacity of the red blood cells), hematocrit (the proportion of red blood cells in the blood), and red blood cell volume (the size of the red blood cells) were investigated by Mujika (1997), who reported that all three parameters increased during the taper phase. These changes would lead to an improvement in oxygen transport and hence a significant improvement in aerobic capacity. Researchers have also found increases in reticulocyte counts (that is, newly produced red blood cells), suggesting an increased erythropoiesis (red blood cell production) during taper. The increase in blood parameters may also help to improve the buffering capacity of the blood through an increased hemoglobin level, which in turn would increase the ability of the body to buffer the lactic acid produced during high-intensity exercise.

Hormonal Effects. The changes that occur in the various anabolic hormones (hormones that help build and repair tissue) and catabolic hormones (stress hormones that cause damage to tissues) during taper have been investigated, and the changes have been related to observed performance improvements (Aldercmetz et al. 1986). These authors have noted a significant correlation between the increase in the testosterone:cortisol, that is, anabolic:catabolic, ratio and the improvement in performance during a four-week taper. Changing the balance between anabolic and catabolic hormones may improve recovery after exercise and speed the elimination of fatigue.

This finding suggests a particularly important consideration for coaches - the elimination of extraneous stress during taper. Reducing any type of stress, even stress not related to the sport (such as arguments with parents, examinations, and so on) can reduce the level of cortisol in the athlete and improve

positive adaptation. This also implies that the added stress from higher-than-normal levels of anxiety and nervousness that occur near major competitions must be accounted for in the taper protocol (such as jet lag, as explained later in this article). Coaches can account for higher anxiety and travel by easing training stress or by helping the athletes cope with stress through sport psychology techniques, such as progressive relaxation and visualization.

As a side note to this discussion, there are two additional issues to point out with regard to stress. First, the more important the competition, the greater the stress; while this is self-evident, it increases the difficulty of planning the taper. The information the coach has gleaned about tapering the athlete has been based on past competition, but at each higher level of competition, the stresses (both internal and external) become greater and require further compensation within the taper. This fact leads to the second important issue, which is keeping accurate and detailed information about past tapers and performances. By referring to this archived information, and looking carefully at the additional, and new potential, stresses involved with an upcoming competition, the coach should be able to adjust the taper.

Neuromuscular Effects. Several studies have examined the effects of tapering on muscle contractile properties and the ability to produce power. The results of these studies suggest that tapering induces alterations in the contractile properties of single muscle fibres. Further, it appears that the Type IIa, or "fast twitch", muscle fibres respond to a taper to a greater degree than the Type I, or "slow twitch", muscle fibres. The increased size, strength, velocity, and power of the IIa fibres may be responsible for the improvements in whole-muscle strength and power after a taper (Trappe et al. 2000). It is appropriate to stop resistance training during the last 10-15 days before an event to allow for adequate time for the muscle to rebuild and regenerate before the beginning of the competition. It is also advisable to avoid eccentric muscle contractions (applying tension while lengthening the muscle) during taper, as this type of muscle stress can cause microtears that take time to repair.

Immune Response Effects. Another significant adaptation that has been shown to occur in response to a taper is the increase

in the cell counts for white blood cells, specifically eosinophils (believed to be important in detoxifying some of the inflammation-inducing substances in the body and destroying allergen- antibody complexes, thus preventing the spread of inflammation) and lymphocytes (white blood cells that fight infection), and these changes seem to be highly associated with the reduction in training volume (correlation coefficient of 0.86). This finding suggests that there is an improvement in the body's capacity to resist illness during taper. It should be noted that stress induces the so-called stress hormones, such as cortisol, which can counteract this effect. Thus, again, stress management skills are important in optimizing and maintaining immune function.

Sleep. A study of female swimmers demonstrated an improvement in sleep duration and perceived sleep quality during taper (Taylor et al. 1997). The improvement in sleep quality is important; as the growth hormone is released during stages III and IV sleep. Naturally released growth hormone acts to repair muscle tissue and speed recovery. Encourage your athletes to get at least seven or eight, and preferably nine, hours of sleep during a taper phase.

The Psychological Effects of Tapering

Tapering has been shown to have positive effects on the psychological state of athletes. Significant improvements in the Profile of Mood States measures of tension, depression, and anger were observed after one week of tapering, with significant improvements in total mood disturbance and fatigue (Hooper et al. 1998). Other benefits include increased motivation, arousal, and psychological relaxation. Coaches should include relaxation exercises such as visualization, progressive relaxation, positive talk, and other confidence-reinforcing techniques in competition preparation.

Critical Variables in Designing an Optimal Taper.

Peaking during a taper is not a physiological mystique, but rather a complex training state that can be attained in a consistent manner. During a taper, coaches decrease training stress to promote improvement in performance. The decrease in training stress can be accomplished by reducing the number of practices (frequency), the intensity of the workouts (intensity), or the volume of training performed in a given session (volume), or by varying the length of the taper

(duration). Obviously, a reduction in taper duration could be detrimental to achieving the anticipated gains in performance and, therefore, should be made cautiously. Most coaches use a "mini-taper" at some point in the season to see how the athlete responds in terms of the extent of the "jump" in performance and its duration; this is valuable information to include along with the responses to past tapers.

Taper is not mystical, but achieving the optimal taper has often taken on mystical proportions. This is truly where the art and science of coaching meet. Each of the critical factors involved in training will now be discussed with regard to designing the taper.

Intensity. Intensity is the one key area where pre-taper training levels should be maintained during the taper itself. The athletes must still practise at competition intensity or higher. In several well-designed studies reviewed by Mujika and Padilla (2003), researchers have shown that only a high-intensity, low-volume taper design is effective in maintaining or improving total blood volume, blood cell volumes, citrate synthase activity (an aerobic enzyme), muscle glycogen concentrations, muscle strength, and running time to fatigue in groups of elite athletes. Thus, it is recommended that coaches maintain training intensity during taper to avoid even minimal detraining. It is through the reductions in the other variables (volume, frequency, and duration) that recovery should be achieved.

Frequency. Reducing the frequency of practice (that is, number of workouts/week) has been shown to improve performance more than maintaining pre-taper frequencies (Oohns et al. 1992). This reduction in training frequency must be balanced with the need to practise optimal motor patterns and technique. Thus, it is recommended that training frequency should be reduced by no more than 20% of pre-taper values to avoid detraining and "loss of feel", especially in technique-dependent sports.

Volume. Reductions of 50%-70% in total training volume have been reported to maintain or improve training-induced adaptations in elite runners and cyclists (Martin 1993, McConnell 1994). Other studies have reported benefits with reductions of up to 85% in total training volume (Mujika et al. 2000). In general, endurance athletes should have less

reduction in training volume than sprinters or strength and power athletes. Thus, the recommendation is to reduce training volume by 50%-85%.

Duration. Research on tapering has suggested that tapers should last from four to 21 days. In general, sprint- and strength-based athletes should taper for longer than endurance athletes, but this should be highly individualized based on how each athlete recovers and maintains his or her sport-specific physiological gains.

Longer tapers are important for sprint and strength events, as the nervous system takes longer to recover and adapt. On the other hand, since aerobic enzyme concentrations decrease rapidly with diminished training, it is important that training be continued in endurance athletes. Males may require a longer taper than females due to differences in muscle mass, and older athletes, with a slower recovery rate, require longer tapers than younger athletes.

Taper Design. Recently, it has been quite well demonstrated that a taper modelled as a "fast decay exponential" reduction in total training stress (intensity, frequency, volume, and duration) is more effective than either a linear or a step reduction (Mujika 2004). This seems to be especially true for shorter tapers or for the short duration mini-tapers that coaches sometimes use mid-season for events of moderate importance.

Examples of each of the potential taper models are presented in the figure above (Mujika and Padilla 2003).

Other Considerations. There are several other key considerations for ensuring an effective taper. First, it is important that the athletes are knowledgeable about and practise optimal recovery habits after each practice. Material on recovery and recovery principles can be found at www.gssiweb.com/reilib/refs/297/rt-46.cfm?pid=38. The second important consideration is to ensure that the athletes practice with optimal technique at all times, even during the warm-up and warm-down phases of the practice, in order to ingrain the appropriate motor pattern. Because the nervous system is particularly sensitive to the activation pattern, the ongoing and habitual use of an optimal activation pattern is crucial to ensure the creation of optimal motor patterns and

neuromuscular co-ordination, especially during times of high stress (Ray and Hume 1998).

The third, and perhaps most important, success factor in creating a perfect taper is to ensure that the athletes unload stress from their lives outside the athletic arena. The off-loading of mental and emotional stress can be just as important in determining the eventual performance as the physical practice. The athletes should be encouraged to make the coach aware of any extraneous issues that are affecting them and may be adding to their potential stress load so that the coach or consulting sport psychologist can aid in relieving the stress level.

Avoiding Additional Stress During Travel.

Sometimes major competitions are held in different time zones, and as this situation adds additional stress to the athlete, it requires special consideration and must be incorporated into the overall taper plan. The major problem with long distance travelling is that, the human body was not designed to sit in a confined space for extended periods of time in the desert-like atmosphere of an airplane and then to be dropped into a different time zone and asked to perform tasks optimally and flawlessly. Jet lag is the body's natural reaction to such conditions as it attempts to adjust and realign itself to new environmental conditions. The following information will serve as a guide and action plan to help diminish the negative symptoms associated with jet lag.

Jet lag impairs the body's and the mind's ability to function and can have many diverse symptoms. There are two main causes of this condition: (1) Dehydration and (2) disruption of the body's natural daily cycles, the so-called circadian rhythms.

To minimize the effects of travel, have your athletes follow these recommendations:

- Drink plenty of fluids - water, fruit juices, and clear liquids.
- Avoid fatty foods. Order low-cal or vegetarian meals.
- Go through a stretching routine two to three times per hour, and move around as much as possible.
- Wear loose-fitting clothing for comfort.

The Anti-Jet Lag Action Plan.

- Three days before travel: Feast. Enjoy generous high protein servings at breakfast and lunch and carbohydrates at dinner.
- Two days before travel: Fast. Eat as above, but only small portions and no evening snacks.
- One day before travel: Feast. Eat the same as three days before travel.
- Travel day: Fast. Eat only small portions and no snacks. For westbound travel, sleep late. Consume caffeine only with breakfast. Eat all meals later than usual. Spend time in natural light upon arrival. For eastbound travel, wake up early. Do not consume caffeine until 6:00 p.m. Try to go to sleep early.
- Day after arrival: Exercise 30 minutes before the normal breakfast time at the new destination. Do not nap, but rest frequently. Try to fall asleep at a reasonable hour at destination time. For eastbound travel, schedule practice for an early p.m. period. For westbound travel, schedule practice for an a.m. period.

Summary

Eight characteristics seem to be common to successful tapering techniques:

- Total training volume is reduced 50%-85%
- The volume of high-intensity training remains high (high intensity is relative to the event that is being prepared for).
- The level of difficulty of training sessions is reduced by increasing recovery time.
- The frequency of training is reduced slightly (up to 20%).
- The duration of taper is between four and 21 days, depending on the individual.
- Use a fast decay exponential taper design.
- Activities performed during taper are specific to the athlete's competitive demands.
- Because extraneous stresses can influence the hormonal response and, therefore, can significantly alter the overall recovery pattern by using up large amounts of energy, the coach should make every effort to identify and minimize outside stresses.

References are available on request. For more information or if you have

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