Introduction
Ross once asked ‘Is the real reason why Olympic weightlifters are good vertical jumpers because they inadvertently do a lot of fast eccentric training in the catch phase of the full movement?’. With power output being fundamental to sporting success or failure, from a swing of a golf club to a push off the wall in swimming, there is always a need to optimise/increase an athlete’s power producing capabilities. This means that it is important that coaches look at all methods by which power output can be enhanced. The above question implies that there may potentially be another mechanism by which Olympic lifts can provide a potent power development stimulus. This mechanism, focussing on the rapid eccentric element of the exercises, is termed ‘fast eccentrics’. Fast eccentrics have been described as eccentric contractions that occur at speeds ≥180°/sec. As Ross previously stated, many strength and conditioning coaches may be inadvertently training fast eccentrics through the Olympic lifts and their derivatives. The purpose of this article is to highlight the benefits of utilising eccentrics in a training programme, and to describe the physiological benefits more specifically of training with fast eccentrics. This article focuses on one specific fast eccentric exercise, the drop jump, and the exercise is expanded on further with regards to how to progress this movement.

Drop Jumps
During sport specific movements there is a requirement for effective and efficient deceleration. Deceleration can come in many forms, during sprinting controlling the late swing phase of the lower limbs and during throwing actions at the release phase. Deceleration can also be seen in whole body actions, not just in localised areas, through rapid deceleration of whole body mass during changes of direction on the sports field/court. Maximising eccentric performance capabilities can be a method of increasing the physical potential of an athlete in a number of ways. 

Table 1. Eccentric Training and Benefits.

| 1. Improving force production | Chronic: Training eccentrically over time has been shown to increase concentric force production including 1RM. |
| 2. Selective fibre type change | Fast eccentrics such as a catch phase of a clean or a catch during a clap push up have been suggested to shift muscular fibre types to more explosive type IIx fibres. |
| 3. Enhancing performance during a taper | Thus allowing greater preservation of strength over a time period of planned competition. |
| 4. Strengthening tensile structures of muscle (pre-rehab) | Eccentric training increases tendon and ligament strength, therefore making joints more robust. |
| 5. Possible decreased inhibitory response to stretch & load | Stretching eccentrically on an acute and chronic level reduces the excitability of stretch receptors, therefore leading to increased range of movement. |
| 6. Potentiation of stretch shortening cycle (SSC) response | Loaded eccentric complex training has been shown to elicit an increased SSC response and therefore increased power output per concentric rep. |
Muscle fibres respond to a stimulus (training) subjected to them and as a result have been known to show some ‘plasticity’ gradually shifting from one fibre type to another over time.\textsuperscript{20,16} Fibre type change from type II\textsubscript{a} to type II\textsubscript{x} has been suggested to be the most common shift of motor units.\textsuperscript{20} Changes from type I to type II fibres have been known in severe cases of spinal cord injury and de-training\textsuperscript{19,16} and therefore this shift in fibre type is unlikely to be a training outcome. One method of achieving the muscular fibre shift from type II\textsubscript{a} to type II\textsubscript{x} is with the use of fast eccentric exercises such as the drop jump. The increase of type II\textsubscript{x} from type II\textsubscript{a} muscle fibres results in greater force absorption and production capabilities.\textsuperscript{15} This is essential to increasing power output in ballistic movements, as well as increasing rate of force development and muscular force production.\textsuperscript{5}

Fast eccentrics are a way of specifically targeting the type II\textsubscript{x} muscle fibres due to the rapid nature of the movements.\textsuperscript{14} This theory goes against the ‘size principle’ which states that smaller motor neurons are recruited before larger ones. Stone \textit{et al.}\textsuperscript{23} and Nardone \textit{et al.}\textsuperscript{14} support this and mention that motor neurone recruitment may be modified according to task specificity, force, velocity and demands of the mechanical movement. There are a number of animal studies that show this selective fast twitch fibre recruitment for rapid voluntary actions\textsuperscript{13,11} however, there is also research to support this in humans.\textsuperscript{9,14,3,24} Muscle fibres with slower relaxation times may not be able to control a sudden descent as is seen in the catch phase of a drop, as they may not be able to express sufficient force in the required time frame. Therefore selective recruitment of faster twitch fibres (type II\textsubscript{x}) could occur, to enable the body to effectively carry out the drop action. This possible mechanism is supported further as forces generated from eccentric contractions (during a catch phase), have little effect on the velocity of muscle shortening resulting in high levels of force output at fast shortening velocities.

**Drop Jump**

The drop jump is an exercise that utilises lower body fast eccentrics through rapid deceleration during the catch phase of the landing.

**Start Position**

The start position requires the athlete to be in an upright stance in an elevated position. The height of the position is determined by the landing capabilities, the training aim of the session and the overall strength of the athlete (Fig.1).

**The Drop**

This phase involves the athlete taking a step forward off the box with hands in an athletic position (i.e. away from the body, reinforcing correct upper body position to react to stimulus in sporting environments), head up and looking forward with an upright body position (Fig.2). A common fault at this stage of the movement, is that the athlete may jump off the box or collapse into the drop whilst moving forward, rather than making a controlled step off in an upright athletic position. A coaching cue could be for the athlete to ‘remain tall’.

**Landing**

An important safety element to this exercise is the landing mechanics involved. Correct landing mechanics are based upon the safe distribution of force through the body upon landing. The force distribution should be transferred from the ‘mid foot’ to the heel section of the feet. A common fault is landing flat-footed or with the weight too far forward leading to poor impact force distribution and an unbalanced landing. A coaching cue for the landing should also be to land ‘silently’ to ensure the correct position of the feet.

The catch of the movement requires the athlete to be at the bottom of a squat position with the femur almost parallel to the ground thus allowing for greater gluteal and hamstring
recruitment\(^2\) (Fig. 3). There may be some sporting variation in the hip/knee angles during this catch phase. For example a sprinter with shorter ground contact times (some contacts as little as around 0.9s\(^{-1}\) and greater hip/knee angles upon contact, may gain a greater transfer of training effect by catching at these greater angles and thus allowing a more sudden and sports specific stopping time). The upper body should be in an upright athletic position.

**Progressions and Adaptations**

This exercise can be developed further by increasing the intensity of the drop. This can be achieved by increasing the height of the elevated position or by increasing the body weight by wearing a weights vest. Multiple fast eccentric landings could be implemented through a staggering of various box heights or by using a sloping embankment or hill. A progression would be to introduce bands attached around the waist of the athlete, thus increasing the velocity of the drop (see Fig. 4). Bands could also be attached from the floor at different angles thus producing pulling forces at
different points, causing the athlete to stabilise upon landing with different muscle groups and thus simulating the complex forces applied upon the body during sporting activities. Once such skill acquisition has been completed, from the accepted starting position (Fig.2), a side step off the box into a split stance landing could be introduced which would replicate sports-specific movements such as the lunge landing in squash (Fig.5). Once a similar pathway of progression in the split stance has been achieved a single leg landing approach could be implemented.

**Practical Application**

With the nature of sport and many sporting actions requiring maximal exploitive intent there is a prerequisite for training the fast twitch muscle fibres of the body. Utilising fast eccentrics in an athlete’s training programme could be a novel way of adding variation to the training programme while at the same time potentially increasing the number of type IIx muscle fibres within the musculature of the athlete.

**Considerations**

Drop jumps are a high impact exercise, therefore implementing the exercise should be considered in an appropriately periodised plan. Due to the intensity of the exercise, the athlete should be injury free and demonstrate a sufficient level of overall strength. He/she should also display a good base level of eccentric control before approaching this exercise. For example fast eccentrics can be applied to a number of different exercises and not just regarding the lower extremities. Any exercise utilising landing mechanics and/or exercises that follow this principle of rapid deceleration can be applied to different muscle groups and movement patterns. Further research is therefore required to establish fast eccentric training in a wide range of muscle groups, movement planes and patterns.

**References**