

PLYOMETRICS

JUMP further, RUN faster ... AND save energy?

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Every time a sprinting athlete puts a foot down, they generate an impact of around 2.5 times body weight. Multiply that by up to 12 during jumps – and it’s an injury waiting to happen. Plyometrics can train you to deflect impact from the muscles onto the tendons, which then act like a spring to help launch your next stride. So you can always ensure that the force is with you!

Plyometric training, also known as ‘jump training’, has traditionally been reserved for athletes in jump-related or athletics-based sports. This is mainly due to the similar movements involved in the drills for these two sports – but they are also comparable in terms of the forces impacting on the body. For example, a sprinting athlete will load around 2.5 times bodyweight during each stride of the race [1]. During triple jumping this figure increases, up to 12 times body weight – sometimes more at the elite level. For a 75kg athlete, this could mean around 900kg travelling through the ankle, knee and hip on each contact.

plyometric training with sprinting speed [2]. So much so that top-flight clubs are now starting to use plyometrics to improve speed or jump distance in other sports such as football, basketball and even cricket.

Plyometrics – what you need to know

■ What can I expect?

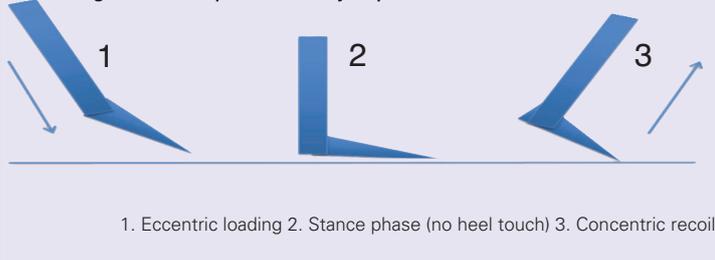
Jump training requires exactly what it says on the tin – jumping. However, it is important that this is progressed slowly to avoid injury and increase strength over time – exactly like your weights programme in the gym. Typical recommendations suggest that you should be able to squat at least 1.5 times your body weight [3]. However, this is quite a high expectation for many, so an added proviso here would be to keep the drills low (to the ground) and short (in distance) to begin with.

■ How do plyo’s work?

In a nutshell, they help to develop stiffness of muscles during landing, which causes the tendons to be loaded and stretched instead. Tendons, such as the Achilles in the heel (illustrated), can deal with very high loads. When they are stretched, they will naturally return to their resting length as quickly as possible – just like an elastic band.



Figure 1. The phases of a jump



Protect and enhance – a dual benefit

To enable a triple jumper to condition their body and cope with the high loads when competing – as well as use them to their advantage – they need appropriate plyometric training to strengthen muscles, tendons and joints and help prevent injury. Achieving this successfully means that whatever force you put into the ground is used to propel you forward (Newton’s 3rd Law of Motion) – hence the incredible feats of athleticism.

Recent research from the University of Technology, Australia, has shown a very high crossover of

Figure 2. Exercises and progressions

Ankling

Knees slightly bent and directly under hips.

Drive up into the air, lifting toes up whilst in the air and forcibly slapping down onto balls of the feet during ground contact.

Repeat in quick succession with limited time on the ground.



This is great for athletes because it means that your tendons can literally fire you into your next stride – increasing your sprint speed or jump distance.

■ **How does the energy saving happen?**

Because it is the tendon that is mostly responsible for propulsion, the muscle expends less energy, as all it has to do is stay the same length throughout the movement (i.e., muscle stiffness). It has been documented that, if conditioned correctly, the athlete may be able to recover around 60% of energy expenditure by effectively using tendons such as the Achilles in each stride [4]. Thus good plyometric ability also means good resistance to fatigue.

Jump phases – the hard science

This is all possible because of what is known as the ‘stretch-shortening cycle’. This process involves the muscles staying contracted under tension when the balls of the feet land on the floor, allowing the Achilles to extend (eccentric phase), immediately followed by contraction (concentric phase) to cause the recoil effect (Figure 1). If this happens fast enough – under a quarter of a second – it allows the tendon to absorb the force by stretching and then recoiling to its resting length, thus firing you forward or upward. If it doesn’t happen fast enough or if the heel touches the ground, the stored energy in the tendon is simply lost as heat [5].

Exercises and progressions

These exercises and progressions will help develop your plyometric ability (and thus sprint speed and jump distance) via muscle stiffness and improved tendon elasticity (Figure 2). Remember, low and short is the key to begin with. Once you have mastered this, you can progress to higher and longer jumps. We recommend that you perform two or three sets of 6–10 repetitions to begin with. You can add more to your programme as you improve, but ensure no heel touches and allow full recovery between sets.



References

1. Keller TS, Weisberger AM, Ray JL *et al.* Relationship between vertical ground reaction force and speed during walking, slow jogging, and running. *Clin Biomech*, 1996, **5**, 253–259.
2. Lockie RG, Murphy AJ, Schultz AB *et al.* The effects of different speed training protocols on sprint acceleration kinematics and muscle strength and power in field sport athletes. *J Strength Cond Res*, 2011 Sep 9 [epub ahead of print].
3. Baechle TR, Earle RW. *Essentials of strength training and conditioning* (2nd Edition). Human Kinetics, Champaign, Illinois, 2008.
4. Verkoshansky YV. Quickness and velocity in sports movements. *IAAF Quart: New Stud Athlet*, 1996, **11**, 29–37.
5. Turner A, Jeffreys I. The stretch-shortening cycle: proposed mechanisms and methods for enhancement. *Strength and Cond J*, 2010, **32**, 87–99.

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Jump and stick

Adopt an ‘athletic’ position (hips and knees slightly flexed, with shoulders over knees).

Extend ankles, knees and hips (triple extension) to jump forward.

Land on the balls of the feet.

Do not allow heels to make contact with the ground.

Finish with a stiff landing (stick).



Jump to box

Choose an appropriately sized box.

From a standing position, perform a countermovement and explosively triple extend.

Land on the centre of the box.

Land on the balls of the feet.

As far as possible, do not allow heels to make contact with the box.

Jump lunges

Start with split-feet position.

Jump upwards and switch leg position before landing.

Landing should be on balls of the feet.

Three jumps, then stick the landing

As above – but do three jumps in quick succession, sticking the last jump.

