The ALTIS Rudiment Hop Series

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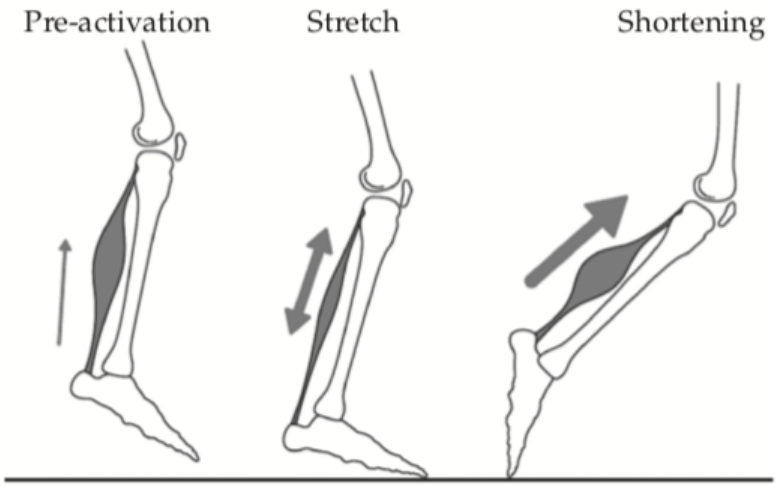
ALTIS

Rudiment Hop Series

The Rudiment Hop Series (RHS) can be used as an introduction to plyometric training, and is one of the more versatile training tools we have in our toolbox. Consisting of a series of low-amplitude hops, the RHS can be inserted virtually anywhere into a training program - warm-ups, supplementary work within a track session, return to play protocols, post weight-room sessions, and more.

Before getting into the details of the RHS, let's spend a little time outlining plyometric training in general.

Plyometric training is a staple in the development of speed and power athletes in many settings, and utilizes the stretch-shortening cycle (SSC) in a variety of different exercise protocols.



The SSC is present in most human locomotion and consists of isometric, eccentric, and concentric muscle actions, in that order. Its main purpose is to increase the performance output of the final phase (concentric) when compared to the concentric action being executed in isolation [1]. Further, this increased performance is achieved alongside greater mechanical efficiency. Image from [1].

Whether it be depth jumps, hurdle hops, speed bounds, skips, or a combination of these and many more, targeting the SSC in training is a common approach to improve performance on the pitch, field, or court.

A major player within this is the musculotendinous unit (MTU). It takes on many roles in an effective SSC, including:

1. Transfer force generated by the muscle to the skeleton
2. Store elastic energy
3. Create favorable force-length-velocity relationships for the muscle [2]

As for its role in the energetics behind running economy, the Achilles tendon can reduce the metabolic cost by minimizing muscle shortening [3]. In order to do this effectively, an appropriate level of stiffness is required.

In general, optimal stiffness of the MTU facilitates faster forward propulsion, shorter contact times, and more efficient running economy – likely enhancing maximal sprint speed [4,5].

In order for all of this to occur, the pre-activation prior to eccentric muscle action must be well-timed, the eccentric action must be short and fast, and the transition between eccentric and concentric action (coupling time) must be minimized [6].

Timing is everything here, and the timing characteristics of the SSC are often used to categorize various types of plyometric training. Table 1 is adapted from [7] and highlights a key differentiator between plyometric training modalities - slow versus fast SSCs.

	Slow SSC	Fast SSC
Ground Contact Time (GCT)	>250ms	<250ms
Angular displacement of hip, knee, and ankle	Large	Small
Examples	Countermovement Jump, Power Skip for Height	Drop Jump, Sprinting, Speed Bounds

Table 1 - comparing slow and fast stretch-shortening cycles

Further, with the dynamic efforts needed in many sports, tendon health is key to longevity and diminishing training gaps.

"During activities that require energy production, such as jumping, tendon springs allow for an increase in muscle work output and better performance. During energy dissipation, such as in landing, power attenuation by tendons may protect muscle from damage [8]."

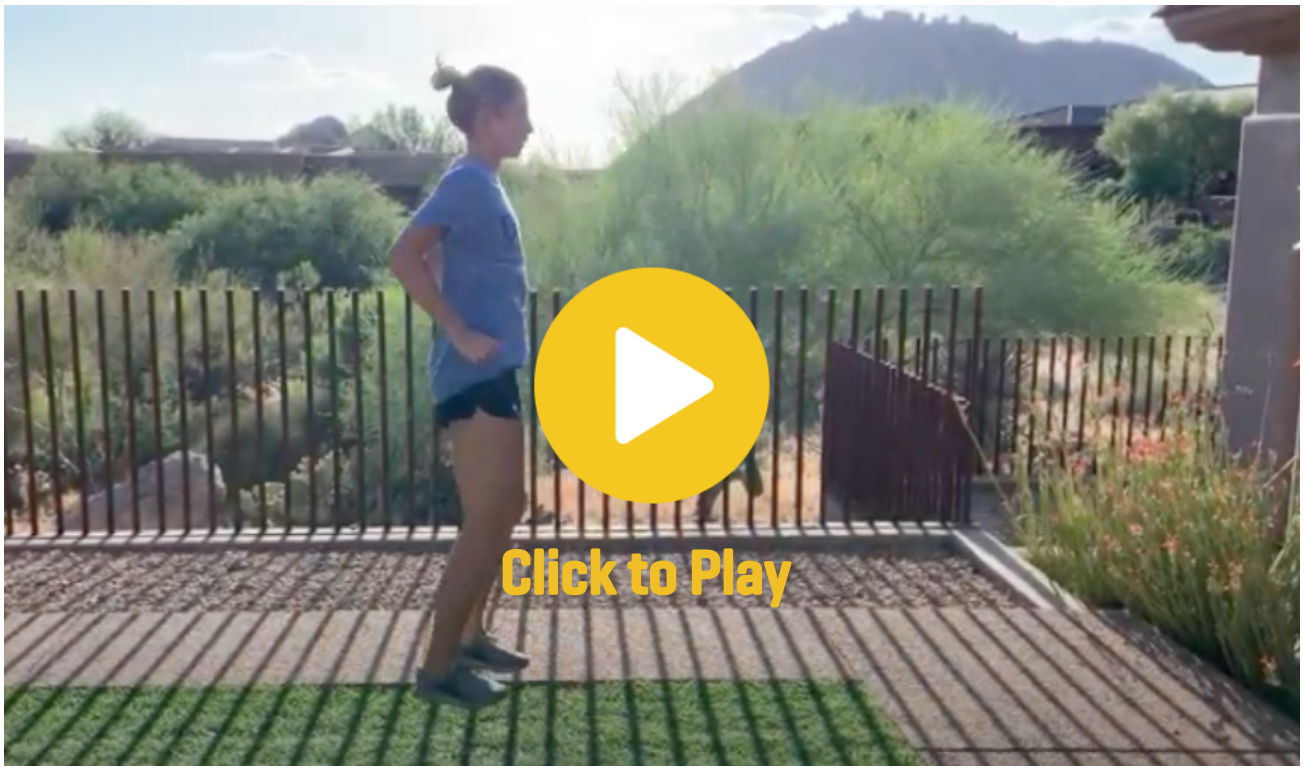
So - knowing that the SSC is important to performance and that tendon health is a key contributor, we must ask, "**What is a good starting point for plyometric training?"**

This is where the Rudiment Hop Series comes in

As the name implies, this series serves as a great introductory option to increasing loads of plyometric exercise (skipping, jumping, sprinting, bounding, etc.). Within this series, the goal should be to execute flat-footed contacts, utilizing the hips and knees (through controlled amounts of flexion and extension) in concert with a relatively stiff ankle.

The following material highlights the Rudiment Hop Series in still-frame and a video, and then in list form.

The kinogram is built from a double-leg forward hop and shows (from left to right) touch-down, mid-stance (or maximal amortization), and toe-off. The kinogram method is great tool to highlight joint angles and postures throughout the various hops.



Rudiment Hop Series	
1	Double Leg Hops Backwards
2	Double Leg Hops Forwards
3	Single Leg Hops Backwards
4	Single Leg Hops Forwards
5	Single Leg Medial Hops
6	Left-Left-Right-Right

We know that heel strike patterns are associated with reduced activation of the calf and soleus musculature when compared with a forefoot strike [9]. Therefore, contacting the ground with a flat foot has a greater likelihood of targeting the tendinous structure, and subsequently the health and performance benefits previously mentioned (namely, reducing the metabolic cost by minimizing muscle shortening).

As for the frequency of the hops, a self-selected, 'preferred' hopping frequency of 2.2 hops/second was determined while hopping in place [10]. While on a treadmill, the subjects selected nearly the same frequency, which on average did not increase between speeds of 0.5 and 2.0 m/s.

At frequencies below 2.2 hops/second the body did not behave in a spring-like manner and it "appeared likely the storage and recovery of elastic energy was reduced". The subjects maintained the behavior of a spring-mass system up to the highest frequency (3.6 hops/second) during both normal and maximum-height hopping.

With this, there appears to a be a range of both frequency (2.2-3.6 hops/second) and speed (0.5-2.0 m/s) which will satisfy the training objective for the RHS. In practical terms, increasing degrees of flexion at the hip and knee joints and increased ground contact time accompany the lower frequencies. When in doubt, a metronome may help to find an appropriate frequency, but we have found that the combination of the athlete selecting an economical strategy combined with a coach's feedback will normally suffice.

The following video features Dan Pfaff discussing why he created the series as well as touching upon some of the implementation.

A Note on Variety

The variety (bilateral, unilateral, multi-planar) in the drills brings about a few benefits. First, as has been noted by Boo Schexnayder, “Lateral jumps and bounds force/teach the athlete to utilize their hips more because the knee and ankle contribute much less.” This is a great consideration for those who appear knee-dominant in their movement.

Second, the full series serves as a great **movement screen.** As the velocities are low and the distance traveled is minimal, the coach and/or therapist has a great vantage point from which to analyze. Any potential asymmetries between limbs will often become very apparent, and can perhaps guide practitioners in any further exploration.

With this, it is important to note that what occurs at low velocities does not always occur at high velocities. Therefore, a comprehensive movement screen covering a broad range of velocities, planes, ranges of motion, levels of effort, etc. is advised.

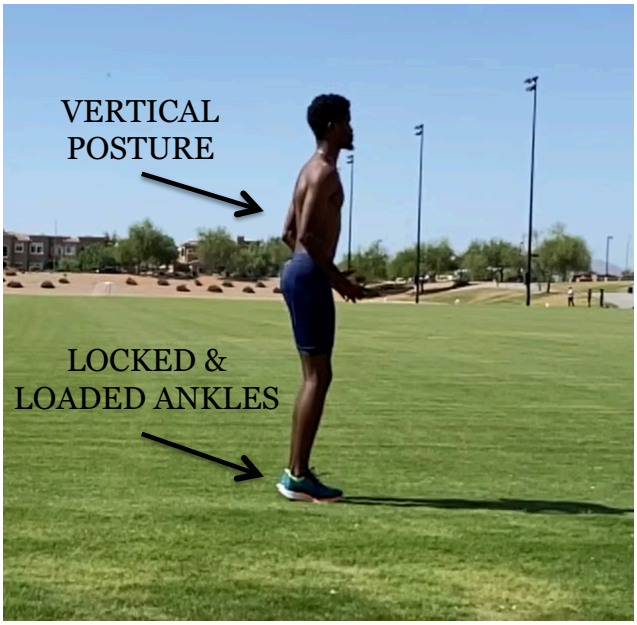
Programming Considerations

It is important athletes are intentional with their execution of any movement task - and the RHS is no different. Below are some technical and practical guidelines we should be aware of:

1. Emphasizing the vertical direction allows for increased specificity to upright sprinting, increased uniformity between the knee and hip joints, and a quicker ground contact time

2. Beginning the series with double-leg backwards hops forces the athlete to direct force through their heel into the ground. This provides context for how the forward hops should feel

3. Programming a set number of contacts rather than a distance to cover decreases the likelihood of the athlete rushing the movement (which manifests in a horizontal bias). When athletes rush the movement we will see excessive plantar flexion and forward trunk lean, as well as longer ground contact times.



With our Track & Field population we typically begin with around 20 contacts per double-leg movement and 10 contacts each leg, for the single-leg movements. With team sport athletes, we often prescribe half this volume, until they are proficient, as many bias towards overly plantar-flexed initial ground contacts, and excessive ankle extension at toe-off.

Once an athlete is capable of executing the initial volume proficiently, then we have an option to either increase the volume (more contacts), the intensity (higher hops, or load with external resistance), or variability (randomly changing task within the series).

While we often program this series following a track workout, it can be inserted virtually anywhere into the training plan. We often utilize this series early in the training year in preparation for increased demands, for example.

With team sport athletes, we have found the RHS to be a useful exercise prior to maximum speed training, as the the technical focus can help provide context to more efficient ground contacts. For example, athletes who 'collapse' through mid-stance during a sprint may benefit from alternating between upright sprinting and rudiment hops.

We know that the vertical component of ground reaction force in sprinting is related to an athlete's ability to halt the downward velocity of the center of mass at touchdown and reverse it to produce an upward vertical velocity at toe-off [11].

Although the RHS lacks in some areas of specificity to upright sprinting, it allows the athlete to rehearse the sensation and intention of ground contacts in a controlled and repeatable manner. In this sense, the hops can serve as a 'bridge' between various stops along the spectrum of transferability.

Additionally, the RHS can be used as part of a Return to Play (RTP) program as tissue remodeling is enhanced by early manipulation of forces [12].

Further, the RHS can be programmed within a pool to help offload following an injury. Adjusting the depth of the water provides an additional variable to manipulate during this important time. During early stages of RTP, the RHS can be performed with water at chest-level, and we can move the athlete into shallower water over time until they can finally transition to the ground.

The RHS has a place in any program aiming to prepare athletes for dynamic and explosive movements. It can serve as a starting point for more complex and intense forms of plyometric training and, due to its relative simplicity and low intensity, can be implemented year-round, virtually anywhere within the training plan.

Give it a try and share your results!

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