Layout Movement Analysis

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Introduction

A layout is a tumbling skill performed in cheerleading and in gymnastics where there is no ground contact made during rotation. According to Davlin, Sands, and Shultz (2001), a somersault rotation of 360 degrees in the sagittal plane at about 600 milliseconds. The primary difference between a layout and a somersault is that the body remains flat throughout the skill until the landing. A layout is an example of a linear motion, where the body follows a fixed point throughout the movement. It occurs primarily in the sagittal plane with minimal movement of the upper extremities in the frontal plane during the initial set. The sagittal plane is defined as a longitudinal plane that divides the body into right and left halves, whereas the frontal plant vertically splits the body into anterior and posterior halves. Triple extension of the hip, knee, and ankle is also demonstrated during this skill. The skill performed in this analysis was preceded by a round off (RO) and a backhandspring (BHS) in order for momentum to be generated so the athlete can execute this skill safely.

Key Positions & Exercises for Improvement

	Launching Posture	Abdominal strengthening, via weighted sit ups or reverse crunches to speed the abdominal flexion to begin rotation
	Multiplication of Body Posture	Weighted hip adductions to allow the athlete to keep thighs aligned
	Concluding Posture	Abdominal exercises, toe touches or v-ups, to allow the athlete to flex the hips at a faster rate, to decrease the angle of the hips prior to landing
	Landing Posture	Leg press and squats would increase lower extremity strength and lead to a stronger landing, potentially preventing taking steps back

Acknowledgement: Savannah Ray (athlete shown in pictures)

Launching Posture

Launching posture is critical to the efficiency of the entire skill. According to Lightsey (1983), the athlete should remain rigid in order to stay in the sagittal plane. The athlete stays in the sagittal and frontal planes, displaying no movement in the transverse plane. However, there is excessive hyperextenstion of the thoracic spine, suggesting a greater need for force production earlier in the movement in order to convert forces to vertical momentum. According to King et al. (2003), the two most important factors for successful performance during flight are angular velocity and angular momentum at take off from the floor. This athlete takes off with her angular velocity more horizontal rather than vertical, which is displayed by the 74 degree relative angle of her shoulders, rather than a 180 degree absolute angle. The result is a landing posture several meters from takeoff, whereas an ideal landing is closer to initial takeoff.

Multiplication of Body Posture

The athlete is in the middle of rotation. This posture is often referred to the flight phase of the somersault. According to Potop, Niculescu, and Triboi (2013), the greatest amount of angular velocity is achieved during the multiplication of body posture. This is shown through the 180 degree angle at the cervical spine, and patellar joints. The athlete shown displays shoulder flexion, along with plantar and dorsi flexion of the feet, which is not ideal. Optimization of the rotational velocity would be created through dorsi flexion of both feet, which also prepares for the landing.

Position	Plane(s)	Flexion	Extension
Launching Posture	Sagittal, Frontal	Shoulders	Spine is hyperextended, leg, hip and ankle (triple extension)
Multiplication of Body Posture	Sagittal	Arms, left foot is dorsi flexed and right foot is plantar flexed (not ideal)	Neck, spine, hips, knees
Concluding Posture	Sagittal	Thoracic spine, lumbar spine, feet are plantar flexed	Neck
Landing Posture	Sagittal	Ankles are plantar flexed	Knees, hips, spine, neck

Concluding Posture

Athlete's feet are dorsiflexed prepared for the landing posture. The knees are almost in full extension but are not locked out in order to absorb the force of the landing. According to Potop, Manole, and Andreyeve (2014), the average angle of the hips should be approximately 130 degrees for an efficient landing. The athlete shown has a pelvic-joint degree angle of about 103 degrees, slightly less than the recommended angle.

Landing Posture

Athlete lands on toes then quickly shifts weight to heels in order to manage the ground reaction force of about 6.8-13.3 times their body weight (Wade, Campbell, Smith, Norcott, & O'sullivan, 2012). Hips and knees are flexed to keep the athlete from having to take a step back after landing. Knees are flexed at about 104 degrees, which is ideal. Wade et al. (2012) state that approximately 30% of gymnasts land with their lumbar spines more flexed than the thoracic or cervial spine, which leads to the conclusion that low back pain prevention programs may be helpful in effectively repressing the pain that may follow repetitive forceful landings.

Conclusion

- Primarily in the sagittal plane
- The body rotates 360 degrees with the majority of the body being in extension
- Neck, spine, hips, and knees display extension except in the landing posture.
- The ankles are dorsi flexed in order to prepare for the landing
- Landing posture is a variation of the athletic position, which absorbs the amount of force that was created
- This movement could be improved if the athlete had the shoulders maximally flexed to 180 degrees rather than partially flexed to 74 degrees
- The immediate hyperextension of the neck during the launching posture inhibits rotation and may cause injury if repeated too often

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