

Fundamental movement skills - Part 3

So, what are some of the key performance variables for running? So when you're analyzing running, and there are a lot of them, but let's look at some of the major ones, right? So there's stride length. So as the name suggests, stride length is the distance covered with each step. Again, this would be different if you're a sprinter, your stride length would be shorter or, you know, it could be longer as well, depending on what strategy you're using, what's your height, what's your anthropometry, right? So all this informs stride length, but nonetheless, we need to know what your stride length is, right? So, stride frequency, so of course we need to know the distance covered. However, cadence, as you've heard this word quite often, this is a quite popular term when you're looking at running, it could be found sometimes on your watch that you wear or on the treadmill as well, wherein it gives you number of steps that you have taken per minute, right? Now it's again useful to calculate efficiency. So if you look at efficiency, running economy, both those parameters look at stride length, stride frequency as your underlying variables. You would also look at the foot strike patterns.

I know you all of you would be aware of how the foot, how you land, or how the runner lands is quite different, it's quite individualized, right? So it's quite important for us to understand how the runner is landing because that completely changes the mechanics between those transition phases and of the stance phase. So the part of the foot that forms the initial contact with the ground, if you're a heel striker, you would land with the heel first, if you're a mid-foot strike, you would land flat on the ground with the mid-foot striking first, if you're a forefoot striker, you would strike with the forefeet landing, right? So you could be either a heel strike, mid-foot strike, and forefoot strike. Now bear in mind, all these three techniques have different performance characteristics and also have different injury considerations. So it's important for you to understand how is your athlete striking the ground.

Also, look at acceleration, right, which is rate of change of velocity during the phases. So when are you accelerating, when is the athlete maintaining the phase, right? And when you actually start to decelerate. And what's the rate at which the acceleration is happening as well. Apart from acceleration, you also look at joint kinematics, right? So you look at joint angles at the hip, knee, ankle, which is lower body, you would also look at the shoulder angle, you know, in terms of the torso twist or your trunk and pelvic as well to understand how is the body positioned, how are you executing the arm swing, what's the interaction between the segments, how is the force being transferred. So all of these can be informed by understanding the joint kinematics heavily.

Again, for your arm swing, you would look at the movement of the arms during running, so angles. Ground contact times, this is quite important. So it's if you're a sprinter and you're spending the least amount of contact time on the ground that's quite important

because you don't want to be spending too much time on the ground. So the amount of time the foot is in contact with the ground is an important key variable to look at. So you want to get your athletes quicker and they're spending a lot of time on the ground, you need to analyze why that's happening.

You know, is there a lack of strength? Is there perhaps you're not getting in a good position, right? So it's a key variable. Now that we've looked at the different jumps and running, which are our locomotor skills. So now that we've looked at the different locomotor skills and how to analyze them, the integration of functional anatomy, biomechanics, and movement analysis, let's look at the stability skills of balance. Now for balance, if you're looking at it, what are the key biomechanical considerations? You're not going to get into the functional anatomy because it's a pure skill, a stationary skill of balance, you're not moving, right? But there are biomechanical considerations that you would look to study balance. So for example, proprioception.

So we're looking at this word for the first time, proprioception is the ability, right? So it's one's ability to sense the position, location, and movement of the body parts. So for example, if you get someone to close your eyes and to stand on a leg, you wouldn't have, you're taking away the sense of position and location, right? So hence your proprioceptive ability is something that you need to work on. So proprioception is that ability to sense the position, location, and movement, right? Whereas your kinesthetic awareness is the awareness of the position and the movement. So that's the awareness and proprioception is the ability without relying on vision, right? So the closing eye example would be ideal for kinesthetic awareness without relying on vision. You should be aware of the position and the movement.

Another good variable would be dynamic balance, right? So it's the ability to be stable, let's correct that, during the movement, right? So the ability of the body to achieve stability during the movement is your dynamic balance, right? And also there's another concept which is the postural sway. So as this term suggests, postural sway is the sway in the posture, so the extent of the body's center in, so extent of movement of the body's center in different directions, right? So that's your postural sway. So whenever you're looking at balance or analyzing balance, you would look at all these four variables, right? Quite important. Another one that you would look at, which we missed actually, which is the base of support. So the base of support is nothing as the name suggests, is the area between the feet, right? That provides the balance.

So as you can see, sometimes people are excellent with you having two feet on the ground, right? But as in how, when it comes to injury prevention protocols and the balance is affected, you might not be having good balance as in how you get the feet narrow together or eventually even move to a single foot, right? So the base of support then is an important characteristic to understand. What's the base of support that they can execute balance with

for you to develop training programs? Another stability skill we've looked at earlier in the examples is turning, right? So let's look at some of the important biomechanical considerations and where would you look at turning. Why would that be an important skill? Why would we need to be efficient at that, right? So what sport do you think the turn would be key at, right? So where it would be underlying, for example, skiing. So there could be ski turns, there could be surfing, again, key turn. It could also be for the ice skater performing a routine, right? So when they do they are flipping turns or a gymnast. So all of these sport that we've looked at have an underlying basic need of turning, right? So when you're turning, your foot placement is one of the key biomechanical considerations.

So it's critical because you initiate and you control a turn and all of that depends on how your foot or your feet are placed, right? Second most important thing during turning that you need to consider is the weight shift. So how is the weight shifting from a different direction? There is going to be an additional benefit or advantages if you start shifting the weight towards where you are rotating, right? So that is what aids you in maintaining balance. Shifting of weight, efficient shifting of weight helps you in maintaining balance and also facilitates a smooth rotation, right? So if you're moving the body weight in that particular direction, you're going to be smoothly transitioning or rotating. Third most important characteristic or consideration would be the rotation of the hips and shoulders. So whenever you're turning, the interaction between your hip, your shoulder, hip shoulder separation, all of that is quite important or those are quite important variables to look at when it comes to turning, right? So coordination is fundamental between the hip and the shoulder.

The timing at which the hip turns or the shoulder turns is quite important as well because during the turn, the initiation is from the hip and then eventually moving to the distal segments, it's going more into the shoulder. So the shoulders follow the hip when you're looking at the turn. For this, it creates efficient and controlled movement. So it's from your big proximal segments into your distal segments. So hence rotation of the hips and the shoulders.

And to assess this, you can look at the different angles, you can look at the timing of when this occurs. So maximum rotation, minimum rotation, start of rotation, all of these are important characteristics that you would look at. And rotation of the hips and the shoulders can be calculated using the 3D motion analysis where you will be putting on your markers and looking at kinematics, right? Another few variables that you would look at is the dynamic stability as we've looked at dynamic balance which is maintaining the body position during movement, right? So we would also look at how is the body maintaining it and it requires the integration of varied muscles to be in synchrony, to be in harmony, and have all of these joint movements coordinated so that there is efficient adaptation to changing forces. Because the forces are changing, right? You are transmitting all of these

forces from proximal to distal as well. And also even if you're turning just on the spot, it's also changing the direction of the force as well during the turn, right? So it's important to have dynamic stability.

Also for your range of motion control, you need proper alignment and coordination of movements, right? So proper alignment and coordination helps you to maintain good center of mass position within the base of support. So if you're turning or you want to maintain your position, if your center of mass is outside of your base of support, right? You're going to have a fall or you're going to incur or your athlete is bound to have an uncontrolled motion leading to injury or fall. Another important point is your arm position and movement. So extend for balance or move in a coordinated manner. It improves rotational dynamics, right? So for example, if you're turning on the spot and you have your arm positions quite close to you, it's going to generate a lot of speed.

Whereas, you know, if you have them widespread across, you're going to have a controlled movement. So based on what you need to achieve in that point in time, you would have the arms position in the same way. Now that we've looked at, you know, now that we've looked at the different stability skills and locomotor skills, let's look at some of the manipulative skills. Again with the manipulative skills, it's a combination and these are quite complex in nature, right? So although it's a throw, there could be different types of throws. Where would you find the action of throwing, for example, or the action that mimics or has an underlying characteristics of throwing, right? So for example, you would have it in baseball pitching, right? You would also have it in when the cricket fielders throw, right? What else? You could also have it in bowling, not exactly throwing, but underlying characteristics are the same.

Tennis serve, again, underlying characteristics are the same, right? So there is a continuous manipulation or an interaction. It is a combination of locomotor and non-locomotor movements, right? So throwing, achieving that, and studying that is quite key. So important in throwing, first one to look at would be your stance. So how wide your feet are, how stable you are on the ground because that sets your foundation and your foot position for the same. So how are your feet positioned, right? So sets the foundation.

So the back foot usually is planted, right? So it provides stability, usually in throwing, that's what happens. So your back foot is planted, while the front foot may be positioned forward to facilitate hip rotation, right? Because you're throwing, so you are going to all this ground reaction forces and the force produced by the lower body muscles is going to be transferred into those distal segments facilitated by your hip rotation. So there's hip rotation happening and as we've looked at quite a little earlier, you are then moving into the shoulder rotation phase, the shoulder movement, right? So your stance and foot position are quite important. Let's look at another one, which would be your grip and hand position. Again because you're throwing the object that you're throwing, in most cases,

which is a ball, right? So your grip on the ball or your grip on the object and your hand position.

So hand position could be, you know, angle at release, which is the release angle. It could also be release height are quite important keys when you look at hand position that helps you control the release and in case you need to add any spin on the object. So there would be of course different grips. For example, with the cricket bowler, you would have a different grip when you are a fast bowler trying to achieve speed versus a spin bowler trying to spin the ball, right? So that would be different grip and hand position. Another thing that would be important is the optimal trajectory.

Now we've looked at the trajectory kinematics when looked at, you know, module four. So trajectory is basically, so this would be a trajectory, right? So for javelin, right? So for a javelin thrower, right? The javelin that's in his hand when the javelin lands, right? So for this journey that it is traveling, the trajectory that it is traveling by, that is quite important. Again, your important would be release angle, release height, your velocities, your vertical and horizontal velocity. And these are quite important to achieve accuracy and distance, right? So for javelin, it's quite important to achieve max distance, right? So optimal trajectory and release angles become quite important in that scenario. Right, so let's look at some of the other variables that are important.

So there's a wind-up and a cocking phase. So that's a phase. And in this phase, you're basically winding up. So now that you've opened up and you're cocking and there's winding up, so there's, it's a sequence of movement, right? So sequential movement is usually studied using kinetics, which talks a lot about the energy flow, the force production, the force transmission, you know. So sequence of movements here in this case would be proximal to distal and into the end goal, which is your pole, you would need to study the kinetics of the same.

Right, so is that sequence happening timely? How is it? Or is there a mismatch of the time? And that stored energy in the body, you're preparing for the forceful release, right? So all that stored energy in the body, all that energy that you have, you know, generated or the force that is produced from your proximal segments, which then eventually gets released with, you know, into the end tangential thing, right? So you're preparing for that and that requires a sequence of this movement, which happens in the wind-up and the cocking phase, right? So it's basically your, you know, your hips to your torso, torso to your shoulder, and then shoulder eventually into the ball. Right, so it's quite important for us to study this variable as well. So as progressing from that, then looking at the kinetics, the kinetic chain is where the sequential activation happens from the lower body progressing into the upper body and then finally into the throat, right? So it's important for us to understand these kinetic chain. How would you study this? This would be 3D motion analysis. You could also use inertial sensors, which are quite popular now.

So combination of inertial sensors and force plates. So you could study this kinetics using these two tools, right? Another important variable would be the shoulder rotation and elbow extension, right? So we've looked at the kinetic chain, looked at the lower body transfers from proximal to distal, but what is exactly happening at that endpoint, right? So from the shoulder, the transition from shoulder rotation to the elbow extension, because as the shoulder rotates, during the arms cocking phase, the elbow extends, right? As you rotate, the elbow is extending to produce the throw or to rapidly release, right? So that is contributing to the speed and force that is thrown into the object, right? So the sequential movement that is happening from your lower body to your upper body need to be ensured, studied. Another important would be trunk rotation, another important segment in this sequential. So it contributes to the generation of torque. You've looked at torque in the kinematics chapter.

So trunk rotation adds, it's a quite big segment, so it adds to the power that's been generated and it's also this link, isn't it, between your lower body and your upper body. So that transition then through the trunk becomes extremely important. So it enhances the transfer of energy from your lower body to the upper body. So just imagine trunk rotation is an important link, right, between your upper body and lower body in throwing. Another important thing, so that's the seventh one. Another important thing would be the weight shift, shifting the body's weight from the back foot to the front foot as well, right? So that's quite important, right? So while these sequential events are happening, you also have to shift your body weight from the back foot to the front foot, which is crucial for generating momentum.

So all the momentum or transferring the momentum or generating momentum and transferring energy through the kinetic chain. So you need to look at the weight shift as well. Right, now that we've looked at, you know, some of the manipulative skills of throwing, let's look at kicking. What are some of the important characteristics of it? So the kicking leg swing, right, which is a rapid and a controlled movement, right? So for example, where would kicking be important? Quite famously, football.

So it's quite important. So it's a rapid and a controlled movement, which again, the goal here is to generate speed and producing force for the kick, right? So it's important to look at the leg swings. The leg swing kinematics would be again, your angles, your forces, so your joint forces, you could also have joint talks, right? So key variables under the kicking leg swing. We'll also look at the contact point and the foot position at impact, right? So for example, if that's the ball and if you're hitting it on here or you're hitting it on here that is going to affect your trajectory for where your ball is going to land, with what force and what direction, right? So precise contact point on the foot, right? And the orientation of the foot at impact is quite important as it significantly influences the direction and the speed as we spoke about, right? So it's quite important of where the ball lands on the foot. Another important thing would be torso rotation here again because it enhances the range

of motion. So what's available for kicking, which is a completely lower-body dominant thing?

However, the torso, which is a link between the lower body and upper body, it enhances that range of motion contributing to overall bar. So it's quite important to look at. Right, so what are some of the other ones? Apart from these, there's also the balance and weight distribution. You see how this variable keeps coming again and again. It's quite important that whenever we're executing all of this, is to maintain your balance and distribute weight majorly from an injury perspective.

It's quite important to maintain and distribute weight so that you get into a good position. And once you get into a good position, then the sequence that you have brought about can be efficiently executed. Right? So appropriately between the supporting leg and the kicking leg, it's quite important for that. It's the lateral contralateral balance.

Right? So for control and effective kick. Now the important thing would be your stance and foot position as we've looked at in throwing as well. It provides the foundation of how you are sturdy, steady on the ground. So your non-kicking foot is what provides the foundation. Right? That's planted for stability, and your kicking foot is positioned according to the type of the kick. So it's based on the direction and speed that you're going for is how you would position your kicking foot.

Whereas your back foot or the non-kicking foot provides the foundation and stability. Now the important thing would be to look at hip flexion and leg lift, of course, because that's the major action as you're kicking the foot, which is flexion and how you're lifting leg. So the hip flexion involves preparing to generate momentum for the striking phase. Right? So as you are striking the ball, you are getting into a hip flexion, and you're lifting the leg. So it helps you generate that or produce that force.

Right. Let's look at another example of manipulative skills, which is catching. So now where would catching be quite important? Right. So again, that would be for baseball.

It could also be for cricket. Right. Catching is important in popularly in these two sport. So what would you need in terms of the biomechanical characteristics? You would look at the hand-eye coordination extremely because you are intercepting an object or a ball in this scenario, you know, and you're visually tracking it. Right. So you need your good hand-eye coordination to be able to have, you know, to position your body accordingly or in the right place for you to achieve the catch. So there's hand and eye coordination, ability to visually track the object and coordinate your hand movements to intercept it accurately.

Right. There's also body position and balance to create a stable platform for catching, as you can see in cricket, for example, if, for example, the fielder is not at the right spot during the catch and is running and catching and is not able to have a stable platform, you often

misses the catch. Right. So it's quite important that you have good body position and balance to create a stable platform for catching. Another important thing is the catching hand configuration. So you would see in a lot of the scenarios when the shape and orientation is quite important.

Right. So if, for example, I am catching the ball and if I open my palms out, it might have a tendency to just, you know, hit harder, which might cause pain. Whereas if you're looking at absorption or if you're looking at anticipating or intercepting that trajectory, you would create a shape which kind of holds the object in and intercepts it by dragging it out. Right. So your orientation and shape is quite important when you're having a catch of your hand or hands, depending on if you're using a single hand or both of it to maximize the catching surface.

Right. So you're maximizing the catching surface and you're also securing the object so it doesn't fall out of your hand. Another variable that's quite important is your elbow and arm positioning, of course, because during your catching, along with your shape and orientation of the hand, appropriate positioning of the elbow and the arm allows for that absorption. Right. So the absorption that, you know, you need to defend from because of the impact of the object.

Right. So it helps you to absorb, which is to facilitate a controlled catch. Right. So quite important, which is your elbow and arm positioning. So in this module, what have we looked at? Let's quickly summarise.

Right. So fundamental movements, as you can see by now, they're the foundation movements, your ABCs that form the building blocks for more complex, specialized everyday tasks, physical activities, and sport. They can be broadly categorized into locomotor, stability, and manipulative skills. We've looked at, as the name suggests, locomotor to be able to move in space, stability, non-locomotor. However, quite important and manipulative skills, which are a combination of both that is achieving balance while moving.

Right. So that's all manipulative skills. We've also looked at the strong foundation for individuals to build on more specialized skills required for participation in various sport and recreation activities. So we looked at how do we apply functional anatomy, biomechanics, motor control, which are important interactions to gain a good technical foundation for sport. How do we analyze these skills? How do we break them down, you know, for coaching, for testing, for queuing, all of that we've looked at in this module. Right. So hope you've got a good understanding of why in movement science we need to know move fundamental movements before we move on to exercise and sport in the next coming modules. Right. Thank you.