Sports - Part 2

Let's look at some of the considerations from motor control before we dive into what does it mean for the sport, right? And we will be looking at a few examples. Right, so from a motor control perspective you would look at how the individual is acquiring skills. So the skill acquisition would demand you to look at the learning process. So how fast, so it would be adaptability. Right, so how adaptable is that individual? You would also get to know what is the foundation. So in terms of if we look, we've previously looked at this hand-eye coordination where it is dominant in a few sport.

So that will inform you about these things. So skill acquisition is how is that individual acquiring basically that skill? How do you teach it? How do you learn it? How do you give feedback? Right, so all of that. And then you would get into, once you get information into your skill acquisition and that's what you figure out, you also look at the underlying foundation of fine and gross motor skills, right? So quite important to look at, you know, if there is tactile and all of those skills that we've looked at earlier, what are the basis of it? Where is the individual scoring in that perspective? And through all this you can understand the learning patterns, right? So learning processes, the adaptability, how is the individual learning? What is the rate of learning that is happening? What are they better responding to? You know, so those are our learning patterns. So you need to adjust your coaching cues accordingly to these learning patterns.

And then your coaching cues then move into your feedback pattern. So how are you giving feedback? Right, and it's a bit of give and take. Right, so we've looked at some of the considerations in the previous few slides, the integration of different fields and the kind of questions you want to answer as a coach, sorry, ask as a coach or as a sports scientist in order to dwell into movement analysis, right, to consider how do we analyse movement. So now let's look at an example, right? So let's look at a tennis serve. So from a needs analysis perspective, what could be some of the demands, right, of the sport? So for a tennis serve, you should be able to achieve, for example, an ace.

Now that could be an aim or a goal. So let's create that. So what are the needs analysis, right? So the needs analysis for this would be speed. Now just remember that we would do needs analysis for the sport, right? So biomechanical needs analysis for the sport. Whereas we're doing this for a particular skill, so it would be speed, it would be direction, it would be spin, right? What else? It could also be something that we say a slice, which is a type of a different spin, right? So it could be all of this.

It could be a combination of all of this, right? So let's say a combination, right? And for the purpose of this analysis, what we'll do is for the aim and the goal, the outcome, let's just look at increased speed, right? So that's our aim or our goal. So that is increased speed or high speed. So that would be your, if you're looking at tennis, for example, that would

be your first serve or your flat serve, if that's what you know it as, right? So aim and goal is to have increased speed on the first serve or the flat serve. Now let's look into doing some analysis or doing, you know, a process of how we can achieve that, what do we look at, right? Rather than achieve it. Now, when you're looking at flat, sorry, flat serve or increase in speed of the serve, so the serve then will be broken down into, the serve will be broken down into its phases, right? So what is, what are the phases? So you're looking at preparation phase.

So what's happening in this phase? You are preparing, right? So that's your backswing for the serve. Next phase you have is the execution phase. So now that you've had your backswing from there, you're executing. So there is impact, right? That's your major or your key event of interest. So that's your execution or your impact.

And then you have your follow through, right? So that's your follow through. And your follow through is when you have swing completion, right? So you're completing your swing. So this is how you're breaking down your serve into preparation, execution and follow through, wherein your backswing, impact and swing completion are the major actions, right? Now what would be the key variable? Say, for example, we from this phase analysis, let's say we go deep into the execution or the impact phase, right? So we want to look at the technique of when you're impacting, what should be your key variables, right? To achieve this, a good impact or to increase the speed. So your key variables would be segmental interaction. Some of them, right? Because we have a lot of variables.

Segmental or what is the sequence? Right? Quite important. So how is the body generating all of this? Sorry, how is the body transmitting all this ground reaction force that's generated and the force produced by the muscles up your chain from proximal to the distal end and then onto the racket, right? So into the racket and then racket to the ball. So that is where we understand the segmental interaction. So what is the sequence? Is it from proximal to distal, right? So what's installing all of this? You would also then look at joint angles, right? It's quite important to understand joint angles. What else would we look at? From an injury perspective, right? Although we are looking at increase in speed, you also want to know or understand the loading patterns.

So we know that when we are designing our coaching sessions, we're not overloading the individual, we're doing too many repetitions or too many, too much intensity, right? So we're looking at loading patterns. We're looking at joint talks, right? So all of this is kinetics, right? From loading patterns, we're doing joint talks. We're looking at moment as well and all these variables you've studied in your module four, joint angles. You're also looking at your, sorry, so looking at your wrist angles, right? So if you're using a lot of tap on the ball, what's the angle at the wrist? So you can get that nice and easy in, in terms of the speed, right? You're also looking at velocities, segmental velocities. So these are some

of the variables that you can look at when you're looking at the tennis serve and you're aiming to increase speed.

So from here, to calculate these variables, what tools and techniques do you think you need, right? So if you are going into the quantitative side, of course you need your 3D motion analysis. Right? Where you would put your markers on and you would calculate all of your 3D kinematics and kinetics. You can also look at some of the variables using inertial sensors. Just completing quickly all of this for you. If you're looking at the quality of the movement, you already have video cameras.

Now quick important thing here, let's recap. If I'm analyzing a tennis serve, what do you think are the right areas to look at? So say for example, you're performing a qualitative analysis, using the camera. What is my camera vision looking at? Which is the best angle to look at? So you would, you can look at it from a sagittal perspective, right? You could look at it from a posterior view. So from the back, that's your posterior view. And you could also look at it from your top view.

Right? So these are some of the views that you can look at. Do you think you would find anything if you look, of course you can't look at it from the front view, that's where you're serving. Right? You would not have them in the camera composition. Right? So these are the views that you would look at if you're looking at the tennis serve. And again, with the sagittal view, you will be obviously looking at it from the dominant hand side.

Right? So that's where you can look at it. So that's the dominant hand side. And these are some of the tools and techniques you could use. In terms of stats analysis we've looked at earlier as well. So now that we've understood what the variables are, and our outcome is increase of speed, you're looking at some kind of a relationship between the two.

So we're looking at relationship between variables and outcome. So in order to do that, you could look at correlations, basically says how these two are correlated. You could also look at regression. Right? These are some of the important statistical analysis that you could do is correlation and regression. Right? In terms of the movement patterns, we've looked at the variables can serve our purpose to look at performance patterns or injury patterns technique again would look at all of those variables.

Right? So we are looking at both at the same time, we can look at performance and injury at the same time, depending on what exactly you are calculating. Right? And in terms of the fundamental movements, so fundamental movements, what do you think it can replicate? So a serve could replicate some kind of a throw, isn't it? Of course, it's not exactly a throw because it's an overhead. It could be an overhead throw, but your fundamental lying thing would be your turn and throw. There's also a lot of rotation there. It's any rotationary component.

So it could be a rotate and throw. In terms of your equipment adaptations, we just had an example in the previous few slides about the Dennis racket. So again, you could have say, for example, excuse my drawing. You could have change in size or shape. You could have change in strings.

So change in tension. Some of them, right? So change in grip. Okay. Grip size. . You could also have slight changes in length as well. So these are some of the things that you could work on or you need to consider.

So your performance and your injury depends on a lot of these factors and how you would get on to do the movement analysis. Now let's look at functional anatomy. So we've got here a picture frozen in time. So in terms of what would this be? It was, it would be an event of interest, isn't it? And this would be from, so you've reached the top of your backswing. You're now about to start the execution phase.

So that's the start of execution phase. Right? So that's why your ball toss has probably reached its high. Now let's look at some of the functional anatomy considerations. Joint action. Right? Let's start with what's happening at the elbow.

It's in a flexed position about to go into extension. Right? So elbow about to go into extension. So let's just write, sorry, let's do that again. So for elbow, you're going from flexion to extension.

Right? What's happening with the knees? So currently it's inflection again. So for knees, again, looking at flexion to extension. Right? What else? Your ankles as well. Once he jumps, you're going into flexion to extension. So you see how you can start breaking down the action.

And you know that, for example, some of the major muscles that are going to be working here specifically for this at this point in time would be your elbow extensors. Right? And also your hip extensors and your knee extensors. Right? So all of that is happening at the same time. So that's your joint action. Now from this, now that the elbow and knee are going into extension, we can then understand what muscles are involved.

So we do know that knee extensors are cords. So your cords are involved or your quadriceps are involved. And of course, when you're looking at elbow extension, we know that the triceps are involved. So you can have a look at where the athlete is suffering, where there is less, you know, force coming from. You can understand the segmental interactions and figure out what exactly is happening.

So if your athlete, for example, has a quadriceps injury, you know for sure that that's the muscle that's going to be used quite a lot when you are playing tennis. Right? Or executing while having a tennis serve. And you would probably reduce or limit your athlete from

performing that. Right? And then from this, because they are your prime movers, the muscle contractions would be concentric in this case, moving into them. Right? And the other way winding down would be eccentric.

And muscular strength as well. You can do all of your strength testing using dynamometers where you can figure out how strong your athlete is and what is the muscular strength level. Right? And train those accordingly. So you would train. So as you can see, there's a little bit of a quarter squat position happening. So definitely we've looked at in the previous modules, a squat and what's the mechanics of it and how you would, you know, use that in your training programs to develop skills for the sport.

Yeah? So for a tennis serve, again, very good example would be to include squat in your training. And then of course, the range of motion that you're trying to achieve, as you can see that there is a lot of lumbar extension happening. There's a bit of rotation happening as well. Slight rotation. And then you go as he hits the ball or goes, gets into the impact phase, you'll have, you know, your lumbar flexion, side flexion happening as well.

So you need to ensure that there is good, for example, lumbar range of motion. Right? So you could have lumbar in this scenario would be lumbar flexion and extension. Right? The moment he starts twisting around, say for example, for a spin serve, you would also need good lumbar rotation capability. Okay. And for anatomical discrepancies in this scenario, of course, we can't judge by looking at the athlete, but you would definitely would want to understand if there are any discrepancies of limb length or any, any kind of considerations for you know, weak, muscular weaknesses and things like that.

Right? So that would of course, have different repercussions. So just writing your, your understanding. So this is how we would break down for functional anatomy and gain more understanding of what's exactly happening. From a coaching science perspective, in terms of increasing your speed for the serve, you would look at including technique drills.

Right? So we are looking at the serve. It depends on where you would find the fold and then how to improve from there. So it could also be that you're including some kind of strength training. It doesn't need to be in part of your coaching session. So it could be your, you know, conversing with your S&C, that there's an increase in strength required and hence the athlete needs strength training.

Right? So the sessions could be of those. Of course, when it comes to the serve and the style, it depends on foot placement. If you're looking at style, so that's for style. So how is the foot placed? You know, is there a jump or not? So jump, no jump. All of these could be the styles of the athlete. So as long as the athlete is achieving good technique, right? With your rotation and your lumbar flexion and all of the timing and coordination, there is, we need to ask ourselves, do we really need to change these style components or these style elements? Right? And all of these then dictate your teaching cues.

Right? How do you plan a session? What would be your teaching cues? You know, how is an athlete learning? It could then just be that you're making him do drills and informing the athlete every time of the technique. Right? Because every serve, it's probably a beginner you're working on it all the time. Right? Sometimes it could just be that you're informing the athlete, right? Your foot placement is incorrect or your toss was low, right? Or your toss was too high or it was not in line. So these are some of the feedbacks, the teaching cues that you start giving. Right? And based on that, once you've had the serves being performed in a drill and the athlete is doing well, maybe you could have a practice match, right? Or you, in between this, you could include targets.

So you could have your athlete achieve a certain speed or you could have the athlete achieve speed along with a particular direction. Right? So add in the complexity. So that's how you would see a tennis serve. So line and length that they're trying to achieve, right? It could be spin, so addition of some kind of spin. Right? So all of these are different techniques that the fast bowler achieves and of course accuracy and consistency and there are so many else.

But let's stick to some examples which is increase in speed, direction, line and length and spin. Right? Now in terms of breaking this down, there are different ways of, you know, doing this. You could also have a detailed way of going into some phases. Right? So we've looked at some of the considerations for able-bodied sport and, you know, the integration of all of the different fields. We've looked at two case study examples as well in tennis serve and cricket fast bowling.

Right? So let's look at the para-athlete. Right? So what are some of the considerations for para-athlete and, you know, how can we ensure that we're taking into consideration their discrepancies and also looking at movement analysis from a point of view that best helps them optimize their performance and at the same time restrict or limit injuries. Right? So biomechanical considerations for para-sport, of course, their unique challenges because they are adaptations that are required for athletes because of the varied physical impairments. Right? So it's important for us to understand and have inclusive understanding, inclusive professionals who can deal with these unique challenges and have physical impairments. Sorry, have athletes have an understanding of athletes with varying physical impairments. Right? So these considerations are important for us to understand athlete’s safety for participation as well as to optimize performance and limit or prevent injury.

Right? So there are some important considerations and let's look into them further. So impairment specific adaptations are quite important for us to understand what's the nature. So what's the nature of the impairment, recognizing the impairments. Right? So if it's an amputation, for example, or if they have any spinal cord injuries, neurological conditions, and you know, understanding these would require you to work in collaboration with your

sports medicine professionals, your sports surgeons, your physiotherapist hand in hand, because you're working with adaptations. Right? So understanding the mechanics then becomes easier once you understand the nature of it.

So significantly, it impacts your athletes movement patterns and your overall biomechanics as well. Right? So in terms of the biomechanical analysis, the need to identify the modified movement patterns, right? So if it's, is it the athlete that's making the mistake or is it the modification of the equipment that's required? So things like that, you know, important questions to answer, identifying movement patterns, or is it, you know, identifying the loading patterns because they will be differences in loading. Right? Force production and distribution is another important variable to understand and movement compensations as well. So what are the compensations that are caused due to the impairment and also with the introduction of the equipment as well.

Right? So quite important from a biomechanical perspective. Another one would be training modifications. So based on what these nature of impairments are, what are the overall biomechanical compensations, you would then have training programs accordingly. So of course, when designing training programs or you're analyzing movement, similar protocol of what we saw earlier from your functional anatomy, motor control, coaching, and biomechanical perspective, similar modalities apply or similar considerations apply. However, based on the nature and the capabilities, those goals or those considerations slightly change. So training modification of course, would be to accommodate your unique biomechanical capabilities in terms for better skill development.

You will also have a lot of, you know, work done on balance and stability and within the context of their impairments as well. So within the context, you need to understand how to have coordination, balance, and stability looked for. Apart from training modifications, it's also important for you to understand the equipment and the assistive devices if in case they use anything. So if it's a wheelchair, we need to understand the wheelchair specifics or the prosthetics. How is that prosthetic helping them? What has changed? What are the compensations that are going to happen so that we can better balance their workouts? It could also be modified sporting gear.

So all of these need to be looked at so that we can cater to their specific needs and the abilities of the para-athletes. Of course, in conjunction with what their sport is, what is needs again, so needs analysis again of the sport so that we can help them to optimize their functionality and performance. So quite important. Let's look at it from an injury prevention and a rehabilitation perspective.

So strategies would be put in place based on the assessment. So there would be definitive biomechanical assessments, there would be movement screening, functional movement screening, looking at strength, all of those protocols that you would do for an able body as

well that you would perform here for the para-athletes. And we would then identify potential injury risk factors or specific impairments that are developed so that you can tailor injury prevention programs and rehabilitation strategies. So all of these information or these are your key variables for you to understand before you design your training programs. And like we discussed before, there would be a collaboration with your associated professionals.

So for example, medical doctors or your physios or your engineers as well. Engineers would come into place of course when you're looking at equipment handling and design and specifics and your medical doctors of course would look at prescribing different protocols or different programs. So this would be to develop a comprehensive and integrated approach. So your approach here would be your athlete would be a case study as you would do for the able body as well where lots of different professionals are working on it, having different considerations. The same would be in this scenario as well along with your medical doctors so that you're doing the right thing and addressing the biomechanical needs of the para-athletes. So you need to have a holistic understanding or a multidisciplinary approach to their training.

So there are lots of different factors involved. So make sure you're consulting with the doctors and the engineers to better understand their equipment and the underlying nature of impairment. So what are some of the considerations that you would look for when you're working with all of them? So how would you apply? So let's look at coaching considerations for para-athletes. So progressions whenever you're progressing make sure that it is quite gradual and increase in difficulty takes into consideration all of the nature of impairments and again the level of skill they are at and it allows for skill acquisition as well. So learning could be different, you know it could be faster again, it could be slower, it depends on athlete to athlete, depends on the type of sport they're engaged in. So when you're looking at coaching science look for allowing enough time for skill acquisition before you move on to the next progression.

And you're also looking at you're giving enough time for muscular adaptations as well. So before you move on to the next progression. So when you are doing session planning make sure each session builds on to the previous one. Again this is quite basic in terms of coaching science. So you want to build a solid foundation or a solid base before introducing complexity, right.

So it's quite important we do that. In terms of proper technique and form is quite important. So you're prioritizing that at each stage so that you're avoiding compensation patterns, right. So technique and form when it comes to para-athletes is quite important so that we don't generate any compensation patterns that could be associated with risk of injury because you're loading them or you're increasing the stress. Also in session planning make sure that you're monitoring workload and intensity quite important so you're not taxing

them with you know enough stress on the joints or you're not loading them too much as you've discussed in the previous point. And it is monitored so that when you're also designing SNC protocols or your training protocols you are in the ozone with the coach to understand what it is that they have performed this week or what is the target for this week, right.

So communication is quite important and of course understanding the equipment optimization how you can optimize the equipment as well. So not all the time it would be the athlete it could also be making it easier better for them because of optimizing the equipment or the needs of the equipment. So it is role versus technique versus role of technique versus equipment modification. So what is good for that athlete adaptation, right.

So you need to understand this as well. So hence you can see that this is a very case study oriented role. You would need to have constant communication, constant checking. So for this module we have looked at the different movement science principles that you would apply for para-athletes also for your you know able-bodied athletes as well. We have looked at the different integrated disciplines and what would you consider what questions would you ask and we've also looked at the two examples of the tennis serve and fast bowling and how we would cater to these questions that we've developed as a layout, right.

So try and do this in your particular sport. If you have any queries you can always drop down and that's the end of this module. You can scrape that last line. Thank you.