

EXERCISE AND SPORTS BIOMECHANICS

Week 12

Lecture 59

Expert Discussion with Dr Saju Joseph (Contd.)

Sir! As an experienced person, **how do you see the role of biomechanics in injury prevention and rehabilitation in Indian sports?** If you could share your experience with the Indian team regarding injury prevention and rehabilitation, that would be great, sir.

Okay! Here I am presenting to you a swimmer who had a complaint about shoulder pain during his butterfly stroke mechanics. See, the biomechanics equipment and water do not sync together because, you know, electronics get spoiled when put in water. Put in water, so it gets spoiled.

What we have done is mimic the movements of the swimmer on a functional trainer and also on an isometric testing at various angles. Now, the first thing if an athlete comes and tells you that he is having pain, then probably you need to diagnose the technique—what is actually happening during the technique—and you need to understand the mechanics of how the person is executing the technique. And once you understand the concept of his technique, then probably from there, the mistakes which he is committing, if they can be identified and corrected, that would be a great thing for the athlete.

Now, a swimmer like this is actually executing butterfly strokes in a 50-meter lap; he executes around 20 strokes. In a 15-meter lap, a butterfly swimmer has 20 strokes. Normally, swimmers train between two to six kilometers per day. Let's say 200 strokes for one kilometer means six kilometers is around 1200 strokes per day. That is the volume of a butterfly swimmer which he executes in a single day—the volume of training is six kilometers. Naturally, if somebody has a muscular issue because of repeating these strokes numerous times, that can lead to injuries.

Here we have actually done testing at various angles, but I am just sticking with a particular angle: 90 degrees. We mimic the movement starting from the initial angle to the force application and follow-through phase. But I am just explaining here the 90-degree angle where you find that the shoulder, elbow, and wrist are in one plane.

And if you look at the graph here, this is actually EMG done on the muscle. here you can find that, in this particular position, the non-injured segment, that is non-injured anterior deltoid of the left shoulder, is not activating just only showing around 1.2, so the threshold level is just at the threshold level whereas the right shoulder you find is around 32.3, and whereas the pectorals muscle in this particular position, the pectoral muscles are supposed to contract and the left is showing yes it is contracting and whereas it is activating and it is contracting, whereas the right injured side, the pectoral muscles, are not activating. Now, in this particular position, the anterior deltoid is not supposed to activate, the reason is that the technique of force application.

Now, when you keep your shoulder, elbow and wrist in one plane and when you try to push down you find that pectoral muscle is activating to a greater extent. But if the orientation of the elbow is slightly higher and in relation to shoulder and wrist if it is in one plane then

when you actually press down you find that the pectoral muscle is not activating and it is actually creating an internal rotation in the shoulder joint which causes pain in the anterior deltoid. that is actually that is why it is twisting movement that is taking place in the anterior deltoid that is why it is actually activating higher. This is actually a main cause for the problem. If the person was in a position to maintain the angle of the shoulder in the maximum force application phase probably this issue could have been solved.

Now, this is also identified with an underwater swim when actually the athlete is doing the underwater swim you can see here, during the butterfly stroke and towards the force application phase the right fingertips are higher than the left fingertips. Now, this is mainly because the internal rotation of the shoulder joint has taken place. Same way if you see here in these two there is actually an internal rotation that has taken place and that is actually causing the anterior deltoid to have the stress, whereas the pectoral muscles are not being used at all during the force application phase. If the technique is corrected, then this athlete would probably perform much better and have better efficiency in the swim pattern.

Now, there are a few things you need to understand during the force application phase. For example here, the athlete is always inclined in relation to the swimming pool. It is not parallel, it is inclined during the force application phase, which means his left shoulder is down. But now what is actually happening is, in relation to the shoulder and joint axis, the forearm—that is, the left force application—is away from the joint rotation axis. If you are applying something that is away from the joint, then there is a possibility for the body to rotate either medially or laterally. If there is internal force application, then probably the medial force activation will be higher, and that can either make the body rotate internally or externally. You need to ensure that during the force application, especially during maximum force, the forearm should be in line with the shoulder joint.

Here in this picture, you can see it is closer and in line with the shoulder. Now, the most important thing is that when applying force, the line of force application during this inclined phase has to be in line with the line of the center of gravity of the body and also the line of buoyancy. Then you get better force application, and the person is in a position to move further. That means the distance covered by the athlete will be greater. If it is away, if the force application is away from the line of buoyancy and center of gravity, then probably you will find that the execution is wide, and as I told you, it can cause internal or external rotation.

Now, one thing we need to look at during the rehabilitation phase or during the stunt training phase is in the gyms you find, if you are doing parallel rows or bent-down rows, you tend to hold the bar perpendicularly and at a different angle in terms of force application. If you have seen here in swimming, you can see that the body is always inclined.

Now, when the force application is from the left, then relatively the orientation of the left shoulder in relation to the equipment also has to be inclined. That means your body portion has to be slightly inclined to the equipment, and when you train, then you are training the muscles specifically. If you stand parallelly, then different muscles are recruited, and that is not going to help you during the swim phase in the water. In order to bring specificity,

what you are doing in the water has to be mimicked even in the gym, so that you get the same group of muscles to be recruited during the phase of force application. This is something which a strength and conditioning expert has to look into. Otherwise, the guidance in terms of doing strength training in relation to the sports specificity is neglected, and you are training the athletes generally. Only general recruitment of the muscle fibers is being done, or the muscles are being worked, and it is not becoming specific.

[Yes, sir, Saju sir, you have shared your rich experience regarding all the questions. And this is a basic question, sir].

When it comes to sports biomechanics, particularly when students come for either an undergraduate program or a postgraduate program, what are the skill sets they need?

And, the moment they qualify academically, what are the other skills they need to equip themselves with? And further, what are the job opportunities for them in our Indian diaspora?

Okay! When a student goes into a university for doing a graduation course or a postgraduate course, the first and foremost thing to enhance their expertise is the set of equipment that is available in the university or the institution, which caters to their expertise. Okay, the more equipment available, the greater the expertise in terms of service would be. Now, after passing out from the university, when a biomechanist goes to help the athletes, you may not find all the equipment that was there in the university available.

The expertise is wide, starting from video analysis, you need to know how to capture a video. And from that, if you can analyze and give feedback to the athletes, that would also serve the purpose to a great extent. Now, the only thing is that when it comes to the ability of the biomechanics expert, you also need to have specificity in a particular sport. The ability to analyze a particular sport is not just sitting and being a technical expert in the lab. But you need to come out of the lab and also provide service to the athletes on the ground.

You are not sticking just with the lab alone, but coming to the field, analyzing the sport, observing the athletes' performance, both with your naked eyes or with video analysis, repeatedly analyzing the movements. Those are the things which are actually going to take you to a greater heights. Observation is something which again is very much important for a biomechanics and the ability to coordinate and work with other sports scientists. That is you are going to cater for the strength and conditioning expert you are going to cater for the physiotherapist, you are also going to cater for the sports medicine doctor, you are going to cater for the athlete and if we are also like technical in terms of equipments you know the uh if you are manufacturing a new equipment you need to identify or assess the performance of the equipment and how it is going to benefit the athletes, what is the dynamics of the equipment, those things are also going to be useful for the biomechanics. The spectrum is there a lot of opportunities the scope of working as a biomechanics in various fields is where it is there so you have to cultivate the habit of learning and have a passion for supporting the athletes in terms of a particular sport or varied sport. Thank you, sir. You have explained about the opportunities and what are the skill sets especially required for the sports biomechanist.

Now, we just want to shift the phases like we want to hear some of the advice specifically for the young athletes who are looking for to maximize the performance, especially through training some kind of scientific support. Now, most of the novice hockey players they try to purchase sticks which are bigger than their size, you know which is more than their required size.

Now for example, you can see the hockey stick is almost above their naval position. What they do is that okay, in order to accommodate the length of the stick they hold the stick you know instead of holding at the edge of the stick they hold around four to five inches inward okay inside. In order to hit the ball they keep the ball away from their body so what is actually happening the swing phase is going to increase relatively a wider swing is created. From the if you look into even to facilitate the swing and contact of the ball they do not keep the ball in line with the front foot they keep it in front almost six to eight inches they keep it in front to contact the ball, and to facilitate the swing and there is no follow through which is taking place, so you find that okay after the ball has been hit they push back with the knee leading leg and you tend to have problems in the knee and the ankle joint. These are all the errors which can actually take place at an early age because of using improper equipments.

The same is the case with tennis also. If you have a heavier racket or in cricket, a heavier bat, these are going to cause problems for either the muscles or the technique execution. Now, in this and all, if you actually see, the players will not be in a position to hit the ball on the carpet. You will find that the ball is always traveling like a projectile. And either in this picture, you can see the ball is being hit on top, so again it may cause a bouncing movement. The ball is not likely to travel on the carpet. In proper equipment, select the proper equipment for these beginner athletes. And see that if you are buying a shoe, it correctly fits their leg, or if you are buying spikes, they are proper.

Wearing a proper kit for playing the particular sport is always to be encouraged, so that you could avoid certain things like drag. Now, having big shorts is going to increase your drag effect, so your running speed could be improved probably if you can have relatively tight shorts which comfortably cover your legs and look decent also. They should look aesthetic also. in that way, if you actually look into those small things, which actually help you in improving the performance. And similarly, protection.

Early days, you know, if you look way back to the 90s, before the 90s, cricket players never had a helmet. They only used to wear the abdomen guard. And hockey goalkeepers, they were using cotton goalkeeper pads. And getting injured was quite common in those days. Whereas now you have advanced technology in terms of equipment, like goalkeeper OBO pads.

Those things have come up, which has good protection and there is no fear in the athletes these days relatively because they are being protected to a great extent. Same way, teeth guard, all these things would certainly help in enabling the performer or the child to perform better. Sir, we are grateful to you because you have shared your rich experience, decades of experience as a sports scientist, biomechanics, strength and conditioning coach for the Indian team and having served in ISN Malaysia, also an administrator HPD in SAI.

We have got rich treasury of information from the answers for the, I mean, almost more than 90 minutes. So finally, sir, what would you like to share to the future sports science professionals, coaches and budding athletes who are going to change and who are going to achieve the podium finish in the Indian sports ecosystem? My first and foremost thing to the sports scientists is that please do not wait for the coaches or the athletes to come to you. Instead of that, you are the first hand of service. You need to go to the coaches and athletes, observe them, start employing your services to them rather than waiting for them to come to you.

My experience in earlier in SAI is to see that, okay, most of the sports scientists used to sit in the lab and they expected the coaches and scientists, I mean, athletes to come to the lab. And that was actually a big drawback because the moment you expect them to come, then they are not going to come also and you are not delivering the things in terms of practical aspects on the field but in terms of fully lab-based services. Lab-based services you may be providing some kind of service but that is not complete proof. It is to be seen that okay how you move from lab to the field any sports scientist.

Whether it is a nutrition expert or a biomechanist or psychologist or physiologist, they need to start going to the ground, observing the athletes, do the test on the field, and analyze the stuff practically when they are doing the training. That is the first and foremost thing which a sports scientist has to do. Second thing is collecting data. You need to look into various aspects of performance.

The performance factor with various variables which are influencing the performance that needs to be looked up. Data collections in terms of pre-training, during training, post-training and recovery aspects, those needs to be collected.

Employment of technologies that are available with you or sometimes if the technology is not available and if you can not manually collect the data, you cannot blame it on the system. There is also a possibility for you to do manual data collection also. See that you are in a position to collect data from every aspects of performance. Then the third thing what I feel the sports scientist needs to look into is reading.

Evidence based research and application of your interpretation in terms of that evidence-based research. a lot of journals you may have to read you may have to publish articles you are from your work research work has to be done and then your presentations um all these things are going to count your expertise as a scientist, so if you do not have all these things and you just you are just doing biomechanics testing it it would be like a technician rather than a scientist. If you want to be called as a scientist, sports scientist, yes, you need to work on the field and have publications, book chapters and other things to be done, that is another thing which you need to specialize.

And fourth is qualifying yourself, higher education, going into doing your post-graduate, either post-graduation or doctoral or MPhil or even post-doctorate degrees needs to be acquired and that will also add up along with attending international conferences, workshops, clinics, getting membership with ISBS, all these things add to your value as a biomechanist. The biomechanists, if they have to strive hard for attaining their status then

you need to totally conquer yourself to all these things which i have mentioned. And lastly i would like to say see all the sports scientists are an unsung hero okay.

When the athlete wins a medal, of course, you get satisfaction that, okay, you have contributed to the effort and that has enabled the athletes to perform. That will give you enough satisfaction, but do not expect that, okay. You have the right to claim that, okay, this is my athlete or this is my because there are so many people who have been involved with that athlete. Do not claim it as your athlete. But you can only claim it as that you have provided a good support service.

Because the making of the athlete is totally coach-centered, a coach driven and athletic athlete center so you need to see that these things are kept as you know a decorum for you to perform and do the best.

[Thank you, so much sir for your valuable information. And so obviously the participants are blessed to have these information which are practical, which you got cornered over the past three more than three decades].

[Thank you, and meet you in the next video].