Injury Pattern - Part 1

Welcome back to Human Movement Science. Today we are looking at injury patterns. This is going to be a module where we understand, where we use our understanding of all the human movements, movement aspects that we have studied in the past, including human anatomy, the characteristics of different joints, the tissues that connect them, the tissues across the human body and how they can be injured. And we will try to explore some basic strategies on how to prevent injuries and how to rehab the date. So let's get started. You will look at identifying injury patterns, basically the kinds of injuries that might occur.

There are multiple ways of characterizing injuries. We will look at one such pattern. Identifying the mechanism by which the injury was caused. Identifying the movements leading to injuries and examples of injuries in sports.

So let's first look at the injury patterns that can exist. This is a classification based on the mechanism by which the injury was caused. So on that, it can either be an acute traumatic injury, or it can be an overuse injury. Let's take a look at both in a little bit more detail. So acute or traumatic injuries occur suddenly to previously normal tissue.

Acute injuries occur due to sudden trauma to the tissue. So sudden trauma to the tissue. The symptoms present themselves almost immediately after the injury. Symptoms present immediately. So, the operating principle behind these kinds of injuries is that the force being applied at the site of injury or the site of impact maybe is much larger than the strength of the impacted tissue.

The tissue could be muscle, ligaments, tendons, or bone. And so the tissue basically breaks down or snaps. So we can split acute injuries into sort of direct or contact injury. So this is basically sort of a head-on collision, for example, between rugby players or in football someone skids and strikes the opponent's leg at the wrong location and ends up injuring their Achilles maybe. So these would be contact or direct injuries.

A lot of times the same tissue that can be damaged by direct injuries can also be damaged by what are called non-contact or indirect injuries. So, in these cases, the site of force application is different from the site of injury and it can occur at a much larger distance from the actual site of force application. One of the common examples given for non-contact injury is ACL tear. So anterior cruciate ligament which is one of the four ligaments present in the knee joint if you remember the anatomy of the joint is one of the most commonly injured knee ligament. Now while a direct impact on the knee can definitely cause a rupture or a tear or an injury in the ACL, the non-contact aspects comes from poor biomechanics or poor movement patterns which lead to over-exertion and over-stressing of that ligament.

In directions it is not designed to take loads in and as such it fails. The failure can be like I said earlier, it could be a tear, or it could be a partial tear, or it could be just swelling or you know a sprain kind of an incidence. The fundamental thing to remember for non-contact injuries is that it does not need to result from any interaction with an external agent or agency. It can happen because of your own interaction with the environment. So other common some common acute injuries can be you know ankle sprains, ACL tear, shoulder dislocation right.

So in particular with regards to the shoulder, if we remember, it is one of the most mobile joints but is also very unstable, and it is primarily in position because of the all the support of tissue, primarily the muscles, and so it is relatively easier to dislocate the shoulder and move it out of the joint because of any sort of acute trauma to that joint or you know poor direction of forces acting on the limb segments of the upper arm. And there are multiple other acute injuries that can happen and I encourage you to explore this as much as you can. So just like acute injuries are short instance immediate impact injuries. So overuse injuries are typically caused by repetitive actions. Now, you might wonder well pretty much all of sports and exercise is repeating actions over and over until you acquire the skills or you develop the strength.

So let us try and understand what happens what happens to the tissue when it undergoes these stresses and strains. So, at the microscopic level, the tissue is stressed by repeated workouts. So if I was performing an exercise like a bicep curl where I am flexing the biceps to lift a load and I am doing this regularly and at fixed intervals, I am stressing the muscles, and at the microscopic level, there is excessive stress developed on the muscles because of the strain that is produced by the flexing and extension action. Now this is the physiological stress. Because of this stress, the tissue, when it is not under this stress, adapts it basically, you can think of it as okay you faced a particular challenge, you learn from it, and you make strategies to not have to face that challenge again, or if you were faced by that challenge again, you know how to overcome it.

In this case, the tissue sort of adapts to this excessive stress that was developed and recovers in a much more stronger condition. So if it is bone tissue the bone density grows by repeated impact activities. If it is muscle tissue, the micro-damage to the muscle tissue repairs, heals, and becomes thicker and stronger. And because of these actions the fundamental requirement is time. Which is why you might have heard your physical instruction teachers tell you that you exercise, and then you exercise the next day.

Now, an over enthusiastic athlete might want to gain muscles faster or become better at a particular skill so they might start training more frequently smaller intervals, which does not give enough time to recover right without enough time to recover. So that primarily can lead to an overused injury because the tissue has not recovered from the previous experience of the physiological stresses, and so when it is subjected to the same stresses

again it is not able to overcome those limitations. The muscle is still doing its thing, it is still recovering, and something goes wrong and it causes an injury. So these appear over time. These kinds of injuries they are not evident in the start.

You might not experience any pain or any discomfort in the beginning even though you are over stressing the tissue but gradually with time these injuries start, the pain starts appearing and you start responding to that physiologically by doing multiple adaptations in your body. So to overcome neck pain for example you might hunch your back a little so the muscles are not strained as much. So that is one way in which overused injuries can occur. Another way is if you had poor posture during a movement. So poor posture could also cause acute injury but in the long term, it actually causes a lot of overused injuries because you tend to use the muscles which are not designed to take those loads and so there you are using those muscles as compensatory activities.

So, for example, in a deadlift and we have seen this example throughout the scores. In a deadlift if you round your back because maybe the weight is too much, right, if this is too heavy, then the weight is too much, and so to be able to hold it in place statically before you can do the exercise, you are rounding your back and tensing your muscles in the back to be able to just hold it in place. If you do it once or twice and you get away without any injury, you might not experience any pain, but you have started to affect this tissue, and if you keep doing this movement repeatedly with this poor form, right, so poor form leads to compensatory actions which leads to the improper use of muscles. So if you keep repeating that exercise in poor form over time, you are bound to injure one or the other muscles or other tissue. The bottom line is you have to have proper form and you have to have enough rest in between your exercise sessions and between training to allow the tissue to recover and learn from the previous session.

When I say learn I mean basically grow according to these stresses to overcome those in any future case of interaction. So, some common examples of overuse injury, right, so stress fractures. If you keep, so if you are a new runner, for example, and you decide to start running marathon distances on day one, you might cause an acute injury, but if you are a new runner and you decide to run, say, two kilometers on the first day itself and you are running with improper form or your bones are not used to those levels of stresses then in a short duration of time you might end up injuring the bone and causing excessive stress to build up which will cause the bone to fracture. Tendons have tendinopathy, so there is excessive stresses in the tendon built over time, and that repeated action so if in a workplace environment you are required to move something or pull at something for your job and that action itself causes some sort of long-term effect on the tendons that can cause tendinopathy. Ligament can have micro tears and chronic degeneration.

So muscles can have fasciitis or what is called delayed onset muscles soreness. So if you do a very heavy squat session, for example, you might experience the pain starting to

appear a day or two days later or even three days and persist for several days, right. So you overused the tissue, and you were not ready physiologically for that kind of loading so the tissue is basically responding to that and saying, hey, we need to slow things down here, and so here is some pain for you to restrict yourself. Pain is basically a mechanism for the body to prevent itself from further injuries.

It's an indicator, right. So bursa is the tissue that surrounds joints, so you can have bursitis at the hip, at the knee, and for nerve tissue, you can have neuropathy. So that's as far as the classification of injuries will be discussed here. Let's look at the injury mechanisms, right. So what all can cause injuries. First and foremost, is of course biomechanical factors, and our dear old friend of course appears here because poor posture is poor biomechanics, right.

So poor posture, faulty movement pattern. If I keep doing a task in the way the muscles are not designed to handle it I am bound to cause injury to some of the other tissue. Sameway, I remember this guy from ergonomics, I believe. Yes. So, this again, is poor posture, and how does this impact? There is extended durations of muscle overstrain, overstraining of muscles, right, which in turn can cause permanent changes in the tissue as opposed to acute changes.

So if I was just doing this for an instant, I can feel a nice stretch in the back and then I recover to a nice relaxed neutral spine position. But if I keep sitting in a hunched position like this, right, over time, the back tissue will expand, and then it will not be able to compensate for some of the loading that is applied on it. So it can lead to injuries more easily now. Another factor that this can lead to is muscle imbalances. So because of a hunched position like so the muscles in the chest area and in my frontal portion will contract because they are in contracted position.

And if I keep doing this over longer durations of time say across the entire day sitting in a hunched position these muscles will in turn develop into a more contract position. So that will become my neutral position with a hunched back like this. And the muscles on the back will expand and so by default, there is an imbalance where the front muscles are in more tension and are by default, slightly more, imposing slightly more force on my upper body compared to my back muscles. And so now I have this imbalance. And if I try to do deadlift with this kind of an imbalance I am of course going to cause over-straining of some other muscles, other tissues at the back, and that will lead to injury.

So this is how biomechanical factors get played very easily. One can link to another. Another factor is joint instabilities. So if you remember the anatomy of the shoulder joint, it is a ball and socket joint. It is the most mobile joint in the human body.

It is also one of the most unstable ones. It is only held together through muscular tissue, tendons, and ligaments. So if the muscles are imbalanced here or if there is any sort of

imbalance because of poor anatomy, maybe during an activity and over time, that can develop into a proper joint instability in a particular plane. So if I start moving the arm in the sagittal, in the frontal plane, it might cause extension of the tissue over here, which is not strong enough to overcome the forces and hence cause some sort of injury. The other thing that can impact cause impact in terms of injuries, is training factors.

So if I suddenly increase in training, the intensity with which I am training, the volume of training which refers to if I am doing bicep curls, for example, if I suddenly start doing five sets of 15, actually five sets of 50 or if I start doing it too frequently, right, so morning, afternoon, night and then I repeat it again and it can cause injuries because of either acute injuries but in this case, it is primarily an overuse injury, right. So it is going to lead to overuse injury. Again, inadequate rest, so you do not let the tissue recover and adapt to the physiological stress that was imposed on it during the exercise cycles and that can lead to further damage. So it is important to get enough rest, and without that, you are bound to have fatigue exhaustion, and there are psychological and neural impairments that can start occurring, right, which will start affecting your technique or if you are employing poor technique from the very start, then that can also lead to injuries. Environmental factors can definitely cause injuries.

I think we all understand that if this guy was running on nice flat surface, actually that looks like water, let me change it. So let us say this guy is running on some nice flat surface, the chances of injury are lower than if there were multiple obstacles along the way here, right, and he had to overcome those obstacles, then he has to change his movement pattern frequently. Another way to look at it is, let us say you are a new runner and you decide to go out running on pavement instead of some relatively soft surface, and within a week, you start facing knee pain because the forces provided by a rigid pavement are going to be far more than those from a soft grassy surface, for example. So oftentimes, people who are recovering from injuries or people who have a propensity for getting injured from high-impact activities are advised to do those activities on softer terrains like trail running or track running.

Okay. If the, of course, goes without saying, if the equipment is damaged, the equipment that you are using, you are quite likely to injure yourself. So if you are batting, for example, and there is a crack in the handle and suddenly when it strikes, the bat flings off, an acute injury can happen with a physical impact or a non-contact injury can happen because you end up reducing the amount of inertia that you were certainly that you were moving and suddenly you were able to move too fast and you end up injuring some muscle in the back of your, right? And the training environment and again, training environment is also an important factor in preventing or causing injuries. If you are, one simple example could be just the ambient temperature and humidity. If it is too hot, you might end up over-exerting, losing too much electrolytes because of over sweating and causing a heat stroke, and in the process, might also injure yourself through some acute injury, right? So training

in the proper environment is as important as are all these other factors. And lastly, there are a bunch of individual factors.

So age being one of the most commonly cited ones, you see all the athletes across sports being preferably under 30 younger people because they have a better recovery rate or they recover faster as age related changes start coming in as you grow. Gender-based differences are also present. Again, I'll give the example of ACL injuries where female athletes have a higher propensity for ACL injuries in dynamic sport movement because of different patterns of muscle recruitment. So the muscle recruitment in the thigh muscles and the hamstrings and the quadriceps and the hamstrings is statistically different enough that it can be attributed to the way movement happens between female athletes and male athletes. Your fitness level can definitely impact your chances of getting injured.

So if you are someone who's facing fitness issues and you decide to again go out for a 5K run on day one itself, then it's a bad idea because that might cause a combination of stress injuries and acute injuries. And if you keep pushing yourself on that without a gradual increase in your training load, in that case, it might cause overuse injuries as well, right? If there is a previous injury history that can also be detrimental, that can also cause a repeated injury on or around the same site or in continuation of the same limb segment because that particular joint might be compromised or a particular limb segment might be compromised. So if my elbow is weak or I've had an injury and I have not recovered enough and I try to do a side dumbbell raise, I might end up causing a secondary injury around here, or because I am now overcompensating for keeping my arms straight, I might end up injuring the shoulder muscles. So, previous injury history can be quite important and in deciding whether you are ready for more activity or when you're ready to return for sports. Then there can be genetic predisposition and genetic factors that impact the kinds of injuries that might happen. Okay.