

Isokinetic Certification 101

Episode 2: Practical Applications

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Introduction to Isokinetic Training and Testing

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Discussion Topics

Today:

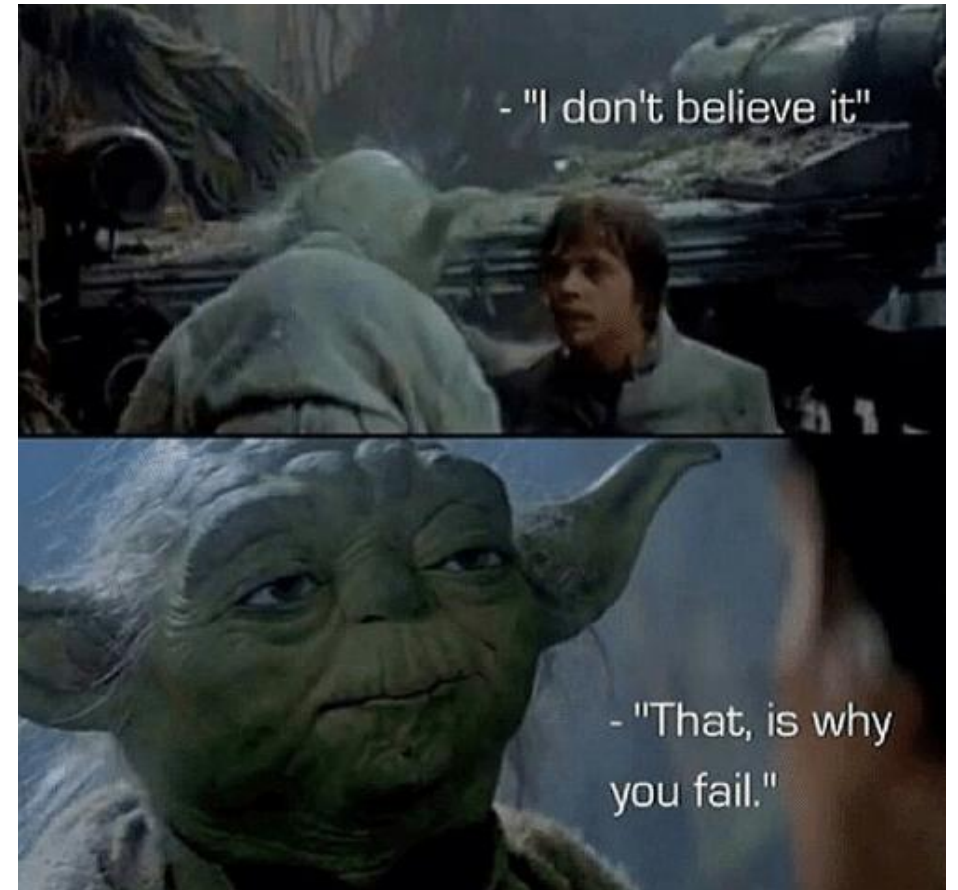
- Preview of different Modes of Exercise with patient specific training techniques

Future:

- In depth analysis of treatment techniques demonstrated today
- Case Studies

“You must unlearn what you have learned”

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“For my ally is ISOKINETICS, and a powerful ally it is”

Shout Outs

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Erik Meira PT, DPT, SCS, CSCS

J.W. Matheson PT, DPT, MS, SCS, OCS, CSCS

THE FIVE BASIC PHASES OF REHABILITATION

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HUMAC NORM Clinical Pathway to Function



Mobility Training Videos



Mobility Training Note

-Prone knee: In this first view, I have our patient in the prone position for passive knee flexion/extension. This position is good after hamstring or quad strains as well as for any knee pathology when you are wanting to work flexion beyond 90deg.

-Sitting knee: In this video, we see John working with Bradley. Now this is the common exercise position for the knee and this is used for more than just post-op, but for any soreness, stiffness, or swelling to increase motion. What John is doing is handing Bradley the safety stop switch.

In this video, we'll see my patient who had a truck bed fall on his knee shattering his patella into five pieces. After surgery and 4 weeks of immobilization, his ROM was been slow to return. He was stuck at 55-60deg of flexion and plateaued there for about 2 weeks. This visit is the first time we got him on a Norm and we were able to get his flexion to 73deg passively.

Mobility Training Notes

- The nice thing about the software is that as his knee loosens up, you can increase his motion by as little as 1 deg at a time and even put in stretches on the fly so it makes increasing ROM very easy and comfortable.
- What I am having him do is to contract his hamstrings lightly into flexion which is reducing his extensor tissue tension from almost 30ftlbs to less than 5ftlbs allowing him to get increased flexion to 78deg comfortably. So this is an example of active assisted ROM.
- The screen the right side shows him contracting with the hamstrings increasing positive torque until he gets to full flexion and his extensor tightness takes over. Each rep is a different color and it allows us to see how he is getting less tissue tension on each attempt.

Now the science behind CPM is that as the joint is moved through the open and closed pack positions, the pressure within increases and decreases in a sinusoidal fashion which creates a pumping effect, reducing hemarthrosis, and reducing effusion. This also acts on the periarticular tissues, renormalizing resting tissue tension length of the ligaments, tendon, muscle, and fascia.

Ankle: Here we see the ankle setup. We all know that early mobilization after ankle sprains has been shown to improve outcomes and get our athletes back on the field quicker. Here are two examples of CPM in Plantar and dorsiflexion and inversion/eversion

Hip: In this video, the hip is being moved through internal and external rotation which your arthritis patients will absolutely love and it is very easy to set-up. Now one great advantage of CPM is that once you set your patient up and give them the stop switch, it frees you up as a clinician to check on other patients, do some documenting, or simply catch your breath. Because the treatment is slow smooth, and predictable with the same parameters on every rep, your patient will be much less guarded and more comfortable compared to traditional PROM with a therapist.

Shoulder flex: In this video, Bradley is demonstrating passive shoulder flexion. Now the first few times I mobilize a shoulder, I do it manually only but after that, I like go with the dynamometer. Each time they go on the machine, I will turn the chair and manually run them through a few passes so that I can get an idea of how they are moving that day. Now I have found that most of my patients are significantly less guarded on the machine and find it more comfortable. Like with the ankle set-up you saw earlier, this set-up is a little more complex but with practice, you can get good at setting them up quickly.

One thing I mentioned earlier is that you can change the parameters during the exercise. For example, we can set the ROM initially to reported tissue restriction for example, 100deg, and as they loosen up, you can click to increase the ROM one degree at a but remaining pain-free. You can also put a stretch and end-range or change the speeds as well. You will see how to do this in next month's webinar .

ER/IR: This is the position for External and internal rotation. Now if a patient comes in complaining of general tightness or aching, this is your go-to position for CPM. It's a much faster set-up and really loosens them up quickly.

Elbow: This video shows passive motion for the elbow which is great for any of your patients after Tommy John or biceps surgery. This patient was further along in the rehab but if he were in mobility phase, I would have adjusted his grip by rotating the adaptor so to put his wrist in a neutral position and relax his flexor mass and pronator teres. You could also mobilize the wrist joint as well.

IASTM: At the start of this section I said I would revisit soft tissue techniques. CPM on the machine is a perfect opportunity to perform soft tissue mobilization either manually or with Instrument Assisted Mobilization. In this video I am using the HawkGrips tools to work on Chris' lateral hamstring and IT band using different Fanning, brushing, sweeping, strumming, framing, and pin and stretch techniques. I am having him completely relax but you can also perform Active Release which the patient is loading the tissue eccentrically.

The ankle position is great for patients with post-tib tendinopathy as well as patients with lateral ankle sprains so this is a great ankle treatment for soft tissue work with mobilization.

Stability Training Videos



Stability Training Notes

Prone Hams: This first position shows prone hamstring contraction. I chose this video because this exercise protocol has the patient perform only one rep in each position before moving on to the next. On the feedback screen, you can see a torque bar raise up as the athlete pulls into the adaptor pad. Typically we have our athletes perform between 3-5 reps in each position before the machine moves to the next position. The key to stability training is that exercise is performed submaximally with a few exceptions.

Screenshot: Next, I am showing you how to navigate the menus on the HUMAC software. On the main screen, I am selecting exercise, joint and position, then choosing the protocol. On the exercise set-up screen, I have selected a protocol for knee extension isometrics from 10-70deg. Now on this screen you can choose to start the athlete at any angle, say 40deg, and you can even easily create a protocol to run the athlete from 40-90deg but we actually will run our post-op ACL's from 20-30deg through 90deg starting at about 4-6 weeks. The way to make this a safe intervention is that we limit the amount of torque produced with the targets option as you will see coming up. You can even select a specific angle and perform that angle only as a single set.

Stability Training Notes

Setup: Here you can see the process of setting up a post-op ACL for safe open chain extension. I am placing the adapter pad proximally on the shin. By either using a proximal pad placement or an anti-shear device, you can negate the shearing effect on the tibia. Here are two research articles demonstrating how this is safe.

Next, we set the anatomic zero. This next screen sets the total ROM for the exercise, so once you set the flexion and extension angles, you are given the mechanical stops settings, and then you can click okay to begin. Now everything you saw me do in the software can also be performed from the dashboard mode which puts everything all in one location and speeds up the exercise set-up process.

Quad Isometrics: I am cueing Bradley to engage his quadriceps lightly and push into the adapter arm. Now, Bradley is currently not post-op, so his first angle is 10deg, but typically our post-op ACL's start at 20-30deg. Many therapists out there may choose to start at 40deg through 90deg and that is fine, but with the light torque amounts and the proximal pad placement, our patients never have any difficulties or adverse responses.

Stability Training Notes

Quad Isometrics: As we zoom into the screen, you can see Bradley is only producing about 5-6ftlbs of torque. The goal here is for neuromuscular re-ed and not strength. I said earlier that we typically have our protocols set for 3-5 reps in each angle, but to save on time in this video, I fast forwarded to different angles. Speaking of different angles, if you are working with patients who have discomfort in a given angle, you can very easily skip this angle.

Targets: Here is the targets feature I mentioned. This keeps your patient from overproducing too much torque. If they go above or fall below the target window, the exercise pauses until they get back in the window. I currently have this set to 5-10ftlbs of torque as Bradley is not post-op and he is in a deeper angle, but you can limit them to 1-5ftlbs for example. You can take this safety mechanism one step further and set the exercise to shut off if they reach a certain threshold which is good for an impulsive patient who may try to see how hard they can push if you walk away.

Stability Training Notes

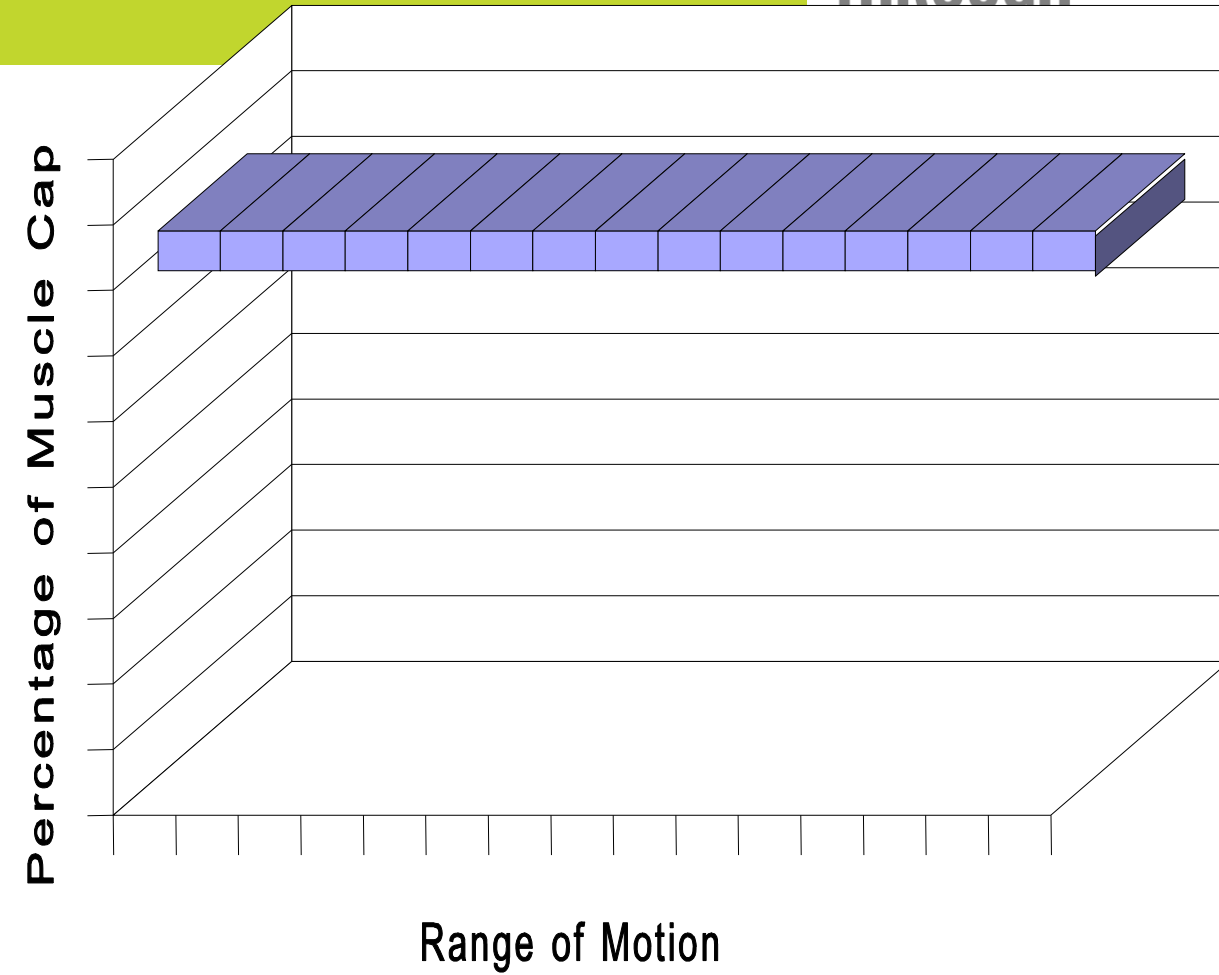
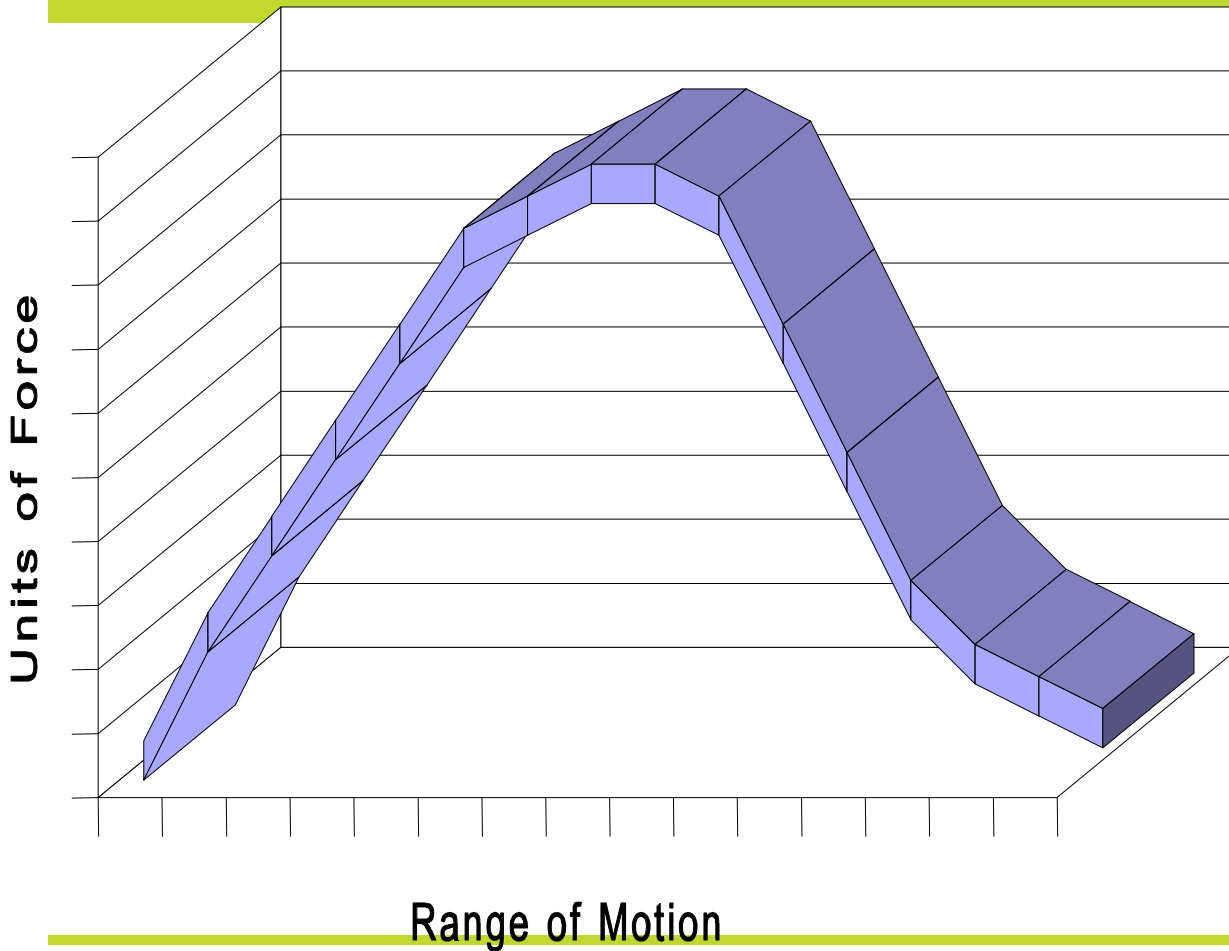
Shoulder ER: Here you see Bradley setting up Chris for shoulder ER multi-angle isometrics. We have him start at 30deg of ER and working every 10deg of the motion down to 30deg of IR. With rotator cuff tendinopathy and general shoulder pain, you can begin this immediately so long as they are pain-free but with post-op you need to delay this. With standard rotator cuff repair, Bankart, and total shoulders you need to wait until about 6-8 weeks post-op and for SLAP repairs wait 2-3 weeks keeping ROM limitations in mind.

Chris is performing 5 reps in each set, but to save time on the video, I am skipping ahead to show some of the different angles.

Now, I am not showing it today, but isometrics are great interventions for the ankle after sprain, foot surgery, or Achilles tendon repair. Also, you can use isometrics for your hip patients as well.

Isokinetic Exercise

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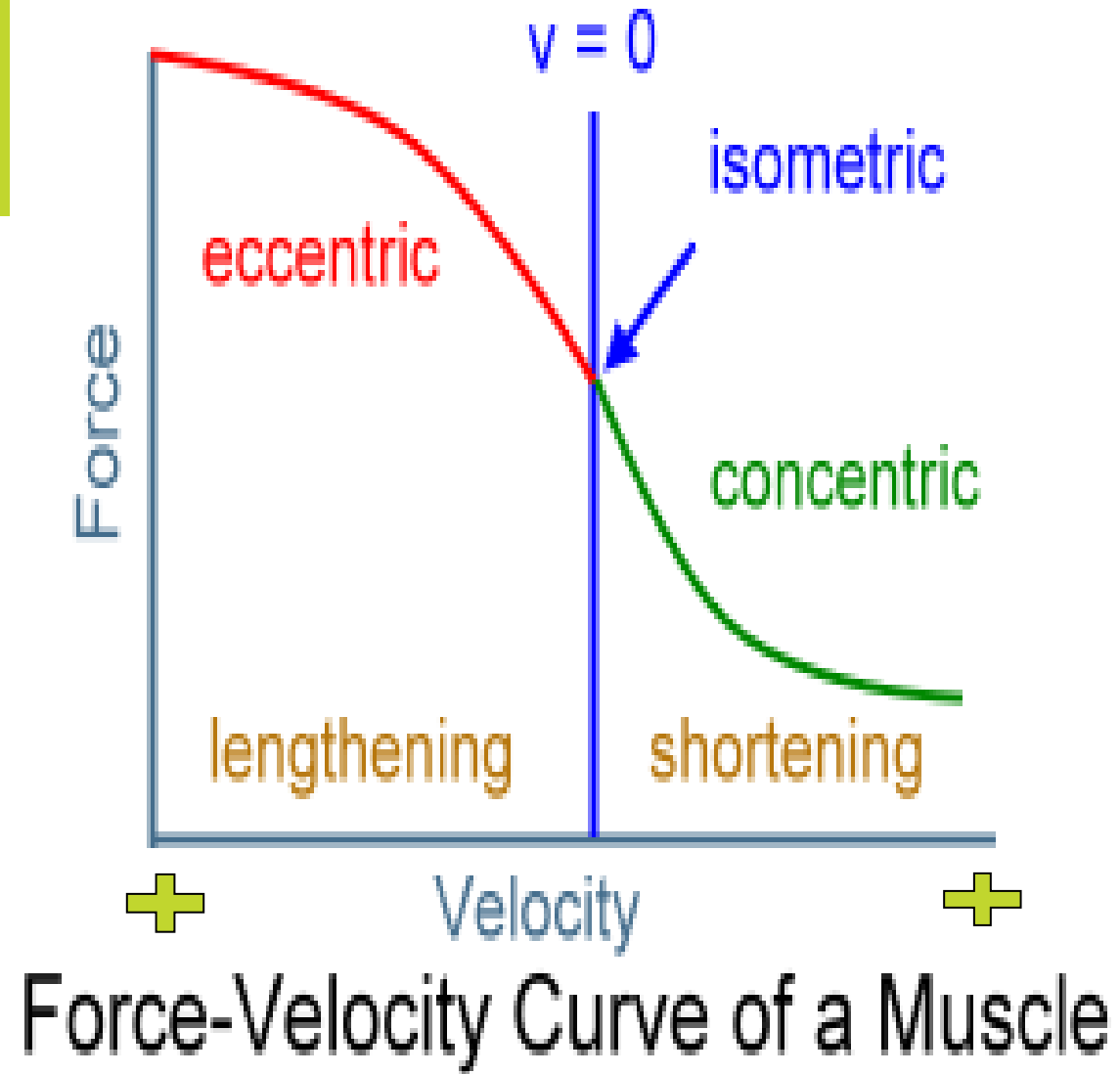
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Force at Skeletal Lever

Force Curve

Order of Torque Capacity:

Fast Eccentric:	Highest torque capacity
Slow Eccentric	
Isometric	Medium torque capacity
Slow Concentric	
Fast Concentric	Lower torque capacity



Strength Training Videos



Strength Training Notes

Knee: Here we see our athlete performing eccentric unloading for her quads after ACL reconstruction. Now this intervention is actually performed prior to multi-angle isometrics as with isometrics you have to produce positive force into the adapter pad, but with eccentric unloading, the muscle has to only overcome the weight of the limb. For ACL patients we can typically start this 2-4 weeks after surgery depending on the patient.

Close-up: You can see in the video that the machine lifts up the limb concentrically and at the top of the motion, at full extension, the patient is instructed to engage the quad isometrically and then lower, or unload, the weight of the limb on the way down. Our patient here is unable to achieve full active extension, but does have full passive so it can be considered active assistive helping her regain full active extension.

Overall, eccentric unloading is an important step in early rehab as it allows for safe neuromuscular reeducation and proprioception. Patients are commonly doing this exercise as part of their rehab or home routine, what makes it a better intervention is that they have to match the speed of the machine keeping between the pad and the strap. We set the machine to 5deg/sec eccentrically and the concentric lift is set to 10deg/sec.

Strength Training Notes

Eccentric progression: Our patient has progressed to active contractions against an eccentric loads starting around week 6 at 5deg/sec only. The force and torque production is still kept minimal as the focus is on neural control of eccentric contraction.

Next we progress to having the patient contract 5deg/sec faster in each progressive set. For example, she is performing three sets of ten eccentric reps in this protocol with the first set performed at 10deg/sec active ecc , Set 2 is 15deg/sec and set 3 is 20deg/sec. The concentric resting speed is set twice as fast as the eccentric exercising speed. For ACL's we typically keep each protocol for 1-2 weeks and then progress to the next protocol when then have a good torque curves and are pain-free.

The next protocol increases each set by only 5deg. So the protocol would then be 15/20/25deg/sec then 20/25/30deg/sec, and finally 25/30/35deg/sec. As the speeds progress, you can have the athlete also increase the torque production as well. Once we are in these progressive eccentric sets, we have the patient increase their intensity. The first set of each day is performed at 25% and then effort up to 50% effort for the remaining sets.

Strength Training Notes

Prone hams: Here you can see eccentric loading for the hamstrings in prone. Up till this point we have used slow speeds meaning that the deg/sec were up to ½ of that of the ROM. In the next video we start medium speeds, or what we call deceleration training. Remember back to the force velocity curve that as speeds increase in the eccentric mode, the amount of torque produced can also increase. So now the velocity is ½ to **2x** that of the ROM. Here the hamstring is contracting from 80-10deg so 70deg total and the velocity is 40deg/sec in deceleration. Once the athlete has progressed into deceleration training we have them give up to 75% effort in each set and we typically begin deceleration training around week 12 post-op ACL.

Sitting hams: In this video we see our athlete performing deceleration training for the hamstrings in sitting. Now not only is he performing the eccentric contraction, but also the concentric contraction. This is used around 16 weeks post-op and because the concentric uses 70% more oxygen, this really works the muscle endurance as well.

Strength Training Notes

Ankle inv/ever: Here we see eccentric loading for everter strengthening following ankle sprain. Because we are having them exercise eccentrically, the torque curve is actually going down below the 0 line horizontally but the direction of the line simply implies direction of force applied against the direction of motion. So the patient is pressing out as the machine moves them in eccentrically loading the everters.

Elbow flexion/ext: Our patient here is performing bicep eccentric contractions pulling up as the elbow is moved into extension. This is helpful for regaining biceps strength after any bicipital procedures. Here you can see him performing eccentric triceps strengthening as well.

Pronation: In this video, the athlete is performing eccentric loading for the pronator teres. This along with eccentric wrist flexor mass strengthening is very helpful after any medial elbow injury or surgery. If you look closely, you can see his pronator teres firing really well in this exercise. These positions along with the biceps and triceps loading you saw previously can safely begin in the 9th week after Tommy John surgery.

Strength Training Notes

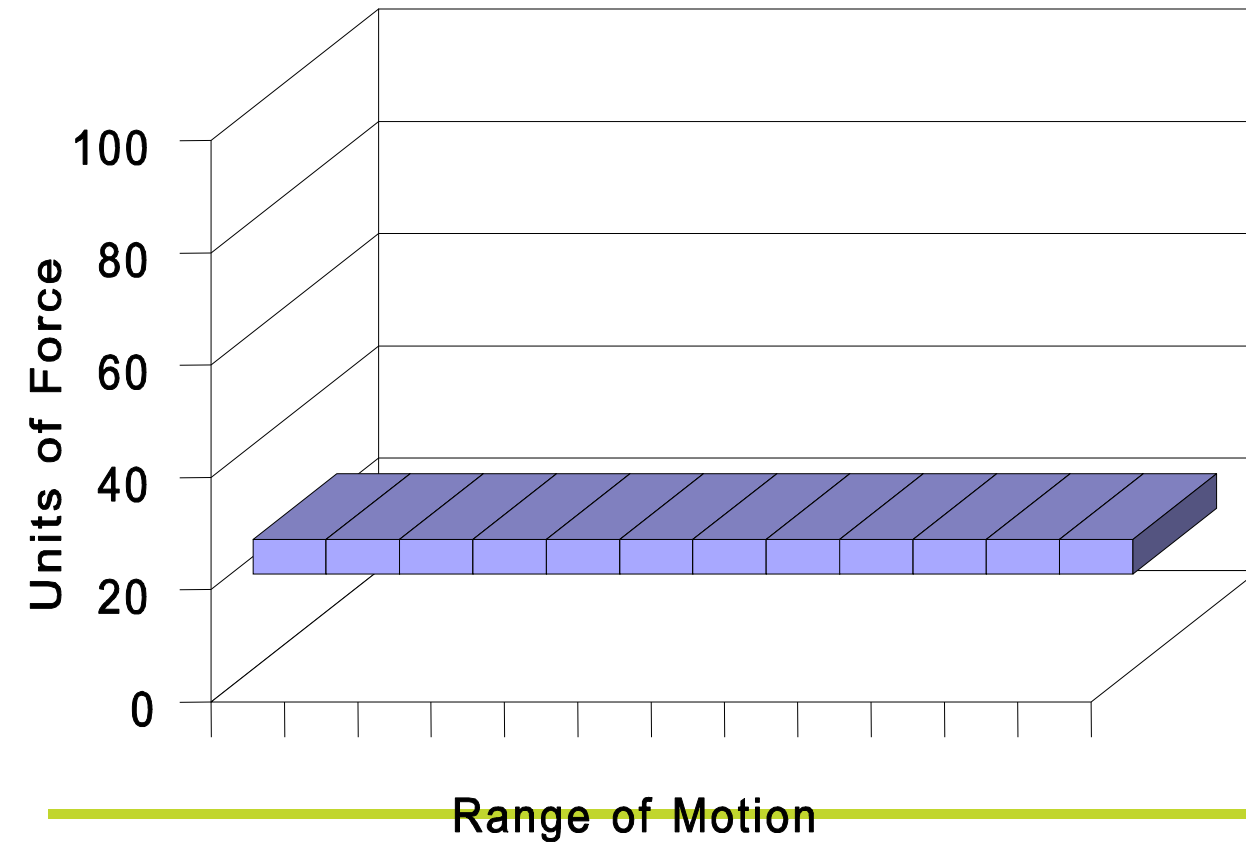
Shoulder ER: Here you see Bradley aligning and setting up Chris for eccentric External rotation. The position of exercise is in the scapular plane with about 45deg of abduction and 20-30deg of horizontal adduction. Next, he finds the shoulder neutral position for ER/IR, clicks anatomic zero, and then sets the exercise ROM for 30deg of external and 30deg of internal rotation.

The exercise Chris is performing is eccentric unloading which can be started safely for rotator cuff repair around when the patient is performing active range of motion exercises which is around 6-8 weeks post-op. The shoulder follows with the same progression rules as the knee, progressively increasing speeds and torque each week as able.

Kin-Com: I skipped ahead to deceleration training for the shoulder. I also wanted to include this because the principles and techniques we discuss can be used for any isokinetic device. Here we see the Kin-Com which is John's baby in the clinic. He has both the Humac Norm and the Kin-Com.

Isotonic Exercise

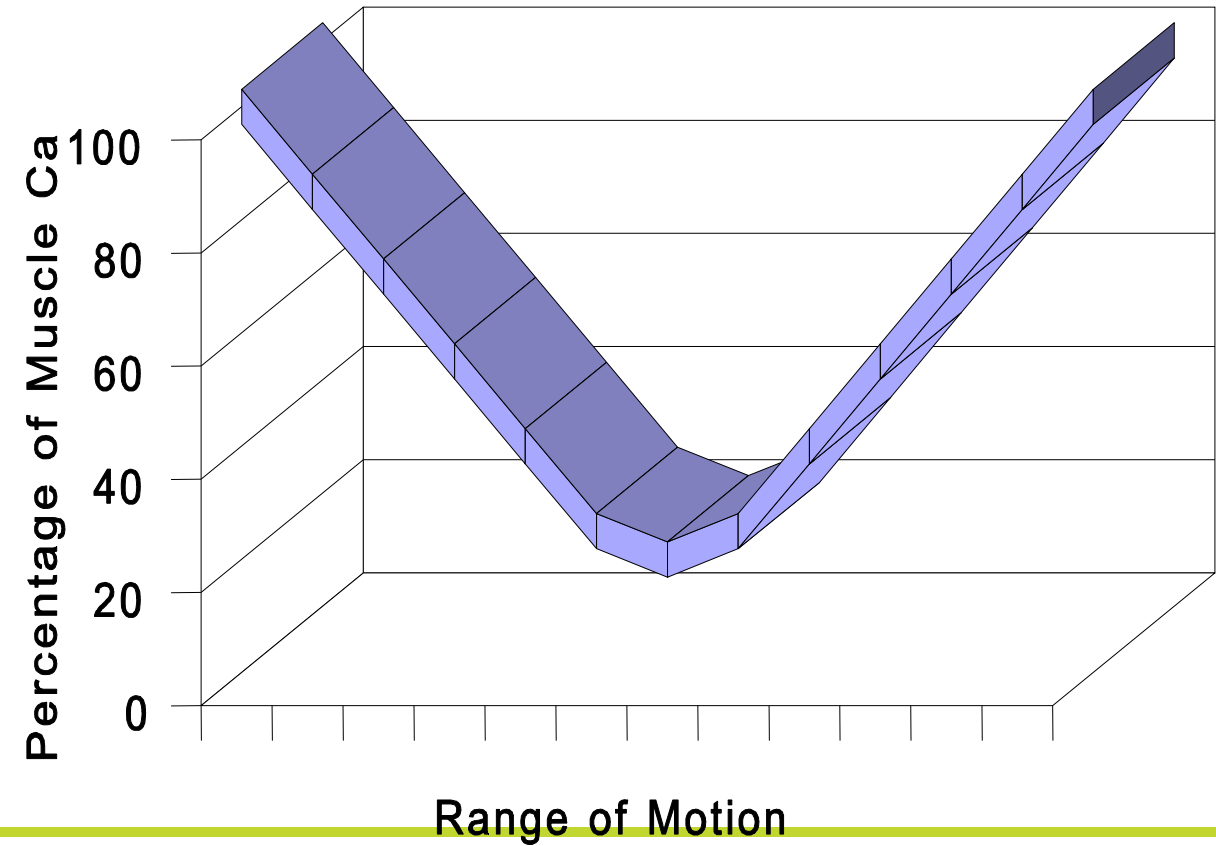
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Force at Skeletal Lever



Force at Muscle

Dynamic Isotonic Videos



Control Training Notes

Pacing bar: First is pacing bar. So with this, we have the bar set to move 2sec concentrically and then 4 sec eccentrically. The patient tries to keep his line within the bar as it moves up and down the screen. I typically do this with very light weight and sometimes, no external weight at all. It is more for teaching the pace of reps for a gym program.

Interactive path: Here we see interactive path. Not only does this work strengthening with position control, but the software also allows us to set the eccentric load separate from concentric. So for example, if the concentric is set to 10ftlbs, we can set the eccentric to 13ftlbs and that is a good starting point for the knee but the shoulder is more like 3-4ftlbs. I try to keep the eccentric 30% heavier than concentric as that is what research tells us the strength difference should be. In the feedback, Chris is controlling the ball position and attempting to keep in the blue path as it moves across the screen. A nice feature is that you can adjust the torque values during the exercise. Now, this 30% eccentric overload gives a quick stretch similar with manual PNF exercise. The quick eccentric stretch induces the stretch-shortening or plyometrics effect. So it helps prepare your patient for plyometric training before it is actually safe to begin plyometrics.

Control Training Notes

Breakout: The next one I want to show you is breakout. The patient here is performing plantarflexion. With all of these isotonics, only one muscle group is being exercised at a time. The patient is controlling the paddle across the bottom of the screen and the goal is to not let the ball get passed you, reflecting it up and breaking bricks. For the ankle, I do not put a 30% overload on and the goal is to keep the resistance very light. Actually with any of these isotonic exercises, you can safely perform them early in the rehab process for proprioception and position control training by not having any resistance added.

Interactive line: Similar to interactive path earlier, interactive line has the patient controlling a pair of dots and as the line passes across the screen, the patient attempts to keep the line centered between the dots. Now the software comes preloaded with these protocols, but it is very easy to create your own line or path exercises. If you look at the bottom of the screen, you can see where you can click to change the torque values and you can also see that I have the 30% eccentric overload in place.

Control Training Notes

Pong: In this video we see Bradley playing of the most classic video games. In pong, the patient controls the paddle on the left and the computer controls the paddle on the right. Like with Breakout, you can make this more or less difficult by adjusting the paddle size, ball speed and acceleration, vary the eccentric/concentric ratios, as well as computer skill. I currently have the ball set to accelerate with each deflection.

Power: In power training we are working on the rate of force development concentrically and then eccentric control. I also like to use the 30% overload here. For the knee, I use 10/13lbs, 20/26lbs ect. Remember power training it about rate of force production not maximal torque. Rate of force production and power have been hot topics the last few years when it comes to returning to sport and this is a great way of working that.

Response time: This last video shows Response Time and is a great proprioception training intervention. In it, the patient controls the purple ball. The computer puts a ring on the screen and the patient places the ball in the ring as quickly as they can and keep it in the ring. Each rep is recorded on the left for response and stability time. I typically use this and other proprioception trainers earlier in the rehab around week 6 without any external load.

Testing Videos



Isometric: The first testing protocol is isometric . For ACL's, this can be performed at 60deg starting at week 8. I typically repeat this at week 12 also before moving on to standard isokinetic testing. For rotator cuff repairs, wait until week 12 and then repeat at week 16 before moving to the interrupted stroke test.

For non-surgical patients, including your older patients, isometric tests are a perfect way to assess strength and progression as it is basically a manual muscle test with precise measurement.

In the protocol, we do 7 warm-up reps (2 reps at 25% effort, 2 at 50%, 2 at 75%, and 1 at 100%) with rep hold at 5sec and 10sec rest between. After the warm-up, the patient rests for 1 minute prior to the test which is 3 reps at the same 5sec hold.. The three reps are averaged together for the report. Now I test both quad and hams, but to save time today, I only included the quads.

Report Pause screen: Here is an example of a test report of the patient I will do my case study on at the end of the year. We are given data on peak torque, average torque and rate of force production which has recently been found to be a very important parameter.

Standard isokinetic: Here we see the standard traditional concentric-concentric quad and hams test. Now, for ACL's I only perform this at week 16 as at week 20, I move on the interrupted stroke test that tests the eccentric function as well. For this test, I use both 60 and 300deg/sec. It is a fast and easy test to perform but it does not give you any eccentric data and therefore is not as good of a test as interrupted stroke.

Report: Here is an example of the standard isokinetic test showing significant deficits in both muscle groups at both speeds.

Interrupted stroke test: Lastly, here is the interrupted stroke test which we use as our primary test. It tests both concentric and eccentric functions and I test quad and hams for the knee, inv/ever for the ankle, and IR/ER for the shoulder. This is a far superior test because it gives the all important eccentric data, and because you can select and deselect the reps to count, you get a much better coefficient of variance. The downside of this test, is that you have to wait until week 20 for ACL's to perform this, it does take longer to test, and the patient will have significant DOMS the next day.

Interrupted stoke test: The warm-up is 2 reps each for con and ecc reps at 50% effort and 75%, and 1 rep at 100% effort. First we warm-up and test the quad, then the hamstring of the uninvolved and then the involved. This typically takes about 30 min to do warm-up reps and test both legs if the patient has never performed eccentric loading on a dynamometer but you can knock it out in 15min on a patient who is used to eccentric loading on the machine. Three reps are recorded for each mode of contraction but you have up to 10 reps in each mode to get the three best.

Report: Here is a sample report for interrupted stroke testing. The first page is the quad with the concentric graph and values on the left, and the eccentric on the right. The second page is for the hamstrings concentric and eccentric. We look at many parameters including not only peak torque values for both concentric and eccentric of both muscles, but we also look at values of work, power, rate of force production, and various ham-quad ratios. It is also important to mention that not only do we do isokinetic testing for return to play, but we also use hop testing and other functional assessments for our athletes.

Questions/Answers

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Music provided by: Bensound.com

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