

## Instruction Manual for Lower MRD

The lower motion restore device (MRD) was specifically designed for the lower extremity kinetic chain of joints involving the hip, knee, ankle, and foot to assist pre and post-surgical clients as well as clients with lower extremity trauma during their early phase of rehabilitation. It is during this phase of rehabilitation when the forces affecting the healing, soft tissues including the muscles, tendons, ligaments, and fascia need to be controlled.

Because of the synergistic and integrated nature of the body's nervous and fascial systems, the lower MRD will impact the tone and length of the myofascia that affects the isolated joint position and motion of the hip, knee, ankle, and foot. The lower MRD is an "open kinetic" chain device, a term used to describe a phase in the way the human body moves against the vertical forces of gravity and ground reaction force (GRF). A kinetic chain is considered "open" when the foot is free to move and not affected by GRF. Conversely, a kinetic chain is considered "closed" when the foot is fixed against the ground and reacting to GRF. In function, the human body has to be able to do both allowing for activities of daily living.

However with an open chain, it is much easier to control both linear and rotational forces on a joint which has been compromised by trauma and/or surgery which is a key to a successful outcome and during the early phase of rehabilitation. In describing functional, human movement like walking, it is a continuum or sequence of open and closed kinetic chain activity. Therefore, no one can deny that an important part of anyone's rehabilitation is being able to perform functional, closed kinetic chain movements, but during the early phase of rehabilitation it is not the time. That is where the lower MRD has its place in the rehabilitation process.

The lower MRD can be used either in the clinic or more importantly in the patient's home environment to begin the process of changing the patient's muscle memory or "myomemory" and remodeling scar tissue vital in preventing "arthrofibrosis." An important key to a client's recovery and return to function from surgery and/or trauma because as we all know "motion is life, motion is freedom!" With myomemory, it is referring to the ability of a client to reproduce a particular movement without intervention of their conscious brain. In short, turn your client's muscles on for a specific movement or skill to "autopilot." That can only occur with active, patient participation and practice which the lower MRD allows the client to do.

Client's who are pre and post surgery or injured from trauma have functional muscle imbalances of the lower extremity chain that has been created over time by their habitual posture and movement altering their joint mechanics. A muscle imbalance is a dysfunctional relationship between muscles being activated and muscles being inhibited causing an imbalance of muscle and myofascial tone and length creating skeletal balance and equilibrium. Understanding muscle spindle and golgi tendon organ (GTO) actions of isolated muscles and altering proprioceptive sensory input are the keys to transforming a dysfunctional myomemory. Surgery does not alter myomemory, but instead will reinforce a dysfunctional myomemory affecting the lower extremity chain of joints.

The lower MRD can be a useful tool in altering dysfunctional myomemory by creating new neuronal, muscle, and myofascial pathways. With the transformation of muscle and myofascial memory, a patient's posture and movement will also change preparing them better for weight bearing and closed kinetic chain, functional activities. It will also allow the client to do concentric and isometric muscle activities to alter proprioceptive sensory input resetting the muscle and myofascial tone and length that affects the position and motion of the dysfunctional lower extremity joints.

## “KEY POINTS TO REMEMBER WHEN USING LOWER MRD”

- WHEN POSITIONING A CLIENT ON THE LOWER MRD, MAKE SURE THE AXIS OF MOTION FOR THE KNEE IS ALIGNED WITH AXIS OF MOTION OF THE DEVICE.

- POSTURE WHEN USING THE LOWER MRD IS IMPORTANT TO A SUCCESSFUL OUTCOME. MAKE SURE THE CLIENT IS IN A “NEUTRAL” SITTING POSTURE HAVING EQUAL WEIGHT DOWN INTO BOTH PITS BONES ON EITHER SIDE OF THE PELVIC GIRDLE WITH A SLIGHT LORDOTIC CURVE OF THE LOWER BACK. THE HEAD, FACE, AND PELVIC AND SHOULDER GIRDLES ARE STRAIGHT AHEAD WITHOUT ANY ROTATION. THE CHIN IS PARALLEL WITH THE FLOOR.

- WHEN BEGINNING A PROGRAM, INSTRUCT YOUR PATIENT HOW TO “READ” THEIR PAIN. LET THEM KNOW THEY MAY INITIALLY EXPERIENCE PAIN WITH MOVEMENT, BUT THE PAIN WILL GO AWAY ONCE THEY STOP THE MOVEMENT. THAT IS “DYSFUNCTIONAL PAIN” AND IS EXPECTED BECAUSE THEY ARE WORKING TISSUES IN A NEW AND REMODELED WAY. IF THEY WORK THE TISSUES AND EXPERIENCE PAIN AND THE PAIN PERSISTS FOR HOURS AFTER DOING THE MOVEMENT, THAT IS MOST LIKELY PAIN FROM INFLAMMATION AND TISSUES WORKING BEYOND THEIR CAPABILITIES. THE IDEA IS TO WORK THE HEALING TISSUES IN THE NEW, REMODELED WAY WITHIN THEIR CAPABILITIES AND WITHOUT CAUSING INFLAMMATION. THIS IS NOT A SITUATION OF “NO PAIN, NO GAIN.” WHEN WORKING WITH “DYSFUNCTIONAL PAIN,” WORK UP TO THE POINT OF FIRST EXPERIENCING PAIN AND/OR STRETCH. DO NOT TRY TO WORK THROUGH THE PAIN. IF THE PAIN IS DYSFUNCTIONAL, THEY WILL BE ABLE TO GRADUALLY GAIN MORE AND MORE RANGE OF MOTION (ROM) WITHOUT INCREASING INFLAMMATION AND THEIR LEVEL OF PAIN.

- THE LOWER MRD AND ITS DEVICE ARM ALLOWS THE CLIENT TO BETTER CONTROL THE MOTION OF THEIR KNEE WITHIN THEIR “DYSFUNCTIONAL ARC” OF MOTION. IT ALSO HAS A LOCKING MECHANISM FOR KNEE EXTENSION. AS THE “MYOMEMORY” CHANGES, THE CLIENT SHOULD BE ABLE TO GRADUALLY INCREASE THEIR RANGE MOTION IN BOTH FLEXION AND EXTENSION.

- THE DEVICE ARM, ALLOWS THE CLIENT TO DO BOTH CONCENTRIC AND ISOMETRIC MUSCLE ACTIVITIES. WITH AN ISOMETRIC CONTRACTION, THE MUSCLE IS FACILITATED INCREASING THE THE FORCE AND TENSION, BUT THERE IS NO JOINT MOVEMENT. IT IS A STATIC EXERCISE WORKING THE MUSCLE TO IMPROVE JOINT STABILITY. WITH A CONCENTRIC CONTRACTION, THE MUSCLE SHORTENS AND LENGTHENS PRODUCING MOVEMENT OF THE LOWER EXTREMITY. IT IS A DYNAMIC EXERCISE WORKING THE MUSCLE TO IMPROVE JOINT MOBILITY. FOR NORMAL JOINT RANGE MOTION THE CLIENT NEEDS BOTH STABILITY AND MOBILITY.

- THE TIME HOLDING THE END OF A MOVEMENT DEPENDS ON THE TISSUE YOU ARE TRYING TO ISOLATE. FOR MUSCLE, HOLD A POSITION FOR UP TO A MAXIMUM OF 30 SECONDS WHEREAS LONGER WILL AFFECT MORE THE CONNECTIVE TISSUE AND MYOFASCIA. THE HOLD TIME CAN BE USED TO ALTER THE INTENSITY OF THE EXERCISE.

•THE FREQUENCY OF EXERCISE ON THE LOWER MRD VARIES WITH EACH PATIENT. HOWEVER, IT IS BETTER TO SPREAD THE REPETITIONS DONE THROUGHOUT THE DAY RATHER THAN DOING ONE TO TWO INTENSE SESSIONS. THAT IS THE ADVANTAGE OF USING THE LOWER MRD AT HOME. FOR EXAMPLE, DOING A PRACTICE OF A STATIC OR DYNAMIC MOVEMENT EVERY OTHER HOUR WHILE MONITORING THEIR PAIN, SWELLING, AND SKIN TEMPERATURE RESPONSE IS PREFERRED. HAVE CLIENTS DO 3-12 REPETITIONS EACH SESSION.

•REMEMBER THE BUILT IN GONIOMETER TO DOCUMENT INITIAL JOINT RANGE OF MOTION (ROM) AND PROGRESS.

•REMEMBER THE INTENSITY OF EXERCISE CAN BE ALTERED BY THE HOLDING TIME, REPETITIONS, AND ROM.

•REMEMBER THE BODY IS THREE-DIMENSIONAL. WITH THE LOWER MRD, THE SIMPLE MOTION PRACTICED IS WITH KNEE EXTENSION AND FLEXION IN THE SAGITTAL PLANE. HOWEVER BY CHANGING THE PROPRIOCEPTIVE SENSORY INPUT WITH THE POSITION OF THE FOOT AND ANKLE, YOU CAN ALSO AFFECT THE TENSION AND LENGTH OF MUSCLES AND MYOFASCIA IN THE FRONTAL AND TRANSVERSE PLANES.

•ALL MOVEMENTS CAN BE PERFORMED WITH THE EYES OPENED TO FACILITATE VESTIBULAR-OCULAR REFLEXES AND CLOSED TO INHIBIT THE AFFECT OF THESE REFLEXES ON THE TONE AND LENGTH OF THE MUSCLES AND MYOFASCIA.

#### Progression of lower MRD use:

1) Have client familiarize themselves with the LOWER MRD by extending and flexing their knee in the sagittal plane using the active-assist handle. Emphasize that they are in control of their motion.

2) Extend the leg up at the knee into knee extension with the LOWER MRD's arm to where first experiencing dysfunctional pain and/or stretch. Flex the leg back into knee flexion where first experiencing pain and/or stretch. Repeat as much as needed to familiarize the client with the lower MRD. Use the locking mechanism in knee extension to lock in the extension arc of motion in regards to their dysfunctional pain.

#### 3) SAGITTAL/FRONTAL PLANE MOTION:

Begin working the knee in the sagittal plane with flexion and extension. The frontal plane can be incorporated by altering the proprioceptive input at the foot and ankle. During knee flexion, the client can point the ankle and foot down in plantarflexion and during knee extension, the client can flex the ankle and foot up in dorsiflexion.

During concentric exercise, have the client with the lower MRD'S active-assist handle move their knee into knee flexion and plantarflexion until first experiencing dysfunctional pain and/or stretch and hold for 5 to 30 seconds. With the lower MRD's active-assist handle now move into knee extension and dorsiflexion to the locked position and hold for 5-30 seconds. Initially, have client hold the extremes of their arc of motion for knee flexion and extension for 5 seconds and gradually increase the hold time to a maximum of 30 seconds. Do this sequence as just described of knee flexion and extension 3-12 times. Remember you can also alter sensory input by closing the eyes during the knee flexion and extension motion. You can have the client do this concentric flexion and plantarflexion and extension and dorsiflexion motion with both knees. If there is a significant fear of moving their involved leg, start with their uninvolved limb and then do the involved limb.

As the client experiences more confidence with knee flexion and extension motion, you can begin an isometric contraction of the muscles at the extremes of knee the flexion and extension arc of motion. With the lower MRD's active assist arm, have client flex their knee with plantarflexion until first experiencing dysfunctional pain and/or stretch and hold. Keeping their pressure forward on the device's arm, have the client flex their knee without any motion gradually building up their muscle tension of the hamstrings. Build up the tension until first experiencing dysfunctional pain and hold. The intensity of exercise can be modulated by the time of hold to a maximum of 30 seconds and the percentage of tension. When building up their muscle tension, they may start out at about 10-20% of maximum force and gradually build to about 80%. Repeat 3-12 times.

With the lower MRD's active assist arm, have the client extend their knee with dorsiflexion to where it is locked in and hold. Have the client extend their knee without any motion gradually building up their muscle tension of the quadriceps. Build up the tension until first experiencing the dysfunctional pain and hold. The intensity of exercise can be modulated by the time of hold to a maximum of 30 seconds and the percentage of tension. When building up their muscle tension, they may start out at about 10-20% of maximum force and gradually build to about 80%. Repeat 3-12 times.

#### 4) SAGITTAL/TRANSVERSE PLANE MOTION:

Now begin working the knee in flexion and extension in the sagittal and transverse planes. The transverse plane can be incorporated by altering the proprioceptive input again at the foot and ankle. During knee flexion, the client can turn the foot inward toward the midline of the body in inversion for pronation of the lower extremity chain and also turn the foot outward away from the midline of the body in eversion for supination during knee flexion. During knee extension, again foot inversion and eversion can be done to alter the proprioceptive input. Pronation and supination are normal movements of the lower extremity chain during walking.

During concentric exercise, have the client with the lower MRD'S active-assist handle move their knee into knee flexion and foot inversion until first experiencing dysfunctional pain and/or stretch and hold for 5 to 30 seconds. With the lower MRD's active-assist handle now move into knee extension with foot inversion to the locked position and hold for 5-30 seconds. Initially, have client hold the extremes of their arc of motion for knee flexion and extension for 5 seconds and gradually increase the hold time to a maximum of 30 seconds. Do this sequence as just described of knee flexion and extension 3-12 times. Remember you can also alter sensory input by closing the eyes during the knee flexion and extension motion. Repeat the knee flexion and knee extension motion as described above, but this time with foot eversion by turning the foot out away from the midline of the body.

You can then begin an isometric contraction of the muscles at the extremes of the knee flexion and extension arc of motion. With the lower MRD's active assist arm, have the client flex their knee with foot inversion (foot turned inward) until first experiencing dysfunctional pain and/or stretch and hold. Keeping their pressure on the device's arm by pushing forward, have the client flex their knee without any motion gradually building up their muscle tension of the hamstrings. Build up the tension until first experiencing dysfunctional pain and hold. The intensity of exercise can be modulated by the time of hold to a maximum of 30 seconds and the percentage of tension. When building up their muscle tension, they may start out at about 10-20% of maximum force and gradually build to about 80%. Repeat 3-12 times.

With the lower MRD's active assist arm, have the client extend their knee with foot inversion (foot turned inward) to where it is locked in and hold. Have the client extend their knee without any motion gradually building up their muscle tension of the quadriceps. Build up the tension until first experiencing the dysfunctional pain and hold. The intensity of exercise can be modulated by the time of hold to a maximum of 30 seconds and the percentage of tension. When building up their muscle tension, they may start out at about 10-20% of maximum force and gradually build to about 80%. Repeat 3-12 times.

With the lower MRD's active assist arm, have the client flex their knee with foot eversion (foot turned outward) until first experiencing dysfunctional pain and/or stretch and hold. Keeping their pressure on the device's arm by pushing forward, have the client flex their knee without any motion gradually building up their muscle tension of the hamstrings. Build up the tension until first experiencing dysfunctional pain and hold. The intensity of exercise can be modulated by the time of hold to a maximum of 30 seconds and the percentage of tension. When building up their muscle tension, they may start out at about 10-20% of maximum force and gradually build to about 80%. Repeat 3-12 times.

With the lower MRD's active assist arm, have the client extend their knee with foot eversion (foot turned outward) to where it is locked in and hold. Have the client extend their knee without any motion gradually building up their muscle tension of the quadriceps. Build up the tension until first experiencing the dysfunctional pain and hold. The intensity of exercise can be modulated by the time of hold to a maximum of 30 seconds and the percentage of tension. When building up their muscle tension, they may start out at about 10-20% of maximum force and gradually build to about 80%. Repeat 3-12 times.

The Specific Adaptation to Imposed Demands (SAID) principle is a classic sports medicine principle that I can attest to in my experiences of over twenty years with the winter sport of nordic ski jumping. It describes how physical adaptations develop when the body is under physical stress as with exercise, thereby allowing the body to better handle the stress of exercise. A good example of this is how the muscles, tendons, ligaments, bones, and fascia of the right arm for a right handed tennis player like Serena Williams gets bigger and thickened in response to the excessive demands from years of engaging in a right motor dominant sport. In short, the body gets better at doing whatever it does regularly because practice makes permanent implying you need to repeat an action many times for it to become habit. The lower MRD will allow you to accomplish this in your rehabilitation process, but it takes your persistence, energy, and practice. The secret to a successful rehabilitation program is practice because practice only makes for improvement.