



By Tyler Inman

### **Preventable musculoskeletal (MSK) injuries plague Army readiness.**

Among Active Duty Soldiers, [MSK injuries](#) result in over 10 million limited duty days each year and account for over 70% of medically non-deployable Soldiers. Described by health experts as the single biggest health problem in the U.S. Military, almost 50% of service members experience one or more injuries each year, resulting in over 2 million medical encounters, and requiring 90-120 days of lost duty for each injury. Most of these injuries are a result of overuse strains, sprains, and stress fractures to the lower leg and foot; more than half are exercise or sports-related. Of note, available statistics and literature identify [running as one of the major causes](#) of MSK injuries. Recruitment, societal, and cultural issues aside, most health experts and senior Army leaders agree a “balanced fitness program” is a critical component of the prescription required to diminish preventable MSK injuries and increase Army readiness. What does a “balanced fitness program” look like? Who will develop, implement, and supervise these efforts? What Army doctrine should we

look towards to further understand how to optimize fitness while simultaneously reducing risk of injury?

Current Army doctrine does not sufficiently address these issues. It is incumbent upon platoon-level leaders to plan, prepare, and execute physical readiness training that logically and systematically generates the type of comprehensive physical readiness capable of reducing preventable MSK injuries. To achieve this end state, leaders must understand the fundamental principles offered in "[A Leader's Guide to Training for the ACFT](#);" more importantly, leaders must empower subordinates to develop and implement training strategies that look vastly different than the physical training that produced success on the APFT. What follows is a practical, evidence-based template intended for use by junior Army leaders to develop physical readiness training strategies representative of the "balanced fitness program" the Army needs.

### **The ACFT is not an impediment to action; the ACFT is the impetus for action.**

The Army Combat Fitness Test (ACFT) presents some challenges; it also presents a great deal of opportunity. As we learn to train for a new fitness test, we must fine-tune our understanding of fitness in the context of performance. Overall fitness can be divided into two categories: *physical fitness* and *motor fitness*. Measurable qualities of the human body's physical processes, or physiology, are the components of physical fitness: muscular strength and endurance; aerobic and anaerobic endurance. Elements of motor fitness like power, speed, agility, coordination, balance, and reaction time, are often overlooked by traditional training programs, but no less vital to performance. The type of overall fitness that will make Soldiers more resistant to injury can only be obtained when we combine efforts to improve physical fitness with deliberate efforts to improve motor fitness.

### **Precision - the best place to start.**

Evidence suggests that precise movement patterns are fundamental to overall fitness by way of reducing injury risk *and* increasing basic function.<sup>[1]</sup> Precise movement, developed by "grooving appropriate and perfect motion and movement patterns," should be the foundation of a well-designed training program.<sup>[2]</sup> The ability to move precisely (and pain free) through each of the movement patterns demanded by our "sport" also contributes to improved performance in both categories of overall fitness. There are six fundamental athletic movement patterns Soldiers must groove appropriately to reduce injury risk and improve performance.

## **The Precise Pattern Six**

There are six fundamental movement patterns for which Soldiers must build progressive competence: hinge, squat, push, pull, lunge, and rotate.<sup>[3]</sup> For optimal performance and injury prevention, Soldiers must learn to execute each of these patterns with an appropriate range of motion, a high degree of stability, and precise alignment of the body's joints for best use of the body's levers. Figure 1 describes each of the fundamental movement patterns.

## Hinge

Flex at the hips first; push the hips rearward with retracted shoulders; head remains in line with the spine. Continue to flex at the hips until the hamstrings limit range of motion; this should occur when the torso is near parallel to the ground. Legs are generally straight; knees are soft; shins remain vertical and perpendicular to the floor; feet hip width apart.



## Squat

Position feet generally shoulder-width apart; toes pointed forward or up to 15 degrees outward. Push hips backwards while maintaining a neutral spine. Flex at the knees while maintaining a generally upright torso during descent; brace the trunk and maintain torso angle. Squat through a full range of motion (generally until thighs are parallel to the ground). Return to full extension.



## Lunge

Take an elongated step forward, flexing the lead hip and knee to 90 degrees; allow the trail knee to bend until it hovers 1 to 2 inches off the ground. Maintain an upright torso and avoid flexing at the hip of the trail leg. When the lead thigh is parallel to the floor, the rear knee, hip, and shoulder should be stacked vertically.



## Push

Upper-body push exercises must occur in both the frontal and sagittal planes (vertically and horizontally). During both vertical and horizontal pushes, the torso should remain stable and neutral, head in line with the spine, hips underneath or in line with the shoulders, and shoulders held down and away from the ears. Scapulae movement should be smooth and balanced.



## Pull

Upper-body pull exercises must occur in both the frontal and sagittal planes (vertically and horizontally). During both vertical and horizontal pulls, the torso should remain stable and neutral, head in line with the spine, hips underneath or in line with the shoulders. Scapulae movement should be smooth, rhythmic, and retracted while the arms are flexed.



## Rotate

Before we rotate, we must learn to stabilize and resist rotation. Consider the concept of “torsional buttressing” as you stabilize the trunk to maintain balance and proper posture during dynamic movement. Head should remain neutral; lumbar maintains neutral curve. During rotational exercises, rotation should occur through the thoracic spine and lateral flexion of the lumbar should not occur.



Figure 1: The six fundamental movement patterns.

### **Preventing the most likely of scenarios.**

Somewhere, right now, on an installation near you, a Soldier is executing a squat, deadlift, or power clean with a load that is too heavy and with poor form. One of his or her teammates is not only watching but encouraging them to keep pushing forward. Over time, repetitive execution with poor mechanics will result in an injury (not unlike the previously mentioned MSK injuries caused by chronically poor running mechanics). We should applaud our Soldiers for identifying the need to train for muscular strength, but we also have a responsibility to ensure Soldiers have the appropriate motor fitness foundations *before* we load a potentially compromised system. Here's how:

### **Conduct a PMCS: Precise Movement Competency Screening**

Movement competency, or the “cognitive awareness and technical quality of an individual’s movement strategies,” influences muscle activation; joint loading; and ultimately injury risk, strength, and power expression.<sup>[1]</sup> Using the Precise Pattern Six as a guide, Soldiers at the platoon level and below should conduct a screening for movement competency before initiating a training program that progressively loads variations of the six key patterns. Figure 2 is a practitioner’s guide to determining whether a Soldier is ready to advance to more dynamic or intense training techniques.

Precise Movement Competency Screening (PMCS)



Focus	Hinge	Squat	Lunge (& Twist)	Push	Pull	Rotate (Resist)
Range of Motion	With a soft bend in the knee, torso near parallel to the ground	From full extension of the hips at the top of the movement to full depth when thighs are parallel to ground	Lead hip bends to 90 degrees; trail knee hovers 1 to 2 inches off ground	Elbows extend fully at top; chest rests on ground at bottom.	From dead hang: full elbow extension Pulls until bar is even with midline of the neck.	Bicep of raised arm level with and near ear; hip on side of raised leg fully open/extended
Balance	Maintained	Maintained; weight evenly distributed on each foot.	Maintained; weight evenly distributed on each foot.	Weight evenly distributed on each hand.	Even pull with both arms	Maintained; weight does not noticeably shift when knee and hand are raised.
Head	Centered and neutral; remains in line with the spine.	Centered and neutral; remains in line with the spine.	Centered and neutral; remains in line with the spine.	Centered and neutral; remains in line with the spine.	Centered and neutral; remains in line with the spine. Chin level to ground.	Centered and neutral; remains in line with the spine.
Shoulders	Retracted; not rounded. Down and away from the ears.	Retracted; not rounded. Elbows stay in line with ears	Retracted; down and away from ears.	Capable of smooth retraction to facilitate hand lift; lift not initiated by back arch.	Scapulae movement balanced and smooth; does not require kips or jerks.	Base shoulder is stable; shoulder of raised arm is mobile and extends fully.
Trunk	Stable and neutral throughout movement. Maintains natural curve.	Stable and neutral throughout movement. Maintains natural curve.	Stable and neutral; maintains natural curve. Generally upright through full ROM.	Stable and neutral. Forms a generally straight line from shoulder to hips.	Stable and neutral.	Stable and neutral; does not rotate or flex.
Hips	Initiate movement and facilitate trunk flexion	Move back and down; hips do not tuck under; low back does not arch excessively	Appear mobile and stable; do not sink or elevate during twist.	Held in line with the body. Rise at same rate as shoulders and trunk.	Glutes engaged. Hips remain generally underneath the bar; rise w/o excessive arch	Fully open/extend on side of raised leg; hips remain horizontally aligned.
Knees	Very slight/soft bend in the knees. Aligned over feet.	Track in line with the feet, do not extend past toes at full depth.	Aligned with hips; tracking in line with toes; do not move laterally during rotation.	Extended.	Extended or slightly flexed; not used to generate momentum.	Fully extended when leg raised; remain in line with hips and foot.
Ankles	Appear stable, underneath hips.	Appear stable; flex to allow adequate depth	Appear stable; flex to allow adequate depth	Flexed; stable.	Not crossed.	Ankle of raised leg is dorsiflexed - toes pulled towards the shin
Feet	Pointing straight forward; aligned under knees; hip width apart to begin.	Stable; heels remain in contact with ground; balanced on midfoot	Lead foot flat and stable; trail foot flexed and balanced.	Straight; less than a foot-width apart; heels don't fall in or out.	Toes point forward or towards the ground	Toes point rearward or towards the ground.

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Figure 2: Precise Movement Competency Screening (PMCS).

The PMCS is intended for use at the squad level as both a preventive tool (as the acronym alludes) and a gateway to more advanced training techniques. Based on a Soldier's competency in a given movement, he or she may need to spend more time grooving appropriate and perfect movement patterns before adding a load or increasing intensity. This is a qualitative assessment; leaders must conduct some self-study or depend on a teammate with a strong athletic background, to provide corrective feedback with the potential to improve a Soldier's movement. In some cases, a simple cue like "retract your shoulders and maintain a flat back" may be enough to correct a Soldier's movement during a PMCS. When a Soldier demonstrates the ability to execute a given movement well, they may progress to loaded movements in accordance with the unit's training plan.

Remember: a high-quality unit training plan accounts for varying degrees of movement competency and overall fitness by "individualizing" the selected exercises; this means that each prescribed exercise can be scaled to the appropriate level of difficulty for both the weakest and strongest performer in the squad.

As the intensity of the training program increases, Soldiers must continue to demonstrate competency through each of the Precise Pattern Six movements. As with the unloaded

PMCS, simple cues may be enough to correct a Soldier's form; video feedback can also be a powerful tool.<sup>[1]</sup> When cues are no longer effective, or when the intensity of an exercise overcomes the Soldier's ability to maintain precision, he or she must make the wise choice to reduce the intensity until precision is restored. This may require identifying the limiting factor in the kinematic chain. For example, a common error in the squat movement is failing to maintain the entire foot in contact with the ground — usually observed as “coming up on the toes.” A simple cueing strategy is to remind the performer to “keep the weight in the heels.” If a Soldier is unable to achieve this standard, it may indicate a lack of mobility in the ankles or hips, or a lack of stability in the foot or trunk. In this case, the Soldier may need to use a more comprehensive strategy to develop a precise squat pattern. This might include: assisted squats to groove the appropriate motion pattern; exercises to increase hip and/or ankle mobility; and exercises for increasing trunk strength and stability.

### **“We need to treat our Soldiers like elite athletes.”**

Many have heard this mantra before, but most don't know where to begin. A common misconception about “training like an elite athlete” is that cutting-edge techniques and dynamic, high intensity programs rule the day. Often, elite performers focus on precise execution of the fundamentals above all else. Understanding, teaching, and enforcing fundamentals (for movement, for nutrition, for recovery) is exactly how we start treating our Soldiers like elite athletes. In the physical domain, paramount to performance and injury prevention, precise execution of fundamental movement patterns is where it all begins.

### **Where do we go from here? Progression**

Precise execution of fundamental movement patterns (hinge, squat, push, pull, lunge, rotate) is vital to increased performance and injury prevention. As Soldiers increase overall fitness by grooving perfect motor patterns, leaders should progress the training through the following stages:

### **Groove. Stabilize. Increase. Build. Develop.**<sup>[2]</sup>

1. Groove: appropriate and perfect motion and motor patterns.
2. Stabilize: build whole-body and joint stability (mobility at some joints and stability though the lumbar and trunk).
3. Increase: endurance.
4. Build: strength.
5. Develop: speed, power, and agility.

A low to moderate degree of loading may be appropriate to assist Soldiers in building competency in the Precise Pattern Six. Steps 1 and 2, groove and stabilize, have a complementary relationship because an inability to achieve precision in the fundamental movements may result from a lack of mobility or stability. If this is the case, the Soldier must take deliberate action to improve mobility and/or stability in the appropriate joints and regions of the body.

*Potential Scenario: A new Soldier arrives to the unit and their squad leader conducts a PMCS during their in-processing. The Soldier demonstrates a moderate degree of competency in the squat and progresses to a goblet squat with a moderate load. During the execution of the loaded squat, the Soldier demonstrates an inability to maintain proper posture of the torso and the Soldier's heels rise from the ground before the Soldier reaches an appropriate squat depth. The most appropriate course of action is to remove or reduce the load until the Soldier can perform the exercise with precision. While the Soldier works on grooving the appropriate pattern with a reduced load, the squad leader should prescribe some concurrent training aimed at improving both trunk stability and hip and ankle mobility.*

The list below represents “a way” to progress through each of the Precise Pattern Six movements as Soldiers develop competency in each pattern. Videos for many of these exercises are available [here](#).

### Progression of the Precise Pattern 6

#### Hinge

- PVC pipe deadlift and good morning
- Bilateral hip thrust, single leg hip thrust
- Bilateral kettlebell (KB) deadlift, bilateral KB romanian deadlift (RDL)
- KB Swing
- Hex-bar deadlift, unilateral KB/dumbbell (DB) deadlifts
- Loaded good morning, unilateral and single leg RDLs
- Progression through loaded barbell deadlift and RDL

#### Squat

- Band or strap assisted squat



- Air squat
- Goblet squat
- Squat with PVC pipe overhead
- Barbell front squat, DB front squat
- Unilateral DB or KB front squat
- Back squat
- Pistol squat
- Loaded overhead squat

### Push

- DB overhead press
- BB overhead press
- Push press
- Hand-release push-up (HRPU), t-push-up
- Ring push-up, dip
- Bench press
- Plyo push up
- Slide board push up

### Pull

- DB row, ring row
- Bent over row
- Straight-arm pull
- Pull-up
- Ring pull up

### Lunge

- Forward lunge
- Backward lunge
- Walking lunge
- Side lunge (cossack squat)
- Each w/ load (front, back, overhead, unilateral)
- Step up/down
- With load
- Jumping lunge, w/ switch

## Rotate

- Unloaded - lunge with twist, deep lunge with twist
- Resist rotation with the two-point hold
- Lunge position - resist rotation with band resistance
- Dynamic - rotation with med ball throw - 4-way plyo circuit
- Side-shuffle, turn and run
- Backwards run and turn

Check back tomorrow for part 2!

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<sup>[1]</sup>Nowels, Russell G., and Jennifer K. Hewitt. "Improved Learning in Physical Education through Immediate Video Feedback." *Strategies*31, no. 6 (2018): 5-9.

<sup>[2]</sup>McGill, Stuart. "Core training: Evidence translating to better performance and injury prevention." *Strength & Conditioning Journal*32, no. 3 (2010): 33-46.

<sup>[1]</sup>Ibid; Hewett, Timothy E., Joseph S. Torg, and Barry P. Boden. "Video analysis of trunk and knee motion during non-contact anterior cruciate ligament injury in female athletes: lateral trunk and knee abduction motion are combined components of the injury mechanism." *British journal of sports medicine*43, no. 6 (2009): 417-422; Myer, Gregory D., Kevin R. Ford, and Timothy E. Hewett. "Rationale and clinical techniques for anterior cruciate ligament injury prevention among female athletes." *Journal of athletic training*39, no. 4 (2004): 352.

<sup>[1]</sup>O'Connor, Francis G., Patricia A. Deuster, Jennifer Davis, Chris G. Pappas, and Joseph J. Knapik. "Functional movement screening: predicting injuries in officer candidates." *Medicine and science in sports and exercise*43, no. 12 (2011): 2224-2230; Lisman, Peter, Francis G. O'Connor, Patricia A. Deuster, and Joseph J. Knapik. "Functional movement screen and aerobic fitness predict injuries in military training." *Medicine & Science in*

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<sup>[2]</sup>McGill, Stuart. "Core training: Evidence translating to better performance and injury prevention." *Strength & Conditioning Journal*32, no. 3 (2010): 33-46.

<sup>[3]</sup>Kritz, Matthew, John Cronin, and Patria Hume. "The bodyweight squat: A movement screen for the squat pattern." *Strength & Conditioning Journal*31, no. 1 (2009): 76-85; Kritz, Matthew, John Cronin, and Patria Hume. "Using the body weight forward lunge to screen an athlete's lunge pattern." *Strength & Conditioning Journal*31, no. 6 (2009): 15-24; Kritz, Matthew, John Cronin, and Patria Hume. "Screening the upper-body push and pull patterns using body weight exercises." *Strength & Conditioning Journal*32, no. 3 (2010): 72-82.

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