



# Electromyography and Functional Movement Screening as Indicators of Return to Full Activity: Case Study

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## Abstract

**Purpose:** To determine the efficacy of combined FMS and EMG measurements as indicators of return to full-activity after arthroscopic knee surgery.  
**Question:** Are there any advantages to using both FMS and EMG as indicators of return to full activity?  
**Methods:** Prescreening of physically active 55-year old female prior to arthroscopic knee surgery (AKS) included FMS assessment with EMG analysis of rectus femoris while performing FMS. EMG of LESS and box jumps using 30 cm box were also collected. Post-surgery assessments occurred weekly, starting at week three. Final assessment occurred during week nine post-surgery.  
**Results:** Nine-week FMS analysis indicated that full recovery from AKS had been realized. Pre-surgery and nine-week post-surgery FMS scores were both 16. Nine-week EMG analysis did not indicate that full recovery had occurred. Rectus femoris activation pre-surgery during FMS squat assessment was 0.63 (Abs. Int.) with Max-min= 2.05. Rectus femoris activation during the FMS squat nine-week post-surgery was 0.28 (abs. Int.) with Max-min= 0.95. Descriptive data indicate a large difference in muscle activation in both strength and power, from pre to nine-week post-surgery.  
**Conclusion:** EMG and FMS scores combined may be a better indicator of returning to full activity post knee arthroscopy than either of the assessments alone. While the nine-week FMS score indicated that full recovery from surgery had occurred, nine-week EMG data revealed otherwise. The EMG scores were better indicators of muscle imbalance and may be better predictors of risk of injury if subject pursues rigorous dynamic activity too soon.

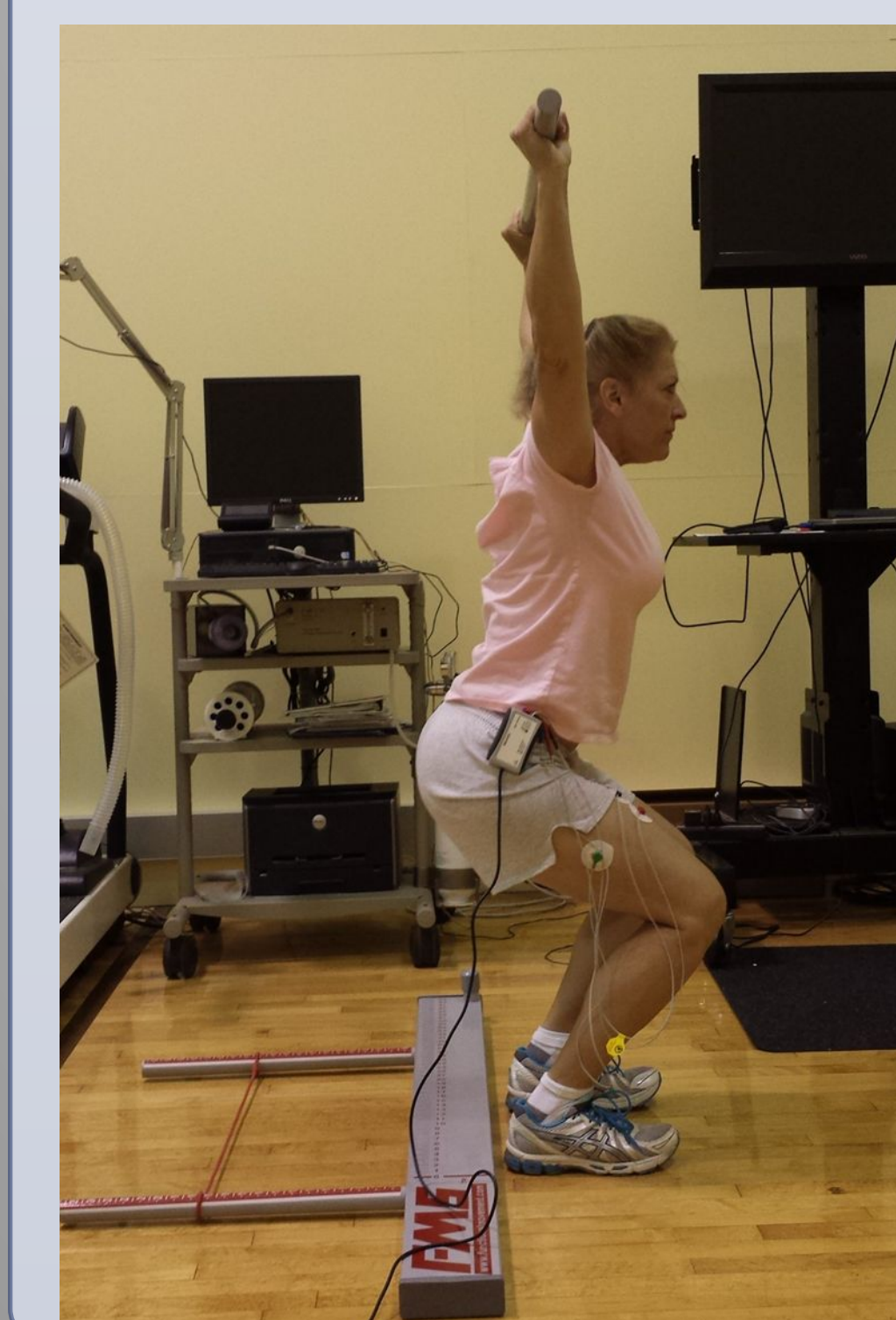
## Introduction

Determining risk of injury and return to activity after injury or surgery may involve FMS assessment by trainers and physical therapists. A diagnostic EMG may detect muscle weakness. Combining FMS and EMG might better determine status of muscular balance and therefore be a better determinant of returning to full activity.

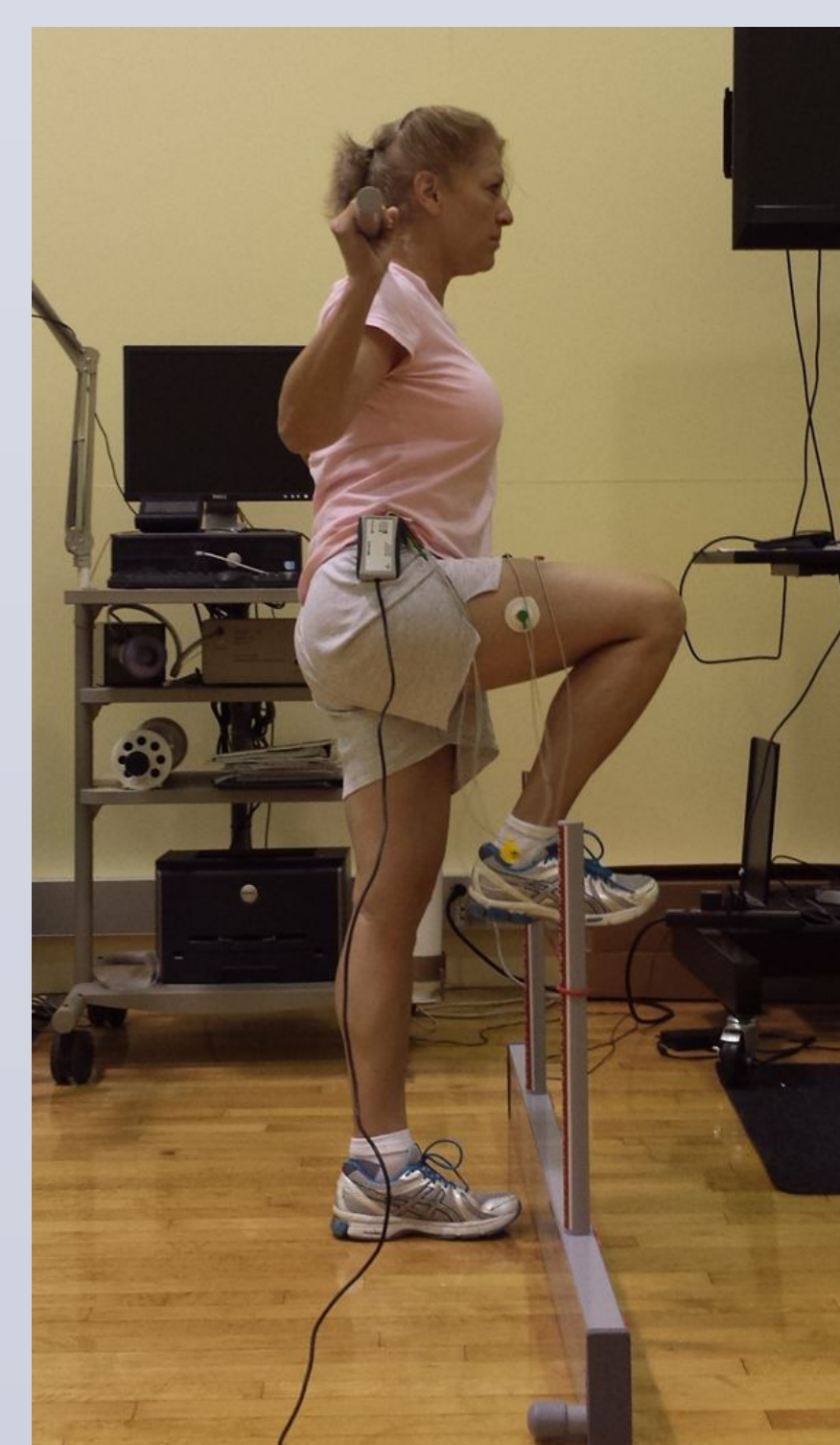
**Figure 1**  
*Right Rectus Femoris EMG Box Jump*



**Figure 2**  
*FMS: Squat Nine Weeks Post*



**Figure 3**  
*FMS: R. Hurdle Nine Weeks Post*



## Methods

- Setting:**
- Small DI Midwestern University Human Performance Lab
  - Fall 2014
- Subject:**
- Physically active 55-yr female with torn right medial meniscus/repair
- Instrumentation:**
- iWorx IXTA -EMG stimulator, computer & LabScribe3 Software
  - Electrodes, leads, B3G iwire
  - FMS equipment
  - 30 cm box
- Methods:**
- Subject volunteered for study
  - Pre-surgery:** EMG data and FMS scores were collected
    - Electrodes were connected to belly of (R) rectus femoris (RF)
    - Subject completed 3 of each FMS, 3 box jumps, 3 LESS jumps
    - Data was recorded on computer connected to IXTA using LabScribe3
    - Subject received medial right knee partial meniscectomy
  - Post-surgery:** Subject attempted each FMS movement, box jump, and LESS three times each, starting at week three, following the same format and procedures as pre-surgery
  - Data was analyzed with LabScribe software

## Results

| Table 1                                             |     |      |      |      |
|-----------------------------------------------------|-----|------|------|------|
| FMS Scores Pre Six, Eight, & Nine Week Post Surgery |     |      |      |      |
| Assessment                                          | Pre | Wk 6 | Wk 8 | Wk 9 |
| L/R Hurdle                                          | 3   | 3    | 3    | 3    |
| Squat                                               | 2   | 0    | 1    | 2    |
| L/R Lunge                                           | 3   | 0    | 3    | 3    |
| L/R Leg Raise                                       | 3   | 3    | 3    | 3    |
| L/R Rotary                                          | 1   | 0    | 0    | 0    |
| Push-Up                                             | 2   | 2    | 2    | 2    |
| L/R Shoulder                                        | 2   | 2    | 2    | 2    |
| Total FMS Score                                     | 16  | 10   | 14   | 16   |

| Table 2                                                                               |             |         |          |         |          |         |          |         |          |         |  |
|---------------------------------------------------------------------------------------|-------------|---------|----------|---------|----------|---------|----------|---------|----------|---------|--|
| <i>Electromyography of Right Rectus Femoris Pre &amp; Six -Nine Week Post Surgery</i> |             |         |          |         |          |         |          |         |          |         |  |
|                                                                                       | Pre-Surgery |         |          | Week 6  |          | Week 7  |          | Week 8  |          | Week 9  |  |
| Assessment                                                                            | Abs. Int    | Max/Min | Abs. Int | Max/Min | Abs. Int | Max/Min | Abs. Int | Max/Min | Abs. Int | Max/Min |  |
| L. Hurdle                                                                             | 0.17        | 1.18    | 0.07     | 0.57    | 0.07     | 0.41    | 0.06     | 0.54    | 0.08     | 0.33    |  |
| R. Hurdle                                                                             | 0.45        | 2.90    | 0.15     | 1.71    | 0.14     | 2.38    | 0.10     | 0.10    | 0.14     | 1.35    |  |
| Squat                                                                                 | 0.63        | 2.05    | 0.23     | 1.23    | 0.28     | 0.91    | 0.26     | 1.13    | 0.28     | 0.95    |  |
| L. Lunge                                                                              | 0.44        | 1.96    | 0.14     | 0.58    | 0.12     | 0.48    | 0.12     | 0.54    | 0.23     | 0.67    |  |
| R. Lunge                                                                              | 0.42        | 2.18    | 0.18     | 0.68    | 0.13     | 0.54    | 0.12     | 0.49    | 0.1      | 0.54    |  |
| Box Jump                                                                              | 1.78        | 2.80    | N/A      | N/A     | N/A      | N/A     | 0.13     | 1.72    | 0.18     | 2.81    |  |
| LESS                                                                                  | 3.26        | 23.82   | N/A      | N/A     | N/A      | N/A     | N/A      | N/A     | N/A      | N/A     |  |

\*value=0.7

## Results

| Table 4                                 |      |      |            |         |
|-----------------------------------------|------|------|------------|---------|
| Difference in EMG Pre to Week Nine Post |      |      |            |         |
| Assessment                              | Pre  | Wk 9 | Difference | Percent |
| L. Hurdle                               | 0.17 | 0.08 | 0.09       | 47      |
| R. Hurdle                               | 0.45 | 0.14 | 0.31       | 31      |
| Deep Squat                              | 0.63 | 0.28 | 0.35       | 44      |
| L. Lunge                                | 0.44 | 0.23 | 0.21       | 52      |
| R. Lunge                                | 0.42 | 0.1  | 0.32       | 24      |
| Box Jump                                | 1.78 | 0.18 | 1.6        | 10      |

Subject did not feel confident in performing the LESS nine weeks post-surgery.

## Discussion

EMG of the rectus femoris nine weeks post surgery indicated that full recovery had not been realized. For example, squat performance nine week post surgery for the rectus femoris was 44% of pre-surgery EMG muscle activation and 52% for the left lunge. This data indicates that even nine weeks post surgery, the rectus femoris was not firing at full capacity. However, nine week FMS scores were identical to pre-surgery scores at 16/21. Trainers and physical therapists rely on FMS assessments as predictors of risk of injury. Knapik et al (2015) reviewed FMS as a predictor of injury in research of 1,045 male and female US Coast Guard. Researchers found that males scoring  $\leq 12$  and females scoring  $\leq 15$  indicated a greater risk of injury. However, researchers concluded that FMS seemed to have limited promise in predicting risk of injury.

If  $\leq 15$  for females is standard for indication of increased risk of injury, the subject of this study would have been cleared for full activity at week nine. EMG data indicated otherwise. According the CORE Institute (2015, May) after AKS, most patients are able to return to work at 3-6 weeks, but all people are different and workplaces and sports have different demands. Nevertheless, progressive rehabilitation is important after AKS (CORE, 2015).

## Conclusion

There may be advantages in combining FMS and EMG assessments when evaluating individuals recovering from arthroscopic knee surgery. FMS alone may not be the best indicator for a return to full activity if that activity requires great physical demands like particular sports where muscle balance is crucial. EMG assessments appear to be more informative of muscular fidelity during recovery as well as the fidelity of the rehab or physical therapy program engaged in by the patient.

## References

Knapik, J. J., Cosio-Lima, L. M., Reynolds, K. L., Shumway, L. S., (2015). Efficacy of functional movement screening for predicting injuries in coast guard cadets. Journal of Strength and Conditioning Research/National Strength and Conditioning Association, 29(5), 1157-62. Human Kinetics, USA.

The CORE Institute (2015, May) from <http://www.thecoreinstitute.com/patient-and-visitor-information/core-patient-education/knee/knee-a-arthroscopy.html>