# Football Specific Hand Muscle Patterns & Training Approaches

**Bill Reichelt (Head Athletic Trainer - BC Lions - CFL)**
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**Abstract**

SEMG was used to evaluate the finger muscle fire patterns in football specific activities, as well as to evaluate three common finger training protocols used currently in athlete preparation and rehabilitation.

According to **Carlos De Luca of Boston University**, sEMG is useful in activities involving 1) the activation timing of muscles, 2) the force/EMG signal relationship (though more than not, an accurate quantitative relationship is elusive) and 3) the use of the EMG signal as a fatigue index.

1. sEMG proved to be effective tool in determining finger muscle firing patterns in football catch, throw and grip actions.
2. sEMG showed that finger extensor muscles, as well as finger flexor muscles, play a great role in football catch, throw and grip actions.
3. sEMG showed that 3-D finger flexion and extension training using the Handmaster Plus device provides the most complete (natural ROM's), convenient (all exercises in one device) and comprehensive (full ROM's) finger training protocol for the football athlete.
4. Additional sEMG studies are necessary to further evaluate the use of sEMG in technique and skills evaluation and coaching.

# Football Specific Hand Muscle Patterns & Training Approaches

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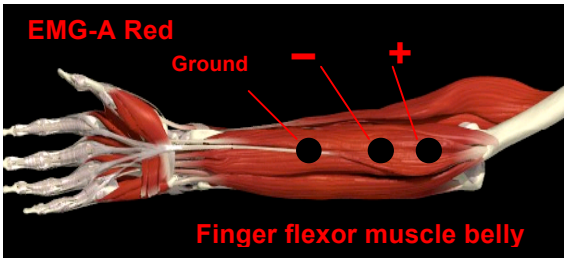
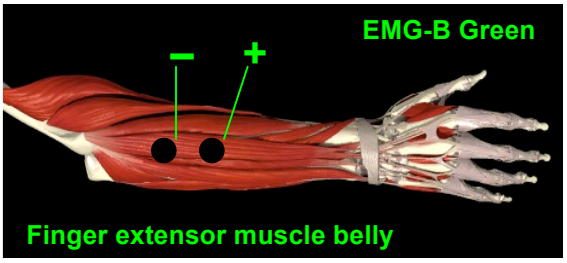
Surface electromyography (sEMG) was used to test the contribution of hand muscles, as well as to observe hand muscle patterns in football specific activities. The data collected allows us to test current hand muscle training and rehabilitation protocols and theories and to gather insight into the biomechanics of catching, throwing and gripping a football.

Particularly, we were able to explore the participation and cooperation of finger extensor vs. finger flexor muscle groups. We also tested the effectiveness of three commonly hand muscle training approaches: 3D flexion and extension resistance (using Handmaster Plus), 2D spring-loaded grip resistance (using Digiflex) and 3D grip resistance (using Eggserciser). sEMG graphs, force output data, as well as conclusions are included.

The J&J Engineering I-330 C2 Mini-sEMG was used in various trials with Lyle Green, running back and Javier Glatt, linebacker of the BC Lions of the Canadian Football League (CFL). The EMG leads were placed on the finger flexor belly (EMG-A Red) and the finger extensor belly (EMG-B Green) of the right forearm of Lyle (dominant hand) and the left forearm of Javier (non-dominant hand). Placements were determined using palpation during isolated finger flexion and extension, respectively. Lead placement patterns are illustrated below:

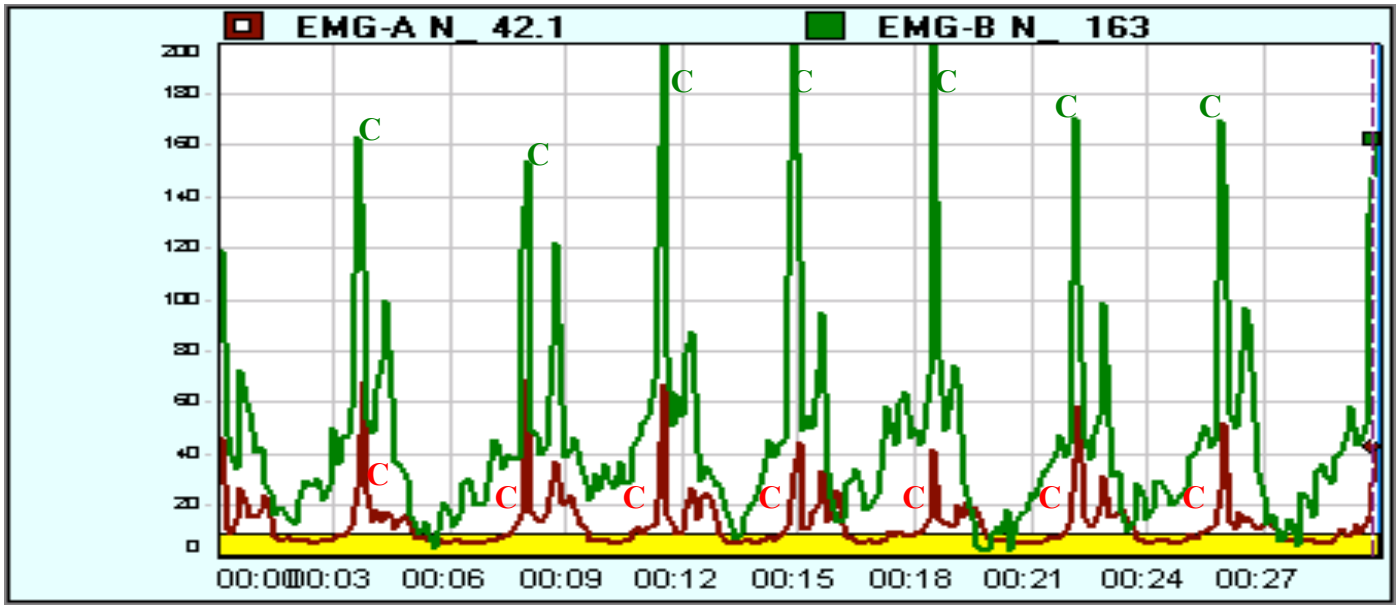



The first test involved Lyle Green. Lyle was initially instructed to catch a football (thrown from 5 yards) as data was collected using the I-330 C2. Lyle was then instructed to catch the football and throw it back, as data was collected.

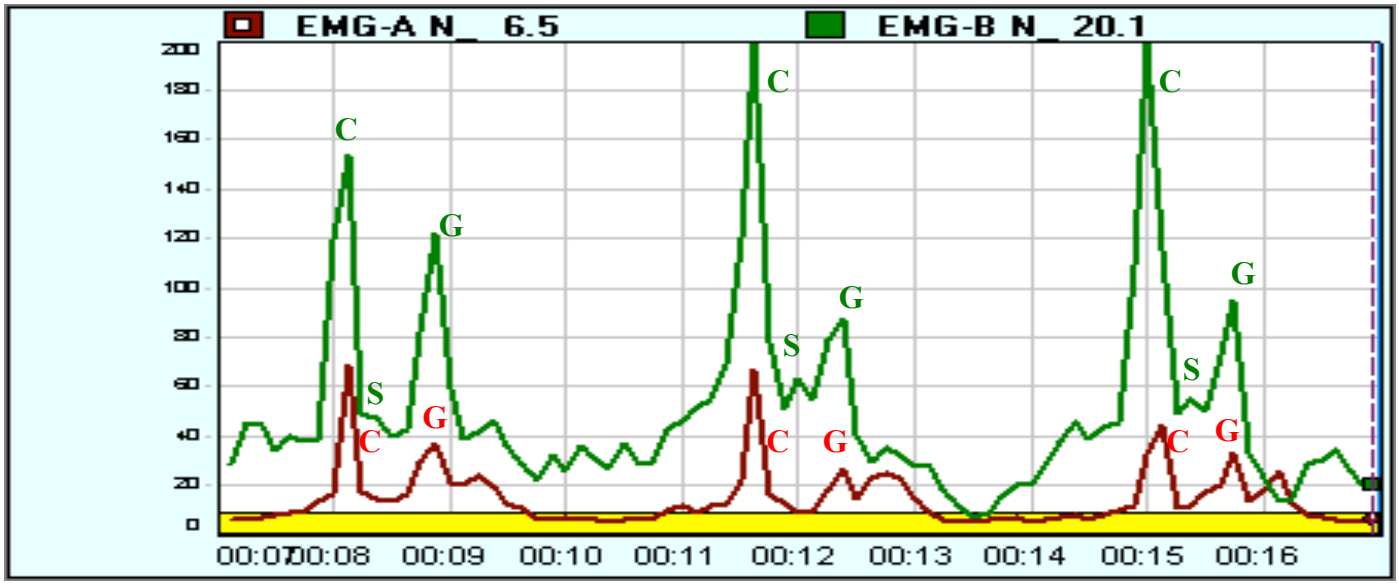
**Table I** illustrates the pattern of muscle fire that occurs in catching a football, the green signal illustrating the fire of the finger extensor muscles, the red signal illustrating the fire of the finger flexor muscles. It is of great interest to observe the degree of initial finger extensor muscle fire that occurs in catching a football (green C) when compared to the initial finger flexor muscle fire (red C).

**Table I – sEMG Finger Muscle Patterns In Catching A Football (Lyle Green, CFL)**




In **Table II**, the signal during the catching action is isolated and expanded for study purposes. One can again observe the initial fire of both the finger extensor (green C) and finger flexor (red C) muscle groups in catching. The observer can also identify a secondary spike pattern (green S) that seems to occur regularly in the finger extensor muscle group during a football catch. It is my feeling that this secondary spike pattern may illustrate the component of 'touch' or 'soft hands,' a subtle ingredient to all great receivers. **Table II** also allows for the observation of

**Table II – Close-up of sEMG Finger Muscle Patterns In Catching A Football (Lyle Green)**



the finger muscle pattern required in gripping a football (green G, red G). Note that both the finger extensor muscles (green G) and the finger flexor muscles (red G) are actively firing while gripping a football. This is a very important concept to grasp, especially when developing optimal routines for training grip strength (see conclusions) in athletes.

**Table III** reflects the sEMG pattern recording from Lyle Green as he caught and then threw the football. Notice again a very characteristic finger extensor muscle spike (Green C) during the catch and finger flexor muscle spike (red T) during the throw. **Table IV** allows a more specific observation of this catch/throw pattern.

**Table III – sEMG Finger Muscle Patterns Catching/Throwing A Football (Lyle Green)**

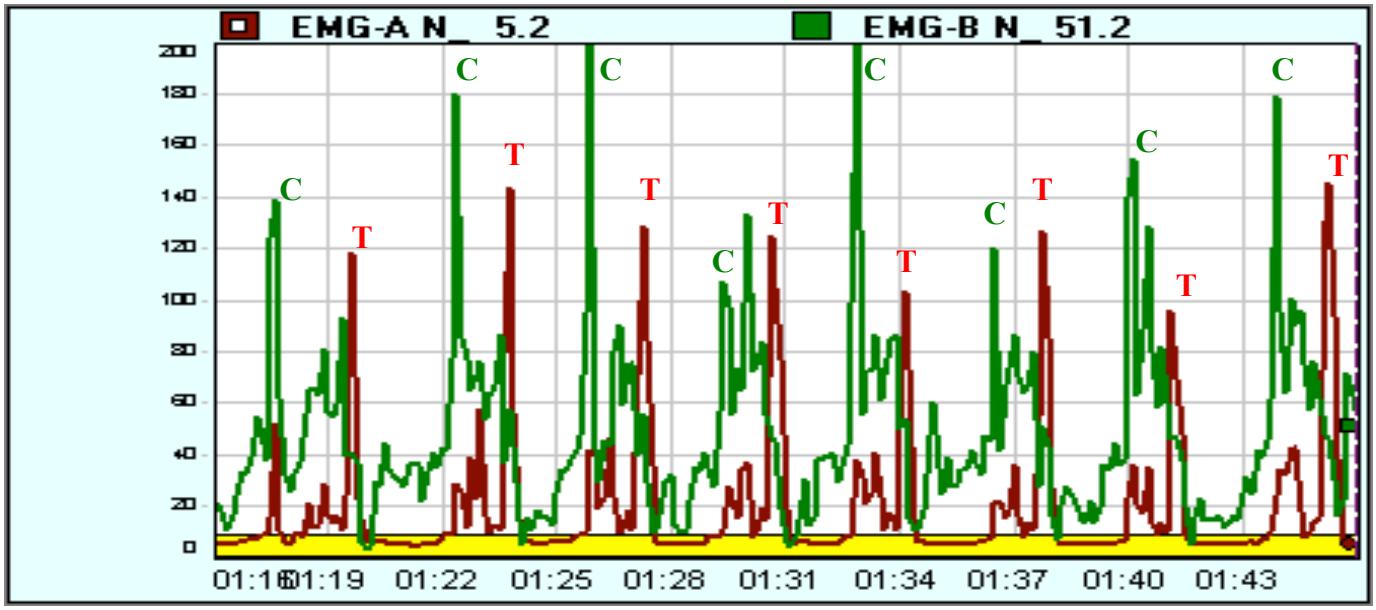
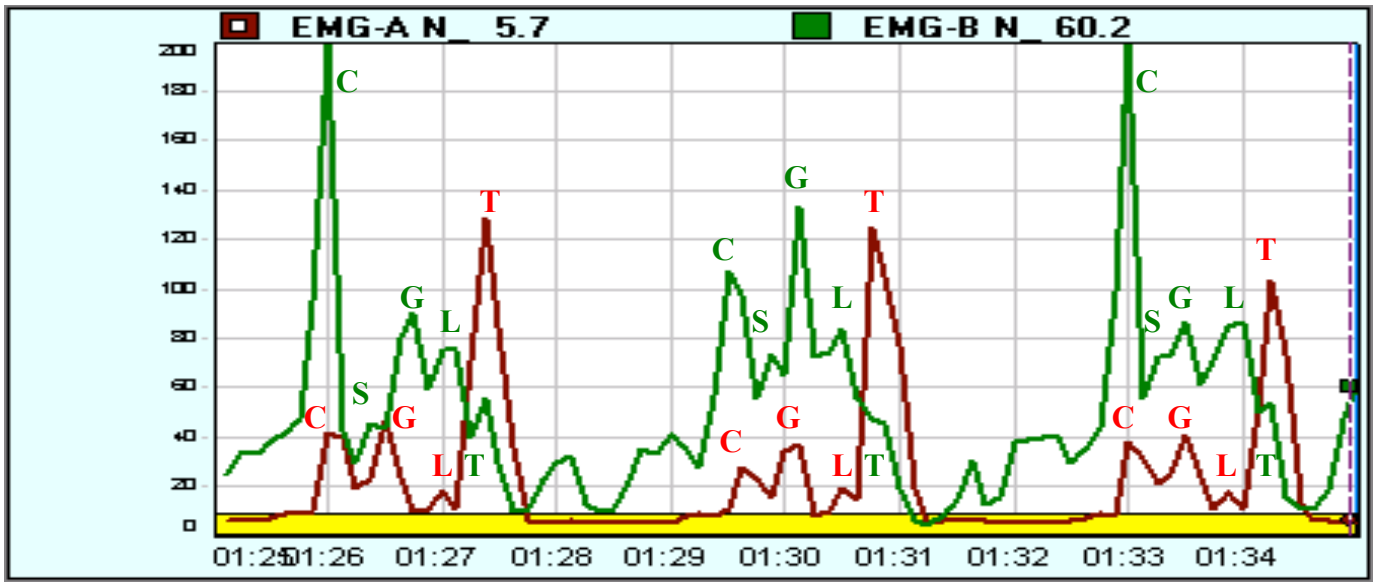



**Table IV – Close-up sEMG Finger Muscle Patterns Catching/Throwing Football (L. Green)**



Notice how the catch (C's), grip (G's), load to throw (L's) and throw (T's) of the football by the player are clearly defined. Notice the dominant participation of the finger extensor muscles in the catch phase (green C), the grip phase (green G) and the load to throw phase (green L). The finger extensor muscles (green T) also clearly fire in a well-timed effort with the finger flexor muscles (red T) in the throw phase.

**Table V** illustrates the football catch pattern of BC Lion linebacker, Javier Glatt. Notice the dramatic participation of the finger extensor muscles (green C) in the football catch phase. Table VI shows a close-up view of the pattern where one

**Table V – sEMG Finger Muscle Patterns Catching A Football (Javier Glatt)**

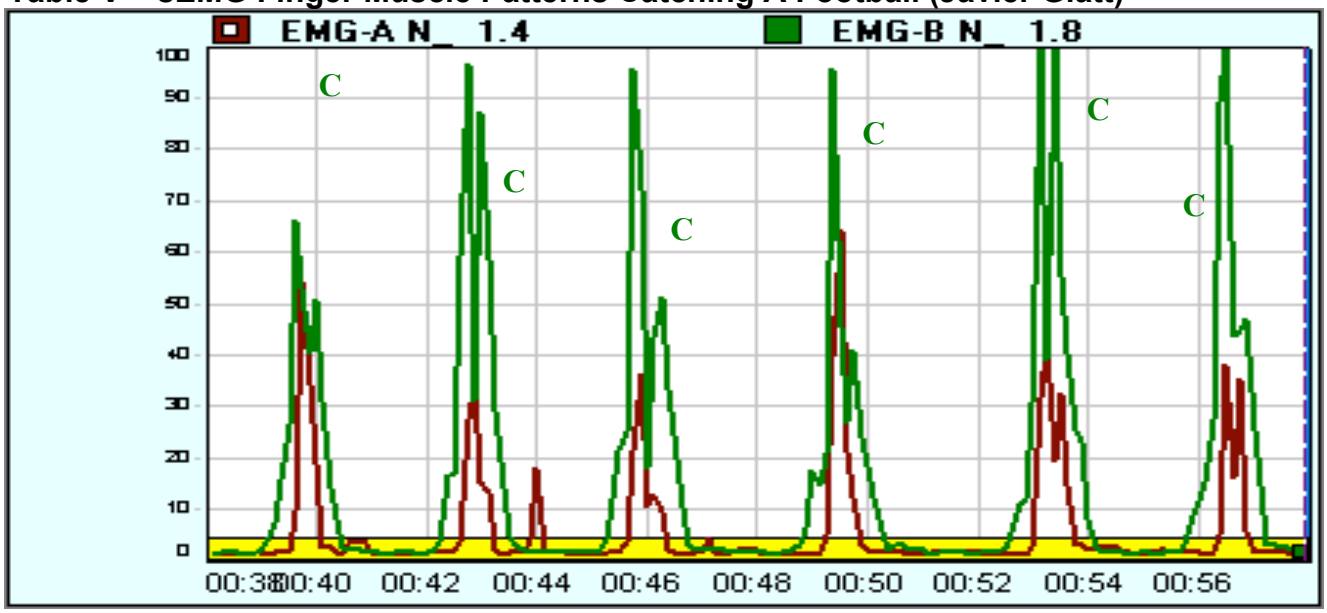
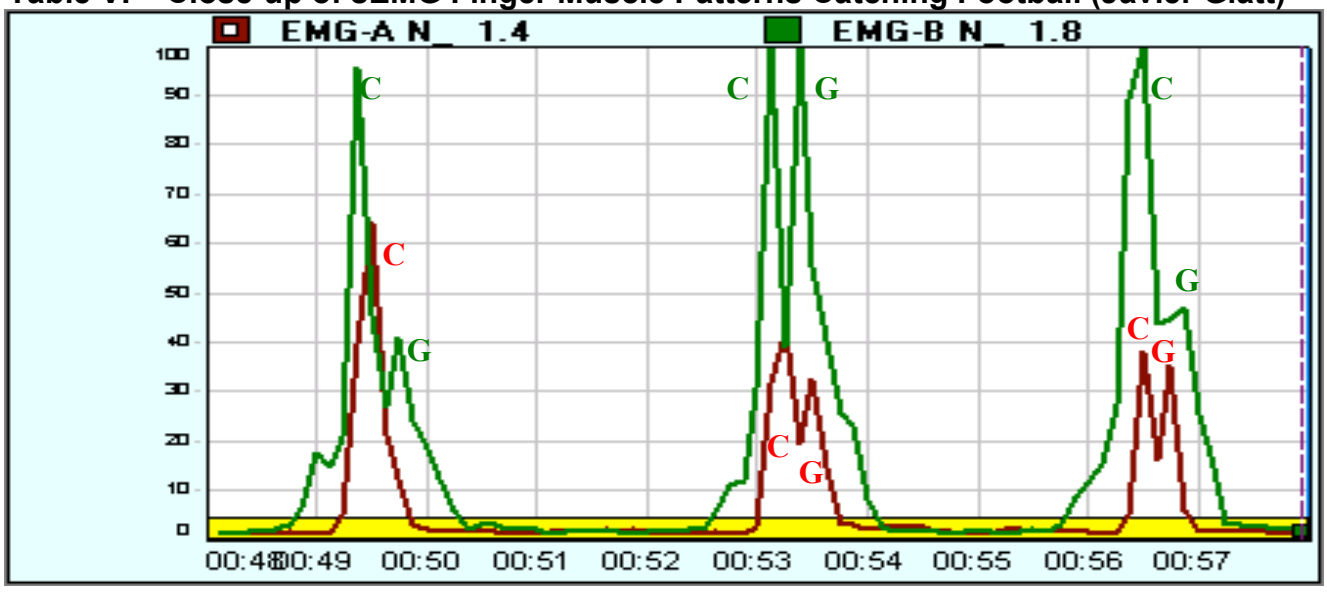



**Table VI – Close-up of sEMG Finger Muscle Patterns Catching Football (Javier Glatt)**

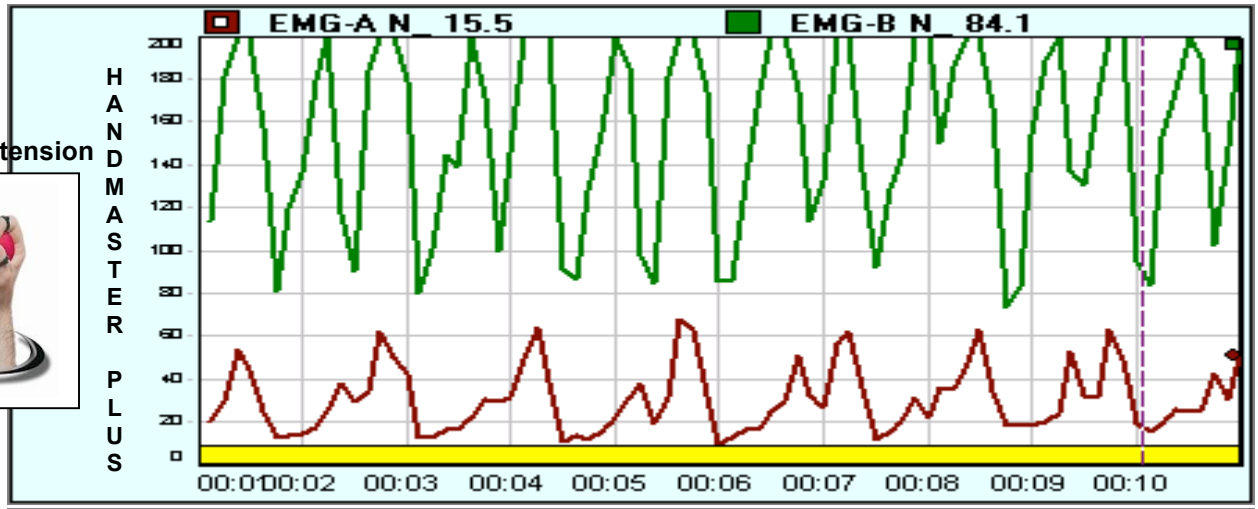


can see a pattern of finger muscle extensor and finger muscle flexor cooperation in both catching (C's) and gripping (G's) a football.

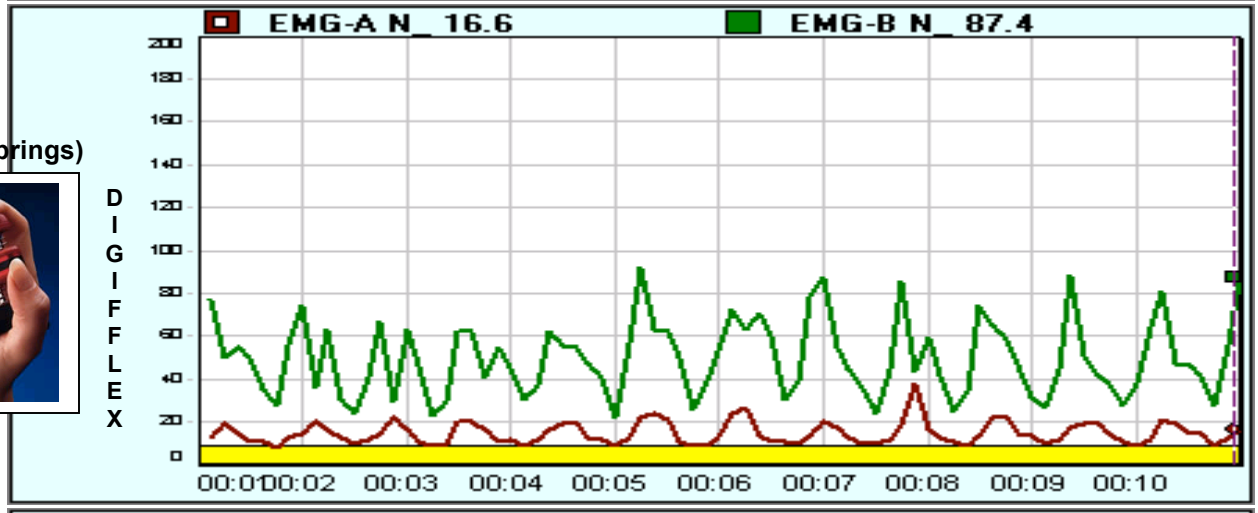
## Part II – sEMG & Hand Muscle Training Protocols (L. Green)

Finger muscles monitored by sEMG as Lyle trains for 25 seconds with each protocol.

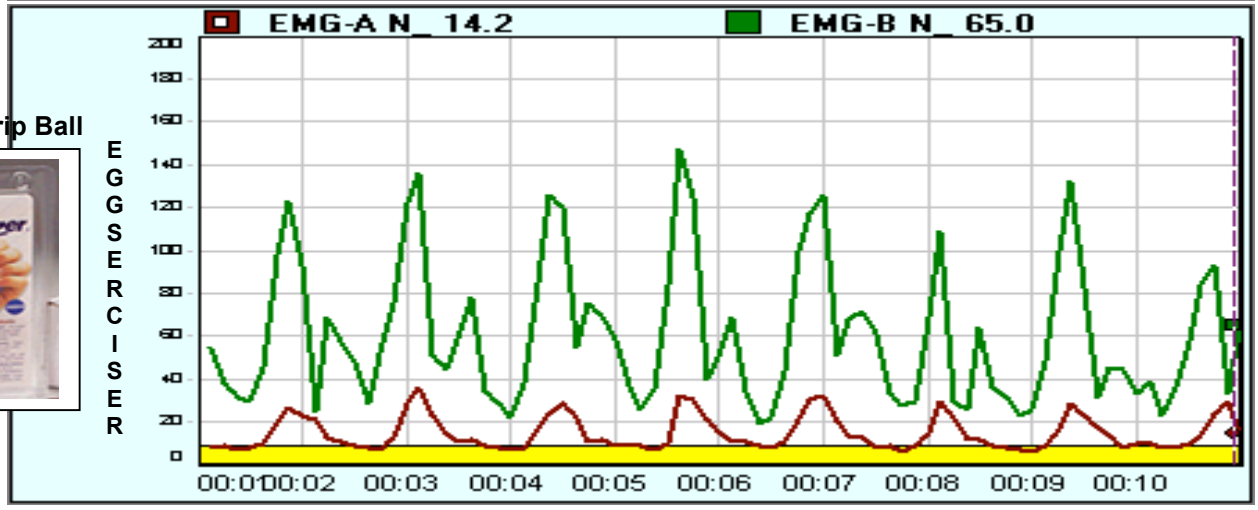
**3D Flexion/Extension**


**2D Flexion (Springs)**

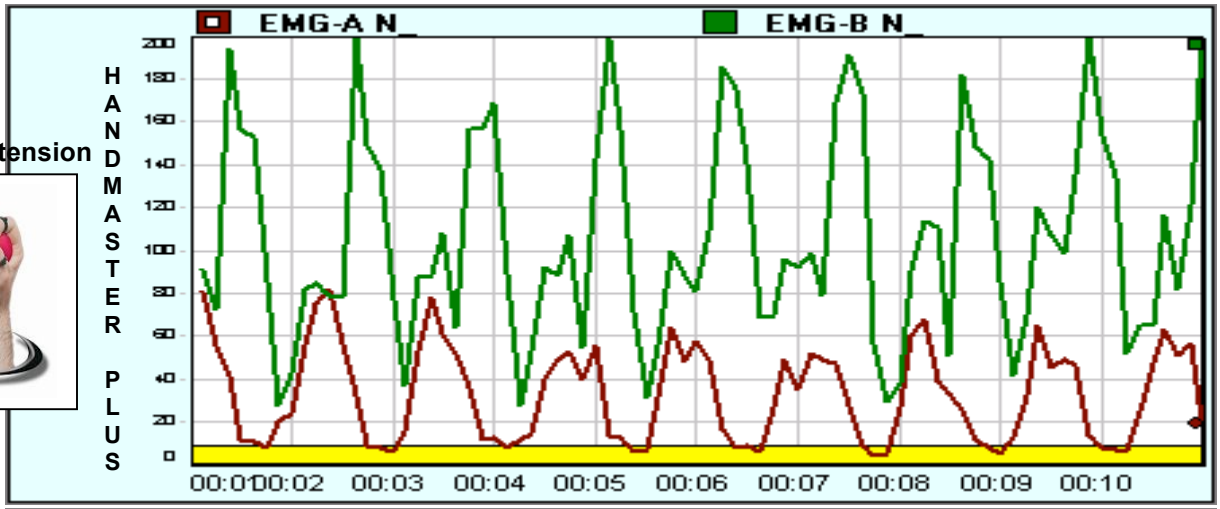

**3D Flexion Grip Ball**

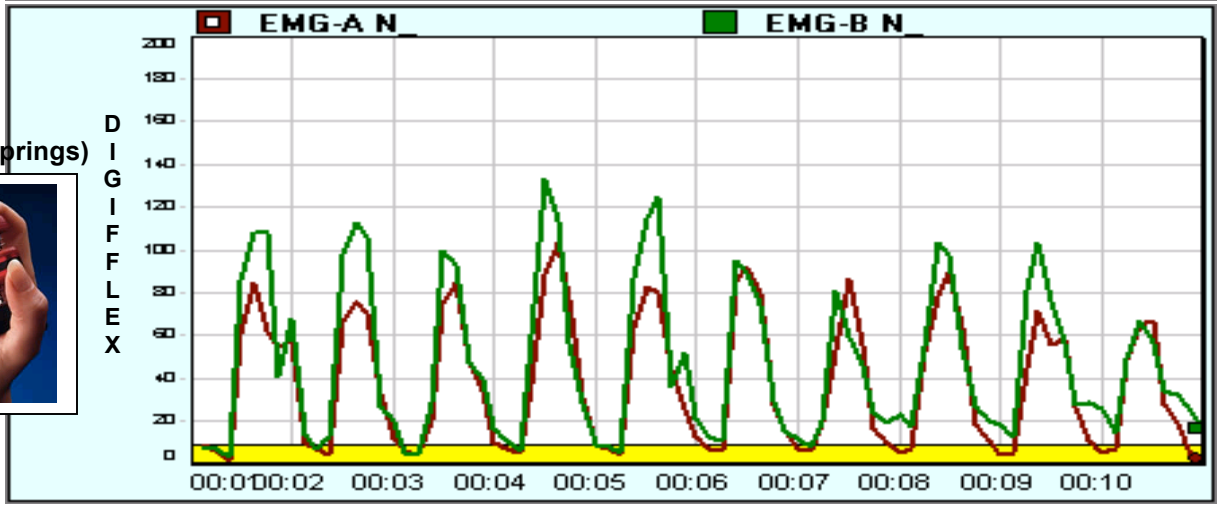
## sEMG & Hand Muscle Training Protocol (J. Glatt)

Finger muscles monitored by sEMG as Javier trains for 25 seconds with each protocol.

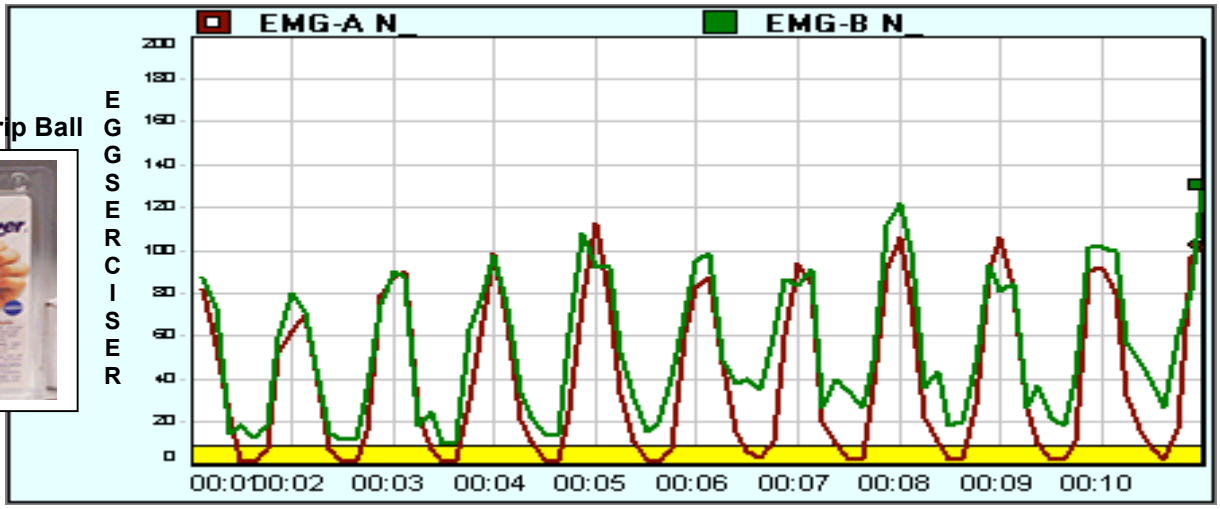
**3D Flexion/Extension**


**2D Flexion (Springs)**


**3D Flexion Grip Ball**

## sEMG & Hand Muscle Training Protocols – Force Expenditure Data Tables

### Lyle Green, RB

RB **Handmaster+**

| Task | Time | EMG-A N_ | EMG-B N_ |
|---|---|---|---|
| **1** | **0:00:05** | **25.9** | **160.93** |
| | 0:00:10 | 33.02 | 169.31 |
| | 0:00:15 | 33.57 | 173.25 |
| | 0:00:20 | 34.12 | 163.35 |
| | 0:00:25 | 32.02 | 137.94 |
| | **AVG.** | **31.73** | **160.96** |

RB **Digiflex**

| Task | Time | EMG-A N_ | EMG-B N_ |
|---|---|---|---|
| **2** | **0:00:05** | **13.28** | **46.66** |
| | 0:00:10 | 14.89 | 50.61 |
| | 0:00:15 | 15.1 | 44.66 |
| | 0:00:20 | 15.17 | 40.71 |
| | 0:00:25 | 16.2 | 45.39 |
| | **AVG.** | **12.44** | **45.61** |

RB **Eggserciser**

| Task | Time | EMG-A N_ | EMG-B N_ |
|---|---|---|---|
| **3** | **0:00:05** | **14.99** | **66.13** |
| | 0:00:10 | 14.75 | 58.16 |
| | 0:00:15 | 13.14 | 53.97 |
| | 0:00:20 | 13.05 | 54.68 |
| | 0:00:25 | 15.59 | 68.1 |
| | **AVG.** | **14.30** | **60.21** |

### Javier Glatt, LB

LB **Handmaster+**

| Task | Time | EMG-A N_ | EMG-B N_ |
|---|---|---|---|
| **1** | **0:00:05** | **33.75** | **102.72** |
| | 0:00:10 | 29.45 | 107.71 |
| | 0:00:15 | 31.76 | 94.74 |
| | 0:00:20 | 30.37 | 94.59 |
| | 0:00:25 | 28.87 | 92.3 |
| | **AVG.** | **30.84** | **98.41** |

LB **Digiflex**

| Task | Time | EMG-A N_ | EMG-B N_ |
|---|---|---|---|
| **2** | **0:00:05** | **39.5** | **50.19** |
| | 0:00:10 | 36.64 | 44.98 |
| | 0:00:15 | 30.88 | 45.83 |
| | 0:00:20 | 29.45 | 42.58 |
| | 0:00:25 | 24.67 | 35.58 |
| | **AVG.** | **32.23** | **43.83** |

LB **Eggserciser**

| Task | Time | EMG-A N_ | EMG-B N_ |
|---|---|---|---|
| **3** | **0:00:05** | **34.71** | **45.04** |
| | 0:00:10 | 39.36 | 56.73 |
| | 0:00:15 | 35.74 | 57.38 |
| | 0:00:20 | 34.47 | 58.04 |
| | 0:00:25 | 32.91 | 56.89 |
| | **AVG.** | **35.44** | **54.82** |

### Analysis Of Data

1. Force/output by hand muscle groups is highest using Handmaster Plus when compared to Digiflex and Eggserciser, illustrating that 3-dimensional flexion/extension training of the hand muscles offers the most efficient and complete training protocol for the football athlete.
2. Fatigue was highest using Handmaster Plus. This is probably due to the fact that the hand muscles are resisted through their full range of motion, thus increasing energy output by muscles.
3. Handmaster Plus provides the most challenging workout for the finger extensor muscles, coupled with a competitive workout for the finger flexor muscles. For the athlete and the trainer, this means completeness of workout and efficiency of time, as all finger exercises are provided in one protocol.

## Conclusions & Observations

According to Carlos De Luca of Boston University, sEMG is useful in activities involving 1) the activation timing of muscles, 2) the force/EMG signal relationship (though more than not, an accurate quantitative relationship is elusive) and 3) the use of the EMG signal as a fatigue index.

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