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The Use of EMG as a Physical Therapy Learning Aid

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The use of EMG as a physical therapy learning aid

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Abstract

The purpose of this study was to compare the muscle recruitment of an agonist and antagonist muscle during the step up physical therapy exercise with and without visual electromyographic (EMG) biofeedback. 15 healthy, college-aged subjects were recruited to participate in the study. Subjects performed the step up with and without visual feedback in two separate sessions over a four-week period. Muscle activity was recorded from the Vastus Medialis (VMO) of the target leg and Medial Gastrocnemius (MG) on the contralateral leg. EMG recordings were collected using a BTS FREEEMG system and data was processed using BTS SEMG analyzer software (BTS Bioengineering, Brooklyn, NY). Results: The mean \pm standard deviation MG muscle activity during visual sessions was 0.340 mV (SD 0.141) and 0.310 mV (SD 0.138) during non-visual sessions. The mean \pm s.d. VMO muscle activity was 0.309 mV (SD 0.097) during visual sessions and 0.299 mV (SD 0.139) during non-visual sessions. A paired t-test was used to determine statistical significance between sessions with values considered significant with a $p < 0.05$. No significant differences were observed between visual and non-visual trials for the agonist and antagonist muscles. Following complete data analysis on the 15 subjects, subsequent trials were conducted on two subjects while visual, verbal, and palpation feedback was given throughout the entirety of the visual feedback exercise trial. While no statistical analysis of the subjects could be performed, the results showed trends of greater muscle activity in the agonist muscle and less activity in the antagonist muscle when the subject received biofeedback. These findings support the conclusions of previous studies (Holermann, Taian, Vieira, Taskiran, Ekblom, One-Bin), suggesting that EMG biofeedback can be used as a tool for assisting patients with proper muscle recruitment during physical therapy sessions.

Limitations

- Visual and verbal feedback during the initial study was not continuous; it was only given at the start of the exercise. This protocol methodology does not reflect a PT setting, as Physical Therapists' give not only visual and verbal, but also biomechanical and palpation feedback throughout the whole exercise.

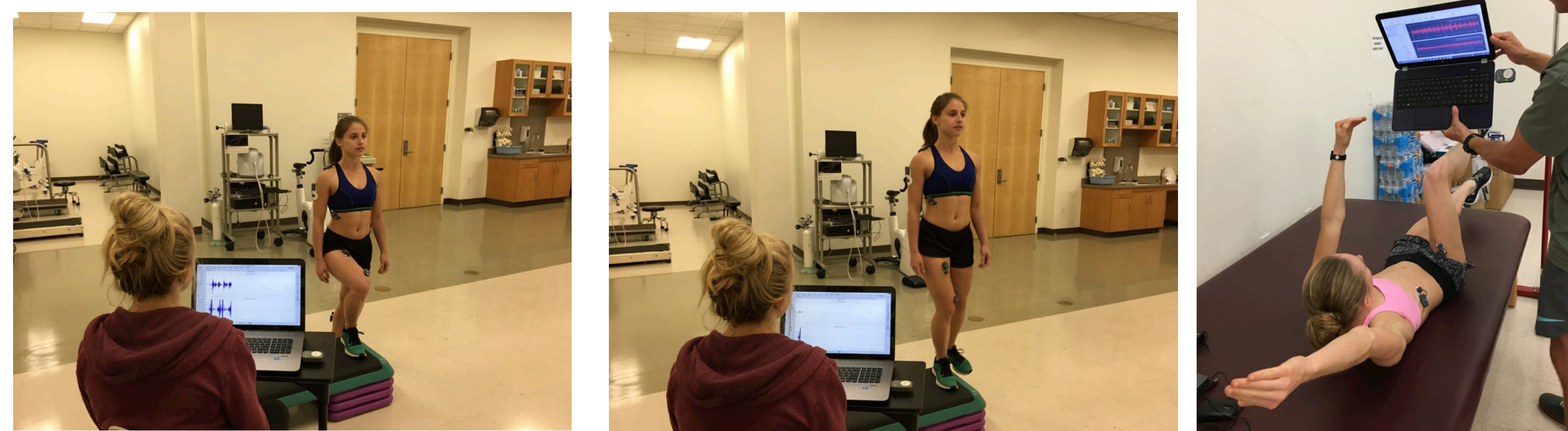
Strengths

- Visual EMG feedback combined with verbal, biomechanical and palpation feedback is a useful tool for correct muscle recruitment during Physical Therapy exercises.
- Subjects can adjust agonist and antagonist muscle recruitment while receiving a combination of different types of feedback to improve exercise mechanics and overall exercise outcomes.

Clinical Applications

The positive correlation established from pilot trials propose that EMG biofeedback combined with continuous verbal, biomechanical and palpation feedback is a useful tool for the correct muscle recruitment during PT exercises. Patients are able to visualize recruitment of target muscle groups and limit antagonist muscles, improving the effectiveness of Physical Therapy exercises.

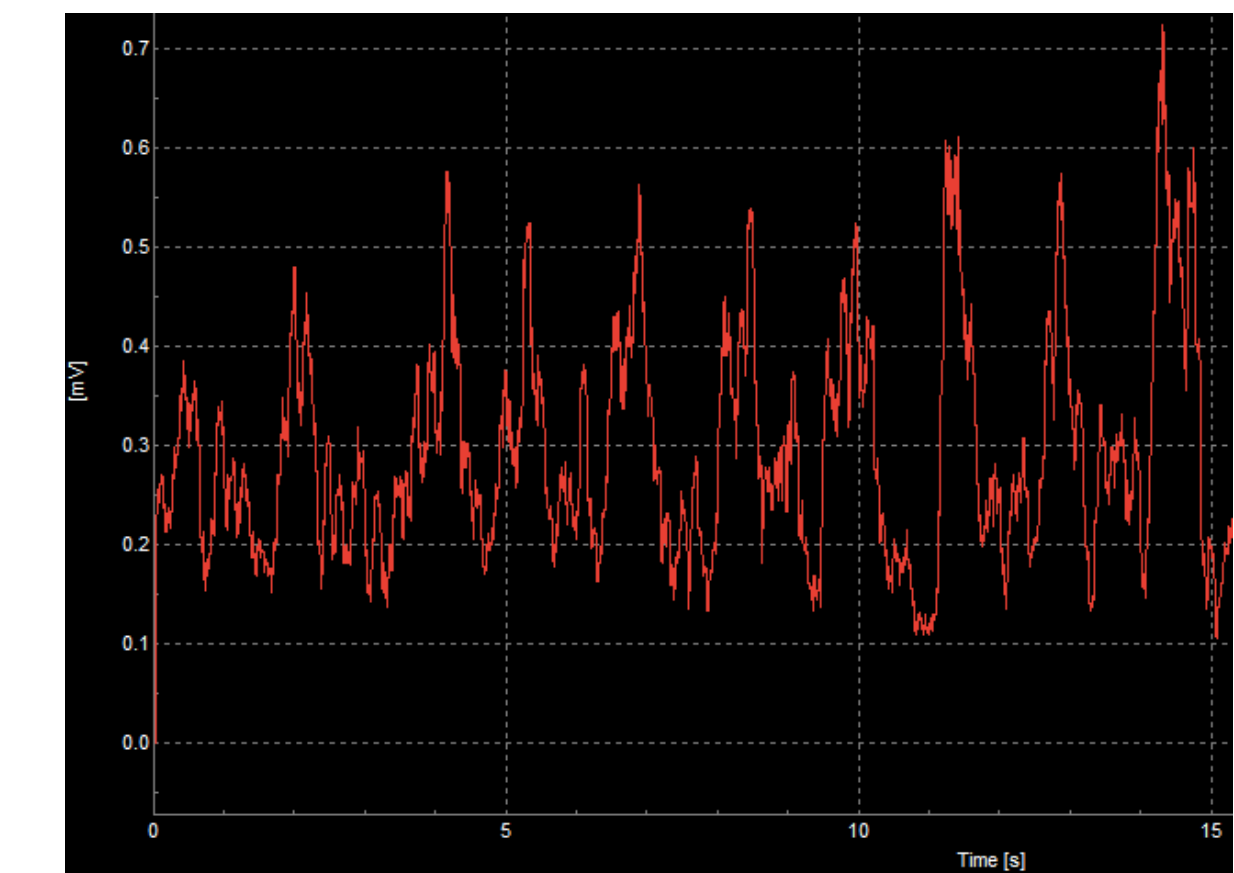
Execution of Step Up and Dying Bug



On the left, the subject executes the step up exercise without visual EMG feedback. The subject is instructed to push up from the step using only the involved leg, and to control their movement while stepping down to the original position with the uninvolved leg. On the right, the subject receives continuous visual and verbal feedback, including biomechanical and palpation feedback (not shown) during the dying bug exercise.

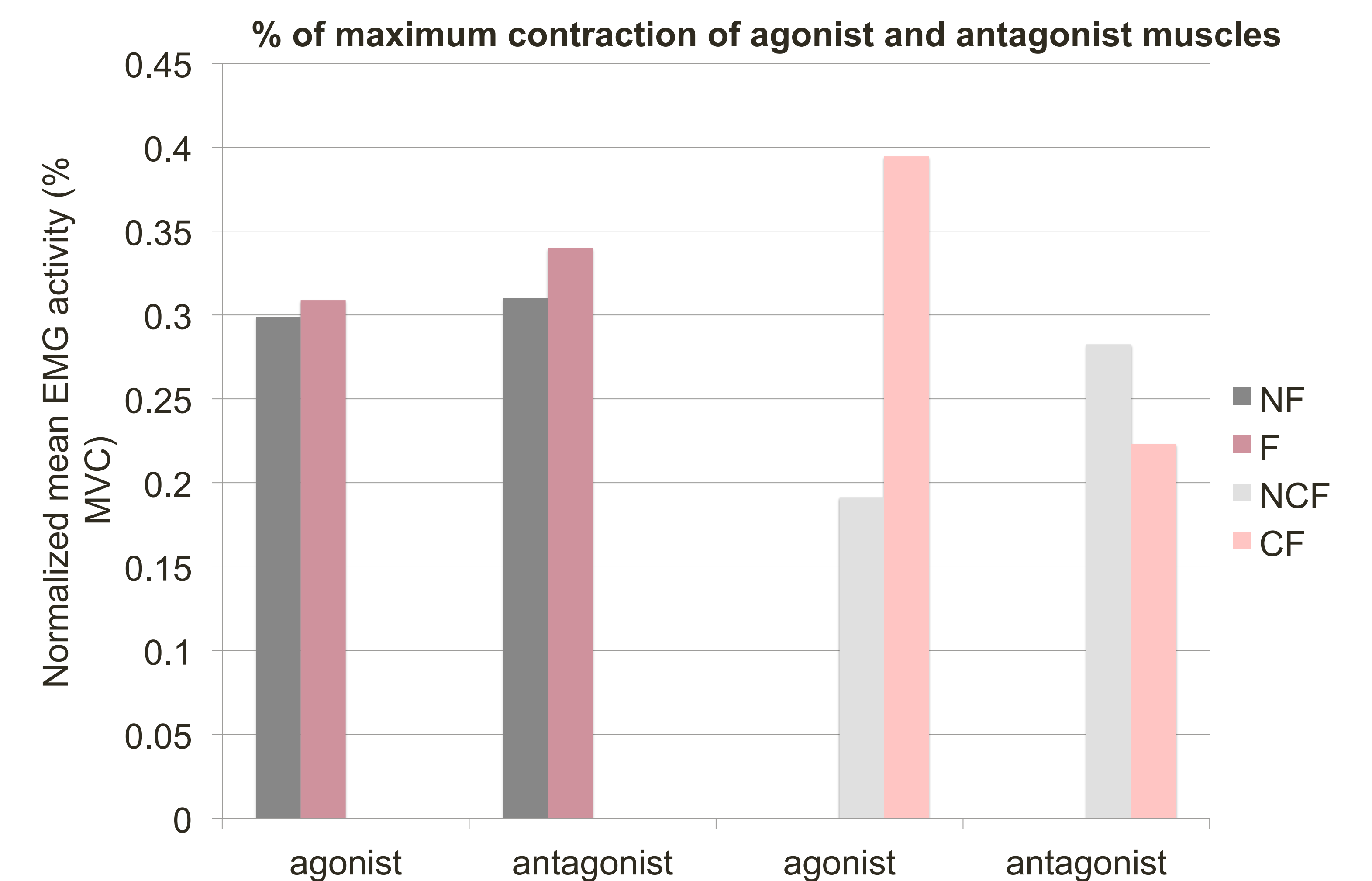
Exemplar Data

The raw data shows an increase in the activation of the right external oblique during the pilot testing as the subject receives continuous verbal, visual, biomechanical and palpation feedback.



Primary Findings of Study and Pilot testing

During the study no significant findings were found between visual and non-visual biofeedback sessions during the step up exercise. The study methods involved only initial feedback to subjects for both the visual and non-visual trials. Subsequent pilot data was collected on two subjects performing the dying bug. Subjects received continuous feedback- visual, verbal, biomechanical and palpation- throughout the entirety of the visual feedback trial. With the feedback mimicking a PT setting, there was a correlation between correct muscle recruitment and biofeedback. Recruitment of the agonist, the right external oblique, was increased with biofeedback while activity of the antagonist, the rectus femoris, decreased.



Initial study results are shown on the left-most bars while pilot study results are shown on the right-most bars. No feedback (NF), initial verbal and visual feedback (F), no continuous feedback (NCF), continuous verbal, visual, biomechanical and palpation feedback (CF).