CHANGES IN MUSCLE FORCE PRODUCTION AND PAIN: IS THERE A RELATIONSHIP?

A. J. Witte, E. A. Dannecker

INTRODUCTION

- Studies have shown that the presence of pain results in decreased muscle force production (1) as well as decreased adherence to exercise and strengthening programs (2).
- The aim of this project was originally to test if actual performance in the form of isometric muscle force production is related to muscle pain. However, it was observed that within the same subject similar force may have been produced at two different time points, but, in one instance, the force was apparently increasing and in the other instance, the force was previously decreasing (Fig. 1).
- This prompted additional analyses of whether or not the directionality of force just prior to rating pain affected the relationship between force and pain.
- Clarification of this relationship could improve assessments and use of pain intensity ratings in patients during actual performance such as therapeutic exercise or functional tasks at home.

METHODS

- This project conducted secondary analyses of previously collected data. The original study investigated sensory integration of pain, light, and sound stimuli in 32 healthy participants (54.5% male) with average age 23.5 years.
- During the study, ratings of muscle pain intensity were collected with a 0-100 scale every 3 seconds during a 30s tonic muscle contraction.
- Force production was also measured every 3 seconds by following the contour of the force production line and recording force produced at each time point. This method is referred to as curve analysis. The actual force produced was then divided by each participant’s strength so that the percentage of actual maximal force (i.e., strength) could be analyzed.
- For the secondary analyses, the directionality of changes in force was coded as increasing, stable, or decreasing immediately before the time of pain rating and force recording within a subsample of 14 participants, which resulted in 23 increasing force epochs, 77 stable force epochs, and 40 decreasing force epochs.
- Because the data were not normally distributed, Spearman correlations were calculated between pain rating and percentage of maximal force produced for all the data and within each direction of change in force. Then the correlations within each direction of change in force were statistically compared by Fisher’s z transformation.

CONCLUSION

- The results showed that overall, there was a statistically significant negative correlation of -0.34 between self-reported pain and the percentage of maximal force produced. In other words, the more muscle force production, the lower the report of pain.
- Possible explanations for this inverse relationship could be exercise induced hypalgesia (3,4) due to increased A-beta neuron activity that caused a pain blocking effect at the level of the spinal cord (5), descending inhibition (6), or increased blood pressure.
- The correlation between pain and force was -0.33 for decreasing force, -0.31 for stable force, and -0.57 for increasing force. Statistical comparison by Fisher’s z transformation yielded no significant difference between the 3 directions of change in force.
- This preliminary study suggests that the directionality of force does not affect the relationship between pain and force production during tonic muscle contraction.
- A possible limitation to this study was that subjects significantly increased their pain ratings within the duration of the contraction (Fig. 2). If more increasing, decreasing, or stable force epochs occurred in a small section of the test by chance, the correlations might be affected. In a future study, the duration of the contraction could be decreased, or data collection could be limited to a 6-12 second window within the contraction.
- Another possible limitation was the small sample sizes of the force epochs. Sample sizes could be improved by adding more participants or by adding participants that are instructed to steadily increase or decrease force production in addition to the tonic contraction group.

REFERENCES: