Author's response to reviews

Title: The Preferable Shoulder Position Can Isolate Supraspinatus Activity Superior to the Classic Empty Can Test: An Electromyographic Study.

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Author's response to reviews: see over

Dear BMC Musculoskeletal Disorders Editors and Reviewers

Title: The Preferable Shoulder Position Can Isolate Supraspinatus Activity Superior to the Classic Empty Can Test: An Electromyographic Study.
Ref: Submission ID 50561acd-5566-4dc1-b773-803d92b1af35

Thank you for the opportunity to revise our manuscript, "The Preferable Shoulder Position Can Isolate Supraspinatus Activity Superior to the Classic Empty Can Test: An Electromyographic Study." We appreciate the careful review and constructive suggestions. It is our belief that the manuscript is substantially improved after making the suggested edits. Following this letter are the reviewers' comments with our responses, including how and where the text was modified. Changes made in the manuscript are marked using yellow highlight. The revision has been developed in consultation with all coauthors, and each author has given approval to the final form of this revision.

Reviewers 1' comments:

In general, I think this is a relevant topic in BMC Musculoskeletal Disorders. This study aimed to determine a shoulder position that isolates supraspinatus from the deltoid activity and evaluate the EMG activity for periscapular muscles. The manuscript is original and well-prepared, with figures and tables. The effect size calculation was provided for the final sample size. The methodology of the study is understandable and consistent with previous studies. The statistical analysis is appropriate for the purpose. However, first, the background information regarding the purposes and significance of this study, the chosen testing muscles, and the variables calculated need to be further justified. Secondly, the structure of the manuscript needs to be reorganized and written in a reading-friendly manner. Especially the Methods and the Results need to be concise and clear. Detailed information for data processing should be included. Lastly, the justification for selecting results and using the supraspinatus to middle deltoid (S:D) ratio to suggest the best position is lacking. There were no clear, practical implications in the discussion. According to these limitations, the current study is suggested for major revision.

Major issues

1. Please provide more information in the method section of the abstract. A more specific variable is needed to correspond to the calculation of S:D. It is recommended to provide subject information. Please also include the statistical analysis.

Responses: Thank you very much for your valuable recommendations. We add these points into our abstract.

Changes in manuscript: "21 healthy participants, without any history of shoulder disorder, aged 29 $\pm$ 0.9 years old with a dominant-right arm.*"* And "The supraspinatus to middle deltoid (S:D) ratio was calculated using the standardized weighted EMG and the maximum voluntary isometric contraction of the SSP and middle deltoid muscles, for each shoulder position to determine the best isolated SSP muscle strength test position. Results were analyzed with the Kruskal–Wallis test for non-normally distributed data." were added into "methods" section of abstract (Line 55-57, 59-63 page 2) and highlighted with yellow color.

2. Please objectively provide the inconsistent findings based on the current evidence for

diagnostic accuracy in EC and FC tests in the Background. Additionally, the reasons for conducting an EMG study for seven periscapular muscles need to be further justified. Furthermore, the background information should be closely related to the variables calculated in this study. Therefore, the S:D ratio needs to be introduced.

Responses: Thank you very much for your valuable suggestions. We add these points into our background.

Changes in manuscript:

- "Traditionally, the shoulder physical examination has been a cornerstone of the diagnostic process. Largely based on the result of these two original studies (7, 8), both EC and FC tests have turned into classic used clinical examination for diagnosing SSP pathology. Nevertheless, the result of their previous EMG studies (7, 8) provided insufficient information to support the conclusion that the EC and FC tests can specifically isolate SSP activity. Certainly, previous EMG studies suggest that the EC and FC tests extremely activate deltoid muscle(9, 10), infraspinatus(9, 11) as well as SSP. In clinical practice, the EC and FC test could be painful and difficult to achieve for patients, resulting in apparent weakness from the pain-mediated reflex inhibitor of the muscle. Many previous studies have manifested the unsatisfactory diagnostic accuracy of these tests in terms of clinical application(5, 12-14). Longo et al.(14) conducted a review article on clinical testing for SSP pathology, they found that the EC test mostly had a sensitivity lesser than 80% (4 out of 6 studies), and a specificity of less than 80% (5 out of 6 studies). Correspondingly, they also found that the FC test mostly had a sensitivity and specificity lesser than 80% (3 out of 4 studies). Some studies also demonstrated sensitivity, specificity, and accuracy of the EC test as low as 30%, 35% and 50%, respectively(8, 15, 16)." was added into "background" section (Line 101-116 page 4-5) and highlighted with yellow color.
- 'These seven periscapular muscles are selected based on previous relevant EMG studies that demonstrated an activation of these muscles during shoulder abduction(8, 11, 13). Subscapularis and Latissimus dorsi were excluded due to its prime function as an internal rotation and low activity during shoulder abduction(8, 13, 22)." was added into "experiment protocol" section of Material and Methods (Line 171-174 page 7) and highlighted with yellow color.

- "Chalmers et al. advocated the SSP and middle deltoid ratio (S:D ratio) as a parameter to represent and quantify how well each shoulder position isolated SSP activity from deltoid activity(17)." was added into "background" section (Line 119-121page 5) and highlighted with yellow color.

Reference:

- Jobe FW, Moynes DR. Delineation of diagnostic criteria and a rehabilitation program for rotator cuff injuries. Am J Sports Med. 1982;10(6):336-9.
- Kelly BT, Kadrmas WR, Speer KP. The manual muscle examination for rotator cuff strength. An electromyographic investigation. Am J Sports Med. 1996;24(5):581-8.
- Malanga GA, Jenp YN, Growney ES, An KN. EMG analysis of shoulder positioning in testing and strengthening the supraspinatus. Med Sci Sports Exerc. 1996;28(6):661-4.
- Reinold MM, Macrina LC, Wilk KE, Fleisig GS, Dun S, Barrentine SW, et al. Electromyographic analysis of the supraspinatus and deltoid muscles during 3 common rehabilitation exercises. J Athl Train. 2007;42(4):464-9.

- Boettcher CE, Ginn KA, Cathers I. Standard maximum isometric voluntary contraction tests for normalizing shoulder muscle EMG. J Orthop Res. 2008;26(12):1591-7.
- Park HB, Yokota A, Gill HS, El Rassi G, McFarland EG. Diagnostic accuracy of clinical tests for the different degrees of subacromial impingement syndrome. J Bone Joint Surg Am. 2005;87(7):1446-55.
- Boettcher CE, Ginn KA, Cathers I. The 'empty can' and 'full can' tests do not selectively activate supraspinatus. Journal of Science and Medicine in Sport. 2009;12(4):435-9.
- Longo UG, Berton A, Ahrens PM, Maffulli N, Denaro V. Clinical tests for the diagnosis of rotator cuff disease. Sports Med Arthrosc Rev. 2011;19(3):266-78.
- Bak K, Sørensen AK, Jørgensen U, Nygaard M, Krarup AL, Thune C, et al. The value of clinical tests in acute full-thickness tears of the supraspinatus tendon: does a subacromial lidocaine injection help in the clinical diagnosis? A prospective study. Arthroscopy. 2010;26(6):734-42.
- Ostör AJ, Richards CA, Tytherleigh-Strong G, Bearcroft PW, Prevost AT, Speed CA, et al. Validation of clinical examination versus magnetic resonance imaging and arthroscopy for the detection of rotator cuff lesions. Clin Rheumatol. 2013;32(9):1283-91.
- Chalmers PN, Cvetanovich GL, Kupfer N, Wimmer MA, Verma NN, Cole BJ, et al. The champagne toast position isolates the supraspinatus better than the Jobe test: an electromyographic study of shoulder physical examination tests. J Shoulder Elbow Surg. 2016;25(2):322-9.

3. Please include the demographic information of the 21 participants in the Materials and Methods. Did the shoulder instability assess by the researchers or self-reported during the testing? More information is needed on the inclusion and exclusion of the participants.

Responses: Thank you very much for your valuable recommendation, and we apologize for the confusion. We can kindly explain that all participants have been screened with a complete shoulder physical examination by the orthopedic surgeon before recruitment. We add this point into our Material and methods.

Changes in manuscript:

- "After informed consent was obtained from patients, baseline characteristics—including age, gender, and body mass index (BMI)—were recorded. Total of 21 participants were included in the final sample. All participants were males aged 29 $\pm$ 0.9 years old with a dominant-right arm. The mean BMI was 24.6 $\pm$ 2.9 kg/m^2." was added into "Material and Methods" section (Line 149-153 page 6) and highlighted with yellow color.
- "Participants who were normal healthy individuals aged 18–40 years old without any history of shoulder instability, major shoulder trauma, shoulder surgery, shoulder or periscapular pain were included. A complete shoulder physical examination was performed in every participant by the orthopedic surgeon. Participants with medical comorbidity-affected shoulder motion, or abnormal shoulder examination were excluded." was added into "Material and Methods" section (Line 135-140 page 6) and highlighted with yellow color.

4. Please provide the data processing information. For example, what is the sampling frequency of the EMG system used in this study? Did the authors filter the raw data? What time window did the S:D variable was calculated, 5 s?

Responses: Thank you very much for your valuable suggestions. We add these points into our Material and Methods.

Changes in manuscript:

- "The EMG signals were sampled by computer at 1000Hz. Eight integrated channels were used for signal filtering (10Hz and 400 Hz, Butterworth) and rectification. The isometric contraction was measured for a total of 5 seconds interval." was added into "experiment protocol" section of Material and Methods (Line 175-177 page 7) and highlighted with yellow color (8).

Reference:

- Kelly BT, Kadrmas WR, Speer KP. The manual muscle examination for rotator cuff strength. An electromyographic investigation. Am J Sports Med. 1996;24(5):581-8.

5. Please justify the reasons to include healthy participants only.

Responses: Thank you very much for your comment, we can kindly explain that experimental testing was conducted on a healthy participant as it was determined that interpretation of SSP testing in patients with SSP pathology has to be established base on a precise understanding of normal EMG muscle activation. This is in keeping with previous EMG studies examining these tests.

Changes in manuscript:

- "Experimental testing was conducted on a healthy participant as it was determined that interpretation of SSP testing in patients with SSP pathology has to be established base on a precise understanding of normal EMG muscle activation (13). Besides, our protocol was set up in the same fashion as many previous EMG studies(4, 11, 13, 17)." was added into "Study design and participants" section of Material and Methods (Line 140-143 page 6) and highlighted with yellow color (8).

Reference:

- awkes DH, Alizadehkhaiyat O, Fisher AC, Kemp GJ, Roebuck MM, Frostick SP. Normal shoulder muscular activation and co-ordination during a shoulder elevation task based on activities of daily living: an electromyographic study. J Orthop Res. 2012;30(1):53-60.
- Boettcher CE, Ginn KA, Cathers I. Standard maximum isometric voluntary contraction tests for normalizing shoulder muscle EMG. J Orthop Res. 2008;26(12):1591-7.

- Boettcher CE, Ginn KA, Cathers I. The 'empty can' and 'full can' tests do not selectively activate supraspinatus. Journal of Science and Medicine in Sport. 2009;12(4):435-9.
- Chalmers PN, Cvetanovich GL, Kupfer N, Wimmer MA, Verma NN, Cole BJ, et al. The champagne toast position isolates the supraspinatus better than the Jobe test: an electromyographic study of shoulder physical examination tests. J Shoulder Elbow Surg. 2016;25(2):322-9.

6. The structure of the manuscript overall is confusing. The sample size calculation is supposed to be stated before the participants' recruitment. The participants' demographic information needs to be in the Methods and Materials section instead of the Results.

Responses: Thank you very much for your valuable suggestions. We rearranged our manuscript as your suggestions.

Changes in manuscript:

- "The sample size was calculated using STATA 15.0 and a reference from a previous study(8). The following values were used to calculate the sample size: an alpha error of 0.05, power of study of 0.8, mean SSP MVIC in 90° shoulder flexion and external rotation of 7.65 volts, SD of 1.58 volts, mean SSP MVIC in 0° shoulder flexion and external rotation of 6.69 volts, SD of 2.96 volts, 23 measurements, 1 baseline measurement, and a between-measurement correlation of 0.8. The total sample size needed was 21 participants." was rearranged before the participants' recruitment in "Study design and participants" section of Material and Methods (Line 144-149 page 6) and highlighted with yellow color (8).

- "A total of 21 participants were included in the final sample. All participants were males aged 29 $\pm$ 0.9 years old with a dominant-right arm. The mean BMI was 24.6 $\pm$ 2.9 kg/m^2." was added into "Material and Methods" section (Line 151-153 page 6) and highlighted with yellow color.

Reference:

- Kelly BT, Kadrmas WR, Speer KP. The manual muscle examination for rotator cuff strength. An electromyographic investigation. Am J Sports Med. 1996;24(5):581-8.

Minor issues

1. Please be specific on the test. The author is talking about the sensitivity and specificity of the EC or FC test here. Lines 99-100

Responses: Thank you very much for your valuable suggestion, and we apologize for the misnomer. The sensitivity and specificity were belonged to the EC test.

Changes in manuscript:

- "Some studies also demonstrated sensitivity, specificity, and accuracy of the EC test as low as 30%, 35% and 50%, respectively(8, 15, 16). " was revised in "background" section (Line 114-116 page 5) and highlighted with yellow color.

Reference:

- Kelly BT, Kadrmas WR, Speer KP. The manual muscle examination for rotator cuff strength. An electromyographic investigation. Am J Sports Med. 1996;24(5):581-8.
- Bak K, Sørensen AK, Jørgensen U, Nygaard M, Krarup AL, Thune C, et al. The value of clinical tests in acute full-thickness tears of the supraspinatus tendon: does a subacromial lidocaine injection help in the clinical diagnosis? A prospective study. Arthroscopy. 2010;26(6):734-42.
- Ostör AJ, Richards CA, Tytherleigh-Strong G, Bearcroft PW, Prevost AT, Speed CA, et al. Validation of clinical examination versus magnetic resonance imaging and arthroscopy for the detection of rotator cuff lesions. Clin Rheumatol. 2013;32(9):1283-91.

2. I don't think the value of MVIC testing for each muscle can provide meaningful information due to it is varied a lot between individuals. However, please check the units provided here. It is a volt or millivolt. Lines 198-200, 208-209, Table 2

Responses: Thank you very much for your valuable suggestion. We kindly explain that in order to overcome the difficulty in making comparison between EMG value obtained from identical muscle in different subject, or even different muscle from the same subjects, the concept of normalization has been developed to enable comparing EMG signal. One common technique of normalized method is MVIC method. For this reason, despite it is varied a lot between individuals, we still evaluated MVIC value for each muscle to utilized as normalization EMG method in our study. And we do confirm the unit described and represent in volt.

Reference:

- Ha, S. M., Cynn, H. S., Kwon, O. Y., Park, K. N., & Kim, G. M. (2013). A reliability of electromyographic normalization methods for the infraspinatus muscle in healthy subjects. Journal of human kinetics, 36, 69–76. https://doi.org/10.2478/hukin-2013-0007
- Halaki, M. , Ginn, K. . Normalization of EMG Signals: To Normalize or Not to Norm alize and What to Normalize to?. In: Naik, G. R. , editor. Computational Intelligence i n Electromyography Analysis - A Perspective on Current Applications and Future Ch allenges [Internet]. London: IntechOpen; 2012 [cited 2023 Jan 13]. Available from: ht tps://www.intechopen.com/chapters/40113 doi: 10.5772/49957

3. Please be specific about how many subjects are needed. Line 201

Responses: Thank you very much for your valuable suggestion. We modified our manuscript as your suggestions.

Changes in manuscript:

- "The total sample size needed was 21 participants." was modified in "Study design and participants" section of Material and Methods (Line 149 page 6) and highlighted with yellow color

4. Please keep the writing concise and reading-friendly. No needs to repeat the calculation again as it has been described previously already. Lines 217-219

Responses: Thank you very much for your valuable suggestion. We removed the repeated sentence from our manuscript as your suggestions.

Changes in manuscript:

- **"**The standardized weighted EMG of seven muscles was accessible in 21 shoulders." Was removed from "Standardized weighted EMG testing" section of Results

5. The reasons to exclude the infraspinatus, pectoralis majors, upper trapezius, and posterior deltoid are needed. To my understanding, the reasons could not support the hypotheses, and it is not ideal for researchers to select data. Lines 229-232

Responses: Thank you very much for your comments, and we apologize for the misnomer sentence. We can kindly explain that,

Regarding our primary objective, "conduct an electromyographic study to determine which shoulder position best isolates SSP from deltoid activity", we intended to bring only data from deltoid and SSP into an analysis and finally represented as S:D ratio parameter from the beginning. Fortunately, after we collect all raw data, and plot trend from deltoid and SSP muscles (Table 3, supplementary figure2), we observe as spike shape line graph which could imply that there is a significant relationship found between shoulder position and these muscle activities.

For other muscles, based on the percentage of standardized weighted EMG (%sEMG) within all seven muscles that demonstrated in Table 3, and illustrated trend in supplementary figure2.,

- Shoulder position (abduction, horizontal flexion, and rotation) didn't significantly affect %sEMG of the infraspinatus and pectoralis major at all. The trend is nearly flat (supplementary figure2) which could imply that no relationship found between shoulder position and these muscle activities. Preliminary analysis also shown no significant relationship found for these muscles with shoulder positions.
- Upper trapezius demonstrated trend related with only shoulder abduction, but not related to horizontal flexion and rotation (low magnitude change). This abduction related trend could also be found and represented in deltoid and SSP muscle activity.
- Posterior deltoid demonstrated similar trend to middle deltoid (but relatively lower magnitude).

As we hypothesized that lower degrees of abduction and horizontal flexion would better isolate SSP activity from the deltoid activity. And to simplify the data and avoid of overflow non -significant information, we decide to reported only data of %sEMG of all muscles to achieve our secondary objective in table 3.

Besides, our result & analysis pattern was conducted in the same way as the previous EMG study. In order to avoid confusion, we will modify the sentence and try not to use the "exclude" word to make the sentence to be more understandable.

Changes in manuscript:

- "According to the relationship between shoulder positions and %sEMG (Supplementary Figure 2), the infraspinatus and pectoralis major demonstrated unrelate activity in any shoulder position, illustrated as a nearly flat graph over all positions. Additionally, the upper trapezius and posterior deltoid manifested similar trend to SSP and middle deltoid respectively, but with a relative lower magnitude of EMG changes." was modified in "Standardized weighted EMG testing" section of Results (Line 256-260 page 13) and highlighted with yellow color

Reference:

- Chalmers PN, Cvetanovich GL, Kupfer N, Wimmer MA, Verma NN, Cole BJ, et al. The champagne toast position isolates the supraspinatus better than the Jobe test: an electromyographic study of shoulder physical examination tests. J Shoulder Elbow Surg. 2016;25(2):322-9.

6. The p-values included in the tables are unclear. Main effect or which comparison?

Responses: Thank you very much for your valuable suggestion, and we apologize for the confusion. We kindly explain that

- In table 2, ∞: P-value from Kruskal-Wallis was determined from the comparisons among 3 position of shoulder abduction (30,60, and 90 degrees) and among 3 position of shoulder horizontal flexion (0,30, and 60 degrees). For comparison between external vs internal rotation, μ: P-value from Mann-Whitney test was utilized.
- In table 5, all P-value was analysed from the mixed-effects logistic regression represented the differing coefficients between groups with higher degrees of motion (60,90-degree abduction compared to 30-degree abduction) and (30,60-degree horizontal flexion compared to 0-degree horizontal flexion)
- In table 7, all P-value was analysed from the multiple regression with parsimonious model to determine the variable factors associated with supraspinatus: middle deltoid (S:D) ratio.

Reviewer 2

Objectives of the study were to (1) determine which shoulder position best isolates supraspinatus from deltoid activity and (2) evaluate the EMG activity within the supraspinatus, deltoid, and surrounding shoulder muscle after resisted abduction force in various shoulder positions.

The findings of the study have certain clinical and scientific values. Shoulder abduction, horizontal flexion, and humeral rotation significantly affected the activity of the middle deltoid, supraspinatus, and supraspinatus to middle deltoid ratio. Previous reference assessment--the classic empty cup position showed the smallest supraspinatus to middle deltoid ratio. Thus, the findings of study could provide better and accurate diagnosis of supraspinatus related injury or disease.

Please indicate more details

For emg analysis, did you use filter to pre-process the data?

Responses: Thank you very much for your valuable suggestions. We add this point into our Material and Methods.

Changes in manuscript:

- "The EMG signals were sampled by computer at 1000Hz. Eight integrated channels were used for signal filtering (10Hz and 400 Hz, Butterworth) and rectification. The isometric contraction was measured for a total of 5 seconds interval." was added into "experiment protocol" section of Material and Methods (Line 175-177 page 7) and highlighted with yellow color (8).

Reference:

- Kelly BT, Kadrmas WR, Speer KP. The manual muscle examination for rotator cuff strength. An electromyographic investigation. Am J Sports Med. 1996;24(5):581-8.

For normalized EMG, what method did you apply?

Responses: Thank you very much for your comments, we can kindly explain that we normalized all standardized weighted EMG activities to %sEMG by MVIC normalization method, which can be calculated by dividing the sEMG of the activities by their MVIC

Changes in manuscript: The information was provided in "Standardized weighted EMG testing" section of Results (Line 245-246 page 12) and highlighted with yellow color

Reference:

- Halaki, M., Ginn, K. Normalization of EMG Signals: To Normalize or Not to Normali ze and What to Normalize to? In: Naik, G. R., editor. Computational Intelligence in El ectromyography Analysis - A Perspective on Current Applications and Future Challen ges [Internet]. London: IntechOpen; 2012 [cited 2023 Jan 13]. Available from: https:// www.intechopen.com/chapters/40113 doi: 10.5772/49957

Page 12 line 229, you mentioned relationship, will you be able to provide more details?

Responses: Thank you very much for your comment, we can kindly explain that,

Based on the percentage of standardized weighted EMG (%sEMG) within all seven muscles that demonstrated in Table 3, and illustrated trend in supplementary figure2.,

- Shoulder position (abduction, horizontal flexion, and rotation) didn't significantly affect %sEMG of the infraspinatus and pectoralis major at all. The trend is nearly flat (supplementary figure2) which could imply that no relationship found between shoulder position and these muscle activities. Preliminary analysis also shown no significant relationship found for these muscles with shoulder positions.

- Upper trapezius demonstrated trend related with only shoulder abduction, but not related to horizontal flexion and rotation (low magnitude change). This abduction related trend could also be found and represented in deltoid and SSP muscle activity.
- Posterior deltoid demonstrated similar trend to middle deltoid (but relatively lower magnitude).

Changes in manuscript:

- "According to the relationship between shoulder positions and %sEMG (Supplementary Figure 2), the infraspinatus and pectoralis major demonstrated unrelate activity in any shoulder position, illustrated as a nearly flat graph over all positions. Additionally, the upper trapezius and posterior deltoid manifested similar trend to SSP and middle deltoid respectively, but with a relative lower magnitude of EMG changes." was modified in "Standardized weighted EMG testing" section of Results (Line 256-260 page 13) and highlighted with yellow color

Page 16, table 7. Please indicate how the regression analysis supports the objectives of the manuscript.

Responses: Thank you very much for your comment, we can kindly explain that, the multiple regression with parsimonious model could determine a variable factor that associated with S:D ratio values, we found that factors inversely associated with the outcomes were shoulder position, body weight, and scapular angle, $P < 0.0001$. This information highlighted the significant of shoulder position related to S:D ratio values as proposed in our primary objective.

Changes in manuscript:

- "This information highlighted the significance of shoulder position related to S:D ratio values as proposed in our primary objective." was added in "Standardized weighted EMG testing" section of Results (Line 304-306 page 17) and highlighted with yellow color

Reference:

- Diaz-Ramirez LG, Lee SJ, Smith AK, Gan S, Boscardin WJ. A Novel Method for Identifying a Parsimonious and Accurate Predictive Model for Multiple Clinical Outcomes. Comput Methods Programs Biomed. 2021 Jun;204:106073. doi: 10.1016/j.cmpb.2021.106073. Epub 2021 Mar 27. PMID: 33831724; PMCID: PMC8098121.

I suggest authors may consider indicating or add the significance of the study from clinical or scientific perspective during introduction session.

Responses: Thank you very much for your valuable suggestions. We add this point into our background.

Changes in manuscript:

- "Traditionally, the shoulder physical examination has been a cornerstone of the diagnostic process. Largely based on the result of these two original studies (7, 8), both EC and FC tests have turned into classic used clinical examination for diagnosing SSP pathology. Nevertheless, the result of their previous EMG studies (7, 8) provided insufficient information to support the conclusion that the EC and FC tests can specifically isolate SSP activity. Certainly, previous EMG studies suggest that the EC and FC tests extremely activate deltoid muscle(9, 10), infraspinatus(9, 11) as well as SSP. In clinical practice, the EC and FC test could be painful and difficult to achieve for patients, resulting in apparent weakness from the pain-mediated reflex inhibitor of the muscle. Many previous studies have manifested the unsatisfactory diagnostic accuracy of these tests in terms of clinical application(5, 12-14). Longo et al.(14) conducted a review article on clinical testing for SSP pathology, they found that the EC test mostly had a sensitivity lesser than 80% (4 out of 6 studies), and a specificity of less than 80% (5 out of 6 studies). Correspondingly, they also found that the FC test mostly had a sensitivity and specificity lesser than 80% (3 out of 4 studies). Some studies also demonstrated sensitivity, specificity, and accuracy of the EC test as low as 30%, 35% and 50%, respectively(8, 15, 16)." was added into "background" section (Line 101-116 page 4-5) and highlighted with yellow color.

Reference:

- Jobe FW, Moynes DR. Delineation of diagnostic criteria and a rehabilitation program for rotator cuff injuries. Am J Sports Med. 1982;10(6):336-9.
- Kelly BT, Kadrmas WR, Speer KP. The manual muscle examination for rotator cuff strength. An electromyographic investigation. Am J Sports Med. 1996;24(5):581-8.
- Malanga GA, Jenp YN, Growney ES, An KN. EMG analysis of shoulder positioning in testing and strengthening the supraspinatus. Med Sci Sports Exerc. 1996;28(6):661-4.
- Reinold MM, Macrina LC, Wilk KE, Fleisig GS, Dun S, Barrentine SW, et al. Electromyographic analysis of the supraspinatus and deltoid muscles during 3 common rehabilitation exercises. J Athl Train. 2007;42(4):464-9.
- Boettcher CE, Ginn KA, Cathers I. Standard maximum isometric voluntary contraction tests for normalizing shoulder muscle EMG. J Orthop Res. 2008;26(12):1591-7.
- Park HB, Yokota A, Gill HS, El Rassi G, McFarland EG. Diagnostic accuracy of clinical tests for the different degrees of subacromial impingement syndrome. J Bone Joint Surg Am. 2005;87(7):1446-55.
- Longo UG, Berton A, Ahrens PM, Maffulli N, Denaro V. Clinical tests for the diagnosis of rotator cuff disease. Sports Med Arthrosc Rev. 2011;19(3):266-78.
- Bak K, Sørensen AK, Jørgensen U, Nygaard M, Krarup AL, Thune C, et al. The value of clinical tests in acute full-thickness tears of the supraspinatus tendon: does a subacromial lidocaine injection help in the clinical diagnosis? A prospective study. Arthroscopy. 2010;26(6):734-42.
- Ostör AJ, Richards CA, Tytherleigh-Strong G, Bearcroft PW, Prevost AT, Speed CA, et al. Validation of clinical examination versus magnetic resonance imaging and arthroscopy for the detection of rotator cuff lesions. Clin Rheumatol. 2013;32(9):1283-91.

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Thank you for your valuable comment & consideration of our manuscript for publication in your journal. We hope that we can get the best opportunity from your decision.