Reviewer's report

Title: SEAS (Scientific Exercises Approach to Scoliosis): a modern neurophysiological evidence based approach to exercises for idiopathic scoliosis

Version: 2 Date: 31 July 2013

Reviewer: Eric Parent

Reviewer's report:

Scoliosis currently considers the following article types: Case Report, Letter to the Editor, Methodology, Research and Review articles.

This may be a review article but it is mostly a description of a scoliosis specific exercise approach for Scoliosis. Which I assume is for the thematic series.

1. Is the question posed by the authors new and well defined?
   This is a description of the exercise approach and as such the intent is clear.

2. Are the methods appropriate and well described, and are sufficient details provided to replicate the work?
   The description of the method is currently very high level. I recommend providing significantly more details. This will improve the value for the readers.

3. Are the data sound and well controlled?
   --There is no research results presented that are new. Some previous publications are summarized.

4. Does the manuscript adhere to the relevant standards for reporting and data deposition?
   -description of approaches don't match a clear typical reporting format I am familiar with.
   I make suggestions to improve the reporting flow.

5. Are the discussion and conclusions well balanced and adequately supported by the data?
   - This does not really apply in this case. I recommend preparing a concluding statement nevertheless.

6. Do the title and abstract accurately convey what has been found?
   -Yes but it may be more descriptive by including the definition of the SEAS abbreviation and stating:
   Description of the SEAS scoliosis-specific exercise approach (Scientific Exercise Approach to Scoliosis)

7. Is the writing acceptable?
The paper should be reviewed for adequate English language throughout. I make some recommendations but English is a second language for me as well.

Please make your report as constructive and detailed as possible in your comments so that authors have the opportunity to overcome any serious deficiencies that you find and please also divide your comments into the following categories:

• Major Compulsory Revisions (which the author must respond to before a decision on publication can be reached)

• I do not comment on minor English corrections but an English editor should review the whole manuscript.

2. In the abstract: I recommend adding the following key characteristics to the rehabilitation program section: Patients for which the approach is indicated; goals pursued; program dose in terms of (number of sessions at which frequency over which duration; session durations: home exercise frequency and duration…).

3. Intro paragraph 1: You refer to most-qualified European centers: On what basis can the qualification be judged. Will this be relevant for the readership. It would be just as meaningful to simply list the specific centers having influenced the developers. Interestingly the approach is described as scientific but the initial development is based on influence from different opinion leaders. If these centers provide research evidence the evidence should be cited instead. Rather than listing cities and countries. Please refer to specific centers or researchers having had influence. Rather than refer to prestige and reputation of consulted colleagues it would be more convincing to refer to their data, evidence…. Otherwise it adds little meaning for the readers.

4. Intro. In listing the basic characteristics of the Lyon approach adopted consider using an action verb for each item. EG Improve the patients understanding of the deformity. (do you want improved understanding or awareness?). For the last characteristic I suggest: (.so as to use the brace to provide resistance to the exercises.

5. Page 2: (Stabilization paragraph). You need to cite evidence to the unknown cause of scoliosis (eg an etiology review). I recommend surgical implants to replace metal bars, physicians to replace medic, brace to replace corset.

6. Page 2 (stabilization paragraph): You need to provide citation to support that scoliosis is associated with a degree of instability. Please define instability in this context (ideally accepted definition supported with reference). Similarly, define what you mean by “counteract spinal collapse”. It may be worth referring to the work of Stokes et al on how mechanical imbalances in loading vertebrae and disc contribute to scoliosis progression by affecting bone growth.

7. Page 3 (SEAS exercise) Here and throughout the text, you refer to SEAS training the reflex response towards the correct position. I am not sure I agree with the use of reflex in this context. You need to define what you mean. I believe we want the patients continuously maintain the correct position, not only as a
reflex to a perturbation. I agree that we want to train them. We also want to ensure that it become maintained “automatically” without constant conscious correction. I would support a term that would mean integrated/independent of conscious contraction but I don’t, think it a reflex in the typical sense of an involuntary response to a stimuli.

8. P3 (SEAS exercise) There is theory and research evidence supporting some of the ideas SEAS is using to facilitate the involuntary integration of the correct posture. Reviewing the literature on the effect of initially providing visual feedback then removing it for better learning would be relevant in this paper. Similarly, there is literature on the value of progressing from focused simple activities to complex activities while distracted to facilitate motor learning. The literature may not be on scoliosis but motor learning theory is relevant here and citing it would support the name given to your approach.

9. Page 3 (objective 1) Please define what are the targeted functions? (are they functional activities as per the ICF language or do you mean impairments detected during the evaluation.

10. “The evolution of unstable scoliosis always runs toward a worsening condition.” Please add a reference and ensure it is linked to a clear definition of unstable scoliosis. Not all scoliosis is evolutive and identification of progressive cases is not an exact science and I am not aware of a clear demonstration that “segmental instability is at play”.

11. In the sentence here I don’t think I agree with the use of maintain stability; it seems stability is used here in lieu of physiological alignment and biomechanically symmetrical distribution of forces rather than segmental instability. “The asymmetrical distribution of the load and the progressive deformation of the vertebrae gradually decrease the spinal column’s capacity to maintain stability.” Similarly in the following sentence clarifying the use of the terms destabilization and imbalance (do you mean risk of falling or asymmetrical load distribution) would be beneficial.

12. After presenting the principles to understand SEAS, I believe you should describe an overview of how SEAS is implemented: Evaluation, teach exercise, family education, home program and follow-up strategy. (maybe use the PROTOCOL paragraph from page 7) Then you could describe which for which patients it is indicated to use SEAS and if these consist of different categories, then later on in the manuscript keep referring to each category and explain how the approach is modified for each (EG mentioned already, small curves immature, in brace, during brace weaning, in adults…). Then a section could expand each of the topics: evaluation, teaching exercises, education … Currently objective 2 refers to exercises targeting elements identified at the evaluation but we do not yet know what is a SEAS evaluation assessing.

13. The evaluation description on page 3 and page 8 should be more specific. SEAS’s prescription is directly related to the assessment. A clear description of the assessment strategy is therefore very important. Describe which postural impairments are assessed that guide treatment prescription. Ideally you could refer the reader to preferred methods or describe how these are assessed.
14. Specify which body structures and function are tested and possibly guiding exercise selection in SEAS. EG. which muscle lengths, strengths, (Fatigability?) are tested? How? One particularity of the SEAS approach is its integration of neuromotor evaluation and training. Please describe how neuromotor impairments are detected? Which ones are assessed and how?

15. Page 8. If SEAS uses unique outcomes measures to track the effect of treatment these should also be described and referenced.

16. In describing the teaching of the exercises, I recommend first explaining how the exercises are taught and then introduce the questions used to self-appraise performance. (or introduce both together). At the moment, when the questions are introduced the reader does not know quite enough about the exercise progression to fully understand.

17. P6-7 You are detailing 2 exercises which is interesting but to help the reader you may want to illustrate the progression that would be given to a few patients to illustrate how the exercises selected and dosage are progressed during the program. We understand from your description that the combinations could be almost infinite depending on the needs/ impairment of the specific patient but illustrating a few progressions would be informative and detailing a basic and advanced exercise would then be more meaningful as the reader could understand when and how these could be used.

18. P6-7. You suggest that the exercises have a bias towards self-correction in the frontal plane in the basic example and towards the transverse and sagittal plane in the advance exercise case. You should clarify how the therapist is to choose the bias selected in instructing the patients in self-correction.

19. P8 The bullets 3-6 could be move to a section where you explain the principles underlying the SEAS approach. Ideally supporting evidence should be summarized along this principle presentation.

20. P8 The test aims sections is somewhat too vague and as such is redundant with some references to the evaluations made earlier. I suggested earlier to provide much more details about this key component of the SEAS approach and this section therefore may be significantly changed and possibly moved to before describing the exercises.

21. P9. Strengths paragraphs. Consider reporting criteria for progression from simple to complex. This could go into a more detailed introduction of the exercise progression as suggested earlier. Similarly define the treatment phases and criteria for moving from one phase to another.

22. P10. The result of the literature section is too vague. One of the most valuable part of the paper will be the inventory of the studies so far on SEAS. I suggest creating a summary table for these studies. For each it should be clear which were the patients included (clarify the age, gender, skeletal maturity, curve types and severity), Describe BOTH treatments compared (type, overall duration, number of sessions, home program) Specify the targeted outcomes (report main results providing information to judge both the clinical and statistical significance.), specify the study designs.
23. P10 Under results (3rd paragraph). For these other important effects please create a paragraph highlighting the differences about how the SEAS approach is implemented in these different context.

- Minor Essential Revisions (such as missing labels on figures, or the wrong use of a term, which the author can be trusted to correct)

1. In the abstract: I would move the content from the result section to the background as a justification of why there is value in describing the approach to a wider audience. Provide some specific key results to help the reader realize the clinical importance of the findings to date.

2. In the abstract and the text. Please refer to the published articles and abstracts directly without emphasizing the indexing in only PubMed.

3. In the introduction paragraph. How were the therapeutic objectives derived from data?

4. In the intro paragraph: A clear reference to a description of the Lyon Approach should be provided.

5. Page 2 Stabilization paragraph): replace “until peak of osseous” by “peak of skeletal maturity”.

6. Page 2 (SEAS active correction). Cite the 2005 consensus replace the term “this topic” specifically with the wording used in the SOSORT consensus.

7. Page 2 Seas active correction paragraph) in the last sentence replace most important by widely published Scoliosis specific exercises. (most important is a judgment statement that may be questioned, reformulate as a factual statement.

8. Page 2 (SEAS Active self-correction). Replace “comprehend” by “understand”

9. Page 2 (SEAS Active self-correction). The following could be stated more clearly avoiding jargon and referring to work expanding the concept (Stokes again?) “determined by the constant disharmonic pressure upon the vertebrae.”

10. Page 2 the following statement should be supported by a reference or rephrased as a hypothesis: “However, it is not possible to maintain the correct position beyond those sessions”

11. Page 2: In the following statement, Please define what you mean by neuromotor function in this context (add a reference?). Also explain what you mean by "direct/ indirect" and by “external aides”: “The purpose of SEAS exercises is to train the neuromotor function so as to stimulate the maintenance of self-correction posture during the activities of daily life. According to the SEAS approach, achieving an "indirect" self-correction using these external aides does not allow the achievement of the purpose on which this concept is based.”

12. Page 2. Explain what you mean by “best functional stimulation of the alignment reflex”. Reflexes are typically defined by a stimulus and the response characteristics. Can a reference be cited where this is described?

13. P3 Explain what you mean by “overhang” or adopt the more commonly
accepted “frontal imbalance”, if I understood correctly. How does the bullet “improvement of the postural components” differ from the previous two above?

14. Throughout the manuscript please replace deficits by impairments to align with International Classification of Functioning (ICF) language.

15. P3 (SEAS exercise section) Avoid the use of accredited methods as there is not a widely accepted accreditation system for exercise method at the present. Consider replacing by scoliosis-specific exercise approach and defining this in the intro.

16. P3 (SEAS exercise) Explain how self-correction is done.

17. P3 (Objective 1) The paragraph closes with a non-exhaustive list of the types of exercise variations that are used in SEAS. Here or later in the specific exercise prescription it would be important to explain all the exercises types used in SEAS and the criteria that the therapist are to use in selecting which ones to prescribe.

18. Page 8. (Under Scheduled tests aim:) how is the 2nd item different from the 4th?

19. Page 4, (second paragraph) you suggest that the purpose of assessing is a reliable general diagnosis but this may create confusion with the medical diagnosis. Simply create a paragraph clarifying who the approach is indicated for and then clarify that the assessment is essential to identify which impairments should be targeted by the therapy.

20. Page 4, (The 4 questions). The last sentence suggests that the questions arise over the course of treatment but in fact they apply to the performance of each exercise please specify.

21. Page 4 (First question) Last sentence. Please clarify what you meant by being in a relaxed position not requiring any particular control (elsewhere you state: not be knowingly relaxed). Could you simplify and say this is the patient’s natural position?

22. Page 5, the English wording of the 4th question is awkward. Could it be simplified as follows: Can I still notice a difference between my self-corrected position at the end of the exercise and my natural position?

23. P5 (Learning Self-correction) You suggest that exercises are selected based on the pathology. I recommend deleting pathology and keeping morphologic feature and posture. You could also choose to replace pathology with impairments. This would be more consistent with our lack of knowledge about the true etiology of scoliosis.

24. P5 Please replace contrast postural collapse by a better term. Schroth for example use expand compressed/concave areas.

25. P5 Movement in the sagittal plane. Please specify where the extension is to occur (lumbar?)

26. P5 (bottom) I do not understand what is meant by: “Before starting active self-correction, the patient stays active, to recover postural collapse.”

27. P6 (top instructions). A discussion or a rationale section nearby should be
added to justify why you propose the instructions in the first 3 bullets. Are these evidence based?

28. P6 Fourth bullet: How is the primary curve identified by SEAS (How are the criteria in the parenthesis leading to a decision?).

29. P6 5th bullet. Identify the neuro fibers as somatosensory or event better proprioceptive here and throughout the text.

30. P6 (5th Bullet). Summarize the evidence supporting the progressive removal of visual feedback to achieve motor learning of corrected posture.

31. P6 (6th bullet (add the bullet?)). Specifically explain breathing instructions used in SEAS to achieve posture corrections. This may be a key difference with other approaches and it should be detailed. Can you report evidence justifying your recommendations with regards to breathing? Or explain the rationale about why and how using breathing helps?

32. P6 (7th Bullet (add the bullet?). Ideally a justification for the use of fatigue as a criterion would be provide. (evidence cited if possible). Also what would be the source of the perceived fatigue: Muscle physiology? Neurotransmission fatigue, or psychological/concentration issues?

33. P6: I recommend the patient is to move from the sitting to the standing position. (not pass).

34. P6: (bottom) Please consistently used Thoraco-lumbar rather than introduce a new terms (dorso…)

35. P6 In the first bullet under basic exercise. Specify if the translation is to the convex/concave side of which curve?

36. P6 Correct typo for the reference to Fig 13.

37. P7 In the 2nd bullet under Advance exercise: Specify the sagittal plane correction requested of the patient. P7 3rd bullet under Advanced: Specify the instructions for the feet position during the exercise. And delete the parenthesis content. (I like the term posture)

38. P7. In the overview of the protocol. Discuss how long is devoted to the evaluation, the teaching and the counselling during the 1.5 hr session. Here or in a separate section, please describe who is involved in delivering the SEAS therapy and their qualification process.

39. P7 Consider adding a paragraph or a few sentence to explain the topics covered in counselling and how it is done.

40. P7 In the program overview, specify the overall duration of SEAS therapy delivery and follow-up. What criteria are used to discontinue therapy and discharge patients?

41. P7 bottom: remove sentence between parentheses.

42. P8 (top) I am not sure the “stress” created by the exercise is the right term. Consider using the challenge level or the difficulty level instead.

43. P8 Bullet 1; under exercise type (typology) can you specify a list of the types of exercise in the SEAS approach (e.g. dynamic motion of more or less range,
balance exercise of more or less difficulty, loading/strengthening exercise....)

44. P8 Monopodalic is unusual. Consider single leg stance.

45. Throughout the paper the term stimulate is used in two different context. To avoid confusion: 1) as stimuli to elicit a reflex response (use stimuli or triggering a reflex). 2) to provide a training challenge/ stimulus (use to train or to challenge).

46. P8. The second bullet is redundant with material presented above. Delete? This may give you more space to explain the evaluation in greater details.

47. P8 The 3rd bullet. The first sentence is unclear. Please rephrase.

48. P8 6th bullet. Re parenthesis at the end. Please specify criteria to be used by the therapists to decide on when to reduce visual feedback in favor or greater reliance on proprioceptive feedback.

49. P9 Explain what is meant by increasing plasticity.

50. P9 Under strength....: The following part of a sentence is unclear please clarify: “After some months, the exercises would change and try to take advantage of the tilt of the brace as a useful tool to obtain a better shaping of the torso,...” Can you also cite supporting evidence of the muscle weakness issues associated with brace wear?

51. P9. Unders scoliosismanager: I do not recommend emphasizing "Complex". I recommend using the term Therapist instead of operator to clarify the target audience. I recommend to only focus on the software exercises meant for scoliosis in this paper. The term discriminant is confusing.

52. P13. For fig 2,4, 6, 8. Please clarify that the pictures are not after self-correction they are during self-correction. (you could consider introducing pictures of patients before the program compared to the after the program.). Maybe also clarify that Fig 5 and 7 (any others as well) reflect the natural posture of the patients without doing the exercise or the self-correction.

53. P14. The pictures chosen for Fig 14 and 15 do not illustrate a clear difference. It may be important to change picture and create a legend clearly detailing what is highlighted.

54. P16 Some terms are unusual.

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• Discretionary Revisions (which are recommendations for improvement but which the author can choose to ignore)

1. Abstract(background): Second sentence. I recommend “The basis and changes of the approach do not result....

2. Abstract: You conclusion could be made specific to SEAS.

3. Page 3 (SEAS exercise) Based on your definition provided at the beginning of this section, I was under the impression that self-correction is itself an exercise. Also given how self-correction the goal of multiple exercises in Schroth, I was used to called Self-correction an exercise. You may want to provide a
clarification.

4. Throughout where applicable please replace self-correction posture by self-corrected posture.

5. Page 4 for the second question, It appears that patients see themselves only in a mirror placed in front of them. Please state what symmetry elements they are taught to monitor using the mirror. Do they have the ability to detect how adequate is their derotation and sagittal corrections?

6. On page 5, You suggest that a patient answering non to the 3rd question is prescribed an easier exercise. Please, also state the criteria used to prescribe a harder exercise. I was also wondering if therapists would be able to adjust the dose of a given exercise before changing to an easier exercise task.

7. IDEA: On page 5, you introduce the 4th question. It implies that upon finishing all exercises patients have to return to their natural posture and demonstrate a difference between their posture at the end of the exercise and their natural posture. I am wondering if there is a risk that patients interested in convincing themselves they have maintained correction would actually exaggerate the deformity at this stage. From a motor learning point of view, just like you do with the mirror, would it be relevant to remove the emphasis on the fourth questions and promote instead continued maintenance of the corrected posture at all times. This Idea could be presented in a short discussion section.

8. A short discussion section could be prepared to discuss the key similarity and differences between SEAS and the other scoliosis-specific approaches. The discussion could highlight the level of evidence available to support the various guiding principles supporting how the approach is implemented and highlight a research agenda for the topics for which more evidence is needed (eg. The idea presented above).

9. Can you explain in SEAS how the patients are instructed in derotation?

**Level of interest:** An article of importance in its field

**Quality of written English:** Not suitable for publication unless extensively edited

**Statistical review:** No, the manuscript does not need to be seen by a statistician.

**Declaration of competing interests:**

'I declare that I have no competing interests