Effectiveness of surgical versus conservative treatment for symptomatic unilateral spondylolysis of the lumbar spine in athletes: a systematic review protocol

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Review question/objective

This systematic review aims to determine the effectiveness of surgical fixation, performed after a trial period of conservative management, compared to conservative management only for unilateral spondylolysis in athletes.

More specifically, the objectives are:

- To assess whether surgical fixation compared to conservative management of unilateral spondylolysis allows athletes to return to their regular sport more rapidly.
- To identify which intervention is more effective in supporting the athlete to resume pre-injury function.

Background

Spondylolysis is a common cause of low back pain in athletes, especially amongst adolescent athletes. The incidence of the condition in the general population is between 6\%-8\%;\textsuperscript{1,2} however in the athletic population the incidence has been reported as high as 47\%.\textsuperscript{3} Spondylolysis refers to a defect or fracture of the pars interarticularis of vertebrae which can be either unilateral or bilateral. The pars interarticularis is the junction of the pedicle, articular facets and lamina.

Historically stress injuries of the pars interarticularis were thought to be mostly bilateral\textsuperscript{4} and were noted in young athletes competing in sports requiring repetitive lumbar extension movements such as gymnastics and swimming.\textsuperscript{5} The growth of professional sport has seen more athletes exposed at a younger age to the repetitive actions which can lead to this condition. This, combined with advances in lumbar spine imaging in the past 20 years has revealed that unilateral spondylolysis is more prevalent than originally thought and further demonstrated that amongst participants in some sports, such as cricket for example, unilateral spondylolysis may in fact be just as common as bilateral spondylolysis.\textsuperscript{6,7}
Studies using Magnetic Resonance Imaging (MRI) or high resolution Computerized Tomography (CT) scanning have estimated that between 32% - 48% of all cases of radiologically confirmed spondylolysis in athletes are unilateral. 8,9 Amongst cricket players, it has been shown that up to 55% of young fast bowlers may suffer from unilateral spondylolysis.10 If this injury is not managed appropriately it significantly limits player’s ability to pursue their sporting career.10,11 A large amount of research regarding unilateral spondylolysis has involved this specific group of athletes.6,7,10-13

Unilateral spondylolysis occurs when repetitive stresses are placed on the pars interarticularis. The specific combination of repetitive extension, rotation and side flexion creates a shear force on the pars interarticularis that causes stretching of the pars and eventually stress microfracture.4 With ongoing stress an incomplete fracture occurs that can lead to chronic non-union. The condition occurs most commonly at the L5 vertebral level.9 A spondylolytic injury can have substantial impact on athletes, regardless of their chosen sport. The injury can cause significant pain and impediment to activity and lead to significant time away from sport.5,6

Despite growing knowledge regarding the epidemiology and aetiology of unilateral spondylolysis, the optimum management of athletes with this condition still remains unclear. It has been recommended by several review articles on spondylolysis that conservative management including rest; activity modification and physiotherapy, facilitate a patient’s return to sports over time.4,5,14 A study by Blanda et al.15 demonstrated that a 6-month protocol of non-operative management led to apparent radiographic union of the unilateral pars interarticularis defect in 87% of patients, however the authors did not report on return to sport or clinical outcome in this group. Sys et al.8 noted similar outcomes for a subgroup of 11 patients with unilateral spondylolysis treated with lumbar bracing for an average of 16 weeks. These patients all achieved CT identified osseous healing of the fracture, with most of the athletes able to return to a previous level of sport.8 These studies indicate that conservative treatment of up to 6 months achieves positive results in most patients. However, it remains unclear in patients who do not respond to conservative treatment within six months, if surgery or ongoing conservative treatment is more beneficial, or even whether it would potentially be more beneficial for patients to have surgical intervention immediately after the initial diagnosis of the injury.

Various methods of surgical fixation have also been described, with surgical fixation only attempted after an initial trial period of conservative management.4,5,14 The general aim of surgical intervention is a direct repair of the pars interarticularis. In the past spinal fusion was used as the first line of surgical treatment, however internal fixation devices have superseded spinal fusion as the gold standard surgical treatment.14 Despite technological advances the role of surgical intervention and its effectiveness remains controversial, and it remains unclear whether athletes with unilateral spondylolysis are able to return to the sports field more rapidly or if they are able to compete to the same level as prior to their injury.

A search of the Cochrane (CENTRAL) and CINAHL databases using the keywords “unilateral spondylolysis”, “surgical versus conservative intervention”, and “systematic review” in an attempt to locate any recently published systematic review and/or protocols for review on the topic. No systematic reviews or protocols looking specifically at unilateral spondylolysis were identified. This highlights the value of the proposed research, which will provide sports rehabilitation practitioners with the first synthesis of the available evidence on the effectiveness of surgical intervention compared to conservative management for unilateral spondylolysis in athletes.
Keywords
spondylolysis, pars interarticularis, stress injury, fracture, surgical treatment, conservative treatment, athletes.

Inclusion criteria
Types of participants
This review will consider studies in which participants are athletes with symptomatic unilateral spondylolysis of the lumbar spine. Athletes will be defined as individuals under the age of 50 competing in regular organised sporting activities. Both professional and amateur athletes will be considered participating in any type of sport. For participants to be included in the review unilateral spondylolysis has to be radiologically diagnosed in athletes with back pain using CT scanning, MRI or by Single-photon Emission Computed Tomography (SPECT) scanning. An inclusive approach will be adopted with respect to the geographical location of studies with participants from all countries and health care settings to be considered. Only studies where participants have first undergone a trial of conservative treatment prior to surgical intervention will be considered, as this is the current recommended practice.

Types of intervention and comparators
Surgical interventions, which attempt a direct repair of the pars interarticularis, will be considered for this review. Even though direct repair in the form of Buck's Repair is the most widely recommended surgical treatment for spondylolysis, other surgical techniques including segmental wire fixation and pediculolaminar hook screws have also been shown to be effective and will hence be included in the review.

Types of outcomes
The primary outcomes of interest in this review are return to sport, length of time before return to sport and level of sporting activity after treatment. With respect to measures of outcomes, a yes/no response will indicate return to sport, which may be gathered by patient observation or report. All objective and subjective measures of time to return to sport and level of post treatment sporting participation/activity level will be considered.

Overall function and pain are secondary outcomes for the review. Various functional pain and disability scales that are specific to this injury will be considered. The Oswestry Disability Index is commonly used to review the effectiveness of interventions in subjects with low back pain. This comprehensive questionnaire looks at the impact of low back pain on all aspects of life including activities of daily living, social life, sleep and work capabilities. Another measure that is commonly used in this patient group is the Short Form (SF) 36 Health Survey which is a global assessment of health and is not specifically focused on low back pain. Results for these measures will be included. Other measures of general
function or health that will be considered are specific scales to measure low back pain that are commonly created by subspecialist research groups or associations. Examples include the The Quebec Back Pain Disability Scale and the Roland Morris Low Back Pain and Disability Questionnaire. Similar to the Oswestry Disability Index, these tools measure the impact of the injury on various aspects of a patient's life with a general focus on activity limitation.

Expert opinion indicates that the ideal follow-up period when measuring outcomes following treatment for spondylolysis is two years. The review will adopt an inclusive approach with respect to follow up time and studies with any duration of follow-up will be considered. However, the issue of how length of follow may affect results will be considered in the analysis and any limitations relating to insufficient follow up highlighted.

**Types of studies**

This review will consider both experimental and epidemiological study designs including randomized controlled trials, non-randomized controlled trials, quasi-experimental, before and after studies, prospective and retrospective cohort studies, case control studies and analytical cross sectional studies for inclusion.

This review will also consider descriptive epidemiological study designs including case series, individual case reports and descriptive cross sectional studies for inclusion. Given the anticipated paucity of research on this subject, studies that clearly report data on a subgroup of subjects with unilateral spondylolysis as part of a wider study on spondylolysis will be retrieved and reviewed for possible inclusion.

**Search strategy**

The search strategy aims to find both published and unpublished studies. A three-step search strategy will be utilized in the review. An initial limited search of MEDLINE and CINAHL will be undertaken followed by analysis of the text words contained in the title and abstract, and of the index terms used to describe articles. Second, a search using all identified keywords and index terms will then be undertaken, across all databases. Thirdly, the reference list of identified reports and articles will be searched for additional studies.

The following databases will be searched to identify published studies:

- PubMed
- CINAHL
- Cochrane (CENTRAL)
- Scopus
- Centre for Review and Dissemination databases
- PEDro
- EMBASE
To identify unpublished studies the following will be searched:

- Online clinical trials registers
- MedNar
- ProQuest Dissertations

Given that surgical techniques still used today that were developed in the early 1970s studies published between 1970 and 2013 be considered for inclusion in this review. With respect to language, only studies published in English language will be considered for inclusion.

Examples of initial keywords that will be used in the exploratory stage of the search for studies in electronic databases are: spondylosis, pars interarticularis, stress injury, fracture, surgical treatment, conservative treatment, athletes.

Informed by the findings from the initial exploratory searches in the range of databases to be covered, further key words will be identified and a detailed search strategy will be developed and implemented for each database.

**Assessment of methodological quality**

Methodological quality of considered studies will be assessed by two independent reviewers for methodological validity prior to inclusion in the review using standardized critical appraisal instruments from the Joanna Briggs Institute’s Meta Analysis of Statistics Assessment and Review Instrument (JBI-MAStARI) (Appendix I). Any disagreements that arise between the reviewers will be resolved through discussion, or with a third reviewer.

**Data collection**

Details describing each study and results on effectiveness in promoting the outcomes of interest will be extracted from papers included in the review using the standardised data extraction tool from JBI-MAStARI (Appendix II). In addition to extraction of the results for outcomes relevant to the review question and specific objectives the information extracted will include details about the interventions, populations and method of the included studies. Authors of primary studies will be contacted for missing information or to clarify unclear data.

**Data analysis and synthesis**

Quantitative data will, where possible be pooled in statistical meta-analysis using JBI-MAStARI. All results will be subject to double data entry. Effect sizes expressed as odds ratio (for categorical data) and weighted mean differences (for continuous data) and their 95% confidence intervals will be calculated for analysis. Heterogeneity will be assessed statistically using the standard Chi-square and also explored using subgroup analyses based on the different study designs included in the review and the sub-questions (or objectives) of the review. Where heterogeneity implies that statistical pooling is not possible the findings will be presented in narrative form of tables and figures. Data permitting subgroup analysis will be conducted to shed light on any differences in the effectiveness of conservative versus surgical treatment between professional and amateur athletes.
Conflicts of interest

There are no conflicts of interest to report.

Acknowledgements

The primary reviewer would like to thank Dr Judith Gomersall as the primary supervisor of this project.
References


Appendix I: MASTARI critical appraisal checklist

**JBI Critical Appraisal Checklist for Randomised Control / Pseudo-randomised Trial**

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>Unclear</th>
<th>Not Applicable</th>
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<tr>
<td>1. Was the assignment to treatment groups truly random?</td>
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<td>2. Were participants blinded to treatment allocation?</td>
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<td>3. Was allocation to treatment groups concealed from the allocator?</td>
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<td>4. Were the outcomes of people who withdrew described and included in the analysis?</td>
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<td>5. Were those assessing outcomes blind to the treatment allocation?</td>
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<td>6. Were the control and treatment groups comparable at entry?</td>
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<td>7. Were groups treated identically other than for the named interventions</td>
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<td>8. Were outcomes measured in the same way for all groups?</td>
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<td>9. Were outcomes measured in a reliable way?</td>
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<td>10. Was appropriate statistical analysis used?</td>
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**Overall appraisal:**  Include □  Exclude □  Seek further info. □

Comments (Including reason for exclusion)

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Appendix II: MASTARI data extraction

### JBI Data Extraction Form for Experimental / Observational Studies

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#### Study Method

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<th>Retrospective</th>
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#### Participants

- Setting
  
- Population
  

#### Sample size

- Group A
  
- Group B
  

#### Interventions

- Intervention A
  
- Intervention B
  

#### Authors Conclusions:

- 
  
- 

#### Reviewers Conclusions:

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- 

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