Update for Chapter 14: How should you treat spondylolysis in the athlete?
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Since the publication of Evidence-based Sports Medicine,1 there have been a number of publications addressing the subject of spondylolysis. Although much of this literature expands the cumulative knowledge base on spondylolysis, there are still no published controlled trials on the treatment of spondylolysis in the athlete nor any studies comparing the most widely used diagnostic imaging modalities for this condition. As discussed in the original chapter on spondylolysis for Evidence-based Sports Medicine,2 there is a general consensus among authors on the pathogenesis and demographics of the disorder, but there are substantial differences in the diagnostic and treatment approaches recommended by various authors. This update will address the recent literature on spondylolysis as it relates to the fundamental question: How should you treat spondylolysis in the athlete?

Epidemiology

Rossi and Dragoni3 have published the results of a radiographic study describing the results of 4243 young athletes studied with plain radiographs. All the athletes had complaints of low back pain and were assessed between 1962 and 1998 with studies that included antero-posterior, lateral, and oblique films. The authors found that 13.9% of the athletes studied had evidence of spondylolysis on plain radiographs, and that 47.5% of these had a concurrent spondylolisthesis. As has been noted in multiple prior studies, some sports had much higher rates of spondylolysis identified than others, with diving, wrestling, weight lifting, track and field, and gymnastics included in the sports with a higher prevalence and baseball, archery, golf, and equestrian in the sports with a relatively low prevalence. The prevalence of spondylolysis among athletes in this study is fairly similar to prior reports.2

Diagnostic Imaging

The role of various imaging modalities in the diagnosis of spondylolysis has been addressed in several studies. A study by Stretch et al.4 on fast bowlers utilized plain radiography, nuclear imaging with single photon emission computed tomography (SPECT), and computed tomography (CT) to establish the diagnosis. They found that 8 of the 10 athletes with positive SPECT scans had normal plain radiographs and that 3 of these same 10 athletes had no evidence of fracture on initial CT (although one of these 3 did have a fracture present on CT at three months out that subsequently healed on repeat CT at twelve months). By 12 months out from diagnosis, 5 of the 7 fractures identified initially showed complete or near-complete healing, with the 2 that did not heal having features of old bilateral fractures on initial CT. The only treatment mentioned is that the athletes were removed from participation in fast bowling and prohibited from activities that involved spinal flexion and rotation of the low back for 3 months with a graded program for return to activity. These findings are consistent with those of earlier studies that showed a markedly increased sensitivity for SPECT over plain radiography and the occurrence of normal appearing CT scans in patients with a positive SPECT study.2

Two studies have addressed the role of magnetic resonance imaging (MRI) in the diagnosis of spondylolysis. Hollenberg et al.5 presented a classification system for findings in the pars interarticularis. The authors retrospectively reviewed 55 MRI scans performed on young athletes with low back pain who were evaluated for possible pars injuries. A classification system was developed based upon the appearance of the pars...
and graded on a 0 to 4 scale with defined criteria for each grade thought to correspond with varying types of injuries or pathological states of the pars. Although the authors did feel that their classification system was reliable, the clinical utility of this system is unclear. Unfortunately, there was no comparison of these studies to either SPECT or CT, no clinical data on outcome, no clear means of establishing pathological correlates to the findings, and no discussion of the prevalence of these findings in a normal control group. Without any of this information, the classification scheme presented has no proven role in the diagnosis and treatment of adolescent athletes with spondylolysis.

Takata and colleagues have presented an as yet unpublished study assessing the significance of high intensity signal in the pedicle on MRI to assess healing.\textsuperscript{6} Thirty-two adolescents with suspected spondylolysis were studied both with MRI and serial CT scans. The presence of high intensity signal in the pedicle was a predictor of bony healing. Treatment involved the use of a soft corset and activity modification.

Overall, the role of MRI in the diagnosis of spondylolysis remains unclear with insufficient data on the relative sensitivity and specificity compared to SPECT and CT and limited clinical data. Although some authors advocate the primary use of MRI in the diagnosis of spondylolysis,\textsuperscript{7} the preponderance of authors of recent reviews on the topic endorse varying degrees of a combination of plain radiographs, SPECT and CT in athletes in whom the diagnosis of spondylolysis is suspected.\textsuperscript{8–13}

\section*{Treatment}

Several recent studies have addressed the treatment of athletes with spondylolysis. The available studies are summarized in Table 1. Unfortunately, there are no controlled trials published to date, and there is thus no means of providing evidence for efficacy of one treatment approach over another. There remain disagreements among authors on the need for bracing, brace type and duration of use (when used), and the diagnostic evaluation necessary before the initiation of treatment. The largest series published is that of d’Hemecourt \textit{et al.}\textsuperscript{14} The authors retrospectively assessed 73 adolescent athletes who had been treated with a Boston Overlap Brace for the diagnosis of spondylolysis. The diagnosis was established by the use of plain radiographs, nuclear imaging (bone scan with SPECT), and CT if no fracture was visible on plain films. As the authors note that 14 of the 73 patients had negative “bone scans” and all 73 patients had CT scans, it is uncertain what the “gold standard” for establishing the diagnosis was, however. The patients in this study were advised to wear their orthosis 23 hours per day for 6 months with a weaning period of several months. Physical therapy emphasizing a flexion bias was also provided, and athletes were allowed to return to sport at 4–6 weeks if they had no pain with extension provided that they wore the brace and remained pain free. 77\% of their patients had a “good” or “excellent” outcome, although the exact numbers in each category and the time necessary for return to sport were not published. The authors noted several predictors of poor outcome, including being female and participating in “high risk” sports, such as gymnastics, dance, soccer, and football. The lack of controls, retrospective design, limited data on outcomes, and unclear diagnostic criteria are all significant limitations of this study.

\section*{Conclusions}

Overall, there has been no data published to alter our recommendations for diagnosis and treatment from those in the original publication of \textit{Evidence-based Sports Medicine}.\textsuperscript{1,2} As before, there remains a substantial need for controlled trials of different treatment methods (for example, relative rest with or without a brace) and for studies that
directly compare the relative sensitivity and specificity of different imaging modalities, especially for SPECT vs MRI. Until these are available, a rational approach to treatment will have to be based upon a thorough understanding of all the available science on the natural history, pathogenesis, diagnosis, and treatment of spondylolysis.

References

<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Diagnosis</th>
<th>N</th>
<th>Mean</th>
<th>Diagnostic</th>
<th>Treatment Summary</th>
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<tr>
<td>Sys, et al, 2001 (15)</td>
<td>Cohort</td>
<td>Spondylolysis with “subtle fractures”: negative radiographs, positive SPECT</td>
<td>34</td>
<td>17.2 years</td>
<td>Plain X-ray, planar bone scan &amp; SPECT, CT</td>
<td>Rigid brace (Boston Overlap Brace) with thigh extension 23° per day until follow-up scintigraphy negative or 6 months (average 15.9 weeks)</td>
<td>100% of unilateral fractures healed, 5 of 17 bilateral fractures healed fully (7 additionally showed unilateral healing)</td>
<td>92.9% “excellent” or “good” outcome, 89.3% returned to prior level of competition at average of 5.5 months, 1 had surgery</td>
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<tr>
<td>D’Hemecourt, et al, 2002 (14)</td>
<td>Retrospective Case Series</td>
<td>Spondylolysis by radiographs or CT, 4 of 73 patients with spondylolisthesis</td>
<td>73</td>
<td>15.7 years</td>
<td>Plain X-ray, SPECT, CT</td>
<td>Rigid brace (anti-lordotic Boston Overlap Brace) 23° per day for 6 months, then weaned, physical therapy with flexion bias</td>
<td>Not reported</td>
<td>77% “excellent” of “good” outcome</td>
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<td>Stretch, et al, 2003 (4)</td>
<td>Prospective Cohort</td>
<td>Fast bowlers with spondylolysis, all with positive SPECT</td>
<td>10</td>
<td>15-22 years</td>
<td>Plain X-ray, SPECT, CT</td>
<td>Activity restriction, for 3 months (no bowling or tasks with lumbar extension or rotation) and active rehabilitation program</td>
<td>80% healed at 1 year (2 of 10 that did not heal had “old bilateral fractures”)</td>
<td>Not reported</td>
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Table 1