SPONDYLOLYSIS IN ATHLETICS

– *Written by Rebecca G Breslow and Kathryn E Ackerman, USA*

INTRODUCTION

Sport and Exercise Medicine clinicians caring for the young athlete with low back pain should have a high index of suspicion for spondylolysis, an acquired stress injury to the pars interarticularis of the spine. In a retrospective case comparison study of one hundred adolescent athletes (ages 12 to 18 years) with low back pain versus one hundred adults (ages 21 to 77 years) with low back pain, spondylolysis was the culprit in 47% of the adolescent group, compared with only 5% of the adult group[1]. Other studies have cited a prevalence of 4.4 to 4.7% in the general pediatric and adolescent population[2], with young male athletes at greatest risk[3]. Thus, not only should clinicians suspect the diagnosis, they should also have familiarity with diagnostic work-up, management strategies, and requirements for return to sport.

Spondylolysis most commonly occurs at the L5 vertebra, with a reported frequency of 91 to 95% at L5, and only 5 to 23% occurring at L4[4]. Injuries span the spectrum of mild stress reactions to severe, chronic non-union fractures. They are thought to be due to repetitive stress, either chronic overuse or acute overload. In particular, activities involving repetitive spinal extension place excessive load on the vertebral posterior elements, weakening the pars interarticularis and making it susceptible to fracture[2]. Patients with bilateral pars lesions are also at risk for spondylolisthesis, or slipping, of the vertebrae.

PREVALENCE IN ATHLETICS

The low back is a common site of injury for the athlete participating in track and field (athletics). In a study of self-reported injuries in 147 track and field athletes in the United Kingdom, the back was the second-most common site affected (14.4% of all reported injuries)[5]. Of those with back injuries, 30.8% were throwers, 29.6% were sprinters, 20% were long distance runners, and 6.7% were middle distance runners. In particular, the hyperextension and rotation involved in throwing events places increased loads on the axial structures of the spine[6]. Schmitt et al. reported on 21 retired javelin throwers and found that 10 of the 21 had spondylolisthesis and three had isolated spondylolysis, with most reporting persistent back pain[7].

Pole vault has also been shown to be high-risk for spondylolysis, particularly at the collegiate level. Rebella conducted a prospective cohort study of collegiate pole vaulters (male and female, 135 athletes) over a single season, and found that the low back was the most common site of injury (16.7%)[8]. One-third of low back injuries were spondylolysis in this population, which was season-ending in 75% of cases. When contributing biomechanical factors were analyzed further, all spondylolysis injuries could be traced to the plant/take-off phase of the vault, in which the spine is in forced hyperextension, particularly in over-striders. These findings were not previously seen in an earlier study by the same investigators examining injuries in 140 high school-level pole vaulters, in which only one case of spondylolysis was identified[9].

CLINICAL PRESENTATION

Symptoms and Signs

The hallmark sign and symptom of spondylolysis is extension-based back pain,

which is frequently chronic and insidious in onset. Less commonly it radiates to the buttocks and lower extremities, although objective neurologic symptoms are rarely present. Strenuous activity exacerbates symptoms. Worsening of pain may also indicate spondylolisthesis, and warrants prompt evaluation[4]. Providers should inquire about historical details of a recent growth spurt or puberty, as spondylolysis may coincide with these developments[2]. Athletes exhibit pain with spinal extension during physical examination, and the single leg hyperextension, or Stork test, is used to reproduce the causative mechanical stress on the posterior elements. However, one study found that this test was neither sensitive nor specific for active injury[10]. Other physical examination findings include lumbosacral tenderness, reduced thoracolumbar range of motion, flattened lumbar lordosis and tight hamstrings[2]. The neurologic examination is generally normal.

Imaging Studies

Traditionally, providers have used plain radiographs as the initial imaging modality to evaluate for spondylolysis. The practice of obtaining four views – anterior-posterior (AP), lateral and two oblique views – has been called into question, as there is no difference in sensitivity with two views only (AP and lateral)[2]. In a retrospective study of 2,846 patients (ages 10 to 19 years) over an eight year period, Miller et al found that 86% of spondylolysis injuries were diagnosed by plain radiographs, and that there was no difference between 2-view and 4-view studies in sensitivity (78% versus 72%)[11]. Lateral views, in particular, may provide useful information about degree of slippage or slip angle in spondylolisthesis[4].

Other imaging modalities, such as bone scan and computed tomography (CT), are used for initial diagnosis and to monitor for healing, although these subject patients to high radiation levels, making them less desirable[11]. Magnetic resonance imaging (MRI) may be utilized for patients with persistent pain, or hallmark symptoms without clearly diagnostic x-ray findings. Kobayashi et al conducted a prospective cohort study on 200 young athletes (mean age 14.1 years) with low back pain, and found that 48.5% of patients with negative plain radiographs subsequently had pars injuries detected by MRI[12]. Without the risks of radiation, the main drawback of MRI is the expense. Masci et al reported good concordance between MRI and CT scan for diagnosis of spondylolysis, though lower sensitivity than bone scan[10].

MANAGEMENT

Non-Operative Management

Early stage, unilateral spondylolysis, characterized by non-displaced hairline fractures, have an excellent prognosis. One review cited a 100% healing rate, with an average time to return to activity of 2.5 months[2]. Even more advanced injuries display high rates of healing, with the same review suggesting nearly 94% resolution. Bilateral injuries with associated spondylolisthesis are at higher risk for non-union and pseudarthrosis. These may be categorized according to the Meyerding classification, a grading system for the degree of anterior slippage (Grades I through V), and can assist with predicting prognosis[13].

Recommendations for non-operative management include rest from the culprit sport for two to six months and physical therapy, with a focus on core strengthening and improving hamstring flexibility. Optimizing nutrition and ensuring appropriate calcium and vitamin D intake may also augment healing[2]. Though some providers include a period of bracing as part of non-operative management, this practice is controversial. Most studies reporting on bracing in spondylolysis have been retrospective case reports/series[14,15]. In one paper of 57 pediatric and adolescent soccer players with spondylolysis, all patients were prescribed an anti-lordotic thoracolumbosacral orthosis full-time for 3 months and told to stop all sports activities during that time. Based on different levels of compliance, the athletes were divided into different adherence groups. The authors concluded that those who were braced and rested from sports had better outcomes than those who did not wear the brace and did not participate in exercise and those who wore the brace and continued sport activity[16]. Activity modification alone is highly successful in the pediatric population[4], and no randomized controlled trial has yet been conducted to demonstrate superior or inferior outcomes with bracing. In a comprehensive literature review of 14 studies of conservative management, including 589 patients (average age 15.7 years), 85% returned to sport within 3 to 6 months[4]. This review also found that non-union did not compromise overall outcomes or return to play; 70 to 90% of the athletes studied returned to play even in the absence of radiographic evidence of bony healing.

Operative Management

Surgical referral may be recommended after 6 months of unsuccessful conservative therapy, defined as persistent pain and radiographic evidence of bony and/or fibrous non-union[2]. Surgical success rates are higher in young patients (less than 25 years) with unilateral lesions at L5. Arthrodesis, or Bucks Fusion, is a common surgical technique in which the facet joints are fused in order to stabilize the fracture. However, full function and return to play may be compromised as this approach results in reduced range of motion. Milder, earlier-stage lesions without spondylolisthesis may undergo direct pars repair, which is less invasive with fewer complications. Operative success is similar to non-operative, with one systematic review citing a success rate of 87.8% among 194 patients (average age 19 years) across 13 studies reporting on surgical treatment[4].

RETURN TO SPORT

There is evidence that early referral to physical therapy shortens healing time and return to activity. In a retrospective study of 196 adolescent athletes (mean age 14.3 years), those who were referred to physical therapy less than 10 weeks post-diagnosis returned to sport after approximately 115 days, which was significantly sooner than the comparison group referred after more

than 10 weeks, which had an average return to sport time of 140 days[17]. A systematic review comparing conservatively-managed athletes to athletes who underwent surgery suggests that conservative management results in slightly better outcomes[18]. In this review, which examined a total of 15 studies (8 non-surgical and 7 surgical), 92% of those managed conservatively returned to play at any level, and 89% at their pre-injury level, with an average return to play of 4.6 months. Those treated surgically also did well (88% returned to play at any level, and 81% at their pre-injury level), although average time to return to play was 6.8 months. Taken together, these studies suggest that a management plan which includes a trial of conservative management and timely referral to physical therapy is essential for optimal outcomes and expeditious return to play.

CONCLUSIONS

Athletes participating in track and field (athletics) are at risk for back injuries, and spondylolysis is a common cause in those reporting extension-based back pain. The Sport and Exercise Medicine clinician should be familiar with hallmark signs and symptoms, and will be able to diagnose this condition clinically and with a limited number of plain films in most cases. Other imaging modalities may be useful in some cases; MRI is the safest, but also the most expensive. Management includes both conservative and surgical approaches, and overall rate of recovery and return to play is high, even in the absence of radiographic evidence of healing. Clinicians can optimize recovery and shorten time to return to sport by early referral to physical therapy to address underlying biomechanical factors contributing to this injury.

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Rebecca G. Breslow M.D.

Associate Physician
Division of Sports Medicine,
Department of Orthopedic Surgery,
Brigham and Women's Hospital

Instructor in Orthopedic Surgery,
Harvard Medical School

Boston, MA, USA

Kathryn E. Ackerman M.D., M.P.H., F.A.C.S.M.

Medical Director
Female Athlete Program,
Division of Sports Medicine
Boston Children's Hospital

Associate Director
Sports Endocrine Research Lab, Neuroendocrine Unit,
Massachusetts General Hospital

Assistant Professor
Harvard Medical School

Team Physician
USA Rowing

Boston, MA, USA

Contact:
kathryn.ackerman@childrens.harvard.edu