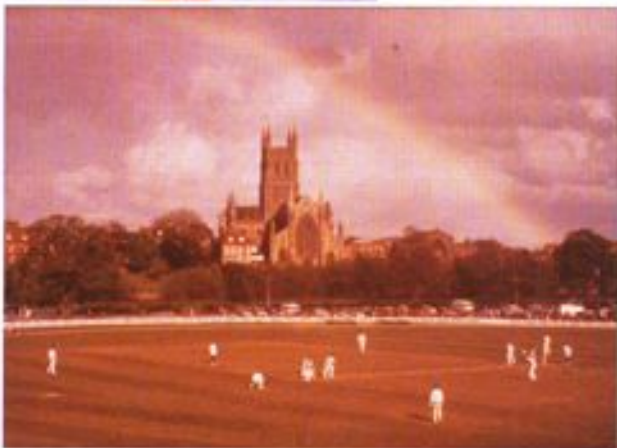


Low back pain in English Professional Cricketers

James Davis MCSP



This article will present some of the scientific literature relating to low back pain in cricket with reference to common pathologies, aetiological factors, investigations and rehabilitation.



The author's interest in low back pain in cricket dates back to 1987 to a newly signed fast bowler with a pre-existing L4 spondylolisthesis. During the bowler's first two seasons he impressed sufficiently to be selected on a full England Tour to the West Indies the following winter. For one reason or another his low back pain increased and he was sent home early from the tour. After I finished working at that club to study in Perth, WA, for 1 year, it was decided that this bowler should undergo a screw fixation to stabilise the symptomatic L4 spondylolisthesis. On my return to the UK the bowler made contact and told me that both the screws had sheared and was unable to bowl painfree. He decided to retire from first class cricket. There were lessons to be learnt from the post-surgical management of this bowler and to this day he remains my inspiration in developing effective ways of preventing these types of problems. This particular problem raised a number of searching questions. Should

he have undergone surgery in the first place? Do we as physios allow a problem to develop, ie the shearing of screws. It is likely this problem occurred because of failure to reduce segmental loading produced by an aberrant bowling action. If we know a particular bowling type is closely associated with stress fracture do we intervene early and prevent the defect from occurring in the first place, but risk destroying a bowling action that was successful in the player being signed professionally in the first place? Interesting and heated discussions with the medics and bowling coaches always ensue. The issue of surgery is controversial to some. In my experience the advantages of necessary surgical intervention have outweighed the disadvantages - stabilising a site of segmental instability, earlier return to cricket, no need for extensive psychological input because the bowler is secure in the knowledge the fracture is stable. The issue for me in the example above was not whether surgery was indicated, I think it was, but what could have been done to prevent the screws from shearing initially and perhaps have retained a promising fast bowler to the English game for longer.

So to the topic of low back pain in cricket. Incidence of low back pain in professional cricketers is high and highest within the sub group of fast bowlers. Lumbar segmental instability (LSI) is the likely cause of low back pain in 20% to 30% of patients (Taylor 2000) and is probably the most common cause of low back pain in fast bowlers. A more comprehensive discussion of LSI is provided elsewhere (Nachemson 1985, White & Panjabi 1992, O'Sullivan 2000). Other common causes of LBP in cricket are lumbar facet joint degeneration/fracture and discal pathology, which are closely associated with LSI. Common pathologies of lumbar segmental instability seen in professional cricketing fast bowlers are spondylolysis and spondylolisthesis. Spondylolysis is a defect or break in the pars interarticularis of the neural arch of a vertebra between the superior and inferior articular facets (Fig 2) Rotational strain (Farfan 1970) should also be considered.

Spondylolysis is prevalent in 6% of the normal population. It is not a congenital defect but occurs in 5% of youngsters by the age of 7 years and 6% by adulthood (Hensinger 1989). Incidence is highest in certain groups of the population, Inuits 26% (Lonstein 1999) and sportsmen such as cricket fast bowlers 58%, (Elliott 1992), gymnasts 11% (Jackson 1976), and American footballers 15% (McCarrol 1975) see Table 1.

Figure 2a

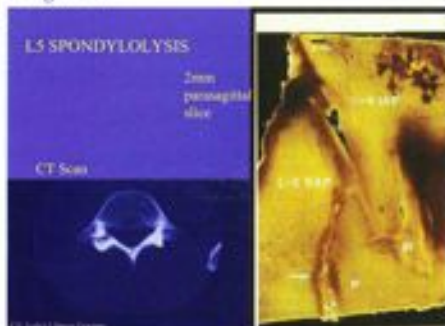


Figure 2b

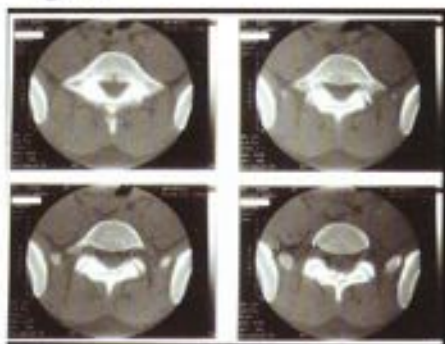


Table 1
% INCIDENCE OF SPONDYLOLYSIS/LISTHESIS IN SPORT

	Spondylolysis	Spondylolisthesis
Wrestling	6.7	
Male gymnasts	11.5	11.5
Soccer	6.5	3.2
Tennis	10.0	6.7
Male athletes	8.5	5.1
Non athletes	6.0	
Female athletes	19.2	15.4
Cricket fast bowlers	39.0	19.0
American football	15.2	
Board surfers	7.0	

Lumbar spondylolysis can occur unilaterally or bilaterally and occur at different lumbar motion segments from L1 to L5 (Fig 3). In the cricketing fast bowler unilateral stress fractures tend to occur on the contralateral side to the bowling arm but not always.

Spondylolysis may occur at one motion segment or at multiple levels.

Figure 3 A technetium bone scan. Hot spots seen at Right L3 and Left L5



Spina bifida occulta in the lumbar spine is not uncommon. This may occur in association with a unilateral spondylolysis (Fig 4).

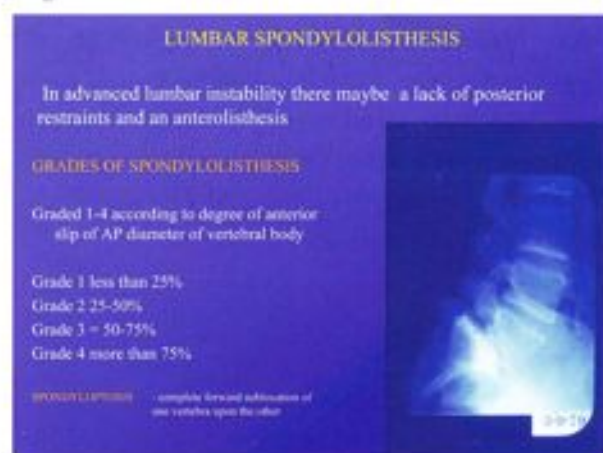
Figure 4

Illustrates an ununited right L5 spondylolysis, a spina bifida occulta and significant sclerosis of left parsinterarticularis. In this example there was an obvious rotary instability on PPIVM testing



Spondylolisthesis is the forward subluxation of one vertebra upon the one below (Fig 5). It can be congenital-6% (Frederickson 1984) but is more likely to occur as a result of a pre-existing spondylolytic defect. Spondylolytic spondylolisthesis is common in adolescence and is associated with a growth spurt at the lumbosacral angle. It commonly occurs in adults in their 30's and is associated with disc degeneration (Floman 2000). It is commonly seen at L5 and to a lesser extent at L4.

Figure 5



In a twelve-year retrospective study from 1992 to present day, the author identified twenty-one contracted professional players to Essex County Cricket Club with lumbar spondylolysis or spondylolisthesis. The sample excluded fringe academy and youth cricket. Four players had a L5 spondylolisthesis and one player with an L4 spondylolisthesis. Ten players had a unilateral spondylolysis varying from L1 to L5 and six players had bilateral spondylolysis; five players at L5 and one at L4. Of this sample of twenty-one, thirteen were bowlers, nine fast bowlers, four all rounders, and seven were batsmen. Nine cricketers underwent surgical repair. All cricketers returned to their contracted role in four to six months without further breakdown.

An acquired defect of the pedicle of a lumbar vertebra it is called a pediculolysis. A right-sided L5 pediculolysis was detected in a professional fast bowler last season.

Lumbar facet joint degeneration and fracture is not uncommon. Excessive biomechanical loading on the zygapophyseal joints during the bowling action can result in erosion of articular cartilage and subsequent joint degeneration and possible fracture (Fig 6)

Figure 6



Lumbar disc degeneration is common in professional fast bowlers. The integrity of the IVD is reliant upon many factors not least the protective role of the zygapophyseal joints and an intact neural arch. A compromise because of possible pedicle or laminar fracture, trophism, or trauma may result in significant change in the instantaneous axis of rotation (IAR) of the motion segment and premature disc degeneration may occur. In the author's study in 1991 of 11-13 year old fast bowlers in W. Australia, 21% showed signs of lumbar disc degeneration or bulging at varying levels. Interestingly each of these bowlers had a "mixed" bowling action (Elliott 1993).

THE FAST BOWLER

"If you take a cricket ball, soak it in kerosene, set it alight, and fire it from a cannon you will get some idea of the Demons speed. When he bowls there is a smell of burnt leather in the air. His mighty thighs lifted like pistons of the Melbourne Express, his boots hammered the ground like a mob of wild horses, angry blasts of air whistled through his nostrils. The ball left his hand like a red streak. The consensus of opinion afterwards was that it was on the off but nobody really saw it." (Stevens 1955).

The cricketing fast bowler is the strike force within the team. Without this potent weapon to take important wickets in an innings (twice in championship cricket) it is unlikely teams will win matches or trophies. The preservation of a fast bowler is therefore paramount and a challenge to every physiotherapist within the cricketing world. Unfortunately "too many fast bowlers are lost to the game of cricket without fulfilling their true potential

because of injury" (Foster 1989). In England during season 2002 the incidence of low back pain in bowlers was 13% (PICC 2002) compared to 14% in Australia (Orchard 2000, 2001). In discussion with experienced fast bowlers on the county circuit, a fit fast bowler, would be expected to play in 16 1st class championship matches, 16 NCL 45 over games, 1 cup competition (5x50 over games to the final), a new 20 over competition, tourist and pre-season matches. He could expect to bowl approximately 900 to a 1000 overs in a domestic season, not including winter tours. Multiply this by six balls per over and it is not hard to understand why 6000 repetitions of running to the wicket and delivering the ball sometimes at 90 to 100 mph causes high impact loading injuries on joints of the lower limb (especially the knee), pelvis and lumbar spine.

BATSMEN

Low back pain in batsmen is not as common as one may think. Batsmen in the professional game who have serious bony pathology in the lumbar spine have at one stage or another bowled with a mixed action in adolescent years and continue to bowl at colleagues in net practises on a daily basis. In the author's 12 year retrospective study 7 batsmen were diagnosed with 'lolyis or 'listhesis. Of these, 4 have never bowled competitively in a 1st class match but were classified as an elite bowler in their adolescent years.

WICKETKEEPERS

LBP in wicketkeepers is a common clinical problem and is regarded as an occupational hazard. The underlying cause is commonly postural in origin. Continued squatting and standing and diving to each side results in gross muscle imbalances in the lower limb and pelvis. Excessively long and weak hamstrings coupled with short and strong quads tilt the pelvis anteriorly and 'wedges' L5 in extension producing intermittent ache during lumbar flexion.

AETIOLOGY OF SPONDYLOLYSIS AND SPONDYLOLISTHESIS IN BOWLERS

The cause of lumbar spondylosis in cricket is multifactorial. The main predisposing factor would appear to be the type of bowling action as described by Elliott and Foster who were amongst the first authors to associate an aberrant bowling style with the prevalence of stress fractures and other causes of LBP in bowlers. Until the 1970s there were traditionally two main types of bowling action: the side-on and front-on types (Elliott 1984)

For demonstration purposes definitions of bowling types are for right arm bowlers

The Side-On Action

When a right arm bowler approaches the wicket, during his delivery stride, the right foot at back foot impact (BFI) is parallel to the crease and the bowler's head is positioned outside the leading left arm. A line drawn through both shoulders and hips would point towards the opposing batsman. The primary spinal movement is lateral flexion. (Figs 7 & 8)

Figure 7



Figure 8



The Front-On Action

In the front on bowling action the right foot at BFI points towards the batsman with the head and chest facing forwards and the head inside the leading left arm. The primary spinal movement is lumbar flexion and extension (Figs 9 & 10)

Figure 9



Figure 10



The Mixed Bowling Action

In the mid 1970s Dennis Lillee, a famous Australian bowler, suffered a stress fracture of the L5 vertebrae. With the help of Elliott and Foster he remodelled his bowling action from a "mixed" to a "side-on" action over a 9-month period. These two authors were the first to

document the third type of bowling action, the "mixed" bowling type. A mixed bowling action is a combination of the two traditional techniques. Original text described Dennis Lillee having a mixed front-on action. During delivery stride his back foot was front-on and his shoulders were side-on. The increased torque at the low lumbar spine combined with repeated flexion and extension caused a fatigue fracture of the L5 lamina. In his case no surgery was undertaken.

Since 1992 the author has observed that all lumbar spondylolysis in fast bowlers had a mixed side-on action and has since sub-divided the "mixed" bowling action into two sub groups: a) mixed side-on and b) the mixed front-on. During the mixed side-on action the bowler has a side-on rear foot at BFI and front-on shoulders and chest. The definition of each is dependant upon the location of the back foot during the delivery stride. The method of defining bowling action using BFI is consistent, quick, reliable and does not require hi-tech equipment. It is the author's clinical opinion that the mixed side-on technique is very responsible for the high prevalence of lumbar stress fractures in fast bowlers today. (see Fig 11 & 12). The incidence of stress fractures in bowlers with front-on or side-on action is virtually non-existent.

Mixed Side-On Action

At BFI the rear foot is almost parallel to the rear crease line(side-on). The head looks inside the leading left arm and the bowler's chest is open (front-on). (Figs 11 & 12)

Figure 11



Figure 12



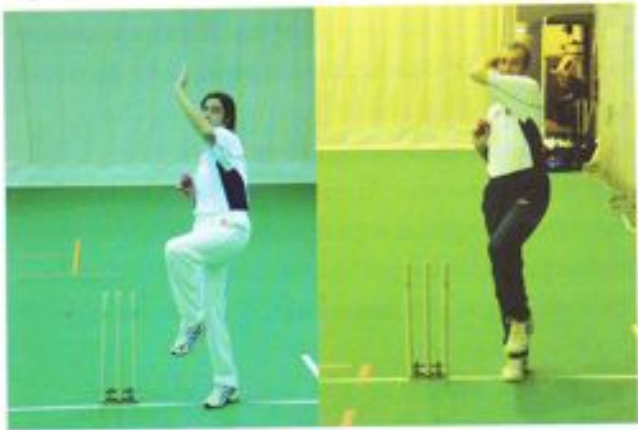
Mixed Front-On Action

At BFI the rear foot faces towards the batsman and during the delivery stride before front foot impact (FFI) the shoulders counter-rotate to the side-on position. The torque at the low lumbar spine increases. (Figs 13 & 14)

Figure 13



Figure 14



Semi Open Bowling Action

At BFI the rear foot is approximately positioned at 45 degrees to the rear crease facing toward the square leg umpire. The head is positioned inside the left arm. (Figs 15 & 16)

Figure 15



Figure 16



Proposed mechanism of lumbar pars fractures in bowlers

The mechanism of vertebral arch fracture is analogous to bending a metal ruler forwards and back. If performed for long enough it first becomes hot and then fatigues and eventually breaks. During lumbar segmental extension the inferior articular process (IAP) buttresses the lower superior articular process (SAP) where further movement is blocked by the lamina of the lower vertebra. With the addition of rotation maximum impact loading occurs at the pars interarticularis (see Fig 2). During intersegmental flexion the IAP glides superiorly and forwards over the SAP of the vertebrae above (McCormick 1989). Although facet joint concussion is much reduced compared to extension, it is thought there is sufficient ligamentous tension to generate high tensile forces at the fracture site.

The ossification sites of the juvenile neural arch are not complete until 18 to 20 years. High compressive and repetitive lumbar flexion, extension and rotation forces associated with an aberrant bowling action or indeed any other sporting activity, on immature cartilaginous growth plates of the pars interarticularis will predispose to lumbar spondylolysis and spondylolisthesis which may explain the high incidence in sporting adolescents.

There are two other important considerations to make when discussing acquired stress fractures of the lumbar spine. First, the immature spine and second bowling environment. The abolition of a mixed bowling action before the adolescent growth spurts occur is crucial in the prevention of an acquired lumbar stress fracture. An adolescent fast bowler will characteristically undergo growth spurts between the approximate ages of 13 - 18. This represents a most vulnerable time for a potential fast bowler with a mixed bowling action. It has been noted on numerous occasions that fast bowlers with a mixed side-on bowling action with radiologically defined pars defects commenced their bowling activity whilst their spine was skeletally immature. It is clinically remiss to allow adolescent fast bowlers to continue to bowl with a mixed side-on or front-on action. Further the advent of indoor cricket schools allows for all year round cricket coaching. The frequency and intensity of bowling therefore has a significant effect on predisposing reasons for stress fractures. Consideration must be made to the type of floor surface and to the shock absorption qualities of the underlying surface. Up to five times body weight of ground reaction force is transmitted as high as the lumbar spine during normal running (Elliott 1984). The bowler's indoor run-ups and follow through must therefore be carefully considered. Cushioned floors and shock absorption insoles help to reduce the forces transmitted to the lower limb and pelvis.

PHYSICAL EXAMINATION

Subjectively a fast bowler with an acute lumbar spondylolysis will complain of localised intermittent sharp pain of a non-irritable nature aggravated by bowling. If the lesion becomes irritable a constancy of ache may occur with more generalised activities. In the clinic objective assessment of bony landmarks of the spine and pelvis are invaluable. Movement patterns in walking, quarter squatting, sitting to standing are assessed for lack of movement of the spine and movement anomalies such as hinge points, movement dysfunctions etc. Brian Edward's Combined Movement concept is a useful

assessment tool for highlighting a spondylolysis because pain elicited in lumbar extension, ipsilateral side flexion and contralateral rotation in standing has proved positive in reproducing the sharp boney pain associated with acute spondylolysis. The severity of this provocative movement is also a key in defining the irritability of the lesion. Palpation of spinous processes in flexion in standing or side lying may reveal a 'spondylolisthetic' step at L4 or L5. In PPIVM testing of motion segments L4/5/S1 in flexion, extension and lateral flexion in side lying may reveal hypomobility of L5-S1 movement compared to the hypermobile L4-5 segment for an L5 spondylolisthesis. It is possible for a clinician to detect a rotary segmental instability associated with a unilateral spondylolysis with a rotation PPIVM in side lying. Assessment of hip movements, posture and bowling action are yet more clues to help one diagnose a lumbar stress fracture.

RADIOLOGICAL AND SURGICAL INTERVENTION

SPECT or technetium 99 bone scans are used to assess for boney hot spots. CT and X-ray are obtained if required. The procedure used at Essex C.C.C. is for an initial t-bone scan of lumbar spine and if hot spots are present the player is rested for six and eight weeks to allow for spontaneous healing. A technetium scan is repeated at six to eight weeks and a decision then made on whether or not a CT/X-ray is required to assist with the question of surgery. If spontaneous healing of the pars defect has taken place remodification of the bowling action and other physical disfunctions are addressed. From a surgical perspective a Buck's repair (Buck 1970, Beckers 1986) has been the option of choice in the nine successful cases of surgical intervention to date at Essex County Cricket Club. Preservation of the medial branch of the dorsal rami is a distinct advantage to effectively recruit lumbar multifidus!

PHYSIOTHERAPY

Clinical reasoning for the conservative or surgical approach is based on several criteria. Over the years I have discussed various regimes, procedures and techniques with physios and doctors with reference to the most effective way of rehabilitating lumbar stress fractures. A "hot" fracture that does not heal within 8 to 10 weeks is unlikely to heal spontaneously. The question is then do you allow a bowler to reshape his bowling action and resolve other predisposing reasons, knowing there is a segmental instability present or, proceed to surgery for screw fixation? Will the bowler have confidence in his back and those looking after him should he break down again because of it? Consider his loss to

the team and the coach. Welcome to the field of professional cricket where often the physio's decision is scrutinised in the press for good measure. The difficult issue of surgery is averted with spontaneous healing of the spondylolysis and allows for physical therapy from day one. Clearly the first consideration when rehabilitating lumbar segmental instability is to stabilise the problem as much as possible using trunk core exercises utilising the deep abdominals, diaphragm, pelvic floor and lumbar multifidus progressing to global muscle control (O'Sullivan 1997) and eventually a pain free bowling action. O'Sullivan's 1997 RCT provides the strongest scientific link to date between radiologically determined pars defects and the role of exercises.

The question of surgery is less straightforward. The interests of the bowler are paramount. The views of family members, the surgeon, physiotherapist and head coach are considered. A two week period of convalescence following surgery is normally followed by early mobilisation in the hydrotherapy pool using buoyancy vests and a graduated rehabilitation programme which includes trunk core stability (inner and outer units), spinal proprioception training and much more. For more information refer to the work of O' Sullivan, Diane Lee, and the Uni of Queensland. At approximately three months a comprehensive skeletal assessment is given which includes examination of hip extension, sacro iliac joint mobility and lumbar spinal function. When bowlers present with "normal" osteokinematics and good neuromuscular control the remodelling of the aberrant bowling action takes place from three months onwards commencing with initially bowling off one step and then

EME
EME SERVICES



Electro Medical Engineering Services

- Service, safety testing, calibration/alignment & repairs to all types & makes of physiotherapy equipment
- First class service & computerised reporting to all our NHS, private & governmental customers
- Highly experienced & qualified physiotherapy equipment engineers
- Quality assured to ISO9002
- Authorised sales distributors for all Physio Med products

A main agency for



Tel: 0161 748 5660 Internet: www.emeservices.com
Fax: 0161 748 5668 Email: sales@emeservices.com



to a progressively longer run. Some bowlers adapt to the new action like ducks to water whereas the "proprioceptively vacant" bowlers sometimes struggle to replant their feet in optimal positions. The more difficult bowlers to remodel are the "shufflers" ie at BFI they land front-on and shuffle to side-on. Increased muscle memory and approximately 10,000 repetitions later the bowler will have completed his rehabilitation and be ready for a return to the bowling coaches and a painfree bowling career. At Essex CCC each of the nine contracted players who have undergone surgery have had an uneventful recovery. Each player has returned to 1st class cricket within 4-6 months. Testament to the local spinal surgeon, Prof. J Dowell and the physiotherapist!

SUMMARY

- ❑ **Stress fractures of the lumbar pars interarticularis occur as a result of high repetitive compression stresses involving extension/flexion and rotation movements of the lumbar spine**
- ❑ **There is a loss of the posterior restraints and segmental muscle control**
- ❑ **At greatest risk are certain groups of sporting adolescents (14-18 yrs old), especially fast bowlers, hockey players**
- ❑ **In cricket lumbar pars defects occur as a result of a mixed bowling action on an immature spine**

REFERENCES

- Beckers L 1986 Buck's operation for treatment of spondylolysis and spondylolisthesis. *Acta Orthopaedica Belgica*, 52(6):
- Buck J 1970 Direct repair of the defect in spondylolisthesis: Preliminary report. *Journal of Bone and Joint Surgery*. 52B: 432
- Elliott B, Foster D 1984 A biomechanical analysis of the front on and side on fast bowling techniques. *Journal of Human Movement Studies* 10: 83-94
- Elliott B, Foster D, Blanksby B (Eds) 1989 *In Send the stumps flying*, Perth: University of Western Australia Press
- Elliott B 1992 The influence of fast bowling and physical factors on radiological features in high performance fast bowlers. *Sports Medicine Training and Rehabilitation*, 3 (2): 113-120.
- Elliott B, Davis J, Hardcastle P, Khangure M 1993 Disc degeneration and the young fast bowler. *Clinical Biomechanics*, 8: 227-234
- Floman Y 2000 Progression of lumbosacral isthmic spondylolisthesis in adults. *Spine* 25(3): 342-347
- Foster D, John D, Elliott B, Ackland T, Fitch K 1989 Back injuries to fast bowlers in cricket: A prospective study. *British Journal of Sports Medicine*, 23(3): 150-154.

Farfan H (1970) Rotational instability. *Journal of Bone and Joint Surgery*, 52A: 468.

Foster D 1989 Back injuries to fast bowlers in cricket: A prospective study. *British Journal of Sports Medicine*, 23(3): 150-15

Fredrickson B 1984 The natural history of spondylolysis and spondylolisthesis. *Journal of Bone and Joint Surgery*, 66A: 699-707

Hensinger R 1989 Spondylolysis and spondylolisthesis in children and adolescents. *Journal of Bone and Joint Surgery*, 71(7): 1098-1107

Hodson A 1994 Too much too soon? - The risk of overuse injuries in young football players. *Sports Care Journal*, 1,6: 19-24

Jackson D 1976 Spondylolysis in the female gymnast. *Clinical Orthopaedics and Related Research*, 117(6): 68-73

Lonstein J 1999 Spondylolisthesis in children. *Spine* 24(24): 2640-2648

McCarroll J, Miller J, Ritter M 1986 Lumbar spondylolysis and spondylolisthesis in college football players. *American Journal of Sports Medicine* 14: 404-405.

McCormick C, Taylor J, Twomey L 1989 Facet joint arthrography in lumbar spondylolysis: anatomic basis for spread of contrast medium. *Radiology* 171, 1: 193-196.

Nachemson A 1985 Lumbar spinal instability. *Spine* 9: 714-719

PICC 2002. First Class Counties 2002 Season Injury Report. Physiotherapists In County Cricket. ECB, Lords Cricket Ground

Orchard J, James T 2000 Australian Cricket Board Report 2000 Sydney: Australian Cricket Board.

Orchard J, James T 2001 Australian Cricket Board Report 2001 Sydney: Australian Cricket Board.

O'Sullivan P, Twomey L, Allison G 1997 Evaluation of specific stabilising exercise in the treatment of low back pain with Radiologic diagnosis of spondylolysis and spondylolisthesis. *Spine*, 22(24): 2959-67

O'Sullivan P 2000 Lumbar segmental instability: clinical presentation and specific stabilising exercise management. *Manual Therapy*, 5(1): 2-12.

Stevens D 1976 *In the Australian Council For Health, Physical Education and Recreation.*

Twomey L, Taylor J (Eds) 1987 *In Physical therapy for the low back.* New York: Churchill Livingstone.

White A, Panjabi M 1992 *Clinical biomechanics of the spine.* Philadelphia: JB Lippincott

Address for correspondence:

James Davis MCSP
 Anglia Spinal & Sports Physiotherapy Centre
 Essex County Cricket Club
 New Writtle Street
 Chelmsford, Essex CM2 0PG
 Tel: 01245 349096
 E-mail: jamesdavis@angliaphysio.co.uk