Long-term review of the lumbar spine in javelin throwers

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We studied 21 former top-class competitive javelin throwers to investigate radiological and clinical symptoms in the lumbar spine many years after the end of their athletic careers. The athletes underwent clinical and radiological examinations at an average of 20 years after retiring from athletics. The Hannover questionnaire was used to evaluate functional restrictions in daily living.

Degenerative changes in the lumbar spine were more marked towards the caudal aspect of the spine. Ten athletes also had spondylolisthesis, but with little progression (< 15%) throughout the observation period. Athletes both with and without radiologically demonstrated spondylolisthesis, complained of no more back problems than the normal population (93% for athletes v 86% for controls). Slight progression followed their retirement from athletics.

Subjects and Methods

We carried out clinical and radiological examination on 21 specialist male javelin throwers at a mean time of 20 years after they had retired from high-level competitive sport. The inclusion criteria were retirement from competitive sport for at least ten years, a personal best of 70 m for javelin throwers who had competed in the 1970s and of 80 m for those who had been competing in the 1980s.

A total of 35 athletes was identified from the German Athletics Association’s lists of top performers, of whom four had died from unknown causes since compilation of the lists, and ten did not meet the inclusion criteria. The study group therefore comprised 21 Olympic and world-record holders and top athletes. A questionnaire was used to obtain a detailed competition and training history from each subject, with special reference to any athletic activity engaged in since retirement from competition. Subjective symptoms experienced during and after the competitive period were recorded. The mobility of the lumbar spine and all symptoms were assessed. Local pain induced by pressure or movement was recorded. Limitation of movement and sensory defect in the limbs were also noted.

The version of the Hannover function questionnaire (FFbH-R) which deals with backache (which deals with backache was used to assess impairment of daily activities. The sample studied in the Lübeck study on backache (n = 3000) was used as a control reference. This included 663 men in the same age group as those in our study (mean age 50 years). The mean score in the whole group with and without pain was 86.4%; in the subgroup with backache it was 76.2%.

Radiological examination consisted of anteroposterior
views showing the lumbar, pelvic and hip regions with the subject in a standing position against a grid and a lateral view of the lumbar spine in a standing position. The extent of any spondylolisthesis was classified according to Meyerding's system. Radiographs taken while they were still competing were also available for evaluation in 15 of our 21 athletes; eight had spondylolisthesis and an assessment of the progression was possible. The lumbar index, Boxall’s angle, the sacral inclination, the slip angle and the percentage degree of displacement were all assessed.

Assessment of the degenerative changes seen on the radiographs was based on the classification system described by Kellgren and Lawrence. The classification of Weber and Morgenthaler was used for cases of spondylisis and of chondrosis: 1, only small osteophytes; 1g only large osteophytes; 2, slight reduction in intervertebral disc space and small osteophytes; and 2o, as 2 but without osteophytes; 3, narrowing of the intervertebral disc space to half with osteophytes; 3o, as 3 but without osteophytes; 4, pronounced narrowing of the intervertebral space and large osteophytes; and 4o, as 4 but without osteophytes.

It would only have been possible for former world-class athletes to meet the very strict inclusion criteria observed in this study. A necessary consequence of this was that the study group was small and did not allow any statistical tests involving analysis of subgroups. The results are therefore reported in a descriptive fashion as the arithmetic mean with the least and greatest values (minimum to maximum) in each case.

**Results**

The anthropometric data and sport-specific characteristics are shown in Table I. At the time of examination 19 years after retirement from competitive sport, 14 of the 21 athletes complained of back pain which had been present for some of the time; sciatic pain was not reported. Two athletes had required spinal surgery during the active phase of their competitive careers, in one open discectomy at L4/L5 and in the other spinal fusion (L3 to L5) after which he had retired from competitive sport. Three athletes had undergone lumbar disc surgery after retiring from competitive sport.

Clinical examination did not reveal acute symptoms in any subjects; mobility was not restricted, except in the man who had undergone spinal fusion. There was no evidence of motor or sensory deficit.

| Table I. Anthropometric data and sport-specific characteristics of 21 former elite javelin throwers |
|---------------------------------------------|-----------|-----------|
| Arithmetic mean | Minimum | Maximum |
| Age (years) | 50.0 | 35.0 | 59.0 |
| Body mass index | 27.7 | 23.8 | 31.6 |
| Personal record (m) | 82.54 | 71.00 | 104.80 |
| Competitive sport career (years) | 13.0 | 4.0 | 23.0 |
| Years after finishing CSC* | 19.0 | 10.0 | 25.0 |
| Training in hours per week during CSC | 14.0 | 5.0 | 25.0 |
| Strengthening training in hours per week during CSC | 5.0 | 1.0 | 12.0 |
| Number of throws per week during CSC | 190.0 | 60.0 | 500.0 |
| Number of throws with balls or shots per week during CSC | 420.0 | 120.0 | 1200.0 |

* competitive sports career

Radiological progression of spondylolisthesis at L5/S1 in a former elite javelin thrower (personal record >90m) at the age of a) 20, b) 24 and c) 43 years.
During their active phase, nine of ten athletes with spondylolisthesis, two of three with spondyloysis and four of eight with neither spondylolisthesis nor spondyloysis had complained of lumbar pain. After their retirement from competitive sport, eight of ten with spondylolisthesis, one of three with spondyloysis and four of eight with neither, reported occasional back pain which had been present for some time.

The radiographs demonstrated spondylolisthesis in ten athletes (at L5/S1 in eight and at L4/L5 in two), and spondyloysis without spondylolisthesis in three others (at L5/S1 in two and at L4/L5 in one); in seven athletes there was no abnormality of the pars interarticularis, while in one there was evidence of earlier ankylosis of L3 to L5.

With a single exception there was narrowing of intervertebral spaces which increased progressively in the caudal direction. The extent of the degenerative changes are shown in Table II.

The severity of the spondylolisthesis was assessed as grade 1 in all cases (Fig. 1). There were eight athletes for whom radiographs taken more than 18 years before were available for study. In seven of these, progression was observed in the form of a mean increase in displacement of 2.7 mm (1 to 5). No grade-2 spondylolisthesis was demonstrable either during the active competitive phase or at the time of the study. All signs of progression were at the level of L5/S1. The extent of the slip was less than 15% in all cases (2.9% to 13.9%, mean 7.6%).

The mean sacral angle in athletes with spondylolisthesis was 39.3° (14 to 80) and for those without spondylolisthesis, 32.3° (24 to 50). The mean Boxall angle was 100.2° (50 to 120) in the athletes with spondylolisthesis, and 108.3° (85 to 124) in the others. The mean lumbar index (posterior rim to anterior rim of L5) was 0.85 (0.7 to 1.0) in the group of athletes with spondylolisthesis and 0.94 (0.82 to 1.0) in the group without spondylolisthesis. In two athletes, both with spondylolisthesis, there was a change in the lumbar index with the passage of time.

The angle of slip was between 12° and 45° in the athletes with spondylolisthesis. Six athletes had an S-shaped sacral base and in two it was domed; two athletes had flat epiphysyeal plates.

The angle of sacral inclination was 43.9° (32 to 68) in the group of athletes with spondylolisthesis and 43.7° (34 to 58) in the group without spondylolisthesis.

The data collected from the questionnaire (FFbH-R) showed that 14 athletes had no restriction of activities of daily living and achieved full scores, but seven felt slightly restricted. The mean functional capacity of all athletes was 93% (57 to 100). Seven of the ten athletes with demonstrable spondylolisthesis achieved the maximum functional capacity possible, as did two of the three with spondyloysis and five of the eight with no changes in any pars interarticularis.

### Discussion

The degenerative changes seen in the lumbar spine in these patients increased in severity in the caudal direction: the upper lumbar spine showed only mild changes. The radiological changes affected most segments and were comparable to those in people undertaking heavy physical work.

The clinical symptoms were classified by the former athletes in our study as mild, as in other clinical studies. Spondyloysis and spondylolisthesis were observed more frequently in our subjects than in the normal population.

According to Saraste et al, there is a greater risk of later lumbar symptoms when a spondylolisthesis of more than 10 mm is present, when the lumbar index is low (increasingly trapezoid shape of L5 with lowering of the posterior rim), with unusually pronounced lumbar lordosis, with spondyloysis at L4 and with an early onset of symptoms. Saraste et al attributed the occurrence of symptoms to a local bony lesion (e.g., a fracture), instability or disc degeneration.

Neither spondyloysis nor spondylolisthesis necessarily causes symptoms. Studies by Porter and Hibbert on over 2000 patients with back pain revealed no increased incidence of spondyloysis. Most patients with spondylosis or spondylolisthesis have no symptoms. In a study by LaFond only 9% of 415 patients needed treatment. Saraste reported that only 13% complain of recurring back symptoms. Hefti, Brunazzi and Morscher reported 20 of 32 patients to be completely free from symptoms 28 years after diagnosis. Muschik et al also found no symptoms over an observation period of five years in active athletes with spondylolisthesis, although the slip had progressed by 10.5%.

Our studies confirm that, despite extreme stress in top-level competitive sport, the athlete with spondylolisthesis does not complain of more back pain than the normal population. The Hannover function questionnaire used to assess the degree of restriction experienced in activities of daily living revealed no distinction between athletes with and without spondylolisthesis. The values achieved were clearly higher than those in the control group of men who were subjects in the Lübeck back pain study and were the same age as those in our group. The fact that most of our athletes continued to engage in sport such as tennis, golf and weight-lifting after retirement from top-level competition will have contributed to this. After a successful career in sport there may also be a concomitant psychosocial

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**Table II.** Radiological classification of the degenerative changes of the lumbar spine in 21 former elite javelin throwers according to the classification of Weber and Morgenthaler

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factor. In addition, spondylolisthesis of no more than grade I was found in our subjects.

Although the displacement in spondylolisthesis does not usually increase after the cessation of growth, progression has been noted in some long-term studies. Seitsalo et al., described progression in 1% of cases of mild spondylolisthesis and in 7% of higher grades, and Frennered, Danielson and Nachemson observed the same in 3% of patients. Saraste noted progression of the slip by more than 5 mm in one-third of adult patients and in one-fifth of younger patients in a prolonged study covering 20 years. The progression of the slip is attributed to degeneration of the intervertebral discs. Ohmori et al. found demonstrable progression after ten years in all patients.

In our study group the progression was less than 5 mm, and occurred in seven of eight athletes. There was no association between progression and the presence of symptoms. Isolated studies have shown a correlation between symptoms and the grade of spondylolisthesis. Dubousset found a correlation between the lumbosacral angle and progression and recommended that operative treatment should be carried out in patients with spondylolisthesis with an angle less than 100°, which he believed to indicate progression.

Our study shows that progression had taken place in all subjects with a lumbosacral angle of less than 100°. With only mild symptoms and, in some cases none, surgery was not indicated. Rosok and Peterson noted a steeper sacral inclination in patients with spondylolisthesis. Our athletes with spondylolisthesis had a steeper sacral inclination; the Boxall angle was smaller and the lumbar index lower.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

References