Characteristics of Recurrent Cases after Conservative Therapy in Adolescent Lumbar Spondylolysis

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Abstract

Purpose: Occasionally lumbar spondylolysis in adolescents will recur after conservative treatment. The goal of this study was to retrospectively review the conditions in which recurrence transpired in a subset of adolescent patients diagnosed with acute lumbar spondylolysis.

Subjects: A retrospective survey was conducted in 152 patients who had been treated for spondylolysis and had obtained bone union. Twenty subjects were selected who had recurrent lumbar spondylolysis after returning to sports activity following the first spondylolysis treatment. There were 18 males and two females with an average age at the time of initial consultation of 13.3 years and 14.1 years at the time of recurrence.

Results: The average period of initial treatment was 101 days, and the average time to recurrence after healing was 149 days. There were three cases at L3, two cases at L4 and 15 cases at L5. At recurrence, 18 patients had unilateral involvement and two patients presented with bilateral occurrence. Four cases did not achieve bony union.

Discussion: In this study, the recurrence rate was 13.2%. Eighty percent of cases had recurrence within six months after healing. After recurrence, 20% of the cases reached pseudoarthrosis. It is useful to take regular MRI images to detect recurrence within six months after returning to sports.

1. Introduction

Lumbar spondylolysis during adolescence sometimes recurs after healing. Although the frequency of recurrence of lumbar spondylolysis has been reported to be 26% [1], the recurrence rate may differ depending on the timing of return to sports activity. Most patients return to the same sport after healing with conservative treatment, but some patients return to the hospital with recurrence of lumbar spondylolysis. The aim of this study was to identify in a retrospective study the conditions of repeated lumbar spondylolysis,

2. Subjects And Methods

Of 152 patients (male:125, female: 27) between 2014 and 2021 who were diagnosed with acute spondylolysis with bone marrow edema on magnetic resonance imaging (MRI) at the first visit and obtained bone union by conservative treatment, 20 patients with recurrence at the same site after returning to sports activity were included in this study. Of these, two patients had two recurrences, but the analysis was limited to the first recurrence (2nd spondylolysis). Acute lumbar spondylolysis was defined as an MRI short tau inversion recovery (STIR) image showing a high signal change around the pedicle. Conservative treatment was implemented by wearing a semi-hard brace and suspending sports activity. Termination of conservative treatment occurred when diminished bone marrow edema around the pedicle was observed by signal normalization on MRI STIR. Bone continuity was checked by computed tomography (CT) after diminished bone marrow edema. All patients returned to the same sport in which

they were engaged before injury after initial spondylolysis and healing. Recurrence was defined by bone marrow edema on the lesions that coincided with the once fused lesion. When the second lumbar spondylolysis occurred, conservative treatment was performed with a semi-hard brace and again suspending sports activity. Conservative treatment was continued until the disappearance of bone marrow edema. When signal normalization was confirmed on MRI STIR, CT was performed. If CT showed continuity of the pars interarticularis, it was considered bony union. Lack of continuity of the pars interarticularis observed by CT was considered pseudoarthrosis. Pseudoarthrotic lesions that had no bone marrow edema on MRI at the first visit or the second visit were excluded.

We analyzed sex, age at the first visit, age at the time of recurrence, the treatment period during the first spondylolysis, the treatment period during the recurrent spondylolysis, the period between initial healing and recurrence, vertebral level of the lesion, whether the lesion was unilateral or bilateral either initially or at recurrence, side (right or left) of the recurrent lesion side, treatment result after recurrence, and sport discipline. This research was approved by the IRB of Tsukuba University Hospital Mito Clinical Education and Training Center/ Mito Kyodo General Hospital, and the methods in this study were performed according to the guidelines and regulations. Written informed consent was obtained from the patients' parents or legal guardians.

3. Results

Eighteen males and two females with recurrence were included in the study. Their average age at the first consultation was 13.3 years (range: 10-17 years, standard deviation (SD): 1.92) and the average age at the time of recurrence was 14.1 years (range: 10-18 years, SD: 2.09). The average treatment period during the first spondylolysis was 101 days (range: 31-213 days, SD: 42.1) and the average treatment period during the recurrent spondylolysis was 100 days (range: 36-182 days, SD: 44.8). All 20 patients returned to sports after 2nd conservative treatment.

The period between healing and recurrence after healing was 149 days (range: 42-402 days, SD: 80.2). Sixteen patients presented with recurrence within six months after returning to sports activity.

The vertebral levels of the spondylolytic lesions were L3 (n = 3), L4 (n = 4) and L5 (n = 15). Fifteen cases had unilateral spondylolysis and five had bilateral involvement. At the time of recurrence, 18 cases were unilateral and two cases were bilateral. At the time of recurrence, seven lesions were on the right side and 15 lesions were on the left side. Four patients did not achieve bony union.

All patients played a specific sport every day: five played baseball or softball; four played soccer; two each competed in volleyball, track and field, or swimming; and one each participated in karate, table tennis, tennis, badminton, or taekwondo.

4. Illustrative Case

A 14-year-old boy felt bilateral low back pain when he smashed a ball as a tennis player and presented to our hospital six weeks later. Physical examination revealed low back pain during lumbar extension and restricted range of motion in extension. At the first visit, the MRI STIR showed bone marrow edema on both sides of L5 (Fig. 1a). An axial view CT slice revealed fracture lines on both sides, which were classified as progressive on the right side and early stage on the left side (Fig. 1b). In the sagittal view, they were classified as 1a on the bilateral side (Fig. 1c, d). After conservative treatment, suspending sports activities, and a semi-hard brace for 19 weeks, bone healing was achieved with normal bone intensity on MRI (Fig. 2a) and bone continuity shown by CT (Fig. 2b-d). However, 12 weeks after healing and a return to playing tennis, bilateral L5 spondylolysis recurred. MRI showed bone marrow edema on the left side again (Fig. 3a). The spondylolysis was classified as pre-lysis stage on the left side from the axial MRI view (Fig. 3b) and as 1a on the left side from the sagittal view (Fig. 3c). Disappearing bone marrow edema and bony union were achieved with 10 weeks of the 2nd round of conservative treatment (Fig. 4a-c) and he subsequently returned to tennis.

5. Discussion

Treatment of lumbar spondylolysis causes athletes to leave competition for at least a few months. All patients in this study returned to their original sport after the initial healing of lumbar spondylolysis but returning to sports too early caused recurrence. From this survey, the period to recurrence was within six months after returning to sports in 16 of 20 patients.

Early return to sports activity may cause recurrence of spondylolysis because bone strength of the healed lesion is insufficient. In this study, the average period after healing until recurrence was 149 days; the recurrence of spondylolysis did not occur immediately after returning to exercise. Suspending sports activity for longer can reduce the recurrence rate but lengthening the time to return to sports is not desirable for athletes. Therefore, strength of the lesion was sufficient and the timing to resume sports was appropriate. The average treatment period for the initial spondylolysis was 101 days, and the treatment period after the recurrence was 100 days. Therefore, we conclude that the cause of the recurrence was not that the treatment period was too short. All 20 patients returned to sports after the 2nd conservative treatment but two patients returned with a 3rd spondylolysis (2nd recurrence). Because adolescents are not physically mature, it is difficult to prevent 100% recurrence of lumbar spondylolysis in this age group, but that the patient had only partially recovered bone strength and the spondylolysis unfortunately recurred.

Recurrence in the earliest case occurred 42 days after healing. Therefore, recurrence may occur after an early return to sports. It will be necessary to instruct the athletes and parents to refrain from sudden high-intensity exercise immediately after resuming sports.

Males with lumbar spondylolysis with bone marrow edema constituted 79.6% of the subject population in our previous report [2]. The recurrence rate for males was 18/125 (14.4%) and for females was 2/27 (7%).

The recurrent proportion of males in this study was 90%. Although the number of patients in this study was small, recurrence may be more likely to affect males.

There were initially five cases of bilateral spondylolysis and two after recurrence. Once suffering from lumbar spondylolysis, the patient learns related symptoms such as the location of pain. As a result, because the patient tends to visit the hospital earlier and more cases can be diagnosed as unilateral before reaching bilaterality, the number of bilateral cases at the time of recurrence is lower. Therefore, post-treatment follow up is necessary given the possibility of recurrence and patients and their parents should be informed about the possibility of recurrence.

Both the age of patients initially treated for spondylolysis and its recurrence, and the predominance of L5 in most cases of spondylolysis were consistent with previous reports [3].

Even in cases in which union was obtained once, some patients had non-union after recurrence. It has been proposed that there is a predisposition for lumbar spondylolysis in some individuals [4], and it is possible that the predisposition also affects the union rate. Individual characteristics may influence both fusion and the tendency for lumbar spondylolysis in the first place. As all recurrent cases had a history of bony fusion once, they have some potential to regenerate bone. However, this study showed that patients may not always heal even if the same treatment led to bony union in the past. We are paying close attention to recurrence after returning to exercise and are considering ways to detect recurrence earlier. As MRI is useful for early detection of lumbar spondylolysis [5], it is important to regularly perform additional MRI analyses to confirm the presence or absence of recurrence. In addition, when low back pain appears after returning to sports following treatment for lumbar spondylolysis, MRIs should be taken early for diagnostic purposes.

The limitation of this study is that the number of cases is small and statistical examination is insufficient for univariate or multivariate analysis.

6. Conclusion

In this study, the time to recurrence after healing averaged five months after return to sports activity. Not all patients obtained bony union after recurrence, even if they had achieved union after the initial treatment and healing period. As in prior studies, the most common vertebral level for spondylolysis was L5. Because recurrence can happen, it is useful to take regular MRI images even after returning to sports activity to detect recurrence at an early stage, especially if the patient is reporting lumbar pain.

Declarations

Funding:

None.

Conflicts of Interest:

The authors declare that there are no relevant conflicts of interest.

Ethics approval:

All procedures including review of patient records used in this research were approved by the institutional review board.

Consent to participate:

Written informed consents were obtained from all patients and their parent to participate in this study.

Availability of data and material:

The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.

Code availability:

Not applicable.

Author contributions:

Masaki Tatsumura conceived and designed the study. Hisanori Gamada and Shun Okuwaki collated and analyzed the data. Fumihiko Eto, Katsuya Nagashima, Takeo Mammoto, Atsushi Hirano and Toru Funayama treated the patients. Masaki Tatsumura drafted the manuscript. Masashi Yamazaki critically revised the draft manuscript. All the authors approved the final version submitted for publication.

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Figures

Fig.1

Fig. 1a

Fig. 1b

Fig. 1c

Fig. 1d

Figure 1

The short tau inversion recovery magnetic resonance images (STIR-MRI) at the first examination showed high signal change bilaterally (white arrows) in the pedicles of L5 (a). CT revealed bilateral faint fracture lines (white arrows) on the axial slice (b) and slight bone resorption (white arrows) on the ventral side of the lamina in the sagittal view (c, d).

Fig. 2

Fig. 2a

Fig. 2b

Fig. 2c

Fig. 2d

Figure 2

Nineteen weeks after the first examination, the signal change on MRI disappeared (a). The fracture lines disappeared on the axial CT slice (b) and there was no obvious worsening of the resorption in the sagittal view (c, d).

Fig. 3

Fig. 3a

Fig. 3b

Fig. 3c

Figure 3

Twelve weeks after the first healing, short tau inversion recovery magnetic resonance images (STIR-MRI) showed high signal change (white arrow) on only the left side (a). CT revealed no fracture line (white arrow) in the axial view (b) but slight bone resorption (white arrow) on the ventral side in the sagittal view (c).

Fig.4

Fig. 4a

Fig. 4b

Fig. 4c

Figure 4

Ten weeks after the second conservative treatment, the signal change on MRI disappeared (a). No abnormality was detected from the axial or sagittal CT slices (b, c).