

Rates of Return to Sports and Recurrence in Pediatric Athletes after Conservative Treatment for Lumbar Spondylolysis

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Abstract:

Introduction: Lumbar spondylolysis is common in pediatric athletes, and many athletes can return to sports with conservative treatment. There are two initial treatment strategies: bony union or pain management, but the outcomes of these strategies have not been clarified. The purpose of this study is to investigate the rates of return to sports (RTS) and recurrence in pediatric athletes after conservative treatment for lumbar spondylolysis and to compare both treatment strategies.

Methods: A total of 180 patients with lumbar spondylolysis were managed with a trunk brace and cessation of sports activity (bone union [BU] group, n=95) or treated for pain only (pain management [PM] group, n=85). RTS and recurrence rates according to type of conservative treatment were compared.

Results: The RTS rate was 98.9% in the BU group and 97.6% in the PM group at 4.7±1.9 and 1.8±1.7 months, respectively. Recurrence occurred in 7.4% of patients in the BU group at 19.0±16.0 months and in 4.8% of the PM group at 17.8±5.2 months.

Conclusions: The RTS rate in pediatric athletes with lumbar spondylolysis was high at more than 95%, regardless of type of conservative treatment. The mean time to RTS was longer in the BU group than in the PM group (4.7 vs. 1.8 months) because of the time required for bone healing. There were several cases of recurrence after RTS. Strategies to prevent recurrence of lumbar spondylolysis in pediatric athletes are discussed.

Keywords:

Lumbar spondylolysis, Conservative treatment, Return to sports, Recurrence

Spine Surg Relat Res 2022; 6(5): 540-544
dx.doi.org/10.22603/ssrr.2021-0242

Introduction

Lumbar spondylolysis is a stress fracture of the pars interarticularis¹⁻³⁾ and is common in pediatric athletes. Two conservative treatment strategies can be used for lumbar spondylolysis in pediatric athletes who wish to resume playing sports. When the spondylolysis is at the stress fracture stage, the aim of conservative treatment is bone union (BU), which can be achieved by the cessation of sports and use of a hard brace. However, when the spondylolysis reaches the pseudoarthrosis stage, and there is little or no possibility of bone healing, the aim of conservative treatment is pain management (PM)⁴⁾.

Sairyo et al.⁴⁾ investigated the BU rates in the different

stages of lumbar spondylolysis based on computed tomography (CT) and magnetic resonance imaging (MRI) findings and found a decrease in the BU rate with progression through the stages. They recommended that conservative treatment be considered for lumbar spondylolysis based on its stage.

Many previous studies have investigated return to sports (RTS) after conservative treatment for lumbar spondylolysis⁵⁻⁹⁾. However, the effect of the type of treatment provided on the time to RTS remains unclear. Furthermore, lumbar spondylolysis may recur in some athletes, but there are few reports on the time to recurrence and its incidence. Therefore, in this study, we investigated the rates of RTS and recurrence in pediatric athletes after conservative treatment.

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Received: December 1, 2021, Accepted: January 15, 2022, Advance Publication: March 4, 2022

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We also examined differences between two conservative treatment strategies, namely, one aiming for BU and one aiming for PM.

Materials and Methods

Subjects

The subjects in this retrospective study were pediatric athletes aged 6-18 years who were diagnosed with lumbar spondylolysis between January 2014 and September 2020. Patients who did not play sport and did not adhere to the physical therapy program were excluded.

Demographic and clinical information, including sex, age at first visit, height, weight, body mass index, type of sport played, vertebral level and staging of the lesion, type of treatment provided, status of RTS, recurrence after RTS, time to RTS, and time to recurrence, was collected by reviewing medical records and imaging findings.

Imaging diagnosis

Lumbar spondylolysis was diagnosed based on X-ray, CT, and MRI findings and staged as early, progressive, or terminal on CT scans^{4,10-12)}. Staging was as follows: early, hairline fracture, or bony absorption; progressive, a clear bone gap, such as a complete fracture through the pars interarticularis; and terminal, presence of pseudarthrosis. Short tau inversion recovery MRI findings were used to evaluate marrow edema in the adjoining pedicle, which appeared as a high signal intensity.

Conservative treatment

The aim of conservative treatment was BU or PM. Treatment aiming for BU was recommended for lumbar spondylolysis in the early or early progressive stage (positive marrow edema in the pedicle). PM was recommended for patients with late progressive (no marrow edema in the pedicle) or terminal lumbar spondylolysis.

When the aim of treatment was BU, patients were asked to wear a hard brace and cease sports activities. Pain management and physical therapy were also provided in these patients. Physical therapy included improving thorax mobility, lower extremity flexibility, and basic core stability training. BU was evaluated using CT after approximately 3-6 months of brace therapy. Thereafter, athletic rehabilitation was implemented, aiming for RTS. Athletic rehabilitation differed from physical therapy in that it involved more specialized exercises aimed at returning the patient to sports. Specifically, it included core training with dynamic movements depending on the sport.

PM was used mainly in patients with terminal lumbar spondylolysis (pseudoarthrosis) and consisted of bracing with a soft corset, physical therapy, and pain medication. These patients were allowed to continue sports activities as their pain allowed and to return to their original activity level after intensive athletic rehabilitation when the pain had

Table 1. Patient Demographics and Clinical Characteristics.

	BU group	PM group	P
Sex (male/female)	83/12	64/21	
Age at first visit, years	13.6±2.0	14.4±2.2	<0.01
Height, cm	160.8±12.1	162.8±12.3	0.24
Weight, kg	53.0±13.8	54.3±12.6	0.50
Body mass index	20.1±2.9	20.2±2.7	0.76
Sport played, n			
Baseball	44	22	
Soccer	20	17	
Track and field	8	9	
Basketball	5	7	
Tennis	5	5	
Other	13	25	

Data are shown as the mean±standard deviation or as the number, as appropriate. BU, bone union; PM, pain management

subsided.

Outcomes

The RTS and recurrence rates were compared between the BU and PM groups. RTS was defined as being able to play at the pre-injury activity level. Recurrence was defined as a pars fracture not only on the ipsilateral side at the initial level but also on the contralateral side at the same level and/or at another level.

Analyses

The patients' age at first visit, height, weight, and body mass index were compared between groups using the unpaired t-test or Mann-Whitney U test. The time to RTS was compared between the groups using the Mann-Whitney U test. The RTS and recurrence rates were compared between the BU and PM groups.

Results

Follow-up rate

A total of 203 pediatric athletes were diagnosed as having lumbar spondylolysis during the study period. Twenty-three patients who did not adhere to the rehabilitation protocol or were lost to follow-up were excluded, leaving data for 180 athletes (147 male, 33 female) available for analyses. The follow-up rate was 88.7%.

Patient demographics and clinical characteristics

There were 95 patients in the BU group and 85 in the PM group. The demographics and clinical characteristics of the patients are shown in Table 1. Only the age at first visit was significantly different (P<0.01). There were 145 lumbar spondylolytic lesions in the BU group (multilevel, n=5; bilateral, n=38; unilateral, n=52) and 131 in the PM group (multilevel, n=3; bilateral, n=38; unilateral, n=44). The char-

acteristics of the lesions are shown in Table 2.

RTS rate and time to RTS

RTS was possible in 94 of 95 patients (98.9%) in the BU group. The mean time to RTS was 4.7 ± 1.9 months. In this group, the mean duration of brace therapy for BU was 3.4 ± 1.5 months. RTS was possible in 83 of 85 patients (97.6%) in the PM group. The mean time to RTS was 1.8 ± 1.7 months. There was a significant difference in the time to RTS between the groups ($P < 0.01$).

RTS was not possible in one patient in the BU group and in two in the PM group. One patient in the BU group and one patient in the PM group did not resume sports activities for a nonmedical reason. Both patients were third-year high-school students who did not continue sports activities after graduating high school. RTS was not possible in the other patient in the PM group because of persistent pain.

Recurrence rate after RTS and time to recurrence

RTS was possible in 177 of 180 patients, 11 of whom had a recurrence. The characteristics of the patients with recurrence after RTS are shown in Table 3. Recurrence oc-

curred in 7 of 94 (7.4%) patients in the BU group. The recurrence was at the site where BU had previously occurred in four patients and at other sites in the remaining three patients. The time to recurrence after RTS was 19.0 ± 16.0 (range, 1-42) months. Recurrence occurred in 4 of 83 patients (4.8%) in the PM group. In one patient, the recurrence was at the site where BU had previously occurred. The remaining three patients had terminal stage defects bilaterally at another level (L5). Therefore, these three patients were deemed to have multilevel spondylolysis. The mean time to recurrence after RTS was 17.8 ± 5.2 (range, 13-24) months.

Discussion

This study investigated the RTS and recurrence rates in pediatric patients with lumbar spondylolysis who received conservative treatment according to whether the aim was BU or PM.

Return to sports

The RTS rate was high, over 95%, in both the BU and PM groups. This result was consistent with previous studies¹³⁻¹⁵. The cessation of sports activities, physical rehabilitation, and pain relief has been reported to be important for RTS in these patients^{16,17}. Patients in this study received rehabilitation and ceased sports activities for the purpose of reducing pain, and those who did not adhere to the rehabilitation protocol were excluded. As we strongly recommended the rehabilitation program and 180 patients (88.7%) completed the program, a high rate of RTS was successfully obtained.

In the two patients who did not resume sports activities for nonmedical reasons, their motivation for sports may have decreased during conservative therapy. Maintaining motivation for RTS in the treatment of pediatric patients with lum-

Table 2. Lesion Characteristics.

	BU group	PM group
Vertebral level		
L3	3	3
L4	41	20
L5	101	108
Staging		
Early	71	17
Progressive	61	15
Terminal	13	99

BU, bony union; PM, pain management

Table 3. Characteristics of Recurrent Cases after Return to Sports.

Case number	First lesion				Recurrent lesion	
	Vertebral level	Staging	Determination of BU	Interval until recurrence, months	Vertebral level	Interval until recurrence, months
BU group						
1	L5, left side	Early	Union	6	L5, left side	8
2	L5, left side	Progressive	Non-union	2	L4, right side	37
3	L4, L5, bilateral	L4, early; L5, terminal	L4 Union	3	L4, right side	1
4	L3, left side	Early	Union	4	L4, left side	14
5	L5, left side	Early	Union	5	L5, left side	6
6	L5, right side	Early	Union	5.5	L4, right side	42
7	L5, left side	Early	Union	4	L5, left side	25
PM group						
1	L5, bilateral	Terminal	-	1	L3, right side	20
2	L4, left side	Early	Union	0.25	L4, left side	14
3	L5, bilateral	Terminal	-	1	L4, right side	13
4	L5, bilateral	Terminal	-	9	L4, right side	24

BU, bone union; PM, pain management

bar spondylolysis may be an important issue for sports physicians, therapists, and trainers.

The time to RTS was longer in the BU group than in the PM group because of the need for brace therapy. Sys et al. reported that the average time to RTS was 5.5 months⁹⁾, which is similar to that in our BU group. Several reports in the literature describe a time to RTS in the range of 2-7 months after conservative treatment¹³⁻¹⁵⁾, but do not mention whether the aim was BU or PM.

In this study, the average time to RTS was 4.7 ± 1.9 months in the BU group. Brace therapy was required for a mean of 3.4 ± 1.5 months in this group. Therefore, RTS was possible at about 1.3 months after finishing brace therapy when the aim was BU. In the PM group, the average time to RTS was 1.8 ± 1.7 months. When the duration of brace therapy was excluded, the time to RTS was similar between the two groups. Therefore, the treatment strategy chosen does not affect the duration of physical rehabilitation required for RTS.

Recurrence after RTS

Recurrence after RTS occurred not only at the site of previous BU but also at other sites, including on the contralateral side and other levels. Our recurrence rates (7.4% in the BU group and 4.8% in the PM group) were lower than the rate of 26.1% reported by Sakai et al.¹⁸⁾. However, in that report, patients were allowed to return to sport activities after radiographic confirmation of BU but without any physical rehabilitation. In most cases, spondylolysis is associated with tightness of the hamstring and quadriceps muscles and the Achilles tendon¹⁹⁾. As mentioned by Sakai et al.¹⁸⁾, mobilization to resolve this tightness before RTS may help reduce the risk of recurrence.

The patients in this study were strongly recommended to complete our rehabilitation regimen and were excluded if they did not. The importance of physical therapy in RTS has been emphasized, but the details of its implementation have not been disclosed^{16,17)}. The main aims of our rehabilitation strategy are mobilization of the thoracic spine and stretching of the hamstrings and quadriceps. Core muscle training is also provided to stabilize the lumbar spine. We attribute the low recurrence rates in this study to our rehabilitation program and the efforts made by patients to complete it.

Limitations

This study has several limitations. First, there was no follow-up after RTS, so the long-term results are unknown. Second, owing to the retrospective design of the study, the possibility that not all recurrences were identified cannot be excluded. We could only identify recurrences in the medical records held at our institution, and it is possible that some recurrences were treated elsewhere. Therefore, the actual recurrence rate may be higher.

Conclusions

This study found a high RTS rate in pediatric athletes with lumbar spondylolysis, regardless of whether the aim of conservative treatment was BU or PM. However, when the aim is BU, the time to RTS may be longer because of the need for brace therapy. Moreover, there were some recurrences, regardless of the treatment strategy used. More intensive rehabilitation may be an effective way of reducing the recurrence rate after RTS.

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

Sources of Funding: None

Author Contributions: Takuya Kasamasu and Koichi Sairyo designed the study; Takuya Kasamasu, Yuko Ishida, and Masahiro Sato performed the experiments and analyzed the data; Yasuyoshi Mase and Koichi Sairyo supervised the experiments; Takuya Kasamasu and Koichi Sairyo wrote the manuscript.

Ethical Approval: This study was approved by the Tokushima University Hospital Ethics Committee (Approval code: 1418-1).

Informed Consent: Informed consent for publication was obtained by all participants in this study.

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