Original Article

J Korean Soc Radiol 2022;83(1):127-137
https://doi.org/10.3348/jksr.2021.0020
eISSN 2288-2928

대한영상의학회지

Prevalence of Incidentally Detected Spondylolysis in Children

소아 환자에서 우연히 발견되는 척추분리증의 유병률

Boram Song, MD[1], Sun Kyoung You, MD[1*], Jeong Eun Lee, MD[1], So Mi Lee, MD[2], Hyun-Hae Cho, MD[3]

[1]Department of Radiology, Chungnam National University Hospital, Chungnam National University College of Medicine, Daejeon, Korea
[2]Department of Radiology, School of Medicine, Kyungpook National University, Kyungpook National University Hospital, Daegu, Korea
[3]Department of Radiology, Ewha Womans University Mokdong Hospital, Seoul, Korea

Received January 30, 2021
Revised May 4, 2021
Accepted June 4, 2021

***Corresponding author**
Sun Kyoung You, MD
Department of Radiology, Chungnam National University College of Medicine, 266 Munhwa-ro, Jung-gu, Daejeon 35015, Korea.

Tel 82-42-220-8108
Fax 82-42-253-0061
E-mail sunkyou@cnuh.co.kr

ORCID iDs
Boram Song
https://orcid.org/0000-0002-9964-0870
Sun Kyoung You
https://orcid.org/0000-0002-1026-5809
Jeong Eun Lee
https://orcid.org/0000-0001-9566-7489
So Mi Lee
https://orcid.org/0000-0002-2073-8198
Hyun-Hae Cho
https://orcid.org/0000-0002-4865-2601

Purpose To assess the prevalence of incidentally detected lumbar spondylolysis in children.
Materials and Methods We retrospectively reviewed the data of 809 patients under the age of 11 years (mean age, 7.0 ± 2.7 years; boys:girls = 479:330) who underwent abdominal and pelvic CT between March 2014 and December 2018. We recorded the presence, level, and laterality (unilateral or bilateral) of spondylolysis. Patients were divided into two groups based on the presence of spondylolysis: the spondylolysis (SP) and non-SP groups.
Results In total, 21 cases of spondylolysis were detected in 20 patients (20/809, 2.5%). The mean age of the SP group was higher than that of the non-SP group (7.8 ± 1.8 vs. 6.9 ± 2.7 years, $p >$ 0.05). The prevalence of spondylolysis in boys was higher than that in girls (15/479 [3.1%] vs. 5/330 [1.5%], $p > 0.05$). The prevalence of spondylolysis in school-age children (6–10 year olds) was higher than that in preschool-age children (0–5 year olds) (17/538 [3.2%] vs. 3/271 [1.1%], $p > 0.05$). L5 was the most common level of spondylolysis (76.2%); one 8-year-old boy had two-level spondylolysis. One case of isthmic spondylolisthesis was detected in a 10-year-old boy (1/809, 0.1%). There were 11 unilateral spondylolysis cases (11/21, 52.4%).
Conclusion In our study, the prevalence of spondylolysis in children under the age of 11 was 2.5%. The prevalence was higher in boys than in girls and in school-age than in preschool-age children, despite the lack of any statistically significant differences.

Index terms Spondylolysis; Prevalence; Child; Computed Tomography, X-Ray

INTRODUCTION

Spondylolysis is an anatomical defect or fracture of the pars interarticularis of the vertebral arch which usually affects the lumbar spine (1). Most cases of spondylolysis are asymptomatic (2), but some become symptomatic or progress into spondylolisthesis (3-5). The prevalence of lumbar spondylolysis in the general population has been reported to be approximately 3%–11% (6-14); it varies with ethnicity, sex, age, and activity level (6, 9, 15-18). Studies that have reported an increasing trend in the prevalence of spondylolysis according to age (8, 19) and physical activity such as athletic training (17, 20, 21), with repetitive microtrauma and degenerative change suggested as potential etiologies (22, 23). However, in rare cases, an acute traumatic event can cause spondylolysis or spondylolisthesis (24-27).

Spondylolysis can be diagnosed by various imaging modalities (such as radiography, CT, and MRI) to identify dissolution of the pars interarticularis. A cross-sectional imaging modality is better than radiography for the diagnosis of spondylolysis and CT is more accurate than MRI (28, 29).

A few studies have assessed the prevalence of lumbar spondylolysis including among pediatric population (8, 19, 30). Fredrickson et al. (8) analyzed radiography images of 6-year-old patients and reported an incidence of spondylolysis of 4.4%. Studies by Lemoine et al. (19) and Urrutia et al. (30) analyzed abdominal and pelvic CT (A-P CT) images of a pediatric population, yielding a prevalence of spondylolysis of 4.7% and 3.5%, respectively.

To our knowledge, no studies have examined the prevalence of spondylolysis in an Asian pediatric population. Therefore, in this study, we reviewed A-P CT images to evaluate the prevalence of incidentally detected spondylolysis in an asymptomatic pediatric population.

MATERIALS AND METHODS

This study was approved by the Institutional Review Board of our institution and the requirement for informed consent was waived (IRB No. 2020-02-002).

PATIENTS

This was a single center, retrospective study of the prevalence of spondylolysis in a pediatric population under 11 years of age. We retrospectively reviewed A-P CT images acquired at our institution from March 2014 to December 2018. A total of 888 A-P CT images from 832 patients were reviewed. If there were multiple CT scans available, we selected the CT scan that was the first to be acquired (n = 56). We excluded CT scans acquired for evaluation of trauma (n = 23). No patient complained of back pain. A total of 809 A-P CT images from 809 patients were reviewed. Sex and age at the time of the CT examination were also recorded.

CT EXAMINATION PROTOCOLS

All patients underwent CT using a 64-channel multi-detector CT scanner (SOMATOM Sensation 64, Siemens Medical Solutions, Forchheim, Germany) in our hospital. We obtained axial, sagittal, and coronal CT images. The tube voltage and current varied based on the weight of each patient. The other scanning parameters were as follows: rotation time, 0.35 s; slice thicknesses, 3 mm; and field of view of 203 × 203–256 × 256 mm.

IMAGE ANALYSIS

The CT images were retrospectively analyzed by consensus by two radiologists (S.K.Y, board-certified radiologist with 11 years of experience and B.R.S, second grade radiology resident). The observers were blinded to the clinical information and personal data.

Lumbar spondylolysis was defined as the dissolution of the normal continuity of the pars interarticularis (19), and spondylolisthesis was defined as the anterior displacement of the vertebral body in reference to the underlying vertebral body (1). Isthmic spondylolisthesis was defined as anterior slippage of the vertebra due to spondylolysis (1).

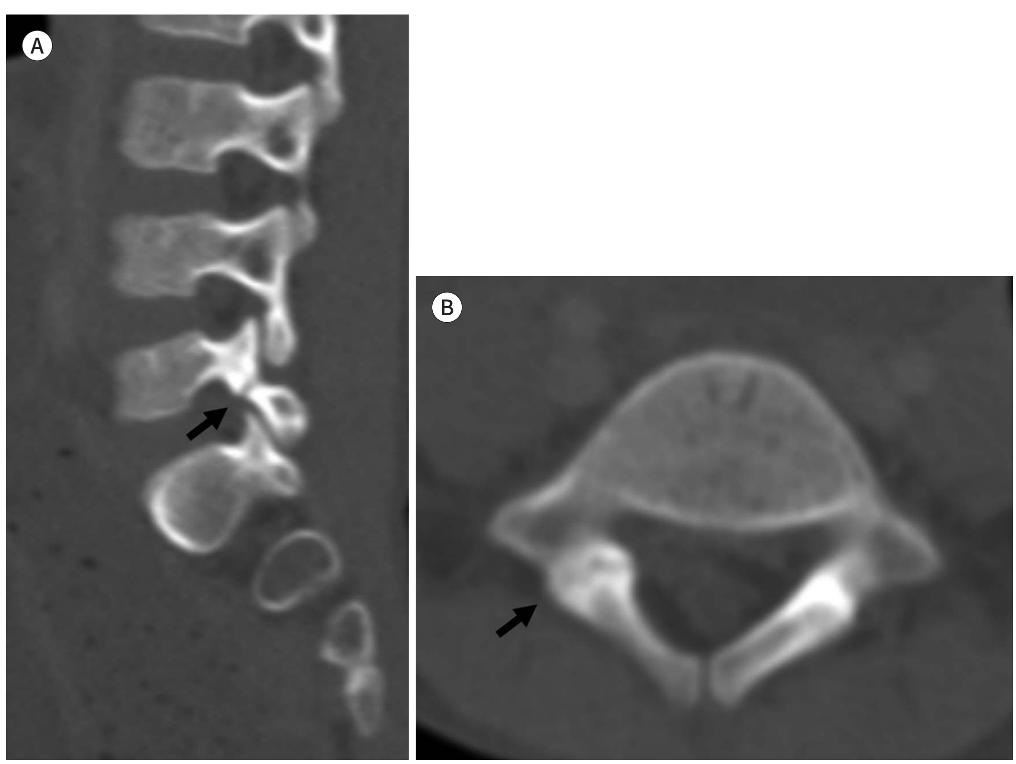
Axial- and sagittal-reformatted CT images (Fig. 1) were displayed at a picture archiving and communication system workstation with bone window settings of width, 2050 Hounsfield unit (HU), and level, 250 HU. The readers were permitted to change the display window setting. The sagittal reformatted image was first viewed to find the defect in the lumbar spine, following which the defect was confirmed in the axial image.

The presence or absence of spondylolysis, affected level, and laterality (unilateral or bilateral) of the lesion were recorded. We also recorded the presence of spondylolisthesis. Patients were divided into the SP and non-SP groups based on the presence of spondylolysis.

STATISTICAL ANALYSIS

All statistical analyses were performed using SPSS version 21.0 (IBM Corp., Armonk, NY, USA) for Windows. p values < 0.05 were considered statistically significant. Continuous data were presented as means and standard deviations. We used a Student's t test and Pearson's

Fig. 1. Unilateral spondylolysis in a 5.4-year-old girl.
A. Sagittal reformat image with a bone window setting illustrates a defect in the right pars interarticularis of L5 (arrow), suggesting spondylolysis.
B. Axial image illustrates a defect (arrow) with irregular margins and sclerotic changes in the right pars interarticularis of L5.



chi-square test or Fisher's exact test to assess the differences between the two groups.

RESULTS

A total of 21 spondylolysis cases were detected in 20 patients (2.5%, 20/809). An 8-year-old boy had two-level spondylolysis at L3 and L5. The mean age of the SP group was higher than that of the non-SP group but the difference was not statistically significant ($p = 0.052$) (Table 1). There was no significant difference in the sex distribution between the SP and non-SP groups. The prevalence of spondylolysis in boys (3.1%, 15/479) was higher than that in girls (1.5%, 5/330) but the difference was not statistically significant ($p = 0.146$).

When we divided patients according to age, i.e., including preschool-age, between 0 and 5-years-old, and school-age, between 6 and 10-years-old, the prevalence of spondylolysis in the school-age group (3.2%,17/538) was observed to be higher than that in the preschool-age group (1.1%, 3/271), but the difference was not statistically significant ($p = 0.076$) (Table 1).

L5 was the most common level of spondylolysis (16/21, 76.2%) (Table 2). There were 11 unilateral spondylolysis cases (11/21, 52.4%) and 10 bilateral spondylolysis cases (10/21, 47.6%). The mean age of the bilateral group was higher than that of the unilateral group ($p = 0.004$) (Table 3). There was no significant difference in the sex distribution according to the laterality of spondylolysis ($p = 0.476$).

Among 21 spondylolytic defects, one bilateral defect (1/21, 4.8%) at the L5 level accompanied with anterior slippage of the L5 vertebra over S1 was observed to be compatible with

Table 1. Prevalence of Spondylolysis

	SP Group (*n* = 20)	Non-SP Group (*n* = 789)	Total (*n* = 809)	*p*-Value
Mean age, years	7.8 ± 1.8	6.9 ± 2.7	7.0 ± 2.7	0.052*
Sex				0.146†
Boy	15	464	479	
Girl	5	325	330	
Age, years				0.076‡
Preschool-age, 0–5	3	268	271	
School-age, 6–10	17	521	538	

*Student's *t* test.
†Pearson's chi-square.
‡Fisher's exact test.
NSP = patients without spondylolysis, SP = patients with spondylolysis

Table 2. Level of Spondylolysis

Level	*n* (%)
L1	2 (9.5)
L2	0 (0)
L3	2 (9.5)
L4	1 (4.8)
L5	16 (76.2)
Total	21

Table 3. Analysis of Laterality in the Patients with Spondylolysis Group

	Unilateral (n = 11)	Bilateral (n = 10)	p-Value
Mean age, years	6.8 ± 1.5	8.9 ± 1.3	0.004*
Sex			0.476†
Boy	8	8	
Girl	3	2	

*Student's t test.
†Fisher's exact test.

Fig. 2. Isthmic spondylolisthesis of L5 on S1 in a 10.8-year-old boy with bilateral spondylolysis.
A. Sagittal reformat image revelas anterior slippage of the L5 vertebra over the S1 vertebra (arrow).
B. Axial image illustrates defects (arrows) in the bilateral pars interarticularis of L5.

isthmic spondylolisthesis, Meyerding grade I (Fig. 2) (31). There were no cases of spondylolysis in patients younger than 4 years of age.

DISCUSSION

Spondylolysis is a pathological bone defect that occurs at the level of the pars interarticularis of the vertebra. Several studies have reported variable prevalences of spondylolysis based on ethnicity, age, sex, and activity level; however, relevant studies of pediatric populations have remained scarce (8, 19, 30). To our knowledge, our study was the first to include an Asian pediatric population. Moreover, one of the strengths of our study was that we reviewed the largest number of cases among several studies that have investigated the prevalence of incidentally detected spondylolysis in pediatric populations.

https://doi.org/10.3348/jksr.2021.0020

In this study, the prevalence of spondylolysis among patients under the age of 11 years was found to be 2.5%(20/809). It was lower than that reported by previous pediatric population studies (8, 19, 30), and we assume that this discrepancy might be attributable to the ethnicity and age range of the study population (Supplementary Table 1 in the online-only Data Supplement).

In our study population, the prevalence of spondylolysis in the school-age group was higher than that in the preschool-age group (3.2% vs. 1.1%), and there were no cases of spondylolysis in children younger than 4 years. Lemoine et al. (19) reported that the prevalence of spondylolysis increased with increasing age and activity: 1% in children under 3 years of age, 3.7% in under 6 years of age, and 4.7% in under 8 years of age. Some studies (32, 33) reported that spondylolysis is related to physical activities such as standing and walking. Tsirikos and Garrido (32) reported that most cases of spondylolysis occur after children start walking and Rosenberg et al. (33) reported that non-ambulatory patients do not experience spondylolysis. These reports lend support to the idea that the microtrauma related to standing and walking may be a cause of spondylolysis.

Similar to the results of other studies of pediatric populations (19, 30), our study revealed a male predominance. The boy:girl ratio of the spondylolysis prevalence is 2:1 (3.1% vs. 1.5%). Urrutia et al. (30) observed a ratio of 1.9:1, and Lemoine et al. (19) observed a ratio of 1.3:1. The male-to-female ratio of adult spondylolysis varies from 2–3.3:1, and most studies have reported a male predominance (6, 8, 9, 14, 16, 34). However, the underlying reason for this trend remains poorly understood.

Similar to the findings of other studies on children (8, 19) and adults (6, 16, 35), the most common level of spondylolysis in this study was L5 (16/21, 76.2%). Lemoine et al. (19) and Fredrickson et al. (8) reported that 75% and 86% of cases of spondylolysis were at the L5 level, respectively (6, 16, 35). The predominance of spondylolysis at the L5 level may be explained by the fact that L5 is the level subjected to the greatest amount of stress during daily activities (2).

In our study, 11 unilateral spondylolysis cases and 10 bilateral spondylolysis cases were detected among a total 21 of spondylolytic defects. The mean age of the bilateral spondylolysis group was significantly higher than that of the unilateral group (8.9 ± 1.3 vs. 6.8 ± 1.5-years-old, $p = 0.004$). Similar to our study, in the study of Lemoine et al. (19), the mean age of the bilateral group was higher than that of the unilateral group (5 years and 8 months vs. 3 years and 3 months). Though several other studies reported patients who had bilateral and unilateral defects among adult populations (7, 16), however, they did not provide information on patient age differences.

There are two possibilities that may explain the age differences between the bilateral and unilateral groups. First, each group may have a different pathophysiology. Lemoine et al. (19) reported that unilateral spondylolysis was significantly related to spinal malformations such as spina bifida occulta and hemivertebra ($p = 0.004$). Based on this result, they hypothesized that a specific pathophysiology rather than microtrauma may be associated with unilateral spondylolysis detected in younger patients; however, they lacked sufficient evidence to support this hypothesis.

Second, previous studies (36, 37) suggested that the instability of unilateral spondylolysis may lead to compensatory changes on the contralateral side, resulting in an increased risk of bilateral spondylolysis. Sairyo et al. (38) demonstrated that the stress on the contralateral pedicle increases as high as 12.6-fold in a unilateral spondylolysis model compared with an intact model, in a specific position (axial rotation to the contralateral side). According to these studies, which suggest that a unilateral defect can develop into a bilateral defect over time, we could infer that the bilateral spondylolysis detected in relatively older patients began as unilateral spondylolysis.

In our study, only one defect was accompanied with grade I slippage of the vertebra (1/21, 4.8%) in a 10-year-old boy with bilateral spondylolysis at the L5 level. Urrutia et al. (30), Lemoine et al. (19), and Fredrickson et al. (8) reported 25.0%(2/8), 48.0%(12/25), and 59.1%(13/22) prevalence rates of spondylolisthesis in pediatric patients who had spondylolysis, respectively. In adults, Sakai et al. (16) reported a 60.5% rate of spondylolisthesis (75/124) and Kalichman et al. (34) reported a 71.4%(15/21) rate of spondylolisthesis at the time of diagnosis of spondylolysis.

According to the literature on the relationship between spondylolysis and spondylolisthesis, slippage usually occurs before adulthood (9, 39) and is thought to be related to growth plates. Kajiura et al. (40) reported that the growth plate is the weakest portion of the vertebra to resist anterior shear forces that play an important role in slippage. Based on these studies, we could infer that the prevalence of spondylolisthesis is higher in the adult spondylolysis group than in the pediatric spondylolysis group.

With regard to the progression rate, Beutler et al. (9) reported an 81.8%(18/22) progression of slippage rate in a 45-year follow-up and Ohmori et al. (41) reported a 40.9%(9/22) rate in a 22-year follow-up of spondylolysis patients. However, in our study, we could not evaluate the rate of progression to spondylolisthesis owing to its retrospective nature. Follow-up studies of patients with spondylolysis are warranted for further comparison with other studies.

In our study, only one child (1/809, 0.1%) was found to have a two-level spondylolysis. Some previous studies reported on the incidence of multiple level spondylolysis in adult populations. Sakai et al. (16) reported an 0.3%(5/2000) prevalence in the general adult population in Japan. Ravichandran (42) reported a 1.48% prevalence among patients with lower back pain. With regard to pediatric populations, one case report reported pediatric athletes with multiple level spondylolysis (43); however, it was difficult to find a study on the incidence of multiple level spondylolysis in general pediatric populations. Comparing our results with those of Sakai et al. (16), their incidence of multiple level spondylolysis was higher than that of our study. This is could be related to the higher incidence of spondylolysis in adults.

Spondylolysis is a relatively common disease, and is usually asymptomatic, though symptoms may develop over time or progress to spondylolisthesis. Knowing the prevalence of spondylolysis is helpful to radiologists and clinicians in order for them to be able to more thoroughly assess the presence of spondylolysis, which is easily overlooked in A-P CT. If spondylolysis is incidentally observed, the clinician can ask about whether the patient experienced back pain or leg pain in their daily life and can follow-up with regard to the progression of the slippage. Especially in pediatric populations, patients cannot accurately express their symptoms, so reporting the incidental abnormalities on imaging is important. In addition, considering their long remaining life, following up for future degenerative spinal disease in spondylolysis patients may be helpful.

Our study has some limitations. First, was a single-center study; thus, the local environment may have biased the results. Second, this was a retrospective study and we could obtain limited medical records on past trauma history or symptoms related to spondylolysis. Therefore, we selected A-P CT, rather than lumbar spinal CT, and excluded A-P CT scans obtained for trauma evaluation. Additionally, no patient complained of back pain at the time of CT acquisition. Third, we could not follow up with the study population. To assess progression to spondylolisthesis or any relationship to other degenerative spinal diseases, additional cohort studies are required.

In conclusion, the prevalence of incidentally detected lumbar spondylolysis in pediatric patients under the age of 11 years was observed to be 2.5%. It was higher in boys than in girls and in school-age than in preschool-age children, despite the lack of any statistically significant differences. The mean age of the bilateral spondylolysis group was higher than that of the unilateral spondylolysis group. The information obtained from this study may be helpful for the screening of pediatric populations for spondylolysis.

Supplementary Materials

The online-only Data Supplement is available with this article at http://dx.doi.org/10.3348/jksr.2021.0020.

Author Contributions

Conceptualization, Y.S.K.; data curation, Y.S.K., S.B.; formal analysis, Y.S.K., S.B.; investigation, Y.S.K., S.B.; methodology, Y.S.K., S.B.; project administration, Y.S.K., S.B.; resources, Y.S.K., S.B.; software, Y.S.K., L.J.E.; supervision, L.J.E.; validation, L.S.M., C.H.H.; visualization, Y.S.K., S.B.; writing—original draft, S.B.; and writing—review & editing, L.J.E., L.S.M., C.H.H.

Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

Funding

None

REFERENCES

1. Gagnet P, Kern K, Andrews K, Elgafy H, Ebraheim N. Spondylolysis and spondylolisthesis: a review of the literature. *J Orthop* 2018;15:404-407
2. Leone A, Cianfoni A, Cerase A, Magarelli N, Bonomo L. Lumbar spondylolysis: a review. *Skeletal Radiol* 2011;40:683-700
3. Standaert CJ. Spondylolysis in the adolescent athlete. *Clin J Sport Med* 2002;12:119-122
4. Yang J, Servaes S, Edwards K, Zhuang H. Prevalence of stress reaction in the pars interarticularis in pediatric patients with new-onset lower back pain. *Clin Nucl Med* 2013;38:110-114
5. Floman Y. Progression of lumbosacral isthmic spondylolisthesis in adults. *Spine (Phila Pa 1976)* 2000;25:342-347
6. Roche MB, Rowe GG. The incidence of separate neural arch and coincident bone variations; a survey of 4,200 skeletons. *Anat Rec* 1951;109:233-252
7. Belfi LM, Ortiz AO, Katz DS. Computed tomography evaluation of spondylolysis and spondylolisthesis in asymptomatic patients. *Spine (Phila Pa 1976)* 2006;31:E907-E910
8. Fredrickson BE, Baker D, McHolick WJ, Yuan HA, Lubicky JP. The natural history of spondylolysis and spondylolisthesis. *J Bone Joint Surg Am* 1984;66:699-707
9. Beutler WJ, Fredrickson BE, Murtland A, Sweeney CA, Grant WD, Baker D. The natural history of spondylol-

ysis and spondylolisthesis: 45-year follow-up evaluation. *Spine (Phila Pa 1976)* 2003;28:1027-1035; discussion 1035

10. Sonne-Holm S, Jacobsen S, Rovsing HC, Monrad H, Gebuhr P. Lumbar spondylolysis: a life long dynamic condition? A cross sectional survey of 4.151 adults. *Eur Spine J* 2007;16:821-828
11. Waldron HA. Variations in the prevalence of spondylolysis in early British populations. *J R Soc Med* 1991;84:547-549
12. Amato M, Totty WG, Gilula LA. Spondylolysis of the lumbar spine: demonstration of defects and laminal fragmentation. *Radiology* 1984;153:627-629
13. Hu SS, Tribus CB, Diab M, Ghanayem AJ. Spondylolisthesis and spondylolysis. *J Bone Joint Surg Am* 2008;90:656-671
14. Kalichman L, Kim DH, Li L, Guermazi A, Berkin V, Hunter DJ. Spondylolysis and spondylolisthesis: prevalence and association with low back pain in the adult community-based population. *Spine (Phila Pa 1976)* 2009;34:199-205
15. Stewart TD. The age incidence of neural-arch defects in Alaskan natives, considered from the standpoint of etiology. *J Bone Joint Surg Am* 1953;35:937-950
16. Sakai T, Sairyo K, Takao S, Nishitani H, Yasui N. Incidence of lumbar spondylolysis in the general population in Japan based on multidetector computed tomography scans from two thousand subjects. *Spine (Phila Pa 1976)* 2009;34:2346-2350
17. Sakai T, Sairyo K, Suzue N, Kosaka H, Yasui N. Incidence and etiology of lumbar spondylolysis: review of the literature. *J Orthop Sci* 2010;15:281-288
18. Crawford CH 3rd, Ledonio CG, Bess RS, Buchowski JM, Burton DC, Hu SS, et al. Current evidence regarding the etiology, prevalence, natural history, and prognosis of pediatric lumbar spondylolysis: a report from the scoliosis research society evidence-based medicine committee. *Spine Deform* 2015;3:12-29
19. Lemoine T, Fournier J, Odent T, Sembély-Taveau C, Merenda P, Sirinelli D, et al. The prevalence of lumbar spondylolysis in young children: a retrospective analysis using CT. *Eur Spine J* 2018;27:1067-1072
20. Soler T, Calderón C. The prevalence of spondylolysis in the Spanish elite athlete. *Am J Sports Med* 2000;28:57-62
21. Swärd L, Hellström M, Jacobsson B, Peterson L. Spondylolysis and the sacro-horizontal angle in athletes. *Acta Radiol* 1989;30:359-364
22. Labelle H, Mac-Thiong JM, Roussouly P. Spino-pelvic sagittal balance of spondylolisthesis: a review and classification. *Eur Spine J* 2011;20 Suppl 5:641-646
23. Labelle H, Roussouly P, Berthonnaud E, Transfeldt E, O'Brien M, Chopin D, et al. Spondylolisthesis, pelvic incidence, and spinopelvic balance: a correlation study. *Spine (Phila Pa 1976)* 2004;29:2049-2054
24. Cope R. Acute traumatic spondylolysis. Report of a case and review of the literature. *Clin Orthop Relat Res* 1988;230:162-165
25. El Assuity WI, El Masry MA, Chan D. Acute traumatic spondylolisthesis at the lumbosacral junction. *J Trauma* 2007;62:1514-1516; discussion 1516-1517
26. Lamm M, Henriksen SE, Eiskjaer S. Acute traumatic L5-S1 spondylolisthesis. *J Spinal Disord Tech* 2003;16:524-527
27. Lonstein JE. Spondylolisthesis in children. Cause, natural history, and management. *Spine (Phila Pa 1976)* 1999;24:2640-2648
28. West AM, d'Hemecourt PA, Bono OJ, Micheli LJ, Sugimoto D. Diagnostic accuracy of magnetic resonance imaging and computed tomography scan in young Athletes with spondylolysis. *Clin Pediatr (Phila)* 2019;58:671-676
29. Delavan JA, Stence NV, Mirsky DM, Gralla J, Fadell MF. Confidence in assessment of lumbar spondylolysis using three-dimensional volumetric T2-weighted MRI compared with limited field of view, decreased-dose CT. *Sports Health* 2016;8:364-371
30. Urrutia J, Cuellar J, Zamora T. Spondylolysis and spina bifida occulta in pediatric patients: prevalence study using computed tomography as a screening method. *Eur Spine J* 2016;25:590-595
31. Meyerding HW. Spondylolisthesis. *J Bone Joint Surg Am* 1931;13:39-48
32. Tsirikos AI, Garrido EG. Spondylolysis and spondylolisthesis in children and adolescents. *J Bone Joint Surg Br* 2010;92:751-759
33. Rosenberg NJ, Bargar WL, Friedman B. The incidence of spondylolysis and spondylolisthesis in nonambu-

latory patients. *Spine (Phila Pa 1976)* 1981;6:35-38
34. Kalichman L, Guermazi A, Li L, Hunter DJ. Association between age, sex, BMI and CT-evaluated spinal degeneration features. *J Back Musculoskelet Rehabil* 2009;22:189-195
35. Rothman SL, Glenn WV Jr. CT multiplanar reconstruction in 253 cases of lumbar spondylolysis. *AJNR Am J Neuroradiol* 1984;5:81-90
36. Garber JE, Wright AM. Unilateral spondylolysis and contralateral pedicle fracture. *Spine (Phila Pa 1976)* 1986;11:63-66
37. Kim KS, Kim YW, Kwon HD. Unilateral spondylolysis combined with contralateral lumbar pediculolysis in a military parachutist. *J Spinal Disord Tech* 2006;19:65-67
38. Sairyo K, Katoh S, Sasa T, Yasui N, Goel VK, Vadapalli S, et al. Athletes with unilateral spondylolysis are at risk of stress fracture at the contralateral pedicle and pars interarticularis: a clinical and biomechanical study. *Am J Sports Med* 2005;33:583-590
39. McPhee IB, O'Brien JP, McCall IW, Park WM. Progression of lumbosacral spondylolisthesis. *Australas Radiol* 1981;25:91-95
40. Kajiura K, Katoh S, Sairyo K, Ikata T, Goel VK, Murakami RI. Slippage mechanism of pediatric spondylolysis: biomechanical study using immature calf spines. *Spine (Phila Pa 1976)* 2001;26:2208-2212; discussion 2212-2213
41. Ohmori K, Ishida Y, Takatsu T, Inoue H, Suzuki K. Vertebral slip in lumbar spondylolysis and spondylolisthesis. Long-term follow-up of 22 adult patients. *J Bone Joint Surg Br* 1995;77:771-773
42. Ravichandran G. Multiple lumbar spondylolyses. *Spine (Phila Pa 1976)* 1980;5:552-557
43. Sairyo K, Sakai T, Yasui N, Kiapour A, Biyani A, Ebraheim N, et al. Newly occurred L4 spondylolysis in the lumbar spine with pre-existence L5 spondylolysis among sports players: case reports and biomechanical analysis. *Arch Orthop Trauma Surg* 2009;129:1433-1439

소아 환자에서 우연히 발견되는 척추분리증의 유병률

송보람[1] · 유선경[1]* · 이정은[1] · 이소미[2] · 조현혜[3]

목적 소아에서 우연히 발견되는 요추 척추분리증의 유병률을 평가하고자 한다.

대상과 방법 2014년 3월부터 2018년 12월까지 복부-골반 컴퓨터단층촬영술을 시행한 11세 미만의 환자 809명(평균나이 7.0 ± 2.7세, 남아:여아 = 479:330)의 자료를 후향적으로 분석하였다. 척추분리증의 유무, 척추분리증이 있는 위치, 그리고 편측성(일측성 혹은 양측성)을 기록하였다. 척추분리증의 유무에 따라 환자군 spondylolysis (이하 SP) 그룹과 non-SP 그룹으로 나누었다.

결과 20명의 환자에서 21개의 척추분리증이 확인되었다(20/809, 2.5%). SP 그룹의 평균 나이가 non-SP 그룹보다 많았다(7.8 ± 1.8세 vs. 6.9 ± 2.7세, $p > 0.05$). 남아에서 여아보다 유병률이 높았다(15/479 [3.1%] vs. 5/330 [1.5%], $p > 0.05$). 만 6–10세의 학령기 연령에서 만 0–5세의 미취학 연령보다 유병률이 높았다(17/538 [3.2%] vs. 3/271 [1.1%], $p > 0.05$). 척추분리증은 요추 5번에서 가장 흔하게 보였고(76.2%), 8세 남아에서 두 개의 요추에서 척추분리증을 보였다. 10세 남아에게서 척추분리전방전위증이 확인되었다(1/809, 0.1%). 11건의 일측성 척추분리증은 확인되었다(11/21, 52.4%).

결론 본 연구에서 11세 미만의 환자에서 척추분리증의 유병률은 2.5%였다. 척추분리증은 여아보다는 남아에게서, 미취학 연령군보다는 학령기 연령군에서 더 높은 유병률을 보였으나, 통계학적으로 유의미한 차이는 없었다.

[1]충남대학교 의과대학 충남대학교병원 영상의학과,
[2]경북대학교 의과대학 경북대학교병원 영상의학과,
[3]이화여자대학교 목동병원 영상의학과