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Long Term Radiological and Clinical Outcome of Symptomatic Lumbar Intraspinal Synovial Cyst: A Retrospective 4-Year Study

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ABSTRACT

AIM: To examine the prevalence of symptomatic lumbar synovial facet cysts in lumbar spinal magnetic resonance imaging (MRI) of patients who admitted to neurosurgery clinic of our institution, retrospectively. Also, we aimed to report the clinic and radiologic outcome of patients with symptomatic spinal synovial cyst, who undergo conservative treatment.

MATERIAL and METHODS: One thousand two hundred forty-three patients who admitted to Ordu University Neurosurgery outpatient clinic between 2015-2019 and underwent lumbosacral Magnetic resonance imaging and lumbosacral computed tomography examinations were reviewed retrospectively. The disappearance of cysts during radiologic follow up was accepted as spontaneous complete resolution, besides reduction in cyst dimensions and/or contrast enhancement were considered as radiologic regression. Decrease in radiculopathy, back pain and neurologic deficit complaints were also considered as clinical improvement.

RESULTS: Thirteen patients (8 men, 5 women) with lumbar synovial cysts who admitted to the neurosurgery outpatient clinic with low back and radicular pain complaints were included in the study. 9 patients (69.2%) had clinical and radiological improvement, 1 female patient (7.7%) was operated due to the leg pain, progressive motor deficit and lumbar disc hernia. Radiological spontaneous complete resolution was detected in 3 patients (23.1%). Spontaneous complete resolution period was determined between 3 months to 24 months.

CONCLUSION: The symptomatic lumbosacral synovial cyst treatment algorithm has not been fully demonstrated. However, as in our series, spontaneous complete resolution of cysts and effectiveness of conservative treatment in symptomatic patients should not to be underestimated and immediate invasive procedures should be postponed.

KEYWORDS: Lumbar synovial cyst, Conservative treatment, Resolution

ABBREVIATIONS: CT: Computed tomography, **MRI:** Magnetic resonance imaging, **NSAID:** Nonsteroidal anti-inflammatory drug, **SCC:** Spinal synovial cysts

INTRODUCTION

Spinal synovial cysts (SCCs) are small, fluid-filled cystic sacs associated with the facet joint. They are pseudocysts, which are lined with synovial membrane and contain myxoid material (11). Synovial cysts were first described by Baker in 1877 and ascribed to joint degenerative processes (1). Soon after, Von Gruker described extradural, intraspinal synovial cysts of the spine detected at autopsy (17). Kao et al. proved the role of synovial cysts in spinal nerve compression, and they defined the term juxtafacet cyst to

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distinguish between ganglion cysts and synovial cysts (19,20, 37).

The majority of SCCs occur in the lumbar spinal region (85–94%), especially at the lumbar L4-L5 level. They rarely occur in the cervical and thoracic spinal region. In lumbar cross-sectional imaging studies, SSCs were detected in 0.7– 2.0% (18). Lumbar spinal trauma and microimbalances are the main causes of these cysts. Previous research showed that a lack of synovial lumbar stabilization played a role in the development of SCCs (2). A recent study demonstrated that synovial cysts of the cervical and lumbar regions were a more common cause of pain and radiculopathy than previously thought (24).

Magnetic resonance imaging (MRI) is the imaging modality of choice for the diagnosis of synovial cysts. Advances in imaging technologies, especially MRI, have increased the detection of symptomatic and asymptomatic SCCs in routine neuroradiology practice and led to the development of treatment strategies for SCCs. In some cases, conservative treatment, supported by clinical and radiological follow-up, is considered an option for SCCs. Percutaneous steroid treatment, transforaminal epiduroscopic laser ablation, or surgical resection (e.g., endoscopic resection or total resection by microsurgery) are other alternatives. Current treatment should be planned as cyst resection and decompression of the nerve compression in line with clinical symptoms (2).

In the present study, we aimed to retrospectively examine the prevalence of symptomatic lumbar synovial facet cysts in lumbar spinal magnetic resonance images. Patients' ages and complaints, neurological examination findings, treatment methods, steroid use, preoperative histories, spontaneous complete resolution, and recovery times were examined.

MATERIAL and METHODS

This retrospective study comprised 1,243 patients who presented to the neurosurgery outpatient clinic of Ordu University between 2015 and 2019 and underwent lumbosacral MRI and lumbosacral computed tomography (CT) examinations. Patients with a history of lumbosacral oncological surgery and those with lumbosacral infections or rheumatological diseases were excluded from the study. Patients with spinal trauma histories were also excluded.

Serological tests and infection markers (sedimentation, C-reactive protein, brucella, etc.) were studied in all patients to exclude active spinal infections and rheumatological diseases. Physical therapy and rehabilitation program application conditions, nonsteroidal anti-inflammatory drug (NSAID) usage, corticosteroid usage, lumbar spinal stenosis, a history of back surgery, recovery of complaints, duration of recovery, spontaneous resolution of cysts, and the duration of complete resolution were evaluated.

The MRI scans were obtained using a 1.5-T unit GE MR360 system (Optima; General Electric Medical Systems, WI, U.S.). The MRI sequences included T2 axial and sagittal planes, T1 axial and sagittal planes, and contrast-enhanced, fat-sat T1 axial and sagittal planes. In MRI, sections 4 mm thick were obtained. The CT scans were performed using a 16-slice multidetector (Alexion; Toshiba Otawara-shi, Tochigi, Japan). Routine axial CT scans were performed at an angle parallel to the vertebral corpus endplate.

Patients who were admitted to our institution with complaints of low back and radicular pain were evaluated by noncontrast lumbar MRI. Subsequently, patients thought to have a synovial cyst underwent contrast-enhanced lumbosacral MRI and lumbosacral CT for the differential diagnosis of malignant pathology. A short-term follow-up (2-mo period) was recommended to the patients. Follow-up data between 2 and 4 y were also evaluated.

The disappearance of cysts during the radiological follow-up was accepted as spontaneous complete resolution, and a reduction in the cyst's dimensions and/or a decrease in contrast enhancement were considered radiological regression. A decrease in radiculopathy, back pain, and neurologic deficit complaints were also considered as clinical improvement.

RESULTS

Thirteen patients (males, n = 8; females, n = 5) with lumbar synovial cysts who presented to the neurosurgery outpatient clinic with low back and radicular pain complaints were included in the study. The average age was 58.4 y (range: 40–83 y). Lumbar SSCs were most frequently detected at the level of L4-5 (11/84.6%). However, they were also detected at the L3-4 level (1/7.7%) and L5-S1 level (1/7.7%). Lumbar spondylolisthesis was detected in 7 (53.8%) patients (Figure 1A, B). Radiculopathy was detected in 10 (76.9%) patients. Three (23.1%) of the 13 patients had low back pain. Seven (53.8%) of the 13 patients had lumbar spinal canal stenosis. Three (23.1%) patients had motor deficiency, and 7 (53.8%) patients had sensory deficiency. The time between the occurrence of the patients' complaints and the presentation of the patients to the clinic varied from 2 wk to 2 mo.

In all cases, the patients were first treated with conservative (rest) treatment and NSAIDs. Two (15.4%) of the 13 patients who had severe back pain took part in a physical therapy and rehabilitation program. One (7.7%) of the 13 patients who was followed up had a history of lumbar surgery.

On noncontrast MRI, SSCs were detected as cystic lesions associated with the facet joint in all 13 patients. The SCCs appeared as isointense on T1W images and hyperintense on T2W images. Contrast-enhanced MRI examinations showed mild-to-moderate contrast enhancement in the cystic wall, without any soft or bone tissue involvement. In the radiological follow-up, the size of the cyst and/or contrast enhancement decreased in 9 (69.2%) patients. Parallel to the radiological improvement, a clinical improvement was observed in these nine patients. One female (7.7%) patient underwent surgery, as the conservative treatment provided no benefit (Table I). This patient had leg pain, progressive motor deficits, and a lumbar disc hernia. In this patient, microdiscectomy and synovial cyst excision were performed (Figure 2A-F).

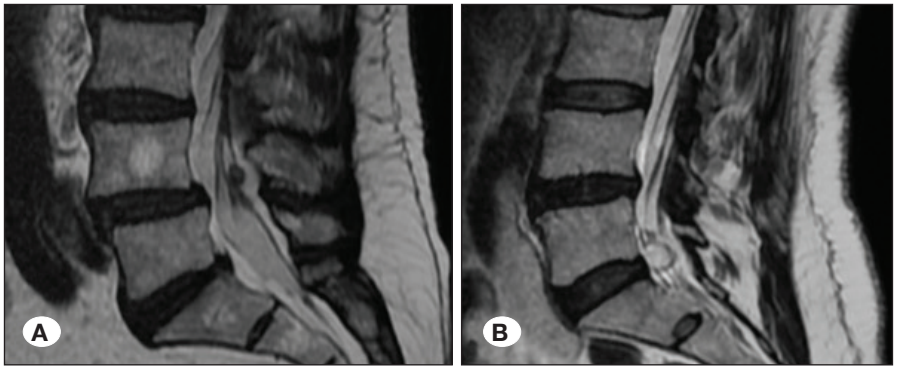

Figure 1: A) L 4-5 spondylolisthesis and spinal synovial cyst, Sagittal T2 Weighted Lumbar Spinal MRI. **B)** L5-S1 spinal synovial cyst, Sagittal T2 Weighted Lumbar Spinal MRI.

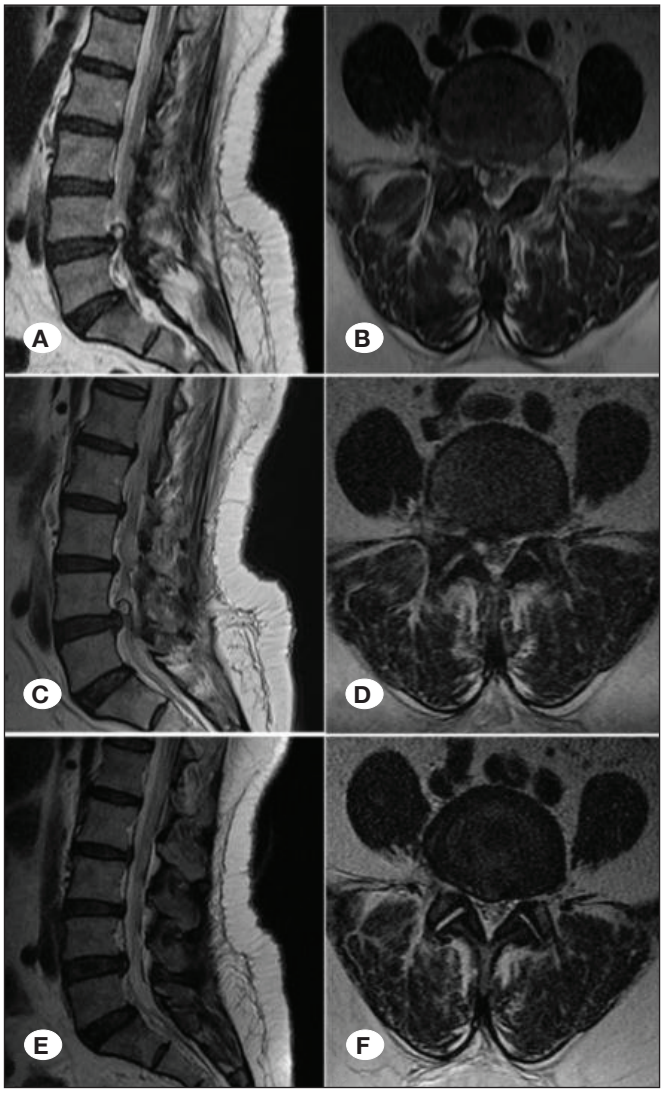

Figure 2: 58 years old female patient with right sided L4-5 spinal synovial cyst, admitted with back and right leg pain, hypoesthesia and 2/5 motor deficit at the right side, Sagittal and axial T2 weighted Lumbar Spinal MR images. **A, B)** At the time of hospital admission **C, D)** 2nd month control, radiologic regression of cyst dimension on axial image **E, F)** 18th month control, radiological spontaneous complete resolution of cyst both on axial and sagittal images.

Table I: Patient Demographics

Patient Characteristic	Value
Gender (M/F)	8/5
Mean age (± SD)	58.4
Level of cyst (n/N [%])	
L3-4	1/13 (7.7)
L4-5	11/13 (84.6)
L5-S1	1/13 (7.7)
Clinical symptoms n/N [%])	
Radicular pain	10/13 (76.9)
Low backpain	3/13 (23.1)
Lumbar canal stenosis	7/13 (53.8)
Lumbar listhesis	7/13 (53.8)
Motor deficit	3/13 (23.1)
Sensory deficit	7/13 (53.8)
Conservative treatment(rest)	13/13 (100)
Surgical treatment (Female)	1/13 (7.7)
Physical therapy and rehabilitation therapy	2/13 (15.45)
Conservative treatment -NSAID therapy	13/13 (100)
Operation history	1/13 (7.7)
Radiologic regression and clinic recovery	9/13 (69.2)
Spontaneous complete resolution	3/13 (23.1)
Spontaneous complete resolution duration	3-24 month

At the radiological follow-up, complete resolution was detected in 3 (23.1%) patients (Figure 3A-F). The time to spontaneous complete resolution varied from 3 to 24 mo (Table II).

DISCUSSION

SSCs are synovium-coated cysts containing clear or xanthochromic fluid and connected to the facet joint capsule. The prevalence of SSCs is not known, although in one study they were detected in 2.3% of patients with low back pain and radicular pain (24). In SCCs, epidural enlargement of the

Table II: Motor Deficit, Sensor Deficit and VAS Scores of the Patient Pre and Post Treatment

Patient No	Age	Sex	Motor Deficit		Sensor Deficit	VAS Score (1-10)	
			Pre	Post	Level*	Pre	Post
1	54	M	-	-	L4-L5 / Left	5	1
2	83	F	4/5	5/5	L4-L5 / Right	6	2
3	64	M	-	-	L4-L5 / Right	8	4
4	57	M	-	-	-	7	3
5	60	M	4/5	5/5	-	5	4
6	53	F	-	-	-	6	3
7	40	F	-	-	-	6	4
8	54	M	-	-	L4-L5 / Left	7	3
9	58	F	2/5	4/5	L4-L5 / Right	8	2
10	47	F	-	-	L4-L5 / Right	5	3
11	62	M	-	-	-	4	2
12	56	M	-	-	-	6	3
13	71	F	-	-	L4-L5 / Left	5	3

**All patients have hypoesthesia.*

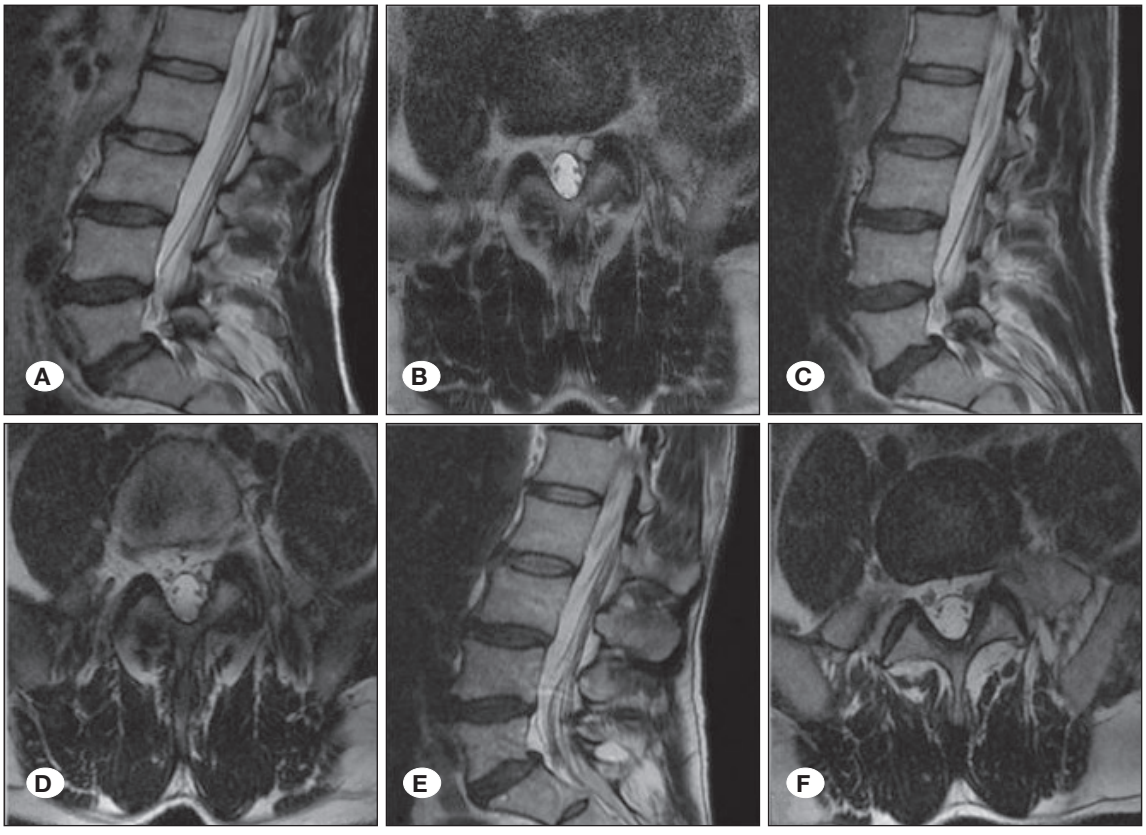

Figure 3: 54 years old male patient with left sided L5-S1 spinal synovial cyst, admitted with back and left leg pain, hypoesthesia at the left side, without motor deficit, Sagittal and axial T2 weighted Lumbar Spinal MR images. **A, B)** At the time of hospital admission **C, D)** 2nd month control, radiologic regression of cyst dimension both on axial and sagittal images **E, F)** 6th month control, radiological spontaneous complete resolution of cyst both on axial and sagittal images.

cysts toward the spinal canal and neural foramen can cause compression of neural structures and lead to radicular pain and neurological deficits.

Some studies reported that synovial cysts were relatively common in female patients (11-16). In our study, SSCs were more common in male (61%) patients, similar to the findings of other studies (4,24). In terms of patient age, many previous studies reported that most SSC patients were in their sixth or seventh decade (24,31,34). In parallel with the literature, most of the patients in our study (46.2%) were in their sixth decade, and the mean age was 58.4 y. Most synovial cysts in the lumbar spine appear at the L4–L5 level because of the maximum mobility of this point and increased degenerative spondylosis induced by mobility (21,31). In our study, in accordance with the literature, most of the SSCs (84.6%) were at the L4-5 level. Considering the literature on the association of lumbar spondylosis and listhesis (6,7,24,28,30), in our study, both spondylolisthesis and an accompanying narrow canal (53.8%) were observed at the L4-5 level in more than half the cases.

Mansilla et al. reported that patients' complaints varied, depending on the location and size of the SSC (25). In their study, the most common finding was low back pain (100%), followed by radiculopathy (77%) and motor and/or sensory impairment (15%). Conversely, in our study, radiculopathy (76.9%) was the most common complaint, and lumbar back pain was less common. This can be explained by the relatively late admission times of the patients to our clinic, given the onset of symptoms. In our study, 23.1% of patients had motor deficits, and more than half the patients (53.8%) had sensory deficits.

Recently, advances in imaging techniques, especially CT and MRI, have led to increased detection and reporting of SCCs. MRI provides more information than CT about soft tissue and connective tissue, with sensitivity up to 95% (Figure 4A-F). In addition, the multiplane and high-resolution features of MRI allow documentation of different configurations, three-dimensional appearance of facet joints, their connection with synovia, and the nature of cysts (14,28,38). Technological developments and preoperative three-dimensional planning mean that various treatment options, such as percutaneous steroid injections, endoscopic resection, and surgical treatment, are now possible. However, a conservative approach is still the first-line treatment option. Conservative treatment methods for SCCs include bed rest and analgesics. According to the literature, a conservative treatment approach is recommended for patients with low back pain and no motor deficits. In our study, bed rest was recommended to all our patients, and NSAIDs were prescribed. Two (15.4%) patients took part in a physical therapy and rehabilitation treatment program, in both cases at the request of the patients themselves. In our study, conservative treatment with bed rest

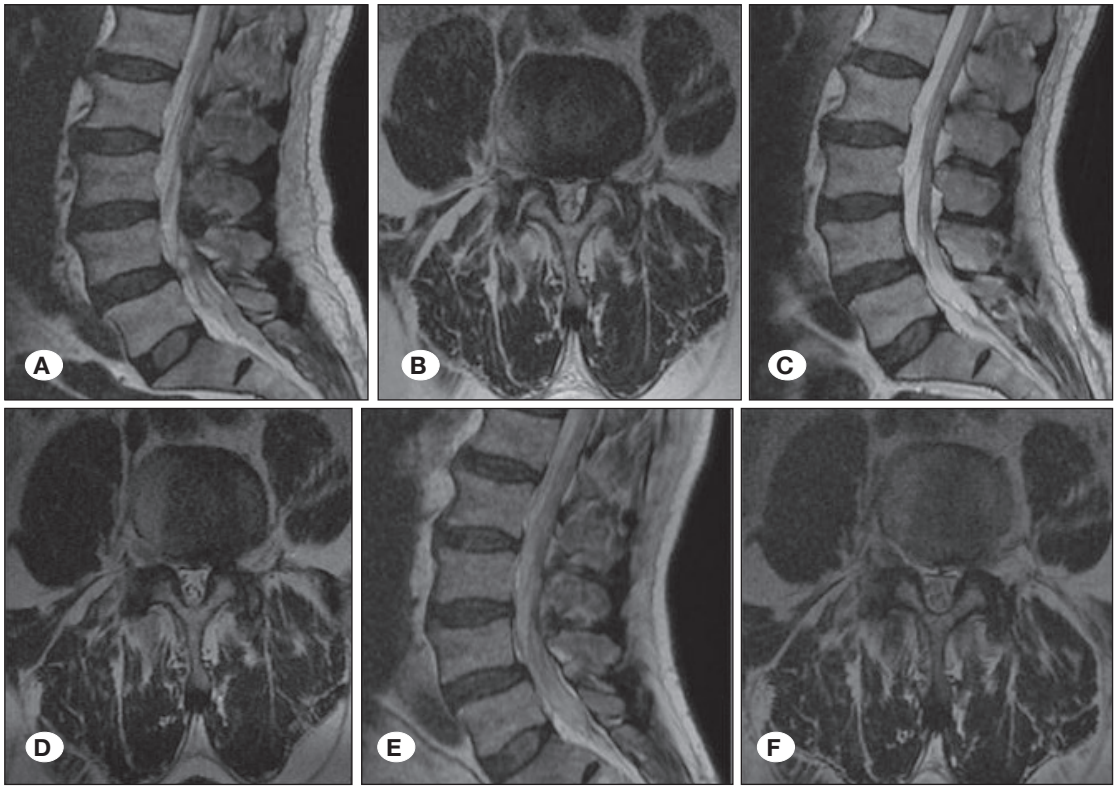

Figure 4: 71 years old male patient with left sided L4-5 spinal synovial cyst, admitted with back and left leg pain, hypoesthesia at the left side, without motor deficit, Sagittal and axial T2 weighted Lumbar Spinal MR images. **A, B)** At the time of hospital admission **C, D)** 10th month control, radiological spontaneous complete resolution of cyst both on axial and sagittal images **E, F)** 36th month late period control.

and NSAIDs were highly effective (92.3%) for the treatment of symptomatic SSCs. This finding was in accordance with that of many other studies (5,9,26,27,29,33).

During long-term follow-up (2–4 y) of our patients, spontaneous regression, such as a reduction in the cyst's dimension and a decrease in contrast enhancement, was noted on radiological imaging, accompanied by clinical improvements in low back pain and radiculopathy. This finding is important, as it confirms the effectiveness of conservative treatment. However, in the literature, there is no consensus on the role of conservative versus surgical treatment for SCCs. According to some studies, conservative treatment was not effective for SSCs. These studies suggested that only surgical interventions were successful for treating SSC. Some studies recommended surgical treatment for patients with radicular pain and progressive motor deficits (16,36). In a study by Shah et al. that included 10 patients, nine patients with radicular pain whose complaints did not improve following conservative treatment were treated surgically. Therefore, the effectiveness of surgical treatment was emphasized (32-34). According to some studies, percutaneous steroid injections were more successful methods than others (3,10,12). However, many other studies concluded that endoscopic resection was the most successful method (4,8,13,22,31,35). Among these three methods, there are other studies claiming that surgical resection is the most successful one for SSC treatment (2,15,23,31,34). In our study, only one of the 13 patients was managed surgically. This was a female patient with low back pain, intractable radicular pain, and progressive motor neurological deficits. After the surgical treatment, the patient's low back and leg pain improved. There was also some improvement in motor deficits.

In the literature, spontaneous complete resolution of symptomatic lumbosacral SC has been rarely reported. Factors that contribute to spontaneous complete resolution are thought to include extrusion of the cystic content, absorption of the cyst, and changes in local forces that initially lead to synovial walls. Spontaneous complete resolution has been reported more frequently in females than in males. Spontaneous complete resolution of a synovial cyst was also been reported in a long-term clinical follow-up study (33). In our study, the patients were followed for between 2 and 4 y. Spontaneous complete resolution was observed in the radiological follow-up of two male patients and one female patient. In the same patients, improvements in radicular pain and low back pain were detected at the clinical follow-up at 3–24 mo. Motor and sensory deficits were not detected in the clinical follow-up of these three cases (Figure 1A, B).

In our study, conservative treatment, supported by clinical and radiological follow-up, was a highly effective approach to symptomatic SCC patients. Given the possibility of spontaneous complete resolution of cysts during follow-up, we recommend a conservative approach as first-line treatment for patients with low back pain, radiculopathy, and nonprogressive neurological deficits. Invasive procedures should be reserved for patients with intractable radicular pain and progressive neurological deficits, despite conservative treatment.

Limitations

The small number of patients was a limitation of this retrospective, observational study. As the collected data were evaluated retrospectively, some patients who had very small synovial cysts might have been missed and not included in the study.

CONCLUSION

The symptomatic lumbosacral synovial cyst treatment algorithm has not been fully demonstrated. Invasive or surgical treatment options may be appropriate for patients with intractable radicular pain and progressive neurological deficits who do not respond to conservative treatment. However, as demonstrated in our series, spontaneous complete resolution of cysts and the effectiveness of conservative treatment in symptomatic patients should not be underestimated. Thus, we advocate that immediate invasive procedures should be postponed.

REFERENCES

1. Baker WM: On the formation of synovial cysts in the leg in connection with disease of the knee-joint. 1877. Clin Orthop Relat Res (299):2-10, 1994
2. Bruder M, Cattani A, Gessler F, Droste C, Setzer M, Seifert V, Marquardt G: Synovial cysts of the spine: Long-term follow-up after surgical treatment of 141 cases in a single-center series and comprehensive literature review of 2900 degenerative spinal cysts. J Neurosurg Spine 27(3):256-267, 2017
3. Campbell RJ, Mobbs RJ, Rao PJ, Phan K: Interventions for lumbar synovial facet joint cysts: A comparison of percutaneous, surgical decompression and fusion approaches. World Neurosurg 98:492-502, 2017
4. Chazen JL, Leeman K, Singh JR, Schweitzer A: Percutaneous CT-guided facet joint synovial cyst rupture: Success with refractory cases and technical considerations. Clin Imaging 49:7-11, 2018
5. Delen E, Tutunculer B, Akinci AT, Kunduracilar M: Spontaneous regression of a symptomatic lumbar facet synovial cyst in one month. Sch J App Med Sci 3(3):1587-1589, 2015
6. Doyle AJ, Merrilees M: Synovial cysts of the lumbar facet joints in a symptomatic population: Prevalence on magnetic resonance imaging. Spine 29(8):874-878, 2004
7. El Shazly AA, Khattab MF: Surgical excision of a Juxtafacet cyst in the lumbar spine: A report of thirteen cases with long-term follow up. Asian J Neurosurg 6(2):78-82, 2011
8. Eshraghi Y, Desai V, Cajigal CC, Tabbaa K: Outcome of percutaneous lumbar synovial cyst rupture in patients with lumbar radiculopathy. Pain Physician 19(7):1019-1025, 2016
9. Ewald C, Kalff R: Resolution of a synovial cyst of the lumbar spine without surgical therapy - a case report. Zentralbl Neurochir 66(3):147-151, 2005
10. Fletcher-Sandersjöö A, Edström E, Kuntze Söderqvist Å, Grane P, Elmi-Terander A: Long-term pain relief following percutaneous steroid treatment of spinal synovial cysts: A population-based cohort study. J Neurointerv Surg 12(9):874-878, 2020

11. Ganau M, Ennas F, Bellisano G, Ganau L, Ambu R, Faa G, Maleci A: Synovial cysts of the lumbar spine – pathological considerations and surgical strategy. Neurol Med Chir 53(2):95-102, 2013
12. Haider SJ, Na NR, Eskey CJ, Fried JG, Ring NY, Bao MH, Pastel DA: Symptomatic lumbar facet synovial cysts: Clinical outcomes following percutaneous CT-guided cyst rupture with intra-articular steroid injection. J Vasc Interv Radiol 28:1083-1089, 2017
13. Hellinger S, Lewandrowski KU: Clinical outcomes with endoscopic resection of lumbar extradural cysts. J Spine Surg 6(1):133-144, 2020
14. Hemminghytt S, Daniels DL, Williams AL, Haughton VM: Intraspinal synovial cysts: Natural history and diagnosis by CT. Radiology 145(2):375-376, 1982
15. Hohenberger C, Brawanski A, Ullrich OW, Höhne J, Zeman F, Schebesch KM: Degenerative symptomatic spinal synovial cysts: Clinical presentation and functional outcome. J Clin Neurosci 3(62):112-116, 2019
16. Hsu KY, Zucherman JF, Shea WJ, Jeffrey RA: Lumbar intraspinal synovial and ganglion cysts (facet cysts). Ten-year experience in evaluation and treatment. Spine 20(1):80-89, 1995
17. Indar R, Tsiridis E, Morgan M, Aldham CH, Hussein AA: Intraspinal lumbar synovial cysts: Diagnosis and surgical management. Surgeon 2(3):141-144,2004
18. Jackson DE Jr, Atlas SW, Mani JR, Norman D: Intraspinal synovial cysts: MR imaging. Radiology 170(2):527-530, 1989
19. Kao CC, Uihlein A, Bickel WH, Soule EH: Lumbar intraspinal extradural ganglion cyst. J Neurosurg 29(2):168-172, 1968
20. Kao CC, Winkler SS, Turner JH: Synovial cyst of spinal facet. Case report. J Neurosurg 41(3):372-376, 1974
21. Khan AM, Synnot K, Cammisa FP, Girardi FP: Lumbar synovial cysts of the spine: An evaluation of surgical outcome. J Spinal Disord Tech 18(2):127-131, 2005
22. Kim KH, Kim SY, Ok HG, Kim TK: A staged treatment of symptomatic lumbar intraspinal synovial cysts. Pain Physician 22(5):451-456, 2019
23. Klessinger S: The incidence of dural tears after complete resection of lumbar synovial cysts and the relation to the outcome. Clin Neurol Neurosurg 144:14-19, 2016
24. Lyons MK, Atkinson JL, Wharen RE, Deen HG, Zimmerman RS, Lemens SM: Surgical evaluation and management of lumbar synovial cysts: The Mayo Clinic experience. J Neurosurg 93(1):53-57, 2000
25. Mansilla B, Isla A, Pérez-López C, Román-de Aragón M, Zamorano J, Giner J: Spinal sinovial cysts: Surgical treatment and clinical outcomes in a series of 18 cases. Neurocirugia (Astur) 28(2):88-92, 2017
26. Ngo T, Decina P, Hsu W: Spontaneous resolution of symptoms associated with a facet synovial cyst in an adult female - a case report. J Can Chiropr Assoc 57(1):87-92, 2013
27. Nordmann NJ, Michael AP, Espinosa JA: Resolution of symptomatic lumbar synovial cyst after traumatic event. World Neurosurg 128:69-71, 2019
28. Parlier-Cuau C, Wybier M, Nizard R, Champsaur P, Le Hir P, Laredo JD: Symptomatic lumbar facet joint synovial cysts: Clinical assessment of facet joint steroid injection after 1 and 6 months and long-term follow-up in 30 patients. Radiology 210(2):509-513, 1999
29. Pulhorn H, Murphy M: Spontaneous resolution of a symptomatic synovial cyst of the lumbar spine. Br J Neurosurg 26(1):123-124, 2012
30. Salmon B, Martin D, Lenelle J, Stevenaert A: Juxtafacet cyst of the lumbar spine. Clinical, radiological and therapeutic aspects in 28 cases. Acta Neurochir (Wien) 143(2):129-134, 2001
31. Schmid G, Willburger R, Jergas M, Pennekamp W, Bickert U, Köster O: Lumbar intraspinal juxtafacet cysts: MR imaging and CT-arthrography. Rofo 174(10):1247-1252, 2002
32. Shah RV, Lutz GE: Lumbar intraspinal synovial cysts: Conservative management and review of the world's literature. Spine J 3(6):479-488, 2003
33. Sinha P, Panbehchi S, Lee MT, Parekh T, Pal D: Spontaneous resolution of symptomatic lumbar synovial cyst. J Surg Case Rep 10:1-6, 2016
34. Splavski B, Rotim A, Brumini I, Koprek I, Gajski D, Božić B, Rotim K: Lumbar spine synovial cyst: A case series report and review of surgical strategies. Acta Clin Croat 58(3):491-496, 2019
35. Sukkarieh HG, Hitchon PW, Awe O, Noeller J: Minimally invasive resection of lumbar intraspinal synovial cysts via a contralateral approach: Review of 13 cases. J Neurosurg Spine 23:444-450, 2015
36. Trummer M, Flaschka G, Tillich M, Homann CN, Unger F, Eustacchio S: Diagnosis and surgical management of intraspinal synovial cysts: Report of 19 cases. J Neurol Neurosurg Psychiatry 70(1):74-77, 2001
37. Vosschulte K, Börger G: Anatomische und funktionelle Untersuchungen über den Bandscheibenprolaps. Arch. f. klin. Chir 265:329-355,1950
38. Yarde WL, Arnold PM, Kepes JJ, O'Boynick PL, Wilkinson SB, Batnitzky S: Synovial cysts of the lumbar spine: Diagnosis, surgical management, and pathogenesis. Report of eight cases. Surg Neurol 43(5):459-465,1995