

CASE SERIES: MILD® PROCEDURE AS A MINIMALLY INVASIVE OPTION FOR LUMBAR SYNOVIAL CYST DECOMPRESSION

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Background: Lumbar synovial cysts are benign, fluid-filled lesions arising from the facet joints, often associated with degenerative changes and segmental instability. These cysts can cause neurogenic claudication and radiculopathy, significantly limiting mobility and quality of life. While traditional treatments include conservative management, injections, aspiration, and open surgery, each has notable limitations. The Minimally Invasive Lumbar Decompression (MILD®) procedure, originally designed for lumbar stenosis, may offer a less invasive alternative for synovial cyst resection, especially in patients who are poor candidates for extensive surgery.

Case Report: Three patients with symptomatic lumbar synovial cysts refractory to conservative therapy underwent the MILD® procedure. The first, a 68-year-old man with an L4-5 cyst, experienced minimal relief from injections but showed marked improvement in walking and standing tolerance after MILD®, with magnetic resonance imaging (MRI) at one year demonstrating significant cyst reduction and canal restoration. The second, a 73-year-old man with bilateral radiculopathy and an L4-5 cyst, reported substantial functional gains, walking up to one hour at 12 weeks post-procedure. The third, an 80-year-old woman with multifactorial stenosis and a right L4-5 cyst, underwent 2-level MILD® decompression, resulting in improved ambulation and standing capacity at follow-up.

Conclusions: The MILD® procedure is a minimally invasive procedure that was associated with clinical improvement in 3 reported cases of patients with lumbar synovial cysts causing neurogenic claudication or radiculopathy after conservative measures failed. This technique may offer the potential for rapid functional recovery and reduced morbidity, which could be particularly advantageous for older adults or those with comorbidities. While larger studies are needed to better establish its safety and efficacy for this indication, these cases suggest that MILD® may be a potential treatment option for symptomatic lumbar synovial cysts.

Key words: Minimally invasive lumbar decompression (MILD®); lumbar synovial cyst; lumbar spinal stenosis; neurogenic claudication; radiculopathy; facet cyst

BACKGROUND

Lumbar synovial cysts are common, benign fluid-filled sacs that arise from the synovial lining of lumbar zygapophyseal joints (lumbar facet joints). They are typically associated with degenerative spondylosis, segmental instability, or spondylolisthesis (1,2). These cysts frequently pres-

ent with symptoms such as low back pain, radiculopathy and neurogenic claudication, and can significantly impact patients' walking and standing tolerance and quality of life (1,3). Synovial cysts vary in size, in some cases occupying more than 50% of the spinal canal (4,5).

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Traditional treatment modalities for lumbar synovial cysts range from conservative measures including rehabilitation and medical management, epidural steroid injections (interlaminar or transforaminal), facet joint injection with pressurization of the cyst, percutaneous aspiration and surgical intervention including laminectomy, facetectomy and cyst excision (1,3). However, these strategies face significant limitations. Percutaneous aspiration may be performed; however, direct access to the cyst can be challenging, the synovial cyst fluid can be thick, and the cyst may be compartmentalized, leading to unsuccessful treatment. Such treatments are associated with a high recurrence rate. For example, one study found that 30% of patients who underwent synovial cyst aspiration received surgery to resolve recurrent symptoms within 6 months of aspiration (6). Surgery effectively relieves symptoms but is associated with typical surgical and anesthesia risks, soft tissue damage, longer recovery, potential for persistent postoperative pain (i.e., postlaminectomy syndrome), and potential postoperative instability that may necessitate spinal fusion (4,7).

The development of minimally invasive surgical techniques (MIS) has transformed the management of lumbar synovial cysts. MIS approaches include the use of tubular retractors and endoscopic or microscopic assistance to decompress neural elements and remove the cyst with minimal trauma to surrounding structures (1,2,8). These novel techniques have demonstrated reductions in pain and disability, low perioperative complication rates and shorter recovery time when compared to traditional open procedures (1,2,8). Notably, MIS decompression has also proven effective in patients with coexisting low-grade spondylolisthesis, challenging the traditional idea that these cases require routine spinal fusion (1,2).

The minimally invasive lumbar decompression (MILD®) procedure represents further refinement of MIS techniques. Originally developed for lumbar spinal stenosis due to ligamentum flavum hypertrophy, the MILD procedure is an x-ray-guided treatment that involves the percutaneous removal of biopsy-sized portions of bone and ligamentum flavum through a 5 mm incision and tubular access, thereby decompressing the spinal canal (9). Due to its minimally invasive nature, the procedure allows for rapid recovery, outpatient treatment and preservation of future surgical options, making it an optimal treatment for spinal stenosis. Since the location of the synovial cyst is often accessible with the MILD instrumentation, the

same procedural technique could be utilized to decompress the central canal due to a synovial cyst arising from the adjacent facet joint. Therefore, this may be an ideal treatment for synovial cyst resection in younger or older adults when less aggressive treatments such as physical therapy, medical management, and epidural injection have failed. Given the simplicity of the procedure and tolerability in all ages, it could be particularly helpful to the elderly population who may not be ideal candidates for more extensive surgeries (10).

In this case series, procedures were performed under fluoroscopic guidance with monitored anesthesia care. The facet joint harboring the synovial cyst was accessed with a spinal needle, and intraarticular contrast was injected to opacify the joint and its communicating cyst. This rendered the cyst visible under live fluoroscopy and established the target for decompression. Standard MILD® access was then obtained through a dorsal approach at the affected level, with epidural portal placement confirmed on anteroposterior and lateral imaging. Using the MILD® tissue-sculpting rongeur, the hypertrophic ligamentum flavum and the contrast-opacified cyst were debulked with serial (multiple) bites, with the instrument directed toward the region highlighted by the intraarticular contrast. Incremental tissue removal was continued until the previously opacified cyst was no longer visualized and repeat contrast injected into the facet joint flowed freely across the joint into the epidural space, confirming disruption of the cyst wall and communication with the decompressed segment.

While the MILD® procedure has previously been studied in the context of neurogenic claudication with a low complication profile, its role in decompression of neural structures affected by synovial cysts remains underexplored. This case series explores the utility of the MILD procedure as a minimally invasive option for achieving functional recovery in select patients with lumbar synovial cysts (10,11).

CASE SERIES

Patient 1

The patient is a 68-year-old man with a history of hypertension and anxiety who presented with a one-year history of bilateral buttock pain radiating down the left leg. Pain levels fluctuated between 3/10 and 7/10 using the Visual Analog Scale (VAS) and worsened with walking or standing. He had undergone 8 weeks of physical therapy, nonsteroidal anti-inflammatory drugs

(NSAIDs), rest, and activity modification with minimal improvement. His walking tolerance was 5 minutes, and standing tolerance was 10 minutes.

Magnetic resonance imaging (MRI) of the lumbar spine demonstrated lumbar spondylosis, most pronounced at L4-5, where there was a central/left paracentral disc extrusion with a 1.3 cm inferior sequestered disc fragment and an 8 mm medially projecting synovial cyst associated with the left L4-5 facet joint. These findings contributed to moderate-to-severe spinal canal stenosis and moderate bilateral neural foraminal stenosis, likely causing impingement on the descending L5 nerve roots (left greater than right). Additionally, there was contact of the exiting L5 nerve roots (right greater than left) due to neural foraminal stenosis at L5-S1 (Fig. 1). Physical exam revealed a positive left-sided straight leg raise and an antalgic gait, with preserved strength and sensation.

One month later, an L4-5 paramedian epidural steroid injection with 4 mg of dexamethasone was performed under fluoroscopic guidance. The patient experienced 80% relief during the first week; however, symptoms returned to baseline, rendering him unable to work. One month later, a second injection was performed to rupture the synovial cyst at the left L4-5 zygapophyseal joint. After placing the needle into the facet joint and confirming placement with contrast, the facet joint was pressurized with additional contrast-saline mix. A loss of resistance was noted and spread of contrast into the epidural space was observed, believed to represent cyst membrane rupture. An additional 3 mL of saline

was injected, followed by an epidural steroid injection with 4 mg of dexamethasone and 1 mL of normal saline.

Two weeks after this procedure, the patient noticed only mild improvement, with pain rated 6/10 and continued limitations in walking and standing. A minimally invasive synovial cyst resection using MILD® instrumentation was discussed, and the patient elected to proceed. The procedure was performed under monitored anesthesia care using standard technique. The left L4-5 synovial cyst was highlighted via intraarticular facet contrast injection to assist with visual targeting and decompression.

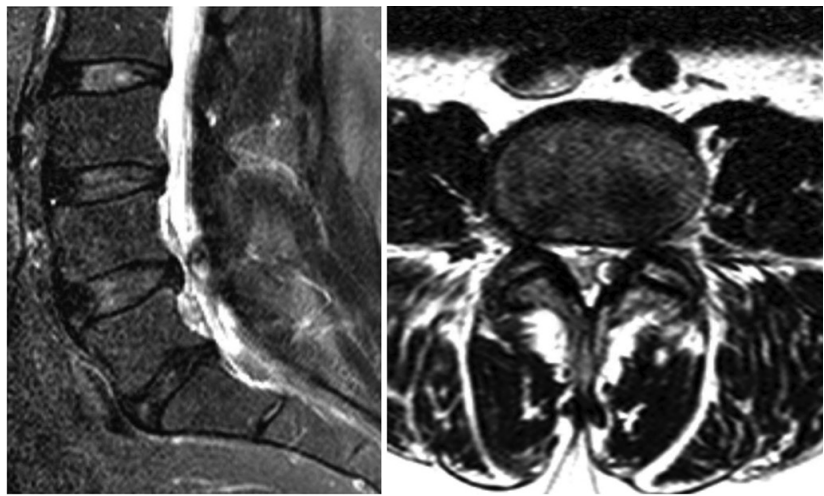


Fig. 1. Left L4-5 synovial cyst with central canal narrowing and right leg neurogenic claudication. MRI was obtained prior to MILD® procedure.

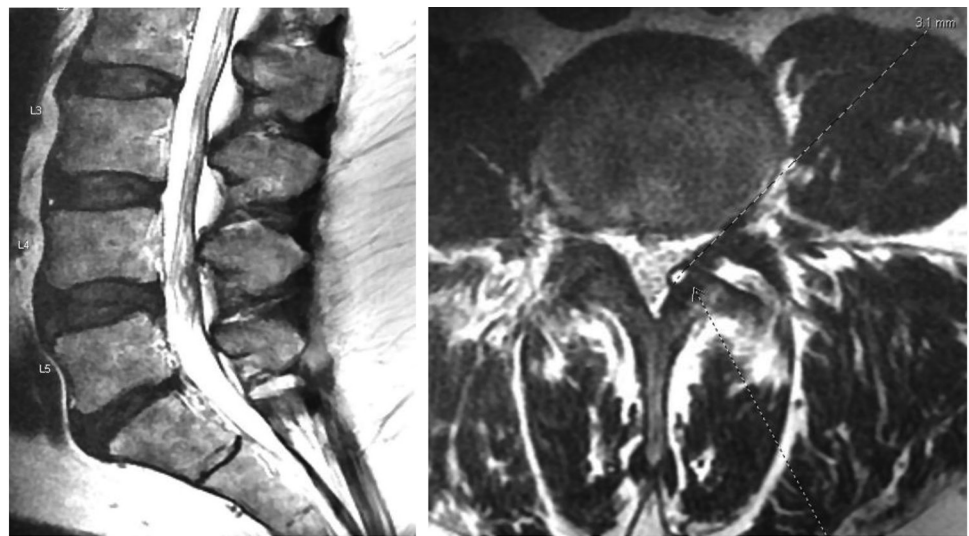


Fig. 2. Post-MILD® axial and sagittal view of the L4-5 synovial cyst at demonstrating marked reduction in cyst size with restoration of central canal patency

At 2-week follow-up after the MILD decompression, the patient's walking and standing tolerance increased to 25 minutes. At 6 weeks, he reported walking up to 30 minutes (half a mile) and standing for 30 minutes. At 12 weeks postoperatively, he could walk for 40 minutes continuously with no standing limitation. Approximately one year after the MILD® procedure, a follow-up lumbar MRI (ordered by another physician) revealed a significant reduction in the size of the synovial cyst and restoration of canal dimensions (Fig. 2). Of note, the patient also had a 1.3-cm inferiorly sequestered disc fragment; therefore, the central canal stenosis and symptoms were likely multifactorial, and the relative contributions of the synovial cyst and disc fragment cannot be determined. Although the patient experienced substantial improvement after MILD® decompression and follow-up MRI demonstrated marked reduction of the synovial cyst with restoration of canal patency, these findings support—but do not definitively establish—the cyst as a major contributor to his presenting symptoms.

Patient 2

A 73-year-old man with a history of bilateral hip osteoarthritis presented with radicular pain radiating down both lower extremities, more pronounced on the right side. His walking and standing tolerance were limited to 10 minutes. The pain persisted despite acupuncture, chiropractic care, NSAIDs, and physical therapy.

MRI of the lumbar spine revealed an L4-5 symmetric disc bulge, moderate facet and ligamentum flavum hypertrophy, and prominent posterior epidural fat, resulting in severe spinal canal stenosis. No significant foraminal narrowing was noted. A T2 hyperintensity related to the left facet joint was consistent with a synovial cyst. At L5-S1, there was moderate bilateral facet hypertrophy with cystic changes and ligamentum flavum hypertrophy, more prominent on the right, but the foramina remained patent.

Two months later, the patient underwent an L5-S1 interlaminar epidural steroid injection with dexamethasone, which was uncomplicated but did not relieve symptoms. Given the severity and persistence of his symptoms, a MILD® procedure targeting the ligamentum flavum and L4-5 synovial cyst was performed under monitored anesthesia care using standard technique. The cyst was enhanced via intra-articular facet contrast injection for visual guidance during decompression. A post-procedure epidurogram demonstrated improved contrast flow at the previously stenotic segments.

At the 2-week follow-up, the patient's walking tolerance increased to 40 minutes, and standing tolerance improved to 15 minutes. At 6 weeks, he was able to walk for one hour and stand for 30 minutes. At 12 weeks postoperatively, he maintained these improvements with the ability to walk for one hour and stand for 30 minutes.

Patient 3

An 80-year-old woman with a history of cervical spinal stenosis, stroke, and ulcerative colitis presented with anteriorly radiating right lower extremity symptoms. MRI showed severe spinal stenosis at L3-4 and moderate stenosis at L4-5, with ligamentum flavum infolding at both levels. A 5.79 mm synovial cyst was identified at the right L4-5 facet joint.

Despite physical therapy, NSAIDs, and an epidural injection, her walking was limited to 30 minutes and standing to 15 minutes—less than desired. MILD® decompression was recommended at both right L3-4 and L4-5 to address multifactorial stenosis involving ligamentum flavum thickening and the synovial cyst.

The procedure was performed under monitored anesthesia care using standard technique. The right L4-5 synovial cyst was highlighted using intra-articular facet contrast, and the posterior epidural space was visualized using an epidurogram. A 2-level decompression was performed. Post-decompression imaging showed improved epidural flow.

At 2 weeks postoperatively, the patient tolerated walking for 30 minutes and standing for 15 minutes. By 6 weeks, her tolerance improved to 45 minutes of walking and 60 minutes of standing. It is noteworthy that she began physical therapy at this time due to trochanteric bursitis. At 12 weeks, she was able to walk and stand for 60 minutes each.

DISCUSSION

The MILD® procedure is a minimally invasive lumbar decompression technique that may shift the current treatment paradigm for managing symptomatic lumbar synovial cysts. Historically, symptoms related to synovial cysts—such as radiculopathy and neurogenic claudication—have been managed conservatively with physical therapy, medications, epidural steroid injections, facet pressurization, or cyst aspiration. While open surgical options, including standalone decompression or decompression with fusion, have demonstrated efficacy, they are associated with increased perioperative

risk and may be less suitable for elderly patients with comorbidities (12).

Recent evidence suggests that ultra-minimally invasive procedures such as the MILD® technique offer favorable functional recovery and a low complication profile in lumbar spinal stenosis, prompting a reconsideration of current treatment algorithms (9,13).

This case series presents 3 patients with lumbar spinal stenosis in whom synovial cysts were a major contributing factor to spinal canal narrowing, resulting in radiculopathy or neurogenic claudication with impaired walking and standing tolerance. Each patient underwent the MILD® procedure after failure of conservative management, including epidural steroid injections and/or facet pressurization. All patients demonstrated early functional improvement in walking and standing tolerance as early as 2 weeks postprocedure, with continued improvement observed at 6- and 12-week follow-up intervals.

In real-world spine practice, routine post-intervention MRI is uncommon in patients who demonstrate significant clinical improvement and is frequently not reimbursed by insurance providers. Accordingly, systematic post-treatment imaging was not routinely obtained in this series. However, in one case, preprocedure and postprocedure MRI obtained as part of an unrelated clinical workup demonstrated a substantial reduction in synovial cyst size following the MILD® procedure (Figs. 1 and 2). Despite the absence of routine post-treatment imaging, the preliminary clinical outcomes in this series are notable, with near-complete resolution of neurogenic claudication observed in all cases in which synovial cysts were the primary contributors to spinal canal stenosis.

Based on these favorable outcomes, we propose the integration of the MILD® procedure into the treatment algorithm for symptomatic lumbar stenosis secondary to synovial cysts, particularly when imaging confirms focal neural compression and symptoms persist beyond 12 weeks of conservative therapy. While open decompression—with or without fusion—offers the lowest reported recurrence rates, it also poses the highest surgical morbidity. Decompression without fusion is less invasive, but recurrence rates vary widely, with reported rates ranging from 0% to 33% (14). The

MILD® procedure offers an intermediate, less invasive, cost-effective option that can precede consideration of open decompression.

In a 2-year follow-up study of the MILD® procedure, results showed no evidence of spinal instability, a reoperation rate of 5.6%, and an adverse event rate of 1.3% (10). These findings highlight its potential for high patient satisfaction, faster recovery, and reduced procedural risk compared to traditional surgery. Furthermore, minimally invasive surgical approaches have been found to significantly reduce hospital stay duration and complications such as intraoperative bleeding, making these options especially attractive for patients with multiple comorbidities (15). While appropriate for adults of all ages, this technique may be particularly well suited for older individuals or those seeking less invasive alternatives to conventional spinal surgery.

Apart from one patient who underwent postoperative MRI, a limitation of this case series is the absence of routine postprocedural confirmation of synovial cyst rupture via MRI or computed tomography and reliance on patient-reported outcomes to gauge treatment success. A valid critique is that symptom improvement could be attributed primarily to ligamentum flavum debulking rather than cyst rupture. Future research should incorporate standardized postoperative imaging protocols to verify cyst resolution and restoration of spinal canal patency.

CONCLUSIONS

We propose that the MILD® procedure be considered within the treatment algorithm for radiculopathy or neurogenic claudication when a synovial cyst is identified as the primary or major contributor to lumbar spinal canal stenosis. As a minimally invasive intermediate intervention, MILD® may offer reduced morbidity, faster return to function, and improved quality of life while avoiding the risks of open surgery and general anesthesia. Although suitable for adults of all ages, this approach may be particularly advantageous for older patients with significant comorbidities. As this is an off-label application supported by a limited case series, larger prospective studies are needed to confirm its safety and efficacy for this indication.

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