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Review Article

Perspective: Operate on lumbar synovial cysts and avoid ineffective percutaneous techniques

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ABSTRACT

Background: Lumbar synovial cysts (LSC), best diagnosed on MR studies, may cause symptoms/signs ranging from unilateral radiculopathy to cauda equina compressive syndromes. Attempts at percutaneous treatment of LSC typically fail. Rather, greater safety/efficacy is associated with direct surgical resection with/without fusion.

Methods: Treatment of LSC with percutaneous techniques, including cyst aspiration/perforation, injection (i.e., with/without steroids, saline/other), dilatation, and/or disruption/bursting, classically fail. This is because LSCs' tough, thickened, and adherent fibrous capsules cause extensive thecal sac/nerve root compression, and contain minimal central "fluid" (i.e., "crank-case" and non-aspirable). Multiple percutaneous attempts at decompression, therefore, typically cause several needle puncture sites risking dural tears (DT)/cerebrospinal fluid (CSF) leaks, direct root injuries, failure to decompress the thecal sac/nerve roots, infections, hematomas, and over the longer-term, adhesive arachnoiditis.

Results: Alternatively, many studies document the success of direct or even partial resection of LSC (i.e., partial removal with marked cyst/dural adhesions with shrinking down the remnant of capsular tissue). Surgical decompressions of LSC, ranging from focal laminotomies to laminectomies, may or may not warrant additional fusions.

Conclusions: Symptomatic LSC are best managed with direct or even partial operative resection/decompression with/without fusion. The use of varying percutaneous techniques classically fails, and increases multiple perioperative risks.

Keywords: Lumbar, Synovial Cysts: Operative Management, Avoid Cyst Aspiration, Failure Percutaneous Treatment, Adverse Events, Cyst Perforation, Cyst Disruption, Bursting, Lumbar Decompression, Fusion

INTRODUCTION

Lumbar synovial cysts (LSC), best diagnosed on MR studies, may cause symptoms ranging from unilateral radiculopathy to cauda equina syndromes/compression [Table 1].[1-16] Typically, attempts at percutaneous cyst aspiration, injection (i.e. with/without steroids/other), dilatation, and/or disruption typically fail. Further, these procedures risk producing; multiple dural tears (DT)/persistent CSF leaks, direct nerve root injuries, inadequate decompression of the thecal sac/nerve roots, infections, hematomas, and over the longer-term, adhesive arachnoiditis. Rather, here we reviewed how direct or partial (i.e., with LSC capsular/dural adhesions leaving a small

Table 1: Lumbar Synovial Cysts: Demographics, Diagnostic Studies, and Management.

Author [Ref.] Journal Year	Study Design	Results	Results	Results	Conclusions Outcomes
Bureau[2] **Radiology 2001**	12 LSC Percut Rx Steroid Injection+Distension	Clinical and Imaging F/O-Correlate Post Percut Rx	12 Pts: 4 M, 8 F, Avg Age 60 (Rg 45-79)	Percut Injection+Distention 9 Excellent 2 Partial Reduction 1 Same	Failed 3 1 Short Relief 2 Same 25% Failure Rate Percut Steroids
Epstein[3] **J Spinal Disord Tech 2004**	Etiology SC Disruption FJ Leads to DS 40% Pts	Preop Symp LBP, Rad INC	Surgery Dec +/- Fus Avg Age 60's M/F 2:1 to 1:1	Descending Frequency of DS Local L45, L5S1, l34, L23	Surg Unilat or Bil Laminotomy HemiLam Lam +/- Fus Non-Instr vs Instr SF-36 Results
Epstein[4] **Spine 2004**	Outcomes SF-36 Outcomes-Olisthy LSC SpSt (45 Pts) or LSC/SpSt/DS (35 Pts)	LSC/SpSt vs. LSC/SpSt/DS LBP 40-33 Rad 43-33 INC 41-26	Surg Avg LSC/SpSt vs LSC/SpSt/DS Lam 3.8 – 3.5 Outcomes at 2 Postop yrs	Postop 5/45 LSC/SpSt New DS 11/35 LSC/SpSt/DS Increase Gr I-Gr II Olisthy	LSC/SpSt vs LSC/SpSt/DS SF-36 Imp Physical Fx+44 vs. +38 Consider Primary Fusion
Epstein[5] **Surg Neurol Int 2012**	SC Surg vs Cyst Asp Symp Unil or Bil RAD, CES-Best Outcomes Surg Not SC Asp	Anatomy Cystic Dilatation SS Extruded from FJ Into Canal	Dis FJ Instability Compromise Cephalad Caudad Nerve Roots	SC Aspi Failure Rate 50-100% Under Fluoro or CT	Treatment Dec +/- Fus Resolved LBP 91.6-92.5% Rad Pain 91.1 – 91.90%
Scholz[15] **Clin Neurol Neurosurg 2015**	Incomplete Resect L SC Risk Recur 148 Pts MicroS CS Removal 2000-2011	Typical Adhesions SC to Dura/Risk Dural Tears F/O 1 yr Minimum	8 (5.4%) Incomplete Removal-Dural Adhesion/Risk DT-No Reop	Incomplete Resection in 8 Pt-Adequate Outcomes	Adhesions L SC 8 (5.4%) Incomplete Resections Adequate Outcomes
Epstein[6] **Surg Neurol Int 2015**	DT 3-27% 336 Avg l 4.7Level Lumbar Lam 1.4 Level NonInstrF	2005-2015 DT/CSFF 7 ESI 6 L SC 5 OYL 3 Postop Scar 3 Tumors	CSFF 24 (7.14%) of 336 Cases	Minus 7 ESI+3 Tumors Risk of CSFF 4.2%	CSFF 7.14% of 336 Lumbar Lam+NonInstrF Note 6 Due to LSC
Eshraghi[8] **Pain Physician 2016**	Outcome Percut LSC Rupture for Rad30 Pts 2006-2013 Mod/Severe LBP, Rad Ages 42-80 F/O 6-24 mos	Literature Success Surgery LSC Lam +/= Fus 83.5% Here Percut Fluoro Guided L SC Rupture LSC	Pain Relieve >6 mos at 14/30 (46% pts) 1-6 mos Pain relief 7/30 Pts	9 (30%) Recurrent SC Need Repeat Rupture 6 (20%) Surgery Avg Pain 71.2% Imp Postop	80% Avoided Surgery Percut Rupture Risks Cyst Expansion Fail to Rupture Risk Neural Compress
Epstein[7] **Surg Neurol Int 2016**	Low Reop Rates 336 Multilevel L Lam+NonInstrF	336 Pts Avg 66.5 yrs old-Avg 4.7 Level Lam	SpSt 336 195 DS Gr I 67 DS Gr II	9 (2.7) Reop Avg 6.3 Postop yrs (2-15)	Other Series Reop After Instr Fus Up to 80% at 5 Postop yrs

(Contd...)

Table 1: *(Continued).*

Author [Ref.] Journal Year	Study Design	Results	Results	Results	Conclusions Outcomes
	LSpSt +/- DS/Unstable Rare Fus	Avg 1.4 Non-InstrF-F/O Avg 7.1 yrs (2-16.5 yrs)	154 Discs 66 S.C. Look Reop Rate+ASD	Avg 4.8 Level Lam+1.1 Level NonInstrF	
Janssen[10] **Clin Spine Surg** **2018**	Incidental LSC out of 19,010 Lumbar MR 2004-2015 2 Tertiary Spine Centers	Sx LSC: Rad Unilateral More Seen with Older Age	Prevalence LSC 6.5% in 19,010 or 1,236 Pts 46% Incidental 54% Symptomatic	Rad Correlated with Larger LSC Size and Anterior Occurrence	1/15 Pts with LSC +/- Symp Correlation Older Age Deg Disease >Rad with Larger LSC+Anterior Local
Ramhmdani[14] **World Neurosurg** **2019**	LCS Diagnostic FJ Instability Often+DS LCS+DS 4 Databases 17 Meta-Analysis with 824 Cases	Frequency LSC Same Level 42.5% LSC+DS 89.3% SC/Arthrosis 48.8% SC+DDD	Pts with DS More Likely Have Fus vs. Lam Only More Likely Reop vs. Pts Without DS	Combined LSC+DS more Likely Have Fus vs. Lam Only vs. LSC+No DS	Pts with SC+DS More Likely Require Reop with Fus
Wun[16] **Clin Spine Surg** **2019**	LSC Reop Recurrent LSC for Dec 55 Pts vs. DecFus 32 Pts -20 yrs	Preop Sx LBP. Rad, Neurologic Deficits 58% Initial LSC at L45 Level	Recurrent LSC 10 (11.5%) Pts for Dec Only vs. 0 -DecFus Total Series Avg F/O 65.1 +/- 48.6 mos	10 Reop for Dec Alone 4 Reop Dec 6 Reop DecFus Avg Time to Recurrence LSC 23.0 +/- 17.3 mos	Both Groups Improved Postop But Higher Reop Rate for Initial Dec Alone
Morishita[12] **J Neurosurg Spine** **2021**	After Lam Incidence Postop LSC 326 pts 384 Levels	Posterior Lam/Decomp No Fusion Decomp 107 Unilat 277 Bil	Recurrent LSC Postop 18/384 Segments Surgery All Bil Lam- Decomp	None X-ray Instability 17/18 Facet Spondylosis 12/18 Local Retrolisth	Conclude Disruption FJ or Sig DDD Higher Risk Postop LSC after Initial Bil Decomp
Page[13] **J Neurosurg Spine** **2022**	Predictive Model LSC Recurrence Rate After Dec No Fus 20 yrs Experience	89 Patients 11 (12.3%) LCS Recurred Required Reop	LCS Score Factors Predict Recurrence: Facet Incline Angle >45% Canal St >50%	LCS Score Factors Predict Recurrence: T2 Joint Hyper Grade I DS	"...cyst recurrence ...< 5% for a score of 2 or less to>88% for a score of 7"
Lalanne[11] **BMC Surg** **2022**	Outcome LSC Instr PLF- 69 Pts Avg F/O 7.4 yrs-43 F 26 M-Avg Age 57.8	Non-Surgical 3 mos 63 Pts 100% Need Surgery Most L45 Level (63.77%)	McNab Criteria 63 Good/Exc (91.3%) 6 Fair/poor (8.6%) No LSC Recurred	Concluded Non-Surgical Management Failed 100%	Recommend Surgery Lam + PLF To Avoid LCS Recurrence

(Contd...)

Table 1: *(Continued).*

Author [Ref.] Journal Year	Study Design	Results	Results	Results	Conclusions Outcomes
Benato[1] **J Clin Med 2023**	Decomp +/- Fus L SC Review Meta-Anal 6 Studies 657 Pts	Compare Results Lam vs. LamFus For L SC	Used 2020 PRIXMA Guidelines Better Results LamFus vs. Lam Alone for L SC	Results Both Same Reop and AE Rates Postop	LamFus for L SC Resulted in Lower Postop Recurrent LBP and Lower L SC Recurrence Rates
Gonzalez[9] **Neurosurgery 2023**	LSC +/- Fus 2212 Lam 1631 Lam/Fus	MarketScan Database Recurrence LSC at 2 yrs 3.1% Lam 1.7% Lam/Fus	LSC and Lam +/- Fus Pts 2:1 Ratio Propensity Matched	LamFus 100% Fused+Less Risk Recur LSC or Symp vs. Lam	Concluded Sig Lower Risk Reop for Recurrent LSC with LamFus vs. Lam

SC=Synovial Cyst, MR=Magnetic Resonance Imaging, CT=Computed Tomography, L=Lumbar, DS=Degenerative Spondylolisthesis, GrISpondy=Grade I Spondylolisthesis, F=Female, M=Male, Pts=Patients, yrs=Years, mos=Months, wk=Weeks, ESI=Epidural Injections, Asp=Aspiration, Rupt=Rupture, Percut=Percutaneous, INC=Intermittent Neurogenic Claudication, Rad=Radiculopathy, CES=Cauda Equina Syndromes, Dyn=Dynamic, XR=S-rays, ROM=Range of Motion, Mod=Moderate, Sev=Severe, Sig=Significant, St=Stenosis, Bil=Bilateral, Lam=Laminectomy, Fus=Fusion, FJ=Facet Joint, Preop=Preoperative, Postop=Postoperative, Reop=Reoperative, LST=Lumbar Stenosis, Surg=Surgery, LSCS=Lumbar Synovial Cyst Surgery, Avg=Average, SF-36=Medical Outcomes Trust Short Form-36, Path=Pathology, SS=Synovial Sheath, Dis=Disruption, Instab=Instability, NonAsp=Non-Aspirable, SurgD=Surgical Decompression, NonInstrF=Non-Instrumented Fusions, InstrF=Instrumented Fusions, SpSt=Spinal Stenosis, ASD=Adjacent Segment Disease, LSC=Lumbar Synovial Cysts, LSCS=Lumbar Synovial , Symp=Symptoms Cyst Score, DT=Dural Tear, CSFLk=Cerebrospinal Fluid Leak, CSFF=CSF Fistulas, Prev=Prevalence, DS=Degenerative Spondylolisthesis, RBCWRUMMC=Review Board Case Western Reserve University/Metroheatlh Medical Center, TelInt=Telephone Interview, WilcoxSRT=Wilcox Signed -Rank Test , IBM-MCCED=IBM MarkeetScan Commercial Claims/Encounters Database, LamFus=Laminectomy with Fusion, End=Endoscopic, TF=Transfacet, Decomp=Decompression, LPF=Lumbar Posterior Decompression, LDF=Lumbar Decompression Fusion, PRISMA=Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA GUIDELINES), LFSC=Long-term Clinical Outcomes Percutaneous Lumbar Facet Synovial Cyst Rupture, Hypo=Hypointense, Hyper=Hyperintense, LBP=Low Back Pain, Non-Instr=No- Instrumented , Instr=Instrumented, Fluoro=Fluoroscopy, Fx=Function, IUI=Intermittent Urinary Incontinence, ED=Erectile Dysfunction, DDD=Degenerative Disc Disease, Dec=Decompression, Imp=Improvement, F/O=Follow-Up, AE=Adverse Events, PLF=Posterolateral Fusion, IBM MCCED=IBM MarketScan Commercial Claims and Encounters Database, Rev=Review, Meta-Anal=Meta-Analysis, Decomp=Decompression, Retrolisth=Retrolisthesis, M=Males, F=Females, Rg=Range, MicroS=Microsurgical Removal, Sx=Symptomatic, ASx=Asymptomatic, Deg=Degenerative, ISD=Interspinous Fusion Device, OYL=Ossification Yellow Ligament

segment of capsule behind to avoid a DT/CSF leak) LSC resections/decompressions with/without fusion usually offer the best outcomes.

6.5% Frequency of Symptomatic/Asymptomatic Lumbar Synovial Cysts

In 2018, Janssen *et al.* found that in 19,010 lumbar MR scans (2004-2015 obtained at 2 tertiary care spine centers), lumbar synovial cysts (LSC) occurred in 6.5% or 1236 patients; 54% were symptomatic, while 46% were asymptomatic [Table 1].[10] The 1 of 15 patients with LSC were typically older, exhibited significant degenerative facet disease, and developed larger and more anteriorly located LSC more likely to be associated with radicular pain.

Etiology and Level of Lumbar Synovial Cysts (LSC)

The etiology of lumbar synovial cysts (LSC) occurring in patients in their sixties who developed radicular deficits were ascribed by Epstein (2004) and others to disruption of the facet capsule [Table 1].[3] Notably, 40% of the time, patients had accompanying degenerative spondylolisthesis (DS) located in descending order at the L45, followed by the L5S1, L34 and L23 levels. Surgical intervention could involve unilateral or bilateral laminotomies/laminectomies with/without attendant non-instrumented vs. instrumented fusions.

Failure of Non-Surgical Management of LSC

Lalanne *et al.* (2022) observed that 100% of 69 patients with LSC failed to improve following 3 months of non-surgical management; all 69 underwent decompressions/instrumented posterolateral lumbar fusions that resulted in no LSC recurrence [Table 1].[11] Further, utilizing Macnab's Outcomes Criteria, 91.3% demonstrated good/excellent results (63 patients), with only 8.6% (6 patients) showing fair/poor outcomes.

SF-36 Postoperative Outcomes for Patients with Lumbar Synovial Cysts, Stenosis with/without DS Treated with Decompressions Alone

Utilizing the Short-Form 36 (SF-36) patient-based outcome measure, Epstein (2004) compared postoperative results for patients undergoing decompressions for resection of LSC/Stenosis (45 patients) vs. 35 with LSC/Stenosis/DS [Table 1].[4] Two years postoperatively, 5 of 45 without DS became unstable (i.e. developed a Grade I olisthy), while 11 of 35 who originally had Grade I DS showed an increase in olisthy to Grade II; nevertheless, both groups demonstrated comparable good/excellent postoperative SF-36 Physical Function Scores (+44 vs +38). Here, the author commented: "As synovial cysts reflect disruption of the facet joint and some degree of instability, primary fusion should be considered to improve operative results for patients in both categories".

High Lumbar Synovial Cyst Occurrence Rates Following Decompressions Alone

Two studies highlighted 6.7% to 12.3% rates of postoperative LSC occurrences in patients undergoing bilateral lumbar decompressions [Table 1].[12,13] Morishita *et al.* (2021) performed 107 unilateral and 277 bilateral lumbar laminectomy/decompressions without fusions (i.e. 326 total patients, at 384 levels) [Table 1].[12] All 18 (6.7%) postoperative LSC occurred in the 277 patients undergoing bilateral laminectomies (i.e. reflecting greater instability) vs. none following unilateral procedures. Over a 20-year period, Page *et al.* (2022) found an even higher 12.3% (i.e. 11 of 89) incidence of postoperative LSC requiring reoperation out of an initial series of patients undergoing bilateral lumbar decompressions without fusions [Table 1].[13] Risk factors predisposing these patients to developing postoperative LSC included; "...facet angle of > 45%, canal stenosis of > 50%, T2 facet joint hyperintensity, and grade I degenerative spondylolisthesis".

LSC/Lumbar Stenosis Treated with Primary Decompressions/Fusions Reduced LSC Recurrence Rates vs. Decompressions Alone

Five studies showed that patients with LSC/Stenosis undergoing primary decompressions/fusions resulted in lower LSC recurrence rates vs. for those having decompressions alone [Table 1].[1,7,9,14,16] Utilizing 4 databases (i.e., 17 studies; 824 patients), Ramhmdani *et al.* (2019) found that patients with LSC/Stenosis/DS were; "...more likely to undergo spinal fusion surgery than laminectomy alone compared with patients with LSC and no preoperative DS" [Table 1].[4] Notably, preoperative LSC were located at the same level of DS (42.5%), and this correlated with facet arthropathy (89.3%), and degenerative disc disease (48.8%). In 2016, Epstein documented that 66 of 336 patients undergoing average 4.7 level lumbar laminectomies/1.4 level non instrumented fusions had LSC at the primary surgery along with DS (i.e., 195 patients with Grade I, and 67 patients with Grade II DS); only 1 (1.5% or 1 of 66 patients with LSC) of 9 patients required secondary surgery for a recurrent LSC [Table 1].[7] Over a 20-year period, Wun *et al.* (2019) found that 11.5% (i.e., 10 of 55) of patients exhibited recurrent LSC following decompressions alone vs. 0% recurrences of LSC after decompressions with initial fusions (i.e. involving 32 patients); notably, second operations for the decompression alone group included 4 additional decompressions, but warranted 6 decompressions/fusions [Table 1].[16] In their

meta-analysis of 6 studies (i.e. including 657 patients), Benato *et al*. (2023) found that treating symptomatic LSC with decompressions/fusions resulted in less postoperative low back pain, fewer recurrent LSC, but comparable reoperation and complication rates vs. laminectomy alone [Table 1].[1] When Gonzalez *et al*. (2023) evaluated 1631 patients with LSC undergoing primary laminectomy/instrumented fusions vs. 2212 with LSC having initial laminectomies alone, they found the laminectomy/fusion group had a lower 1.7% incidence of postoperative LSC recurrences requiring additional surgery vs. a much higher 3.1% recurrence rate of LSC for those undergoing initial decompressiona alone [Table 1].[9]

Low Failure Rates for Incomplete Surgical Resection of Lumbar Synovial Cysts

Scholz *et al*. (2015) documented that 8 (5.4%) of 148 patients with lumbar stenosis and LSC underwent incomplete microsurgical cyst resections [Table 1].[15] Partial LSC resections were largely attributed to marked cyst/dural adhesions, where dissection was carried around the residual capsule to avoid/limit the risk of dural tears/cerebrospinal fluid fistulas. With adequate surrounding neural decompressions, partial LSC removals did not negatively impact patients' outcomes.

Stenosis with/without DS Treated with Lumbar Decompressions/Non-Instrumented Fusions Result In Few Dural Fistulas Attributed to LSC

In 2015, Epstein found an overall 7.14% frequency (i.e. 24 patients) of dural tears occurring in 336 patients undergoing average 4.7 level lumbar laminectomies/1.4 level non-instrumented fusions for stenosis with/without DS [Table 1].[6] Notably, 6 (1.7%) DT were uniquely attributed to LSC, while the remainder were due to; 7 epidural steroid injections (ESI), 5 ossification of the yellow ligament (OYL), 3 postoperative scar, and 3 elective durotomies for tumor removal.

High Failure Rates for Multiple Percutaneous Procedures Addressing LSC

Three studies summarized the multiple failures for various attempts at percutaneous treatment of LSC [Table 1].[2,5,8] Bureau *et al*. (2001) documented 3 (25%) treatment failures out of 12 patients with LSC managed with percutaneous steroid injections for distension of LSC capsules; 1 had only short-term relief and required additional procedures, while 2 were not improved [Table 1].[2] In 2012, Epstein reviewed the 50-100% rate of failed attempts at LSC utilizing unilateral/bilateral aspiration or dilatation under CT-guidance or fluoroscopy; notably, good outcomes were achieved with operative decompression with/without fusion (i.e. > 90% resolution of low back pain/radiculopathy). [Table 1].[5] Further, in 2016, Eshraghi *et al*. (2016) looked at the efficacy of attempted percutaneous LSC rupture in 30 patients with low back/radicular complaints; 9 (30%) attempts failed, resulting in recurrent/residual synovial cysts, with 6 (20%) requiring surgery (2006-2013) [Table 1].[8]

CONCLUSION

Symptomatic LSC are best managed with operative decompression/fusion. Notably, the various percutaneous cyst aspiration, distension, dilatation/other techniques typically fail, unnecessarily exposing patients to added perioperative/postoperative adverse events.

Ethical approval

Institutional Review Board approval is not required.

Declaration of patient consent

Patient's consent not required as there are no patients in this study.

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Conflicts of interest

There are no conflict of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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