

<b>Author Year</b>  <b>Country</b> <b>Research Design</b>  <b>Score</b> <b>Total Sample Size</b>	<b>Methods</b>	<b>Outcome</b>
<p>Schaan &amp; Jaksche 2001</p> <p>Germany</p> <p>Cohort</p> <p>N=30</p>	<p><b>Population:</b> Gender: males=21, females=9; Level of severity: complete=24, incomplete=6.</p> <p><b>Intervention:</b> Patients with syringomyelia were divided into 3 groups: Group 1 (n=18) received single or multiple shunting procedures; Group 2 (n=5) received shunting procedures before surgical creation of a pseudomeningocele; Group 3 (n=7) was treated only with the surgical pseudomeningocele.</p> <p><b>Outcome Measures:</b> Sensory and motor deficit, Pain, Syringobulbia.</p>	<ol style="list-style-type: none"> <li>1. There were no significant differences in outcomes between groups.</li> <li>2. Prior to shunting (n=18) 15 had sensory deficits, 13 had motor deficits, 14 had pain and two had syringobulbia. Post-surgery: <ol style="list-style-type: none"> <li>a. Sensory deficits improved in five, deteriorated in two, and were unchanged in eight patients.</li> <li>b. Motor deficits improved in five, deteriorated in two and were unchanged in four patients.</li> <li>c. Pain improved in five, deteriorated in four, and was unchanged in five patients.</li> <li>d. Syringobulbia improved in one and deteriorated in the second patient.</li> </ol> </li> <li>3. Prior to shunting and pseudomeningocele (n=5) five had sensory and motor deficits, one had pain and one had syringobulbia. Post-surgery: <ol style="list-style-type: none"> <li>a. Sensory deficits improved in four and deteriorated in one patient.</li> <li>b. Motor deficits improved in three, deteriorated in one and was unchanged in one patient.</li> <li>c. Pain and syringobulbia improved in both patients.</li> </ol> </li> <li>4. Prior to pseudomeningocele only (n=7) seven patients had sensory deficits, six had motor deficits, three had pain, and one had syringobulbia. Post-surgery: <ol style="list-style-type: none"> <li>a. Sensory deficits improved in six and were unchanged in one patient.</li> <li>b. Motor deficits improved in two, deteriorated in one, and were unchanged in three patients.</li> <li>c. Pain and syringobulbia improved in all patients.</li> </ol> </li> </ol>
<p>Davidson, Rogers &amp; Stoodley, 2018 Australia</p>	<p><b>Population:</b> Mean Age: 42 yr; Gender: males=19, females=22; Injury etiology: SCI Trauma=13, Arachnoiditis=4, Chiari=5,</p>	<ol style="list-style-type: none"> <li>1. Ninety percent (n=32) of patients experienced a reduction in syringomyelia size at 3 mo follow-up. Post-operatively, eight patients</li> </ol>

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Pre-Post N=41	Other=19; Localization of syrinx: cervical=11, cervicothoracic=5, cervicolumbar=3, thoracic=18, thoracolumbar=2. <b>Intervention:</b> Syrinx to subarachnoid shunt. <b>Outcome Measure:</b> Reduction, stabilization, or recurrence of syringomyelia, self-reported quality of life (SF-12), clinical symptoms.	had clinically stable syringomyelias, while one patient's condition was deemed clinically worse. 2. There were no significant differences in SF-12 post-surgery for physical (p=0.64) or mental (p=0.74) health. 3. The majority of patients had improved clinical symptoms (n=32) on pain, posterior column sensory loss, motor weakness, myelopathy, spasticity, and bladder dysfunction. Eight patient's symptoms remained stable, while one patient had an increased incidence of spasticity.
Tassigny et al., 2017 Belgium Pre-Post N=17	<b>Population:</b> Mean age: 43.3 yr; Gender: males=10, females=7; Injury etiology: SCI-trauma=5, arachnoid cyst=2, tumor=1, Chiari malformation=4, unknown=7; Localization of syrinx: cervical=1, cervicothoracic=5, thoracic=1, thoracolumbar=2, pan-medullaris=4, multiple=4. <b>Intervention:</b> Placement of myringotomy tube with drain. <b>Outcome Measure:</b> Syringomyelia clinical status, radiological status (shrinkage), reoperation.	1. Three patients experienced syrinx disappearance, the clinical status of eight improved, five stabilized, and one patient experienced clinically worse progression of syringomyelia. 2. Between one and three days post-operatively, an MRI was conducted to determine shrinkage. Eight patients experienced complete shrinkage, three almost complete, four a reduction in size, and two achieved stable size. 3. A total of three patients required recurrent surgery, one 'surgical exploration' and two for a syringoperitoneal shunt.
Karam et al. 2014  Canada  Pre-Post  N=27	<b>Population:</b> Mean age: 40 yr; Gender: males=24, females=3; Injury etiology: MVA=16, Bicycle/Tractor/Airplane Accident s=3, Falls & All-terrain Vehicles=3, Motorcycle Accidents=2; Severity of Injury: AIS A=14, C=3, D=10. <b>Intervention:</b> Sixteen patients underwent a shunting procedure, 14 of which received a syringo-subarachnoid procedure and two received a syringo-pleural procedure. 11 patients underwent duraplasty including	1. Amongst the 16 patients who received a shunt only, 10 required revision surgery whereas only three of the 11 patients who received a shunt plus duraplasty required revisions; the difference between the groups was non-significant (p=0.0718). 2. No improvements in ASIA score from admission were reported. 3. Sequential MRI scans were available for 11 of the patients with a significant correlation being found between clinical improvement assessed by the Odom Score and a reduction in the size of the syrinx (p<0.001).

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	seven patients who received shunting and lysis of adhesions.  <b>Outcome Measures:</b> Odom Score, Level of syrinx.	4. Size of syrinx reduced from an initial 12±6 levels to 6±7 levels at follow-up.
Ushewokunze et al. 2010  UK  Pre-Post  N=40	<b>Population:</b> Mean age: 32 yr; Gender: males=38, females=2.  <b>Intervention:</b> A laminectomy with the creation of a cerebrospinal fluid conduit and shunting.  <b>Outcome Measures:</b> Adverse events, Stabilization rate.	<ol style="list-style-type: none"> <li>1. Overall, 27 patients reported a stabilization of symptoms while 13 patients experienced a deterioration of symptoms.</li> <li>2. At 6mo follow-up, a reduction in the size of syrinx was reported in 21 out of 33 patients.</li> <li>3. Twenty-three patients required no further surgery while 17 patients underwent further surgery for deteriorating symptoms.</li> <li>4. The most common early complications included pain (n=5), neurological deficit (n=4), wound infection (n=4), and CSF leak (n=2).</li> </ol>
Li et al. 2021  USA  Case Series  N=34 (pre- and post-operative MRI for 24 patients)	<b>Population:</b> Mean age: 44 yr; Gender: males=15, females=9; T1=116; Severity of injury: AIS A=12, B=0, C=2, D=9, E=1.  <b>Intervention:</b> Participants underwent surgical treatment consisting of syrinx fenestration, lysis of adhesions, and duraplasty. 21 of the patients underwent laminectomies, 21 patients underwent intradural lysis of adhesions, 17 underwent cyst fenestration, and 19 underwent duraplasty. In four patients, pre-existing syrinx shunts were removed; in two others, syrinx shunts (syringo-pleural and -subarachnoid) were placed.  <b>Outcome Measures:</b> Syrinx length (measured in spinal segments), syrinx axial	<ol style="list-style-type: none"> <li>1. The majority (15 of 24) off participants had cervical SCI.</li> <li>2. The average syrinx length, measured in spinal segments, was similar when comparing pre- and post-operative MRIs (5.5 and 5.4 spinal segments, respectively).</li> <li>3. Syrinx axial dimension was decreased in 16 of the patients postoperatively and stable or increased in the other eight.</li> <li>4. Of the 24 patients, 23 remained clinically stable in regards to motor, sensory, and bowel/bladder function.</li> <li>5. One patient, whose surgical treatment involved syringo-subarachnoid shunt placement, experienced neurologic deterioration; in this patient, motor function decline was noted postoperatively.</li> <li>6. The change in syrinx size did not correlate with clinical outcomes.</li> </ol>

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	dimension (defined as the product of maximum syrinx transverse and antero-posterior dimensions), motor, sensory, bladder/bowel, and overall functional Status.	
Hess & Foo 2001  USA  Case Series  N=8	<p><b>Population:</b> Level of injury: T=2, C=5, L=1; Level of severity: AIS A/B=7, C=1; Mean time since injury: 10 yr.</p> <p><b>Intervention:</b> Charts of patients who received shunts were assessed.</p> <p><b>Outcome Measures:</b> Outcome of shunting, Complications.</p>	<ol style="list-style-type: none"> <li>1. A significant reduction in pain was reported by &gt;80% of patients post-surgery; improvement in strength (n=6) and sensory (n=2) was also reported.</li> <li>2. At follow-up, four patients had shunt failure resulting in neurologic decline, while two developed a new syrinx.</li> <li>3. In one patient a new cavity was found with MRI, while the original remained decompressed.</li> </ol>
Lee et al. 2001  USA  Case Series  N=45	<p><b>Population:</b> Mean age: 45.6 yr; Gender: males=30, females=15.</p> <p><b>Intervention:</b> Records of patients who underwent surgical treatment for posttraumatic syringomyelia were assessed. Patients were divided into three groups: Group 1 underwent untethering only, Group 2 underwent shunting only, and Group 3 underwent both untethering and shunting. Patients were followed up to assess treatment efficacy.</p> <p><b>Outcome Measures:</b> Improvement in symptoms, Magnetic Resonance Imaging (MRI), Complications.</p>	<ol style="list-style-type: none"> <li>1. There were no significant differences in outcomes between groups.</li> <li>2. Patients in the surgical untethering group:               <ol style="list-style-type: none"> <li>a. Demonstrated improvement in motor and spasticity symptoms in the majority of patients (60% and 58%, respectively).</li> <li>b. Experienced one treatment failure and two complications.</li> <li>c. Revealed cyst re-accumulation at one yr follow-up.</li> </ol> </li> <li>3. The shunt only group experienced one complication and three treatment failures; 60% of patients in this group experienced improvement in gait followed by sensory (57%) and motor (54%).</li> <li>4. Among those who underwent both untethering and shunting, 33% had clinical recurrence, one experienced CSF leak, and 50% showed improvement in motor symptoms.</li> </ol>
Lee et al. 2000	<p><b>Population:</b> Mean age: 43.2 yr; Gender: males=23, females=11.</p>	<ol style="list-style-type: none"> <li>1. At follow-up (&gt;1 yr), 26 patients' resolution of one or more of the presenting symptoms was achieved</li> </ol>

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USA  Case Series  N=34	<p><b>Intervention:</b> Records of patients who underwent surgical treatment for posttraumatic syringomyelia were assessed. Patients underwent laminectomies and a syringosubarachnoid shunt was inserted. Patients were divided into three groups: Group 1 underwent untethering only, Group 2 underwent shunting only, and Group 3 underwent both untethering and shunting. Patients were followed up to assess treatment efficacy.</p> <p><b>Outcome Measures:</b> Improvement in symptoms, Complications.</p>	<p>post operatively; two patients experienced deterioration of motor function.</p> <ol style="list-style-type: none"> <li>A decrease in spasticity was the most common improvement in patients who underwent untethering only (67%), followed by motor functioning (57%) and sensory loss (50%); this group experienced one treatment failure and two complications.</li> <li>Improvement in gait was seen in the highest number of patients from the shunt only procedure group (60%), followed by motor (50%) and sensory loss (50%); in this group, two treatment failures and two complications occurred.</li> <li>Patients who underwent untethering and shunt procedures did not experience clinical reoccurrence; motor (67%) and gait (50%) improved in patients in this group.</li> </ol>
Falci et al. 1999  USA  Case Series  N=59	<p><b>Population:</b> Mean age: 26 yr; Gender: males=49, females=10; Level of severity: AIS A=53, B=1, C=4, D=1.</p> <p><b>Intervention:</b> All patients underwent spinal untethering and if a spinal cyst was present a lumbo-peritoneal shunt tube was placed along the length of the cyst.</p> <p><b>Outcome Measures:</b> Pinprick, Motor and light touch scores, MRI findings, Somatosensory evoked potentials.</p>	<ol style="list-style-type: none"> <li>Participants with no previous surgery showed a significant increase in light touch (+2.38), pinprick (+3.88) and motor scores (+1.47) post-surgery.</li> <li>Participants who had previous surgery had a decrease in touch, pinprick and motor score, although it was minimal (0.7, 0.8, and 0.5, respectively).</li> <li>At 2wk post-surgery, MRI showed decreased cyst size or complete collapse.</li> <li>Somatosensory evoked potentials were improved in amplitude compared to baseline; latency of 2 milliseconds or greater was observed in 27 patients.</li> </ol>
Ronen et al. 1999  Israel  Case Control	<p><b>Population:</b> Mean age: 31.3 yr; Gender: males=10, females=0; Level of injury: C=5, L=4; Level of severity: incomplete=5, complete=5.</p>	<ol style="list-style-type: none"> <li>Four out of five patients in the shunt surgery and rehabilitation group showed functional and neurological deterioration; the fifth patient remained unchanged.</li> <li>Patients in the rehabilitation only group remained unchanged except</li> </ol>

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<p>N=10</p>	<p><b>Intervention:</b> Charts of patients with syringomyelia were reviewed. Patients were divided into two groups: patients receiving rehabilitation only and patients receiving rehabilitation and shunting.</p> <p><b>Outcome Measures:</b> Functional and neurological outcome.</p>	<p>for one who showed significant functional improvement without any change in neurological status.</p>
<p>Hida et al. 1994</p> <p>Japan</p> <p>Case Series</p> <p>N=14</p>	<p><b>Population:</b> Mean age: 48 yr; Gender: males=10, females=4; Level of injury: C=5, T=5, L=4.</p> <p><b>Intervention:</b> Charts of patients who underwent syringosubarachnoid (n=6), syringoperitoneal (n=4), and ventriculoperitoneal (n=1) shunts were assessed.</p> <p><b>Outcome Measures:</b> Neurological, motor, Sensory functioning, Shunt malfunction.</p>	<ol style="list-style-type: none"> <li>1. Neurological amelioration was obtained in all patients.</li> <li>2. Of the nine patients with motor function difficulty, eight improved.</li> <li>3. Sensory disturbance and relief of local pain or numbness improved in all patients.</li> <li>4. Malfunction was reported in three of four syringoperitoneal shunts and in the one ventriculoperitoneal shunt.</li> </ol>