Duration of the horizontal decubitus position for prevention of cerebrospinal fluid leakage following transection of a tight filum terminale

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OBJECT The untethering of a tethered spinal cord in patients with a tight filum terminale is a relatively simple procedure that can prevent or improve neurological symptoms. Postoperatively, patients are usually kept in the horizontal decubitus position to prevent a CSF leak. However, the optimal period for keeping patients flat has not been determined yet. The authors compared 2 cohorts with different periods of horizontal decubitus; one with 72 hours and the other with 8 days.

METHODS The authors retrospectively analyzed surgical results in 2 cohorts of pediatric patients who had tethered spinal cord with a tight filum terminale. One cohort was maintained flat for 8 days and the other cohort for 72 hours postoperatively. The patients’ charts were reviewed for demographic data, clinical presentation, surgical therapy, and clinical course.

RESULTS Three hundred fifty-four patients underwent sectioning of a tight filum terminale. Of those, 238 were kept lying flat for 8 days postoperatively, and 116 were maintained flat for 72 hours. Magnetic resonance imaging was performed 1 to 2 weeks after the surgery. None of the patients in either cohort developed a CSF leak. Pseudomeningocele, which was confirmed by MRI, developed in 1 patient who had been kept flat for 8 days. The occurrence rates of a CSF leak and pseudomeningocele were not significantly different in either cohort.

CONCLUSIONS Keeping patients flat for longer than 72 hours did not change the rate of postoperative CSF leakage or pseudomeningocele. Seventy-two hours or less would be an appropriate period for maintaining patients flat after transection of a tight filum terminale.

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KEY WORDS tight filum terminale; untethering; cerebrospinal fluid leakage; spine
tution was whether there was a low-lying conus (lower than the caudal edge of L-2) or a normally positioned conus with neurological symptoms of tethered cord.

Regarding the surgical procedure, we usually performed 1-level laminotomy at L-4, or partial laminectomy of lower L-4 and upper L-5 in older patients. Dura mater was incised and a filum terminale was identified by its pale color and midline location. A microscope was used for surgical untethering in all cases. Untethering was performed under intraoperative neurophysiological monitoring. We monitored free-running bulbocavernous reflex and stimulated electromyographically confirmed reactions of the muscles of the lower extremities and external anal sphincter. We stimulated the filum and confirmed that no evoked electromyographic reaction was observed. The filum was coagulated by bipolar and sectioned. The 5-mm-long samples were sent for histological examination.

The dura was closed primarily by using 4–0 Neurolon with interlocking stitches. Dural sealant was not used. The laminoplasty was performed using sutures after laminotomy, or small bone particles were put back after laminectomy. The paraspinal muscles and the fascia were closed using 2–0 Surgilon. In addition, the fascia was sutured using 3–0 Surgilon and 2–0 or 3–0 Prolene with the “figure-of-8” technique. The dural layer was approximated using 4–0 or 3–0 PDS suture. The epidermal layer was sutured using 5–0 Ethilon. Postoperatively, patients were maintained lying flat in the supine position. Patients who underwent untethering over the period between May 2003 and June 2012 were kept flat for 8 days, and those who received the surgery over the period between July 2012 and November 2013 were kept flat for 72 hours. Follow-up MRI was performed 1–2 weeks after the surgery to address the postoperative level of the conus. Patients were assessed periodically at outpatient visits.

Statistical analysis was performed using the Fisher exact test to compare categorical variables, including the rate of postoperative complications between the 2 groups. Continuous variables between the 2 groups were compared using the Student t-test. A value of p < 0.05 was considered significant.

## Results

Between May 2003 and November 2013, 354 patients underwent sectioning of a tight filum terminale at our institution. Of those, 238 were kept lying flat for 8 days postoperatively, and 116 were maintained flat for 72 hours. Patients’ characteristics in those 2 groups are shown in Table 1.

For patients maintained flat for 8 days, the median age at surgery was 15.5 months (range 3–138 months). There were 77 males and 39 females. Untethering was performed for 93 symptomatic patients (80%), and for prophylaxis in 23 patients (20%). Those symptoms included bladder dysfunction, urinary tract infection, constipation, stool incontinence, leg/back pain, and gait disturbance. Twenty-six symptomatic patients (22%) with the conus within the normal level underwent operation. Preoperative MRI showed a low-lying conus in 90 patients (78%) and a fatty filum in 54 patients (47%).

No intraoperative complications were observed in either group. Patients were kept lying flat in the supine position for 72 hours or 8 days postoperatively. The wound was carefully observed daily and cleaned with saline on postoperative Day 3. The dressings were kept on the wound until the sutures were removed on postoperative Day 8. Follow-up MRI was performed 1–2 weeks after the surgery.

Regarding postoperative complications, none of the patients experienced CSF leakage in either group. Postoperative MRI demonstrated pseudomeningocele in 1 patient who had been maintained flat for 8 days. No patients developed wound infection, bladder dysfunction, or bowel dysfunction in either group. The mean follow-up period was 25 months (range 4–92 months). One patient who had been maintained flat for 8 days experienced re tethering of the filum. In patients maintained flat for 8 days, the rates of CSF leakage, pseudomeningocele, and overall complications were 0% (0/238), 0.4% (1/238), and 0.8% (2/238), respectively. In patients maintained flat for 72

### Table 1. Clinical findings in 354 patients with a tight filum terminale who underwent surgical untethering

<table>
<thead>
<tr>
<th>Patient Characteristics</th>
<th>Duration of Horizontal Decubitus</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of patients</td>
<td>238</td>
<td>116</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>161 (68)</td>
<td>77 (66)</td>
</tr>
<tr>
<td>Female</td>
<td>77 (32)</td>
<td>39 (34)</td>
</tr>
<tr>
<td>Age in mos</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median</td>
<td>18</td>
<td>15.5</td>
</tr>
<tr>
<td>Mean</td>
<td>43</td>
<td>27</td>
</tr>
<tr>
<td>Range</td>
<td>3–226</td>
<td>3–138</td>
</tr>
<tr>
<td>Surgical indication</td>
<td></td>
<td>0.77</td>
</tr>
<tr>
<td>Symptomatic patients</td>
<td>195 (82)</td>
<td>93 (80)</td>
</tr>
<tr>
<td>Prophylaxis</td>
<td>43 (18)</td>
<td>23 (20)</td>
</tr>
<tr>
<td>Level of conus</td>
<td></td>
<td>0.59</td>
</tr>
<tr>
<td>Low-lying</td>
<td>178 (75)</td>
<td>90 (78)</td>
</tr>
<tr>
<td>Normally positioned</td>
<td>60 (25)</td>
<td>26 (22)</td>
</tr>
<tr>
<td>Fatty filum</td>
<td>161 (68)</td>
<td>54 (47)</td>
</tr>
<tr>
<td>Postop complications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSF leakage</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Pseudomeningocele</td>
<td>1 (0.4)</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

* Except for age, values are expressed as the number (%).
hours, the rates of CSF leakage, pseudomeningocele, and overall complications were all 0% (0/116). There were no significant differences between the rates of CSF leakage, pseudomeningocele, and the overall complications in either group (p = 1.0).

Discussion

The untethering of a tethered spinal cord by transecting a tight filum terminale is a relatively straightforward procedure that can prevent or ameliorate neurological symptoms. The untethering of a tight filum not only for symptomatic patients but also for asymptomatic patients has been reported to prevent future neurological deficit, but a low complication rate is required to justify the prophylactic surgeries.1–5,7,9–12

Leakage of CSF can be a serious complication of untethering, after which poor wound healing, wound dehiscence, and meningitis potentially ensue. To prevent a CSF leak, patients are generally kept lying flat in the postoperative period. However, the optimal period for the horizontal decubitus position has not been determined yet. In our series, we analyzed surgical results in 2 cohorts with different durations of 72 hours and 8 days. None of the patients developed a CSF leak in either cohort. Pseudomeningocele developed in 1 patient who had been kept flat for 8 days. The occurrence rates of a CSF leak and pseudomeningocele were not significantly different in either cohort. According to our results, we consider that longer than 72 hours of maintaining a flat position is not required, but a low complication rate is required to justify the prophylactic surgeries.1–5,7,9–12

In previous reports, duration of the horizontal decubitus position ranged from 24 to 72 hours after the surgery.1,2,11 In those studies the rate of CSF leakage ranged from 0% to 5.9%. Chern et al. reported the largest series, in which 222 patients underwent transection of a tight filum terminale and were kept flat for variable durations from 24 to 72 hours.2 In their series, the rate of CSF leakage and pseudomeningocele was 5.9% (13/222) and 4.1% (9/222), respectively. Their seemingly higher rates of CSF leakage and pseudomeningocele than ours (0% [0/354] for CSF leakage and 0.3% [1/354] for pseudomeningocele) may be due to the shorter duration of the horizontal decubitus position. However, in the other 2 studies in which patients were kept flat for 24 hours and 24–72 hours, respectively, the rate of CSF leakage was 0% (0/60 and 0/45) in both studies, and the rate of pseudomeningocele was 0% (0/60) and 2.2% (1/45), respectively. Taking these results into consideration, there seem to be other factors related to the occurrence of CSF leakage or pseudomeningocele.

The other factor that can contribute to the prevention of CSF leakage is the way the fascia and muscles are closed. In our series, because the fascia is considered to be important for prevention of CSF leakage, we used 3 kinds of suture to achieve a firm, watertight closure. First, we closed the paraspinal muscles and the fascia together by using 2–0 Surgilon, eliminating the dead space under the fascia; then the fascia was further closed using 3–0 Surgilon at the sites between the sutures of 2–0 Surgilon; and finally the fascia was closed using 2–0 or 3–0 Prolene with the figure-of-8 technique in the entire length. Zide et al. also addressed the importance of musculofascial closures to avoid CSF leakage. They also used evenly spaced figure-of-8 sutures of 2–0 Prolene, and demonstrated their method’s effectiveness even in patients who had previously undergone irradiation.15 Such meticulous musculofascial closing could contribute to our low complication rates of CSF leakage (0%; 0/354) or pseudomeningocele (0.3%; 1/354).

The other possible contributing factor is the way in which the lamina is treated at closing: that is, the laminoplasty or the simple laminectomy. In our series, laminoplasty was performed using sutures after laminotomy, or small bone particles were put back onto the dura after laminectomy in older patients. This also may contribute to the prevention of CSF leakage compared with the simple laminectomy. In our series we did not use any dural sealants, subcutaneous drains, dermal adhesives, or pressure dressings. They do not seem necessary for prevention of CSF leakage in this untethering procedure. Chern et al. also demonstrated that the use of a dural sealant was not related to preventing CSF leakage.2

The 2 cohorts in our study were not comparable in age (with older patients in the earlier cohort). This is mainly because recently infants have been increasingly referred to our clinic for sacrococcygeal dimple, and more infants have been diagnosed with a tight filum by MRI and treated surgically. The 2 cohorts were also not comparable in the frequency of a fatty filum (it was less common in the recent cohort). This may be because a fatty filum was less common in infants with a tight filum, which accounts for the larger population of the recent cohort.

Surgical indications for a tight filum terminale are still controversial issues. Surgical indications in our institution, which are conus lower than L-2 in asymptomatic patients and symptomatic patients with normal results on MRI, are arguable and may not be universally accepted. There may be institutions in which surgical indications are only symptomatic patients with significantly low conus. However, differences of surgical indications are not considered to affect our results regarding the rate of CSF leakage, because surgical techniques for a tight filum terminale would be basically the same regardless of different surgical indications.

Our previous study regarding duration of horizontal decubitus had compared the rate of a CSF leak between patients with 8 days of flat positioning in our institution and 72 hours or less in other institutions’ previous studies.1 Our study had shown that the rate of CSF leakage was lower in the cohort with 8 days, which was the opposite conclusion to the present one. This is considered to have been due to confounding factors, including surgical techniques. The 2 groups are considered not to be sufficiently comparable in the previous study.

The results of the current study suggest that longer than 72 hours of maintaining a flat position seems to be unnecessary for prevention of CSF leakage. The optimal period, which would be 72 hours, less, or none, remains to be determined by further studies. If the optimal period were shorter or maintaining a flat position were not neces-
sary at all, hospitalization could also be shortened, which would not only decrease the financial cost to the health care system and patients, but also improve the quality of the patient’s postoperative period.

Conclusions
Keeping patients lying flat for longer than 72 hours did not change the rate of postoperative CSF leakage or pseudomeningocele. Seventy-two hours or less would be an appropriate period for maintaining patients in a flat position after transection of a tight filum terminale. In our series, the rate of CSF leakage and pseudomeningocele was 0% and 0.3%, respectively. We suggest that meticulous muscular-fascial closure and laminoplasty may also contribute to the prevention of CSF leakage.

References

Author Contributions
Conception and design: Ogiwara, Morota. Acquisition of data: Ogiwara, Joko, Takado, Uematsu, Kameda, Sasaki, Kitagawa. Analysis and interpretation of data: Ogiwara, Joko. Drafting the article: Ogiwara. Critically revising the article: Ogiwara. Reviewed submitted version of manuscript: Morota. Approved the final version of the manuscript on behalf of all authors: Ogiwara. Statistical analysis: Ogiwara.

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