Conservative management of ossification of the posterior longitudinal ligament

A review

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Object. Ossification of the posterior longitudinal ligament (OPLL) can result in significant myelopathy. Surgical treatment for OPLL has been extensively documented in the literature, but less data exist on conservative management of this condition.

Methods. The authors conducted a systematic review to identify all reported cases of OPLL that were conservatively managed without surgery.

Results. The review yielded 11 published studies reporting on a total of 480 patients (range per study 1–359 patients) over a mean follow-up period of 14.6 years (range 0.4–26 years). Of these 480 patients, 348 (72.5%) were without myelopathy on initial presentation, whereas 76 patients (15.8%) had signs of myelopathy; in 56 cases (15.8%), the presence of myelopathy was not specified. The mean aggregate Japanese Orthopaedic Association score on presentation for 111 patients was 15.3. Data available for 330 patients who initially presented without myelopathy showed progression to myelopathy in 55 (16.7%), whereas the other 275 (83.3%) remained progression free. In the 76 patients presenting with myelopathy, 37 (48.7%) showed clinical progression, whereas 39 (51.5%) remained clinically unchanged or improved.

Conclusions. Patients who present without myelopathy have a high chance of remaining progression free. Those who already have signs of myelopathy at presentation may benefit from surgery due to a higher rate of progression over continued follow-up. (DOI: 10.3171/2011.1.FOCUS10273)

Key Words • posterior longitudinal ligament • myelopathy • ossification • conservative management

Ossification of the posterior longitudinal ligament is an ectopic ossification that can cause a significant amount of chronic pressure on the spinal cord, resulting in myelopathy. It generally occurs in patients over 40 years of age and is considered a rare entity if it appears earlier than the third decade of life. The frequency of OPLL has varied between 0.8% and 3.2%.

Managing OPLL can involve either surgical or conservative treatments. Patients with severe progressive myelopathy due to OPLL have generally been considered definitive candidates for surgical treatment. Current indications for surgical management of patients with OPLL include severe progressive myelopathy and MR imaging evidence of increasing cord edema. Several factors found to correlate with progression of OPLL-induced myelopathy can also be used as indications for surgical management. These include a C1–7 range of motion greater than 35°, segmental-type OPLL, and the presence of high signal intensity changes in the spinal cord on T2-weighted MR images. Surgical therapy for OPLL includes either direct removal of the ossified mass via an anterior approach or decompression via a posterior approach. Patients who have a segmental type of OPLL will benefit more from an anterior approach. Those with extensive OPLL affecting more than 3 levels of the spine will benefit more from a posterior approach and laminoplasty.

When patients present without myelopathy or with only mild myelopathic signs and symptoms, the question arises as to optimal subsequent management. Current suggested indications for conservative management of patients with OPLL include minimal neurological...
symptoms or significant medical risk factors for surgery. Patients with irreversible neurological deficits, evidenced by findings of myelomalacia on MR imaging and atrophy on clinical examination, should also be considered for nonsurgical management.\(^6\) Conservative treatment can involve regular clinical follow-up, application of a neck brace for cervical immobilization, decreased activity levels, or physical therapy.\(^{22,46}\) Inpatient management can consist of bed rest and a period of cervical traction as well.\(^{11}\) Such conservative treatment has been reported to be an effective therapeutic option, especially for patients with mild myelopathy from cervical spondylosis.\(^{21,39,40}\) Management of patients who have OPLL without myelopathy still remains controversial, however, considering the propensity for these patients to develop subsequent enlargement of OPLL or possible severe neurological deficits following minor trauma.\(^{5,10,20,32,34,35}\)

In this paper we provide a literature review on the conservative management of OPLL. Although the literature is rich regarding various surgical treatments, there are fewer studies reporting data regarding outcome of conservatively managing these patients. To our knowledge, this is the first attempt to aggregate all known articles regarding the conservative management of OPLL.

### Methods

English literature was identified using the MEDLINE database. Several combinations of “ossification posterior ligament,” “OPLL,” “conservative,” “natural history,” “observation,” and “nonsurgical” were searched from January 1975 to October 2010. In addition, “OPLL” and “surgery” were used to search for surgical series that may have included conservatively managed patients as well. References were also searched for relevant literature. This process was conducted by 3 independent authors.

Inclusion criteria were: 1) that a study included OPLL patients who were conservatively managed without surgical intervention upon initial diagnosis, and 2) that there was clinical follow-up regarding the progression of myelopathy. Exclusion criteria were: 1) any study reporting a group of conservatively managed patients who were included in a later study that met our primary inclusion criteria, and 2) any study in which OPLL patients were being conservatively managed due to an acute injury. Data were then extracted for number of patients conservatively managed, mean duration of follow-up in the study, clinical presentation, type of conservative management reported, clinical change on follow-up, and radiological change on follow-up.

Three authors independently reviewed all studies that provided any details in these categories, and any discrepancies were resolved by consensus after re-review of primary data before inclusion for analysis. We considered any nonoperative treatment and/or observational follow-up as conservative management in this review.

The authors of several papers used the JOA score to evaluate the severity of myelopathy (highest score, 17 points).\(^{14}\) The JOA score quantifies cervical myelopathy by evaluating upper-extremity function (4 points), lower-extremity function (4 points), sensation (6 points), and bladder function (3 points).

### Results

#### Published Studies

Eleven studies detailing the conservative management of OPLL met the criteria for discussion in this review (Table 1). Of the 11 included articles, 7 were primarily clinical studies, 3 were primarily radiological studies, and 1 was a case report. There were a total of 480 patients (range per study 1–359), with a mean per-patient follow-up of 14.6 years (range 0.4–26 years). Matsunaga et al.\(^{27}\) had the largest study, with 359 patients, accounting for 74.8% of this aggregate population. In addition to

<table>
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<th>TABLE 1: Studies included for this review*</th>
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<td>Authors &amp; Year</td>
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<td>Harsh et al., 1987</td>
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<td>Maiuru et al., 2000</td>
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<td>Takatsu et al., 1999</td>
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<td>Trojan et al., 1992</td>
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<td>Yu et al., 1988</td>
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* FU = follow-up; Pts = patients.  
† Whose cases were conservatively managed.  
‡ For studies involving more than 1 patient, the mean value is given.
Conservative management of OPLL

### TABLE 2: Studies initially considered for review and subsequently excluded

<table>
<thead>
<tr>
<th>Authors &amp; Year</th>
<th>Study Type</th>
<th>No. of Pts w/ OPLL*</th>
<th>Reason for Exclusion</th>
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<tr>
<td>Jayakumar et al., 1996</td>
<td>clinical</td>
<td>17</td>
<td>incomplete FU</td>
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<tr>
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<td>radiological</td>
<td>22</td>
<td>same patients already included in another study</td>
</tr>
<tr>
<td>Matsunaga et al., 1994</td>
<td>clinical</td>
<td>207</td>
<td>incomplete FU; same patients already included in another study</td>
</tr>
<tr>
<td>Matsunaga et al., 1996</td>
<td>radiological</td>
<td>101</td>
<td>incomplete FU; same patients already included in another study</td>
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<tr>
<td>Matsunaga et al., 2001</td>
<td>clinical</td>
<td>126</td>
<td>same patients already included in another study</td>
</tr>
<tr>
<td>Matsunaga et al., 2002</td>
<td>clinical</td>
<td>167</td>
<td>same patients already included in another study</td>
</tr>
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</table>

* Whose cases were conservatively managed.

regular clinical follow-up, reported types of conservative management included cervical brace or immobilization (4 studies), cervical traction (3 studies), physical therapy (1 study), and daily activities including bed rest (3 studies), and physical therapy (1 study).

Six other studies that were initially considered for inclusion in this review were subsequently excluded. Those studies can be found in Table 2. Reasons for exclusion were: incompletely documented clinical follow-up or absence of documented clinical follow-up (4 studies) and presence of overlapping patients in studies already included in this review (4 studies).

**Presentation**

Of all 480 conservatively managed patients across these 11 studies, 348 patients (72.5%) presented without any signs of myelopathy (Table 3). This is in comparison with 76 patients (15.8%) who presented with signs of myelopathy (Table 4). Status specifically regarding myelopathy could not be determined in 56 patients (11.7%). Reasons for nonsurgical intervention in the 76 patients presenting with myelopathy were: refusal of surgery (39 patients), myelopathy determined to be mild (28 patients), patient not medically stable for surgery (1 patient), and undetermined (8 patients).

Four studies reported initial JOA scores in their conservatively managed patient population (Table 5). In a series of 11 patients, all of whom had mild myelopathy, Matsumoto et al. reported a mean JOA score at initial presentation of 14.3 ± 1.6. Mochizuki et al. and Takatsu et al. reported mean initial JOA scores for a mixed non-myelopathic/myelopathic population with 15.6 ± 0.9 and 15.1 ± 2.7, respectively. Morio et al. specified a mean JOA score in their myelopathic population as 12.9; altogether, however, their total population of 23 patients, including those without signs of myelopathy, had a mean initial score of 16.1. Based on these 4 studies, the mean aggregate JOA score on presentation of 111 OPLL patients who were subsequently managed conservatively was 15.3.

**Clinical Progression**

Of 330 patients with clinical follow-up data who initially presented without myelopathy, 275 patients (83.3%) remained progression free while 55 patients (16.7%) developed signs of myelopathy. In 76 patients who already had signs of myelopathy on presentation, 39 patients (51.3%) either remained unchanged or improved, whereas 37 patients (48.7%) showed clinical aggravation or worsening of their myelopathy on follow-up.

Follow-up JOA scores were available in only 3 of the 11 studies (Table 5). In a study of 56 conservatively managed OPLL patients, Takatsu et al. showed a final mean JOA score of 14.8 ± 3.1 after a mean follow-up period of 7.8 years. This was slightly decreased from a mean JOA score of 15.1 ± 2.7 on initial presentation, but they reported this to be a nonsignificant change. For their 11 mildly myelopathic patients treated conservatively, Matsumoto et al. reported a final mean JOA score of 13.8 ± 1.7 during a mean follow-up period of 3 years. This was decreased from 14.3 ± 1.6 on initial presentation. Mochizuki et al., however, demonstrated an improvement in their population of 21 patients. In their group of 6 nonmyelopathic and 15 mildly myelopathic patients, a mean JOA score of 16.4 ± 1.0 was achieved after a mean follow-up period of 4.5 years—an improvement from an initial mean JOA score of 15.6 ± 0.9.

**Discussion**

Ossification of the posterior longitudinal ligament is an important cause of spinal cord disease. Chronic compression of the spinal cord is believed to be the mechanism for myelopathy and may contribute to significant neurological disability. Although the majority of cases (92%) affect the cervical spine, OPLL can also appear at the thoracic (4%) and lumbar (4%) spinal levels.

Good results from the surgical treatment of patients...
with OPLL have been reported throughout the literature. In several high-volume series of over 100 cases, rates of neurological improvement have been reported as ranging between 86.5% and 89.4%. Major concerns with respect to an anterior approach revolve around inadequate decompression, dural loss or laceration, CSF leak, or neurological injury of the compressed spinal cord. Vertebral instability with pseudarthrosis has also been reported with anterior approaches, with rates ranging from 4%–6% for 1-level fusions to as high as 17% for 3-level fusions. Posterior approaches may run into continued progression of OPLL. Other complications resulting from posterior approaches include post-surgical kyphosis and C-5 palsies. Symptomatic neurological deterioration, however, occurs only rarely and has been cited as occurring in less than 1% of cases.

It has been suggested that conservative treatment be pursued for patients with a JOA score of at least 14 points. This suggestion was based on a study by Mochizuki et al., who reported a mean JOA score improvement from 15.6 ± 0.9 to 16.4 ± 1.0 over a mean follow-up period of 4.5 years. When Matsumoto et al. managed their 11 myelopathic patients conservatively, however, they saw a decline in mean JOA score from 14.3 ± 1.6 to 13.8 ± 1.7 over a mean follow-up period of 3 years. Our review showed that nonmyelopathic patients had a 16.7% chance of showing myelopathic progression over an aggregate mean follow-up period of 14.6 years. If a patient already had myelopathy on initial presentation, the chance of further progression increased to 48.7% with conservative management.

Over a mean follow-up period of 17.6 years, Matsunaga et al. showed that only 55 (17%) of the 323 patients who presented with myelopathy but declined surgery, experienced progression. The majority of this progression occurred in patients who had at least moderate myelopathy at initial presentation (Nurick Grades 3, 4, and 5). On the other hands, patients who initially had mild myelopathy (Nurick Grades 1 and 2) had the same functional outcome whether they were managed conservatively or surgically.

A long-term observational study of OPLL demonstrated progression of ossification longitudinally in 60% of patients and transversely in 52%. This radiographic progression, however, did not necessarily correlate with the appearance of myelopathy in in patients who had previously shown no signs of spinal cord disease. Likewise, Matsunaga et al. demonstrated similar findings in their observational study of 207 patients followed up for a mean period of 10.25 years. Although 32% of the 65 patients who had an increase in ossification thickness showed aggravation of myelopathy, there were cases in which patients had no worsening of myelopathy in the face of marked ossification, as well as those in which patients experienced worsening myelopathy in the presence of only slight ossification. They determined that the onset and aggravation of myelopathy could not be attributable to the development of ossification alone and pointed to

<table>
<thead>
<tr>
<th>Authors &amp; Year</th>
<th>No. of Pts w/ Myelopathy at Presentation</th>
<th>No Change</th>
<th>Improvement</th>
<th>Worsening</th>
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<td>1</td>
<td></td>
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<tr>
<td>Matsumoto et al., 2000</td>
<td>11</td>
<td>5†</td>
<td>6</td>
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<td>Matsunaga et al., 2004</td>
<td>36</td>
<td>13†</td>
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<td>Yu et al., 1988</td>
<td>2</td>
<td>1</td>
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* Overall, 76 patients with conservatively managed OPLL initially presented with myelopathy. Improvement or no change was reported in 39 (51.3%) and worsening in 37 (48.7%).
† No change or improvement (not categorized separately).

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<thead>
<tr>
<th>Authors &amp; Year</th>
<th>No. of Pts w/ OPLL†</th>
<th>Mean JOA Score at Initial Presentation</th>
<th>Mean JOA Score at FU</th>
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<td>11</td>
<td>14.3 ± 1.6</td>
<td>13.8 ± 1.7</td>
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<tr>
<td>Mochizuki et al., 2009</td>
<td>21</td>
<td>15.6 ± 0.9</td>
<td>16.4 ± 1.0</td>
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<td>Morio et al., 1999</td>
<td>23</td>
<td>16.1</td>
<td>NR</td>
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<tr>
<td>Takatsu et al., 1999</td>
<td>56</td>
<td>15.1 ± 2.7</td>
<td>14.8 ± 3.1</td>
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</table>

* Based on the available data, the overall mean JOA scores were 15.3 at initial presentation (4 studies) and 15.05 at follow-up (3 studies).
† Including asymptomatic patients and those with myelopathy.
incidence of cardiovascular disease and dynamic range of motion factors as well. An increase in the extent of OPLL in addition to these other factors may be needed to induce myelopathy. In our review of these 11 studies, only Murakami et al. commented on radiographic progression; in their case report, they noted an increase in ossification that coincided with the appearance of myelopathy 26 years after their patient’s initial presentation.

There are significant caveats for this review. Data gathered were partly based on retrospective series that included conservatively managed cases as part of a larger report of surgical treatments. Patients who were chosen for conservative management typically had presentations that were more benign than their surgically managed counterparts. This may represent a selection bias that may underestimate the severity in progression of OPLL’s true natural history should higher grades of OPLL be managed without surgery. In addition, the clinical and radiological progression of OPLL is not linear. Studies have shown that patients with moderate to severe myelopathy will experience faster progression than those with only mild myelopathy. Therefore, the simple presence of myelopathy on initial examination without a descriptor of its severity is not enough to predict outcome. Because many studies did not report a particular grade or score of presenting myelopathy and because several studies aggregated their conservatively managed patients, it may be difficult to predict a true slope of progression. Last, because the study of Matsunaga et al. study from one Japanese center constituted the majority of this review’s patient population, the conclusions reached here may not be completely applicable to all patients with OPLL.

To the best of our knowledge, this is the first attempt to review the clinical course of all OPLL patients reported on in the literature who were conservatively managed without surgery. It is hoped that our findings will provide continued guidance as to deciding the appropriate treatment in patients with this condition.

Conclusions

The indications for conservatively managing patients with OPLL remain vaguely defined. Patients who present without myelopathy have a high chance of remaining progression free. Those who present already with symptoms or signs of myelopathy may benefit from surgery due to a higher rate of progression over continued follow-up.

Disclosure

Dr. Hsieh reports being a consultant for DePuy Spine and Medtronic, and receives support from DePuy Spine for non-study-related clinical or research effort.

Author contributions to the study and manuscript preparation include the following: Conception and design: Pham, Attenello, Stapleton, Hsieh. Acquisition of data: Pham, Lucas, He. Analysis and interpretation of data: all authors. Drafting the article: Pham, Lucas. Critically revising the article: Pham, Attenello, Hsieh. Reviewed final version of the manuscript and approved it for submission: Pham, Attenello, Hsieh. Administrative/technical/material support: Stapleton. Study supervision: Hsieh.

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