OPLL
Ossification of the Posterior Longitudinal Ligament
2nd Edition
Ossification of the posterior longitudinal ligament (OPLL) is no longer only a Japanese disease. In 2004, 18 papers on OPLL and related conditions were published, and 7 of those were from countries other than Japan. Major textbooks on spine surgery, such as The Spine, The Cervical Spine, and Spine Surgery, have devoted chapters to OPLL. Although OPLL has been recognized as a distinct spinal disease entity, several questions regarding etiology and treatment have remained unanswered.

In 2002, the Committee for Study of Ossification of Spinal Ligaments, subsidized by the Ministry of Health, Labour and Welfare and chaired by Professor K. Nakamura, decided to systematically review papers on OPLL and related conditions. The purposes were to direct the research activities of the committee more effectively and to provide more certain knowledge about OPLL, in the form of clinical practice guidelines, for general practitioners and for patients suffering from the condition. A committee for this task was formed in cooperation with the Japanese Orthopaedic Association, and clinical practice guidelines for OPLL, consisting of 4 chapters and 75 research questions, were developed after almost 3 years. Unfortunately, the guidelines have been published only in Japanese as of this writing. Therefore, 4 chapters of this book (“Overview of Epidemiology and Genetics,” “Overview of Etiology and Pathogenesis,” “Diagnosis of OPLL and OYL,” and “Overview of Treatment for Ossification of the Longitudinal Ligament and the Ligamentum Flavum”) were included as summaries of the 4 chapters of the guidelines.

One of the important issues that arose during the development of the guidelines was that of diagnostic criteria. OPLL was discovered before computerized tomography had been devised; therefore, OPLL was diagnosed on the basis of clinical and roentgenographic findings from conventional imaging techniques such as plain roentgenography or tomography. However, with an increase in the diversity of medical professionals who take care of patients with spinal disease and with advances in imaging technology such as computerized tomography, a small ossified lesion that usually would not grow to compress the spinal cord is sometimes diagnosed as OPLL, which confuses patients. Diagnosis of OPLL has been made based on tactical knowledge—that is, knowledge held by a closed society made up of experts in the field. This is not a rare example. Several common spinal diseases, such as cervical spondylotic myelopathy, lumbar disc herniation, and lumbar canal stenosis, are diagnosed in this manner. The committee has set tentative diagnostic criteria for OPLL until more definite criteria can be established scientifically, and those tentative diagnostic criteria for OPLL are included in this book.

Since 1997, when the first edition of OPLL was published, research on OPLL has progressed steadily in genetics and bone cell physiology. Genetic studies using a variety of approaches, supported by nationwide collaboration, seem to be narrowing in on a disease-related gene. The process of ossification in this condition has been elucidated by studies using techniques of bone cell physiology. Clinical studies using imaging and electrophysiological modalities have clarified the pathophysiology of the spinal cord in OPLL. Follow-up studies have revealed long-term (more than 10 years) results of surgical treatment of both posterior and anterior approaches. All the chapters have been updated with these findings.
As clearly shown in this new edition, many facts regarding hyperostotic conditions of the spine have been cleared up through research activities over the past 30 years, mainly by the successive committees on OPLL. However, many important questions in basic and clinical research have not yet been clarified. Among the basic ones: What are the causative genes? What mechanisms work in hypertrophy and ossification of spinal ligaments in the condition? And there are others. In the clinical area, surgical decompression of the spinal cord in thoracic OPLL and ossification of the yellow ligament (OYL) is still a challenging subject. Although arguments over choice of surgical procedure have been settling down, criteria for the surgical technique for individual patients have not yet been established.

Progress in basic research of OPLL may largely depend on advances in the basic sciences of genetics, bone cell physiology, and related fields. In surgery, assiduous efforts by surgeons to devise a technique for better and safer results are mandatory. Such improvement in treatment for any surgical condition is general. Additionally, for relatively rare conditions such as OPLL, establishment of a system of clinical trials is important to substantiate the significance of a new treatment, and this is the surgeon’s task.

Through the challenge posed by this disease, we Japanese spine surgeons have learned many things about bone biology and about the spine and spinal cord as well, and we have developed various surgical techniques to conquer the condition. OPLL, however, still confronts us, and to surmount this refractory hyperostotic condition of the spine, we must expand our research into new fields. Development of drugs to control bone formation is one example—drugs that not only prevent progression of ossification of the spinal ligament but that also preserve spinal mobility, which we spine surgeons sometimes have neglected. Another example is repair or regeneration of the injured spinal cord. I hope that these goals will be achieved with further study of OPLL.

The editors express their sincere thanks to the members of the Committee on Clinical Practice Guidelines of OPLL: Drs. K. Yonenobu (Chairperson), M. Iwasaki, K. Satomi, T. Taguchi, M. Tanaka, Y. Toyama, and S. Matsunaga; and to the members of the working group for reviewing papers: Drs. H. Aono, Y. Itoh, S. Okuda, K. Kato, K. Kaneko, J. Kouno, K. Takeuchi, K. Toyoda, K. Hayashi, and A. Miyauchi. Without their perseverance, the guidelines as well as this book would not have been completed.

Kazuo Yonenobu
Ossification of the Posterior Longitudinal Ligament (OPLL) has long been a challenge to orthopedic spinal surgeons in Japan, and their struggle to meet that challenge has marked a turning point in the history of spinal surgery. Investigation of the etiology and treatment of the condition has taught surgeons to see diseases of the spine and their surgical treatment in a new perspective.

It was truly a surprise to learn that the posterior longitudinal ligament could become a thick, bony plate in the cervical spine and impinge on the spinal cord, leading to paralysis. Even more amazing, however, is that innumerable roentgenological findings of such thick, bony lesions could be overlooked for decades before OPLL became well recognized by physicians in Japan. Progress in diagnostic imaging technology, first in computed tomography (CT) and then in magnetic resonance imaging (MRI), has helped in diagnosis and evaluation of the disease and in deciding therapeutic modalities. There is no better tool than CT and CT myelography for demonstrating the real threat of OPLL to the cervical spinal cord. MRI, however, provides more information on widespread ossified lesions from the cervical to lumbar regions, and on the intramedullary changes caused by chronic compression. It is not a great exaggeration to say that OPLL is one of the leading reasons for the enthusiastic expansion in the market for the newest diagnostic imaging tools in Japan.

Despite Tuki yama’s autopsy report of OPLL in 1960, the etiology of OPLL remained unclear and its symptoms and characteristics were unfamiliar until 1975, when the Investigation Committee for OPLL moved toward better patient care and research of the etiology of the disease. Under the auspices of the Ministry of Health and Welfare, diagnostic criteria for OPLL scoring both of physical manifestations and of roentgenological findings were first established.

With dissatisfied patients who failed to recover after conventional laminectomy, a new technique of decompression had to be developed. Failure of surgical decompression was thought to be due to careless methods of laminectomy in which the thick rongeur blade or Kerrison punch was introduced into an extremely narrow spinal canal. Anterior disectomy and interbody fusion by either the Smith-Robinson or Cloward method often caused paraplegia. In the 1960s, patients with OPLL thus remained unhappy even after surgery; it was a dreary time for spinal surgeons in this country. Then came the introduction of a high-speed surgical drill for laminectomy, along with technical developments such as expansive laminoplasty (Hirabayashi, 1981) and anterior decompression by the floating of OPLL (Yamaura, 1983), which ensured decompression of the spinal cord without excision.

Considered as a systemic disease, OPLL was recognized rather early to occur with high frequency in patients suffering from diabetes mellitus. There were also a few reports on metabolic and endocrine disorders in close relationship with OPLL: hypophosphatemic rickets or hypoparathyroidism. OPLL is not simple calcification, however, but ossification of the ligaments; the etiological relationship between these disorders of calcium metabolism and ectopic ossification was explored in vain. As
precise pathological study progressed, the real harm of the lesion proved to be hyperplasia or growth of the ligament leading to occupation of the spinal canal. Fibrocartilagenous cell proliferation and matrix hyperplasia and subsequent ossification were found to be the essential processes of OPLL.

What mechanism, then, stimulates the growth of the ligament in a middle-aged or older person? Various growth factors or cytokines were found to be present in the growing front of OPLL, but the mechanism that releases or regulates them has yet to be clarified. A metabolic or endocrine system abnormality may influence this renewed growth. Predisposition to OPLL has been examined in familial surveys including studies of twins, and in the future, HLA gene analysis may be able to identify those at high risk of OPLL.

Finally, we consider what impact surgery for OPLL has on traditional spinal surgery. Decompression with spinal stability unimpaired, expansion of developmental canal stenosis without laminectomy, or sufficient decompression without excision of a lesion mass—these have been developed to treat paralysis due to OPLL. They have been made possible through the enthusiastic research and practice of Japanese spinal surgeons, and are now widely applicable to all sorts of diseases of the spine, without being limited to the cervical spine.

This monograph should be dedicated to those patients who were destined to suffer pain and paralysis without benefit of the current achievements in spinal surgery.

Keiro Ono
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