A 20-year-old male winter sports athlete presented with a 2-year history of chronic low back pain that had started during sports practice and was worse at nighttime. When his low back pain worsened, he was diagnosed as having a lumbar vertebral stress fracture. A subsequent medical examination revealed an osteoid osteoma in the anterior portion of the L4 vertebra. His night pain was relieved immediately by a non-steroidal anti-inflammatory drug. However, the effect

Figure 1. Nidus and surrounding bony consolidation in the anterior vertebral body observed (arrowhead) on reconstructed sagittal (A) and axial (B) computed tomography scans. (C) A short tau inversion recovery magnetic resonance image showing inflammatory changes around the nidus in the L4 vertebral body (arrow).
of the medication waned, and his pain worsened over time to the point that he could no longer participate in sports training. Thus, at this point, he was referred to us for surgery.

At the first visit, his low back pain was triggered when bending forward. Neurologic examinations and laboratory investigations were deemed normal. However, computed tomography (CT) scans revealed a lesion with a heterogeneous enhancement pattern that was surrounded by calcification (i.e., the nidus of osteoid osteoma) in the anterior vertebral body at L4 (Fig. 1A, 1B). Sagittal short tau inversion recovery magnetic resonance images showed inflammatory changes around the tumor (Fig. 1C). He did not have scoliosis (Fig. 2A, 2B). A bone scintigraphy image demonstrated a focal accumulation of increased activity in the anterior portion of the L4 vertebral body that appeared to be associated with the tumor (Fig. 2C).

Considering that the tumor was very small and was located on the ventral side of the vertebral body, we anticipated difficulty in performing a biopsy concurrent with complete removal via a transpedicular approach. Moreover, given that the patient was an elite athlete, we needed to devise a minimally invasive strategy to minimize the risk of iatrogenic injury to the muscles, bones, and joints. Therefore, we opted to perform a minimally invasive surgery via an approach normally used for lateral interbody fusion (LIF) and used a CT navigation system. We made a 3-cm incision on the lateral side of the left rectus abdominis muscle to allow both placement of the reference antenna of the navigation system on the superior anterior iliac spine and collection of bone for grafting from the iliac crest. After reaching the anterior aspect of the L4 vertebral body via the LIF approach,
the nidus was then detected under CT navigation (Fig. 3A). The nidus and surrounding tissues were completely removed using an air drill and curettage. Pathological findings showed small osteoblasts lining the margin of irregular trabecular bone, which was then diagnosed as osteoid osteoma (Fig. 3B). Postoperative CT confirmed that the nidus had been completely resected (Fig. 4A, 4B). After the operation, we restricted training that places vertical load on the core and allowed only trunk muscle training and partial muscle training for 3 months. He then experienced complete relief from low back pain 1 month after the operation and made a full return to his previous level of athlete competition. Approximately 1 year later, CT revealed regrowth of bone at the resection site, and the patient reported complete resolution of his back pain (Fig. 4C, 4D).

Osteoid osteoma has been defined as a benign tumor that typically occurs in the long bones. Although this tumor is sometimes encountered in the posterior elements of the spine, reports of osteoid osteoma in the anterior column are very rare. Some authors have reported that radiofrequency ablation is a useful minimally invasive treatment for this tumor. However, Baal et al. found that 10 (14.1%) of 71
patients who underwent CT-guided radiofrequency ablation for osteoid osteoma experienced symptomatic recurrence. Radiofrequency ablation via a posterior approach cannot completely remove a tumor in the vertebral body because it is too difficult to manipulate the probe and to confirm that the tumor has been ablated completely. An osteoid osteoma must be completely removed or ablated to avoid recurrence. Fujiwara et al.\textsuperscript{8} resected osteoid osteoma in five cases using intraoperative navigation and showed the safety and accuracy of the procedure. This report is the first to describe the use of a minimally invasive LIF approach in combination with intraoperative navigation for complete removal of an osteoid osteoma\textsuperscript{9}. When this tumor is localized in the anterior portion of the vertebral body, resection via a posterior approach has some disadvantages, including muscle damage, facet violation, and residual tumor. This report shows that combination of the LIF approach and a navigation system can pinpoint the exact location of an osteoid osteoma and allow its removal with high accuracy.

**Conflicts of Interest:** The authors declare that there are no relevant conflicts of interest.

**Sources of Funding:** None.

**Author Contributions:** R.M.: data acquisition and drafting of the manuscript; T.H.: study design, data acquisition, drafting of the manuscript, and critical revision of the manuscript; T.Y.: measurement of radiologic data and data acquisition; H.O.: data acquisition and software; H.I.: data acquisition and software; M.Y.: data acquisition and critical revision of the manuscript; Y.M.: data acquisition and software; S.M.: data acquisition and software; H.K.: data acquisition and interpretation of the data; S.S.: data acquisition and interpretation of the data; K.Y.: data acquisition and interpretation of the data; A.O.: supervision and critical revision of the manuscript.

**Ethical Approval:** Ethical approval was waived by the ethics committee because this is not required for case reports.

**Informed Consent:** Informed consent for publication was obtained by the patient described in this study.

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