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Syndesmophytes: Understanding Spinal Bone Growth in Inflammatory Arthritis

Feang Xu*

Department of Radiation Oncology, Peking University Third Hospital, Beijing, China

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Corresponding author:
Feang Xu

feang@xu.cn

Department of Radiation Oncology, Peking University Third Hospital, Beijing, China

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Introduction

The human spine is designed for flexibility and movement, supported by intervertebral discs, ligaments, and joints. In certain inflammatory conditions, however, abnormal bone formation can occur within the spine, leading to stiffness and reduced mobility. One such feature is the development of syndesmophytes—bony growths that form inside spinal ligaments, bridging adjacent vertebrae. Syndesmophytes are most commonly associated with ankylosing spondylitis and other forms of axial spondyloarthritis, where they play a central role in progressive spinal fusion. Understanding syndesmophytes is important for early recognition of disease, monitoring progression, and guiding treatment strategies.

What Are Syndesmophytes?

Syndesmophytes are thin, vertically oriented bony outgrowths that develop within spinal ligaments, particularly the **annulus fibrosus** of intervertebral discs. Over time, they may extend and connect neighboring vertebrae, forming rigid bridges that reduce spinal flexibility. Unlike bone spurs (osteophytes), which grow horizontally and are often linked to wear-and-tear degeneration, syndesmophytes are inflammatory in origin and typically aligned with the spine's vertical axis.

Causes and Mechanisms

The exact mechanisms behind syndesmophyte formation remain under investigation, but they are strongly linked to chronic inflammation in spondyloarthritis. Key contributing factors include:

Chronic inflammation: Persistent inflammation at the entheses (sites where ligaments and tendons attach to bone) stimulates abnormal bone formation.

Genetic predisposition: The **HLA-B27 gene** plays a major role in susceptibility to ankylosing spondylitis and syndesmophyte development.

Immune pathways: Cytokines such as tumor necrosis factor-alpha (TNF-α) and interleukin-17 (IL-17) drive inflammation and contribute to new bone growth.

Biomechanical stress: Repeated mechanical loading of the spine may influence where syndesmophytes form.

Syndesmophytes in Disease

Syndesmophytes are most commonly seen in:

Ankylosing spondylitis (AS): Characterized by progressive spinal fusion due to widespread syndesmophyte formation. Over time, this can result in the classic "bamboo spine" appearance on X-rays.

Other spondyloarthritides: Psoriatic arthritis, reactive arthritis, and inflammatory bowel disease–associated arthritis may also feature syndesmophytes, though they are often asymmetrical or less extensive.

Differentiation from osteophytes: In degenerative spine disease, osteophytes are common but differ in orientation and pathology from syndesmophytes. Correct identification is important for accurate diagnosis.

Clinical Impact

The presence of syndesmophytes significantly influences disease progression and quality of life:

Reduced mobility: Fusion of vertebrae restricts spinal flexibility, affecting posture and daily activities.

Chronic pain: Ongoing inflammation and altered biomechanics contribute to persistent discomfort.

Fracture risk: A fused, rigid spine is more prone to fractures, even

from minor trauma.

Functional limitations: Patients may experience difficulties with bending, twisting, and maintaining balance.

Diagnosis and Imaging

Detection of syndesmophytes is critical for monitoring disease progression. Diagnostic tools include:

X-rays: Reveal bony bridges and fusion, often used to assess structural progression in ankylosing spondylitis.

MRI: Identifies early inflammation at entheses before visible bone formation.

CT scans: Provide detailed imaging of bony structures but are less commonly used due to radiation exposure.

Treatment and Management

There is currently no way to reverse existing syndesmophytes, but treatment aims to reduce inflammation, slow progression, and preserve mobility.

Non-steroidal anti-inflammatory drugs (NSAIDs): First-line therapy for pain and stiffness.

Biologic therapies: TNF inhibitors and IL-17 inhibitors target key inflammatory pathways, reducing disease activity and potentially slowing new bone growth.

Physical therapy: Stretching, posture training, and mobility exercises help maintain spinal flexibility.

Lifestyle modifications: Regular activity, smoking cessation, and maintaining healthy bone density are important supportive measures.

Research Directions

Ongoing studies aim to clarify why some patients with ankylosing spondylitis develop extensive syndesmophytes while others do not. Biomarkers, genetic profiles, and advanced imaging may help predict progression and personalize treatment in the future. Additionally, research into new biologic and targeted therapies holds promise for better control of inflammation and prevention of structural damage.

Conclusion

Syndesmophytes are hallmark features of inflammatory spinal diseases such as ankylosing spondylitis, representing the body's abnormal response to chronic inflammation. Their development leads to spinal stiffness, pain, and long-term disability if not properly managed. Early recognition through imaging, combined with effective anti-inflammatory treatments and lifestyle strategies, can help slow progression and preserve quality of life. As research advances, better understanding of syndesmophyte formation may open new avenues for prevention and treatment, offering hope to patients living with these challenging conditions.