

INTRODUCTION

All physicians and patients are aware that cigarette smoking is the leading avoidable cause of lung cancer and heart disease. However, smoking also has well-documented effects on the musculoskeletal system that are not generally appreciated by both doctors and the general population. Cigarette smoking damages the bones, cartilage, muscles, soft tissue, and the intervertebral discs and increases the risk of osteoporosis and fractures.

Using the online database PubMed, we identified and reviewed articles on the impact of cigarette smoking on the musculoskeletal system.



Professional athletes can be role models for good health. National Football League (NFL) quarterback Len Dawson (1967) and Major League Baseball (MLB) first baseman Richie Allen (1972) were exceptions. Few athletes now smoke.

- Alkherayf and Agbi found that among patients with ages ranging from 20-59, there was a 7% increase in the prevalence of chronic back pain among those who smoke versus nonsmokers. [5]
- Shiri et al. found a stronger link between current smoking and low back pain in adolescents than adults. [1]
- Smoking worsens back pain in patients with scoliosis. [2]
- Smoking increases risk of lumbar radicular back pain, clinically verified sciatica, and hospitalizations or surgery due to a herniated lumbar disc or sciatica. [15]



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- Individuals who smoke are 17% more at risk of a fracture at age 60, 41% at 70, 71% at 80, and 108% at 90 than those who do not smoke. [4]
- For all individuals who smoke, the relative risk of a spine fracture is 1.76, and the relative risk of a hip fracture is 1.39 (1.26 for all fractures). [4]
- Nonunion of a fracture is twice as frequent in patients who smoke. [6]
- Currently smoking men aged 69-80 are 76% more at risk of any new fracture than men who do not smoke. [6]

Bone Mineral Density

- Women who smoke over a pack of cigarettes a day in their forties are two times more likely to report having osteoporosis at ages 50 and up than those who did not smoke at all. [3]
- Osteoporotic fractures are over two times more likely among currently smoking elderly men. [6]
- Bone mineral density decreases in smoking postmenopausal women by 4% at age 70, 6% at age 80, and 8% at age 90. [4]
- Lorentzon et al. in a study of 1068 patients between the ages of 18-20 found that the patients who smoked had lower bone density at the spine and hip, lower cortical bone size at the tibia, and thinner cortices at both the radius and the tibia. [4]
- Individuals who smoke have significantly lower levels of vitamin D and increased parathyroid hormone levels, both indicative of low blood calcium levels. Vitamin D and calcium are both vital for bone formation. [7]

BONES

Back Pain

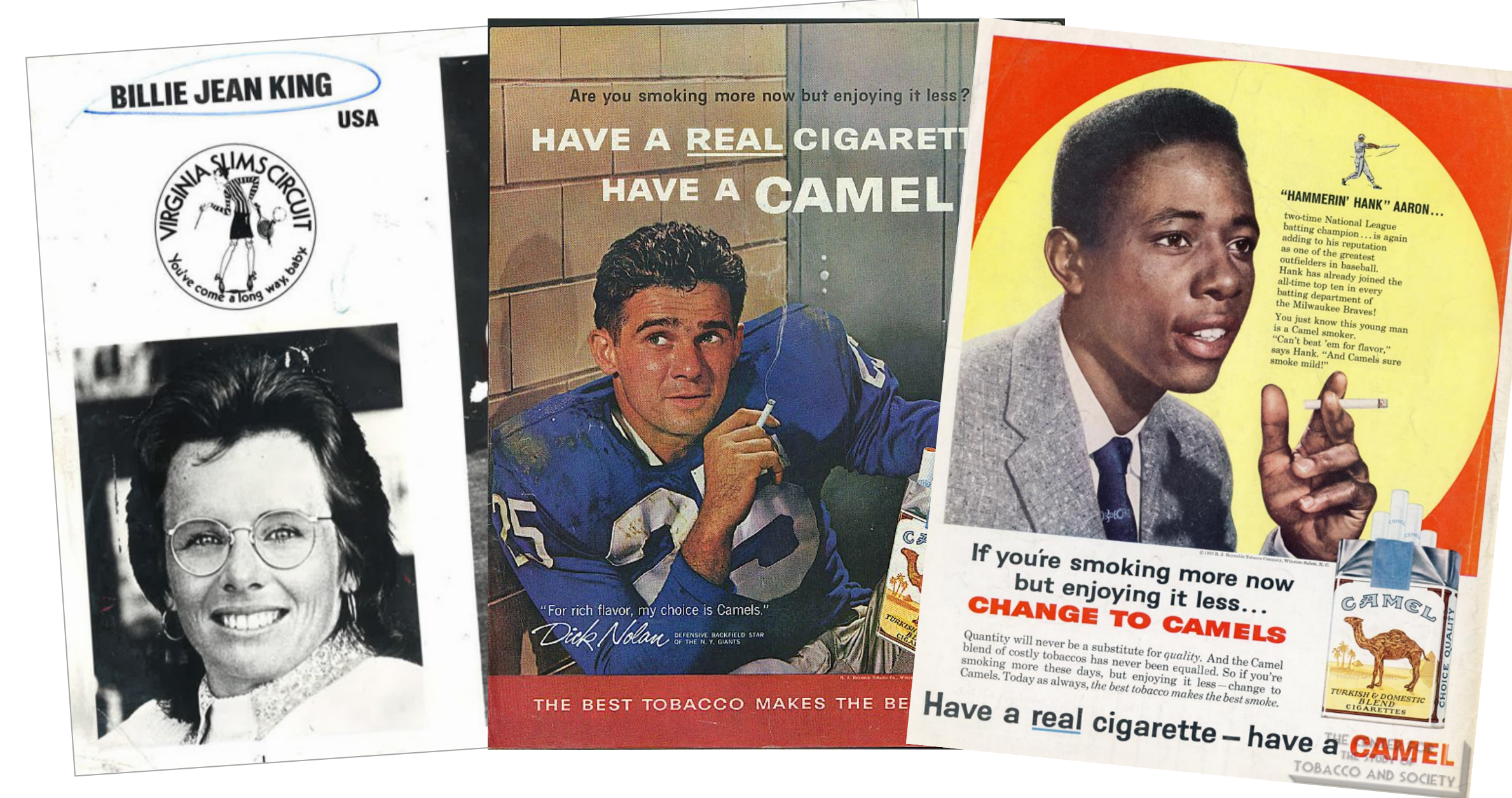
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Fractures

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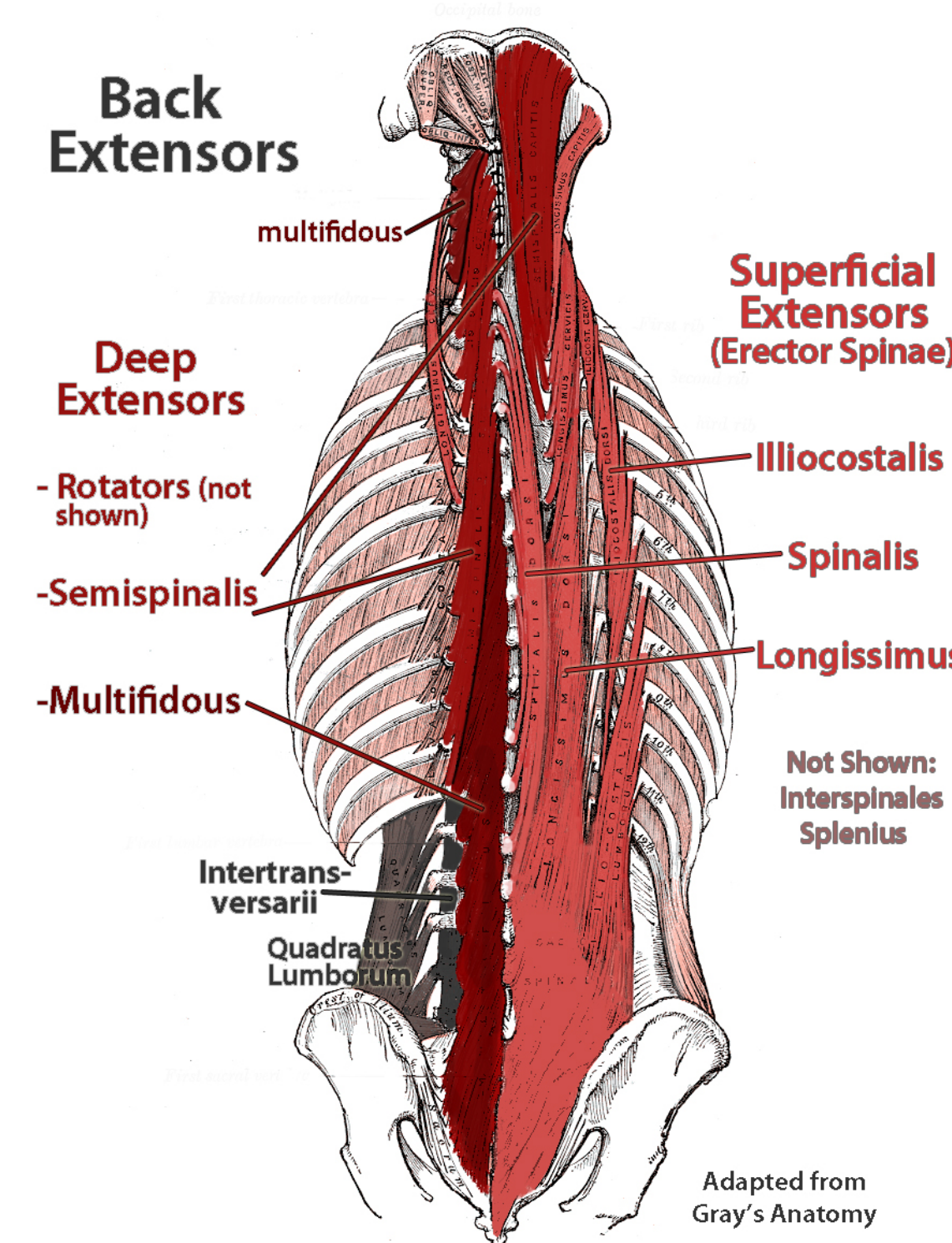
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Throughout the 20th century, tobacco companies sought to associate cigarette smoking with athletic prowess. In 1970 Billie Jean King and 8 other tennis players chose Philip Morris' Virginia Slims cigarettes as the title sponsor for the first women's pro tennis circuit. In the 1950s, NFL player Dick Nolan and MLB star Hank Aaron were paid by RJ Reynolds to endorse Camel cigarettes.

MUSCLES AND SOFT TISSUE

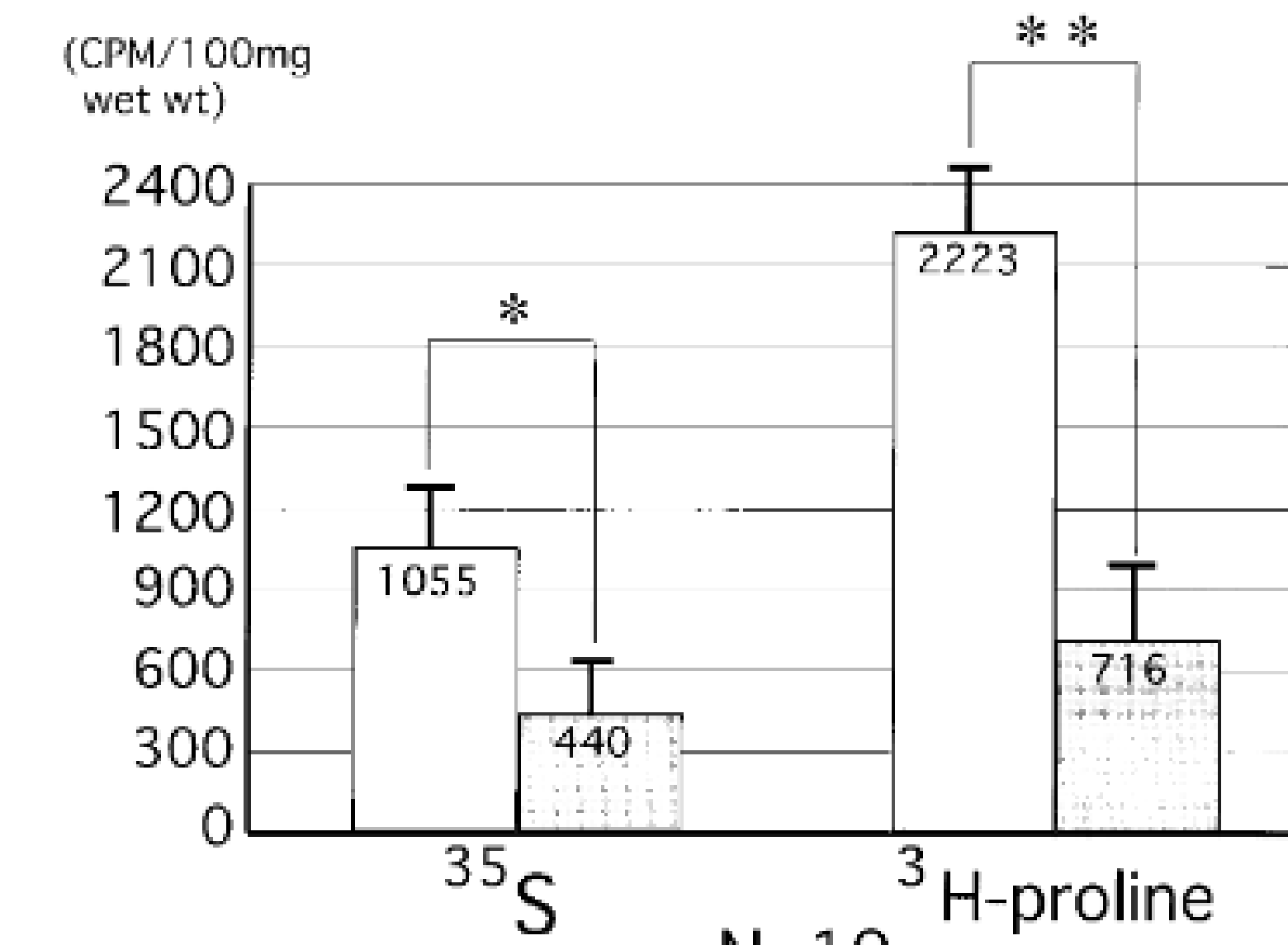
- Nicotine in cigarette smoke impedes the process of healing soft tissue wounds. The first step of wound healing is the formation of granulation tissue. Nicotine impairs the migration of fibronectin, collagen and elastin, all of which are vital to the formation of granulation tissue. [7]
- Smoking decreases subcutaneous blood flow by up to 50%, helping to cause tissue hypoxia. [7]
- The hydrogen cyanide found in cigarettes impairs oxygen transport and oxidative metabolism, which are crucial for the healing of soft tissue wounds. [7]
- Kok, Hoekstra, and Twisk found that 100 grams of tobacco smoking (roughly 200 cigarettes) a week resulted in a 2.9% reduction in knee muscle strength in men and a 5% reduction in women. These results can be generalized to the strength of other skeletal muscles as well. [12]
- Individuals who smoke have weaker grip strength and fatigue more quickly than nonsmokers. [13]
- Adedoyin et al. found that athletes who smoke perceive themselves to be exerting their back extensor muscles more than similarly aged nonsmokers. Also, after fatigue was induced, smoking athletes experienced a much higher reduction in their back extensor muscle strength than nonsmokers. [7,14]



Adedoyin et al. observed that athletes who smoke have significantly weaker back extensor muscles, shown here, than athletes who do not smoke.

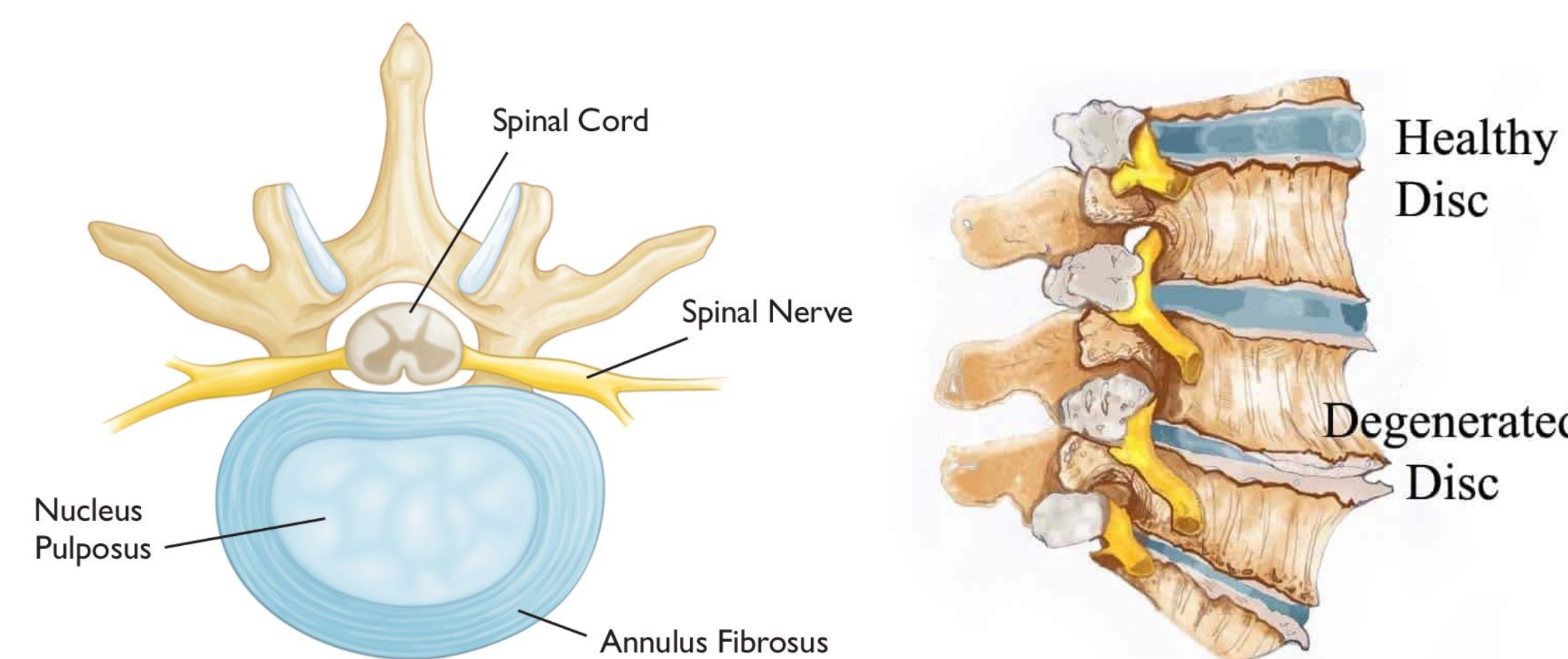
INTERVERTEBRAL DISCS

- Uematsu, Matuzaki, and Iwahashi implanted nicotine pumps in rabbits to simulate the nicotine consumption of heavy smokers for 4-8 weeks (about 30 cigarettes a day). The nicotine injection resulted in reduced synthesis of proteoglycan (left on the graph below) and collagen (right on the graph below) in the intervertebral discs. These are both key components of the extracellular matrix. [9]



Proteoglycan levels (left) and collagen levels (right) of rabbits treated with nicotine (dotted bars) vs the control group (white bars)

- Nicotine causes necrosis in the nucleus pulposus of the intervertebral disc, as well as partial cracks and detachment in the fibrous ring. [9]
- Nicotine creates a hypoxic environment which ultimately leads to disc degeneration. [8]
- Nicotine causes a dose-dependent degeneration of the cellular matrix of the intervertebral disc. [10]
- Nicotine also inhibits extracellular matrix synthesis and the proliferation of nucleus pulposus cells in vitro. [10]



Cross-section of a healthy intervertebral disc.

Comparison between a healthy disc and a degenerated one.

- Cigarette smoking constricts the vascular network that surrounds the intervertebral discs, reducing the quantity of nutrients that are transported from the blood vessels to the discs. [11]

PERIPHERAL ARTERIES

- Peripheral artery disease (PAD) is a condition in which the blood vessels are constricted, which reduces blood flow to the extremities, causing inflammation and swelling. PAD leads to infection and gangrene, and amputations are necessary in many cases. Up to 80% of patients who suffer from peripheral artery disease currently or formerly smoke.



Australia (left), France (middle), and the United States beginning in June 2021 (right) employ the use of graphic warning labels on cigarette packs that depict the adverse health consequences of smoking, including peripheral artery disease.

ADDENDUM: *Metastatic cancer*. Although smoking is not directly linked to cancer of the musculoskeletal system, bone is one of the top sites of lung cancer metastasis, along with the brain, the liver, lymph nodes, and adrenals.

SUMMARY

Cigarette smoking has been definitively linked with an increase in back pain and a decrease in muscular strength. Bone mineral density is decreased, with a greater likelihood of developing osteoporosis. This in turn increases the risk of fractures. Muscles and soft tissue are deprived of oxygen due to the hydrogen cyanide and carbon monoxide. Nicotine damages the intervertebral discs. Smoking also causes peripheral artery disease, increasing the risk of amputation. Bones are a common site of lung cancer metastasis.

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