

## Immobilization and Calcium Paradox

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### Introduction

Loss of muscle strength causing a decrease of physical stress to the bone decreases bone mass [1,2]. Immobilization or insufficient physical stress and strain on the bone is one of the major causes of osteoporosis along with hereditary, metabolic, and other causes. Along with aging, osteoporosis and its consequences, notably fracture, is known to increase, presenting with a serious menace to the health and welfare of the population [3]. One of the most common forms of immobilization osteoporosis in the 1950s was poliomyelitis, prior to the development of Salk vaccine which virtually terminated its menace. Through my experience as a research resident physician at the Chronic Disease Research Institute of University of Buffalo, I witnessed many polio patients develop huge renal pelvic stones, staghorn calculi, leading to renal failure and death in the dark age without hemodialysis therapy, despite futile attempts at reducing the risk of immobilization such as rocking bed.

Immobilized bone rapidly loses calcium to become osteoporotic. Bone calcium rapidly falls, with a rise of urinary Ca excretion, while blood Ca concentration is miraculously maintained constant. The astronomical degree of concentration difference among bone at 100,000,000, blood at 10,000 and cytosol at 1 absolutely necessary for maintenance of life may thus be exposed to a serious risk of destruction [4,5]. This is a typical example of Calcium Paradox.

### Calcium Homeostasis

In order to maintain such beautiful and even miraculous order of calcium metabolism, a unique mechanism called calcium homeostasis is at work. A specially designed endocrine-metabolic system exists to maintain the inter-relationship between various routes of calcium metabolism. This is called calcium homeostasis, one of the wonders of human physiology. The core of this system is parathyroid hormone (PTH). In the calcium-deficient environment, maintenance of constant serum Ca level, one of the essential regulators of cellular, especially cardiac, function, is the first requirement for survival. On an even minute fall of serum calcium, PTH secretion promptly increases and

serum Ca restored through increase of bone resorption, decrease of urinary Ca excretion, and cytosolic Ca uptake. Osteoporosis eventually develops. The rest of the body mainly consisting of soft tissue, is flooded with Ca. Co-existence of Ca abundance in soft tissue and Ca deficiency in bone is another example of Calcium Paradox [6].

### Good-Bye to Calcium Paradox

In order to escape from the threat of calcium Paradox, we should fight with a two-edged sword. One is re-mobilization of the excessively mobilized Ca back to the bone through exercise, and the other Ca supplementation by providing a new source to disrupt the vicious cycle. AAACa, active absorbable algal calcium, is the most effective supplement shown to increase bone mineral density reduce fracture and to meet this requirement [7,8]. Extremely low Ca intake in Japan and other East Asian countries, 600 mg/day or less, should be doubled by effective Ca supplementation. Addition of vitamin D derivatives also helps. We have then nothing to worry about our bone health to continue a healthy and constructive life.

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