

## **Biological Concept of CPM**

The originator of the biologic concept of continuous passive motion was Robert B. Salter, OC, MD, MS, FRCSC, a pioneer in the field of orthopaedic surgery who served as Chief of Orthopaedic Surgery at Toronto's Hospital for Sick Children for over forty years.

Dr. Salter has published more than 150 articles as well as a major textbook, Diseases of the Musculo-Skeletal System. His honors include the 1969 Gairdner International Award for Medical Science for his contributions to the understanding of cartilage degeneration and necrosis of the epiphyseal plate, induction into the Canadian Medical Hall of Fame, and the 1997 F.N.G. Starr Award, which is the highest award the CMA can bestow upon a member.

Recognized as a world-renowned surgeon, teacher, and scientist, Dr. Salter now serves as the surgeon-in-chief emeritus and senior orthopaedic surgeon emeritus at the Hospital for Sick Children.

In 1994, Dr. Salter published The Physiologic Basis of Continuous Passive Motion for Articular Cartilage Healing and Regeneration, in which he presented an overview of the first 23 years of basic research on the biologic concept of CPM and the first 15 years of his experience with the clinical application of CPM to a variety of disorders and injuries.

### **Basic Premises and Hypotheses of CPM**

The basic premises that led Dr. Salter to the concept of continuous passive motion were that:

1. Synovial joints were meant to move and actually deteriorate when not allowed to do so,
2. Motion enhances nutrition to the articular cartilage surface of synovial joints by facilitating the movement of synovial fluid into and out of the cartilage matrix,
3. The synovial membrane should glide over the articular surface and becomes adherent to the underlying cartilage if prevented from doing so, and
4. Synovial joints were meant to last a lifetime.

With these premises in mind, Dr. Salter hypothesized that continuous passive motion should have the following effects on synovial joints:

1. Enhance metabolic activity and joint nutrition,
2. Stimulate pluripotential cells to differentiate into hyaline cartilage rather than fibrocartilage or bone, thereby leading to healing and regeneration of hyaline cartilage, and
3. Accelerate healing of articular cartilage and periarticular structures, such as tendons and ligaments.

### **Overview, Results, and Conclusions of Basic Research**

Dr. Salter and a succession of Basic Research Fellows have conducted experimental

investigations in both adult and adolescent rabbits on the effects of CPM on full and partial-thickness defects, intra-articular fracture, acute septic arthritis, intra-articular fluid pressures, clearance of hemarthrosis, wound healing, muscle atrophy, immobilization, tendon and ligament healing, autogenous and allogenic intra-articular periosteal grafts, and chondral shaving and subchondral abrasion.

This basic research led Dr. Salter to the conclusions that CPM:

1. Is well tolerated,
2. Has significant stimulating effects on articular cartilage and peri-articular tissues,
3. Prevents adhesion formation and joint stiffness,
4. Does not interfere with, and actually enhances, healing of incisions over a moving joint, and
5. Regeneration of articular cartilage through neochondrogenesis is possible under the influence of CPM.

Note: This information is intended for educational purposes only. The data is based on animal laboratory studies and may not represent human clinical situations.

### **Clinical Applications and Results**

In 1978, Dr. Salter began to apply CPM to humans following procedures such as ORIF of intra-articular, metaphyseal, and diaphyseal fractures, surgical release of extra-articular joint contractures, arthrotomy and incision with drainage for acute septic arthritis, synovectomy, biologic resurfacing, ligamentous repair and reconstruction, tendon repair, tibial osteotomy, and total joint replacement.

Results from these clinical applications include: CPM is well tolerated, maintenance of an increased ROM, normal wound healing, absence of complications, and shortened period of hospitalization and rehabilitation.