



GOLDEN CONNECTION BETWEEN STEM CELLS AND ORTHOPEDIC SERVICES

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INTRODUCTION

Utilization of stem cells in orthopedics has increased dramatically. Consequently, stem cells were discovered to have many roles. Some researchers have used them for regenerative medicine, while some have discovered them as a natural source of immune modulators. Currently, there are several research teams studying the translational potential of stem cells, while clinicians have begun treating patients with orthopedic problems (1).

Over the past fifteen years, orthopedic surgeons have prioritized Mesenchymal Stem Cell (MSCs) treatment. Several animal experiments have had favorable results, and there is rising concern over their use in human trials. In these clinical studies, stem cell operations were intended to promote fracture healing and cure nonunion, regenerate articular cartilage in degenerated joints, repair ligament or

tendon injuries, and replace degenerative spinal disks (1,2).

In past research, stem cells have been used for bone tissue regeneration. Bone tissue engineering presents an alternative treatment that may produce a microenvironment with osteogenic, osteoinductive, and osteoconductive properties. In recent studies, researchers have devised methods for combining MSCs with three-dimensional biodegradable polymeric scaffolds. In addition, Udehiya et al. found that the use of hydroxyapatite scaffolds in conjunction with Bone Marrow-MSCs (BM-MSC) accelerates and enhances the healing of bone segmental defects in a rabbit model compared to the use of hydroxyapatite scaffolds alone. Muwan Chen and colleagues discovered that human BMMSC combined with hyaluronic acid and b-Tri calcium phosphate-coated polymeric scaffold stimulated osteogenic differentiation, cellular proliferation, and

reorganization of the cellular matrix in vitro (1–3).

Since 2010, stem cells have undergone a paradigm shift where previously stem cells can differentiate and heal injured organs. This stem cell misunderstanding has led some practitioners in the United States and around the world to advertise the availability of stem cell treatments, e.g., MSC can heal blindness, make paralyzed people walk, and makes old tissue young again. In further studies, it was found that at the site of disease, MSCs rarely or never differentiated into tissue at that location, but they do secrete bioactive factors such as growth factors and their therapeutic effects can be analyzed as a site-specific clinical outcome parameter (2–4).

Orthopedic Indications of Stem Cells in most orthopedic procedures are performed to address bone, cartilage and soft tissue problems. These procedures are carefully conducted to increase patient satisfaction and the quality of regenerated tissue. Additionally, there are reductions in recovery time. Some of the treatment related complications can now be avoided because of the evolution of management and treatment techniques and the extension of scientific and technological knowledge (4–6).

Fractures-Bone Defects on extrusion of bone fragments following high energy trauma or gunshot wounds might result in open fractures with cases of bone loss. Missing bone fragments are one of the most challenging conditions seen in orthopedic trauma. Masquelet and Henrich et al. conducted stem cell investigations in this problem. They used membranes containing

MSCs to treat femoral bone fragment loss and found that the levels of vascular endothelial growth factor (VEGF), bone morphogenetic protein-2 (BMP-2) and transforming growth factor (TGF) were significantly elevated in the membranes. These results raise the question of whether MSCs can be used to repair bone loss. In their comprehensive study, Lio et al. found that bone marrow derived stem cells (BMDSCs) can enhance bone formation and bone mineral density (6,7).

Nonunion is annually, there are 6.2 million fractures in the United States of America and 5 to 10 percent end in nonunion. This is a catastrophic condition that contributes to increased morbidity and cost among patients. Concerning this challenging condition, there is a rising interest in stem cell research, and encouraging results have been reported. A tibial nonunion patient was treated with BM-MCSs and calcium sulphate by Bajada et al. In a short length of time, they found complete union with BM-MCSs and calcium sulphate. Similarly, Giannotti et al. effectively treated seven patients with nonunion of long bones with BMDSCs. According to Grgurevic et al., the combination of BMDSCs with bone morphogenetic protein (BMP) 1- 3 promotes type-I collagen and osteocalcin in rats with nonunion of long bones (1,7,8).

Cartilage Defects due to the limited regenerative capacity of hyaline cartilage, certain materials are necessary for efficient regeneration of hyaline cartilage. Recent research has demonstrated that mesenchymal cells (MSCs) have a consistent and repeatable effect on cartilage regeneration, prompting various

authors to advocate for their application. Numerous studies have shown that human bone marrow stem cells (hMSCs) are capable of chondrogenesis and regeneration. Under appropriate growing conditions, MSCs can produce cartilage-like tissue with a type II collagen and aggrecan matrix. In clinical practice, isolated chondrocytes derived from normal cartilage tissue and cultivated via cell culture have been successfully then injected intraarticularly into knees (1,7,8).

Wakitani was the first to disclose the therapeutic application of MSCs for osteoarthritic knee therapy and to exhibit better arthroscopic and histological results. Murdoch et al. discovered that hMSCs cultured using Transwell permeable membranes as a growth and differentiation factor produced rigid transparent cartilaginous discs and cartilage-specific structural proteins like aggrecan and type II collagen. Zhu et al. preferred the combination of BM-MSCs and a connective tissue growth factor and showed that the hyaline cartilage regenerated after therapy was equivalent to normal hyaline cartilage. Guo et al. used BM-MSCs in combination with TGF-beta to successfully treat full thickness defects in articular cartilage. Similarly, Reyes et al. successfully demonstrated that BMDSCs in conjunction with BMP effectively treated rabbit knees with osteochondral lesions (1,2,8).

Ligament-Tendon Injuries nearly 50% of musculoskeletal injuries involve soft tissue damage, such as to ligaments and tendons. Complete ligament and tendon healing can take up to 2.5 years after damage, and the restored tissue may have less structured

collagen fibrils, resulting in lower mechanical strength; hence, the likelihood of re-injury and re-rupture is increased (1,2,8).

In general, most authors have stated that stem cell treatment can enhance ligament-tendon repair and regeneration. According to Saether et al., MSCs can accelerate the recovery of ligament-tendon lesions. There have been fewer stem cell experiments with contradictory results in this sector. To optimize stem cell role, increase favorable results, and reduce the risk of re-injury, further research is needed (2,3).

Anterior Cruciate Ligament Lesions Knee injuries are relatively common, with 17 to 61% requiring surgical intervention. MSCs and anterior cruciate ligament (ACL) fibroblasts have been shown to have reparative effects on ACL rupture (2–4).

Medial Collateral Ligament Lesions, Saether et al. evaluated the effectiveness of MSCs in the treatment of medial collateral ligament (MCL) tear in rats and observed that treatment of MSCs can reduce inflammation and produce rapid, high-quality of regeneration (1,8).

Meniscopathies are frequent among individuals of all ages. In the latter stages of meniscopathies, the knee's biomechanics deteriorate, and osteoarthritic changes develop in the knee joint if the ailment is not successfully managed. Hatsushika et al. administered BM-MSCs to a pig model with a significant meniscus tear and evaluated the effects using magnetic resonance imagery (MRI). They found that BM-MSCs can promote meniscus regeneration (6,8).

Femoral head osteonecrosis is one of the progressive disorders found frequently in younger adults. It is one of the most common progressive diseases, characterized by a disturbance in femoral head and joint deterioration. Papakostidis et al. examined the effectiveness of core decompression and local MSC in the treatment of femoral head avascular necrosis and found that MSC therapy decreases the requirement for total hip arthroplasty (4,6,8). The scientific community's understanding of stem cell applications, their complexity, and their implications has expanded significantly over the course of several years. Stem cell treatment has permeated operative and non-surgical sports medicine, due in part to the growing number of physically active patients seeking greater degrees of improvement.

Stem cell therapy has the potential to be a successful treatment for an extensive range of diseases due to its anti-inflammatory, immunoregulatory, angiogenic, and paracrine effects. In the study of musculoskeletal tissue regeneration, it continues to be a very dynamic option. Although the use of stem cells in ordinary surgical operations is possible, it is too early to say if this will occur (5,7). The ideal stem cell sources (including allogeneic and autologous), preparation, cell quantity, timing, and application methods continue to be investigated, as do the diseases that can be treated with this therapy.

To adequately address these vital concerns, we must guarantee that stem cell translational research is performed in a safe, cost-effective, and morally

acceptable manner. A standardized protocol is required for more high-level investigations. Improving national and international research collaboration, as well as collaboration with governmental entities, is crucial for advancing scientific knowledge in this field of study (6). With official authority, more study on the use of stem cells might be useful. The efficacy of stem cell adjuncts, such as platelet-rich plasma, exosome, secretome which may enhance the signaling, regeneration, and mechanical stimulation of the transplanted stem cells, or fascinating directions for research and need more investigation.

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