ACL PRIMARY REPAIR WITH BONE MARROW STIMULATION AND GROWTH FACTORS

INTRODUCTION

The incidences of ligament around the knee have been steadily increasing following an increase in participation in recreational and competitive sporting activities. According to an ongoing study in the United States, an estimated 200,000 anterior cruciate ligament (ACL) reconstructions are performed annually, and the incidence of ACL injury is roughly 1 in 3000 per year. The treatment of acute rupture of ACL is an area of considerable controversy despite many advances in the sports medicine. ACL reconstruction with tendon graft is considered as a gold standard treatment with a high success rate of 80%, but has some disadvantages like poor proprioception, postoperative muscular weakness, inability to restore normal kinematics, and possible premature osteoarthritis. Many long-term follow-up studies have showed that suture repair of partially torn ACL without any biological stimulation presented failure rates of up to 90% and were therefore abandoned. Despite reports of the poor healing potential of the ACL in the past, 18 recent investigations showed the possibility of ACL healing after primary suture of the ligament augmented with the use of growth factors from PRP preparation and bone marrow–derived multipotent mesenchymal stem cells (BMSCs). Considering the fact that ACL injury and associated chondral injury mostly affects young sports population, leading to considerable morbidity, newer biological therapeutic options should be investigated to address these knee injuries effectively.

Cellular therapies offer an interesting option in the treatment of injured ACL and chondral lesions by addressing the defect in healing at a molecular level and leading to a more biological way of healing. Simultaneous concentration of platelets and bone marrow stem cells, acting as sources of growth factors and “working cells”, can play important roles in future regenerative medicine. Platelet-rich plasma (PRP) contains many important growth factors, and recent studies have proven the beneficial effects of PRP in augmenting the healing of ACL. The rationale for the use of PRP is to stimulate a “supra-physiological” release of platelet-derived factors directly at the site of treatment. Autologous PRP can be obtained from simple blood extraction using a commercially available kit. These Bioactive proteins and growth factors play an important role in tissue healing as they can regulate key processes in tissue repair, including cell proliferation, chemotaxis, migration, cellular differentiation, and extracellular matrix synthesis.

OUR STUDY AND RESULTS

We prospectively studied a group of 50 athletes treated with primary ACL repair combined with bone marrow stimulation and Growth factor rich PRP injection for 5-years. At final follow-up 78% of the patients returned to their sporting activities, a significant decrease in the side-to-
side difference in anterior translation (4.1mm preoperatively to 1.4mm postoperatively, \( P < 0.05 \)), a significant improvement in the postoperative Tegner \( (P < 0.05) \) and the Single Assessment Numeric Evaluation scores \( (P < 0.05) \). Final Marx and Noyes scores were similar to pre-injury values and the final IKDC objective was as follows: normal (A) in 39 patients; nearly normal (B) in 10 patients; and severely abnormal (D) in 1 patient (2%). Re-tear of the repaired ligament was seen in 4 patients, and 1 patient had residual laxity resulting in a survival rate of 90% at the 5-year follow-up.

(a.) Partial ACL tear

(b.) Suturing to torn bundle to the intact bundle

(c.) Bone marrow stimulation.

(d.) PRP injection after suturing the ACL to femoral attachment.
DISCUSSION

Primary Repair with Bone marrow stimulation and growth factor injection is a viable option for acute partial ACL lesions in young athletes. The addition of PRP to BMSCs would form a bioactive composite suited for healing of tissue defects in vivo by acting as sources of growth factors and working cells. Furthermore, with greater advances in tissue engineering and molecular biology, the concept of scaffolds and cell-scaffold composites and their role in augmenting ligament repair offers interesting therapeutic options. Studies have reported accelerated healing with increased tissue formation and enhanced ACL cell viability, metabolic activity, and collagen synthesis after the use of PRP-scaffold composites in tissue healing in experimental ACL models. The underlying premise is that while PRP/BMSCs will act as the source of growth factors and precursor cells, the scaffold would act both as a matrix in the cellular process and as a biomechanical support after primary repair of ACL and provide a secure environment for the cells away from the effects of circulating plasmin in the joint space, which prematurely breaks down the fibrin clot.

Currently we are also exploring the possibility of using autologous Mesenchymal stem cells harvested from adipose tissue to treat chondropathy and early osteoarthritis of knee joint. This new technique is minimally invasive and is associated with less donor site morbidity, short harvesting time and availability of good quantity and quality of mesenchymal stem cells. In the near future this new technique could be the new cellular therapy option for many orthopedic applications.