The management of articular cartilage defects is one of the most challenging problems for sports medicine. Articular cartilage, a highly organized tissue with substantial durability, has a limited intrinsic healing capacity. Damage from trauma or degenerative pathology frequently results in gradual tissue deterioration, leading to debilitating joint pain, functional impairment and degenerative arthritis. At present, the standard surgical intervention for end-stage degenerative joint pathology is total joint replacement. Early surgical intervention for symptomatic cartilage lesions, including microfracture, autologous osteochondral graft transplantation and ACI procedure, has been suggested to restore normal joint congruity and minimize further joint deterioration. Often, these techniques are not long-term clinical solutions, urging the development of regenerative medicine and tissue engineering approaches to restore articular cartilage. New-coming strategies include cell-based (with or without scaffolds) or tissue engineering techniques.

We discuss the basic principles, advantages, shortcomings and outcomes of tissue engineering for cartilage healing. Moreover, we discuss our basic and clinical tissue engineering trials for cartilage repair, with an emphasis on the use of mesenchymal stem cells (MSCs), scaffolds functionalization, implantation-based and one-step therapies.