Basic fibroblast growth factor induces bone regeneration and suppresses the progression of secondary osteoarthritis in a rabbit model of osteonecrosis of the femoral head

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Introduction

Untreated symptomatic osteonecrosis of the femoral head (ONFH) often leads to femoral head collapse and advanced secondary osteoarthritis (OA). The ultimate goal in the treatment of ONFH is to preserve the femoral head in early stages and avoid arthroplasty. Although growth factor therapy such as basic fibroblast growth factor (bFGF) have been proposed [1], no reliable animal model of ONFH was found [2]. Thus, we developed a new animal model of ONFH in rabbits and investigated this ONFH model and the therapeutic effects of bFGF on the repair of ONFH.

Materials and Methods

hrbFGF was provided by Kaken Pharmaceutical Co.,Ltd. (Tokyo, Japan). Biodegradable gelatin hydrogel was prepared through the glutaraldehyde crosslinking of acidic gelatin that was purified from natural bovine bone, as we reported previously [3]. Animal model of ONFH in rabbits were induced by the treatment combining the administration of high dose corticosteroids (40mg/kg of methylprednisolone) and the occlusion of vascular supply to the capital femoral epiphysis by the electrical coagulation of femoral surgical neck and capsule. (Fig. 1) Thirty five male white rabbits underwent ONFH were divided three groups as follows: (1) Control group, in which the rabbits received no further treatment after ONFH; treatment groups: (2) PBS group and (3) bFGF group, in which eight weeks after ONFH, 100 μg bFGF or PBS contained in 100 μl gelatin hydrogel microspheres were directly injected into the femoral head and articular surface. Animals in control group were sacrificed at 0, 4, 8, 12, 24 weeks, the treatment groups were sacrificed at 24 weeks after ONFH (n=5 each). Gross morphologic and histologic examinations, and radiographic assessment by micro CT scans and MRI were performed.

Results

Control group developed ONFH according to radiological and histological stages of ONFH and finally developed secondary OA. bFGF group were significantly better gross appearance, histological score and high bone formation rate than PBS group. Macrosopically, bFGF group did not show collapse. (Fig. 2) The roundness index of the femoral head was significantly less in the bFGF group (52.4±4.9%) than that in the PBS group (62.2±4.3%, P<0.05).

Discussion

bFGF induces bone regeneration and suppresses the progression of OA. Our findings demonstrated that bFGF into the femoral head and articular surface had therapeutic effects on bone and cartilage repair. Our results suggest the potential feasibility of a new treatment for ONFH, adding to the advantages of minimally invasive technique.

References