INTRODUCTION: Osteochondral autograft techniques have been developed for the treatment of focal cartilage lesions. Although the recent reports of these techniques have been encouraging, there are concerns about the healing of the graft with the host tissue and the incongruity of the articular surface. In addition, the characteristics of the repair tissue between multiple grafts are not clear. The possibility that the addition of rhBMP-2 to osteochondral autografts and the recipient site could improve the repair of cartilage defects was investigated using a non-human primate model.

MATERIALS AND METHODS: All experimental techniques were approved by the Institutional Animal Care and Use Committee. Osteochondral grafts (3.5 mm diameter, 6 mm long) were harvested from the trochlear groove, and transplanted into defects created on the medial and lateral femoral condyles. This sized defect encompassed approximately 70% of the width of the condyle in this species. In the experimental group (n=6 defects), 25 µg rhBMP-2 was dripped into the recipient site. Subsequently, the grafts were soaked in rhBMP-2 solution (1.25 mg/ml) for 2 minutes and transplanted into the site. In the control group (n=6 defects), rhBMP-2 was replaced by buffer. The lower limb was immobilized in a cast for two weeks, and passive motion exercises were performed every other day thereafter until the normal range of motion of the knee joint was resumed. The animals were scanned 2, 6, and 9 weeks postoperatively using peripheral quantitative computed tomography (pQCT) to assess bone density in the donor sites. The animals were sacrificed 9 weeks after the operation and the transplants and surrounding tissue were evaluated computerized image analysis of the histologic sections. Each sample was evaluated at three levels of the donor and recipient graft sites. Results were evaluated using the unpaired Student’s t-test.

RESULTS: All the animals had normal function of their knee joints. On gross examination, the joints showed no signs of inflammation. Osteophytes were not found in any joint. Although the surface of the defects appeared level with the surrounding cartilage on gross examination, microscopic observation revealed subsidence of the grafts in most of the cases. The tissue observed grossly covering the surface was actually new tissue, which had formed on top of the grafts. Computerized image analysis was performed by a blinded evaluator to quantitate percent filling of the defect, the new tissue types formed above the original tide mark, the integration of the grafts and the surrounding cartilage, and the viability of the grafted cartilage (Table 1). Favorable results were observed in the rhBMP-2 treated group in all these parameters (Figures 1 and 2). There was mostly fibrous tissue on top of the graft in the control group, while more transitional and chondrocytic tissue, which remodeled the surface and eliminated gaps at the edges, was observed in the rhBMP-2 treated group. Integration between host and graft bone was improved, but more strikingly, integration between host and graft cartilage was also significantly improved. Whereas 9.4% of the grafted cartilage showed evidence of degeneration in untreated grafts, there was no degeneration of the rhBMP-2 treated grafted cartilage. pQCT showed that the bone density increased in the donor sites with time. At 6 weeks and 9 weeks after the operation, the tissue in the rhBMP-2 treated donor sites was significantly denser and the healing process was more advanced compared to control sites. Histologically, the donor sites contained regenerated bone trabeculae with fibrous tissue at the surface in all the cases.

DISCUSSION AND CONCLUSION: These results demonstrated that the healing of osteochondral grafts in articular cartilage defects was improved by the addition of rhBMP-2. The most dramatic improvement was the newly formed transitional tissue, which remodeled the surface of the defect site. rhBMP-2 also promoted new cartilage formation between the graft and the host cartilage, which significantly improved the integration of graft. In the donor site, rhBMP-2 accelerated the regeneration of subchondral bone. These results suggest that the combination of rhBMP-2 and osteochondral grafts might be a potent strategy in the treatment of articular cartilage defects.