Mesenchymal Stem Cells and BMP7 Promote Bone Allograft Integration

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Introduction
Massive bone allografts are widely used in orthopaedic reconstructive surgery to replace bone defects due to trauma or oncologic resections (1). Limited incorporation and modest bone remodeling can cause allograft failure. We previously demonstrated that the association of Platelet Rich Plasma with mesenchymal stem cells (MSC) improves allograft integration (2). Bone morphogenic proteins (BMPs) have been shown to be beneficial in the treatment of a variety of bone conditions including non union. The aim of the study is to investigate whether OP-1 (BMP7) and MSC could improve allograft integration.

Materials and Methods
Twenty Alpine sheep were randomly assigned to four groups of five animals each. A critical full size defect 3 cm wide was made in the diaphysis of the metatarsal bone. The defect was replaced with a sterile allograft. The allograft was implanted alone in the Control Group while around the allograft was applied 4 × 10⁷ MSC in the MSC Group, rh-OP1 (Osigraft 3,5 mg, Stryker Biotech, Massachusetts, USA) in the OP-1 Group, 4 × 10⁷ MSCs mixed with rh-OP1 (Osigraft 3,5 mg) in the MSC + OP-1 Group. In order to investigate allograft integration, all the animals were radiographed in AP view projection at 1, 2 and 4 months. After sacrifice the osteotomy lines were sectioned and all specimens were evaluated non decalcified. The slides were evaluated for histomorphometric analysis. Statistical analysis was performed with the Mann-Whitney test calculated with the Monte Carlo method for small groups.

Results
Only in the MSC + OP-1 Group callus formation increased in the first month, but it decreased after the second month, becoming almost not visible at 4th month. Histology showed that in the Control Group and in MSC Group the integration of the graft was caused mainly by external callus formation with no new bone formed within the graft. On the other hand, in the OP-1 Group and in the MSC + OP-1 Group integration processes occurred mainly by direct new cutting cones penetration. The remodelling processes were predominant inside the graft with a good amount of new bone apposition and the external callus was almost not present. However, in the OP-1 Group the graft after 4 months appeared to be almost completely reabsorbed with a high presence of newly formed vessels and woven bone.

Discussion and Conclusions
In conclusion, this experimental study demonstrated that the addition of MSC and OP-1 can increase the integration of a massive bone allograft with a high amount of new bone formation inside its structure.

References

Disclosures
The study was partially supported by Stryker.