

Skeletal Muscle Autografting Improves Bone Healing in Pigs With Segmental Bone Defects and Volumetric Muscle Loss

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Purpose: Open fractures can be complicated by segmental bone defects (SBDs) with adjacent volumetric muscle loss (VML). Traditionally, VML is treated with tissue transfer procedures to provide wound coverage. However, flaps cannot restore muscle function. We have developed methods to restore functional muscle in a VML defect by filling the void with minced skeletal muscle autograft (SMA). In this study, we study the efficacy of SMA to restore muscle and bone healing in a porcine metacritical sized SBD survival model.

Methods: 12 Yucatan minipigs (YMPs) were subjected to a 25.0-mm SBD in the tibial diaphysis that was stabilized with an 8-hole 3.5-mm compression plate on the lateral surface and a 7-hole one-third tubular plate on the medial surface. Subsequently, a 3.0 x 3.0-cm partial-thickness section of adjacent anterior compartment muscle was resected (7.0 g). Six YMPs had no treatment in the VML defect [VML]. Six YMPs had 5.3 g of the resected muscle manually minced and placed back into the VML defect [SMA]. Animals were sacrificed at 3 months after injury. In vivo manual muscle maximum strength testing was performed prior to injury and monthly until sacrifice with a custom-built testing fixture. Serial radiographs were collected monthly. Bone healing was quantified by modified Radiographic Union of Tibial Fractures Score (mRUST) (CT data are currently pending).

Results: Two of 7 VML specimens healed the defect compared to 4 of 5 SMA pigs (Fig. 1). Healing trajectories were affected within the first month after injury. Muscle strength was not improved but was improving in SMA specimens at the time of sacrifice.

Conclusion: SMA significantly improved bone healing in a YMP SBD model with VML. Longer follow-up will be needed to determine the effect of SMA on functional muscle strength.

