# Cortical bone: a ground-breaking source for multipotent stem cells

Multipotent stromal cells also known as mesenchymal stem cells (MSCs) are a family of cells derived from the mesodermal germ layer, distinguished by their ability to replicate themselves and differentiate, or change morph into different types of cells or tissues including bone, fat, and cartilage. MSCs are different from red blood cells and white blood cells. Since their discovery in 1976 by Dr. Friedenstein*, a* massive number of investigators concluded that these cells can be found in different body tissues, including bone, cartilage, skin, fat, teeth, blood, tendons, amniotic fluid, placenta and umbilical cord among others. The promising qualities and abilities of MSCs acting on tissue regeneration and immune system control sows a tempting idea to use them as therapy in regenerative medicine.

The ideal source for MSCs is unknown. While derived from different tissues, MSCs show similar surface characteristics yet diverse properties depending on the source of origin. In the regenerative field, bone marrow MSCs (BM-MSCs) have been widely accepted and used in orthopedics, but they constitute only a small amount of cells in the bone marrow and the obtaining method, bone marrow aspiration, is painful and carries several complications. The advantages of using fat as a source of MSCs include less invasion, more cells and a superior ability to proliferate.

The purpose of this study was to compare MSCs obtained from the cortical bone versus the bone marrow and the adipose tissue which are, currently most used methods to obtain MSCs. The bone has two boney “compartments”, the cortical bone (i.e. out compartment) and cancellous bone (inner compartment). The bones were obtained from cortical bone fragments from patients undergoing spinal surgery. Bones were cleaned from any tissue remnant and processed with enzymes to acquire the cells.  Once cells were obtained, histologic staining, cell collection and culture, proliferation assays and genetic expression characterization was performed.

Our data analysis in vitro suggested that cortical bone MSCs (CBF-MSCs) are a superior source of cells for the purpose of bone regeneration compared with adipose and bone marrow derived cells. Compact bone MSCs show enhanced production of mature osteoblast (i.e bone cells) and bone production when compared with bone marrow MSCs, these results can be translated into the clinical practice for bone healing and repair.  Interestingly, when placed in an environment with very little oxygen, their ability to regenerate the components of bone, like calcium, were increased compared to normal oxygen levels. This suggests that an ideal environment for the production of bone is in low oxygen levels, like what is seen in the healing wound.

The superior behavior and ability of CBF-MSCs to increase their biosynthetic activity under deficient amount of oxygen conditions may suit better for some orthopedic tissues and scenarios, including spinal fusion to avoid abnormal motion of the vertebrae seen in trauma, degenerative conditions, spinal tumor and in spinal deformity.

With our study we demonstrate several differences between MSCs acquired from different sources (fat, bone marrow, and cortical bone) exist regarding their potential to produce and repair bone, and these differences are augmented in low oxygen settings.

Choosing the cell source for MSCs should be personalized on the surgical application and patient needs, developing a specific therapy. More research in vivo is fundamental to characterize the optimal source for orthopedic regeneration.

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## Publication

Enhanced osteogenic potential of mesenchymal stem cells from cortical bone: a comparative analysis.
Fernandez-Moure JS, Corradetti B, Chan P, Van Eps JL, Janecek T, Rameshwar P, Weiner BK, Tasciotti E.
*Stem Cell Res Ther. 2015 Oct 26*