Key Points:
- Stem cell therapy is an exciting new therapy for damaged tissues.
- Stem cells have the ability to multiply and differentiate into multiple tissue types.
- In addition to providing constructs of new tissue, stem cells may also augment the healing process.

The therapeutic use of stem cells or progenitor cells for veterinary patients has become more commonplace in the last several years. The exciting possibility of regenerating damaged tissues, especially tissues that heal poorly like cartilage and tendon, has spurred growth in this area. However, the more the technology has been studied, the more we realize it may not work exactly as originally thought. Moreover, the different types of stem cells or mesenchymal cells that might be used for injury as well as the number of applications has multiplied, and the questions about which approach or which cell type is best for which type of injury have not been answered. The complexity of the field of regenerative medicine and the complexity of defining a cell as a stem cell has muddied the waters further. This presentation will outline what is currently known about adult tissue-derived stem cells, progenitor cells, and cell mixtures, and what we need to know to utilize these techniques fully and appropriately.

In the early 1960’s Till and McCulloch initiated work transplanting bone marrow from healthy mice and injecting them into anemic mice. They observed formation of colonies of cells in the spleen that were capable of generating blood cells. This exciting work led to the field of adult stem cell biology, demonstrating the first hallmark of a stem cell: the capability of self-renewal. Self-renewal specifically refers to the ability to go through multiple divisions and maintain an undifferentiated state.

The second hallmark of a mesenchymal stem cell is the ability to form multiple tissue types. This is called multipotency. Embryonic stem cells have the characteristic of forming all the tissues of the body, and are therefore referred to as totipotent. The number of tissues that a specific stem cell can differentiate into varies depending on the tissue source of the cells, as well as how the cells are cultured. The three differentiation pathways that have been used most commonly to test multipotency are cartilage, adipose and bone. This is called “tri-lineage differentiation” and is considered a critical hallmark for mesenchymal stem cells. However, these three pathways do not represent all the therapeutic potentials the cells have, nor do these assays determine how functional the cells will be once implanted.

More recently, it has been shown that stem cells interact with the inflammatory process, and recruit circulating cells to areas of injury. These functions have been referred to as trophic effects. The anti-inflammatory and anti-scarring effects seen post-treatment may be more important than integration and differentiation toward the tissue lineage that is being treated. The stem cells can regulate and assist healing, rather than, or in addition to building a new tissue. This area is very exciting, and opens the possibility of using stem cells to treat inflammatory conditions and systemic disease. In addition to direct injection of injury, intravenous injection and regional limb perfusions have been used to treat injuries and inflammatory conditions.
In equine medicine, bone marrow, adipose, muscle, umbilical cord blood, tendon and fetal cells have all shown promise in research studies and/or clinical retrospectives. This presentation will review current veterinary treatments and literature in light of current research in basic science to give a broad overview and context of stem cell biology pertinent to veterinary practitioners.