

## What are MSCs?

MSC stands for mesenchymal stem cell. MSCs are special cells that possess the ability to stimulate some tissues to grow and repair themselves. MSCs can be isolated from several different tissues such as bone marrow, fat, and muscle. The best studied of these are bone marrow MSCs, which aid recovery from a of myriad ailments.

Cell banking offers a way to literally freeze our stem cells in time. We store your cells at a temperature so cold that biochemical reactions cannot take place. The day your cells are thawed, they are effectively the same age as the day they were frozen, as if transported through time.

All that is needed to preserve this vital resource is a small sample of your bone marrow. This procedure has a reputation as being somewhat painful, but in truth, when performed with a local anesthetic, it is described as a mild, pressure-like discomfort, which lasts only moments. This one-time procedure will preserve your MSCs until you and your doctor decide that MSC therapy is right for you in the future.

## What happens to MSCs with age?

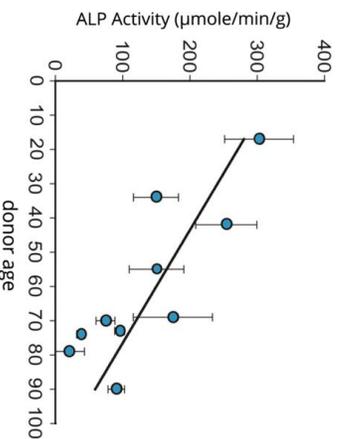
Like many of our body's cells and tissues, as we age our stem cells show signs of wear and tear. What that means on a practical level is that your MSCs are not as good at mending your body as they were last year, or the year before that. This process starts slowly in early adulthood and continues through middle age, but accelerates as we get older. It has been shown that MSCs from older people divide more slowly, and that they cannot easily replace damaged bone.

There are several ways that aging impairs MSCs, but most importantly, all cells accrue DNA damage throughout life. Your cells have two wells of DNA, the nucleus and the mitochondria. When nuclear DNA is damaged, proteins that regulate the cell's life cycle can be damaged, and when mitochondrial DNA is damaged, it affects the cell's ability to produce the energy needed to function properly. Stem cells may respond to this sort of damage by shutting down their normal cycle or division, or by dying off. In either case, the pool of stem cells inside you is diminished.

Clinical evidence indicates that the therapeutic potential of MSCs diminishes with age. For example,

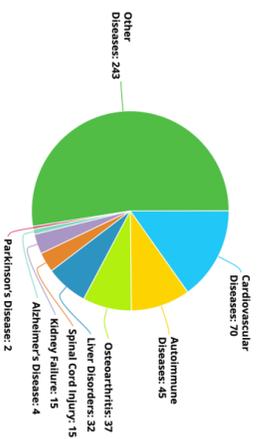
MSCs are currently used to treat osteoarthritis of the hip, and younger patients are significantly more likely to report positive results [Centeno et al., Stem Cell Res. Ther. 2014; 4(10): 242].

## What is their clinical relevance?



**MSCs from older donors differentiate into bone-building osteoblasts less efficiently than MSCs from younger donors.** Zhou et al., Aging Cell. 2008; 7(3):335-43.

There are more than 450 clinical trials investigating the effectiveness of MSCs to fight various diseases.



**Over 450 registered clinical trials employing MSCs were active in 2014.** [www.clinicaltrials.gov](http://www.clinicaltrials.gov)

MSCs appear to have the greatest effectiveness at promoting regeneration. In biology, regeneration means the ability to regrow damaged tissue. Tissue may become damaged because of an injury or disease, and most tissues repair them-selves to a

limited degree. MSCs have been shown to promote the body's natural healing ability in a safe and efficient way. While there are many diseases for which MSCs may be useful, a few of the major diseases currently under study are highlighted below.

**HEART ATTACK:** When one suffers from a myocardial infarction, commonly known as a heart attack, heart tissue is temporarily deprived of oxygen and other nutrients due to a blockage in an artery. When starved of oxygen, tissue dies rapidly. After the cells die, a scar is formed and the heart cannot pump blood efficiently. MSCs have been shown to promote recovery after a heart attack by simultaneously helping to soften the scarred heart, as well as stimulating growth of new cardiac myocytes, the cells that make up the muscle that is your heart. Improvements in objective measures of heart function, such as ejection fraction (the efficiency of blood pumping) and resting heart rate, have been shown to occur after MSC treatment.

**ARTHRITIS:** Osteoarthritis, the degeneration of cartilage around the bone, is the most common form of arthritis. It affects up to half of all adults over the age of 60, causing chronic pain, swelling and decreased mobility in the knees, hands, hips and other joints. Bone and cartilage are made up of the same basic building material as MSCs, a lineage of tissue known as the "mesoderm." As such, MSCs are quite efficient at replacing damaged bone and connective tissue that surrounds it. Currently, osteoarthritis is the most common disease to be treated with MSCs, and it has been shown to be safe and effective wherever it has been tried. MSCs can be injected directly into the affected joint, thereby increasing the likelihood of engraftment. Once in place, they can actually work to replace damaged tissue. Unfortunately, the ability of an MSC to become a bone or cartilage cell has been shown to decrease with age, a phenomenon that accelerates after middle age.

**ALZHEIMER'S DISEASE:** Alzheimer's disease results from the degradation of neural connections (called synapses) and ultimately, death of neuronal cells. Although the origin of the disease is uncertain, it has been shown that MSCs can slow the progression of

Alzheimer's disease by blocking the immune cells that devour synapses, preserving memory and cognitive function for longer.

These are just some of the many diseases of aging that MSCs may potentially be used to treat. Others include stroke, neurodegenerative diseases auto-immune diseases, liver disorders, spinal cord injury, kidney failure, skin diseases, respiratory disorders, aplastic anemia, and Parkinson's disease. Clinical data about MSC therapy from new and ongoing trials is increasing all the time. For more information about the state of MSC therapy, visit our research page and our blog at [www.foreverlabs.co](http://www.foreverlabs.co).

## Why not a family member's cells?

Each of us has a very specific immune system that is able to detect cells that originate outside our own bodies. If we introduce "foreign" cells, our immune system recognizes them as such. Fortunately MSCs, even those from unrelated individuals, do not cause any serious harm like an organ transplant might. However, while not dangerous, there is evidence that cells that come from others do not survive for an extended period of time once injected into the body. On the other hand, our own cells appear to engraft into our tissue and function normally for very long periods of time. Therefore, while cells from a well-matched donor might provide some benefit, they are unlikely to have the same impact on long term health as your own cells are.

Besides not upsetting your immune system, there is strong evidence that MSCs can actually reverse damaging effects of inflammation. Some researchers hypothesize that one of the main mechanisms by which MSCs impart benefits and promote growth is by "turning off" inflammation, and thereby allowing the body more space to repair itself. This may not be the entire story, but it does appear to be at least partly responsible for the benefits of MSCs. Therefore, having perfectly matched cells from your own body likely offers us the best chance of having a high-impact therapy.

By maintaining a population of your own cells locked in time, you will never have to search for a suitable stem cell donor, because you have the perfect one waiting for you already...yourself.

Forever Labs was founded by researchers who specialize in MSC therapy for neurologic disease who each have more than a decade of experience in state-of-the-academy research. The foundational ideal of Forever Labs is that everyone should have the opportunity to provide a long, healthy life for themselves and their families. We strive to bring to our clients the best available knowledge, resources, and medical personnel, so that they may make choices about stem cell therapy with confidence and conviction. While cell banking may not be for everyone, we believe it should be available to everyone. For this reason, we strive to bring stem cell banking to our clients at an affordable price without sacrificing the integrity of the process, which we will never conduct with less than full and total care and precision. Your stem cells are a fleeting resource, and our reverence for them is complete and total.

We urge our clients and anyone else who may be interested to visit our website at [www.foreverlabs.co](http://www.foreverlabs.co) to find more in depth resources, such as information about our uniquely skilled team, our research page, which has more detailed information than can fit into this leaflet, and our blog, where we discuss current and exciting research in the MSC community.

Please do not hesitate to contact us with any questions at  
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