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Exercise triggers stem cells in muscle

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University of Illinois researchers determined that an adult stem cell present in muscle is responsive to exercise, a discovery that may provide a link between exercise and muscle health. The findings could lead to new therapeutic techniques using these cells to rehabilitate injured muscle and prevent or restore muscle loss with age.

Mesenchymal stem cells (MSCs) in skeletal muscle have been known to be important for muscle repair in response to non-physiological injury, predominantly in response to chemical injections that significantly damage muscle tissue and induce inflammation. The researchers, led by kinesiology and community health professor Marni Boppart, investigated whether MSCs also responded to strain during exercise, and if so, how.

"Since exercise can induce some injury as part of the remodeling process following mechanical strain, we wondered if MSC accumulation was a natural response to exercise and whether these cells contributed to the beneficial regeneration and growth process that occurs post-exercise," said Boppart, who also is affiliated with the Beckman Institute for Advanced Science and Technology at the U. of I.

The researchers found that MSCs in muscle are very responsive to mechanical strain. They witnessed MSC accumulation in muscle of mice after vigorous exercise. Then, they determined that although MSCs don't directly contribute to building new muscle fibers, they release growth factors that spur other cells in muscle to fuse and generate new muscle, providing the cellular basis for enhanced muscle health following exercise.

A key element to the Illinois team's method was in exercising the mice before isolating the cells to trigger secretion of beneficial growth factors. Then, they dyed the cells with a fluorescent marker and injected them into other mice to6 see how MSCs coordinated with other muscle-building cells.

In addition to examining the cells in vivo, the researchers studied the cells' response to strain on different substrates. They found that MSC response is very sensitive to the mechanical environment, indicating that conditions of muscle strain affect the cells' activity.

"These findings are important because we've identified an adult stem cell in muscle that may provide the basis for muscle health with exercise and enhanced muscle healing with rehabilitation/movement therapy," Boppart said. "The fact that MSCs in muscle have the potential to release high concentrations of growth factor into the circulatory system during exercise also makes us wonder if they provide a critical link between enhanced whole-body health and participation in routine physical activity."

Next, the group hopes to determine whether these cells contribute to the decline in muscle mass over a person's lifetime. Preliminary data suggest MSCs become deficient in muscle with age. The team hopes to develop a combinatorial therapy that utilizes molecular and stem-cell-based strategies to prevent age-related muscle loss.

"Although exercise is the best strategy for preserving muscle as we age, some individuals are just not able to effectively engage in physical activity," Boppart said. "Disabilities can limit opportunities for muscle growth. We're working hard to understand how we can best utilize these cells effectively to preserve muscle mass in the face of atrophy."

The team published its findings in the journal *PLoS One*. The Illinois

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More information: The paper, "Eccentric Exercise Facilitates Mesenchymal Stem Cell Appearance in Skeletal Muscle," is available online on *PLoS ONE* site.

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