Does skeletal muscle from old individuals adapt to exercise?

Yes it does, but not as rapidly, nor to the same degree, as muscle from young individuals. To prove this, we used a well established animal model of aging, the FBN rat at young and very old ages. To avoid any differences in exercise behaviour between ages, we used a chronic stimulation model of muscle contraction in which the muscles of one leg were made to contract for 3 hours/day, for 7 consecutive days. This represents a standardized, high level exercise workload which can be imposed on one leg of both young and old animals, while the opposite leg remains at rest. At the end of 7 days of this chronic contractile activity (CCA) paradigm, we examined the adaptability of the muscle with respect to fatiguability, mitochondrial content and proteins which are known regulators of mitochondrial synthesis. When the muscles were given a contractile function test, old muscle fatigued more rapidly than young muscle, but the CCA reduced this fatiguability, and "rescued" the old muscle, allowing it to perform similarly to that of the young muscle. However, CCA improved the fatigue response of young muscle even more than old muscle. The reason for this was most likely because CCA increased the mitochondrial content to a greater degree in young, compared to old muscle. Indeed, the levels of regulatory proteins that control mitochondrial synthesis were elevated to a greater degree in young, compared to old muscle, in response to CCA. CCA also beneficially reduced reactive oxygen species production, as well as indicators of cell death in old muscle. Thus, we conclude that muscle from older individuals can acquire benefits from a "training" program, leading to an improved muscle health. However, the rate and/or extent of this adaptation are reduced as compared to muscle from younger individuals.

Reference: Ljubicic, V. A.-M. Joseph, P.J. Adhihetty, J.H. Huang, A. Saleem, G. Uguccioni, and D.A. Hood. Molecular basis for an attenuated mitochondrial adaptive plasticity in aged skeletal muscle. Aging. 1: 818-830, 2009.

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