**MECHANOBIOLOGICAL APPROACH FOR SKELETAL MUSCLE ADAPTATION**

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Skeletal-Muscular system provides the ability to move and to sustain posture. From developing children to elderly, through recovering patients, and athletes, skeletal muscle plays a major role in physical and psychological health. According to World Health Organization, physical inactivity is the fourth leading risk factor for global mortality and a major factor in noncommunicable diseases, such as cardiovascular, cancers, and diabetes. Therefore, deep understanding of the relations between physical activity, exercise, and the biological responses at tissue level is important in order to improve therapies and recommendations

Skeletal muscle is an adaptive soft tissue, which means it can grow (hypertrophy) or shrink (atrophy) according to stress adaptation. Adaptation to restricted motion, as in the case of bone fracture, surgical recovery, or spinal cord injury, leads to muscular atrophy. Conversely, physical health in general, or muscle development in athletes, depends on the right training program. From experimental studies and clinical observations, it is known that external stress promotes the activation or inhibition of certain biochemical families related to adaptation processes. On the other hand, theoretical development on the mechanics of growth, or soft tissue adaptation, considers the increase in size as the result of mass sources that change the state of stress of the material. However, the mechanics of growth does not consider external loading conditions nor the biochemical processes that actually occur during adaptation.

From the stand point of engineering, skeletal muscle can be modeled as a nonlinear elastic material. However, the modeling of the mechanics of growth, the increase in mass of a material, is not a field as developed as the modeling of classical engineering materials. Thus the modeling of skeletal muscle tissue growth, from the engineering perspective, is a developing field. Moreover the biochemical processes related to hypertrophy are not fully understood neither how mechanical loading affects those processes. Experiments from the biology side focus over chemical and physiological responses, whereas experiments from the side of engineering focus on material properties. None of the experimental fronts considers the changes in material properties due to chemical and physiological evolution. Those changes may happen in a timescale of weeks in order to note size effects. With those ideas in mind, the aim of this research is to model, computationally, the process of adaptation in skeletal muscle tissue, due to mechanical loading stimuli and its biological responses.

This research considers a population dynamic system, in which biochemical families specific for muscle adaptation and muscle size are populations. From this system, muscle size is treated as strain and linked to muscle tissue mechanical response. Muscle stress and a proposed set of rules defines tissue growth. The new muscle tissue size modifies population dynamics and mechanical response, thus a hypertrophy loop is established. A qualitative comparison with experimental reports will decide if the model has to be adjusted or results are good enough

The skeletal muscle hypertrophy model developed in this research will support the design of the right therapy for atrophied muscles, and the right training program for the general public and athletes. This research will contribute to the development of a mathematical model for muscular tissue growth as well as to the problem of implementation of nonlinear theory for growing materials.