

Action replay revives wasted muscle

Helen Saul

New Scientist: 4 July 1992

STIMULATING weakened muscles with a pattern of electrical signals produced by healthy muscles may encourage them to regenerate and dramatically improve their function. In patients with rheumatoid arthritis, researchers, led by Jackie Oldham of the University of Liverpool, have demonstrated a fourfold improvement in hand movement. They are going to apply their technique to the thigh muscles of elderly patients.

In conventional electrotherapy, muscles are stimulated with a regular spike of voltage every 10 seconds. According to Oldham, such a uniform signal carries enough information to make muscles act mechanically but lacks an important part of the electrical message muscles require to operate normally. The treatment improves muscle function by 10 to 20 per cent. Oldham says the firing patterns of healthy muscles in a state of fatigue—where the interval between spikes is irregular—carry adaptive information, which may instruct the muscles to perform more efficiently in future.

The recognition that nervous activity influences the behaviour of muscles first came in 1960. In experiments, so-called fast-twitch muscles and slow-twitch muscles assumed each other's characteristics when stimulated with electrical signals characteristic of the other type (*see Goldspink*).

Building on this principle, Oldham identified the firing pattern of a single motor unit in a healthy, fatigued muscle. The muscle was her own dorsal interosseus muscle, which lies between the index finger and the thumb.

Oldham exercised the muscle by placing her hand flat on a specially designed board, and attempting to move the index finger towards the thumb. The finger pushed against a bar, which stopped it moving though the muscle contracted. Oldham repeated this exercise, known as isometric abduction—10 seconds on, 10 seconds off—for an hour, or until the force exerted by the muscle was only 30 per cent of normal and the

muscle was exhausted. She then recorded its firing pattern.

Oldham and her colleagues next attached electrodes to the hands of people with rheumatoid arthritis and delivered the firing pattern she had recorded. Each patient received such stimulation for up to three hours a day for more than 10 weeks.

In a double-blind study, Oldham compared the effect of this pattern of stimulation with that from stimulation at a uniform frequency. She found that in the group given the fatiguing pattern, the strength of people's grip increased four times. Their endurance tripled, and the interosseus muscle—from which the pattern was originally recorded—could push against a bar with double the force. People in the group that received uniform stimulation showed only a slight improvement in these measures—no more than 20 per cent.

The stimulation helped some patients more than others. "There's no rhyme or reason," says Oldham. "It's just a statistical event. We don't know why."

The researchers now believe they have extracted the firing pattern from a single motor unit in a fatigued quadriceps thigh muscle. By playing this back into the quadriceps of elderly people who have difficulty climbing stairs, or rising from chairs, they hope to get them to walk again.

According to Raymond Tallis, head of geriatric medicine at the University of Manchester, who is recruiting patients for the project, the stimulation does not affect the underlying cause of the disability. "But it may halt the downward spiral of disuse leading to wasting, leading to further disuse," he says. "People may require repeated stimulation later to reverse wasting again." Tallis warns that this kind of electrical stimulation is only a research tool at present. "It will be three years before we have a clear-cut answer on its efficacy. It's far too early to say what place it will have in treatment."