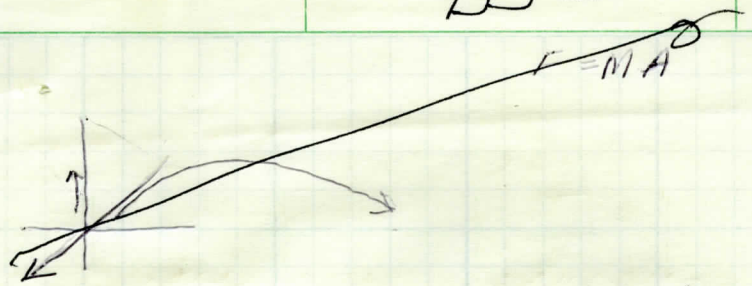
DSO Draft 1



DSO - Neuro muscular adaptation -
Background.

Various systems of the body adapt ~~at~~ to ~~the~~ weightlessness at their ~~own~~ characteristic rates eg bone ~~eg~~ has a time constant of months while certain portions of the nervous system adapt in minutes.

Neuromuscular adaptation to weightlessness is an obvious fact to those who have been involved in return to 1g after space flight. Unless one has 'practiced' on entry it is usually impossible to ~~arise or~~ leave the seat on first attempt. ~~After~~ The sensation of ~~weight~~ heaviness is initially very prominent and walking requires considerable effort and often appears to be unstable. After flights of 7 days these effects are reversed in a matter of hours clearly indicating they are neuromuscular rather than muscular changes. The extent, time course & effects of such adaptation have not been adequately studied, especially the ability to successfully perform emergency egress. Moore found that ~~the weight~~ unknown standard masses were underestimated in weightlessness & early post flight period.

Also
There are several anecdotal experiences of physical feats during entry & landing. Both theory and experience indicate that neuromuscular adaptation will seriously reduce physical performance in the entry & landing period.

The following study would document ~~some of~~ key features of this effect. A simplified isokinetic ergometer will allow measurement of strength of major muscles in arm & leg pre-inflight, ~~during entry~~ and, landing & post flight. This will allow documentation of muscle performance during adaptation & re-adaptation. Several simple physical maneuvers will document actual performance.

Methodology -

Ergometry - a miniature hydraulic isokinetic ergometer will be attached to the limb ~~to be attached to a mid deck seat~~ and a min. of 5 max. effort elbow & knee flexions & extensions will be made at 3 fixed angular velocities. During flight this would be used the same arrangement in the 1G trainer. ~~These ergometers would plug in to existing shuttle seat structure to avoid modification.~~ Performance force & angular displacement would be recorded by an existing miniature 4 channel tape recorder for ground analysis.

[They would ~~be~~ replace the existing arm rest & and incorporate that function as well as allowing having the necessary ergometry ~~arm~~ & attachments ~~These units do~~ All hardware is self contained.

~~Standard~~ Performance demonstrations - would consist of two simple maneuvers in 1g against body weight eg two & if possible one leg knee bends and chins. The former would be done c arm stabilization to eliminate vestibular system effects. The second would involve chinning on the middeck hand hold. Performance would be documented c still or ~~possibly motion~~ ciné photography. These maneuvers would be performed pre flight & post flight at JSC in the 1g trainer, ~~and~~ in the bird on landing & c suitable a chinning bar in the ~~the~~ post-flight exam area.

Subjects & protocol: An initial sample of 5 subjects, one on a flight, should be made, initially using MS's if possible ~~one only~~ for ~~stable~~ background stability, otherwise selected P.S. At least ~~3~~ 3 preflight studies should be done as combined training/measurement sessions. One session should be as close to launch as possible (in crew quarters would be desirable) to launch. ~~Ten max~~ If ~~the~~ a ciné camera such as a DAC could be set up ~~on recovery~~ after landing the entire flight phase operation could be accomplished by the subject. Ten maximum effort repetitions ~~at zero veloc~~ by ~~arm~~ elbow and knee are desired at zero (3 angles) & slow medium & high ~~ve~~ angular velocities.

Knee bends c̄ both legs will be done on immediately leaving the seat at right angles to the camera. If ~~these can be done~~ single leg bends should be done c̄ if possible three reps. are desired.* Chins will also be done at right angles to the camera. A second study ~~trial~~ should be made during the physical exam period and also prior to return to JSC if possible. ~~Another after return should be done if practical.~~ Repeat exams should be made at R+1, 2, 4 + 8 if possible -

Time required - It is estimated that an hour would be ~~suf~~ required for indoctrination & demonstration followed by a 1 1/2 hr. + 2 ca hr. measurement periods. It should take approx. 1/2 hr. to test & stow the apparatus prior to entry and another half hour to set up + perform on landing. ~~It~~ Post flight tests administered by others should take 10 mins.

Hardware & Status -

The miniature hydraulic ergometers are available but would have to ~~be modified to operate on the limb~~ have arms + limb couplings added as well as force & angle transducers added. Dual channel flight qualified recorders and cameras exist. Estimated

* add to above - The subject will laterally stabilize himself by holding on to structure as required.

cost of the ergometer ~~model~~ is $10 to 20 K.

Data analysis - Initial ~~analysis~~ ergometer data reduction and analysis will consist of recording graphically recording the angle & force data on a Gould 55-1000 or equivalent. ~~Strength Man~~ Force at several fixed points on the angle curve will be measured at each of the rates used. The results will be plotted and statistically analyzed.

Knee bend & chinning activity will be evaluated quantitatively by counting repetitions and max angles obtained. ~~Quantitative~~ and the rate at which they were done. Results will be plotted