

Introduction:

Problem - Loss of locomotor function is one of the major effects of spaceflight and is followed by disuse atrophy of muscle bone and the cardiorespiratory systems. Such losses are of concern on return to gravity after long space flight. Currently the most promising methodology for preventing or sharply reducing such losses is replacement of the locomotor function in a treadmill. Such a treadmill must obviously provide a load normal to the treads to allow replace subject weight as well as the usual ^{moving & speed} tread, and control, and other ~~for~~ ess. Both US, & USSR, treadmills use long elastic cords in a trunkal harness to provide this (the limited tread size allowable in current space craft) weight. While there are some relatively small differences is severely limited. }
between in normal ~~to~~ and treadmill running on earth weightlessness, ^{limiting} restricted forces to replace body weight and treadmill mechanics all raise the question of how closely such running locomotion approximates that on earth.

If for example this question is more than academic for muscle and probably bone is sensitive to magnitude and shape of applied forces i.e. distorted distortion of these factors might severely reduce effectiveness or even lead to ~~use~~ injury & ~~necessary~~ use.

Both USSR and US programs use treadmills. The ~~ru~~ USSR flights have employed them extensively since 1971. First U.S. use of ^{simulated} locomotion was on STS-4 and following this a ^{single} ~~limited~~ small true subject driven device was built and ultimately flown on Shuttle STS-3 thru when it was replaced by a slightly modified units on each vehicle. Use was at crews option and no instrumentation or other data sources were available, ^{has is} Has such information on the USSR unit available,

As a beginning to do a ^{reasonably} complete biomechanical study of body forces plus continuous position of body leg segments and tread would be required.

A number of operational limitations allowed on limited single plane photography for position studies i.e., only kinematics ^{data} ~~would be~~ ~~were~~ available.

Such studies were done on STS-7 & 8 and are reported here. — — —

Methods and materials -

The treadmill has been described elsewhere.

but essential features are shown in Figure 1 & 2.

It is ~~for~~ subject powered ^{area} ~~area~~.

1 Running tread surface is of X cm. and

speed range is of — to — MS^{-1} in six

discrete steps. Treads are ~~individual~~ dual rectangular

sections mounted on antifriction bearings ^{ing} ~~runned~~ in

~~the~~ machined tracks for minimum friction. The track is

coupled to flywheel which provides the equivalent of

— kg. mass inertia to the treads and ~~is~~ its

angular velocity is controlled by a centrifugal brake. Unlike

motor driven treadmills the ~~to~~ develop a

driving force along the ~~bet~~ treads' axis it is 1 g.

the treadmill must be elevated until the

horizontal this component is equal to

the internal resistance of the ~~m~~ T/M - ~~2~~ Since
internal losses

Subject weight is simulated by ~~an~~ ^{bungees or} 4
folded elastic cords connected to the T.M. at its
4 corners and connected to the subjects harness ~~in~~
^{fore & aft,}
~~a~~ calibrated straps long enough to vary the bungee
tension. Nominal length produces a balanced force
equal to subject weight. A padded harness Fig 2
^{wa wraps from the back,}
folds around the iliac crests and is crossed
in front. Attached to the front & rear of this
hip belt over the shoulder belts. ~~Then~~ Generally
approximately $\frac{1}{3}$ of the load is carried by
shoulder belts ~~the~~ and the remainder by the hips
but this is left to the user. Total weight is
normally distributed

Ex- Stat.

History

U.S.

SkyLab is only U.S. experience

Initial studies/exercise did not include locomotion - only cardio-respiratory and Ca^{++}

Ad Hoc study showed post flight strength losses of ___ % for legs and ___ % for arms in ___ days - leg not changed

Leg losses were little affected by doubling duration of bicycle exercise on SL-3

Arm losses were sharply reduced by simple, brief strength exercises

~~Cardiorespiratory stud~~ After fluid reequilibration, there was cardio-respiratory capacities were unchanged by ^{any} flight -

Bone losses ~~fell~~ ^{on all flights} approximated predictions.

On SL-4 leg losses were sharply reduced by brief locomotor exercise - exercise was too brief to affect Ca^{++} loss -

Summary -