

Suggestions (1)

Astronaut Candidate Simulated Exam

(musculoskeletal)

- 1.1 History - include alcohol consumption, cigarette smoking, and general attitude both toward exercise and health.
- 2.1 Include under this section grossly observable anomalies such as genu varus, spine abnormalities such as scoliosis, lordosis, etc.
- 2.4.1 Cervical Spine - need to stabilize trunk up to but not including, cervical spine (such as a high back chair) for these exercises.

Thoracic-Lumbar

- o Shoulder rotation - must keep hips from moving and head should remain perpendicular to the plane of the shoulder.
 - o Trunk flexion - must stabilize legs and hip against a wall.
 - o Trunk extension - must place toes and both iliac crests against wall when doing this to prevent throwing hips forward.
 - o Lateral bends - must keep both knees locked and feet about one foot apart.
- 2.5.1 Hips (do these horizontal)
 - o Extension - make sure both iliac crests remain in contact with surface.
 - o Abduction - subject should stand with opposite leg and shoulder against wall with the shoulder on the abducted side supported by an assistant.
 - 2.5.2 Thigh/Knee - {
 - o Flexion - upper leg should be supported in horizontal position, and allowance made for flexing leg under the supporting table.
 - o Ankle/Foot - change sub-head to "dorsi-plantar flexion angle" - leg should be stabilized (stopped?) in a horizontal position for this measurement but supported off the surface about one inch at a point two inches above the ankle:

- 2.6.1 Pectoral Girdle/Shoulders - these should be checked only for 180° ranges grossly, except for the rotation measurements, which I think are important to leave as is.
- 2.6.2 Arms, Elbow - hand should be open when doing these measurements, not with closed fist.
- 2.6.3 Wrist - include pronation and supination here.
- 2.7
- o Popliteal Ht - should be done with knee at right angle
 - o Anatomic - Knee length - back should be flat against a wall and knee at 90°
 - o Funct. reach, arm - done to tip of thumb
 - o Funct. reach, leg - done to ball of foot.
 - o Shoulder breadth - skin to skin of lat. deltoide
- 2.8 Functional - the three exercises were changed to the universal machine and included maximum weight for one repetition.

The three exercises were:

- (1) bench press
- (2) leg press
- (3) two arm pull-down (lat machine)

General

1. Need to stabilize in a fixed position, non-moving part above the moving joint.
2. Need to rearrange the protocol (this not necessarily the recording form) so that as many measurements can be done at each single station before going on to the next.

Rationale for musculo-skeletal examination

For convenience the musculo-skeletal system is viewed from two aspects. The first might be called static or relatively fixed and includes the size, shape, composition, and integrity of the system, while the second is dynamic and should be a measure of performance such as strength and mobility *as well as neuro-muscular & joint integrity.* One major index of performance will have already been determined as a part of the cardiovascular exam, the maximum O_2 uptake. Implicit in both of these is some attempt to evaluate overall "physical condition" and the persons ability to achieve or maintain a satisfactory condition.

Certain aspects of the exam of importance to space flight must be emphasized; e.g., anthropometric limits such as seated height or immobility of crucial body segments. Finally, the exam should be as accurate, objective and quantitative as possible using easily reproducible and meaningful methods.

A question then arises as to whether the initial exam will be a screening process to be followed by a more comprehensive study. There is much to be said for this approach and the protocol which follows allows this option. In any event, the entire protocol should be performed in final selection of new crewmen.

Methodology

1. History - other medical history should be available for review and the following areas included.

time course of height, weight, physical activities; any limitations and injuries.

2. Physical inspection and Palpation of all major structural and muscular segments including observation of walking, bending, squatting and leg rises will be done. General subjective assessment will be made and any specific anomalies searched for. All major joints will be palpated for normal and abnormal relaxation and mobility.

3. Anthropometry, if not done elsewhere any critical dimension such as seated height, reach, etc., should be obtained and an exact height (standing and supine) obtained with the jig we have devised for this measure -- an exact weight will also be obtained. A front and lateral photo should be made against a standard grid for quick future approximation of other measurements. This could be done with a polaroid negative for ease of processing and to allow future reproduction.

4. Percentage of body fat should be approximated by specific gravity (weighing in and out of water) Standard tables would be used for estimation of residual volumes and conversion to percentage body fat--N.B., although skin fold thicknesses are frequently resorted to here, their poor correlation ^{to objective determinations} is well known.

5. Measurement of strength should be done with a quantitative method of which the best is the recorded isokinetic ergometer. This should include lower and upper arm, back, hip and knee bilaterally. If time or facilities prevent this during the initial exam, some poor estimates may be obtained by

bilateral weight lifts, chinning and one legged rises or squats.

Range of joint motion, all of the critical segments should be measured and recorded by calibrated jigs. An automated photo-optical device currently under construction may be available and would increase speed here. If time does not allow more than a cursory exam, simple estimates should be made in the traditional clinical fashion.

Other factors affecting physical performance including attitudes toward maintenance of condition will be noted where pertinent and objective data summarize and subjective overall evaluation will be made.

Facilities

The woman's section of the astronaut gym, which is currently unused, with possible access to bars and weights would be an ideal location. This, of course, depends upon FOD approval. One aide with minimal training to help in reading/recording and the like would speed the process up. A chaperone will be required for females. All subjects should be in shorts or shorts-halter with facilities for changing and drying (after specific gravity).

Equipment - desk, forms

Photo - SX-71 with flash, pos/neg film and a calibrated back board.

Jigs for specific anthropometric measures such as seated heights local construction.

Set of scales calibrated to 1/8 pound. <

Specific density tank and weighing apparatus (available Whitmore Enterprises).

Cybex isokinetic ergometer and recorder (Lumex, Inc.)

Standing/supine height jig - local construction.

Tapes and goniometer - standard.

Jigs for angle measurements.

Automatic anthropometric data reader/recorder (currently under construction, South West Research Institute).

Time per subject:

~ 1 hour including changing clothes for screening exam

~ 1-1/2 hours for complete exam

~ 45 minutes additional will be required for analysis and preparation of report