Current Exercise Operational Support for Japanese astronauts

Hiroshi Ohshima
JAXA
## Medical risks for human space flight

<table>
<thead>
<tr>
<th></th>
<th>During space flight</th>
<th>After landing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular</td>
<td>Fluid shift</td>
<td>Orthostatic hypotension</td>
</tr>
<tr>
<td>Neuro vestibular</td>
<td>Motion sickness</td>
<td>Motion sickness</td>
</tr>
<tr>
<td>Muscle</td>
<td>Muscle atrophy</td>
<td>Sprain</td>
</tr>
<tr>
<td></td>
<td>Muscle weakness</td>
<td>Muscle injury</td>
</tr>
<tr>
<td>Bone &amp; Calcium</td>
<td>Bone loss</td>
<td>Fracture</td>
</tr>
<tr>
<td></td>
<td>Renal stone</td>
<td>Renal stone</td>
</tr>
</tbody>
</table>
JAXA astronauts usually stay in Houston

Organization of JAXA Medical Operation

JAXA Medical Operation Team
- Chief Medical Officer
- FS
  - J-ASCR
  - Psychological Support
  - Radiation Health Control
  - BNE
  - Environ. Health

Contract between JAXA and NASA/Wyle

NASA's Medical Operation Team
- Director
- MCC-T
- MCC-H
- MMOP
- SMOT

Russian Medical Operation Team
- Crew Surgeon

ESA's Medical Operation Team
- ASCR
- CSA'S MOT

Organization of JAXA Medical Operation

Director
program manager

MCC-T
MCC-H
MMOP
SMOT
MCC-M

@TKSC

@MCC-H / MCC-M
・1st Japanese station astronaut
・Launch and land by Space shuttle
・Attend R+0 press conference at KSC

・2nd Japanese station astronaut
・Launch and land by Soyuz
・First R+0 return to Houston

Dream
Pursuit of truth
Thoughtful
JEM, H-IIB Rocket, and HTV

- JEM
- Remote Manipulator System (JEMRMS)
- Experiment Logistics Module Exposed Section (ELM-ES)
- Air Lock
- Pressurized Module (PM)
- Exposed Facility (EF)
- Mission Control Center @ TKSC

H-II Rocket

HTV

11.2m

10m
Onboard schedule of JAXA astronauts

2009年

Astronaut Yamazaki
19A
No earlier than March 18, 2010

2010年

Six-month stay from Dec. 21, 2009
15A
2J/A
Soyuz (21S)
Launched on March 16, 2009
Returned on July 31, 2009

2011年

Six-month stay from spring 2011
Soyuz
Soyuz

2012年

Six-month stay from early summer 2012
Soyuz
Soyuz

2013年

Astronaut Hoshide
32/33 Expedition crew

Completed

Astronaut Wakata
18/19/20 Expedition Crew

Just Completed

Astronaut Furukawa
28/29 Expedition Crew
Pre-flight training program

(Targets)
- Built up physical strength for mission success
- Prepare for in-flight training

(Program)
- 2 hours x 3 days/week
  (Aerobic and Resistance training)
- shuttle mission: voluntary training
- ISS mission: scheduled training as medical requirement
- For EVA: Add upper limb training
  (Rock climbing, Hand ergometer)
In-flight training program

(Targets)
- To maintain physical strength, and to prepare walking after landing
- Early Phase: Acclimation to onboard exercise in μ gravity
  Middle P: Maintain physical strength
  Final P: Preparation for Re-ambulation

(Program)
- 6 days a week
- 2.5 hours/day
  (1) Aerobic (CEVIS or T2)
  (2) Resistance T(ARED)

CEVIS   T2 (or TVIS)   ARED

NASA   JAXA
CEVIS

- 1 hour X 3 days a week
- Program
  1) Greenleaf’s interval training
  2) PFE protocol
      (25, 50, 75, 25 %Vo2 Max)
  3) Tour De ISS Protocol
- Target Strength
  1) Borg’s scale: 13
     (somewhat hard)
  2) NTE HR

NASA

JAXA
TVIS/T2

- 1 hour x 3 days a week
- Target Strength
  1) 60-80% HR Max
  2) Borg’s scale 13
- Axial load by use of harness
  (60 ~ 100% BW)

- Vibration Isolation System
- Stabilized by Gyroscope
## Resistance Training

- **ARED**

- **NASA**
- **JAXA**

<table>
<thead>
<tr>
<th>Monday Thursday</th>
<th>Tuesday Friday</th>
<th>Wednesday Saturday</th>
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</thead>
<tbody>
<tr>
<td>Squat</td>
<td>DL</td>
<td>Wide Stance Squat</td>
</tr>
<tr>
<td>RDL</td>
<td>SL Squat</td>
<td>Sumo DL</td>
</tr>
<tr>
<td>SDL Hi pull</td>
<td>Bench</td>
<td>RDL</td>
</tr>
<tr>
<td>Heel Raise</td>
<td>SL Heel Raise</td>
<td>Upright Row</td>
</tr>
<tr>
<td>Bent-over row</td>
<td>Shoulder Shrug</td>
<td>Single Arm Row</td>
</tr>
<tr>
<td>Shoulder Press</td>
<td>Triceps</td>
<td>Biceps Curl</td>
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</tbody>
</table>
Landing day after 138 days space flight
1st Japanese station astronaut

Landing day after 161 days space flight
2nd Japanese station astronauts
Post-flight Rehabilitation Program

- 2 hours/ day of protected rehabilitation for 45 days

Phase 0 (Landing day)
Symptomatic treatment
- Orthostatic Intolerance
- Vestibular dysfunction
Prevent fall
- Assist walk

Phase 1 (~ R+7)
Readaptation to gravity
- Aerobic exercise
- Dynamic/ static Stretching
- Walking Exercise, Med Ball Training
- Balance Training, Core Exercise

Phase 2 (~ R+14)
Incremental physical conditioning
- Frequent rest
- Aerobic and Resistance training
- Hydrotherapy, massage

Phase (~ R+45)
Obtain pre-flight level of fitness
- Aerobic and Resistance training
- Agility training, Balance training
- Hill running, Hot Spring

RSA
NASA
JAXA
Dynamic stretching at the beginning of training

- Cool down
- Improve ROM

Static stretching at the end of training

- warm up
- Reduction of stiffness

NASA
JAXA
Aerobic training after landing

1. Cycle ergometer \( (R+1 ~ ) \)
2. Ellipse training \( (R+3/5 ~ ) \)
3. Treadmill walking \( (R+7 ~ ) \)
4. Truck running \( (R+14 ~ ) \)
5. Field running \( (R+21 ~ ) \)

NASA
JAXA
Training with balls
Core Exercise
Resistance Training

- 8-12RM x 1-3 sets
- Not to repeat next day
Walking Exercise

NASA

Balance Training

JAXA
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Wyle
  Laughlin M

NASA
  Taddeo T
  Hayes J
  Repley M