

**Commentary on the Cuban boot, 40 years after the Experiment “Support” in  
Space**

*Comentario sobre las Botas cubanas, a 40 años del uso del experimento “Soprte”  
en el espacio cósmico*

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The invention and development of the Cuban Boot 40 years ago was a major, pioneering milestone to reproduce the effects of Earth gravity on Cosmonauts while they were in space.<sup>(1)</sup> The Cuban boot allowed crew members to simulate standing posture for 4-6 hours in a way so comfortable that Cosmonauts enjoyed wearing them. This Cuban boot was invented by Dr. C. Roberto Paulino Hernández and González Corvo and was decades ahead of its time. Moreover, the invention has facilitated the subsequent development of integrated physiologic countermeasures to improve crew health in space and to aid re-adaptation to ground-reaction forces and normal weight bearing after return to Earth. Crew members often complain of higher sensitivity and pain on the foot soles after prolonged space flights. 40 years ago, the joint flight of Cuban cosmonaut Tamayo and Russian cosmonaut Romanenko tested the Cuban boots and discovered how beneficial they were.

In general terms, mechanisms responsible for physiologic adaptations to the microgravity of space include: 1) loss of hydrostatic (gravitational) pressures within fluid columns of the body such as arterial and venous blood, cerebrospinal fluid and lymph, 2) loss of body weight and greatly-

reduced mechanical loads, 3) decreased sensory inputs, and 4) altered Starling, transcapillary and lymphatic forces/transports.<sup>(2)</sup> Normal daily activity on Earth involves about 16 hours of upright posture with approximately 4-6 hours of standing/walking activity and 10-12 hours of seated activity. The remaining part of the day consists of eight hours of sleep without axial loading. The Cuban Boot may well produce about 4-6 hours of standing/walking activity, but continuous ground-reaction force data are necessary to confirm this hypothesis.

In actual microgravity, external compression of body surface areas is minimal. The greater compression of tissues on Earth due to body weight increases interstitial fluid pressures and probably dehydrates these tissues with weight bearing due to greater interstitial flow into the microcirculation. Combined with some form of lower body negative pressure, the Cuban Boot may provide weight bearing beneath the feet as well as prevention of jugular vein congestion and vision impairments due to head-ward fluid shifts in space.<sup>(3,4)</sup>

## References

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## Conflict of interest

The author declares that he has not conflict of interest.