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Effects of Deep Core Activation Method Using Wearable Cyborg HAL in Supine Position for Ameliorating Defecatory Function : A Pilot Study

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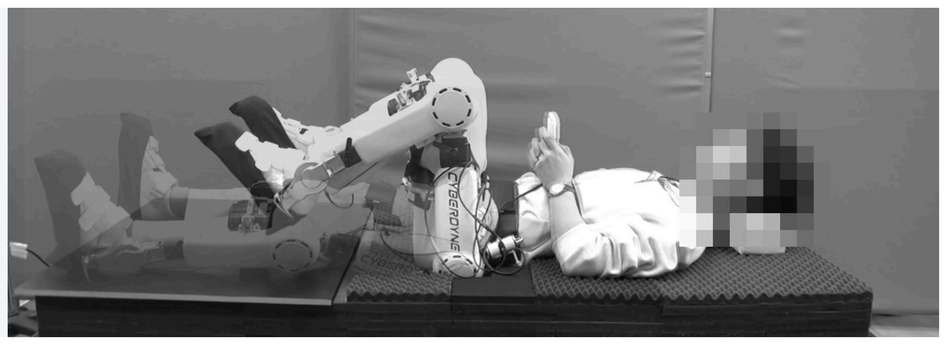
Cybernics fusion of human, machine and information systems

ICORR

Objective
Development of deep core activation method for defecation disorder treatment.

Methods
Robot-assisted deep core exercise with wearable cyborg HAL.

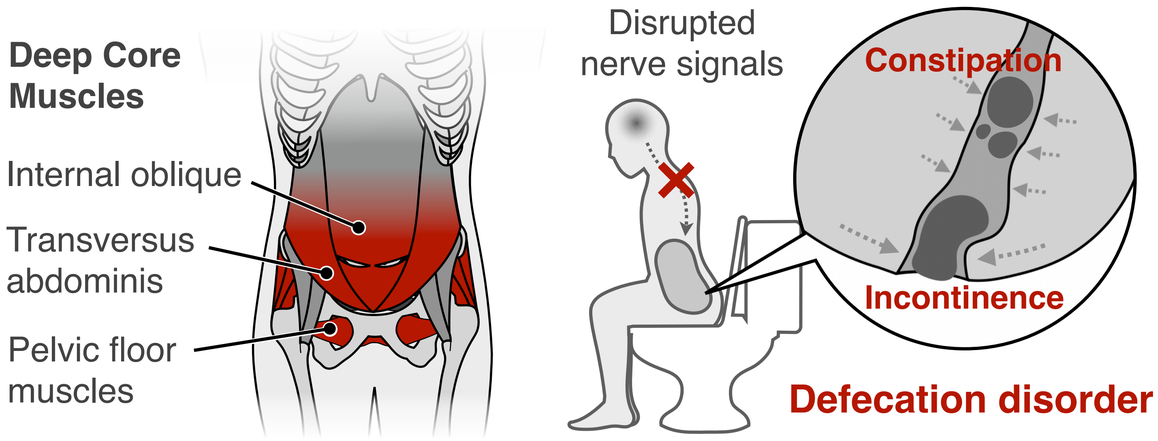
Result / Discussion
Our device enhanced deep core muscular activity related to defecation function.



Background

Defecation Disorder

Paralysis in deep core muscles due to neurological disease
→ causes **constipation, incontinence**



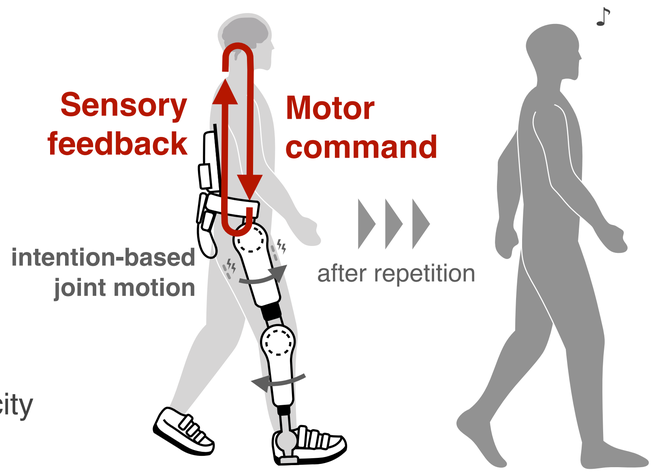
Abdominal pain / Anxiety about incontinence **impairs QoL**

Cybernics Treatment

Treatment strategy using wearable cyborg-assisted training to promote neural plasticity
→ **ameliorates paralyzed muscular activity** after a long-term training

Treatment principles

1. Measure volitional bio-electrical signals
2. Control joint based on the signals
3. Joint motion activates sensory receptors
4. Sensory signals go back to the brain
5. Bio-Feedback loop induces neural plasticity



Applicable to deep core muscles?

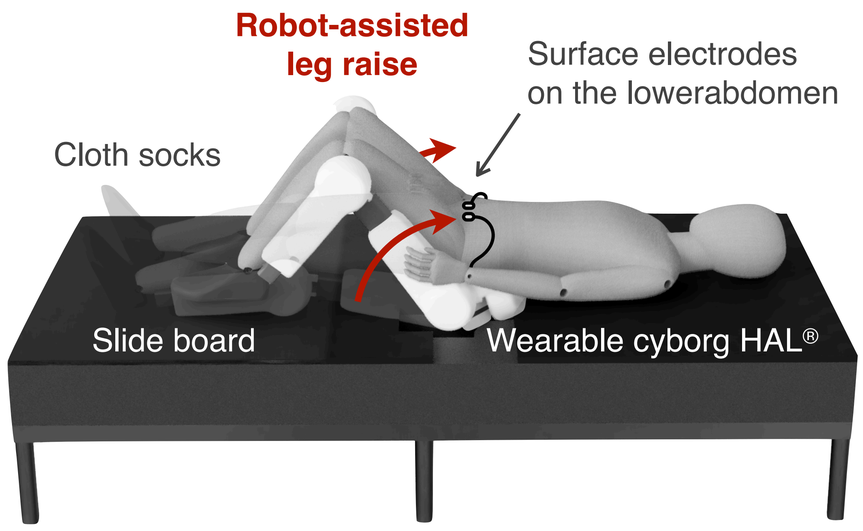
Objective

Develop deep core activation method with wearable cyborg & Confirm its feasibility and effect of amelioration

Materials & Methods

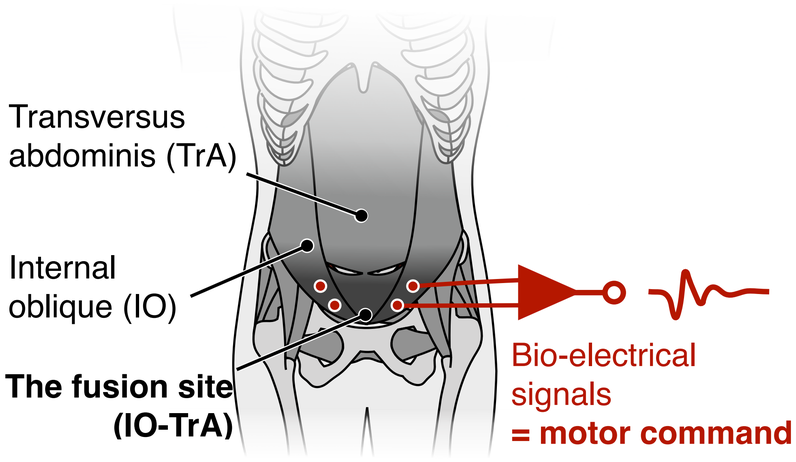
Deep core activation method

Robot-assisted leg raise returns intention-based sensory feedback from the deep core to the brain



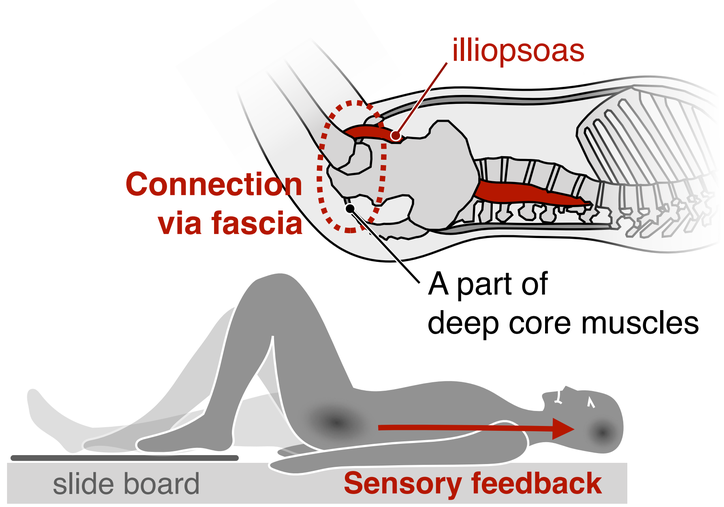
1. Detect motor command to deep core

- **Bio-electrical signals** represents motor intention
- Bio-electrical signals in deep core leak out from **the fusion site of IO and TrA (IO-TrA)**



2. Induce sensory feedback from deep core

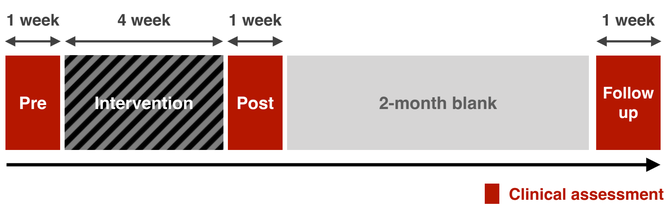
- Deep core is functionally **connected to illiopsoas**
- Contraction of illiopsoas by **leg raise exercise** results in somatosensory feedback from deep core



Experiment

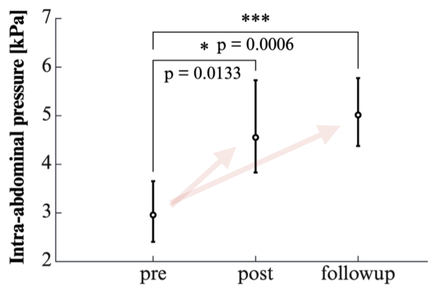
Intervention

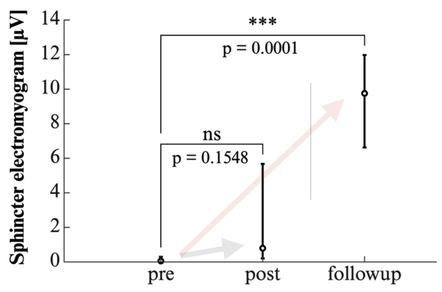
- Participant
  A patient with L1 spinal cord injury
- Procedure
  Robot-assisted leg raise exercises
  4 times a week for a total of 4 weeks
- Outcome measures
  I. Intra-abdominal presure
  II. Sphincter electromyography



Result / Discussion

Intervation effect





I. Intra-abdominal pressure

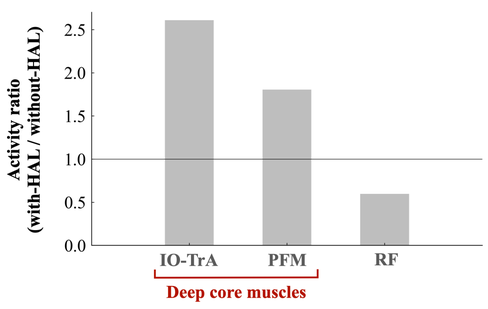
- Significant increase in pre v.s post, follow-up

II. Sphincter electromyography

- Signals begin to appear after intervention

(+ The participant reported ease of expulsion)

Electromyoactivity (with-HAL v.s without-HAL)



- **Deep core muscles were more active in with-HAL than in without-HAL.**
- Without-HAL showed compensatory action by the Rectus Femoris.

Our method selectively activated deep core muscles
resulting in amerioration on deep core muscular activity

Conclusion

Confirmed not only feasibility of our method but also possibility for amelioration on deep core muscular activity