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Discussion Session: Technology - Robotics and Gaming

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Speaker’s Background:
Dr. Hasegawa is a physical therapist working in the University Tokyo Hospital that is the one of the largest and leading acute care hospitals in Tokyo. He has had experiences to utilize robotics and gaming in clinical settings since he started working in CYBERDYNE Inc that has developed the exoskeleton rehabilitation robot called Hybrid Assistive Limb (HAL). He has used and studied several rehabilitation technologies including not only HAL but also PARO (mental support animal robot) and Wii Fit in physical therapy practice.

Introduction:
What is the importance to use robotics and gaming in physical therapy practice?

・To provide the optimal benefits for patients
・To make more effective interventions
・To develop a new concept and paradigm shift for current and future rehabilitation

Robotics: The latest systematic review and meta-analysis showed robotics such as Lokomat, Gait Trainer, and HAL have positive outcomes for gait rehabilitation in clinical settings.¹)

HAL is an exoskeleton robot with detecting bio-electrical signals to assist hip and knee joints during locomotion such as walking. Wall and others did a systematic review for HAL in 2015 and concluded that HAL might enhance gait function for patients with stroke and spinal cord injury.²)

In Japan, HAL has been used for gait rehabilitation of patients with neural progressive muscular diseases such as Amyotrophic Lateral Sclerosis (ALS), spinal muscular atrophy, and others under the coverage of Universal Health Insurance System after the completion of a multi-centered clinical trial.
Progression of muscle weakness

Continuous and regular HAL training

Delay of muscle weakness

Progression of muscle weakness

time

Figure 3. Schemes of HAL trainings
(from: http://www.mhlw.go.jp/file/05-Shingikai-10901000-Kenkoukyoku-Soumuka/0000040500.pdf#search=%27HAL+治験%27)


About a multi-centered clinical trial:
https://dbcentre3.jmacct.med.or.jp/jmactr/App/JMACTRE02_04/JMACTRE02_04.aspx?kbn=3&seqno=3962

4 aspects for a successful usage of robotics and gaming in physical therapy practice.

1. Availability:
   It should be available with user-friendly operations and affordable costs
   Ex. Ease to use, development of user manual & training course, coverage of health insurance

2. Collaboration:
   Multi personal and interdisciplinary collaborations are necessary to improve their effectiveness
   Ex. active participation of patients, therapists, engineers, and researchers

3. Creativity:
   Physical therapists should be a creative to explore the best usages of these technologies and overcome some limitations of current technologies. Ex. Utilizing optional devices

4. Education/Advocacy
   Various types of educations such as case studies, mini-conferences, and open discussions are required to advocate the best usage of these technologies with culturally sensitive perspectives. Ex. Initial orientation for patients, Conferences, Health fair, and Exhibition

Potential risks of these technologies:
The usage of robotics must be safe for both patients and therapists according to the three laws of a robot. So far, there have been few reports of incidents by utilizing robotics in rehabilitation. However, possible risks might exist when;
1. Users do not know how to use these technologies correctly
2. Users have unrealistic expectations for these technologies
3. Users rely everything on these technologies
Discussion:
The usage of robotics and gaming in the physical therapy and rehabilitation field is still in a developmental stage. In the near future, they can be used for the combination with Degenerative Therapy, Virtual Reality, and Artificial Intelligence. We need to openly exchange our ideas to evolve better usages of these technologies to produce the best benefits for every patient who needs a physical therapy in the world.

Terms:
Robot: A machine capable of carrying out a complex series of actions automatically, especially one programmable by a computer. (Oxford dictionary)
The three law of a robot (Asimov, Isaac (1950). *I, Robot.*):
1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.
2. A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.
3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws.

Example of usages of technologies
- Functional Intervention
  => HAL, Lokomat, Paro, Wii Fit, Kinect, etc
- Leisure Education
  => Group games, Wii Fit, Kinect, etc
- Recreation Participation
  => Game competition, Cybathlon, etc

Leisure Ability Model:

References:
3) Peterson AC, Stumbo JN: Therapeutic recreation program design, principle and procedure. Allyn Bacon. USA. 2000