### Supplementary Appendix 1: Literature overview for RATT with the pediatric Lokomat®

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<th>Sample</th>
<th>Intervention Design</th>
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<tbody>
<tr>
<td>1</td>
<td>Labruyère et al. 2013</td>
<td>N=19 children with neurological gait disorders Mean age 13.4±3.6</td>
<td>Game participation during a VR scenario combined to Lokomat therapy  • sEMG (rectus femoris)  • heart rate  • Cognitive capacity (Test of Nonverbal Intelligence)</td>
<td>Muscle activity and heart rate were higher during demanding parts of the game compared to less demanding parts. Game performance correlated moderately with the cognitive capacity. They conclude that children with neurological gait disorders are able to modify their activity to the demands of the VR scenario.</td>
<td>No, only standardized adjustments for the test setting</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
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<tr>
<td>2</td>
<td>Riener et al. 2013</td>
<td>N=1 healthy adult &gt;&gt; no children</td>
<td>Description and development of a new arm robot and its integration on the Lokomat device</td>
<td>N.A.</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
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<td>3</td>
<td>Trompetto et al. 2013</td>
<td>N=14 adult participants: N=7 adult patients with unilateral hemispheric stroke (mean age 59±11 years) N=7 normal subjects (mean age 56±14 years) &gt;&gt; no children</td>
<td>Lokomat therapy  • postactivation depression, assessed by soleus H-reflex</td>
<td>They showed that physical exercise (RATT) can determine a partial normalization of post-activation depression in patients with spasticity following unilateral hemispheric stroke.</td>
<td>No</td>
<td>No</td>
<td>No</td>
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<td>4</td>
<td>Aurich-Schuler et al. 2013</td>
<td>N=17 participants: N=9 children with neuro-orthopedic disorders (mean age 14±3 years) N=8 healthy children (mean age 12±3)</td>
<td>Lokomat and normal treadmill therapy conditions (randomized order)  • sEMG (tibialis anterior, gastrocnemius lateralis, vastus medialis and biceps femoris) of one leg</td>
<td>Their results suggest that RATT with therapeutic encouragement could appropriately increase muscle activity. RATT in general could induce physiological muscle activation patterns, which might indicate that this training exploits restorative rather than compensatory mechanisms.</td>
<td>No, only standardized adjustments for the test setting</td>
<td>No</td>
<td>No</td>
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| 5      | Arellano-Martínez et al. 2013 | N=14 children with spastic hemiplegic CP | Lokomat therapy or a gait training along a rail inside a hydrotherapy tank (randomized assignment) | • Quantitative measurements of gait  
• GMFCS level  
• modified Ashworth Scale | A significant change from GMFCS level II to I among children and a positive correlation between the quantitative measurement of gait and the GMFCS level could be observed. Patients who trained on the Lokomat improved gait symmetry. A year follow up showed that these improvements sustained only in the Lokomat group. | N.A. (original article in Spanish) | | | | |
| 6      | Drubički et al. 2013 | N=52 children with spastic diplegic CP (N=26 Lokomat group, N=9 control group, 17 dropouts) | Lokomat therapy in addition to individual exercises versus individual exercises only (randomized controlled trial) | • 3D gait analysis: temporospatial parameters, selected kinematic parameters | After the intervention phase, a slight improvement in walking speed in both groups could be shown, without significant difference between the groups. Range of motion decreased slightly in both groups, without significant difference between the groups. In addition, there was significant improvement in maximal range of flexion in the hip joint. It was shown that with a decrease in the mean value of adduction in hip joint, the mean walking speed increased. | No | 20 sessions (45 min. each) | No | No | No |
| 7      | Schuler et al. 2011 | N=17 participants: N=9 children with neuro-orthopedic disorders (mean age 14±3 years)  
N=8 healthy children (mean age 12±3) | Conditions with and without virtual realities while having Lokomat therapy compared to normal treadmill therapy (randomly-presented conditions) | sEMG activity output in both groups was significantly higher during tasks with virtual realities than during normal walking conditions. These results support that | No, only standardized adjustments for the test setting | | | | | |

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**Notes:**
- GMFCS: Gross Motor Function Classification System
- Lokomat: A robotic rehabilitation system that simulates treadmill walking.
- sEMG: Surface Electromyography.
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<td>8</td>
<td>Brütsch et al. 2011</td>
<td>N=24 participants: N=9 children with neurological gait disorders (mean age 12.47±1.84 years) N=14 healthy children (mean age 11.76±2.75 years)</td>
<td>Lokomat therapy in four different conditions, with and without virtual realities (randomly-presented conditions) Biofeedback values Questionnaires assessing the participants' motivation</td>
<td>Overall, both virtual reality-assisted therapy approaches were effective in initiating the desired active participation in all children, compared with conventional training conditions. Motivation was very high and differed between the groups only in the virtual navigation condition.</td>
<td>No, only standardized adjustments for the test setting</td>
<td>No</td>
<td>No</td>
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<tr>
<td>9</td>
<td>Schmartz et al. 2011</td>
<td>N=10 children with spastic CP</td>
<td>Lokomat therapy L-STIFF modified Ashworth Scale</td>
<td>Using the L-STIFF assessment tool, a significant decrease in muscle stiffness, especially in children with high levels of muscle tone, could be shown after a single session of RATT. L-STIFF is a feasible tool for automated measurement of stiffness in children with CP, but it is not sensitive enough to record small changes in muscle tone.</td>
<td>No</td>
<td>No</td>
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<td>10</td>
<td>Družbicki et al. 2010</td>
<td>N=18 children with spastic diplegic CP</td>
<td>Lokomat therapy and physiotherapy 5x per week, for 4 weeks</td>
<td>A statistically significant improvement of balance was found in</td>
<td>No</td>
<td>No</td>
<td>No</td>
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<td>11</td>
<td>Patritti et al. 2010</td>
<td>N=4 children with spastic diplegic CP (2 GMFCS level II, 2 GMFCS level III)</td>
<td>18 sessions of Lokomat therapy during 6 weeks • GMFM D (standing) and E (walking) • 10 meter walking test • 6 min. walking test • Clinical gait analysis using a motion capture system to assess changes in gait mechanics</td>
<td>Children in the GMFCS II group improved more significantly than children in the GMFCS III group both in terms of clinical outcomes and in terms of gait biomechanics. These results suggest that the magnitude and type of motor gains in children with CP following gait training are different according the baseline functional level of the child undergoing RAIT. They also suggest that the augmented feedback technique has an impact on children with GMFCS II where the use of the augmented feedback technique appears to be associated with larger motor gains.</td>
<td>No</td>
<td>3x per week (30 min. each) for 6 weeks (total 18 trainings)</td>
<td>No</td>
<td>No</td>
<td>No</td>
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<tr>
<td>12</td>
<td>Cajigas et al. 2010</td>
<td>N=0 &gt;&gt; no children</td>
<td>Introduction of an extension of the Force Field</td>
<td>N.A.</td>
<td>No</td>
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</table>
| 13    | Brütsch et al. 2010 | N=18 participants: N=10 children with neurological gait disorders  N=8 Healthy children | Lokomat therapy with four conditions with and without virtual realities (randomly-presented conditions)  
  * Biofeedback values  
  * Subjects’ acceptance of the RAGT with VR was assessed using a questionnaire | Active participation in patients and control children increased significantly when supported and motivated either by therapists’ instructions or by a VR scenario compared with the baseline measurement. | No, only standardized adjustments for the test setting | No | No | No | No |
| 14    | Borggraefe et al. 2010 | N=14 children (mean age 8.7±5.4)  
  N=13 with bilateral spastic CP  
  N=1 with spinal paralysis | 12 sessions of Lokomat therapy during 3 weeks  
  * GMFM D (standing) and E (walking)  
  * 10 meter walking test  
  * 6 min. walking test  
  * Outcome variables were evaluated immediately before and after the trial and at a follow up of about six months | The improvements of motor function after a 3 week trial of RATT appear to be sustained after a mean period of 6 months. | Some general recommendations are described. But with individual adaptation during the training and over the whole session. See reference for details | 4x per week (each limited to 50min.) for 3 weeks (total of 12 sessions) | No | No | No | No |
<p>| 15    | Borggraefe et al. 2010 | N=89 children with various neuro-orthopedic disorders | Multicenter survey of safety data of Lokomat therapy using descriptive statistics | In 38 out of 89 patients, adverse events were documented. Most commonly, mild skin erythema at the sites of the cuffs of the device and muscle pain were encountered. In five patients, open skin limited the continuation of the treatment. | No | No | No | No | Yes, see reference for details |</p>
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<td>16</td>
<td>Borggraefe et al. 2010</td>
<td>N=20 children (mean age 11.0 ± 3.1) with bilateral spastic CP</td>
<td>12 sessions Lokomat therapy during 3 weeks</td>
<td>Significant improvements in the GMFM were achieved. Improvements in the GMFM were significantly greater in the mildly affected group (GMFCS I and II) compared to the more severely affected group (GMFCS III and IV).</td>
<td>4x per week (each limited to 50 min.) for 3 weeks (total of 12 sessions)</td>
<td>No</td>
<td>No</td>
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<tr>
<td>17</td>
<td>Koenig et al. 2008</td>
<td>N=15 healthy adults &gt;&gt;&gt; no children</td>
<td>Different VR tasks such as wading through water, playing soccer, overstepping obstacles or training in a street scenario during walking in the Lokomat</td>
<td>Subjects provided positive feedback in reference to the utilized haptic method, specifically addressing the sufficient degree of realism.</td>
<td>No</td>
<td>No</td>
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Recommendations for Robot-Assisted Treadmill Therapy in Children with Cerebral Palsy

Aurich et al. 2015


### Supplementary Appendix 2: Methodological process of Expert Panel development

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<th>Location</th>
<th>Participants/ clinics</th>
<th>Topic</th>
<th>Outcome</th>
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</table>
| Initial Interest Group Meeting| Munich, Germany   | ~4/ 3 different International clinics | • LSTIFF correlates badly with modified Ashworth Scale  
• Collaboration of Munich, Germany and Zurich, Switzerland for first scientific data  
• Discussion about Outcome Measures  
• First initiation of PeLoBASE (Pediatric Lokomat Database) | • N.A.                                                   |
| User meeting November 2009    | Munich, Germany   | ~30/ 9 different European clinics | • Pediatrics  
• Clinical implementation (application of guidance force, assessment tools, augmented feedback)  
• Scientific news pediatric Lokomat | • N.A.                                                   |
| Interest Group meeting March 2010 | Vienna, Austria  | ~10/ 9 different International clinics | • Necessity of a database  
• Problem that RATT is only one part of the therapy program and therefore protocols vary between individuals as well as between institutions  
• Collaboration of scientific and practical expertise | • Formation of the Pediatric Lokomat Interest Group: goals, activities, achievements in accordance to the (adult) Lokomat Interest Group (formed 2006)  
• Interest Group must be distanced to industry  
• Platform for knowledge transfer  
• Databases  
• Periodic meetings  
• The plan to establish recommendations on the basis of best practice/ experience through an Expert Panel |
| User meeting October 2010     | Hamburg, Germany  | ~40/ 13 different European clinics | • New technologies  
• Lokomat and Botox  
• Gait Analysis  
• Practice and questions in groups (pediatrics, SCI, TBI and stroke)  
• Discussion open questions | • Open questions for the expert Panel |
| User meeting June 2012         | Köln, Germany     | ~38/ 17 different European clinics | • Clinical evidence, state of the art and future steps  
• Practice and questions in groups (pediatrics, SCI, TBI and stroke)  
• Discussion open questions | • Open questions for the Expert Panel:  
• A lot of specific orthopedic questions  
• Application after surgeries  
• Cardiovascular questions  
• Technical: Software sensitivity  
• 21cm femur length enough or must children be older, larger?  
• Training goals and modulation of parameters in accordance to impairment level of patients |
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<th>Outcome</th>
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<td>Initial Pediatric Lokomat Expert Group meeting August 2012</td>
<td>Munich, Germany</td>
<td>~15/ 4 different European clinics</td>
<td>N.A. (several unanswered invitations)</td>
<td>• Pediatric User Community increase, experience reveals always the same problems (list of questions) • Idea of a consensus paper with evidence-based guidelines for the application of Lokomat therapy in children with neuromuscular diagnosis • Problem: there is a lack of evidence concerning Pediatric Lokomat therapy • Re-Formulation of goals: experience-based recommendations for children with CP regarding the list of questions assembled at the user meetings • Defining the members of the Pediatric Lokomat Expert Group members who join at different meetings to develop the recommendations</td>
</tr>
<tr>
<td>4 following Pediatric Lokomat Expert Group meetings 2012-2013</td>
<td>Munich, Germany or Zurich, Switzerland</td>
<td>4-5/ 3 different European clinics</td>
<td>zero</td>
<td>• Process of generating the recommendations. Differences in opinion were discussed until consensus was reached. When consensus was initially not reached within the expert group, the topics were discussed with the clinical teams of each center (physicians and therapists), new views were entered in the expert group and discussed until final consensus was achieved</td>
</tr>
<tr>
<td>User meeting May 2014</td>
<td>Munich, Germany</td>
<td>~24/ 14 different European clinics</td>
<td>N.A.</td>
<td>• New scientific data • Presentation and final approval of the experience-based recommendations for RATT in children with CP through the Pediatric Lokomat Expert Panel members • Different examples of clinical integration</td>
</tr>
</tbody>
</table>

Abbreviations:
N.A. = (information) not available
RATT = robot-assisted treadmill therapy; CP = Cerebral Palsy; SCI = spinal cord injury; TBI = traumatic brain injury