

**Methodology** We performed an audit in order to assess the status of hip surveillance in children with cerebral palsy attending our institution from March 2014 to April 2015.

**Result** Of 527 patients coded as cerebral palsy 457 suffered from CP by definition. 30 children suffered from unilateral CP, 153 from bilateral spastic CP, one from ataxic CP, 18 dyskinetic CP and in 30 patients a dominant symptom was not coded.

Only 247 patient older than 2 years of age received at least one pelvis X-ray between their first and last consultation with the neuropaediatrician. The functional levels were as follows: GMFCS I n = 36, II n = 50, III n = 63, IV n = 33 and V n = 65 [mean age 9.6 years (2–18 years); 147 male, 100 female].

Of the 247 patients with X-ray, 51 X-rays showed a Reimers migration percentage (MP) of >50 %, 51 a MP 31 to 49 % and the rest <30 %.

**Conclusion** We analyzed these rather disillusioning results, the exterior differences to functioning hip surveillance systems as well as the interior problems.

There are several ways to improve the results. The ideal way is the implementation of a nationwide screening programme, but this will need to be organized and will cost money.

Another possibility is to organize a “sensible” screening for the children at risk (with GMFCS III–V) according to F. Miller.

Our solution was to communicate the results within our institution and to start a special clinic only for hip surveillance in CP according to the already communicated X-ray standards and clinical examinations.

As long as there is no nationwide screening programme any paediatric orthopaedic surgeon concerned with the care of CP children should act according to the known rules of hip surveillance.

**Neuroorthopedics: Lecture VKO-126**

### *Long-Term Results of Single-Event Multilevel Surgery in Children with Spastic Hemiplegia*

M. Svehlik, C. Schranz, G. Steinwender, M. Sperl, T. Kraus

Univ. Klinik für Kinderchirurgie, Abt. für Kinderorthopädie, Graz, Österreich

**Question** There is solid evidence that single-event multilevel surgery (SEMLS) may improve gait in children with bilateral cerebral palsy and that those improvements can be maintained in long term. However, there is no evidence on long-term outcomes of SEMLS in children with unilateral spastic cerebral palsy.

**Methodology** This is a retrospective analysis of clinical and gait analysis data. We included children with unilateral spastic cerebral palsy with the Gross Motor Function Classification System Level I to III preoperatively and a minimal follow-up of 5 years. All children were evaluated using gait analysis before, 1, 3–5 years and at the most recent examination after SEMLS. The Gait Profile Score was used to evaluate the postoperative changes. The four time points were compared using a repeated measures analysis of variance with a pairwise comparison (SPSS Inc., Chicago, IL, USA).

**Result** The average GPS improvement of 2.2° is well above the minimal clinical important difference of 1.6°. This shows that the postoperative gait improvement was clinically meaningful. Moreover, no significant deterioration occurred during the 10 years of follow-up even if some fine-tuning procedures were needed. The results are in accordance with studies on children with bilateral cerebral palsy.

**Conclusion** The study indicates that SEMLS are beneficial and postoperative gait improvements clinically meaningful in children with unilateral cerebral palsy even in the long term run.

**Neuroorthopedics: Lecture VKO-155**

### *Long-Term Therapy with Intrathecal Baclofen Improves Life Quality in Children with Severe Spastic Cerebral Palsy*

T. Kraus<sup>1</sup>, K. Gegenleithner<sup>1</sup>, M. Svehlik<sup>1</sup>, M. Sperl<sup>1</sup>, G. Singer<sup>2</sup>, G. Steinwender<sup>1</sup>

<sup>1</sup>Medizinische Universität Graz, Kinderorthopädie, Graz, Österreich,

<sup>2</sup>Medizinische Universität Graz, Kinderchirurgie, Graz, Österreich

**Question** Children with severe spastic cerebral palsy (CP) are highly limited in daily life activities causing a reduced quality of life (QoL). This is partly due to an increased muscle tone causing pain and contractures. Continuous intrathecal infusion of baclofen (ITB) reduces the spasticity of affected patients. The hypothesis of the present study was that ITB leads to a significant improvement of QoL in non-ambulant children with CP.

**Methodology** 13 patients (10 male, 3 female, mean age 14 years) were included. Mean time between pump implantation and follow up was 60 months (range 12–100). QoL was assessed before and after baclofen pump implantation using standardized questionnaires (CP CHILD, KINDL). Spasticity was evaluated using the modified Ashworth Scale (MAS) at the two time points.

**Result** QoL improved from pre-implantation to follow up. MAS markedly decreased from 3.8 to 1.7. All interviewed participants indicated, that their expectations had been met and that they would choose ITB treatment again.

**Conclusion** Intrathecal treatment of Baclofen is an excellent method for spasticity management in children with severe cerebral palsy. Quality of life sustainably improves; parents' satisfaction is high and the level of spasticity decreases. Therefore, Baclofen treatment can be highly recommended in non-ambulant children with CP suffering from spasticity.

**Neuroorthopedics: Lecture VKO-161**

### *Possibilities and Limitations of the Newest Generation of Video Based 3D Gait Analysis Systems*

V. Hirschmann<sup>1</sup>, P. Russ<sup>2</sup>, L. Becker<sup>2</sup>, W. Strobl<sup>1</sup>

<sup>1</sup>Krankenhaus Rummelsberg, Schwarzenbruck, Deutschland, <sup>2</sup>Simi Motion, Unterschleißheim, Deutschland

**Question** The newest generation of video based 3D gait analysis systems provides the opportunity to operate 3D movement analysis markerless, markerbased and hybrid. Markerless tracking is seen as a potential technology to make movement analysis simpler, quicker and less error-prone through wrong marker placement. This case study evaluates the accuracy of markerless and hybrid tracking against traditional marker based tracking. The aim of this study is to research

if markerless tracking is comparable insertable for healthy and patients with cerebral palsy.

**Methodology** Patients with cerebral palsy and healthy persons without any limitations will be recruited. The patients are asked to walk along a 12 m gait walk. The patients will be marked with the marker model for lower extremities. Markerless data, hybrid data and marker data will be recorded at the same time using 8 cameras (2.0MP@100 Hz). 3D Marker data will be obtained using Simi Motion 3D (<0.01 mm mean failure), joint angles will be computed using Simi Motion Inverse Kinematics module. Markerless data will be processed with Simi Shape. Hybrid data will be calculated with Simi Shape using different marker combinations to assist silhouette tracking. The results will be compared using the spearman correlation coefficient.

**Result** Only for ankle eversion/inversion inaccurate results with markerless tracking will be expected. Furthermore a high correlation between markerless and markerbased tracking of hip flexion/extension and ankle abduction/adduction and a very high correlation of hip rotation and abduction/adduction, knee flexion/extension and ankle plantar-/dorsiflexion will be expected. It can be assumed that with hybrid tracking all measured joint angles correlate very high with markerbased data.

**Conclusion** This study shows that markerless tracking can achieve good results for most joint angles. Some angles like ankle eversion/inversion can't measured accurately with markerless tracking. However to achieve very good results in all joint angles hybrid tracking with few additional markers to support silhouette tracking is necessary. This is important for segments where geometric appearance barely changes during rotation. This study shows that it will be possible to reduce the markers, thereby save time and reduce the potential for errors through wrong marker placement. A pure markerless system will also be applicable for basic questions in clinical gait analysis.

**Neuroorthopedics: Lecture VKO-151**

### *Predictors for Pelvic Anterior Tilt after Patella Tendon Shortening in Children with Cerebral Palsy*

H. Böhm<sup>1</sup>, M. Hösl<sup>2</sup>, L. Döderlein<sup>2</sup>

<sup>1</sup>Orthopädische Kinderklinik, Ganglabor, Aschau im Chiemgau, Deutschland, <sup>2</sup>Orthopädische Kinderklinik, Kinderorthopädie, Aschau, Deutschland

**Question** Patellar tendon shortening procedure within single event multilevel surgeries was shown to improve crouch gait in Cerebral Palsy (CP) patients [1]. However, one of the drawbacks associated to patella tendon shortening may be increased pelvic anterior tilt with compensatory lumbar lordosis [1]. Since the compensatory lumbar lordosis leads to backpain and impairs the walking ability, the aim of this study was to show what distinguished patients who showed excessive anterior tilt after patellar tendon shortening.

**Methodology** Thirtytwo patients with spastic cerebral palsy GMFCS I (4) and II (28) mean age 13.4 (SD = 3.3) years were included. All 49 limbs that were operated received patella tendon shortenings within multilevel surgery. Instrumented gait analysis and clinical testing was performed pre- and 24.1 (SD = 3.5) months postoperatively. Stepwise multilinear regression of the response value mean pelvic tilt during stance phase was performed from preoperative clinical and gait measurements.

**Result** The mean improvement of the knee extension during walking was 13° (SD = 4°). 40 % of the legs showed more than 5° increased pelvic anterior tilt during walking postoperatively. Reduced walking speed together with reduced hip extension power during stance phase together explained 38 % of the increase in pelvic anterior tilt. Hip contracture or hip extension during walking did not show any

predictive significance. Multilevel procedures in addition to the index procedures relevant for pelvic motion were 32 knee extension osteotomies, 15 rectus recessions 7 psoas and 3 knee flexor lengthenings. Those legs with considerable increase in pelvic anterior tilt had 8/32 extension osteotomies, 5/15 rectus recessions 0/7 psoas and 1/3 knee flexor lengthenings.

**Conclusion** In conclusion patients with slower walking speed and less hip extension power during walking pre-op were at higher risk of anterior pelvic tilt post-op. These patients may have insufficient control and strength of hip extensors during walking to adapt to the situation of improved knee extension during walking. The group with less anterior tilt had more frequent psoas lengthenings and proximal rectus recession procedures. These procedures may reduce the tension at the anterior hip muscles to allow a more extended hip following surgery.

### **References**

[1] Sossai et al. Gait Posture 2015; 41:658–65

### **Neuroorthopedics: Lecture VKO-172**

### *The Elbow in Arthrogryposis Multiplex Congenita*

C.U. Dussa, A. Peterarndel, L. Döderlein

Orthopädische Kinderklinik, Kinderorthopaedie, Aschau i. Chiemgau, Deutschland

**Question** Joint contractures are hallmark of Arthrogryposis multiplex congenita. The aim of the study was to look at the different patterns of presentation of Elbow in Arthrogryposis multiplex congenita.

**Methodology** In all these cases a standard examination form was used to measure the range of movement of elbow, muscle strength, degree of contracture. A photo and video documentation was performed in every case. Exclusion criteria were lack of standardized documentation, previous surgery, Pterygium Syndromes, Associated plexus injury.

**Result** Until December 2014, 96 Patients with index diagnosis Arthrogryposis multiplex congenital were seen and documented in the Ergotherapy. Using the exclusion criteria 36 Patients were excluded from the study. Therefore the study comprised of 60 Patients with 119 Elbows. The age group ranged from 3 to 23 years with 28 males and 32 females. Symmetrical involvement was seen in 37 Patients and asymmetrical in 23 Patients.

Based on the involvement, the elbows could be classified into 4 groups. Group A: (1) Flexion contracture <10°, (2) Active flexion and extension, (3) <10° difference between active and passive movements. Group B: (1) Presence of flexion contracture >20°, (2) B+ — Passive = Active flexion ≥90° (Biceps MRC 4/5), (3) B—Passive flexion ≥90°, Active flexion <45° (Biceps MRC <3/5). Group C: (1) Full elbow extension, (2) Active Triceps (MRC >4/5), (3) No active flexion or passive & active flexion <30° and 4. C+—Active flexion <30° & passive flexion <80°. Group D: (1) Weak or absent Biceps and weak Triceps, (2) No or flexion contracture <10°, (3) Passive flexion and extension full (near).

About 50 % of the elbows belonged to group A, and therefore had normal function. The uncommon form of elbow involvement is Group D with passive near full range of movement with no active function.

**Conclusion** In the literature the involvement is only described as flexion and extension types. In our study we have noticed several other naturally occurring forms of elbow involvement with as we noticed can be group into 4 types. The study throws new information on the involvement of the elbow and therefore gives information on about what percentage of elbows that may need treatment of any kind. The compensatory and adaptive movements are also different in each group except group A.