14th Annual Meeting of the Clinical Movement Analysis Society

Final Programme

Thursday 16th April 2015
Venue: Nuffield Orthopaedic Centre

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:00</td>
<td>CMAS Committee Meetings (committee members only)</td>
<td>Oxford Centre for Enablement (OCE) building, 1st floor conference room</td>
</tr>
<tr>
<td>12:15</td>
<td>Lunch provided by Allergan (available to all delegates)</td>
<td>Main hospital building, 1st floor seminar room</td>
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<tr>
<td>12:30</td>
<td>Registration Opens</td>
<td>Main hospital building, 1st floor lecture theatre</td>
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<tr>
<td>13:00</td>
<td>CMAS Standards &amp; Consensus Meeting: Repeatability of EMG</td>
<td>Main hospital building, 1st floor lecture theatre</td>
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<td>14:30</td>
<td>Tea/Coffee</td>
<td>Main hospital building, 1st floor seminar room</td>
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<tr>
<td>15:00</td>
<td>Marker Placement Sensitivity</td>
<td>Main hospital building, 1st floor lecture theatre</td>
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<tr>
<td>16:00</td>
<td>Vicon User Group</td>
<td>Main hospital building, 1st floor lecture theatre</td>
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<td>17:45</td>
<td>Oxford Pub Walk- sponsored by Vicon</td>
<td>Meet at the Kings Arms, Holywell Street, Oxford, OX1 3SP</td>
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<td>19:00</td>
<td>Conference Dinner (Mal Maison – Oxford Castle)</td>
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</table>

Inter-lab marker repeatability on-going during the day to be collected in the Oxford Gait Lab (please see separate schedule - tbc)
14th Annual Meeting of the
Clinical Movement Analysis Society of the UK & Ireland

Friday 17th April 2015
Venue: Magdalen College, University of Oxford

Surgical Procedures in the Treatment of Cerebral Palsy

08:15  Registration at Grove Auditorium- Magdalen College
08:50  Welcome to Oxford by Mr. Tim Theologis
09:00  Guest Speakers (Chair: Mr Rob Freeman)
   • Mr. Guy Atherton – Orthopaedic Surgery in the Upper Limbs
   • Mr. Tim Theologis – Orthopaedic Surgery in the Lower Limbs
09:40  Free Papers (Chairs: Mrs Sally Durham, Dr Adam Shortland)
10:30  Tea/Coffee and Exhibition
11:10  Guest Speaker (Chair: Dr Neil Postans)
   • Dr. Sebastian Wolf – Predicting and Controlling Functional Outcomes of Femoral De-rotation Osteotomy in CP
11:40  Exhibitor Presentations (Chair: Mr Andrew Lewis)
12:00  Lunch and Exhibition
13:00  Free Papers (Chairs: Mrs Sarah Jarvis, Dr Richard Baker)
13:50  Guest Speakers (Chair: Mr Mark Gaston)
   • Mr. Kristian Aquilina – Selective Dorsal Rhizotomy (SDR)
   • Mr. Andrew Roberts – Multi-Level Surgery and its Relation to SDR
14:30  Tea/Coffee and Exhibition
15:00  Discussion
   Chair: Mrs. Rachel Buckingham with guest speakers contributing
   • SDR in the Treatment of Children with Cerebral Palsy
   • What is the role of CMAS gait laboratories in SDR assessment/ outcome analysis?
15:50  Close Meeting
   • Best Paper Award (sponsored by VICON)
16:00  CMAS AGM
   • Marker placement inter-lab repeatability results
17:00  AGM closed
Friday 17th April 2015
Venue: Magdalen College, University of Oxford

Surgical Procedures in the Treatment of Cerebral Palsy
Free Paper Presentations

**Morning Session** - chairs: Mrs Sally Durham, Dr Adam Shortland

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:40</td>
<td>Marker-based and markerless motion capture systems in the analysis of the upper limb</td>
<td>East R, Noble J, Gordon A, Shortland A</td>
</tr>
<tr>
<td>9:50</td>
<td>The clinical impact of hip joint centre regression equation error during gait</td>
<td>Kiernan D, Malone A, O’Brien T, Simms C</td>
</tr>
<tr>
<td>10:00</td>
<td>Results of the Shriners Hospital Upper Extremity Evaluation comparing 3D upper limb kinematic model vs. conventional 2D video data</td>
<td>Letherland J, Stebbins J, Buckingham R, Lewis A</td>
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<td>10:10</td>
<td>Development of a biofeedback system for use in the clinical environment</td>
<td>Millar L, Murphy A, Rowe P</td>
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<tr>
<td>10:20</td>
<td>Design and testing of a mechanical jig to improve the accuracy of de-rotation osteotomies: a work in progress</td>
<td>Skivington J, Murphy A, Read H, Rowe P</td>
</tr>
</tbody>
</table>

**Afternoon Session** - chairs: Mrs Sarah Jarvis, Dr Richard Baker

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>13:00</td>
<td>3D shank and thigh segment orientations and their use in AFO tuning for stroke</td>
<td>Carse B, Meadows B, Rowe P</td>
</tr>
<tr>
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<td>Dimunge A, Taylor P, Street T, Wood D</td>
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<tr>
<td>13:30</td>
<td>Movement controlled robots to encourage exercise compliance and monitor function in children with movement problems</td>
<td>Chruscikowski E, Cook L, East R, Gordon A, Shortland A</td>
</tr>
<tr>
<td>13:40</td>
<td>Development and preliminary validation of the Sheffield Foot Model (SFM) for use in children with normal and altered pathology</td>
<td>Pratt E, van der Meulen J, Dickens W, Davies G</td>
</tr>
</tbody>
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Markerbased and Markerless Motion Capture Systems in the Analysis of the Upper Limb

R.H. East¹³, J.J. Noble¹, A.L. Gordon², A.P. Shortland¹³

1. One Small Step Gait Laboratory, Guy’s and St Thomas’ Foundation Trust
2. Paediatric Neurosciences, Evelina Children’s Hospital, Guy’s and St Thomas’ Foundation Trust
3. King’s College London

Background: There is increasing demand for the development of three-dimensional (3D) movement analysis for individuals with upper motor neuron injury. This talk describes two projects. The first, a repeatability study of a 3D movement assessment using a gold standard motion capture system for children with hemiplegic cerebral palsy (CP) and a control sample. The second, a validation study comparing a markerless motion capture system to the gold standard marker based system. The markerless system used the Microsoft Kinect™ for windows v.2 and custom software designed.

Methods: Fourteen healthy individuals (5 female, mean age 18 years, range 7-28 years, all right handed) and 6 hemiplegic CP (1 female, mean age 11 years, range 9-16 years, 4 left hemiplegia) participated in this study. Participants performed six tasks, simulating activities of daily living, three times each. Task 1 and 6 were the same. 3D joint angles, hand velocity, hand jerk and normalised hand-trunk distance were recorded for both the marker based and Kinect™ systems. Intraclass correlation coefficients (ICC) were computed to access the repeatability of the variables within the tasks. Bland Altman diagrams were used to assess the agreement between the two motion capture methods.

Findings: High levels of repeatability, for both groups, were found across most of the subset of variables chosen for analysis. Significant differences were found between the groups for hand velocity, normalised hand-trunk distance, trunk flexion and elbow range of motion. Generally poor agreement was found between the Kinect™ and the marker based system.

Interpretation: The chosen variables differentiated between the two subject groups well across the tasks tested. The marker based system and protocol showed high repeatability between movements. 3D motion analysis in this way is a feasible assessment tool for analysis and could be used for assessment and planning of intervention. Further work is required before the Kinect™ system can be implemented for motion capture in a clinical domain.
The Clinical Impact of Hip Joint Centre Regression Equation Error during Gait

Kiernan D1, 2, Malone A1, O’Brien T1, Simms CK2.

1 Gait Laboratory, Central Remedial Clinic, Clontarf, Dublin 3, Ireland.
2 Trinity Centre for Bioengineering, Parsons Building, Trinity College Dublin, Dublin 2, Ireland.

Introduction:
Regression equations based on pelvic anatomy are routinely used to estimate the hip joint centre during gait analysis. While the associated errors have been well documented, the clinical significance of these errors has not been reported. This study investigated the clinical agreement of three commonly used regression equation sets (Bell et al1, Davis et al2, and Orthotrak software3) against the equations of Harrington et al3, recently suggested for use during gait analysis4.

Methods:
Full 3-dimensional gait analysis was performed on 18 healthy paediatric subjects. Kinematic and kinetic data were calculated using each set of regression equations and compared to Harrington et al. In addition, the Gait Profile Score and GDI-kinetic were used to assess clinical significance.

Results:
Bell et al was the best performing set with differences in Gait Profile Score (0.13°) and GDI-Kinetic (0.84 points) falling below the threshold of clinical significance of 1.6° and 3.6 points respectively. Deviations were present for the Orthotrak set for hip abduction moment (0.1 Nm/kg) (Fig.1). However, differences in Gait Profile Score (0.27°) and GDI-Kinetic (2.26 points) remained below the clinical threshold. Davis et al showed least agreement with a clinically significant difference in GDI-Kinetic score (4.36 points).

Discussion and Conclusions:
It is proposed that Harrington et al or Bell et al regression equation sets are used during gait analysis especially where inverse dynamic data are calculated. Orthotrak is a clinically acceptable alternative however clinicians must be aware of the effects of error on hip abduction moment. The Davis et al set should be used with caution for inverse dynamic analysis as error could be considered clinically meaningful.

References
Results of the Shriners Hospital Upper Extremity Evaluation comparing 3D upper limb kinematic model vs conventional 2D video data
Letherland J. 1 Stebbins J. 1 Buckingham R. 1 Lewis A. 1
1* Oxford Gait Laboratory, United Kingdom, julie.letterland@ouh.nhs.uk

Introduction
The Shriners Hospital Upper Extremity Evaluation (SHUEE) [1] is a video-based outcome measure for children with hemiplegia. We have been using it to assist surgical decision making within our centre for the past 4 years. Previous audits [2,3] have shown continued discrepancy with inter-rater reliability therefore the aim of this study was to assess the feasibility of using an established upper limb kinematic model whilst completing the SHUEE and to compare the results of this to scores using the 2D/video data alone.

Method
Ten typically developing subjects (11-16 years, 8 female, 2 (L) handed) were recruited to the study. Each subject completed the SHUEE twice, once with and once without upper limb reflective markers in place. The order of this was randomised to reduce the effect of learning bias. A therapist then scored both sessions with a time delay in between and the results were collated. The mean, min and max score differences between sessions were calculated for the spontaneous functional analysis (SFA), total dynamic positional analysis (DPA), as well as for individual segments measured within the 3D model (elbow, forearm and wrist).

Results
![Graph showing results](image)

There was a difference in all subjects for the total DPA which was reduced in all but 2 subjects, when assessed using the 3D upper limb kinematic model. The mean percentage difference was 5.8%. The sum score of tasks assessing wrist flexion/extension increased with the supplement of 3D data whilst for wrist deviation and forearm rotation it decreased.

Discussion
Despite only assessing typically developing subjects, no-one achieved 100% total DPA during the SHUEE. This then raises the question as to whether the maximal scores are representative of actual performance in the general population and an appropriate ideal to be aiming for. There were scoring differences in each segment when comparing the 2D and 3D data therefore on initial examination it appears as though the 3D data is able to identify an increased amount of joint deviations than the use of 2D data alone. A further area that could be explored with this data is the issue of intra and inter-rater reliability, which in previous audits within our centre has been shown to not be comparable to the original study, despite rigorous training and protocol clarification.

References
Development of a biofeedback system for use in the clinical environment
Lindsay J Millar*, Andrew J. Murphy¹, Philip J Rowe¹
¹University of Strathclyde, Department of Biomedical Engineering, Glasgow, UK
*l.clarke@strath.ac.uk

Introduction
The feedback of information to patients in the clinical environment is a key aspect to achieving a desirable outcome following a treatment intervention¹. It has been suggested that providing patients with biofeedback may have a positive effect on functional outcomes². Currently, biofeedback is not widely used in the clinical environment, due to the complexity of systems which can provide such feedback³⁴. The current study aims to develop a method of providing biofeedback to patients and clinicians in a clear and accessible manner.

Methods
A bespoke pelvis and lower limb cluster marker set combined with strategically placed anatomical markers was designed and implemented. Marker trajectory data was streamed in real-time to an object-orientated application development package and bespoke scripting modules written in Lua programming code were used to create an avatar from tracked and virtual markers. The Grood and Suntay method⁵ was used to calculate intersegmental kinematics and a number of biofeedback options were developed (fig1).

Figure1. Biofeedback of knee flexion showing avatar and visualisation of flexion angle. The angle is displayed as a figure alongside a colour scale which indicates how close the participant is to the goal of 90 degrees flexion.

Results
A biomechanical model which allows output of kinematics and visual feedback of movement to patients and clinicians was developed. Pilot testing of the model against Plug in Gait showed promising results for the accuracy of kinematic calculations.

Discussion
The complexity of the motion capture process is greatly reduced with the use of this model. Cluster markers reduce the need for accurate marker placement and visualisation and data feedback can be given in real-time.

Conclusions
The use of real-time biofeedback will hopefully lead to increased patient understanding and an improved clinician-patient dialogue.

References
Design and testing of a mechanical jig to improve the accuracy of derotation osteotomies: A work in progress

James J. Skivington¹, Dr Andrew J. Murphy¹, Ms Heather Read², Prof Philip Rowe¹
¹ – Department of Biomedical Engineering, University of Strathclyde
² – Orthopaedic Unit, Royal Hospital for Sick Children (Yorkhill)

Long bone rotation is categorised by the proximal and distal ends of long bones being rotated out of alignment and occurs when disease or injury causes long-term muscle imbalance. Rotation can cause a variety of upper and lower limb disabilities, such as crouched gait and an inability to reach the mouth with the hand.

The most common cause of rotation is Spastic Cerebral Palsy, where injury to the Upper Motor Neurone Tract leads to spasticity (involuntary muscle contraction) which can affect both upper and lower limbs in multiple combinations.

Where the patients are severely disabled surgical intervention may be required to de-rotate the bones to a more typical alignment and may be done on multiple bones in a single operation, along with treatments such as tendon lengthening and Botox injections (this is known as Single Event Multi-Level Surgery or SEMLS).

The most accurate current method involves using two guide wires – one in the joint proximal to the osteotomy, one distal and rotating until they are parallel¹, but in femoral derotations it has been shown to have a significant over or under correction in 13% of more involved limbs and 59% of less involved limbs². (Involvement indicates which leg is more severely rotated in patients with asymmetric rotation).

In order to improve accuracy during surgery a mechanical jig has been designed to attach to the two guide wires, which can measure the angle of rotation in all three planes. The jig has been designed to allow use on any long bone and can be locked to reduce the risk of inadvertent translation or rotation during plate fastening. (Fig.1)

In order to determine if the jig provides an advantage during surgery a testing protocol has been developed where a sawbone is fitted inside a simulated limb, with limited access, in order to closely simulate operating conditions. It is proposed that trained orthopaedic surgeons perform osteotomies on the limb both with and without the jig with time and accuracy measured and subjected to analysis.

3D shank & thigh segment orientations & their use in AFO tuning for stroke

Bruce Carse¹, Barry Meadows¹, Phil Rowe²
¹ WestMARC, Southern General Hospital, Glasgow, G51 4TF
² Biomedical Engineering, University of Strathclyde, Glasgow, G4 0NW

Introduction
While there is some normal segment orientation data in the literature [1-3], it is not entirely clear how it was calculated, nor is it necessarily applicable to stroke patient populations. Access to normal shank-to-vertical (SVA) and thigh-to-vertical (TVA) data may assist with the AFO tuning process with stroke patients. This paper proposes a method for calculating these from 3D gait data and presents normal data from a group of healthy older adults.

Methods
Using 3D gait data from 81 healthy older adults, which consisted of 39 male (73 (6.9) years) and 42 female (72.6 (7.6) years) volunteers. Segment orientations for the shank and thigh were calculated using the sequence of tilt-rotation-obliquity (TRO) as specified in ISB recommendations [4]. A spatial definition of mid-stance was used, defined as the point at which the swinging contralateral heel drew level with the ipsilateral heel.

Results
The data in Figure 1 showed that the mean SVA was 8.7 (2.6)° and this occurred at 30.5 (1.2)% of the gait cycle. The maximum TVA 19.3 (5.2)° and this occurred at 53 (1.3)% of the gait cycle.

Conclusions
It remains unclear whether or not tuning every patient's AFO to these normal values will yield the optimal results. Future work should include generating similar normal data from healthy younger adult and children's 3D gait data.

References
A service evaluation comparing the effectiveness of functional electrical stimulation compared to ankle foot orthosis for Multiple Sclerosis related dropped foot

Aggie Dimunge¹,², Paul Taylor PhD¹, Tamsyn Street PhD¹, Duncan Wood PhD¹

¹ National clinical FES centre, Salisbury
² King’s College London
a.dimunge@nhs.net

Introduction - Ankle Foot Orthosis (AFO) and Functional Electrical Stimulation (FES) are used to treat the MS related dropped foot. Previous studies report that both devices improve gait in people with MS. However, a review of the current evidence base found that there is a limited understanding of the potential effects of either intervention on the quality of gait in terms of gait biomechanics. This study aimed to compare the effectiveness of FES compared to AFO using clinical gait analysis and other measurable outcomes.

Method - Three AFO users who have been referred to National clinical FES centre with a MS related unilateral foot drop were recruited for this study. The electrical stimulation was provided using Odstock dropped foot stimulator (ODFS)® Pace. The effectiveness of FES was demonstrated using gait kinematics and kinetics, timed 10m walking speed and participant reported outcome measures. The participant gait was analysed before their FES set up appointment with their AFO and at their FES day two and six week appointments with FES.

Results - With FES, all three participants had improved hip, knee and ankle kinematics compared to both AFOs and unassisted walking. Two out of three participants had clinically meaningful reduction in their walking speed with their AFOs while two out of the three participants had a clinically substantial increase in their walking speed with FES. Two out of the three participants had a meaningful improvement in their unassisted walking speed at the six weeks as well. All three participants had a clinically meaningful change in their MS walking scale and while two out of the three participants reported a clinically meaningful change in their quality of life. There was 12% decrease in participant’s fear of falling over the six weeks. No marked changes were found in participant kinetics and spatiotemporal parameters between the devices.

Discussion - Due to the small sample size, it was difficult to identify any patterns of change but hip, knee and ankle kinematics showed a shift towards the ‘normal’ profile with FES. The kinematics highlighted by the motion capture correlated with the clinical exam and previous literature findings. While two out of the three participants had a marked orthotic effect with the stimulation, the other participant’s results indicated a training effect. The kinematics and walking speed data correlated with the self-reported outcome measures on quality of life, fear of falling and impact of MS on walking. There were several limitations to this associated with the small sample size.

Conclusions - The study highlighted the feasibility of investigating the effectiveness of FES compared to AFOs for MS related dropped foot in a larger randomised control study. The study showed the effectiveness of FES on MS related dropped foot compared to the AFOs. The trends identified in this study highlighted the potential future research areas relating to this field.
Obstacle crossing during gait in children with cerebral palsy: Kinematic analysis of dynamic balance and trunk control

A. Malone1, D. Kiernan1, V. Saunders2, H. French3, T.O’Brien1

1 Gait Laboratory, Central Remedial Clinic, Clontarf, Dublin 3, Ireland
2 School of Physiotherapy, Royal College of Surgeons in Ireland, Dublin 2, Ireland

Introduction
Obstacle crossing during gait is a useful tool to evaluate dynamic balance as it demands precise postural and balance control using perceptually-driven anticipatory adjustments1. The objective of this study was to measure balance and trunk control in children with Cerebral Palsy (CP) compared to typically-developing (TD) peers.

Methods
17 children with CP (10 hemiplegia, 7 diplegia) and 17 TD children completed two gait trials crossing a 10cm obstacle in stride. Three-dimensional kinematic and kinetic data were captured using a 4 Coda cx1 system (Charnwood Dynamics, Inc) and Kistler force plates. Trunk data were captured using a validated trunk model2.

Results
All children cleared the obstacle successfully with similar hip and knee kinematics, step length and single support duration. Step width was higher in CP (p=0.025). Centre of mass velocity was significantly slower in CP during lead limb clearance (p=0.027) but not trail clearance (p=0.073). Movement of the trunk and pelvis were different in CP, characterised by significantly greater total pelvic obliquity, pelvic tilt, and trunk rotation of both lead and trail limbs, increased lateral trunk lean during lead limb crossing, and greater sagittal trunk movement as the trail limb crossed (Fig. 1).

Discussion
Children with CP required greater adjustments at the trunk and pelvis to achieve successful obstacle crossing. This may reflect impaired trunk control as a primary problem, or compensatory strategies for reduced stability distally, particularly as obstacle crossing enforces longer single support duration.

References
Movement Controlled Robots to Encourage Exercise Compliance and Monitor Function in Children with Movement Problems

Authors and affiliations: Emily Chruscikowski¹, Lawrence Cook², Rebecca East¹, Anne Gordon³, Adam Shortland⁰

¹One Small Step Gait Laboratory, Guy’s and St. Thomas’ NHS Foundation Trust, ²Engineering, University of Cambridge, ³Paediatric Neurosciences, Evelina London Children’s Hospital, Guy’s and St. Thomas’ NHS Foundation Trust

Introduction: Compliance with at-home physiotherapy programmes for children is low¹ One approach to encourage compliance is to use electronic games with novel input devices. The introduction of movement technology to a therapeutic programme also allows analysis of the patient’s motor control. The 2011 release of a software development kit (SDK) for the Microsoft (MS) Kinect™ has allowed researchers to begin to utilise the Kinect™ for physiotherapy purposes. The Kinect™ consists of a camera and infra-red depth sensor, allowing 3D motion capture. In general, the Kinect™ has been used in physiotherapy applications to control an on-screen avatar². We believe that children may be more engaged by controlling a physical object as opposed to a virtual one. This project therefore seeks to create a physical toy which can be controlled through the Kinect™.

Methods: Custom software was written in C# to request and collect data from a MS Kinect for Windows™ sensor, using MS Kinect SDK v1.8. This software utilises MS Skeletal Tracking functions to determine the positions of a player’s body segments. According to the player’s body positions, the software then transmits a Bluetooth signal to control motors on a robotic car. MS Gadgeteer™ components were used to construct the car.

Results: The system displays an image captured from the camera in real-time and is able to track the user, overlaying a box corresponding to the position of one hand. The user is then able to drive the car in 4 directions dependent on the position of their hand. The toy also has the functionality to follow a line on the floor beneath it when signalled to start and stop via Bluetooth. A preliminary feasibility study suggests a high level of engagement of children with childhood stroke affecting the upper limb.

Discussion: The movement controlled robot we produced is easily modifiable, minimal software changes are needed to track any body segment. The sensor and toy components could be purchased for less than £350, although a PC is also required to use the Kinect for Windows™. Future generations of movement controlled robots will 1) be scaled to the ability of the player, maximising the player’s ability to control the robot with the motor skills at their disposal 2) be transformable to encourage engagement and 3) include capabilities to log movement data during play.

Conclusions: A system utilising a Microsoft Kinect™ sensor to track a player and actuate movement of a toy in real-time has been successfully developed.


Development and preliminary validation of the Sheffield Foot Model (SFM) for use in children with normal and altered pathology

Emma Pratt1,2, Jill van der Meulen1,2, Wendy Dickens1, Geraint Davies1.
1. Sheffield Children's Hospital NHS Foundation Trust 2. Sheffield Teaching Hospitals NHS Foundation Trust

Introduction Pratt et al. (2012) describes an earlier version of the SFM which, in addition to the standard Vicon Plug-in Gait (PiG) lower body marker set, utilises markers placed over the distal 1st and 5th metatarsal heads to output a measure of forefoot in/eversion in gait. The model was validated against the Oxford Foot Model (OFM, Stebbins et al. 2006) from normal adult data. Due to the relative simplicity of the model, interest was shown in its use for some children, for whom limitations in walking tolerance and/or compliance may preclude the use of the OFM. One of the aims of this work was to validate a modified version of the SFM in children with normal pathology through comparison to the OFM.

Data have previously been presented from SCH (Pratt et al. 2013), using the OFM to identify differences between surgical and Ponseti management of congenital talipes equinovarus (CTEV). To investigate the clinical utility of the SFM data, these data were reprocessed to determine whether the SFM could be validated in a pathological population, and to investigate its sensitivity in identifying differences between interventions.

Methods The original SFM bodybuilder code was modified to calculate the SFM outputs relative to the torsioned shank axis system. To validate the modified SFM in children, existing clinical gait laboratory databases of ‘normal’ barefoot kinematics data in different age groups (5-9yrs; 10-15yrs; 16yrs+) processed with PiG and the OFM, were reprocessed using the SFM, and outputs compared in 3D through comparison of the root mean squared difference (RMSD) and Pearson product moment correlation (PPMC). To validate the SFM in a CTEV population, OFM data were reprocessed 16 feet treated surgically, and 22 feet treated with Ponseti intervention, and outputs compared.

Results Subjectively low mean RMSD and high PPMC between outputs of the SFM’s forefoot in/eversion and the OFM’s forefoot/tibia supination/pronation, were calculated for normal data in all age groups (RMSD ≤2.5°, PPMC ≥0.98), and for the surgical and Ponseti CTEV populations (RMSD ≤1.5°, PPMC ≥0.98). Figure 1 shows the mean ±1 s.d. coronal plane forefoot outputs for the two pathological groups, surgical and Ponseti, using the SFM (bold) and the OFM (FFTBA dashed).

Discussion The high waveform similarities and correlations between the validated OFM model and the SFM, suggests the SFM effectively measures coronal plane movement of the forefoot in children with both normal and pathological gait. On investigation of individual trials, one source of difference was shown to be due to the different mechanisms of the ‘foot flat’ option, relating the height of the D1MH to the P5MH in the OFM, but to the D5MH for the SFM. Although neither model shows a significant difference in the coronal plane forefoot movement between treatment conditions, both show the trend for the surgical group to have reduced excursion.

Conclusions Future work is planned to validate the model in children with CP, and investigate the challenges of using the model for clinical use.

Pratt E et al. (2013), ESMAC AGM Proceedings, Glasgow