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P040

Medial unicompartimental vs total knee arthroplasty patients performance during gait: a focus on muscular activity at the knee

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Introduction: Functional outcome in Total Knee Arthroplasty (TKA), as measured by means of gait analysis for kinematics, kinetics, and muscular activity around the knee shows abnormalities even in patients with excellent clinical outcome. Knee flexion during loading response phase is reduced, accompanied by co-contraction of knee extensors and flexors. Such subtle failure in knee performance during loading absorption was claimed to depend on several factors: quadriceps weakness, prosthetic design, pre-surgical pattern, proprioception disruption. It was supposed to damage the implant in time. The lack of the anterior cruciate legament seems to play a major role in the loss of control of the roll back pattern of the condyles on the tibial plateau in TKA patients. Previous works on unicondylar knee artrhoplasty (UKA) demonstrated better gait performance when anterior cruciate ligament was preserved allowing the patients to maintain normal quadriceps mechanics. The aim of the present work is to evaluate UKA patients knee function during gait compared to TKA with the hypothesis that UKA ensures more physiological knee loading response pattern of movement and a more phasic muscular activation, thus reducing the risk of failure.
Patients/Materials and Methods: Twenty patients with Oxford/Exactech UKA (mean age 70 (SD 7.9), mean follow-up 2 years) were evaluated by means of a Vicon 612–8 cameras system, two Kistler forceplates and Telemg respectively for knee 3D kinematics, kinetics and muscular activity. Data of UKA were compared to those of a control population of ten healthy subjects and ten patients with TKA matched for age and follow up. Mean UKA-IKS score at the time of gait analysis was 90.
Results: Time-distance parameters evidenced a slight slow gait with reduced stride length and cadence and a symmetric longer stance phase with respect to TKA and controls. Knee kinematics on the sagittal plane showed knee flexion during loading response very close to controls and a reduced but phasic pattern of joint moments on the sagittal plane. Adduction moment at the knee was normal. EMG showed controversy results as some patients had a regular pattern of activation of rectus femoris and hamstrings without co-contraction whereas other patients had co-contraction.
Discussion: These results indicate that UKA allows in most patients a quite normal knee kinematics and kinetics, although some abnormalities persist in quadriceps activation. Further research is required to understand these findings assessing other factors which could influence quadriceps activity such as age, proprioception, and muscular strength.

P041

A comparison of two functional methods for calculating joint centers and axes in a clinical setting

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Summary: Two algorithms for functional model calibration were compared in a clinical setting.
Conclusions: Two functional model calibration methods, one developed by Schwartz and Rozumalski, and the other by Ehrig et al., produced nearly identical results. The method of Ehrig et al. is about 200x faster.
Introduction: In the clinical setting, accuracy and repeatability are very important when determining hip centers and an effective flexion/extension axis of the knee. So too is speed and ease of implementation. A functional method developed by Schwartz and Rozumalski (Schwartz Transformation Technique – or – STT) has been shown to be objective and repeatable in a clinical setting [1,2]. However, the calculations can be time consuming – taking up to 6 minutes per subject. Both the STT method and the symmetrical center of rotation estimation/ symmetrical axis of rotation approach (SCoRE/SARA) developed by Ehrig et al. impose the constraint that joint centers/axes remain constant relative to the adjacent segments [3,4]. The two methods were shown to produce nearly identical results when applied to simulated data [3,4]. The present study compares the two methods in a clinical setting on actual patient data.
Patients/Materials and Methods: We analyzed 794 hip range-of-motion (ROM) trials and 793 knee ROM trials for patients seen for analysis in our gait analysis laboratory during 2007 and 2008. Approximately 70% of the patients had been diagnosed with Cerebral Palsy, while the other 30% had widely varying diagnoses ranging from Myelomeningocele to Attention Deficit Hyperactivity Disorder. Both the SCoRE/SARA and STT methods for calculating the hip joint center and the knee joint axis were applied to the trials. The hip centers from the two methods were compared (distance), as were the knee axes (angle). Computation time was also examined.

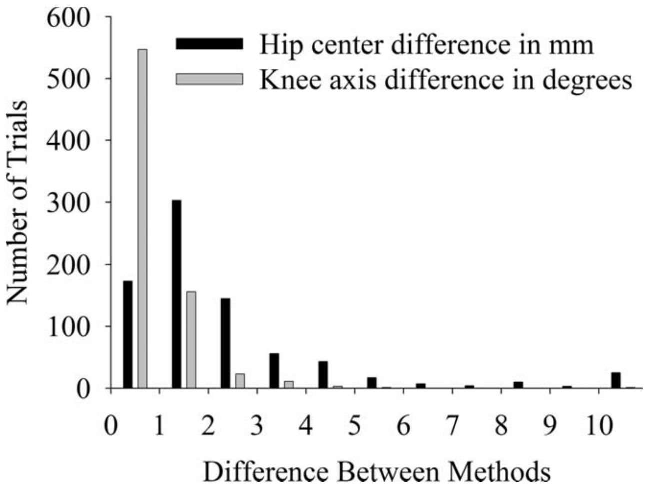

Figure 1. Difference between two joint parameter calculation methods.

Results: The mean distance between the STT and SCoRE hip centers was 2.5 (3.2) mm, with no meaningful bias in any direction. The angle between the STT and SARA knee axes was 0.9º (2.3º) [Figure 1]. The SCoRE/SARA method was 208/210 times faster for computing hip centers/knee axes.

Discussion: The SCoRE/SARA and STT methods have been shown to be equivalent in a clinical setting. The SCoRE/SARA method is many times faster due to the computational methods used.

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P042

Comparison of electromyography in normal and simulated bowleg gait

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Summary: The study compared two modes of gait, normal walking and simulated bowleg walking in normal healthy adults in terms of electromyography (EMG) from eight muscles in the lower limbs. It was found that on average, the phases of muscle activity in normal gait were 0.7 times that of simulated bowleg gait but, the EMG power in normal gait was 2.6 times greater than the bowleg gait.

Conclusions: Muscle activity in simulated bowlegged gait appeared to be weaker in strength but longer in duration than normal gait. Further studies on patients with pathological bowleg would need to be studied to enhance the understanding of the EMG activity in this group.

Introduction: Bowleg gait (genu varus) is a common finding particularly in older people but it is also seen in normal children and apes. So far, muscle activity in such gait patterns has not been fully investigated. In elderly people, osteoarthritis is the major cause of bowleg gait. Other causes include Paget's disease, trauma, infection, tumours and rarely rheumatoid arthritis [1]. Understanding the muscle active patterns in bowleg gait is essential for optimal management, rehabilitation and evaluation of treatment outcomes. Most previous studies have examined the muscle activity pattern of the knee joint including quadriceps and hamstring muscles by surface EMG in bowlegged patients. In a few studies the knee muscle activity has been studied along with other leg muscles [2].

Materials and Methods: Fourteen normal healthy adults were studied using surface EMG. Subjects were asked to walk normally at their own pace and with a simulated bowleg gait. Their ages ranged between 20 and 45 years. The EMGs from eight major muscles, the gluteus maximus and medius, biceps femoris, rectus femoris, vastus lateralis, tibialis anterior, medial gastrocnemius and soleus were recorded. The data was acquired using Vicon® motion capture system (MX F40), two Kislter® force platforms and TSMI® EMG system. Each subject had 8 reflective markers placed on the pre-determined positions on the body. A custom designed program was used to synchronise the data for analysis to determine the relationships between gait and EMG activity.

Results: The biceps femoris and rectus femoris muscles showed prolonged phasic activity with reduced EMG power but the vastus lateralis and gluteus medius muscles showed increased phasic activity without any statistical difference in EMG power. The gluteus maximus muscle activity was prolonged with reduced power in the stance phase of simulated bowleg gait. In medial gastrocnemius, EMG power was decreased with no difference in phasic activity. Tibialis anterior and soleus muscles showed no statistical difference in phasic activity and EMG power between the two modes of gait.

Discussion: This study shows that the muscles around the knee, quadriceps and hamstrings, had more prolonged activity in the stance phase than any other muscles in simulated bowleg gait. In particular, rectus femoris muscle was active throughout stance phase. However, this may be due to the knees being more flexed in stance in the bow-leg gait. In order to confirm the above findings, studies should be carried out in patients with bowleg deformity.

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P043

Measuring three-dimensional knee rotations with skin markers

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Summary: The aim of this study was to evaluate the experimental sources of error associated to a general test of knee joint kinematics in-vivo. In particular, the interest was to assess how critically landmark identification, soft tissue motion and rotation axes estimation on the thigh affect the values of the measurements. Several different multi-marker clusters, including physical markers and calibrated landmarks, were analyzed during gait and elementary exercises of isolated hip and knee joint rotations. The addition of a few direct markers to the standard sets seems to enhance considerably the reliability with which surface clusters can track internal knee rotations.

Conclusions: Skeletal knee rotations can be fully mis-tracked when calculated from standard marker-sets. A medial epicondyle marker or a few additional markers on the distal thigh reduce the errors to a large extent.

Introduction: Despite the recently proposed protocols for gait analysis [1,2], the reliability of three-dimensional knee rotation measurements still remains an issue, also because of the lack of non-invasive validation techniques.

Materials and Methods: A volunteer (male, 29 years, 93 kg, 180 cm) was instrumented with the marker set of two standard protocols [1,3], the wand marker (Tw) being strapped with an elastic band with VELCRO® fasteners; four additional markers were placed in the mid thigh around Tw, according to [2], and at the antero-lateral (LP) and antero-medial (MP) ridges of the femoral groove, for a total of 38 markers. Motion capture was performed (Vicon Motion Systems, UK) in up-right posture and