fréquents étaient le confort, l'efficacité, la solidité et la facilité d'utilisation. L'analyse vidéo montre que la correction du recurvatum est meilleure avec l'attelle dynamique comparativement à l'orthèse préformés.
Conclusion.– Dans une population de patients hémiparétiques marchant au stade chronique, avec recurvatum du genou, l'orthèse dynamique surbaissée améliore la qualité de la marche comparativement à une orthèse préformée et est associée à une satisfaction élevée des patients.

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English version

CO31-001-e

Gait analysis of amputee people

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Lower limb amputation induces a reduction of patient's autonomy in their everyday life activity. Even if prosthetic design and rehabilitation procedure are always in progress, the functional outcome for people with amputation should nevertheless be improved. Indeed, nowadays, an important number of patients find well-adapted solutions for level walking among the offer of prosthetic devices. But, they described some situations as limiting for their locomotion: stairs, slopes and cross slopes are often cited. Not only are these limitations due to the prosthetic components functionalities but also to difficulties in optimally using these prostheses lacking a specific rehabilitation process. Finally, it is clear that, dealing with gait biomechanics of people with amputation, the points of view of both the clinician and the engineer cannot be dissociated.
In the literature, an important number of authors investigated the gait of people with amputation but clinical and biomechanical analyses were not often confronted. Besides, a lot of studies were designed for level walking analysis. Studies on the locomotion in situations as slopes, stairs or cross slopes were not so frequent. More and more teams have now been interested in the locomotion in these situations but often have taken only one situation isolated from the others.
The present communication will aim at demonstrating that the biomechanical study of the locomotion of people with amputation necessitates taking into account simultaneously the different situations these people have to cope with in their daily living. We also want to show the importance of a permanent exchange between the clinician and the engineer in order to realize an efficient analysis of the biomechanical quantitative results of gait analysis. This is particularly true in a domain where the progresses of the patient are due to both the technology and the rehabilitation contributions.

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The bouncing mechanism of running in a transfemoral amputee wearing a blade prosthesis

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Standing posture and gait initiation of hip-disarticulated amputee

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Keywords: Amputee; Hip-disarticulation; Posture; Gait initiation; Prosthesis
Objective.– To assess, for the first time, postural and gait initiation strategies of hip-disarticulated amputees (HDA) using a Canadian-type prosthesis, in order to better understand the rehabilitation difficulties for this population.
Material and methods.– Three HDA wearing a prosthesis composed of a C-Leg knee and a 7E7 exoprosthetic hip and independent for daily living activities, and 19 healthy adults performed a standing postural task and a gait initiation task with the right and left limb moving forward first. The main outcome measures obtained with an AMTI force platform were the center of foot pressure sway during posture, the duration of the gait initiation phases, and the maximal ground reaction forces during gait initiation.
Results.– As compared to healthy participants HDA showed an altered balance in the anteroposterior direction but not in the mediolateral direction. HDA initiated gait more slowly than healthy participants, mainly due to a reduced forward propulsion during the postural adjustments phase. The maximal lateral peak at toe-off was greater in HDA than in healthy subjects, mainly when moving the sound limb forward first. During gait initiation, HDA spent more time in one-leg balance on the sound limb as compared to the prosthesis and the healthy participant.
Discussion.– Gait initiation is the transition from standing posture to steady-speed walking and requires effective postural and propulsive skills. The present results were consistent with previous studies in below- and above-knee amputees and underlined the critical role of the ankle in these two tasks for controlling body motion and for force production during standing posture and gait initiation. The absence of hip muscles in HDA led to an increased and dangerous lateral body-weight transfer when initiating gait with the sound limb and to difficulties for one-leg standing and forward displacement of the prosthesis. As a result, initiating gait with the prosthesis moving forward first is safer for the HDA even though this strategy is slower than when moving forward the sound limb first. These first results show that the gait initiation with prosthesis is a complex task for hip-disarticulated patients.

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Foot biomechanical modeling to study orthoses influence

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Mechanical assessment of knee orthoses: Finite element modeling. Preliminary data

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Keywords: Knee orthoses; Knee braces; Finite elements; Mechanics

Introduction.– Knee conditions often lead to the prescription of knee orthoses for their ''claimed'' mechanical effects. The evaluation of these devices is currently based on biomechanical/pathophysiological studies or therapeutic trials [1,2]. However, data remain weak, highlighting methodological issues, a high variability of effects and arguable – controversial results. This work is placed within the context of developing assessment methods adapted to medical devices.

Objectives.–

1. Mechanical characterization thanks to a numerical finite element model. A model featuring a generic leg braced with an orthosis allows to quantify the mechanical reactions of knee braces against non-physiological movements and to relate these mechanical reactions to the pressure applied by the brace onto the skin.
2. Validation of the model based on physical (mechanical) measurements followed by a clinical validation.

Methods.–

Stage 1: development of a numerical model under Abaqus® featuring a deformable leg braced with an orthosis whose design and fitting characteristics may vary.

Stage 2: mechanical and clinical validation of the numerical model.

Results.– The developed numerical model will be presented; a leg kinematic is imposed in order to output the reaction forces/moments. First results about the comprehension and conceptual adjustments of orthoses will be discussed.

Discussion.– This evaluation method is going to be:

– adapted for different wearing conditions: tightening – skin adhesion;

– validated for ''performance grading'' of mass-produced orthoses (measurements with a metrology apparatus – instrumented simulator of knee movements);

– validated by clinical trials: anti-drawer effect with clinical analysis on functional scales and drawer measurements.

Thanks to this computational tool, novel brace designs can be tested and evaluated for an optimal mechanical efficiency of the devices and a better compliance of the patient to the treatment.

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The strain distribution for the natural and implanted hip joint articulation

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Efficacy and satisfaction of a lowered dynamical ankle-foot orthosis in chronic walking hemiparetic subjects

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Keywords: Stroke; Hemiparesis; Gait; Orthosis

Objectives.– To evaluate in chronic walking hemiparetic subjects the efficacy regarding the correction of the knee recurvatum and the walking performances of a lowered dynamical ankle-foot orthosis (D-AFO) in comparison with a prefabricated ankle-foot orthosis (P-AFO, Ottobock™) and shoes alone (SH). The secondary objective was to evaluate the satisfaction of the patients, with a focus on the putting of the orthosis and the shoes.

Methods.– The D-AFO is a carbon individually made orthosis, with a lowered articulation. Twenty chronic hemiparetic walking subjects were included in this single center comparative study. Gait quality was assessed on a GaitRite treadmill with a video recording performed with the D-AFO as compared to the P-AFO and shoes alone. The walking performances were assessed with a six minutes walking test and a Wade test with the D-AFO versus the P-AFO. The satisfaction was assesses with the ESAT-QUEST.

Results.– Walking with the D-AFO shows a significant improvement of the speed and quality of the gait as compare to shoes alone (walking time: 16.7 s ± 11 s versus 21.9 s ± 17 s, $P = 0.04$; FAP: 64 ± 18 versus 59 ± 16, $P = 0.0018$). The mean walking time and FAP are better with the D-AFO than with the P-AFO, but the statistical comparison doesn't reach significance. The D-AFO allows a better quality and a better control of the knee recurvatum as compare to the P-AFO, and is also associated with a high level of patients 'satisfaction (ESAT-QUEST 43 ± 6/50).

Conclusion.– In a population of chronic walking hemiparetic patients with a knee recurvatum problem, the lowered D-AFO improves the gait quality and walking performances comparatively to a P-AFO and shoes alone. It is also associated to a high level of patients' satisfaction especially regarding the putting of the orthosis and the shoe.

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