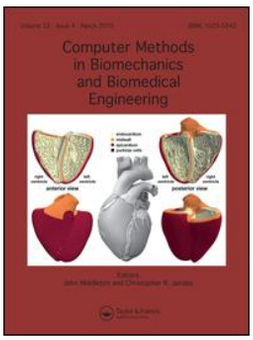

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Preliminary clusters analysis based on functional disability scales for chronic Low Back Pain. Kinematic and EMG differences

Y. Delpierre[a], M. Ritz[a] and C. Garnier[b]

[a]Centre de l'Arche, Pole régional du handicap, 1 bd de Maule, 72650 Saint-Saturnin; [b]Laboratoire d'Automatique, de Mécanique et d'Informatique Industrielles et Humaines, Université du Hainaut Cambrésis, 59313 Valenciennes

KEYWORDS chronic low back pain; clinical scales; electromyography; kinematic; hierarchical cluster analysis

1. Introduction

Chronic Low Back Pain (cLBP) can be caused by several origins with important consequences on life, which induce psychosocial consequences. cLBP is not a pathology but a symptom. Patients with cLBP constitute a heterogeneous population. Psychological subgrouping scheme based on multiple Fear-Avoidance Model has been proposed (Beneciuk et al. 2012), but no relation with life of patients and quantitative data have been analyzed. The impact of LBP on life represents a primary concern. The Quebec Back Pain Disability Scale (QBPDS) and the Dallas Pain Questionnaire (DPQ) are the more used scales. QBPDS is a functional evaluation. The DPQ is based on a cognitive and behavioral conception of chronic pain. This impact is evaluated: on a patient's daily (part 1), work and leisure activities (part 2), on levels of anxiety, depression (part 3), and sociability (part 4). Finally, HAD is applied as a self-report instrument used to evaluate depression and anxiety.

Electromyographic (EMG) and kinematic analysis are applied to evaluate patients other than such clinical scales. Median Frequency (MF) and Root Mean Square (RMS) have been used with such population to describe fatigue process and amplitude of muscular activity (Cardozo et al. 2004). Kinematic quantifies impact on movement, specifically. However, in case of cLBP, trunk is associated with the adoption of a protective movement strategy which overall decreased mobility. Deconditioning appears and induces psychosocial consequences.

The aims of this study were: (1) to defined clusters on cLBP patients from clinical scales which evaluate impact of this symptom on daily life, (2) compare these clusters on muscular activity (erector spinae during hip flexion-extension) and trunk mobility index (during hip flexion-extension/bending/torsion).

2. Methods

2.1 Population

Patients (n = 24; 11 men and 13 women; 38.04 years (6.35)) with cLBP enrolled in a clinical trial comparing behavioral physical therapy interventions to classification based physical therapy completed baseline questionnaires for pain consequences evaluation (DPQ, QBPDS, HAD). Patients were analyzed before rehabilitation program and took part in the Protocole Lombaction (a multidisciplinary reconditioning program coordinated by the French Regional Network for Occupational Health).

2.2 Material& method

EMG on erectors spinae were recorded by two surface electrodes on muscle and placed according SENIAM recommendations. Zero-wire electrodes (1000 Hz) connected to motion capture system (Vicon, Oxford, RU) were used. A band-pass filter of 20–500 Hz was set as SENIAM suggested. Median frequencies (Mf) and RMS were computed for each muscle during hip flexion-extension (R2012, Matlab, USA). This movement was decomposed in three phases: flexion (phase1-from standing up to maximal hip flexion), maximal hip flexion (phase 2), hip extension (phase 3-from maximal hip flexion to standing up). EMG variables were computed for each phase. No normalization of EMG was realized since variables computed are in relation to density spectral power (Halaki and Ginn 2012).

A 3D motion capture system (ViconT10, 100 Hz) recorded data for 34 passive markers (14 mm) to define a plug-in gait model. Hip flexion and extension, hip bending (left and right side), and trunk twists (left and right side) were captured to measure the relevant range of motion values for each plane. From motion capture analysis, an

CONTACT Y. Delpierre uam@asso-prh.fr

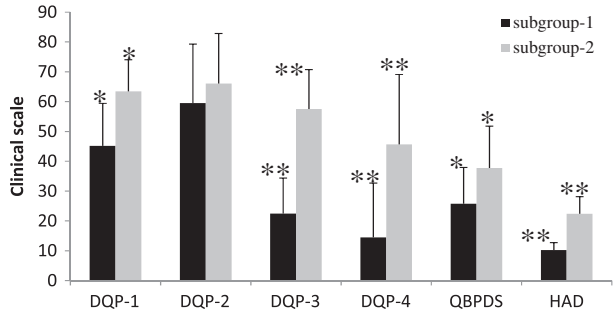

Figure 1. Descriptive statistics for clinical outcomes. *: $p \leq 0.05$; **: $p \leq 0.001$.

Index to quantify deviations from normal Trunk Mobility (ITM) based on range of motion measurements for multiple planes and segments (*article in submission*) was used. As Gillett's gait index in case of gait analysis (Schutte et al. 2000), this index sums up multivariate analysis from motions of trunk in reference to healthy controls data. For each movement, four trails were practiced and averaged. Analyses were performed with Statistica (V13, Dell, USA).

From HAD, QBPDS, each part of DPQ, hierarchical agglomerative cluster analysis (HACA) was applied to create distinct cluster profiles. This agglomerative cluster analysis was performed using Ward's clustering method with squared Euclidean distances as the similarity measure. Muscular activity and global kinematic mobility of trunk were compared between clusters. Results were presented as: mean (standard deviation). Mann-Whitney tests were applied to each variable to compared groups ($p \leq 0.05$).

3. Results and discussion

Two clusters were obtained. Subgroup-1 includes 10 patients; subgroup-2 includes 14 patients. Subgroup-1 is associate to moderate scales whereas subgroup-2 describes cLBP with important consequences on life (DPQ) and important anxiety, scaled with HAD (Figure 1). No statistical difference was notice on ITM between these two subgroups (33.3 (14.1) for subgroup-1 and 28.1 (9.3) for subgroup-2). Trunk mobility is not influenced by these sub-groups.

EMG analysis (Figure 2) reveals no difference on Mf between these two subgroups. Besides, RMS-L-3 reveals statistical differences. Subgroup-2 is associated to more important RMS during hip extension. The absence of significant difference for right muscle ($p = 0.06$) could be explain by more important variation. Globally, this study suggests that our heterogeneous population can be divided in two subgroups according impact of back pain on daily life. Although few statistical differences were found (due to the limited number of subjects), physiological markers (RMS computed from EMG) quantify this impact.

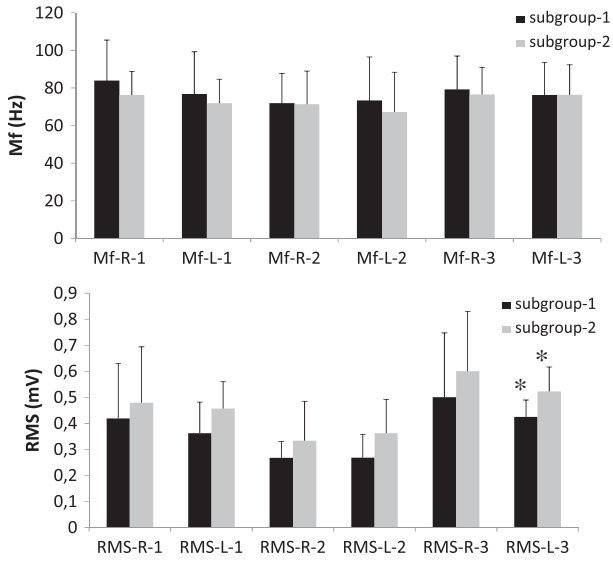

Figure 2. Descriptive statistics for EMG outcomes for each phase of hip flexion-extension. R: right erector spinae. L: left erector spinae. *: $p \leq 0.05$.

As Cardozo et al. (2004) in case of dynamical test, Mf does not present a sufficient sensitivity to distinguish differences or evolutions.

4. Conclusions

With cLBP, this study determines psycho-sociological subgrouping scheme based on scales with similar trunk mobility. This preliminary study may be developed with a more important population. Understanding such subgroup could help to propose a suitable restoration program.

Acknowledgements

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