LOW BACK PAIN IN HOSPITAL WORKERS EVALUATION: BIOMECHANICAL OBJECTIVITY BY ISOKINETIC CYBEX TEST

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SUMMARY
Low back pain has become one of the major reasons from absence from work. The etiology of LBP is still not fully understood and controversy remains regarding the significance of the influencing factors. Clinical objectivity is consistently increased by isokinetic testing devices whose validation is a major goal in clinical practice. By this means we set up a protocol of examination to better qualify subjects affected by LBP between the health workers of 6 hospitals of the region. Protocol and results are presented.

INTRODUCTION
It is not simple to create a useful protocol to perform a valid clinical assessment in lumbar patients, especially related to work particular conditions because of number of parameters and conditions involved and its complexity. They were assigned to the LBP group if they had been certified ill due to low back problems by the medical doctor controlling hospital workers in every single hospital considering literature guidelines about LBP. In this study we tried to evaluate a large population of hospital workers (particularly male and female nurse) by global approach involving clinical examination, postural analysis and isokinetic trunk evaluation simulating an extension-flexion exercise. This kind of movement has been chosen because it’s almost one-dimensional and the isokinetic machine ensures good control and repetitiveness. A validation by computer model has been also executed using muscle-skeletal model by AnyBody Repository 6.3 (Aalborg) which was chosen and adapted in order to correctly simulate the isokinetic extension-flexion movement; AnyBody is a software which can perform complex inverse dynamic simulation and calculate a lot of quantities regarding muscle-skeletal system.

MATERIALS AND METHODS
The isokinetic tests were executed all in the 2010 year, on 267 subjects affected by low back pain; all hospital workers, with no other muscle skeletal pathologies, aged between 23 and 65, sent by the Monitoring Service for Health Workers from 6 different hospitals of the region; population sample has been very randomized about body type, but very consistent for kind of job,subject topology and environment. Each subject has been clinically evaluated by orthopedic surgeon; xographic, NMR and TAC imaging evidences have been noted and interpreted; then subjects have been evaluated by a baropodometric platform in static, dynamic and moreover in anteflexion (10 repetitions) postural test for postural testing – COPs and baricentral tracking has been performed. Then isokinetic test has been performed, using a Cybex 350, mounting correct adapters to perform with the subject seated (fig.1), with the lower limb at 90° degree versus pelvi and flexed at 90° both knees; dinamometer axis is coincident with the rotational axis on frontal plane at L3-L4 level.

The subject has been instructed to use only trunk momentum and dont use lower limb push; the realiability has been strictly observed by the 2 operators present at the test execution. Flexion extension movement of the trunk is very consistent with body weight, height and muscular mass. The trunk test consisted on four isokinetic exercises at different nominal angular speed (30°/sec and 45°/sec); each test of 4 has been preceded by 4 repetitions to familiarized the subject with the procedure. The force applied by the subjects is applicated at costant angular velocity (isokinetic), which grants optimal maximal force during all the test ROM. Changement of the momentum versus range of motion is the result of a center of rotation variation in the lumbar spine and it is registered as a curve alteration/flexus. The outputs measured were: maximum torque, range of motion, work executed; especially important has been considered the presence of alteration of curve describing the extension movement; these eventual alterations have been related to cinematic discontinuities caused by local segmental instability and relevant discopathology (not protrusion). In the photo are displayed the Cybex Dinamometer and EMG electrodes position: there are different phases of the preparation of the testers; in particular we can observe the seated position, chosen to eliminate reduce the pelvi trochanteric muscle interaction with the lumbar low spine muscle stabilization. Also 4 isometric tests at different angles were performed in order to find the EMG Maximal Voluntary Contraction of each muscle (MVC); for the comparative analysis between tests and software a “mean cycle” was created, and both EMG activity, angle and force data were mediated. This was possible because of the extreme repetitiveness of the exercise. The experimental EMG results were elaborated with Smart Analyzer® software with rectification, integration with mobile window and low-pass filtering (5 Hz). The resultant signal of each muscle was then normalized with respect to the MVC value. This software also made possible a good synchronization between EMG and Cybex data, by using the EGN signal. After that a cinematic and a force driver of each exercise was created and a numerical simulation of each exercise was performed.
with 1-element and 3-elements muscle model. At the end of all the simulations data regarding analysed muscle activity and force were recorded. Then the activity calculated by AnyBody was compared with the experimental EMG activity. We have to remember that AnyBody’s activity and EMG activity of a muscle are not properly the same entities: the first one is a ratio between instant muscle force and the maximum strength of the muscle (which is constant in the 1-element model and function of speed and length in the 3-elements model), the second one, instead, is a ratio between electromiographic instant signal and the MVC. This comparison was made for the “mean cycle”, with time in abscissa and also in relation with the knee angle. The most synthetic and, thus, significant analysis is the second one. We have also compared the experimental activity versus their numerical-calculated activity and the torque performed respectively in extension and in flexion. There are many differences among the exercises performed at different speeds and the results are in general better at lower speed exercise, where the numerical tracks are more similar to the real experimental one. In general the difference between numerical and experimental value is not influenced by exercise speed in the analysis of extension movement. Numerical values become significant smaller than experimental ones increasing angular speed in flexion instead.

CONCLUSIONS
The results imply that the functional interactions between all members of the spine complex (spine – hip – femur) is fundamental for a correct assessment of grade capability in low back pain affected workers. Objective quantification of functionality is more and more needed in the clinical assessment of subjects affected by low back pain, especially if related to the kind of job. In the results analysis and interpretation, biomechanical models can greatly help the validation of clinical assumption and be fundamental base of future indications. Computer simulation can also open new interpretation capability and clinical tests or custom machine design.

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