New service for biomechanical assessment of traffic accident victims. Clinical case: diagnosis of malingering

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The *Instituto de Biomecánica de Valencia* (IBV) has set up the Service for Biomechanical Assessment of Traffic Accident Victims. The aim of this service is the objective evaluation of functional repercussions on the musculoskeletal system as a result of traffic accidents. This report shows the utility of this service in the diagnosis of malingering by means of a clinical case of a 45-year-old patient who reported cervical pain and instability leading to falls 15 months after the traffic accident.

Introduction

Musculoskeletal lesions caused during traffic accidents constitute a high annual cost for insurance companies for healing, expenses derived from temporary and permanent disability and compensation for sequelae. For example, if we consider the sequelae and the days needed to stabilise a minor lesion (bruises, cervical sprain and non-traumatic condition), the average cost of the indemnity for physical damages may be placed at around 4,500 Euros, which does not include health care expenses.

The assessment of these musculoskeletal lesions presents major difficulties for the examining physician because:

- **Pain is a subjective symptom** that cannot be determined by means of current radiodiagnostic techniques such as radiography or magnetic resonance.
- **Some patients exaggerate or simulate** painful symptoms or functional limitation if obtaining extra earnings is a possibility.

These factors affect decision-making on the choice of a rehabilitation treatment, a medical discharge report following the progress of a process or the decision to award economic compensation to the patient after the accident.

The **biomechanical assessment techniques** developed by the *Instituto de Biomecánica de Valencia* (IBV), which has longstanding experience in the application of these techniques, **allow us to identify subjective symptoms such as pain or functional alteration produced by a lesion**. The use of these techniques is now widespread as a complementary medical test in the sphere of occupational medicine and they contribute to cost savings for occupational mutual insurance companies. These techniques may also be useful in the assessment of traffic victims and contribute to savings for insurance companies. For this reason, the IBV has prepared and offers a **Biomechanical Traffic Accident Victim Assessment Service** which, illustrated through a clinical case, is presented in this article.

Biomechanical Traffic Accident Victim Assessment Service

The IBV's Biomechanical Assessment Service uses a set of biomechanical techniques to deliver tests specifically targeting the objective functional assessment of the musculoskeletal system. These tests, based on the use of three-dimensional photogrammetry, instrumented insoles and dynamometric platforms, among other instrumental techniques, permit the objective and reliable assessment of bodily damage without the possibility of the measurements being manipulated; they >

> are useful as a complementary medical test in assessing the body injury of traffic victims, and facilitate application of Table VI "Classification and Assessment of Sequelae"[1].

The main tests in the Biomechanical Traffic Accident Victim Assessment Service are:

- Functional assessment of walking capacity.
- Functional assessment of the capacity to walk up and down stairs.
- Functional assessment of bipodal and monopodal postural control.
- Functional assessment of the lumbar column.
- Functional assessment of the cervical column.
- Functional assessment of the shoulder.
- Objective assessment of strength and mobility of the hand, upper limb, lower limb and spine.

They all provide objective and quantitative information on a patient's functional status and regarding the degree of collaboration or sincerity of their effort during the test. The usefulness of these tests to insurance companies lies in the monitoring of the rehabilitation processes which, in some cases, are unnecessarily prolonged, and in the detection of simulated or disproportionate behaviours.

Below is an example of the application of these techniques through a clinical case.

Clinical case: Diagnosis of malingering based on the functional biomechanical assessment of a patient with chronic cervical pain and instability

Background

The patient is a 45-year-old woman who, following a traffic accident *in itinere* in January 2008, was diagnosed with post-traumatic cervical contracture. Since then, she has been reporting intense cervical pain and instability crises that cause her to fall.

During this period she was on treatment with NSAIDs, analgesics, muscular relaxants and heat therapy without reporting any improvement; cervical and cerebral NMR were performed, without obtaining significant findings; she was assessed by different specialists such as ENT and neurologists, without any objective finding that justified the patient's symptoms.

The physical examination showed a generalised limitation of cervical mobility which, with distraction manoeuvres, was significantly attenuated. Postural control assessed by means of Romberg and specific balance tests showed no assessable findings.

1 In the Annex (System for the assessment of damages caused to people in traffic accidents) of the Law on Public Liability and Insurance in Motor Vehicle Traffic, the consolidated text approved by Decree 632/1968 of March 21, as a scale of indemnity of definitive sequelae of Act 30/1995 on the Planning and Supervision of Private Insurance, updated by Act 34/2003, of November 4, on the Modification and Adaptation to the Community Legislation of the private insurance legislation.

Assessment method

The patient was submitted to two biomechanical functional assessment tests:

1. Biomechanical functional assessment of the cervical spine with the NedCervical/IBV system (**Figure 1**), which is comprised of a photogrammetry unit to record kinematic variables and a computing application that calculates and analyses patient data and compares them to three reference populations: normal (without cervical pain or disorders), pathological (people with cervical pain) and malingerers (people who simulate cervical pain). This assessment includes two sections: "limit test", which evaluates pure flexion/extension movements, lateral inclination and rotation, and "functional characterisation of movement", which evaluates all the movements in combination on asking the patient to turn their gaze towards three points above their head.

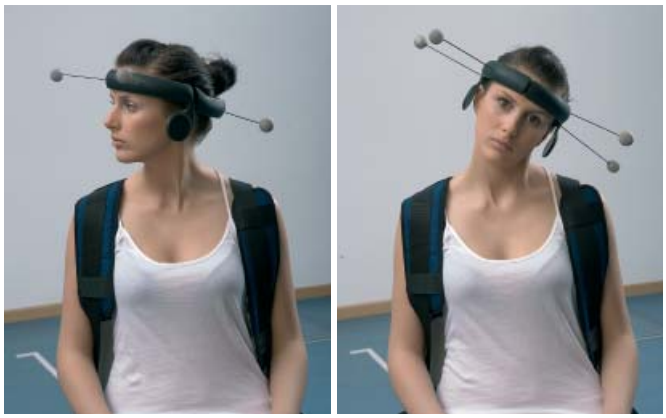

Figure 1. Representative image of the Limit Test with the NedCervical/IBV system.

2. Biomechanical assessment of postural control based on NedSVE/IBV (**Figure 2**), a system of static and dynamic posturography which records the effort and movements of the centre of pressure for a series of tests that the patient does either standing up or walking. The system is comprised of a dynamometric platform and a computing application that calculates and analyses data by comparing them to a database of normality.

Figure 2. Representative image of the RFEC test and Stability Limits with the NedSVE/IBV system.

Results

The results obtained in the biomechanical assessment of the patient are displayed below, and they support a diagnosis of malingering symptoms. All the variables analysed are represented in the form of percentage of normality. Values below 90% reflect a discrepancy with regard to normality.

Biomechanical functional assessment of the cervical spine

In the functional assessment of the cervical column, low repeatability was observed in the execution of flexion/extension, lateral inclination and rotation (**Figure 3**), both in different cycles of the same test and in the comparison of two consecutive tests of the same movement. This indicates that the patient is not carrying out maximum effort and is limiting mobility (**Figure 4**).

	Rango	Vel. máx.	Acel. máx.	Armonía	Repet. intraprueba
Flex.-extens. 1	87.3	80.2	76.8	100.0	74.3
Flex.-extens. 2	70.4	74.5	67.2	100.0	58.0
Flexión lateral 1	100.0	100.0	100.0	93.1	71.0
Flexión lateral 2	100.0	100.0	100.0	92.1	87.3
Rotación 1	83.6	68.6	69.8	94.4	39.7
Rotación 2	69.4	83.0	100.0	100.0	44.3

Figure 3. Percentages of normality of each one of the parameters analysed in the Limit Test. The intra- and inter-test repeatability is highlighted in red. Values below 90% are consistent with a pattern of lack of collaboration.

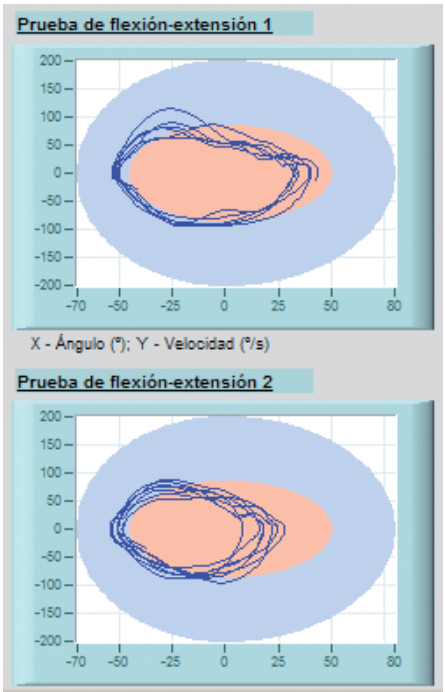

Figure 4. Graphic representation of flexion/extension tests 1 (top graph) and 2 (bottom graph) which represent angular speed with regard to amplitude of movement. A different pattern of movement was observed between both (low interest repeatability). The red arrow highlights the significant variability at maximum amplitude of extension reached in several movement cycles (low intra-test repeatability).

Moreover, the left rotation of the cervical spine performed during the functional characterisation of movement reached approximately 56º of mobility. This fact, compared to the 39º of mobility obtained in the left rotation in the limit test, is not consistent (**Figure 5**), which shows that the patient is capable of greater cervical spine mobility and therefore did not collaborate by carrying out maximum effort in the test. A lack of consistency between the two tests indicates malingering behaviour in the population studied by this system.

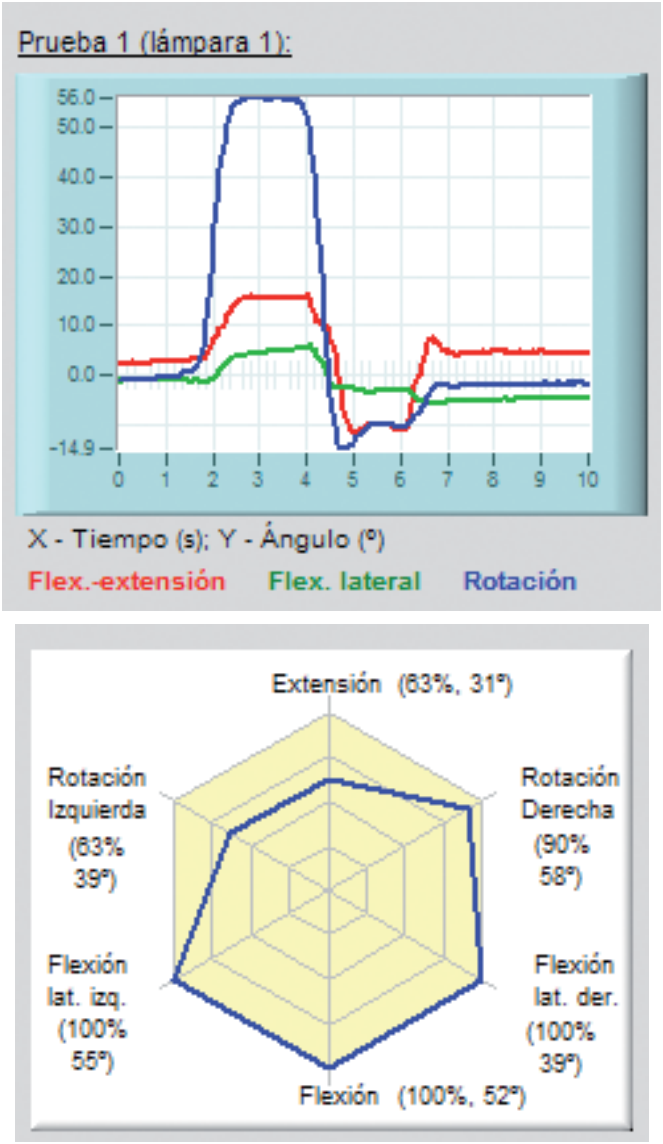

Figure 5.
Top: mobility result in Lamp 1 test (good mobility was observed in the left rotation).
Bottom: result of mobility in Limit Tests (limitation is observed in the left rotation).

Biomechanical functional assessment of postural control

Postural control in the different sensorial tests performed (**Figure 6**) was normal, except in conditions in which visual sensorial information is ruled out by closing eyes (REC and RFEC) with 73% and 76% of normality, respectively. In these conditions, a fall cannot take place, but the oscillations

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recorded are greater than in the normal population. This means that the patient uses visual information more to keep her balance, whereupon suppressing this information affects control more. It is striking, and even inconsistent, that the assessment in the most difficult test (RFEC) obtains a better assessment than in the other similar one, but without foam (REC), which demonstrates that the patient's postural control capacity is possibly better than what she has demonstrated in these tests.

Valoración Sensorial - Dinámica

Prueba	Valoración	Repetibilidad
Romberg Ojos Abiertos (ROA)	93 %	79 %
Romberg Ojos Cerrados (ROC)	73 %	100 %
Romberg Ojos Abiertos + Gomaespuma (RGA)	95 %	100 %
Romberg Ojos Cerrados + Gomaespuma (RGC)	76 %	100 %
Marcha Humana (MARCHA)	95 %	99 %
Sensorial -Dinámica (SENS-DIN)	**86** %	**96** %

Figure 6. Results obtained following the implementation of the Sensorial and Dynamic Assessment balance test for each one of the Romberg tests performed and kinetic analysis of gait. The last column shows test repeatability.

In the dynamic analysis, performed by means of the assessment of gait, no disorder was recorded due to problems of instability, so the walking problems reported by the patient secondary to her symptoms were not detected.

Posturography was also used to evaluate the type of movement strategy used to maintain postural control and avoid falling. The mediolateral strategy corresponds to the hip mobility strategy in balance control and the anteroposterior to the ankle mobility strategy. **Figure 7** shows the percentages of normality of these strategies. The patient correctly used the balance control strategies for all the (Romberg) tests performed, which were above the normal limit, which also supports the fact that there are no postural control problems.

Valoración Estabilidad

Prueba	MedioLateral	AnteroPosterior
ROA	100 %	99 %
ROC	100 %	95 %
RGA	100 %	100 %
RGC	100 %	95 %
Estabilidad	**100** %	**97** %

Figure 7. Assessment of maintaining-balance strategy of each one of the tests and the total average (Stability).

Another important datum in balance assessment is to ascertain the stability limits of the person assessed to estimate the risk of fall. The stability limits represent the area of stability of a person through which he/she may move his/her centre of gravity without actually falling. The patient's stability limits (**Figure 8**) are within the limits of normality and are suitable for a person of these characteristics. This datum means a low risk of falls if destabilising factors occur.

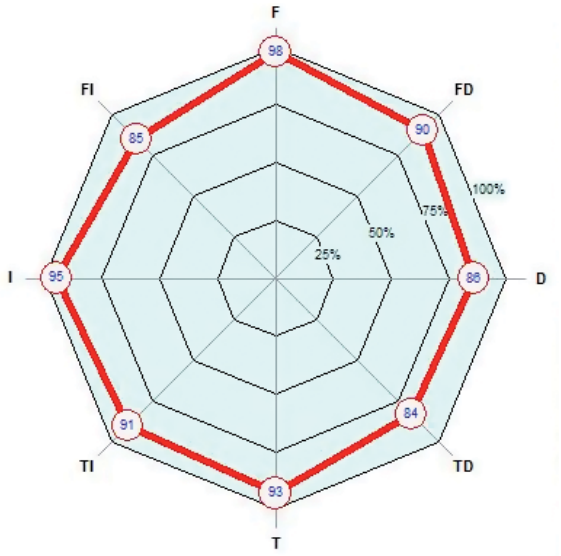

Figure 8. Graph that represents the limits of stability together with their percentage of normality in each direction evaluated.

Conclusions

The conclusions reached in case of this patient are:

1. **The cervical functional assessment test performed on the patient showed**, by means of objective data of low collaboration and consistency of results, **malingering behaviour**.
2. No significant deficits were observed in the postural control of the patient analysed by means of posturography techniques which would justify the deficiencies she reports.
3. The biomechanical assessment techniques presented in this paper, like the other ones delivered in the traffic accident victim assessment service, are useful as a complementary medical test in the diagnosis of malingering, because they are based on objective recordings, they make it possible to analyse the collaboration and consistency of results from different points of view, facilitate the comparison of results with simulation standards and constitute new forms of patient assessment in which the results can hardly be manipulated. ●