

## When Science is Not Enough: Biomechanics in the Legal Arena

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### Editorial

Hopefully, this title as well as the journal it prefaces is going to provoke a discussion about where we currently stand in legal biomechanics and where we want to go. As the subject is huge and there are many different fields to cover, I will stay within my own field of expertise and invite the community to participate. As this is an editorial, it therefore reflects my own personal opinion. However, I will be happy to discuss the scientific background with any interested party. My subject today is Functional Capacity Evaluation (FCE) in the medico-legal field, i.e. the testing of motion, force and coordination of the human body. This may indeed include many different additional aspects, such as gait and motion studies, Pressure studies, Isokinetics, Balance and so on.

FCE has become a new market, even outside of the courtroom, as employers prefer to know the potential ability of a new employee before he/she is contracted. There are systems in place within the market which are claimed to be ideal for this purpose providing relatively quick solutions, the reports are well received and look impressive, with the graphs, tables, colours and precise numbers they present. Whilst we have seen certain related scientific articles, the comparison between testing and real human performance in everyday working life with a large subject sample size still needs to be done.

The reality is more complicated than that. For example, when an injury is already sustained and a professional has to establish the functional deficit of a patient. It might be the case when rehabilitation is planned following the initial treatment, or in order to detect the finality of the treatment, when further rehabilitation might not produce functional. It might be that the functional deficit needs to be determined in order to calculate the compensation. Or it might even be the case that the opinions about the functional limits between two parties are different and experts are summoned into court to provide a qualified opinion. And here the complexity really begins...

In the first place, legal distinctions between various countries make it difficult to develop standardization. When common law is applied, issues are resolved on a case-by-case basis relating to prior situations within the legal area of application. In contrast, when civil law is implemented, cases are subject to the written details of legal texts. These texts are different for all countries. Even within the European Union, where unification is aspired to, there are still major differences. If we take, for example, the arm motion at the sagittal axis (frontal plane), the German law (VersMed. from 2009) defines it as elevation, including ranges of limitation (up to 90° or 120°). On the other hand; the Spanish law (BOE núm. 22 from 2000) defines the normal range to be within 180° of abduction. In motion science, these are important differences, as elevation might occur at the neutral shoulder joint axis (~30° forward rotation), whilst abduction is defined as aligned to the frontal plane. In both situations the underlying muscle action is slightly different. And taking 180° as standard is quite difficult.

Considering a 'pure' motion of the arm without any rotation of the hand outwards, 180° might be achieved when hyperlaxity occurs or a muscle is ruptured, but seldom under normal circumstances. Or we may allow for compensation using the rotation, but then again, we find different muscle actions in the motion. Thus we do not encounter unified criteria for FCE within the legal field, which attests to how many differences one can find in the methodology of the testing processes being applied to the legal system.

And this carries over to the general aspect of definitions, especially within the clinical field. On one side we find that the definition of biomechanical axis has to fit into the old clinical definition of the three general rotational axes we use within the human body, especially at the more complex joints and when deformities occur, and the underlying muscle action that drives these motion definition changes. Certain proposals, such as the "globe definition" of the shoulder are made, but are not taken into general praxis. Other definitions relate to the possible results of the test. A common classification one can find is the use of 'simulation' or 'malingering' in FCE. In the clinical field, this is defined as a mental disorder within the DSM-V or ICM-10. Are we really able to detect a psychological condition using FCE? Or should we insist that such detection be a combined effort between Biomechanics and Psychology? Even with articles describing such detection, I strongly doubt based on my own personal experience that they can be applied as a general methodology.

Additionally, we still cannot measure pain and its effects on human behaviour are so manifold that it is difficult to apply general rules. Together with the complex methodologies we use for muscular-skeletal testing, it finally comes down to the testing and conclusions drawn for each individual case, and not the implementation of general rules.

Furthermore, regardless of the individual being tested, we still do not have a clear classification of the experts undertaking such tests. In order to analyse and appraise static X-rays, for example, professionals ought to undergo specialised training by peers for 4-6 years following the acquisition of a university degree. However, referring to dynamic motion graphs it seems that no special qualification is asked for, even if a profound knowledge of physics and signal processing is needed in order to make a qualified judgement on the data. As biomechanics is not generally considered to be a life-saving discipline, it appears that administration is more lax about it. This does not by any means suggest that we do not have excellent professionals. But there is no guarantee that an individual is indeed being tested by such a professional. And using scientific evidence from general biomechanical testing cannot be directly applied to the legal field, as the level of participation is not given. The latter especially is often found to be defined using very basic statistics, even though we know that motion, force and muscle patterns can be very complex in their analysis. It does therefore raise some very real doubts about the viability of such tests. And I could continue with further examples...

So where do we stand and what can be done?

I personally see the need for specialised education and for scientific debate between distinct fields, especially medicine, engineering and legal fields. At present, tests qualified for use in court should include scientific references that do not pertain solely to a single article. And what I believe is required in order to increase fairness towards the individuals tested, is that the methodology implemented in a test is very well documented and open to debate among professional peers in

order to provide constructive criticism and feedback. Although presenting case studies might be an option, large-scale prospective studies would be ideal.

It is my sincere hope that the *Journal of Forensic Biomechanics* will provide a solid platform for people involved in the field to generate this kind of discussion and to facilitate the dissemination of expertise. And not just for FCE, but for all those fields involving the application of biomechanics in the legal arena as broad a category as this may be.