A video-based method for ergonomic evaluation - now with a checklist based on the Swedish ergonomic regulations

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Abstract
VIDAR, a method developed to support participative interventions, was presented at NES 2003. When using the method an employee is first video-recorded, he/she is then asked to identify physically and psychologically demanding situations, while watching the video inside VIDAR. We, researchers and practitioners, have now extended the method with a checklist, which is based on the Swedish ergonomic regulations. The ergonomist may, after the session with the employee, use the checklist to evaluate the situations. It is easy to obtain printed reports, which are suitable as a basis for discussions. The first tests of the extended method indicate that the new options add value to the analysis with only a small increase of time consumption.

Keywords: Participatory ergonomics, Ergonomic checklist, Exposure assessment

Introduction
There are many developed and reported exposure assessments methods, but there are still very few that are frequently used in practice by ergonomists. There seems to be a mismatch between researcher-made methods and practitioners' needs. In order to match, a balance has to be found between scientific base, complicity, time-consumption and easiness to use.

Ergonomic interventions often lack in success. In a review report (1), Westgaard and Winkel concluded that the changes that have the best chance of success are those with high commitment of different stakeholders (managers, workers, engineers, ergonomists), which utilise multiple interventions to reduce identified risk factors, and those that focus on workers at risk, using measures that actively involve the worker. They conclude that the way to success may be described by one overall strategy: to identify and deal with risk factors relevant for the individual at risk. Accordingly, the active support and involvement of the individual at risk and other stakeholders in the organisation should be ensured. Thus, a participative intervention tool, or at least a method that supports participative ergonomics, should be the aim when designing a practical method.

At NES 2003 a laptop and digital camcorder version of VIDAR, a participative video-based method for ergonomic assessments, was presented (2). It was designed mainly for ergonomists working for occupational health services to be used in participative workplace interventions. There are now practitioners using VIDAR in ergonomics interventions. Also occupational therapists have started to use the method for design of individually customised work places. When using the method an employee is first video-recorded when performing his/her daily work. He/she then does an assessment of physically and psychologically demanding situations. The analyses can also be made by a group of employees by connecting the laptop to a large screen projector. A report of saved situations, including pictures, may be printed directly after the analysis. The reports are suitable as a basis for discussions in

improvement groups. As VIDAR is a participative method, we also try to be participative in its further development. In contacts with practitioners we have been asked to add more input options. This project is an attempt to satisfy that request by adding a checklist module to the program. Such an option should increase the power in comparing the effect of interventions.

The purpose of this project was to increase the usability of VIDAR by adding an "expert module" that makes the data assessment a little more objective and increases to comparability of the analysis results against other work places and the regulations. Moreover, the easiness, time-consumption, and result presentation of the extended assessment program was to be tested by a practitioner in a real case.

The way to an extended version of the program

Microsoft's .Net Visual Basic was used to implement the new program version. As before, functions from Microsoft's framework Direct-X was used to enable communication between the computer and a DV (via IEEE 1394). VIDAR version 3.2 was used as a base and the checklist was added as an option that could be checked or not.

The design of checklist itself, i.e. how to translate the regulation text into an efficiently useful computerised checklist for separate situations as well as for a total work shift, was made in spirally within the group; new versions were send to the members, the version was tested, and discussed through monthly meetings.

The new version illustrated by a case example

To activate the new module you check the Expert evaluation and AFS (i.e. the Swedish name for the document (3) that the checklist is based upon) under Setup in the menu (see Figure 1). The way of using the program is basically the same as in the previous versions, see e.g. (2). In the Analysis mode the worker identifies demanding situations. Then in the Edit mode, data e.g. comments may be changed or added to the saved situations. The most important option of the new module is that the ergonomist, in the Edit mode, now may use the checklist to evaluate the situations saved by the workers. There is now also a possibility for the ergonomist to identify physically demanding situations. This is done by clicking the traffic light symbol beneath the video in the program window (see Figure 1) in the Analysis mode.

The new module was used in an evaluation of a physiotherapist's work in a paediatric hospital. Among other tasks, the therapists tests musculoskeletal functions of children between 5 and 15 years of age. Isometric strength measurements are carried out for ten body regions, with three repetitions for each region (see Figures 1-2). Each subtest lasts for about 5 s. Some of the patients have neurological diseases which impair their ability to co-operate.

The work of the physiotherapist's was video recorded during a test. After the video-recording, the therapist was asked to identify demanding situation when analysing the video together with the ergonomist.

The identified situations were then evaluated by the use of the new checklist by an ergonomist. The checklist is opened by clicking on a traffic light symbol in the Edit mode. It includes two "card registers"; the first concern the situation at hand and includes questions under the cards: Lifts, Push/Pull, Monotonous work, Self-control, and Aggravating factors (such as if the floor is inclined, rough, slippery or rigid). The other register concerns the full work shift. It first shows the question if the work basically is performed standing/walking or seated. The other cards are: Neck, Back, Shoulder/arm, Legs, Monotonous work, and Self-control. The first four cards (Neck to Legs) have questions of work postures in relation to the total time of the full work shift. The last two cards are about monotonous/repetitive work and self-control, and are the same as for a specific situation. The full work shift card register may be edited, from all saved situations. The ergonomist reported that the checklist only added a little time in comparison with the old VIDAR version.
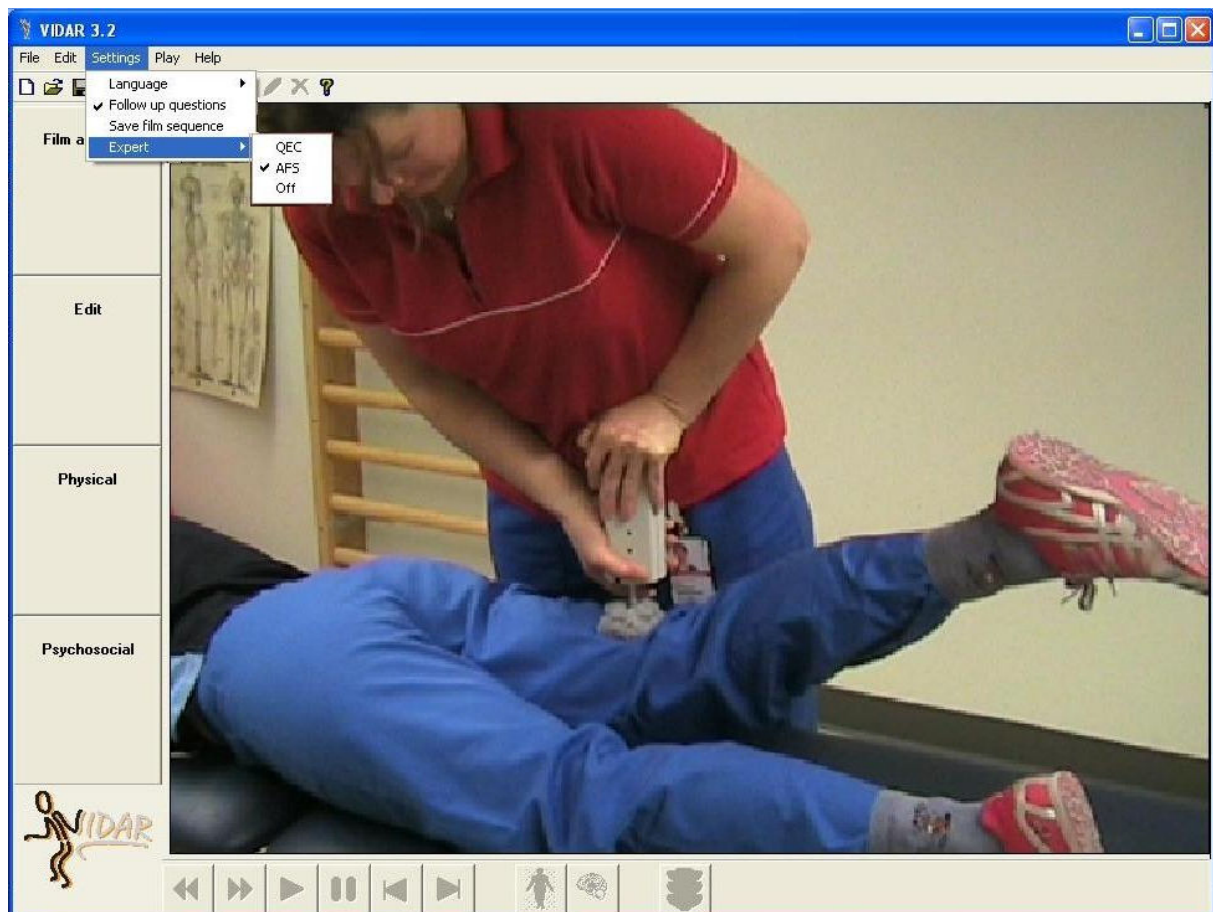
Figure 1. The main program window of the new VIDAR version. The traffic light symbol in the lower list gives the ergonomist a possibility to save and by the use of a regulation-based-checklist evaluate physically demanding situations as well as the total work shift.

The questions have answer alternatives which, in the same way as (3), have the colours green, yellow and red. Green is considered as an acceptable work situation/shift in the respective dimension, yellow represents a situation that should be valuated more closely, and red represents an unsuitable situation where measures should be taken. Green is the default value, i.e. the users does not need to visit all cards, e.g. in a case without a Push/Pull situation, you may save time by neglecting that card. In both registers, there is a Summary card, which shows the user what has been saved so far from the other cards. A report is easily printed, with one situation; its picture and corresponding data, per page. In the case example, nine of ten situations were given yellow remarks, while the tenth was given one remark in red. Most remarks concerned work postures or push/pull forces.

Discussion
This paper shows a new assessment method which is a result of researcher-practitioner collaboration. Instruments that researchers have made with the aim of being practically useful are usually to a very low extent put into practical use. We hope that this attempt is representing a balance between scientifically base and practically efficiency, that is accepted by a large group of ergonomists. One point is that we believe that the ergonomist will visit the relevant cards, and save time by not having to visit all. There are many other video analysis methods proposed in the literature, but the great majority is observation methods, the results of which are time statistics of estimated work postures. These methods are time consuming, and are rarely used by practitioners. A recent review (4) indicated that VIDAR is unique in using the principle of involving the worker's knowledge in the data assessment. You could
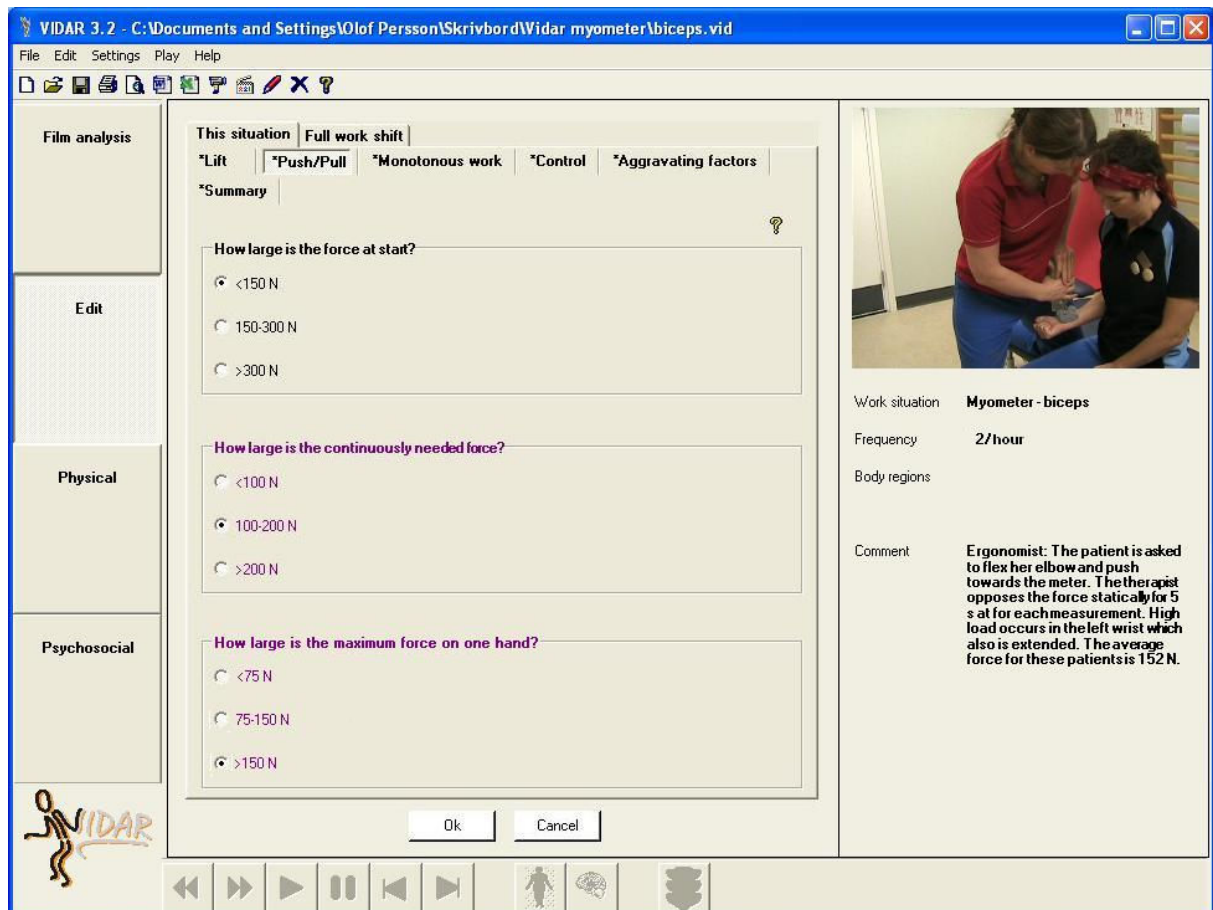
Figure 2. An example of a checklist card. When coming to a card, each question is in its "green" alternative. For increased visibility, in case the user returns to a card, the questions turn purple when an alternative is clicked. A visited card is given an asterisk in its name.

argue that the use of video in itself is hinders time efficiency. But, if it as in the presented method here gives an 'early' participation of the employees and a very clear report that supports the intervention process, it may still be time efficient to use a DV-camera. Another point is that these cameras today are well affordable and easy to use.

VIDAR, in the NES 2003 version, saves worker marked demanding situations. This new version supports also that the ergonomist him/herself saves situations. This function has been a request from users, and it should make the result of an assessment somewhat less subject dependent. The checklist itself has been developed through a process of small steps and frequent project group meetings. The function has probably still not reached its final state; there may be more changes, primarily on a detailed level.

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