

ERGONOMICS, MENTAL WORKLOAD, RISKS, AND ACCIDENT PREVENTION: THE CASE OF HISTOTECHNICIANS

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1. Context

This paper derives from the doctoral thesis entitled Ergonomics, Mental Workload, Risks and Accident Prevention: The Case of the Worker in Histotechnics.

The descriptive research and field study aimed to evaluate which indicators of mental workload (CM) are predominant for the production of accidents in a task of elaboration of histological cuts performed by histotechnicians of the Laboratory of Pathological Anatomy of the University Hospital Gaffrée and Guinle.

Michalany (1980) reports that tissues to be observed under the microscope need to be reduced to very thin portions called histological sections. The task of microtomy consists of a phase of the histological technique during which the histological cuts are performed.

In the formulation of the problem the following question was presented: Are mental workload factors determinant in the production of accidents in a microtomy task?

It was hypothesized that the mental workload factors associated with the risk of accidents to which the operator is exposed in the handling of the rotating microtome represent a source of psychic suffering.

The general objectives of the research were to produce through a preventive analysis of accidents, which can occur during the accomplishment of the histological cuts, the optimization of the task of the histotechnician in the interface with the rotating microtome and to evaluate the mental workload in the task of histological cuts for different mental load factors. Regarding the specific objectives, it was intended to identify which mental load factors could be mediators of the risk situations during the accomplishment of the task. In addition, examine which organizational factors related to environmental conditions, the task, the working hours, the shift system for a preventive action in conjunction with the predominant factors of mental load. The methodological support of the research involved the elaboration of a questionnaire adapted from the method L.E.S.T. (Laboratory of Economics and Sociology of Labor).

We chose to develop the research by the reference framework proposed by Guélaud et al. (1975) which defines the components of the workload from the physical environment, the physical load, the mental load, the psychic load and the working hours. According to Guélaud et al. (1975), the mental load depends on the demands of the task and the level of mobilization of the subject, on the fraction of his work capacity that he invested in the task.

These authors expose four indicators that characterize an aspect of mental stress as stated, time constraint, complexity-speed, attention, and detail. Factors related to the physical environment refer to noise, temperature, lighting, vibrations; the physical loads, such as displacements, maintenance, operative effort, work postures, rest postures; to the psychic load, which refers to the need to obtain consideration and esteem, initiative and communication; according to their duration and structure.

For Dejours (1994) suffering is conceived as the field that separates disease from health.

It should be emphasized that signs of psychic suffering can be linked to the performance of tasks considered to be dangerous, and many work activities can cause physical, mental, emotional and affective costs and expenses to the individual (Wisner, 1994).

It is worth mentioning that for Moraes and Mont'Alvão, (2003):

"The main vocation of Ergonomics is to recover the anthropological meaning of work, to generate active and reforming knowledge that prevents the alienation of the worker, to value

work as a human act through which man transforms and transforms society as a free expression of activity creator, as an overcoming of limits by the human species "(MORAES and MONT'ALVÃO, 2003, p.16)

The model of microtome rotating (American Optical 820) widely used by technicians in the task of microtomy was the object of interest in this research, since many accidents with injuries of fingers and hands were reported in the operation of this equipment when the technician performs the task of histological cuts and in the knife grinding.

2. Method

The Labor Economics and Sociology Laboratory(LEST method) was developed in France in the 1970s by the Laboratory of Economics and Sociology of Labor C.N.R.S. Aix Provence France. It is the result of the effort made by a team of working conditions of LEST, directed by Guy Roustang and his collaborators Françoise Guelaud, Marie Beauchessne and Jaques Gautrat (1975). This method has been tested in numerous automotive and food industries and its application is directed mainly to the analysis of repetitive industrial work.

In this study, the LEST method was very relevant as a methodological reference for the evaluation of the mental workload of the histotechnician, in order to elaborate the "Mental Workload Questionnaire for Histotechnical Work".

The Task Analysis was important for an overview of the activities of the task of the histotechnician, also observing the postural constraints assumed. For this, non-systematic observations were made using the photographic record of the activities of the task as a technical resource.

The Qualitative Analysis of the data obtained from the open questions that compose the questionnaire were evaluated following the procedures of content analysis, according to Campbell & Katona (1946 In: Festinger, L. & Katz, D., 1974).

The interviews with the workers were carried out openly, individually or in groups, in the workplace, observing the availability of technicians' hours without interferences in their routine.

3. Results

The results obtained by the factors considered were (1) time constraints, (2) complexity-speed, (3) attention, (4) detail and (5) psychosocial variables measured from the L.E.S.T. method. were submitted to the Chi-Square Test because they were classified as nominal measures at two levels, yes and no.

A general summary of participants' responses can be seen in Figure 1.

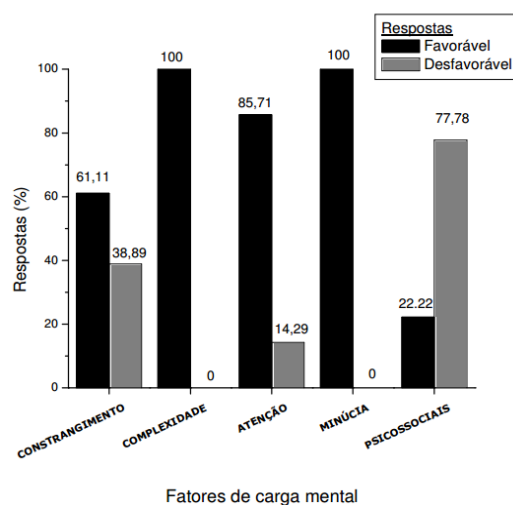


Figure 1: Percentage responses of the variables of mental workload, time constraint, complexity and speed, attention, detail and psychosocial.

The figure 1 summarizes the findings for the five mental load factors obtained through the Questionnaire adapted from Method L.E.S.T. The numerical indices above the bars are the

median values at each level of responses of the mental load variables. The black bars indicate the favorable response index to the mental workload obtained through the Questionnaire adapted from the method L.E.S.T. The gray bars indicate the unfavorable response rate to the mental load and the absence of bars the absence of response for each of the variables. The Questionnaire adapted from Method L.E.S.T. showed to be efficient for the measurement of the mental load in 75% of its factors for the job.

3.1. Task Review

All steps of the processing of the material to be examined were presented in a flowchart of the histotechnical task activities.

The figure 2 below illustrate critical conditions of the microtomy activity, the severity of exposure to the risk of accidents.



Figure 2: Microtome American Optical 820.

Detail of the adjustment of the block in the appliance. Note the position of the hand next to the metal razor of the appliance. One can also see the artifice that the histotechnician used covering the ends of the razor with tape in an attempt to minimize accidents.

In this stage (figure 2) paraffin block is placed in the microtome. The histotechnician regulates the apparatus to adjust the position and inclination of the block relative to the knife and start the microtomy. The attention required is very important not to overburden the block and lose the patient's material.

One can observe the severity of exposure to the risk of accidents with the microtome knife.

3.2. Qualitative Analysis

We emphasize the qualitative data obtained from the Mental Workload Questionnaire of the Histotechnique, adapted from the LEST method, drawing attention to the fact that the technicians cut in average 70 to 100 blocks per day generating this amount in slides per day. The time of dedication to the microtomy station, too, may vary depending on the participation of the technician in other phases of preparation of the slides up to the final product. There is no night work. All the participants suffered accidents involving cuts of hands and / or fingers on the microtome. It can be considered that for the evaluation of the mental work load, the variables attention and detail were very pertinent, as they were presented as predominant indicators of mental load in the task of microtomy pointing a direction to minimize and / or prevent situations of risk or accidents during the task of histological cuts.

4. Conclusion

4.1. The adoption of new equipment: Microtome 'Shadon Finesse 325'

With the development of the research we try to focus on human costs, accident problems related to the task of the histotechnician, the need to adopt equipment more friendly and in keeping with the nature of the task and thus minimize accidents and constraints for the operator.

Thus, during the course of the research the 'Shandon Finesse 325' microtome model shown in figure 3 below was introduced in the routine of work with characteristics that were pointed out by the histotechniques as more appropriate, such as, disposable razors, a place for the discard of the material, a guide (for others), and advance the left hand crank in the same direction as the right hand drive.



Figure 3: LABWRENCH Shandon Finesse 325

This microtome has features which have been pointed out by histotechniques as more appropriate, such as disposable razors, a place for discarding the material, a razor protection guide (for others), and advancing the crank left in the same direction as the right hand drive. It is a manual rotary microtome for high quality paraffin section routine. It has a balanced steering wheel, designed to prevent the stress and damages resulting from the repetitiveness of the task. Includes a removable, paraffin wax tray that provides easy cleaning, and a tray located at the top of the material handling unit. It has precision of response, balanced steering wheel with ergonomic design.

The adoption of this new microtome was very important considering the general objectives of the research to optimize the task of the histotechnician in the interface with the rotating microtome, to minimize the possibility of occurrence of accidents, to increase job satisfaction. Another relevant factor is the advancement of the left hand crank in the same direction as the right hand wheel. In the old microtome, American Optical 820 the finest adjustment was done in the antero-posterior sense requiring the operator a high attention to avoid accidents, being able to lose the material of the patient. In addition, a physical wear and tear is imposed on the operator by the maintenance of an inappropriate posture reflecting the demands of the task on the mental workload

The humanization of work must presuppose the recognition of the psychological suffering of the worker and, above all, the recognition of the worker as a person.

For a preventive action of accidents together with the predominant factors of mental workload, we consider that other factors of the workload, such as those related to environmental conditions, physical workload, psycho-sociological factors, and the introduction of pauses in the work in order to reduce human costs (Dul and Weerdmeester, 2004).

It is also important to emphasize the importance of practicing the Ergonomics of awareness according to the needs involved in each productive context, occupational and environmental risks, to minimize accidents and contribute to the prevention of accidents.

We believe that research on mental workload should emphasize the domain of Cognitive Ergonomics from studies related to perception seeking a better understanding of human-technology interactions for the improvement and construction of equipment and development of more compatible working environments. In addition, relate other domains of knowledge such as research on stress, with the goal of integrating information that is relevant to the workload.

We also emphasize the research on the attention, and factors related to the time constraint, the studies on human error as outstanding factors for the management of accidents.

4.1.1. The Microtomy Post nowadays and the adoption of new equipments

In addition to the equipment that was introduced in the work routine during the development of the research, it is necessary to report the changes that have taken place today, and how the work inspired the direction of the Department of Pathology to a continuous attention in seeking changes to improve the sector through the acquisition of increasingly modern equipment, observing ergonomic criteria for the accomplishment of the task of microtomy, and the consequent reduction of accidents.

Thus, we call attention to the importance of the ergonomic study focused on the hospital environment, prioritizing the prevention of work accidents, minimizing psychological distress, physical constraints contributing to the reduction of expenses caused by the treatment and removal of injured employees and, in the cases of private institutions, actions in labor justice. We present below, respectively, some new models of microtomes that have been used and reported by the technicians as offering greater security from an ergonomic point of view, greater time savings and improved performance.



Figure 4: Zeiss Hyrax 55 model automatic



Figure 5: Leica model RM 2245 Semi automatic



Figure 6: ANCAP modelo YD 315 manual

The model shown in Figure 4 Hyrax 55 is an automatic model that was also introduced in the laboratory to perform the task.

According to the histotechniques the automatic function is more used for research, to cut ten blades, for example, without hurry. Research is the scientific work someone is doing to publish in journals in the health field or to present at scientific meetings. In such cases, the blades need to be made more carefully. Often special colorings are made and the material is documented in the form of photographs that will be used in scientific publications and presentations at congresses or scientific meetings.

The model shown in figure 5 Leica-RM 2245 is semi-automated. Manual sectioning is enhanced by a high precision motorized advance, resulting in efficient operation with maximum sectioning quality and reproducibility. (LEICA-rm2245)

One of the data commented by the histotechnicians is that the semi-automatic models are better, but the manual function is considered more appropriate for the routine. The routine is the day-to-day hospital cases, which have to be quickly cut to give the report because the clinician or surgeon is waiting to treat the patients.

Figure 6 is a manual model YD 315 (ANCAP) also available for the microtomy task. Some characteristics with respect to this model are pointed out as a robust and precise equipment, developed for cuts in paraffin. Its flat lid serves to accommodate with ease, blocks, razors and other accessories. Its steering wheel has double lock; one in any position and the other in the cable in the upper position, which increases safety when changing a block or razor. The disposable razor holder is safer and more efficient, extending its durability. The debris tank is large and easily removable.

One aspect to be considered in relation to the mental load factors of work is that the management of a more friendly technology can favorably influence the requirements related, for

example, the requirements of the task, with regard to attention, the speed of execution of the task and its complexity, are met reducing the overload for the operator.

In the development of this research, it can be observed that the search for professional recognition and appreciation of work emerges in the workers' discourse at various moments. We suppose that an awareness and attitude by a dynamics of recognition of the worker can contribute to the prevention of accidents and so that the work organization avoids a direction of psychic suffering towards illness. People are different and for this reason, recognition must be practiced in a unique way in a human-human relationship.

5. References

ANCAP: <http://www.ancap.com.br/microtomo-manual-yd315-p-15.html> Acesso em 12/08/2017

<http://www.ancap.com.br/anexos/folheto%20YD315.pdf> Acesso em:12/08/2017

CAMPEBELL A.A., & KATONA, G. A national survey of wartime savings, 1946 (In: FESTINGER, L & KATZ, D. Research in Social Psychology, FGV - RJ, 1974.

DEJOURS, C., ABDOUCHELI, E., JAYET, C. Psychodynamics of Work: contributions of the Dejouriana School to the analysis of the relation pleasure, suffering and work São Paulo: Atlas, 1994.

DUL, J. & WEERDMEESTER, B. Practical Ergonomics. Editora Edgard Blucher Ltda. 2nd edition revised and expanded, 2004

GUÉLAUD, F., BEEAUCHESNEN, N-M., GAUTRAT, J. & ROUSTANG, G. Pour une analyse de conditions du travail ouvrier dans l'entreprise. Recherche du Laboratoire d'Économie et Sociologie du Travail C.N.R.S. 4th Edition, Paris: Libraire Armand Colin, 1975.

LABWRENCH:

<http://www.labwrench.com/?equipment.view/equipmentNo/1104/Thermo-Scientific/Shandon-Finesse-325-Microtome//> Acesso em: 11/08/2017

LEICA: <https://www.leicabiosystems.com/pt/equipamento-de-histologia/microtomos-rotativos/detalhes/product/leica-rm2245/> Acesso em: 12/08/2017

MICHALANY, J. **Técnica histológica em anatomia patológica: com instruções para o cirurgião, enfermeira e citotécnico.** São Paulo: EPU. 1980.

MORAES, A. de & MONT'ALVÃO. **Ergonomia Conceitos e Aplicações.** iUsEr: Rio de Janeiro, 2003.

WISNER, A. **A Inteligência no trabalho: Textos selecionados de ergonomia,** São Paulo: FUNDACENTRO, 1994.

ZEISS:

<https://www.zeiss.com.br/corporate/home.html> Acesso em:12/08/2017

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