Ergonomic Breakthrough

Leading microscope manufacturers investigate muscular-skeletal conditions associated with microscope use.

By Thomas Bocher

Daily microscope users can be easily fatigued by awkward sitting positions and complicated controls. This affects many users in microbiology, cytology, hematology and pathology labs. In recent years, researchers have conducted studies to examine microscope ergonomic issues for users with various body heights. This research is critical as data from occupational and medical literature clearly indicate that occupational-based injuries at the workplace are common where microscopes are used extensively.

Musculo-skeletal conditions, including shoulder, neck and back aches, are the most prevalent injuries, with more than 77 percent of users experiencing these issues.¹

Ergonomic Study on Table Microscopes

Some of the leading microscope manufacturers have been investigating these problems. Carl Zeiss MicroImaging began its most recent series of ergonomic studies in 2002 with Henssler and Schultheiss Product Design, a globally renowned engineering, research, consulting, and corporate design firm.²

The study was based on current ergonomic key data and empirical examination results, which were reviewed on a group of 15 participants. The study examined typical work situations and evaluated them on the basis of relevant ergonomic key data.

The study focus was on routine users who spend several hours a day at a microscopy workstation. Problems identified were insufficient microscope height and users maintaining awkward body postures when the viewing height is too low.

**Figure 1** shows that the majority of users with an ergonomically correct sitting posture at the table will find it difficult to look into the eyepieces of a conventional laboratory microscope. The figure shows the body height distribution of men and women around the world, including population groups from Scandinavia, Central and Eastern Europe, Japan and Southeast Asia. The black lined user shape indicates that only five percent of women worldwide are smaller than the size shown; the blue lined user shape illustrates that only five percent of men worldwide are taller than this size. Therefore, it is necessary for the microscope to have an adjustable viewing height.

When the viewing height is too low, users would gravitate towards awkward body postures. Adaptation to the viewing height using an adjustable tilting tube (labeled adjustable eyepieces in **Figure 2**) resulted in changed viewing and poor neck posture in the upper height positions.

Lack of lower arm support resulted in aching pressure points and clumsy operation of the microscope. Other issues included tension on back and head muscles and poor operation of controls caused by the users holding their arms in a wide position. The main outcome of this first study was to develop a vertically adjustable tube with an invariable viewing angle.

This would allow optimal instrument height in an ergonomically correct viewing angle and sitting position.

Further Study Enhances Findings
Carl Zeiss MicroImaging continued its research by conducting a more extensive study in 2004, in collaboration with its scientific partner the Institute for Occupational Medicine, Charité Hospital Berlin.¹ This included field studies at 20 clinical microscope workplaces in scientific and diagnostic departments (anatomy, pathology, neuropathology, and hematology) in five institutes at Berlin university hospitals. The study was used to compare the ergonomics of regularly used standard microscopes from such makers as Carl Zeiss, Olympus, Leica, and Nikon with those of a modified microscope designed to be more ergonomically correct, the Axio Imager with Ergotube 50-15-50 from Carl Zeiss. This model permitted height adjustments (from 0-50 mm), had a fixed 15° viewing angle, and an adjustable extension (from 0-50 mm). Twenty individuals participated in the study, which began with the administration of a questionnaire eliciting information on the study participant's occupation, workplace conditions, and occupational-based injuries of the muscular-skeletal system and eyes. Researchers then conducted a comparison and evaluation of microscope geometries of 20 regularly used microscopes with the modified microscope. Information collected included microscope geometries, adjustment of microscopes and workplaces according to individual needs, individual anthropometric data, evaluation of microscope ergonomics, and individual posture in front of the microscope used in a lateral view.

The study found that the majority of participants were able to adjust the new microscope and tube to achieve the correct ergonomic posture of the head, neck, and shoulders. The eyepiece extension's horizontal distance between microscope pupil and drives was shown to optimize manipulation depth. The 15° viewing angle was within the optimum range, but lacked the ability to make individual adjustments. Adjustments between 8-30° would allow a more dynamic working posture. Figure 3 shows the improved ergonomics of the modified microscope over the standard.

**Designing the Most Ergonomic Microscope**

In 2007, Carl Zeiss MicroImaging started a project in conjunction with TUV Rheinland, a world-renowned independent organization that certifies product safety and ergonomics. The Institute for Occupational Medicine, Charité Hospital Berlin again took part as the scientific partner of the project group. The goal of this project was the development of the most ergonomic laboratory microscope that can be built with today's knowledge and capabilities. The new product was called the Axio Lab.A1. Based on the earlier ergonomic research conducted, the project group established that the two crucial points are the adjustable viewing height and angle, as well as the accessibility of all three main adjustment elements (i.e., focus drive, stage drive and brightness control) with one hand. As a result, the Axio Lab.A1 was equipped with a continuously adjustable height tube from 0-50 mm. In addition, the tube can be swiveled from 8-33° continuously. The design focused on ensuring that the three main adjustment elements were located in close proximity. The main features, ergonomic tube and nearby adjustment elements comply with a multitude of ISO, EN and DIN standards and are designed to incorporate the latest scientific findings. The Axio Lab.A1 is the first light microscope ever to gain this new TUV "ergonomics approved" certificate.³

**Figure 4** shows a photo of the Axio Lab.A1 with its key ergonomic features. The use of this TUV ergonomics approved Axio Lab.A1 configuration allows daily, continuous work with the microscope and can significantly reduce the risk of muscular injuries in the neck and shoulders. **Figure 5** shows a photo demonstrating that all three main adjustment elements are within reach of the user's hand.

**Dr. Bocher is business unit director, BioSciences Division, Educational and Routine Microscopy, Carl Zeiss MicroImaging GmbH.**

**References**

2. Henssler, Schultheiss. Product Design and Carl Zeiss MicroImaging, Ergonomic Design Study,
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