“Conserving the Conservator”: A Participative Ergonomics Approach to Reduce the Risk of Work-Related Musculoskeletal Disorders from Performing Conservation Treatment at Artlab Australia

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Artlab Australia is responsible for conserving the state collections and cultural history of South Australia. Conservation treatment of art works typically involves intensive periods of fine detail work. Art conservators risk sustaining musculoskeletal disorders (MSDs) from cumulative exposure to high precision tasks in often awkward and prolonged static postures. This paper details a decade of collaborative work, undertaken by conservators at Artlab Australia, in conjunction with an Ergonomist / Occupational Health Physiotherapist, to systematically identify and control MSD hazards and risks associated with performing conservation treatments. This partnership has resulted in innovative design solutions and the manufacture of new work tables in most sections, but particularly in textiles and frames, as well as permanent changes in the way Artlab conservators work. The controls have been highly effective in reducing the risk of work-related musculoskeletal disorders from performing art conservation treatments at Artlab Australia.

Practitioner Summary: Art conservators have traditionally relied on administrative controls to reduce their risk of musculoskeletal injury. This paper illustrates how ergonomics principles, utilising a multi-faceted, participative ergonomics approach, can inform and inspire design innovation, which in turn positively reinforces safe work practices. The implications for the industry are significant, with the potential to influence conservation practices locally, nationally and internationally.

Keywords: Art Conservation, Musculoskeletal Disorders, Hazardous Manual Tasks, Participative Ergonomics, Risk Management

Introduction

Conservation treatment of art works typically involves intensive periods of fine detail work. Art conservators risk sustaining musculoskeletal disorders (MSDs) from cumulative exposure to high precision tasks, often performed in awkward and prolonged static postures (Langford et al 2013).

Artlab Australia is responsible for conserving the state collections and cultural history of South Australia. This involves conserving the collections of the Art Gallery of SA, the SA Museum, the State Library of SA, History SA Musea, including the Migration Museum, the SA Maritime Museum at Port Adelaide and the National Motor Museum at Birdwood, as well as Carrick Hill historic house. Artlab also undertakes commercial conservation work for private individuals and organisations across Australia and internationally, work from which Artlab derives roughly one third of its annual revenue.

Numbers of staff employed at Artlab equate to approximately 25 full time equivalent positions, most of which are for highly skilled, specialist art conservators. Staff work in specific divisions, based on their speciality, including Objects, Paintings and Frames, Textiles, Paper and Books, Photographs, Projects, Prevention and Disaster Preparedness and Administration and Managerial positions.

This paper describes a decade of collaborative work, undertaken by conservators at Artlab Australia, in close conjunction with an Ergonomist / Occupational Health Physiotherapist, to systematically identify, and control for, MSD hazards and risks associated with performing conservation treatments. This partnership has resulted in the provision of new work tables in most divisions, but particularly in textiles and frames, as well as permanent changes in the way conservators at Artlab work.

Early Risk Identification and Control

Conservation treatments commonly involve many hours of high vigilance, repetitive tasks, using extremely fine, delicate hand movements, in awkward, static postures (Fig. 1). However, a degree of force can also be
required to remove backing material from a painting or remove corrosion from a metal item. Such treatments can take anywhere from a few hours to several hundred hours, over weeks or months.

Many factors contribute to the burden of risk, including the large, and often unpredictable, variety and nature of objects needing treatment, the location of the work, tight time frames, work load and business constraints of a commercial enterprise, as well as the health and fitness of the conservator. Offsite locations pose unique hazards, due to the conservators’ limited ability to alter the workplace and work environment. Furthermore, a workplace culture of ‘boom and bust’ has existed, which resulted in conservators continuing to work past the onset of early signs of injury.

Conservators at Artlab had long been aware that the nature of their tasks posed a significant risk of developing work-related MSDs, particularly affecting the spine and upper body, and many had already experienced, or were managing, soft tissue pain or disorders. This risk clearly impacted on Artlab, due to the effects on both the health and well-being of conservators, as well as the financial cost of claims, which, in turn, affected its ability to meet its core objectives of caring for the state’s cultural collections, earn commercial revenue and replace highly skilled conservators.

Historically, conservators had relied heavily on administrative controls to manage risk. However, recognising the limitations of such reliance, along with its poor history of reducing MSDs, in 2004, Artlab contracted an Ergonomist / Occupational Health Physiotherapist to conduct a comprehensive ergonomics audit of all work processes undertaken by staff, across all divisions of the enterprise. The audit highlighted the major hazards and risks posed to staff and proposed a range of risk control measures. A first round of training to educate staff in the principles of ergonomics was undertaken in 2006 and focussed on the principles of higher level risk management and control, with emphasis on engineering and ergonomics interventions to reduce musculoskeletal injury risk.

Initially, staff were educated in ways of modifying their work postures and practices, to reduce postural stresses, which relied on modifying the behaviour and attitudes of the conservator (Fig. 2). This was reinforced with posters in each department. Exercise stations were also established to provide interruptions to static postures, but compliance was poor.
Engineering solutions were gradually introduced from 2009, which included the provision of saddle seats in most sections, to allow for improved, more dynamic sitting postures. The first electric, height-adjustable work tables were purchased for use in Objects (Fig. 3) and Paper and Books.

Figure 3. Progression from makeshift step stool in Objects, to a height-adjustable table, to provide optimal working height. © J. Bills

**Eureka Flag Conservation Project**

In 2011, Artlab was commissioned to perform conservation work on The Flag of the Southern Cross (Eureka Flag), normally housed in Ballarat. The work required the flag to be stitched onto a new lining, with the old stitching and lining removed. The flag is large, with dimensions of approximately 2 metres x 4 metres. The stitching used an extremely fine Tetex thread and fine, semi-circular needles. There was a specific time frame for the project, which involved over 300 hours of stitching.

A risk assessment (DPC 0250) was carried out by the Senior Textile Conservator and the Consultant Ergonomist / Physiotherapist, utilising contemporary principles now embodied in the current Work, Health and Safety legislation. It was assessed as posing a high risk of musculoskeletal injury. An engineering solution was designed by the Senior Objects Conservator, based on ergonomics principles previously taught. The work table, in this case the old backboard from the Eureka Flag, was modified, so that it could be raised to make the work surface sloped, which vastly improved visual and manual access to the flag, while at the same time, reducing postural stress.

Once a section of the flag was completed, it was moved down, over the rounded end of the work table, and rolled face out onto a roller, suspended underneath the table. The system incorporated a padded bar attached to the front edge of the table, which protected the surface of the flag, whilst allowing conservators to lean their weight against the bar, reducing the muscular strain associated with unsupported, static postures (Fig. 4).

A number of other interventions to improve seating, provide task lighting with magnification, increase task rotation and optimise workplace layout were also implemented in the project, along with exercise breaks and weekly onsite physiotherapy treatment. No reports of musculoskeletal discomfort or injury occurred throughout the duration of the project.

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1 The Flag of the Southern Cross (Eureka Flag), 1854, unknown artists, wool, cotton, Gift of the King Family, Art Gallery of Ballarat collection, on loan to the Museum of Australian Democracy at Eureka.
Trade Union Banner Conservation Project

In 2012, a treatment was undertaken on a large 3.2 metre x 4 metre silk trade union banner in extremely poor condition. Its fragility made it impossible to roll the banner, so the previous engineering control could not be applied. The banner was placed on a large timber backboard that could be raised and lowered to work at different heights. When working on the edges of the banner, the backboard was placed on a large work table at bench height. For work on the inner sections of the banner, the backboard was lowered to the floor, and a wooden bridge was constructed, spanning the banner 30 centimetres above the floor. The bridge was able to be progressively pulled along the floor as work progressed.

To use the bridge, the conservator lay face down, with her head and shoulders suspended over the front edge of the bridge, with the head supported on a modified treatment table padded headrest that was adjustable for height and length to suit the individual conservator. This allowed the head to be supported, while the arms remained free to work on the underlying banner (Fig. 5).
Development of Customised Work Tables for Textile Conservation

The concept of utilising sloped work surfaces during textile conservation proved so effective in improving operator comfort and efficiency that there was a strong commitment to adapt all future work surfaces, to incorporate sloped surfaces wherever possible. In 2012, Artlab successfully applied for a State Government grant to enable the development and purchase of new work tables for both Textiles and Frames.

The sloped work surfaces now used in the textile conservation laboratory have resulted from a prolonged process of consultation, concept development and implementation, in collaboration with an engineering firm and an ergonomics equipment supplier. The final design resulted in a table top incorporating hinged leaves. The tables are used flat whilst a patch or lining is prepared and can then be tilted to the required angle for stitching.

When a sloping gradient is required, a motorised system pushes the front leaf up, causing it to raise and tilt. As this leaf concertinas, the other leaves slide forwards across the underneath solid surface (Fig. 6). A length of timber, attached to the underside of the front edge of the table, allows for various modifications, such as the addition of a timber trough to hold a roller that allows the textile to be progressively rolled. Again, the front edge of the trough is padded, which allows conservators to support their arms. It can also provide a convenient location for tools. The trough can be removed and a suspended roller can be incorporated under the table, as was done for the Eureka Flag.

The added ability to easily adjust the height of the tables further enhances their adaptability to all conservation applications and can allow work in both sitting and standing. The tables were installed in 2013 and have received strong staff support.

Figure 6. Customised work tables in Textiles provide adjustable height and angle. © Artlab

The same concept has been used to devise similar prototype tented work surfaces for project work overseas (Fig. 7).

Figure 7. Application of adjustable work surfaces to conservation work in India, on Rajiv Ghandi’s garment. © Artlab
Development of Customised Work Tables for Frame Conservation

The conservation of frames had posed particular challenges to conservators in the past. Traditionally, frames that are too large to place on easels have been treated on large, flat work benches. Treatment of the inside surfaces of frames required the conservator to reach and lean over to look down into the frame, particularly if it had a deep profile, with very hazardous work postures (Fig. 8). The engineering solutions devised to reduce this risk involved two different approaches.

For smaller frames, a height adjustable tilt table was designed and custom-built (Fig. 9, left). The front edge includes a channel under the table top into which brackets slide, to secure the frame when the table is tilted to a comfortable working angle. The height adjustment optimises operator posture and comfort in either sitting or standing.

For very large frames, two long, narrow tables have been designed and built, which allow the frame to be supported between both tables. The conservator then stands inside the frame to carry out work on the inner profile, markedly reducing postural stress (Fig. 9, right). Again, they are easily height adjustable. The dual tables have also facilitated the manual handling of large frames.

Since these solutions have been developed, further motorised and/or height adjustable work systems have been developed and purchased for use in Paper, Paintings and Objects, following a second successful grant application by Artlab, to the Government of SA, in 2013-14.
Implications for the Art Conservation Industry

The engineering solutions have received strong acceptance by staff and have proved to be very effective in reducing the incidence of musculoskeletal discomfort. In the three years since the main suite of engineering controls was introduced, there have been no new MSDs from performing art conservation work at Artlab, with a resultant reduction in injury claims costs. There were no reported MSDs throughout the major projects of the Eureka Flag and the Trade Union banner.

Furthermore, the implications for the industry are significant. It has demonstrated that it is possible to change the way art conservators work and perceive how they work. There has been interest shown from within the wider conservation industry, with assessments undertaken by the first author at the National Museum of Australia and the National Archives of Australia, in Canberra. Two papers on the interventions at Artlab have been presented at national conferences of both the art conservation industry and ergonomics professionals.

In 2014, Artlab was a finalist and runner-up in the SafeWork SA Awards, in the category of “Best Solution to an Identified Work Health and Safety Hazard”.

Results of 2014 Staff Questionnaire

To gain feedback from staff on their perceptions of the ergonomics interventions, a questionnaire was distributed in 2014, achieving a 92% response rate. Staff feedback indicated that, compared with 5 years ago, the vast majority of conservators agreed mildly or strongly that their work is less likely to cause them an injury; that they have the right equipment to do their work; that they better understand the risks associated with their work; that they take more care of their health and safety; that they feel strongly that their employer is committed to improving their health and safety; while two thirds feel physically better (Fig. 12). The height-adjustable tables and sloping work surfaces received the strongest support from staff. The main barrier to working more safely was perceived to be time pressures and work deadlines.

I feel physically better when performing work tasks compared with 5 years ago

![Bar chart](chart1.png)

I better understand the risks associated with my work compared with 5 years ago

![Bar chart](chart2.png)
The way I work now is less likely to cause me an injury compared with 5 years ago

Figure 12. Extracts of results from staff questionnaire. © J. Bills

Summary

Art conservators have traditionally relied on administrative controls to reduce their risk of sustaining musculoskeletal injury and disorders. This paper illustrates how ergonomics principles can inform and inspire design innovation, which in turn can positively reinforce safe work practices, which can successfully be applied to offsite project work, including overseas. This multi-faceted, participative ergonomics approach, which combines innovative engineering solutions with a comprehensive range of administrative controls, has been highly effective in reducing the risk of work-related musculoskeletal disorders from performing art conservation treatments at Artlab Australia.

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