



Contexts for Conservation

2013 National Conference - Adelaide 23- 25 October

“Table Talk”: The Development of Modified Work Systems to Reduce the Risk of Work-Related Musculoskeletal Disorders from Conservation Treatment

Kristin Phillips, Principal Conservator Textiles, Artlab Australia,

Justin Gare, Senior Objects Conservator, Artlab Australia

Jo Bills, Occupational Health Physiotherapist/Ergonomist, Director, PhysioLink

Abstract

Conservation treatments often involve the use of awkward static postures and intensive periods of fine detail work, which can lead to injury. Conservators at Artlab Australia, in conjunction with an Occupational Health Physiotherapist / Ergonomist, have systematically considered a range of injury risk factors, including movements and postures, load, work organisation, working environment and personal factors. These factors were then evaluated according to a risk rating matrix that is embedded in the risk assessment process. Using this matrix, the risk rating for musculoskeletal disorders (MSD) of the neck, upper back, shoulders, elbows and wrists was identified as high. As required by contemporary Work Health & Safety legislation, the hierarchy of risk control was applied to ensure the most effective control measures were implemented. As hazard elimination or substitution were not possible in this context, the highest level of risk control measures to be considered was that of engineering controls. Various innovative and unique solutions were developed that involved redesigning the standard equipment normally used in conservation work. These include electric, height adjustable, motorised multi-component work systems and adjustable sloped work surfaces for carrying out textile conservation treatments and modified tables for the unique problems associated with frame conservation. This example of a multi-faceted, participative ergonomics approach, combining innovative engineering controls, has been highly successful in reducing the risk of work-related musculoskeletal disorders from conservation treatments at Artlab, Australia.

Keywords

Art Conservation, Musculoskeletal injury prevention, Hazardous Manual Tasks, Participative Ergonomics, Workplace design, Risk management

There is no escaping the fact that undertaking conservation treatments often involves many hours of repetitive tasks using fine hand movements in awkward postures. Whether it is cleaning a painting, removing corrosion from a metal item, doing a backing removal or stitch

repairs on a textile, a conservator is often required to work in static postures, performing fine, repetitive and highly precise and detailed work. Such treatments can take anywhere between a handful of hours and several hundred hours. Many factors can add to the burden of risk, including the large, and often unpredictable, variety and nature of objects needing treatment, the location of the work, the time frames, work load and business constraints and even the health and fitness of the conservator. Conservators at Artlab have long been aware that the nature of their tasks poses a significant risk of developing work-related musculoskeletal disorders, particularly affecting the upper body, including the neck, back, shoulders and arms. Many have already experienced, or are managing, soft tissue pain and injury.

For a number of years, conservators at Artlab have been working with an Occupational Health Physiotherapist / Ergonomist to systematically identify, assess and control for a range of injury risk factors, including movements and postures, load, work organisation, working environment and personal factors. These factors were then evaluated according to a risk rating matrix that is embedded in the risk assessment process. Using this matrix, the risk rating for musculoskeletal disorders of the neck, upper back, shoulders, elbows and wrists was identified as high. This high rating motivated staff at Artlab to reflect on how they work and what they do and to focus attention on ways of reducing the assessed risk.

As required by contemporary Work Health & Safety legislation, the hierarchy of risk control was applied to ensure the most effective control measures were implemented. The hierarchy involves a “top down” prioritisation of risk control, namely: Elimination, Substitution, Engineering controls (including Isolation), Administrative controls and Personal Protective Equipment. Historically, conservators have relied heavily on administrative controls, such as reducing the duration of time spent on a task at any one time or rotating tasks between more personnel. Whilst these measures have a role to play, they are less effective than engineering and ergonomics interventions in reducing musculoskeletal injury risk. This is well documented in the literature in relation to other fields of endeavour, but less well documented in art conservation. Administrative controls rely on modifying the behaviour and attitudes of the conservator, whilst engineering controls rely on modifying the nature and design of the task to improve performance and reduce injury risk. Time constraints, workload pressures, a reluctance to interrupt work flow and resistance to changing habitual work practices are examples of barriers to implementing successful administrative controls.

As hazard elimination or substitution were not possible in this context, the highest level of risk control measures to be considered was that of engineering controls. Working collaboratively, various innovative and unique solutions were developed that involved redesigning the standard equipment normally used in conservation work.

Engineering Controls

Electric-operated, height adjustable work stations, desks and work benches have been available for a number of years. This existing technology has been adapted to construct multi component work systems for the treatment of objects. These involve work surfaces that are larger than standard work desks and have electric motorised mechanisms in each leg that operate synchronously. This enables the conservator to easily and quickly adjust the height of the work station whilst the objects are on the work surface. An object can then be positioned optimally, so the conservation task can be undertaken as comfortably as possible. Awkward postures, such as bending, stooping, twisting and reaching can be greatly reduced. For

optimum effectiveness, the work system should always be plugged in, to ensure quick and easy height adjustment. Placement of the power outlet and cable is therefore a factor that should be considered when positioning the table, to facilitate utilisation by staff. Floor-mounted general power outlets would be preferable.

Frame Conservation

The conservation of frames poses particular challenges. Traditionally, large frames that are too awkward to place onto easels are treated on large, flat work benches. If the frame has a deep profile, treatment usually requires the conservator to reach up and over the frame member and to look down into the frame, flexing the neck and placing the arms and wrists at awkward angles. The engineering solutions devised to reduce these identified risks involve two different approaches. For smaller frames, a height adjustable tilt work station has been custom designed and built. The front edge includes a channel under the work surface into which brackets slide. For treatment, a frame is placed on the work surface, the brackets inserted into the channel and adjusted to secure the front edge of the frame and the surface is then tilted to a comfortable working angle. The height adjustment aids in optimising operator posturing and comfort. As this approach is not practicable for very large frames, the work system includes two long, narrow work stations, which allow the frame to be suspended between them. The conservator can then stand inside the frame to carry out work on the inner profile, markedly reducing stress on the neck, spine and arms. Being height adjustable as well enables the frame to be easily adjusted to the best working position. Although the work stations are narrow, there is still enough space to place materials and equipment adjacent to the work being performed.

Both systems have received strong acceptance by staff and have proved to be very effective in reducing the incidence of musculoskeletal discomfort. An unexpected advantage of the narrow work stations is that it is now easier to lift frames onto them. One edge of the frame is placed on one component and the other side is then lifted, while the second component is wheeled in to support the opposite side, eliminating the need for a full lift. Having the work stations plugged in at all times remains a minor hindrance, but the modification of longer power cords has reduced this problem.

Sloped work surfaces for undertaking textile conservation treatments

The sloped work surfaces now used in the textile conservation lab have resulted from a prolonged process of consultation, concept development and implementation. A significant barrier to overcome was the resistance to change on the part of the conservators. Carrying out stitching on a flat table is a long established textile conservation practice. Laying the textile flat assists in holding the various layers needing stitching or patching in place. However, the resultant postures required to sew on a flat surface carries with it a very high risk of injury. Common postures involved extreme neck flexion (or bending), particularly when using a very fine thread, sustained arm elevation without arm support, awkward, bent and tilted wrist positions, combined with strong precision pinch grip to grasp very fine needles. Stitching in textile conservation treatments is often the major component of the work required and can take hundreds of hours.

One project that illustrates the application of sloped work surfaces to improve work performance and reduce injury risk was the stitching of the Eureka Stockade Flag to a new lining. The Flag is large, with dimensions of approximately 2 m x 4 m. It was fully lined onto a new backing and required stitching using a fine Tetex thread. There was a limited time frame

for the project, which involved approximately 300 hours of stitching. An occupational risk assessment was carried out for the task and it was assessed as a high risk for static postures and overuse musculoskeletal injury. Engineering controls to reduce the risk of injury were conceived by the Senior Objects Conservator. The work table (in this case the old backboard from the 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, at the same time reducing the risk of neck and postural strain. Once a section of the flag was completed, the flag was moved down the table, over the rounded end of the work table and was then rolled face out onto a roller suspended underneath the table. The system incorporated a padded bar suspended along the front edge of the table, with a 50 mm gap between the bar and the rounded end of the work surface. This bar protected the surface of the flag, allowing the conservators to lean their weight against the bar, reducing back strain. The padding provided support for the elbows and arms, which, in turn, provided support for the worker's upper torso body weight, greatly reducing the muscular strain associated with unsupported static postures. A number of other interventions to improve seating and lighting and to increase task rotation were also implemented as part of the Eureka Stockade Flag conservation project and there were no instances or reports of musculoskeletal discomfort throughout its duration.

The large, sloped table used for the Eureka Stockade Flag was not practical for use with other conservation tasks in the lab and it was deconstructed once the treatment was complete. However, as the concept of the sloped work surface had been so effective in improving operator comfort and efficiency, there was a strong commitment to adapt work surfaces to use sloped surfaces in the lab in the future. Initially, ready-made tilt tables were purchased and used for smaller textiles. Whilst these were relatively effective, their small size and difficulty to set up meant that they were not frequently used. It was decided that the preferred design was to have a tenting system built into the work surfaces. This would allow the work stations to be used flat when required and to adapt quickly and easily to become a sloped surface. The components also needed to be interchangeable, so they could cater for a wide range of sizes.

The final design involves flexible work surfaces incorporating hinged leaves. When a sloping gradient is required, a motorised system pushes the front leaf up, causing it to raise and tilt. As it lifts and tilts, the other leaves slide forward across the solid table top below to form a sloping surface. Along the front edge of the table, a length of timber has been screwed to the underside of the table. The front edge can then be modified as required. Generally, a timber trough is in place, with a roller placed in the trough, which allows the textile to be rolled, facilitating progressive access to sections of the textile needing treatment. Again, the front edge of the trough is padded, which allows operators to support their wrists and arms. It also provides a convenient location for tools, when the trough is not needed to hold a rolled section of textile. This trough can be changed as required and a roller can be suspended under the table to roll the textile, as was done for the Eureka Flag.

The new work system was installed in mid 2013 and, so far, has proved to be highly effective. The work surfaces are used flat whilst a patch or lining is prepared and are then easily and accurately tilted to the required angle, with the touch of a button. Having the same sized hinged leaves on all of the work stations ensures that the system retains maximal flexibility. The added feature of height adjustability further enhances their adaptability to all conservation applications and can allow work in both sitting and standing. Using a fully adjustable

ergonomic office chair allows the conservator to place feet flat on the floor, providing better support and comfort than that afforded by a foot ring on a drafting height chair.

A minor drawback of the current design is the disruption of the flush work surface by the hinges. This has been resolved by the use of a piece of thick Mylar over the joins. Having the system plugged in at all times is also a minor inconvenience, due to cabling potentially causing obstruction to work. Again, floor-mounted general power outlets would be preferable.

Bridge for spanning large, flat objects

A treatment was undertaken on a large 3.2 m x 4 m silk, trade union banner in extremely poor condition. Its fragility meant that it was not possible to roll the banner, so the use of the above engineering control measures could not be applied. It was impossible to reach the centre of the banner without some kind of bridge to span the large textile. To overcome these issues, it was decided to place the banner on a large timber and ply backboard that could be raised and lowered, so that work could be undertaken both at table height and on the floor. When working on the edges of the banner, the backboard was placed on top of a large work table at bench height. For work on the inner sections of the banner, the backboard was lowered and placed on the floor. A wooden bridge was constructed, spanning the banner at a height of 30 cm above the floor surface. Working at this lower height significantly reduced the risk of falls and no handrail was required to be provided on the bridge. The bridge was progressively pulled along the floor as work progressed. This removed the need for lockable castors or other securing devices.

To use the bridge, the conservator lay face down, with head and shoulders suspended over the front edge of the bridge, to reach the underlying banner. There remained a significant risk of fatigue and strain to the neck and shoulders in this position. In consultation with the Occupational Health Physiotherapist/Ergonomist, headrests were purchased, similar to those used on treatment and massage tables. The padded headrest was modified so only the forehead was supported. Each headrest was screwed to a plywood panel on the bridge, over which suitable padding was placed. The conservator's work posture thus involved lying face down on the padded bridge, above the banner, with their head resting on the headrest. The headrest is adjustable for height and length to suit the individual conservator. This allows the head to be supported, with the arms free to work on the underlying banner.

Additional Administrative Controls

Informed by the Risk Assessment process, Safe Operating Procedures are routinely developed for all high risk conservation tasks and may include actions to be taken prior to performing the task, during the task and after the task, such as:

- Preparation prior to the task (as advised by the physiotherapist), including seat and posture adjustment, stretching exercises, use of the padded bar to support forearms;
- Positioning of the magnifying lamp for optimum lighting;
- Placement of trolleys and other equipment for easy access;
- Adhering to a program of strict work breaks and task rotation, utilising timers;
- Utilising all "Micro-pauses" to interrupt static postures and to vary postures and movements;

- Early intervention by the physiotherapist to monitor staff welfare, provide treatment as required and provide ergonomic and other advice, such as to avoid fine sewing or similar precision activities for the rest of the day;
- Advice on regular stretching, aerobic and therapeutic exercise.

A range of other administrative control measures have been implemented at Artlab, in conjunction with the written Safe Operating Procedures and engineering controls.

These include:

- Regular ergonomics audits of all work areas, with individual assessments of staff work practices by the Physiotherapist/Ergonomist, with recommendations on chair, workplace and work method adjustment and modification;
- A framework of education and training in hazardous manual tasks risk management and ergonomics for all staff, developed and delivered by the Physiotherapist/Ergonomist, in line with contemporary Work Health and Safety legislation dealing with Hazardous Manual Tasks;
- Development of poster materials to support the training program;
- Establishing an exercise station within each work area to enable staff to perform exercises during work breaks, to counteract the effects of repetitive, static work postures;
- Increasing staff numbers for high risk or protracted tasks if indicated.

Summary

In summary, the process of how conservators undertake hazardous manual tasks will continue to evolve and change as new equipment is developed and adapted. The multi-faceted, participative ergonomics approach described in this paper, which combines innovative engineering controls with a comprehensive range of administrative controls, has been highly effective in reducing the risk of work-related musculoskeletal disorders from performing conservation treatments at Artlab Australia.

Acknowledgements

Many thanks to Helen Weidenhofer, Assistant Director Paintings, Objects & Projects, Artlab Australia and Sarah Feijen, Assistant Director Textiles & Preventive, Artlab Australia whose unwavering commitment to improving the engineering controls at Artlab has enabled them to happen.

References

Work Health and Safety Act 2012 (SA)
 Work Health and Safety Regulations 2012 (SA) (Ch 4 Part 2 Hazardous Manual Tasks)
 Hazardous Manual Tasks Code of Practice Dec 2011

Suppliers

Backcare and Seating
 U2/27 Anzac Highway

Keswick SA
P 08 8293 5503

Biography of Authors

Kristin Phillips

Kristin holds a Bachelor of Applied Science from the University of Canberra and is presently the Principal Conservator of Textiles at Artlab Australia where she has been employed for 23 years. She is responsible for the conservation of textile collections belonging to the Art Gallery of South Australia, the South Australian Museum, the History South Australia, the State Library of South Australia and Carrick Hill. Conservation for private individuals is also part of her brief

Justin Gare

Originally a Carpenter and Joiner, Justin retrained as an Objects Conservator at the University of Canberra. He has worked as a conservator at Artlab since 2001. He retains an enduring interest in Furniture and Built Heritage.

Jo Bills GDOH, DipTechPhysio, Cert IV TAACPMSIA, RSP(Aust), Member APA & HFESA Occupational Health Physiotherapist/Ergonomist Nationally Accredited Trainer & Assessor Director, PhysioLink

Jo is a registered physiotherapist, who established PhysioLink in 1989. She has been working in Occupational Health and Safety (OHS) for over 25 years, providing on-site Physiotherapy services to industry, consultant ergonomics services, OHS consultancy and training, injury prevention and management programs and Rehabilitation Services for injured workers. She completed tertiary studies in Occupational Health at the University of Adelaide in 1994 and was awarded the Safety Institute of Australia's academic prize. She is a nationally accredited workplace trainer and assessor. From 2006, Jo was a member of the Physiotherapy Board of SA and is the current Chair of the SA Board of the Physiotherapy Board of Australia. She is a past President of the SA Branch of the Australian Physiotherapy Association (APA), a former APA SA Branch Consultant for Ergonomics and Occupational Health and an APA Media Spokesperson. She is a Chartered Professional Member of the Safety Institute of Australia, a Registered Safety Practitioner (Aust) and a past Office Bearer of the Human Factors and Ergonomics Society of Australia. Her special interest lies in musculoskeletal injury prevention from performing hazardous manual tasks, with emphasis on workplace design and redesign, specifically in art conservation and courtroom design, as well as office and dental ergonomics.

List of Illustrations

1. Use of height adjustable table for positioning object at optimal working position
2. Use of tilting table for the conservation of frames.
3. Two component system for the conservation of large frames
4. Sloped work surface for stitching repair on textiles
5. Head support for working on low bridge.



Fig 1: Use of height adjustable table for positioning object at optimal working position



Fig 2: Use of tilting table for the conservation of frames.



Fig 3: Two component system for the conservation of large frames



Fig 4: Sloped work surface for stitching repair on textiles



Fig 5: Head support for working on low bridge.