Playing Games

By Tamara Mitchell

Do you or your kids play computer games? Playing computer games has been shown to increase your chances of developing repetitive strain injury, or RSI. Considering the number of games sold, reported injury rates are relatively low, but they are related to the type of controller used and the number of hours games are played. Wii games are the only ones that have a majority of traumatic, rather than repetitive strain injuries due to strenuous full-body movements. When the player is distracted from their surroundings, impact with other objects or people, as well as loss of balance may occur. Judging from the number of comments on gaming blogs and gaming YouTube videos, it is likely that the occurrence of RSI is under-reported in medical records to some extent. Nobody likes to admit they are having issues with pain, especially when it involves a passionate hobby. We are not going to tell you to stop playing unless you are experiencing advanced symptoms. But there are things you should always do to greatly reduce the probability of injury. Make a few changes and you will be doing yourself and your gaming kids a huge favor by actually extending the number of years you’ll be able to enjoy playing.

Most gaming is very mouse or control oriented. We caution people in the office environment to avoid the mouse as much as possible by learning keyboard shortcuts to perform many application-related actions. In gaming, this is not an option. Things are largely controlled by pressing buttons or moving small joysticks, often using the thumb. The thumb is a very flexible appendage, but it is generally designed for gripping. It was not really designed to make a lot of three-dimensional movements, sometimes with force, like those specifically required when using a gaming console (or texting).

*Double or Single Gamer’s Thumb* is a repetitive strain injury that affects the thumb and wrist. Thumb tendons get strains and lesions from overuse of interactive games using traditional game controllers and almost any other input device. The controllers can be somewhat heavy, the wrists are repeatedly twisted and bent during interaction with the game and, of course, the thumbs are used to activate the various controls. Two tendons can be inflamed from overuse, both the flexor tendon on the underside of the thumb used in bending the thumb such as clicking buttons (flexor tenosynovitis), and the extensor tendon on the top of the thumb and extending down the wrist (deQuervain’s tenosynovitis).
Tendons pass through a sheath that contains a lubricating fluid (synovial fluid) that lets the tendon slide easily through the sheath. When there is overuse, the tendon becomes inflamed, the fluid can become thicker in consistency, and the tendon then has resistance and can even get stuck in the sheath, called trigger finger. Watch these videos for more information on simple exercises to prevent Double Gamer’s Thumb or Gamer’s Thumb. You will really feel the effect of these and you can do them while you are taking a break from gaming:

- Dr. Harrison’s Exercises: Part I  [https://youtu.be/n-5m7M2Wv_M](https://youtu.be/n-5m7M2Wv_M)
Dr. Harrison’s Exercises: Part II  [https://youtu.be/GRtXgm5QVIM](https://youtu.be/GRtXgm5QVIM)

American Physical Therapy Association Exercises: [https://youtu.be/_ZZC8BOA1NQ](https://youtu.be/_ZZC8BOA1NQ)

Carpal tunnel syndrome is another danger from repeated motion of the wrists while holding the console.\(^5\) Also, if you are using a keyboard and mouse, make absolutely sure you are not resting your wrists on a hard surface or on the edge of a desk or keyboard tray. Move your keyboard and mouse to the edge of the work surface so your wrists are suspended in the air and your hands are floating. Pressure on the wrists causes compression that leads to problems, so be aware. Hold your wrists up so they are not resting on any surface. Although wrist rests are supposed to reduce compression, they actually *cause* compression.

Please refer to the very extensive YouTube playlist from Dr. Levi Harrison covering all aspects of gaming, the physical toll it takes on your body, and the many ways to avoid injury with some really good stretches and advice. [https://www.youtube.com/playlist?list=PLoitz_8LdhuxK227095QhzL1-USOrzUGs](https://www.youtube.com/playlist?list=PLoitz_8LdhuxK227095QhzL1-USOrzUGs)

*Give it a rest.*

Most injuries reported in the literature are sadly cases of children as young as 9, who have become so deeply engrossed in interactive games that they spend many hours playing without taking a break. If you have kids, be aware of their physical limitations. Listen if they complain of pain or other physical problems. Pain is not common in children and it indicates there is something wrong that should not be ignored.\(^6\) Determine the source of the problem and cut back on the activities that are injuring them. It is up to parents to call the shots on extracurricular time allocation whether that is sports, gaming, or playing a musical instrument. To decrease your chances of developing RSI set a timer and do not allow yourself or your children to play computer games longer than 45 minutes at a time.

If you use the computer during the day and then go home to play computer games, you are stressing a similar set of tissues. It isn’t simply people who work on the computer during that day who need to be concerned. Any occupation that makes heavy use of the hands such as those in construction, electricians, jewelers, dentists, musicians, etc. come home after work with fatigued muscles, tendons, and ligaments in hands, arms, neck, and shoulders. It is very important to give your body a break. Consider watching a movie or going for a walk rather than sitting down to play a video game. Just let your hands “take a nap” in your lap and don’t ask them to anything for a while. Give your body a chance to recover from the day’s work!

*Neck and shoulder strain* has been reported in about 87% of the Americans who game.\(^7\) It is nearly always a matter of poor posture because of the equipment setup. Just because you are at home and playing a game doesn’t mean you can slouch or place your equipment in a position
that requires reaching or other unusual postures. All the rules for office setup apply to a gaming setup. Sit on a good, supportive chair with good lumbar support, feet flat on the floor, your arms hanging naturally with the shoulders relaxed, keyboard or controls so your lower arms are parallel to the floor, and your head balanced on your neck in an upright position. Do not slouch or slump. Please take a look at the guidelines for setting up correct keyboard/mouse and monitor height, reducing the need to reach, as well as information about getting a good chair and adjusting it correctly: http://working-well.org/Website/wkstn_design.html. Good posture is a “neutral” posture, which means that the body is in a state that isn’t fighting against gravity and it isn’t required to compensate for awkward, unbalanced, or unsupported positions. It doesn’t mean that you are sitting bolt upright in a static state. Movement is absolutely necessary for keeping circulation moving and joints lubricated. The head should be balanced directly over the shoulders with the monitor centered at about eye level, the hip angle should be slightly open, the feet should be supported and flat on the floor, the upper arms should be hanging down alongside the body (not reaching out), and the hands should be just slightly lower than the elbows. This video is primarily about how to avoid back, shoulder, and neck tension including some good stretches. https://youtu.be/CYq02sDWGUQ

Looking at the setup below, the table height should be just below elbow height. If multiple users of different heights are to be using the same gaming station, it would be best to have either an adjustable keyboard tray for the keyboard and mouse or an electric or hydraulic lift for the surface. It is unlikely that most people would have this many displays, but the upper display should be tilted downward at an angle toward the user. Eye level should be about the middle of the two lower screens where most of the action is. This means the displays should be a bit higher than for office work where the top third of the display is at eye level because that is where most content is on a web page. With gaming, the area of focus is lower on the display. The keyboard and mouse need to be moved the very edge of the table to avoid resting the arms on the edge of the table and compressing the tendons, ligaments, muscles, and blood vessels. The chair should not have armrests to allow free movement of the arms and to allow them to hang naturally without encouraging or requiring the player to raise their shoulders. The ambient light level is good, though the desk lamp shown to the left of the displays is likely much too bright in the eyes of the player. Indirect ambient lighting is best and should be about the same brightness as the display. We found many, many
examples online of gaming room setups with very dramatic lighting, but the ambient light level was quite low. High contrast between the ambient lighting in the room and the monitors will cause eye strain. Speakers may be unnecessary in this situation since it appears that the player has a headset to wear. Headsets spare the rest of the household from the sounds generated by the game which can be less than peaceful.

This video covers a few basics about setup for using the mouse and keyboard while gaming. It is specifically geared for gamers, especially younger gamers: https://youtu.be/vG_3bS3fVM.

It is quite possible to use a standing workstation to play, though it will require a period of adaptation. A good anti-fatigue mat is necessary. Standing for several hours (if you play that long) is too challenging for almost everyone, so buying a sit/stand workstation is likely the best solution. Assuming you use your computer for things other than just gaming, you’ll probably want to sit at least some of the time, so having that option is good. Either purchasing a sit/stand workstation or building a standing-height workstation and getting a good bar-height chair (such as our laboratory chairs with backrest: http://working-well.org/Website/pchair.html#lab), will enable you to game in either a sitting or standing position. Standing while gaming allows a lot more movement with the game, which is an additional bonus in addition to the usual health reasons for a standing workstation. If you wear a wireless headset, you’ll be able to take breaks, go to the kitchen for a snack, etc., without totally disconnecting from game.

If you are using a VR system, you need to be conscious of your posture. Don’t just flop down on the couch. Sit in a supported, upright posture to avoid muscle fatigue and postural imbalances. If you have money to burn or an arcade to furnish, you can explore the standing, free movement, 360° Virtuix Omni gaming apparatus that allows you to walk, run, and have free movement of your whole body and upper arms: http://www.virtuix.com. Watch the trailer here: https://www.youtube.com/watch?v=1sIZvuhABGk. Normally, it is necessary to play VR games while sitting down for safety reasons.

Eye strain happens while focusing for hours in a fixed location and at a fixed distance. Whether the game is projected via a VR headset or on a monitor, sitting in a fixed location for long periods of time can cause eye strain. Most of the problem comes from reduced blinking which causes the eye to dry out. Its just one more reason to take breaks which means you’ll be looking around and blinking more, focusing on things at different distances. This video has some eye exercises to help keep your eyes healthy: https://youtu.be/BjVWx9Wxb-Y. Also, take a look at our web page with eye exercises that don’t take long, but are very helpful: http://working-well.org/Website/st_eyes.html.

With the advent of virtual reality headsets, we have yet to see the full potential impact of this on the eyes. It is generally agreed that there is virtually no risk to the eyes with the current technology of headsets. Clearly stereoscopic viewing has been around for a long time and adults who use stereomicroscopes show no sign of eye damage. VR headsets have one small LCD monitor for each eye creating a stereoscopic effect. Risks in children and warnings from manufacturers are probably overly cautious, but there may be some risk of developing myopia (near-sightedness) or eye strain, so limiting use to 20 minutes with a 20 minute break is adviseable. Reports of nausea or disorientation are essentially eliminated with the current
technology because it resulted from poorly rendered or mismatched images to each eye. As a matter of fact, VR headsets are now being used to help treat amblyopia (lazy eye), exotropia (one eye turned outward) and strabismus (crossed eyes) where the brain isn’t communicating properly with one eye, so VR headset gaming may actually prove to be helpful for people with these conditions. People with these conditions may experience difficulty while using the headsets, may not perceive the 3D effect, get headaches, or eye fatigue, so shorter sessions and a bit of caution is advised.

**Equipment**

*Game controllers, mouse/keyboard input.*

The traditional method of interacting with video games is with a two-handed game controller or with keyboard and mouse when gaming on a computer. You can use a normal mouse for gaming, but the resolution of gaming mice is much higher, up to 12,000 dpi compared to 1,000 dpi for a regular mouse. Is higher resolution better? Dr. Levi Harrison, an orthopedic surgeon who specializes in repetitive stress injuries to the hand and wrist. He is a leading authority in prevention and treatment of gaming injuries. Dr. Harrison has found that players who use higher resolution mice tend to flick their wrists and hands more aggressively and are at greater risk for developing RSI in the hands and wrists from this aggressive and repeated movement. Players who set the mouse to lower resolution claim more accuracy and Dr. Harrison has observed less RSI in these players. You should choose a mouse that is comfortable for your hand and has convenient programmable buttons and controls that you use in the games you play. Just because a mouse is advertised to be “ergonomic” does not mean that it will fit your hand and buying online or buying a product in a box doesn’t allow you to feel how the mouse fits. When you place your hand on the mouse, it should follow the natural curve of your hand and the buttons and other controls should be right at your fingertips.

*Joystick controllers* are a potentially attractive option, especially for flight games. Logitech has a very reasonably priced right-handed joystick that allows the arm to be in the preferred neutral vertical position with the wrist straight and 12 programmable buttons. Logitech has included rotation of the joystick as an option, which may be all right as it appears to be well within a normal range of motion and the wrist is not rotated laterally. The joystick is designed for large hands, so watch this video below to see the adaptation made by the reviewer for his small hand. At about 2 minutes 30 seconds into the video he explains.

https://youtu.be/PWloc43J1HY

Other manufacturers of gaming joysticks include Thrustmaster which offers joysticks with three removable components that allow them to be customized for left- or right-handed users, and CH Products which claims to be ambidextrous, but is clearly asymmetrical appears to be geared toward right-handed users. A good review, although somewhat dated, is provided on this YouTube video: https://youtu.be/VGDRzx8CY3c
Touchpad or trackball. What about using a touchpad or trackball in gaming? Control involves so much movement that the intensive spinning of the trackball and associated clicking of the buttons, even using one of our favorite trackballs, the Kensington Expert, resulted in significant wrist fatigue in a very short period of time.\textsuperscript{16} Use of a touchpad or trackpad is rather game-specific according to the trial by RandomFrank.\textsuperscript{17} The limitations of the Apple Trackpad were found to be that (1) there is no adjustment available for sensitivity and (2) gesture movements are not supported. These limitations greatly reduced the overall potential of this input device for gaming. Using a Wacom tablet may take some getting used to, but for reducing repetitive strain on the hand, it is promising. The tablet used in this trial online was a Wacom Bamboo, which is not the size or accuracy of the Wacom Intuos, but it performed quite admirably.\textsuperscript{18}

Adaptive controller. The Microsoft Xbox Adaptive Controller is designed for extremely flexible plug-in of a wide range of external devices and use of the device itself for those with physical limitations.\textsuperscript{19} Nineteen 3.5 mm ports, two USB ports, and a headset jack as well as Bluetooth connectivity to either Xbox One consoles or Windows 10 PCs.\textsuperscript{19} Such input devices can include voice input, traditional and one-handed joysticks, a mouth controller that works with puffs of air, and foot pedals and rudders.\textsuperscript{19} This is the current link to the Assistive Technologies section on the Xbox website that has all kinds of alternative input devices: https://www.xbox.com/en-US/xbox-one/accessories#assistive. It is quite possible that these input devices will provide great options for people without physical limitations as well, and will reduce the chances of developing RSI.

Microsoft X-Box Adaptive Controller

Smartphone controllers.
Controllers are available for use with a smartphone where two control pieces attach to either side of the smartphone or operate via bluetooth.
Interactive gloves.
Probably the most natural interactive interface would be a glove. Gloves allow the hand to be held in a neutral position or in the lap while interacting with the game/computer which eliminates the stress of holding a device with the hands, using buttons and controls in a somewhat unnatural position, and holding the weight of a device for extended periods of time.

Currently, the Peregrine is about the only glove we could find for traditional gaming (or for other input purposes). At this time, it comes in three sizes for the left hand only, has wired connection, is compatible with Windows, Mac, or Linux (not with consoles like XBOX, Wii, or Playstation), and over 30 different keystrokes can be programmed into the glove. It doesn’t utilize gestures, though developers say that and a Bluetooth version are in the works. It utilizes taps on various pressure-sensitive points on the glove…5 on each of the three larger digits and 3 on the pinkie. There are three interactions with these points through touching the thumb tip, thumb pad, or the palm of the hand to the points on the fingers. Some of these points are awkward to reach, so clearly it is important to program the touchpoints that are most comfortable for you to make. It is unlikely that anyone would use all 36 shortcuts possible and there is reportedly a fairly steep learning curve to remember the shortcuts, but once that is mastered, gaming speed is faster than with other input devices. Using the default setup for the shortcuts is reportedly not convenient, so it is important to take the time to program the ones you need and use. It can be used to interact with other programs like Photoshop where use of shortcuts and hotkeys is used frequently and can be used in conjunction with a regular keyboard. At this point, the touches cannot be programmed to perform macros, though this is planned for future versions of the glove. This is a video of how to use the Peregrine glove while gaming and how programming can be set up specifically for a game you play: https://youtu.be/maI0UM2Iy9I.
The Samsung controller is a very lightweight one-handed control that uses your smartphone to interact with the VR system. In the case of the Oculus which provides the display on the VR headset and interacts with the controller. We are happy to see that selection is done with a trigger for the index finger taking much of the load off the thumb. The thumb is used for navigation using the touchpad. During setup, the controller can be programmed for right or left-handed use, so it is ambidextrous.

The Oculus controller for the Oculus GO VR system, a standalone system which requires no computer or smartphone, is a somewhat beefier looking grip than the Samsung controller. It also has a trigger that is well-positioned for the index finger, a touchpad for the thumb and a couple of buttons for Back and Home.

The Oculus Touch controllers for the Oculus Rift VR system, which runs on a standalone PC for more powerful graphics, are held in both hands with trigger for the index fingers and mini-joysticks for the thumbs. They are reportedly very easy, natural, and lightweight to hold that fit the hand very well.

https://youtu.be/-7OrH2ik9H8
Cirque, who developed Glidepoint technology used in touchpads, has released the VR Grip which is available for developers to create interfaces for their VR systems. There is a circular trackpad for the thumb, but the handheld device also senses the position of all fingers and the thumb. We expect that this will become a new interface for gaming and many other industrial and medical applications.

We suggest that you search for controllers compatible with your system that are comfortable to hold, allow natural hand and finger movements, and take ergonomics seriously. Make sure you are not required to hold any fingers in awkward positions, use excess force, or require your wrists or arms to be held in an angled position. One review called most VR controllers “basically rubbish” and not comfortable to hold at all. https://youtu.be/LuMbYQfTRts

For VR, the Manus VR glove is wireless and operates with Vive, Xsens, OptiTrack, PhaseSpace, and Vicon VR systems. A haptic glove by Haptx is in development and is planned for use in all types of applications such as medical, military, arcades, and theme parks. It allows you to not only interact with features in a simulation, but feel the texture, shape, and pressure of objects with about 150 tiny air bladders individually variably controlled. If this is an indication of the future of VR, it appears to be pretty exciting and may lead to fewer RSI’s of the hand by avoiding repetitive button clicks and overuse of the thumb for interacting with the game. Much
more natural hand movements are possible with this type of device. Watch this video for a demonstration of the Haptx haptic glove: https://youtu.be/OK2y4Z5lkZ0.

SUMMARY:
• Take a 10 to 15 minute break every hour, even if you don’t think you need it and change positions frequently.
• Do stretches to release the muscles and stretch the tendons that get tight during playing.
• Use a neutral grip when holding the game controller or other input device. Your wrist should be straight rather than being bent in any direction.
• If one type of input device is difficult to use for a particular game, try using a different device.
• The keyboard should be high enough so that your wrists are parallel to the keyboard.
• If your hands, wrists or arms become tired or sore while playing, stop and rest them for several hours before playing again.
• If you continue to have soreness or discomfort during or after play, listen to the signals your body is giving you. Stop playing and consult a doctor trained to diagnose repetitive strain injuries. Failure to do so could result in long term injury.
• If your hands, wrist or arms have been injured or strained in other activities, use of your system could aggravate the condition.

Please refer to our self-help webpage to care for yourself: http://working-well.org/Website/ctd.html. If you have pain that doesn’t respond to self-help measures and if you have set up your gaming equipment properly, please consult our list of qualified practitioners, http://working-well.org/Website/ctd_resources.html. Your family doctor is NOT trained to treat RSI and is likely to give you a misdiagnosis.

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This article and all of our articles are intended for your information and education. We are not experts in the diagnosis and treatment of specific medical or mental problems. When dealing with a severe problem, please consult your healthcare or mental health professional and research the alternatives available for your particular diagnosis prior to embarking on a treatment plan. You are ultimately responsible for your health and treatment!

All Ergonomics Feature Articles are available online at: http://working-well.org/articles/archive.html

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