

Ergonomics for Shelter Veterinarians

Sara White, DVM, MSc

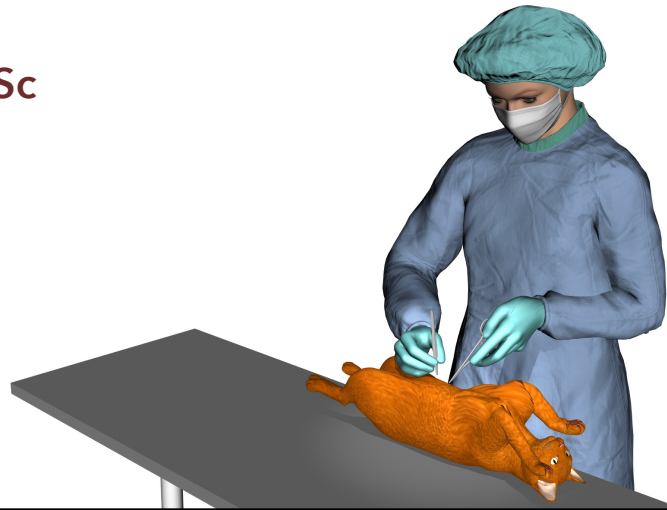
Spay ASAP Inc.

and



Hartland, VT

shelternvet@mac.com



1

About me

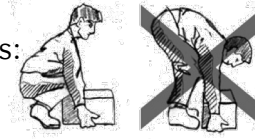
- 21 years in vet practice in Vermont, New Hampshire
 - mixed practice (small animal, dairy, equine)
 - shelter medicine
 - spay neuter MASH mobile
- Interest in vet discomfort and ergonomics: talking with other spay neuter vets
 - repetitive work, minimal variability
 - rapidly expanding area of vet med
 - many described chronic pain
 - often have non-veterinarian bosses designing schedules
 - what is a reasonable work week?
- Survey of work and discomfort in spay neuter vets
- Masters in Ergonomics



2

What is Ergonomics?

- Usually we think of physical ergonomics:
 - “Lift with your legs, not with your back!”
 - “Ergonomic” products:
 - keyboards, computer mice, and kitchen utensils
 - Adjustable office chairs



Searches related to ergonomic



3

What is Ergonomics?

- Maybe we also think of ergonomics when we think of physical pain related to work activities
 - Sore back, or disk trouble
 - Carpal Tunnel Syndrome
 - Etc.



4

What is Ergonomics?

Definition: The aim of ergonomics is to study and to improve the 'fit' between people, their jobs, and their environment in order to improve performance, well-being, safety and health

Ergonomics includes the **physical, cognitive, environmental, and organizational** aspects of work



5

What is Ergonomics?

Examples in small animal surgery:

- **Physical:** humans interacting with patients and objects
 - Lifting, standing, sitting, typing, doing surgery
- **Cognitive:** mental workload and mental tasks
 - Divided attention- a technician watching surgical patient, recovering animals, electronic monitors, and co-workers
- **Environmental:** temperature, noise, lighting, airflow
- **Organizational:** systems, management style, communication



6

Agenda

- Research: Spay-Neuter Veterinarians and work-related pain
- How to approach and control workplace risks: the risk control hierarchy
- Ergonomics and the physical environment in surgery
 - table height
 - patient positioning
 - surgeon sitting or standing; types of seating
 - flooring and shoes
 - glasses and vision
- Surgeon Ergonomics: surgery itself
 - repetitive motions
 - awkward hand/ wrist positions
 - instrument grips
 - forceful motions
- Instruments and Needles
- Movement and Posture
- Perioperative Staff Ergonomics
- Dental Ergonomics



7

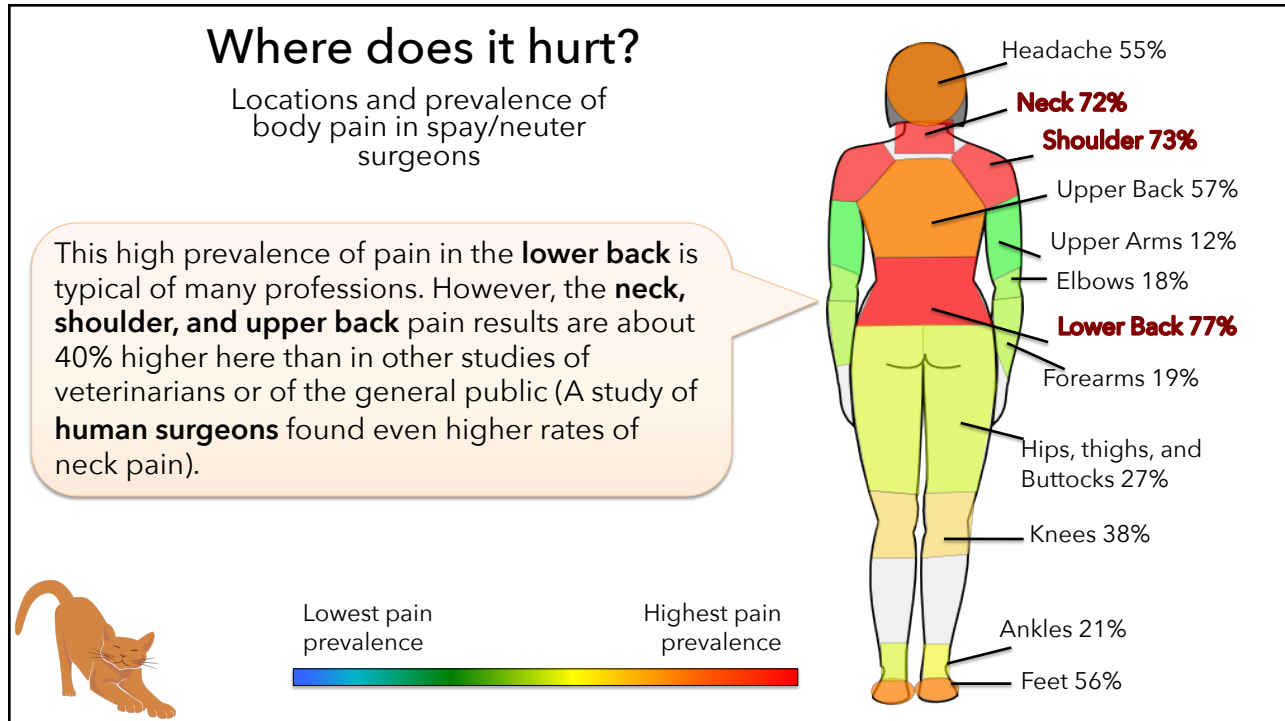
Do we have a problem?

- **Yes!** Some of us do anyway:
- **99%** of 219 spay neuter veterinarians in one survey have experienced musculoskeletal discomfort in the last month.
Specifically:
 - **98%** had body pain
 - **76%** had hand pain
- Previous surveys of veterinarians (many practice types) indicate that 81-96% of vets report musculoskeletal discomfort in the past year.

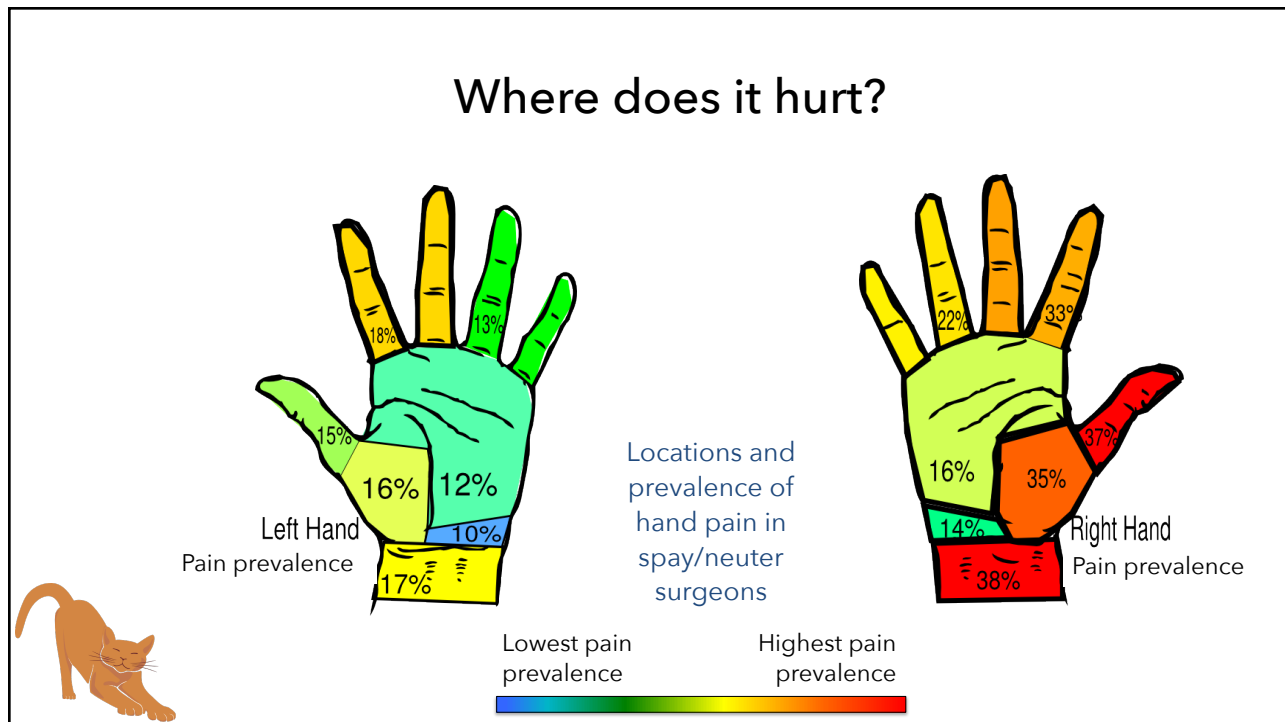


White, S. (2013) Prevalence and Risk Factors Associated with Musculoskeletal Discomfort in Spay and Neuter Veterinarians. *Animals*, 3, 85-108.

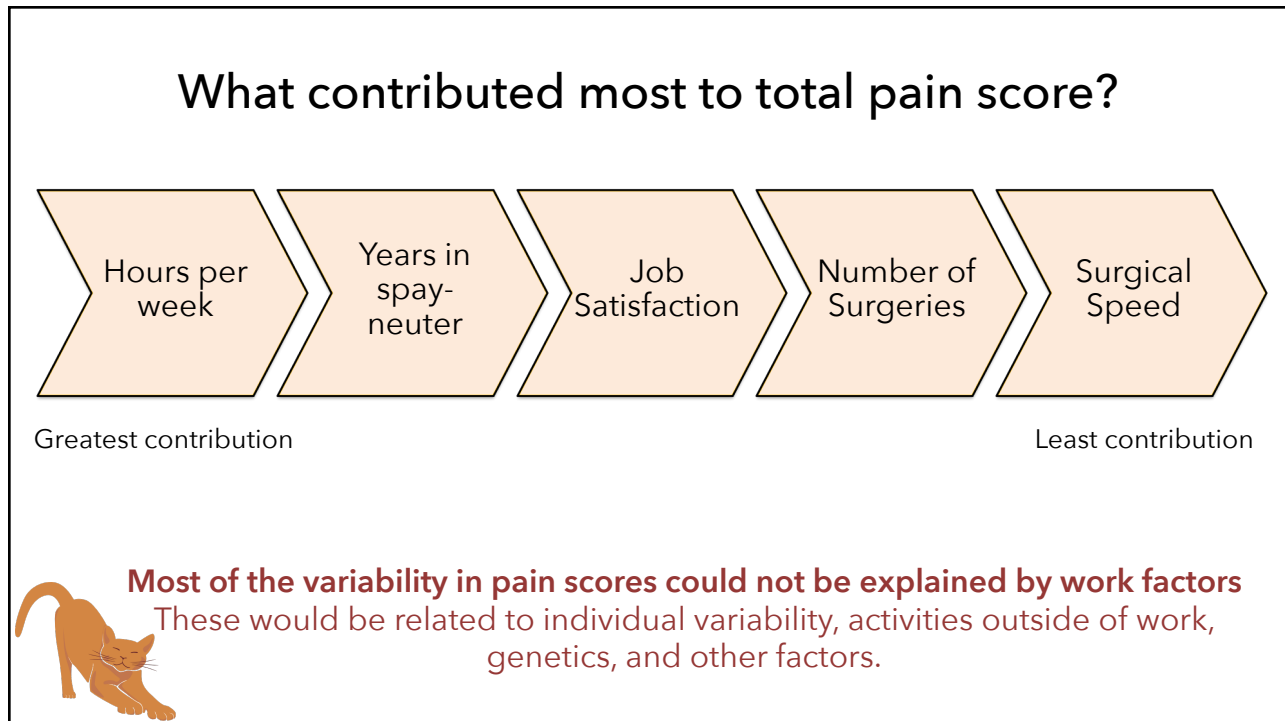
8



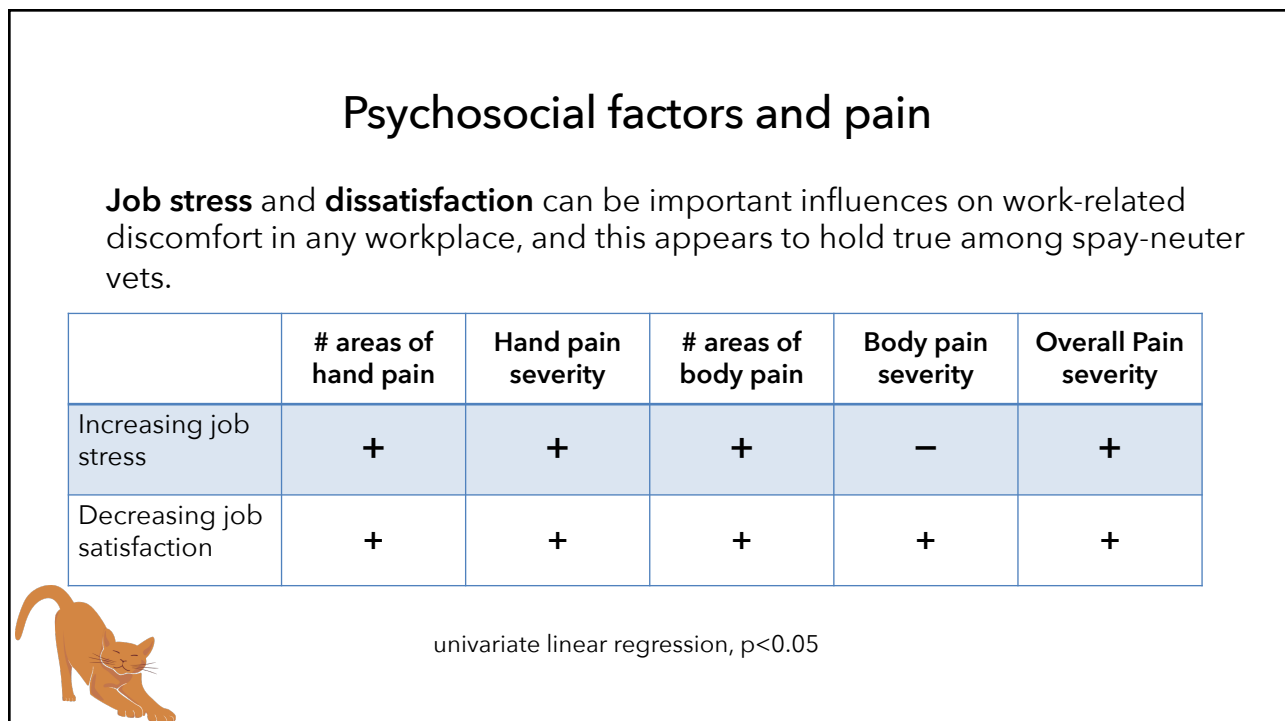
9



10



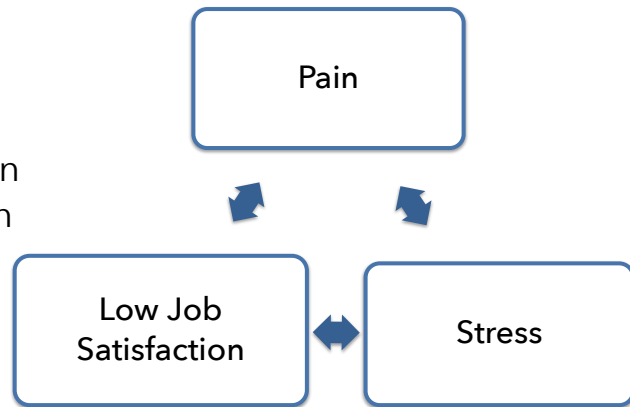
11



12

Psychosocial factors and pain

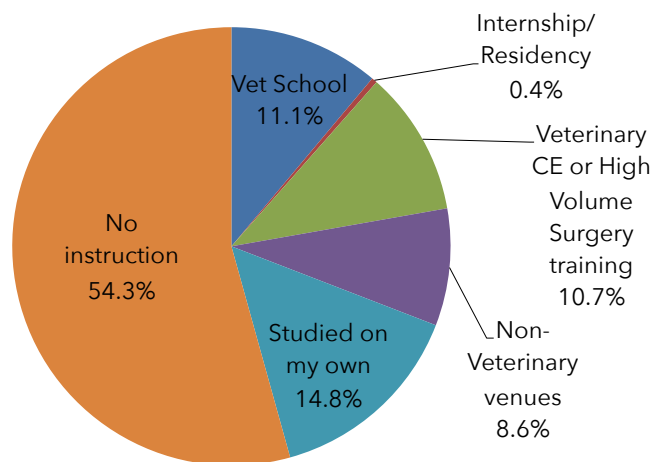
Remember: cause and effect are NOT determined by this analysis, only correlation. In reality, the relationship between stress, job satisfaction, and pain may look something like this:



13

Where do veterinarians learn ergonomics?

Survey of spay/neuter veterinarians: most vets have never received instruction in posture and ergonomics (in 2011)



14

How to control workplace risks (ergonomic and otherwise)

“risk control hierarchy”

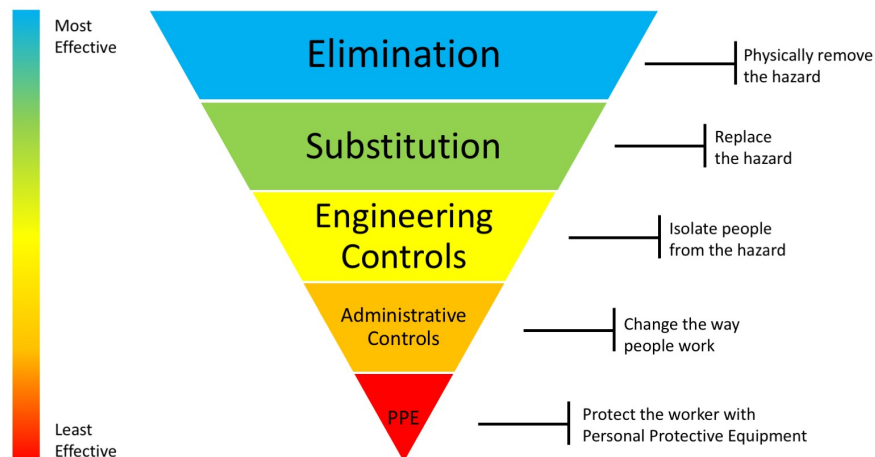
hierarchy = start at the top and work down

- eliminate (*remove the risk*)
- substitute (*replace the risk*)
- engineering control (*use technology to change the task*)
- isolation (*keep people away from the risk*)
- administrative (*make rules and systems to minimize risk*)
- personal protective equipment
- discipline (*for those not following rules or using PPE*)



15

Hierarchy of Risk Control



Adapted from the National Institute for Occupational Safety and Health (NIOSH)

16

How to control workplace risks (ergonomic and otherwise)

“risk control hierarchy”

hierarchy = start at the top and work down

- Not all problems will be amenable to all of these controls. (example: you can't absolutely eliminate risk of injury from animals in an animal care setting)
- But the higher up the hierarchy you can work, the better protected your staff. Relying on the bottom 3 controls (rules, protective gear, and punishment) isn't going to give you a robust safety environment.



17

Ergonomics and the Physical Environment in Surgery

how your workspace shapes what you do with your body



18

How do I know what to change?

- **Take pictures and video** of yourself and your work environment.
- All you need is a smartphone, or a friend or co-worker with a phone or camera.
- Prop your phone against a box, tape it to the IV stand, use a tripod or clip case, or have a friend hold it.
- Take video or pictures from more than one angle to see more detail
 - for example, it may be easiest to see your raised shoulders and tense neck from the back rather than the front or sides.

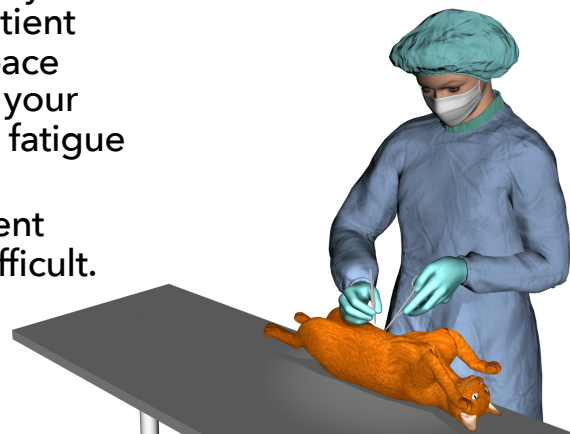


I could place this suture without my shoulders up to my ears, and I don't suture as well when I'm tense. The video helps me see this.

19

The Physical Environment

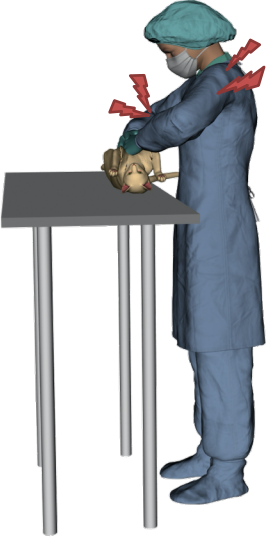
- Things like the height of your surgery table and the positioning of the patient and other objects in the surgery space can influence the way that you use your body and the amount of strain and fatigue that you experience.
- Improving your physical environment doesn't have to be expensive or difficult.




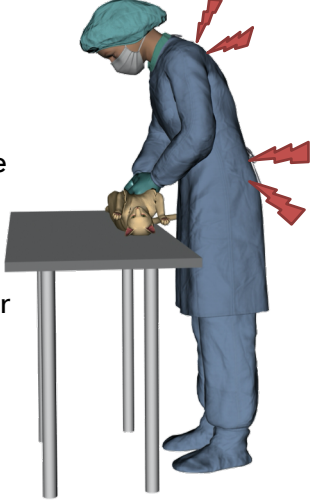
20

Table Too High or Too Low

A surgery table that is too high causes the surgeon to raise the shoulders and abduct the elbows, and places strain on the neck, shoulders, and elbows.




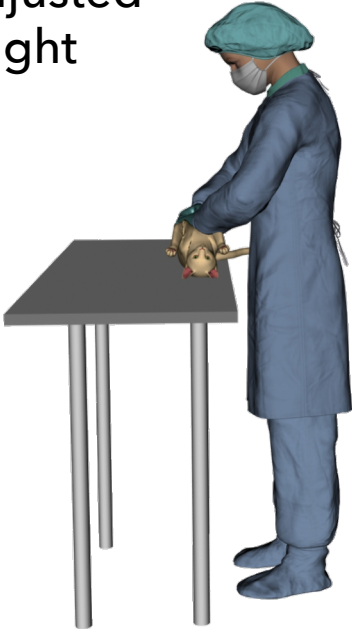
A surgery table that is too low causes the surgeon to lean forward, and places strain on the neck, shoulders, and lower back.



21

Correctly Adjusted Table Height

A correctly adjusted surgery table places the level of the surgeon's hands about 5-10 cm (2-4 inches) below the elbows, and allows a relaxed posture in the shoulders, elbows, and lower back.



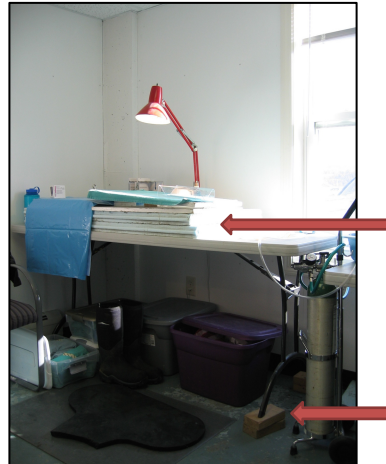
22

Table Doesn't Adjust?

Table is too high and not adjustable? Try standing on a foot stool or a step.



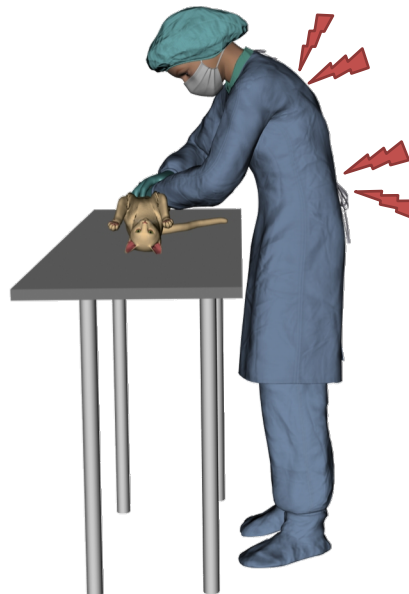
Table is too low and not adjustable? Raise the table by placing blocks under the legs/pedestal, or platforms on top of the tabletop.



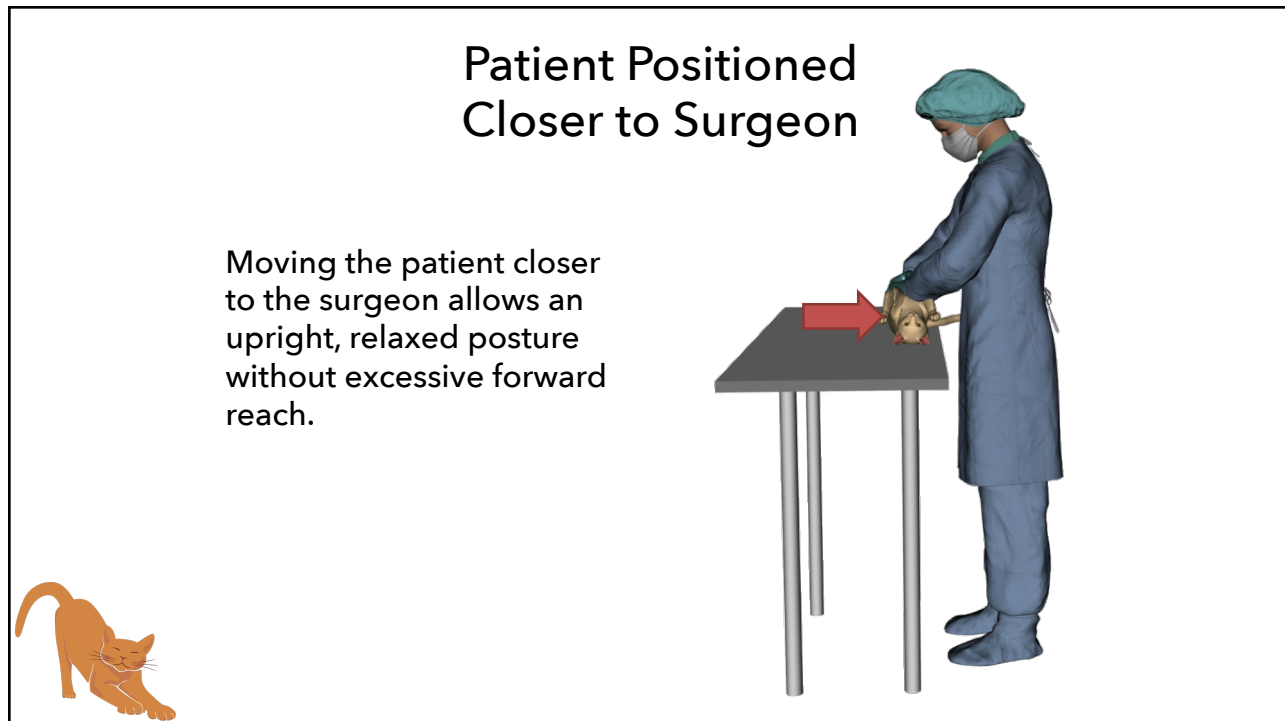
23

Patient Too Far

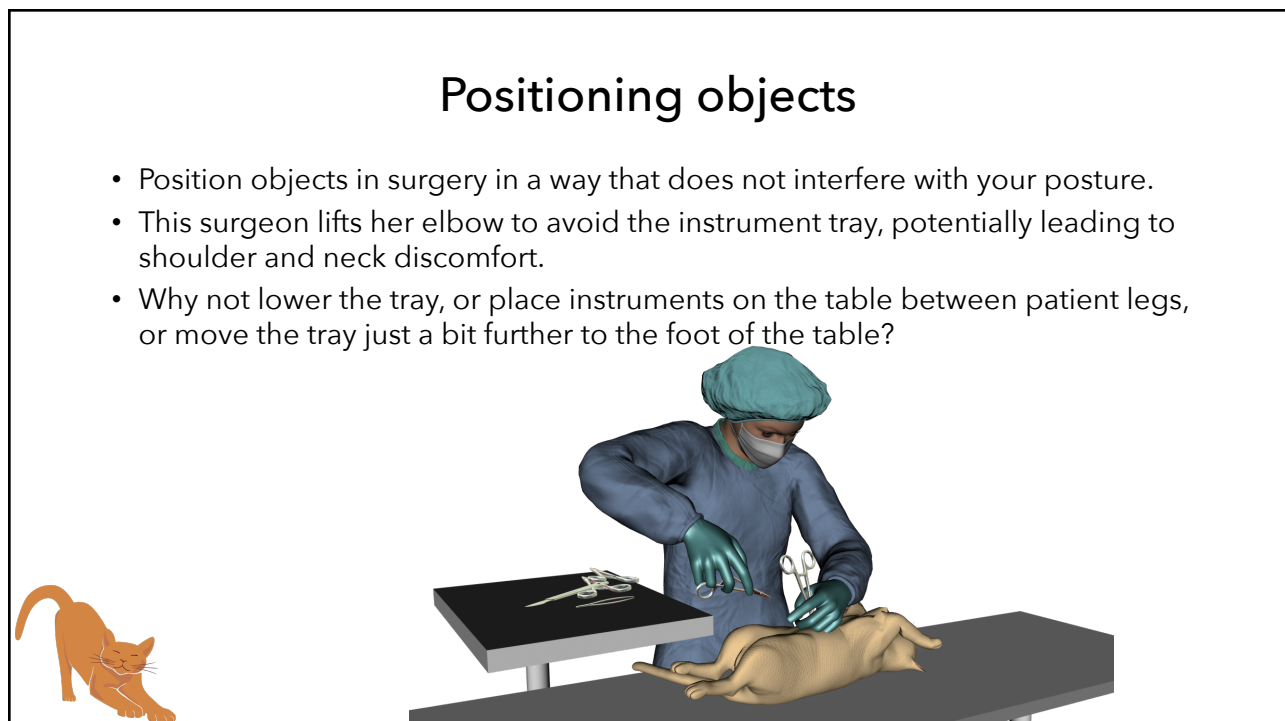
Positioning the patient too far away causes the surgeon to reach towards the patient, placing strain on the upper and lower back and shoulders.



24



25



26

Sitting or Standing?

- Most spay-neuter vets stand for surgery- 84% report standing “always” or “most of the time”
- Recent research with surgeons operating on humans found that sitting for surgery, or alternating between sitting and standing, resulted in less general fatigue, and less fatigue specifically in the spine and lower limbs

**If you normally stand for surgery,
consider sitting some of the time, but be
sure to adjust your table and chair**

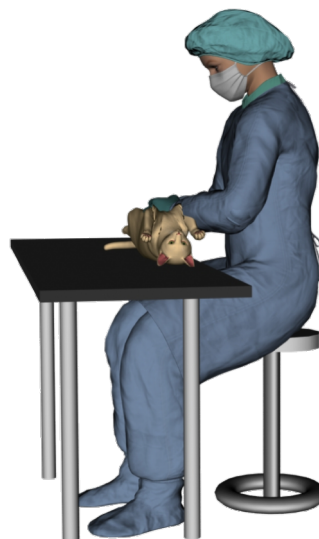


Rodigari, A., Bejor, M., Carlisi, E., Lisi, C., Tinelli, C. & Dalla Toffola, E. (2012) Identification of risk factors for fatigue and pain when performing surgical interventions. *Giornale Italiano di Medicina del Lavoro ed Ergonomia*, 34, 432-437.

27

Have a Seat: small patient

When sitting for surgery with a small patient and a standard table and stool, the surgeon is able to sit close to the table and maintain relaxed upper body positioning.



28

Have a Seat: large, deep patient

With a large, deep-bodied dog, the surgeon sitting on a standard stool raises her shoulders and abducts her elbows to clear the patient's body. The surgeon is unable to lower the table or raise her stool, since her thighs are already in contact with the underside of the table.



29

Have a Seat: Elevate Yourself

Using a saddle-shaped stool when operating on a large dog allows the surgeon to achieve appropriate upper body position while still remaining close to the surgery table

Other options for sitting for deep bodied dog surgeries include various stools and "sit/stand" chairs that allow you to support your weight with the chair while almost standing



30

Have a Seat: Elevate Yourself

Dental student using a
standard chair



Dental student using a
saddle-shaped chair



Gandavadi, A., Ramsay, J.R.E., & Burke, F.J.T. (2007). Assessment of dental student posture in two seating conditions using RULA methodology - a pilot study. *Br Dent J*, 203(10), 601-605.

31

Floor mats

- Using floor mats can decrease lower limb (foot and calf) discomfort and fatigue. The longer a worker stands, the greater the difference between a mat and bare floor.
- However, mats have **not** been shown to decrease back pain
- "Not too hard, not too soft" (the "Goldilocks" mat)
 - With soft mats, you can "ground out"
 - Hard mats aren't as comfortable
- Non-slip, resistance to fluids, cleanable
- Try out mats whenever you see them- find out the brand when you find one you like.

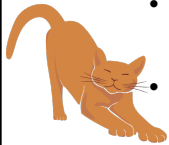


Wiggermann, N., & Keyserling, W.M. (2013). Effects of anti-fatigue mats on perceived discomfort and weight-shifting during prolonged standing. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, 55(4), 764-775. doi: 10.1177/0018720812466672

32

Footwear

- People wearing **cushioned shoes** (as opposed to hard-soled shoes) are more comfortable.
- Some studies have found that **rotating footwear** (different shoes on different days) reduces the risk of plantar fasciitis, though not the risk of foot/leg fatigue.
- A study of nurses' footwear found the best results with a midsole 1.5 cm thick with a heel height 1.8-3.6 cm (a heel-to-toe "drop" of 0.3 to 2.1 cm)
 - minimize foot pressure distribution
 - minimize impact force
 - increase shin and ankle comfort
- **This is fairly typical of a rubber-soled athletic shoe**
- Shoes comfortable for standing still all day may be different from those most comfortable for walking and moving.
- Use trial and error to decide.



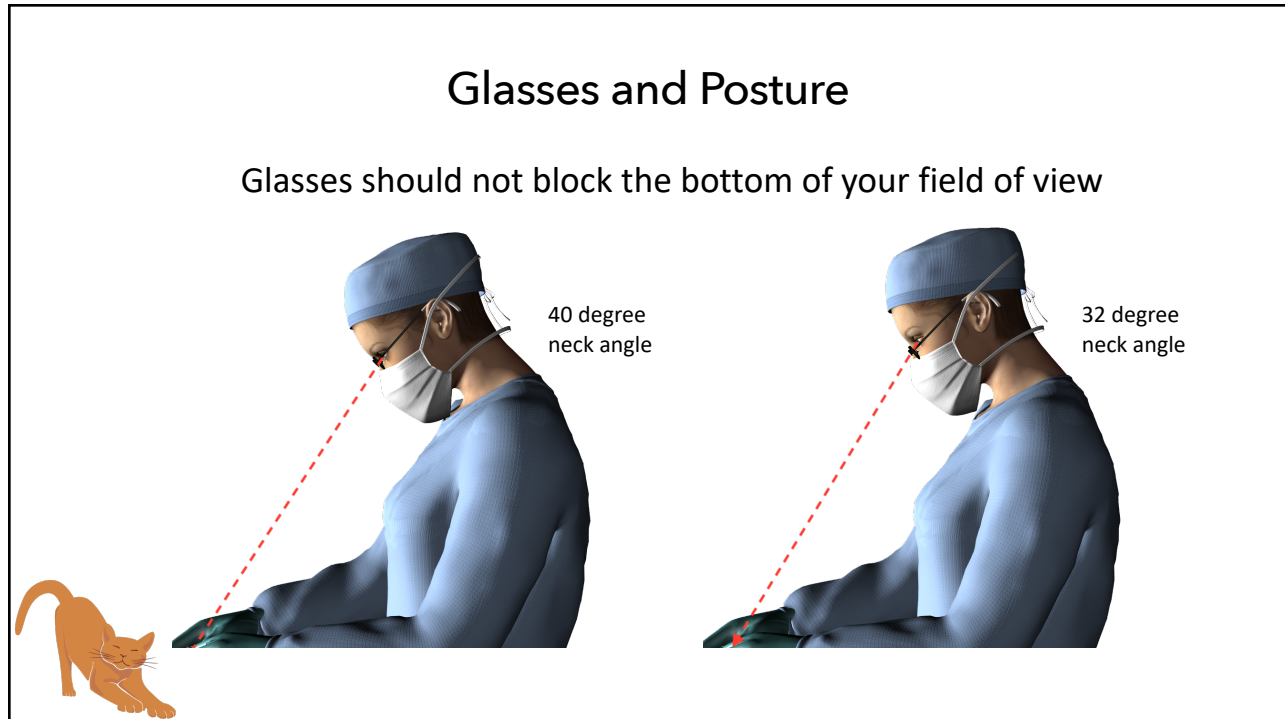
33

Wearing Glasses

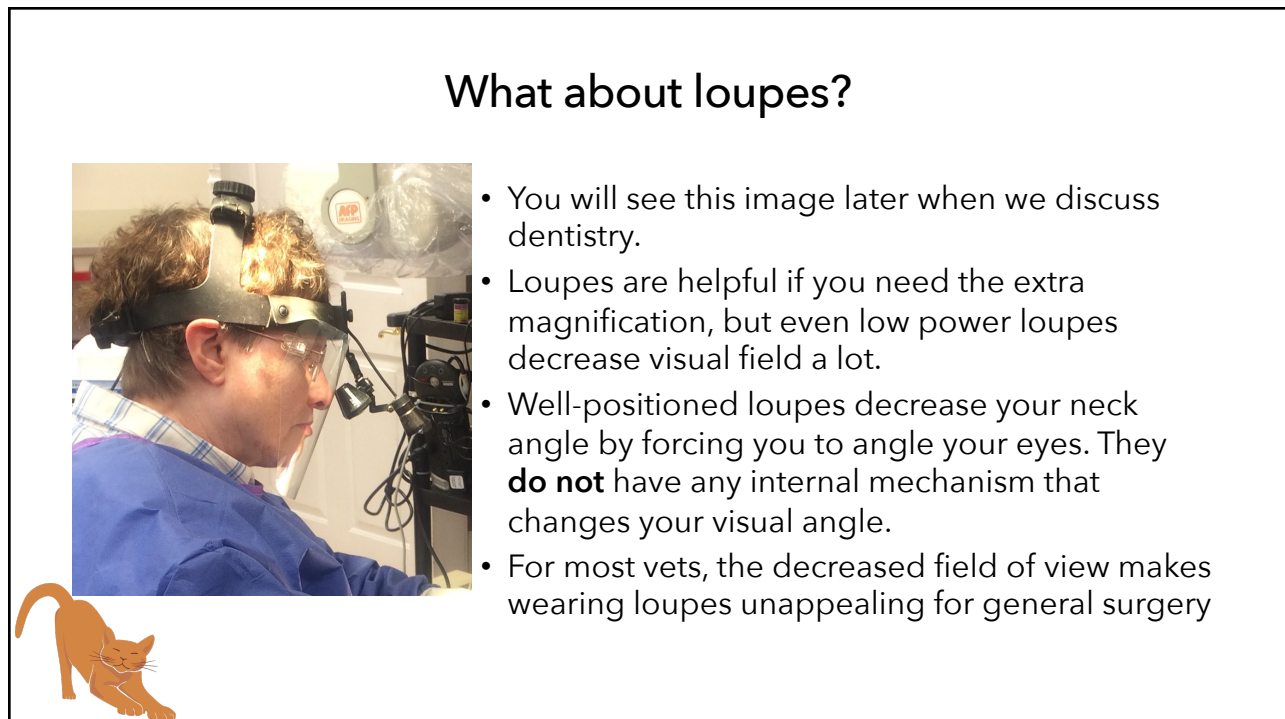
- Wearing corrective lenses can be a challenge in surgery:
 - they fog up,
 - they slide off,
 - the rims block your field of view,
 - the focal distance that's good for surgery is too close to read monitors or see staff
- Possibilities for corrective lenses in surgery:
 - Progressive lenses allow multiple focal distances
 - Contact lenses (multifocal lenses, or one near one far)
 - "half glasses" type reading glasses



34

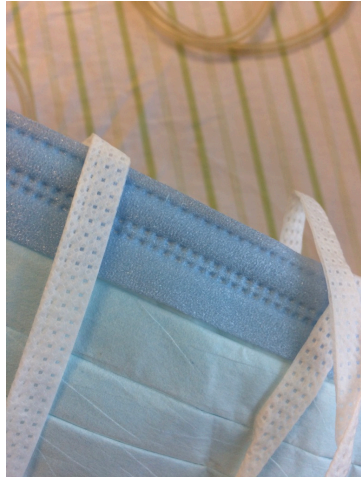


35



36

What about fogging lenses?



- Fog-free masks have a foam strip or an adhesive strip along the bridge of the nose
- Some vets add a piece of tape over the bridge of their nose
- Use an anti-fog solution on the lenses
- One paper described crossing the ties of the mask such that the upper ties are tied at the base of the skull, and the lower ties are tied atop the head, redirecting the breath out the sides of the mask
 - While this is good for fogging, it may be less ideal from an asepsis point of view
- Or, wear contact lenses



37

Surgery Techniques and Movements

- Surgical tasks in HQHVSN require a combination of **repetitive movements** that can at times require **force**, or may be performed with **awkward positioning** of the hands and wrists
- Alone, each of these factors (repetition, force, posture) is only moderately associated with pain in the hand and wrist
- When combined, the association with hand/wrist pain is strong



38

Repetitive motions

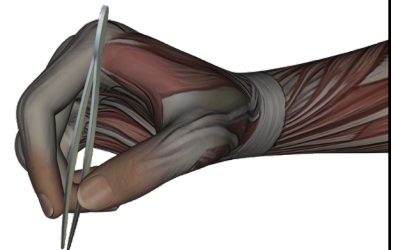
- Repetitive motion is inherent in any high volume workplace
- Repetition in high volume spay-neuter can be reduced by some “high volume techniques”
 - pedicle ties = fewer suture knots
 - shorter incisions = fewer sutures placed, fewer knots
 - efficient technique (minimal wasted motion) decreases repetition as well



39

Awkward or tiring hand positions

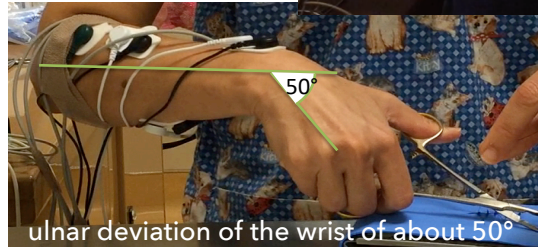
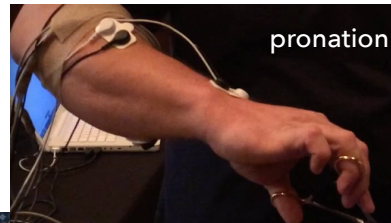
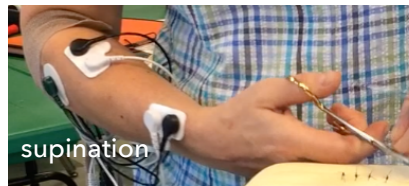
- Awkward hand and wrist postures include pinch grip, ulnar or radial deviation of the wrist, and extreme wrist flexion or extension.
- An example of a pinch grip is the use of thumb forceps.
- Some surgeons minimize the use of thumb forceps, particularly when performing skin closure, both in order to **reduce tissue trauma to the patient, as well as to reduce the hand strain from the sustained pinch grip.**
 - In most cases, awkward postures with extreme flexion, extension, or ulnar or radial deviation are not necessary to performing surgery, but surgeons may use these postures inadvertently.



40

Awkward or tiring arm positions

Some examples of extremes of range of motion while suturing. These positions are not bad on their own but may be sources of strain if repeated or used with force.

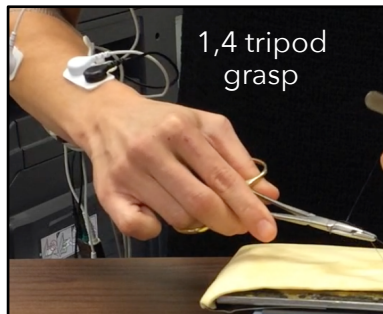


41

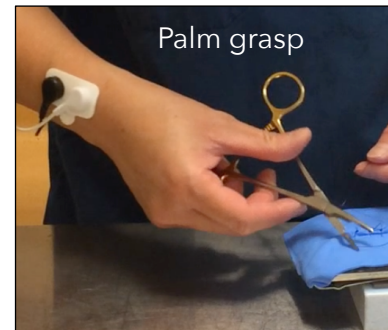
Needle holder grasps

There is much grasp variability between surgeons

Some surgeons feel strongly that the use of a **palm grasp** is more comfortable than the use of a traditional grip with fingers in instrument rings, and that their use of palm grasp has led to decreased hand, wrist, and arm symptoms.



However, no one grasp is "best"-muscle strain depends on **individual technique** more than grasp style

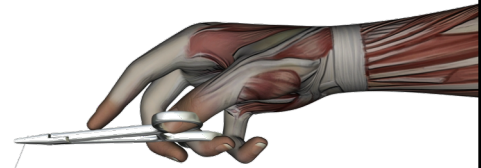


42

Forceful motions: knot tightening

- Secure knot tying requires that the surgeon apply forces to the ends of the suture equivalent to 80% of that suture's breaking strength
- With 3-0 synthetic suture, this = 3 pounds per throw
- With 1 synthetic suture, this = 9 pounds per throw
- A repeated load of 9 pounds has been associated with ligament inflammation and muscle excitability

Avoid using larger-than-necessary suture size (or performing many surgeries requiring large suture) without adequate rest and recovery

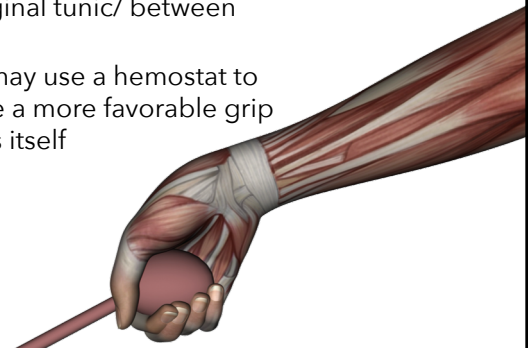


Solomonow, M. (2009). Ligaments: A source of musculoskeletal disorders. *Journal of bodywork and movement therapies*, 13(2), 136-154.

43

Forceful motions: big dog neuter

- Hand /arm strength is required to grasp and exteriorize the testis during closed castration of large, mature dogs
- If big dog neuters are painful or difficult for you to perform, consider:
 - Open castration
 - Sharp dissection of fibrous attachments around vaginal tunic/ between tunic and subcutaneous tissue
 - Once the spermatic cord is exposed, the surgeon may use a hemostat to clamp the cord just proximal to the testis to provide a more favorable grip for applying traction, rather than grasping the testis itself



44

Where posture meets technique

Surgical technique can influence posture. A right handed surgeon performing continuous subcutaneous closure from left to right leans over the patient with an abducted elbow and shoulder and a twisted body.



45

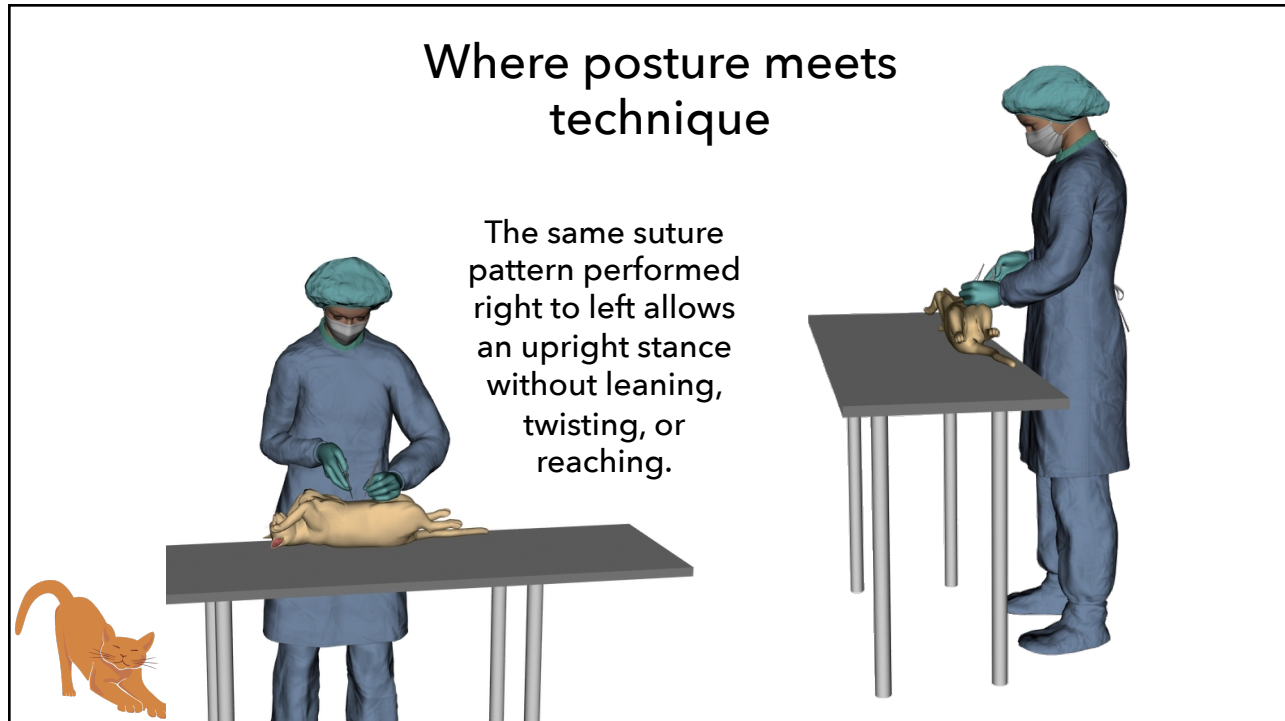
Where posture meets technique

Another view of the same incorrect technique—check out that elbow...

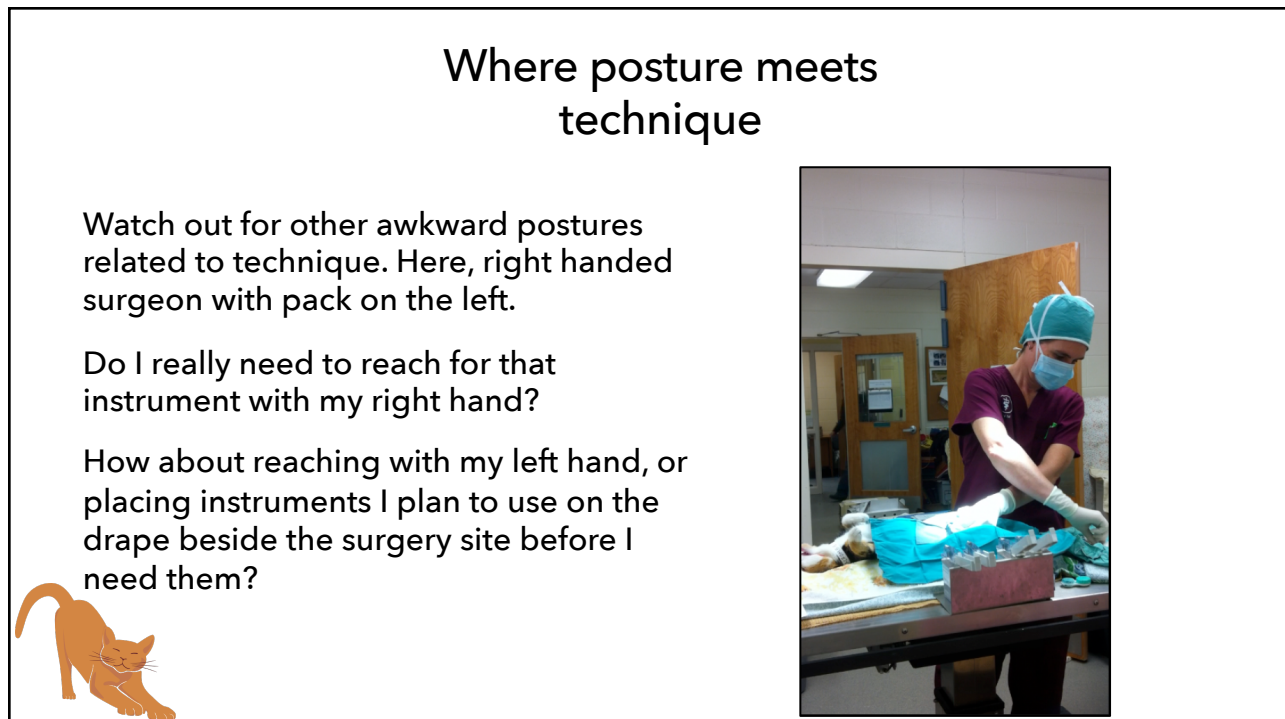
Also this is a good reason to **video (or photograph) yourself doing surgery.** You never know what you may find.



46



47



48

Instruments and Needles

- How much force does it take to close and open the ratchet on your needle holders and hemostats?
 - Aim for about 3 pounds force to close, 1 pound lateral force to open
- Thumb forceps can also be stiff and difficult to operate
- Do you have certain instruments that are more stiff or require more force?
- Applying extra force due to stiff instruments can add to the trauma of a day of repetitive motion.



49

Instruments and Needles

- Reducing the effort needed to use instruments and needles:
 - Good instrument cleaning and processing
 - Sharpen scissors and needle holders when they get dull
 - Discard needles once they become dull, so that you don't have to use extra force to penetrate the tissue
 - Your hands and the patient's tissues will thank you!
 - Purchase instruments that are not difficult to open and close



50

Posture and Movement

how body position and
movement affect pain and
fatigue...
and what you can do about it



51

Posture

Sometimes during surgery we
adopt unnecessarily awkward
postures...

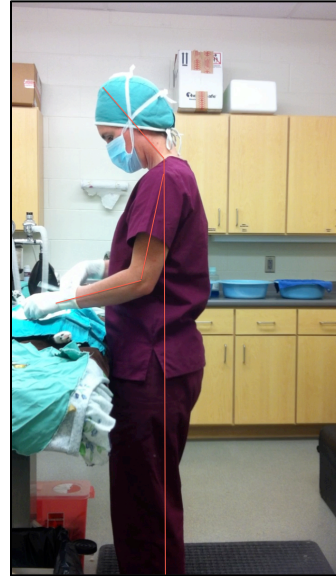
This may be due to
poor room setup
(table height, animal
position), habit, or
unawareness.



52

Posture

- Neutral posture neck angle $\leq 10^\circ$
- Surgeon neck angle often $> 20^\circ$ - 30° (here, it's nearly 40°)
- This is difficult (impossible?) to avoid during spay/ neuter (and many other) surgeries
- People with similar work, such as dentists, also have high prevalence of neck discomfort

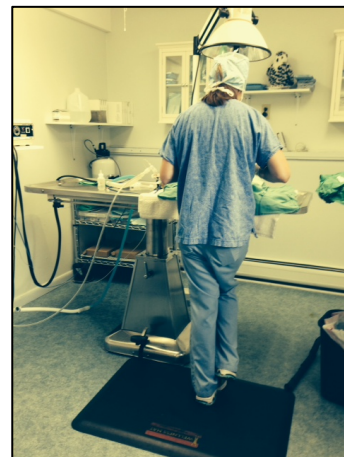


53

Posture

Asymmetrical or twisted posture can be a bad thing....

...unless you make it symmetrical over time by switching sides



54

Movement, Breaks, and "micropauses"

- Movement and changing positions during the surgery day is important to comfort
- "Micropauses" of 20 seconds every 20 minutes (or between each surgery/ every few surgeries) can reduce fatigue and discomfort, and increase accuracy
- Take 20 seconds to stretch, stand up, shake out, move around. It doesn't seem to matter what you do, only that you take that time to release the muscles you are holding.
- The benefits may be related more to the neurological "reset" than to the actual musculoskeletal results of the stretch.



Dorion, D., & Darveau, S. (2013). Do micropauses prevent surgeon's fatigue and loss of accuracy associated with prolonged surgery? An experimental prospective study. *Annals of Surgery*, 257(2), 256-259

55

Fitness: Hands, wrists, ligaments

- **Ligaments adapt** to exercise and use by increasing size, strength, and collagen content (given adequate rest and recovery time between uses)
- Surgeons in regular work may have greater resilience due to this tissue adaptation
- New surgeons (or those returning from an extended break such as a maternity leave) will not have the ligament strength and may be at greater risk for hand/ wrist injury and discomfort.
- Consider having a lighter schedule for new/ returning surgeons to allow their bodies to become conditioned to the work.



Solomonow, M. (2009). Ligaments: A source of musculoskeletal disorders. *Journal of bodywork and movement therapies*, 13(2), 136-154.

56

Fitness: Overall

- Physical activity outside of work is known to be associated with lower prevalence of pain
- Surgeons who are physically active experience less fatigue due to work
- For people experiencing low back pain, maintaining daily activities as much as possible is associated with quicker recovery from symptoms
- Staying physically fit, maintaining friendships outside of work, eating well, and maintaining a work-life balance are all ways to reduce work-related musculoskeletal discomfort and stress.



57

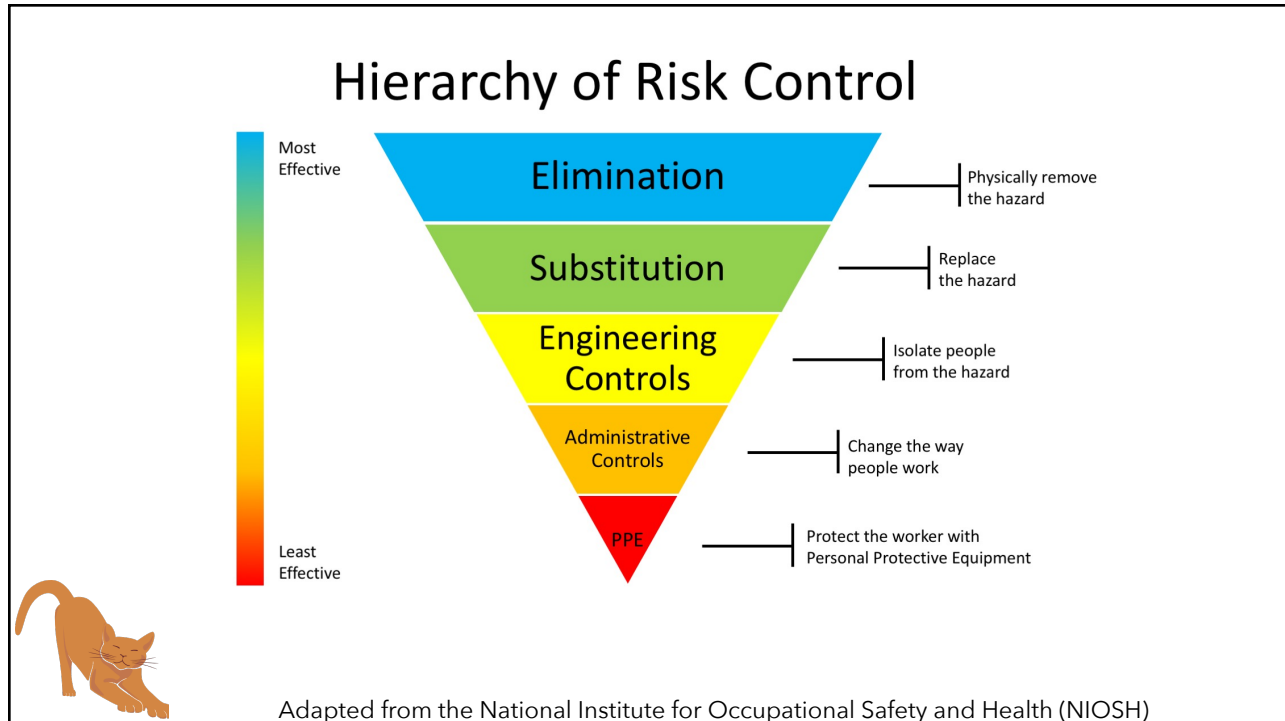
Perioperative Ergonomics

Examples of ergonomic risks in the veterinary workplace

- Lifting and carrying (animals and supplies)
- Prolonged standing or prolonged sitting
 - including vehicle driving
- Handling and Restraining animals
- Repetitive manual tasks
 - Drawing up drugs
 - Injections
 - Clipping and prepping
- Computer use
- Phone use
- Noise




58



59

Perioperative Ergonomic Risks: Patient Restraint

- May have to get down on the floor or lean over the table
- May have to hold tight against wiggling
- Animal may twist or evade- can cause your fingers/ wrist/ arm to twist
- Possibility of bites and scratches
- **Plan: Learn appropriate restraint techniques, and use equipment or protection when necessary**



60

Perioperative Ergonomic Risks: Lifting and Carrying

Modify the risks of lifting and carrying by modifying:

- Weight of load
- Distance of your hands from your lower back
- Height of lift (From floor or from above knee height? How high do you need to lift?)
- Twisting and side bending
- Working in a restricted space
- Good grip, or irregular, bulky, floppy, unpredictable load
- Flooring condition (dry, clean, good condition, or wet or uneven)
- Communication and coordination when lifting as a team



61

Perioperative Ergonomic Risks

- **Repetitive manual tasks**
 - Drawing up drugs
 - Injections
 - Clipping and prepping
- These tasks may require a combination of **repetitive** movements that can at times require **force**, or may be performed with **awkward positioning** of the hands and wrists
- Alone, each of these factors (repetition, force, posture) is only moderately associated with pain in the hand and wrist
- When combined, the association with hand/wrist pain is strong



62

Force plus repetition

- Force = muscular effort
- May be as simple as using a heavy tool throughout the day
- Example: animal clippers
 - One pound difference may not seem like much...until you have to prep 30+ animals, 5 days a week with them
 - Worse if you are using awkward hand/wrist position to hold them



1.1 pounds

2 pounds



63

Awkward hand/wrist position plus repetition

- Awkward position = any time that your wrist is extremely flexed, extended, rotated, or bent.
- Take-away message:
 - Force and awkward position can be OK if they are not combined and repeated.



64

MacGyver Ergonomics

Shop Vac hose suspended from the ceiling. How does this help?

- Now, staff don't have to bend down to pick up vacuum hose
- Hose is no longer a trip hazard on the floor
- Staff don't have to hold vacuum with a bent wrist- instead can lower with wrist straight



65

MacGyver Ergonomics



- With spray bottles, staff must repeatedly squeeze the trigger
- This type of motion, repeated often, may be a factor in carpal tunnel and tennis elbow



- Once the Hudson sprayer is pressurized, staff can spray disinfectant by holding a trigger- no repeated squeezing

66



MacGyver Ergonomics

- A volunteer uses a plastic child's sled with a rope attached to pull a feral cat trap across the parking lot. (A summer clinic might use a wagon instead)



67

Dental Ergonomics

- Ergonomics has been an important issue in human dentistry
- Many of the same ergonomic issues face those performing dental work on small animals

Cause	Number (%)
Musculoskeletal	104 (55%)
Mental and behavioral disorders	54 (28%)
Nervous system/sense organs	17 (9%)
Circulatory	4 (2%)
Neoplasms	3 (2%)
Other	7 (4%)

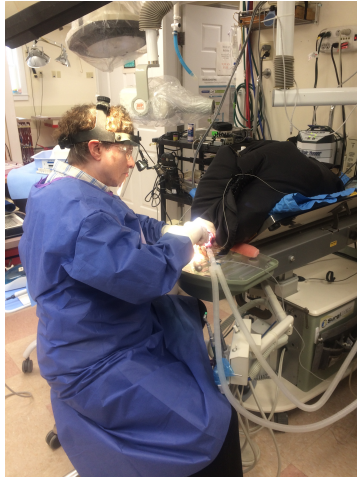
<http://www.posturedontics.com>

Brown, J., Burke, F. J., Macdonald, E. B., Gilmour, H., Hill, K. B., Morris, A. J., . . . Murray, K. (2010). Dental practitioners and ill health retirement: causes, outcomes and re-employment. *Br Dent J*, 209(5), E7. doi:10.1038/sj.bdj.2010.813



68

Dental Suite with good ergonomics

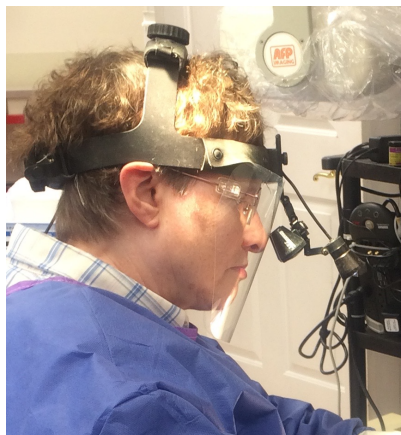


- Adjustable height table with space for knees beneath
- Saddle stool
- Appropriate lighting
 - Adjustable ceiling-mounted task light
 - Head lamp
- Magnification Loupes



69

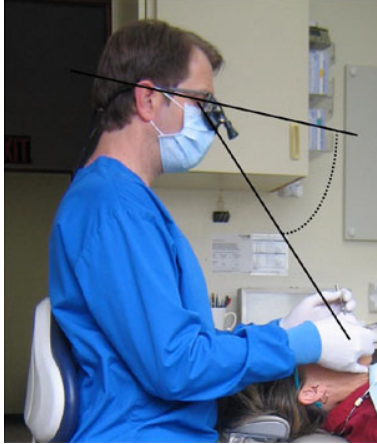
Close-up



- Flip-up magnification loupes and LED light on a headband
- Magnification loupes angled downward to decrease neck angle
 - Flip-up loupes allow greater angle than through-the-lens
 - Greater angle = less neck angle
- Face shield attached to glasses




70



- Magnifying loupes declination angle

<http://www.dentalcompare.com/Featured-Articles/1956-Ergonomic-Must-haves-in-the-New-Dental-Office/>



71

Adjust table height with task

Table lower while suturing lower arcade

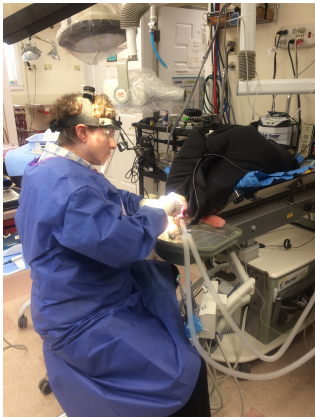




Table elevated to suture upper arcade



72

Human dental students using different chairs

Dental student using a standard chair



Dental student using a saddle-shaped chair



Gandavadi, A., Ramsay, J.R.E., & Burke, F.J.T. (2007). Assessment of dental student posture in two seating conditions using RULA methodology - a pilot study. *Br Dent J*, 203(10), 601-605.

73

Saddle chairs- many styles (and prices) to choose from



74

Dental instruments

Risky

- Tight grasp
- Pinch grasp
- Small diameter instrument shaft
- Force during use
- Unchanging position and grasp style
- Instrument vibration
- Excessive glove tightness



Better

- Use thicker diameter instruments to improve grasp
- Regular instrument sharpening to reduce required force
- Choose textured handles to enhance grip without excessive force
- Alternate between different types of patients, instruments, and angles
- Order multiple glove sizes so all staff have appropriate size

75

Dental instruments



- Add silicone grips to instruments to enhance grip

- It's not just the instruments; it's how you use them. Avoid extreme hand and wrist postures while working to avoid injury



http://www.dimensionsofdentalhygiene.com/2013/10_October/Features/Healthy_Hands.aspx



76

Questions?

Visit **ergovet.com** to review this information and more on ergonomics in veterinary medicine

