Working Through the Risks of Manual Materials Handling

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Produced By:

CCOHS CCHST

Canadian Centre for Occupational Health and Safety | Centre canadien d'hygiène et de sécurité au travail

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- Who we are:
  - A federal not-for-profit corporation
  - Governed by a council representing:
    - Workers
    - Government
    - Employers

- Our mandate:
  - Promotion of the total well-being of working Canadians.

Canadian Centre for Occupational Health & Safety (CCOHS)

- What we offer:

  - Training and education
  - H&S management systems
  - Access to various databases (chemical and legislative)
  - Guide books and publications
  - Podcasts
  - Other special projects

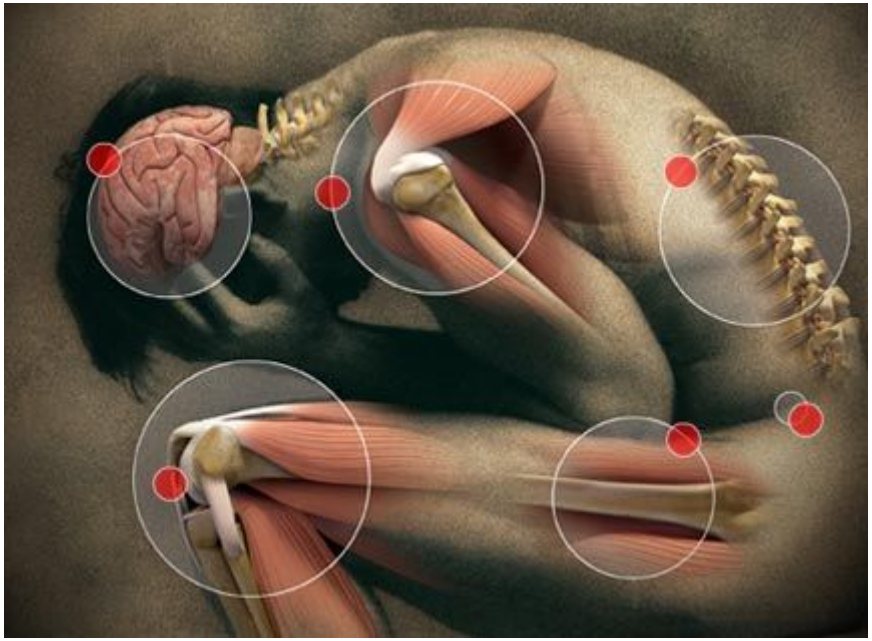
Overview

- *Introduction*
  - *Defining the term "Musculoskeletal Disorder"*
  - *The musculoskeletal system*
- *Physical Demands*
  - *Criteria*
- *How Do Injuries Occur*
  - *Tolerance vs Demands*
- *Assessment Tools*

Introduction

Musculoskeletal Disorders (MSDs)

- A musculoskeletal disorder (MSD) is when there is some sort of damage to a part of the musculoskeletal system.



Introduction

The Musculoskeletal System Consists of:

- Bones
- Cartilage
- Muscles
- Tendons
- Ligaments
- Nerves

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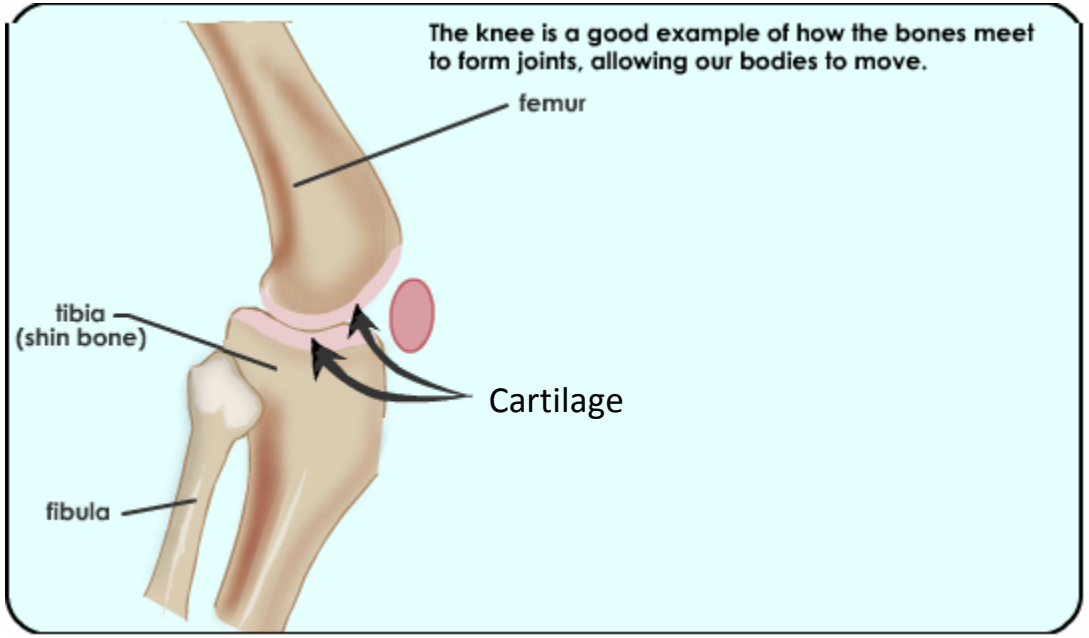

Courtesy of http://kidshealth.org/parent/general/body_basics/bones_muscles_joints.html#

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Courtesy of http://www.mybwmc.org/library/3/100225

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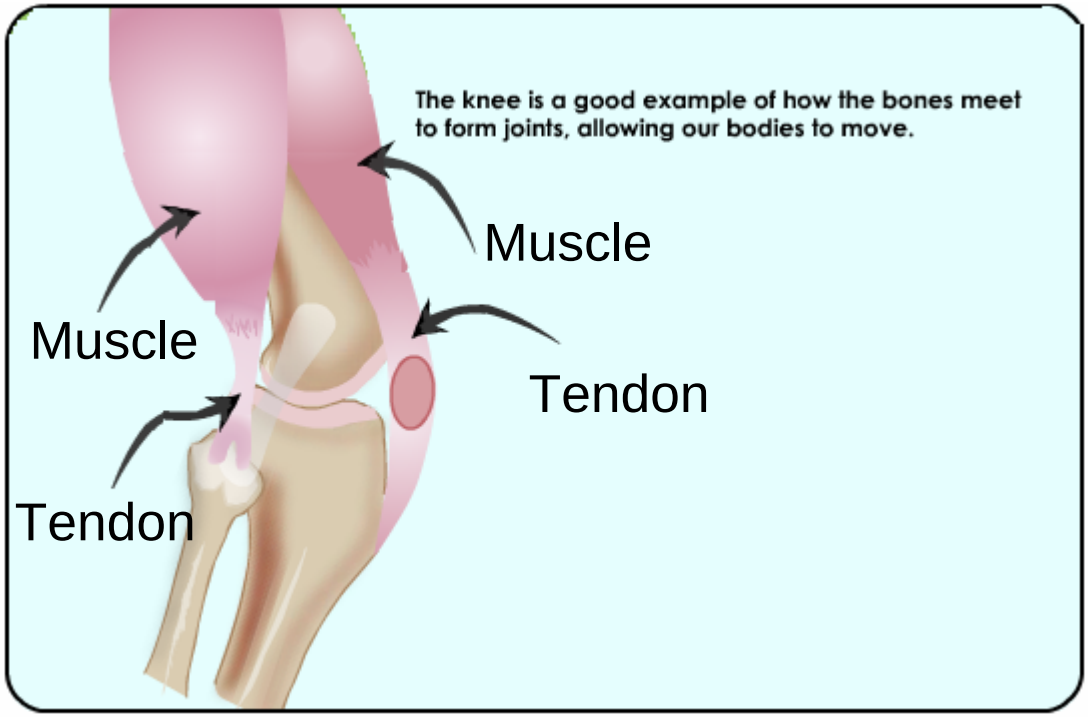

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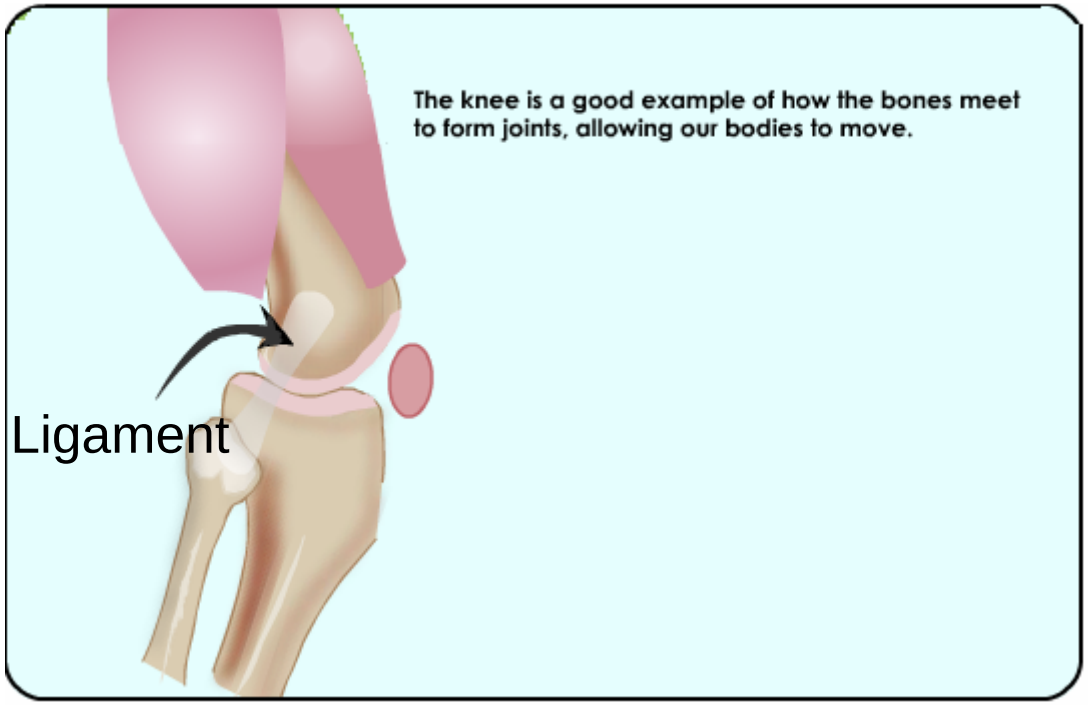

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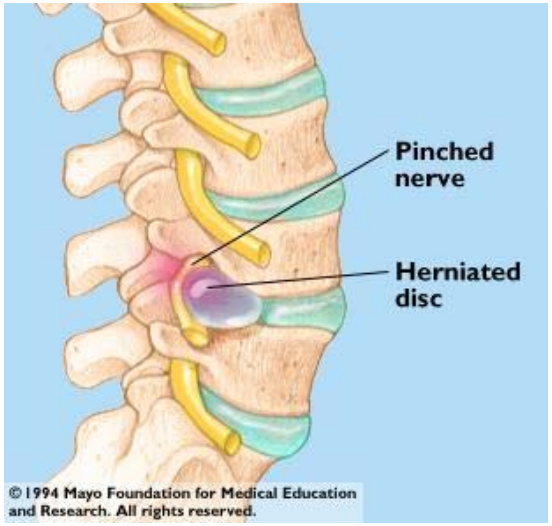
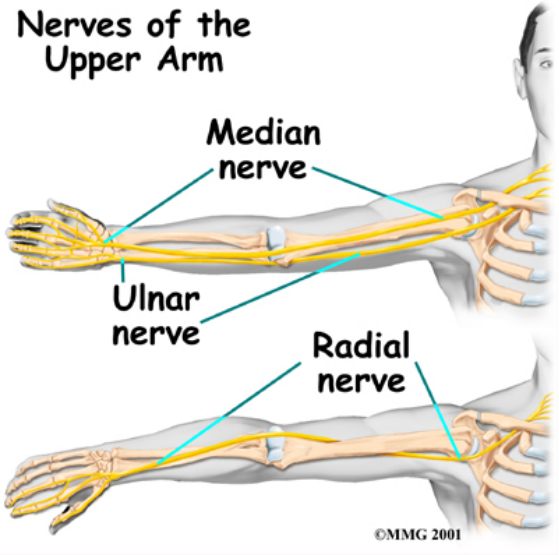




Introduction

Now that we understand what our musculoskeletal system consists of, we need to know how work places demands on these parts of our bodies.

Physical Demands

Main Criteria:

- Force and Contact Stress
- Repetition
- Fixed or awkward body positions
- Environmental Factors

Physical Demands

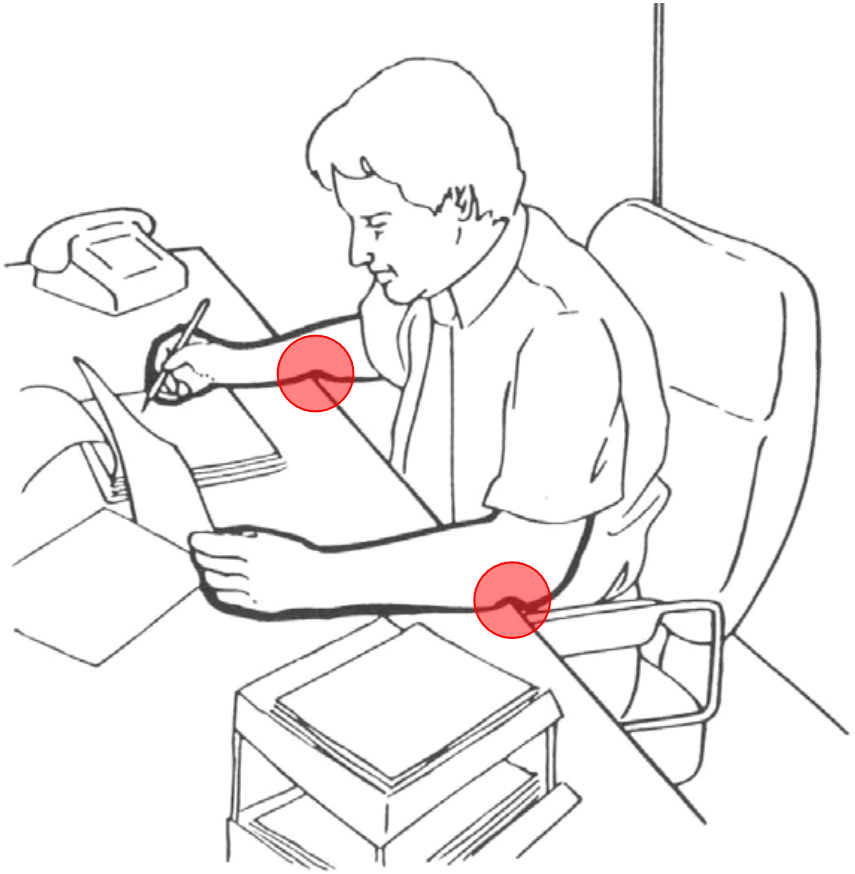
Force:

- When you exert pressure on something, pressure is placed back onto your body.

Physical Demands

Contact Stress

- Contact between the body and hard or sharp work objects.
- Stress intensifies with
  - Little padding
  - Small contact area
  - Long duration



Physical Demands

Repetition:

- Repetition – using the same body parts without giving them a chance to rest

- Repetition is defined using three variables:
  - Frequency
  - Duration
  - Intensity

- Movements are bundled into cycles

Physical Demands

Repetition:

- Cycle of movements
  - Reach for bottles
  - Grasp bottles
  - Move bottles to box
  - Place bottles in box

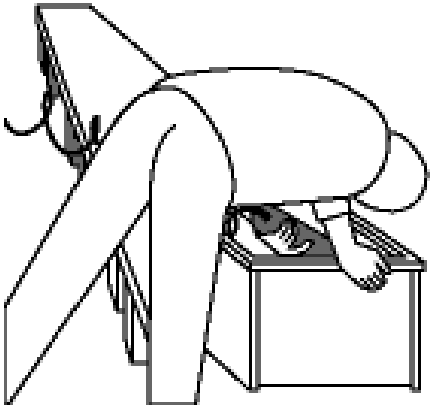
Physical Demands

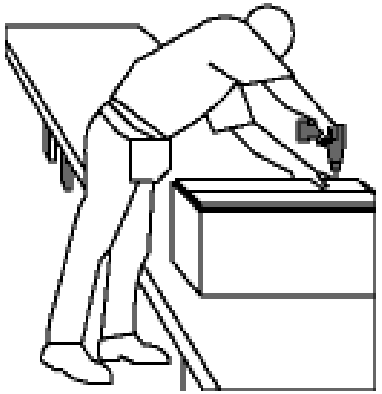
Posture:

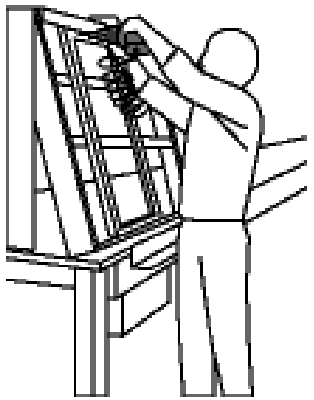
- Posture simply refers to body positions
- Posture falls into two categories:
  - Good, or “ideal”
  - bad or “awkward”

Physical Demands

Posture:

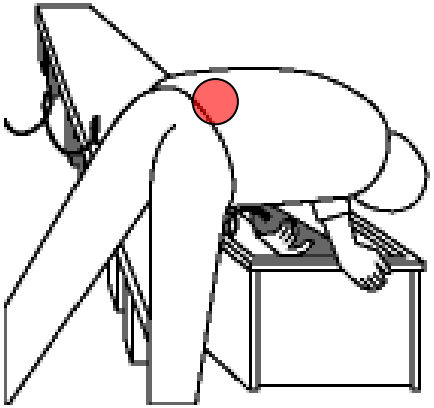


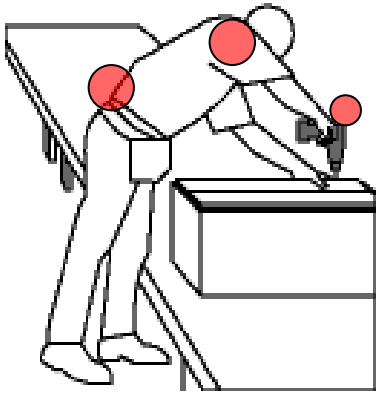


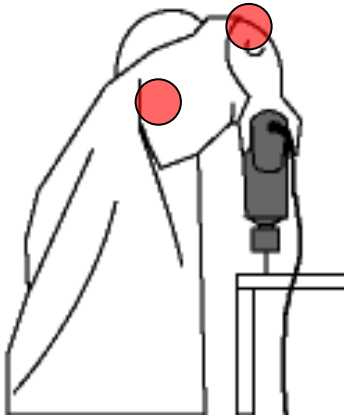


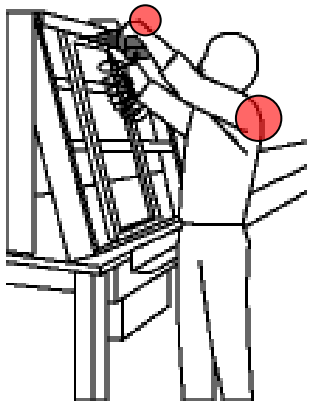
Physical Demands

Posture:





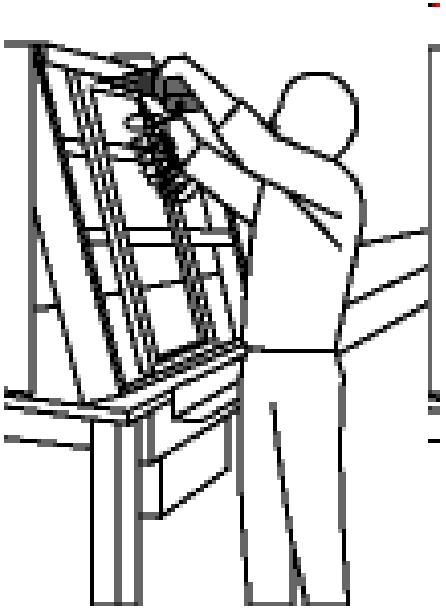




Physical Demands

Posture: Static Loading

- Holding body positions for extended periods of time
  - Muscles are kept tense
  - Blood flow is restricted
  - Rate of local muscle fatigue increases



Physical Demands

Environmental Factors: Lighting, Temperature, Vibration

- Lighting
  - Postures
- Temperature
  - Lack of feeling
- Vibration
  - Whole body
  - Hand-arm

Physical Demands

Quantifying Physical Demands:

- Force and Contact Stress
- Repetition
- Fixed or awkward body positions
- Environmental Factors

How Injuries Occur

Tolerance < Demands

How Injuries Occur

Musculoskeletal Disorders (MSDs)

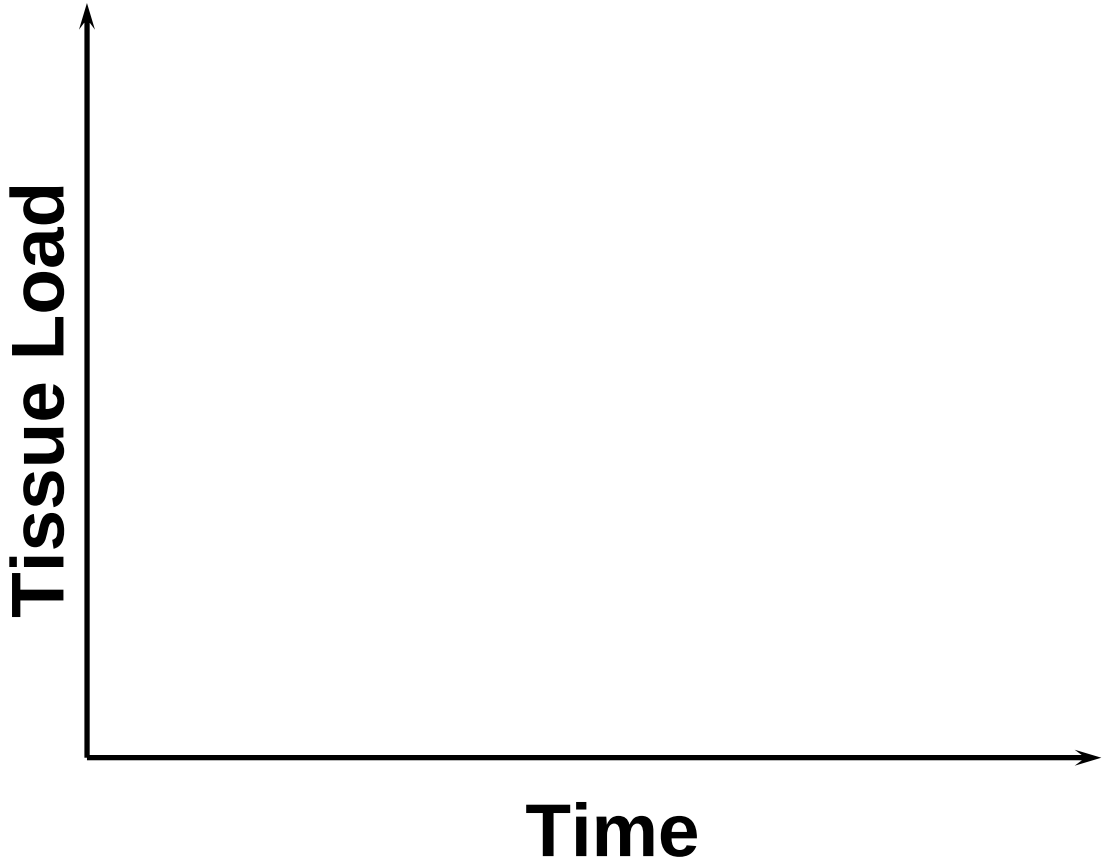
Development

- Cumulative Loading - slowly (weeks, months or years).
  - Wear and tear over time

- Peak Loading – After a single particularly taxing event.
  - One time exertion

How Injuries Occur

Musculoskeletal Disorders (MSDs) – Cumulative Loading



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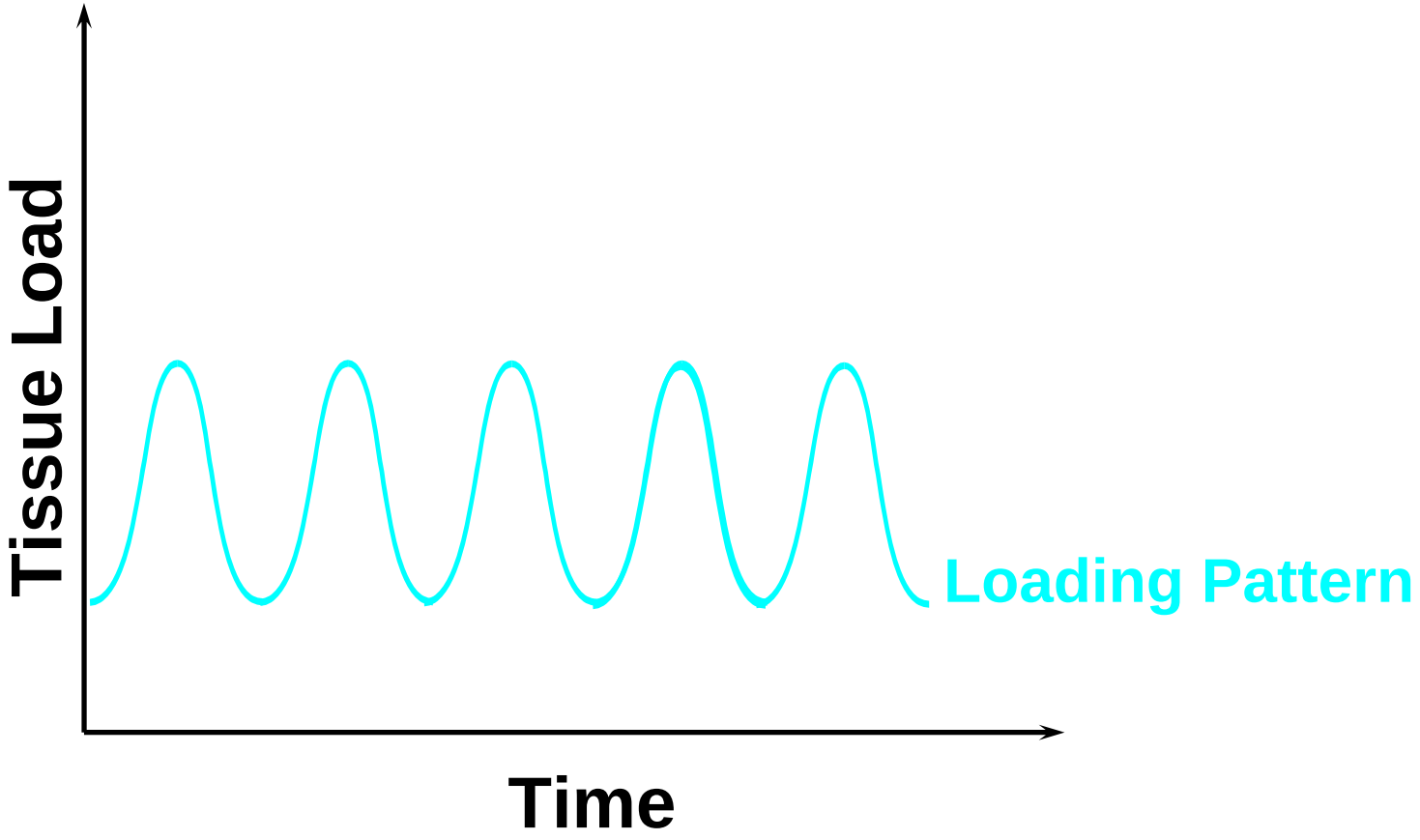

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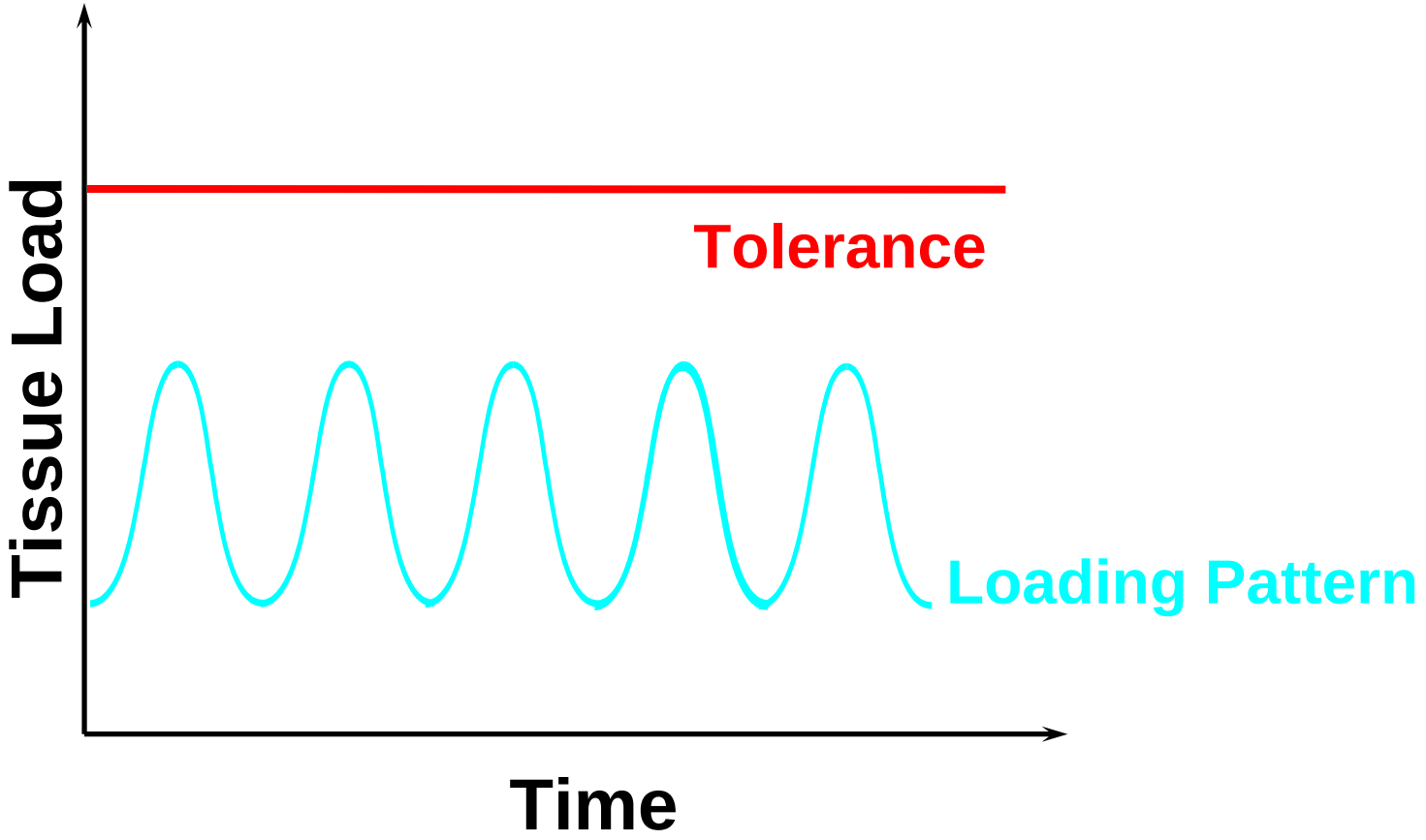

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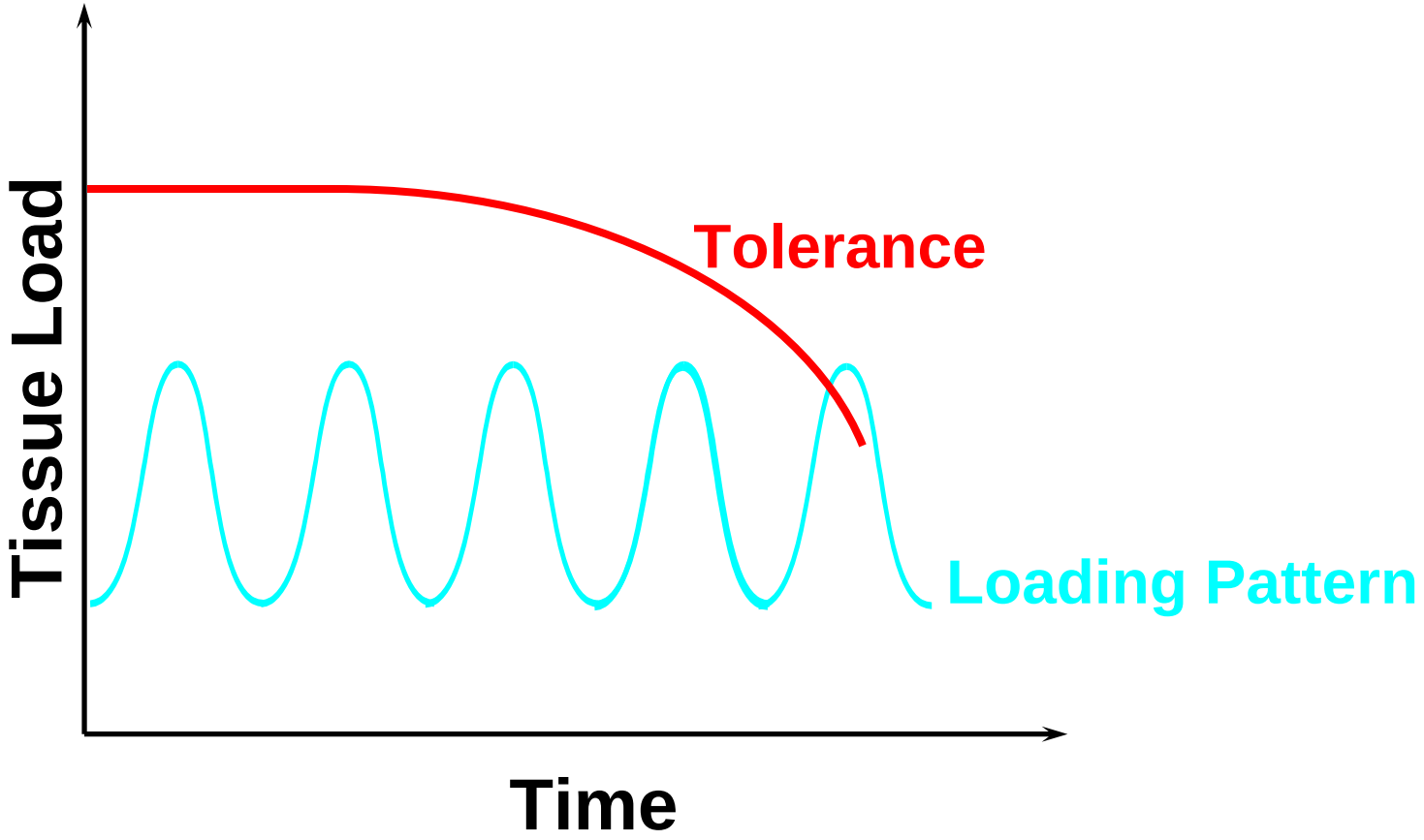

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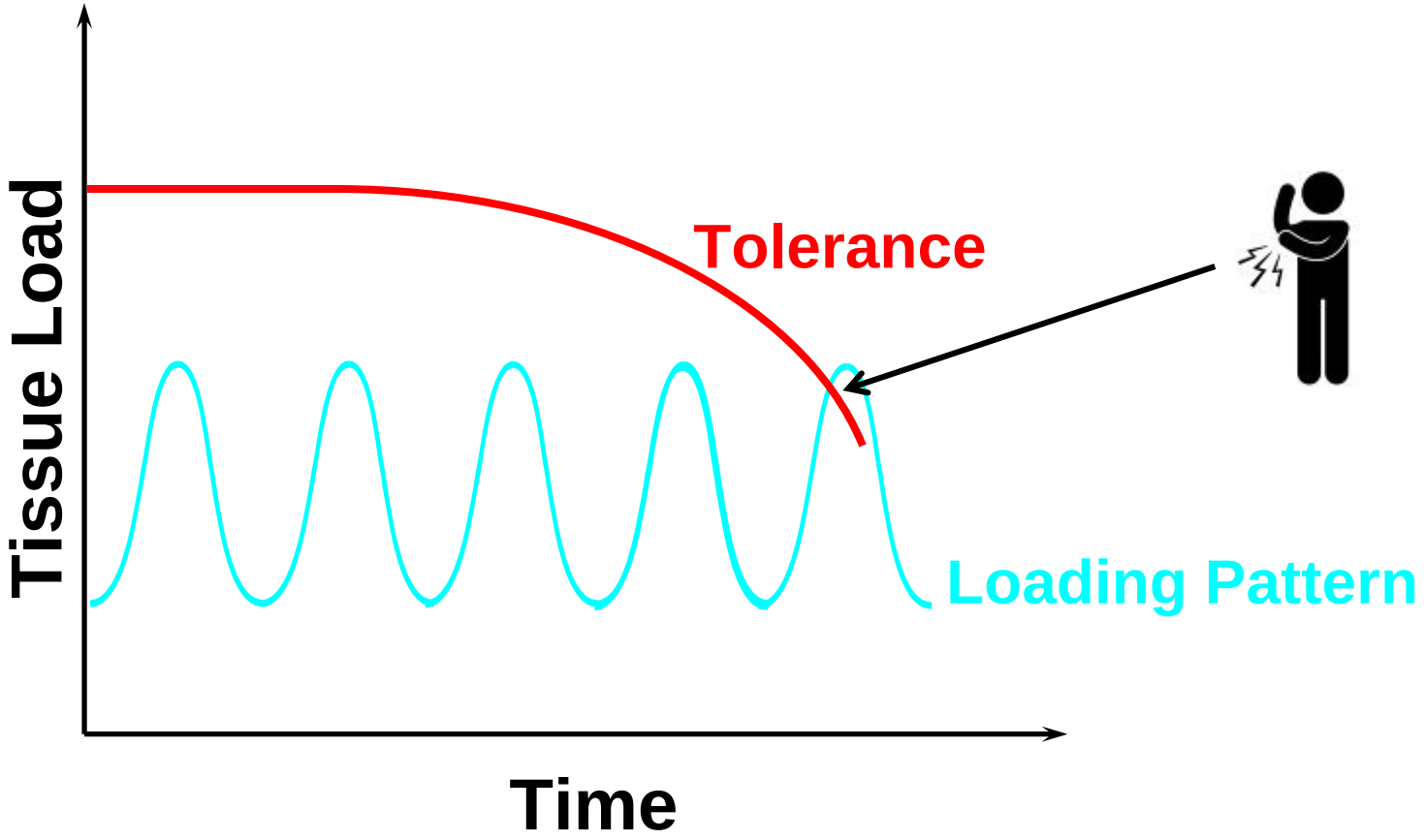

How Injuries Occur

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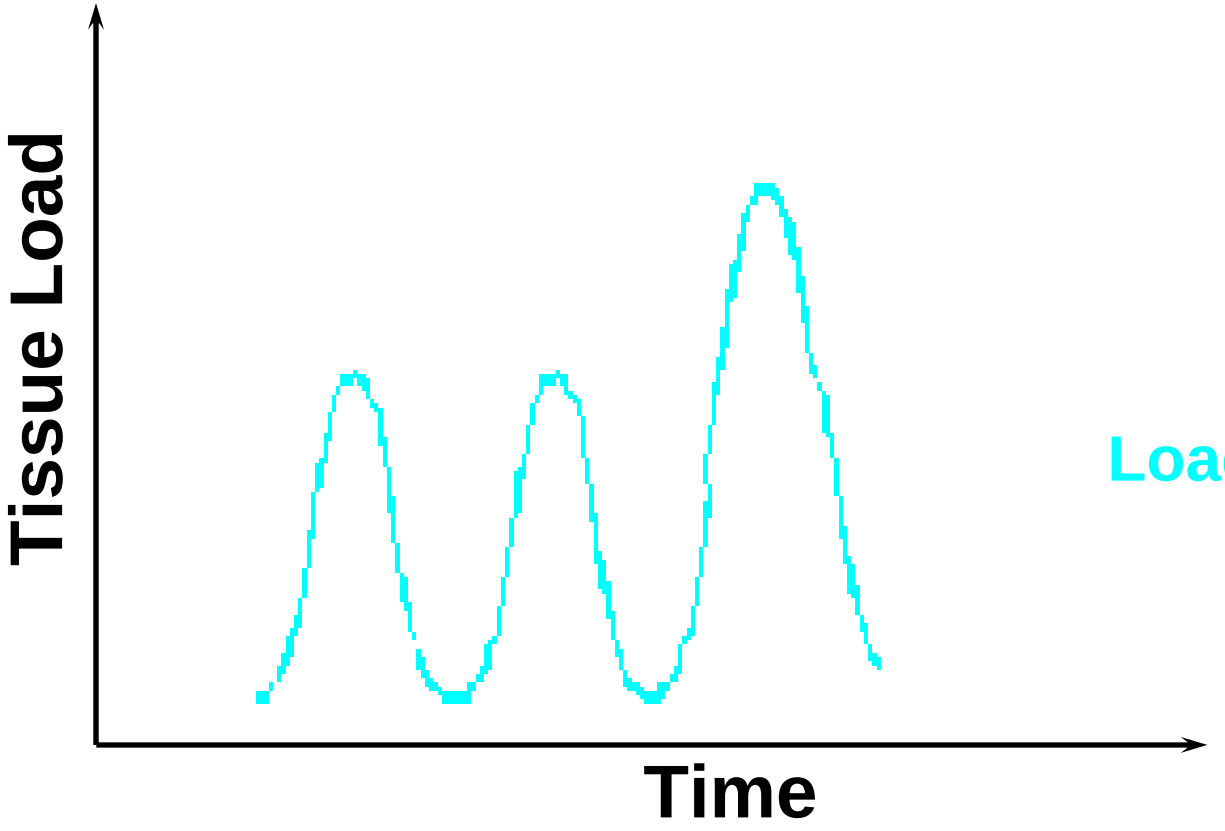

How Injuries Occur

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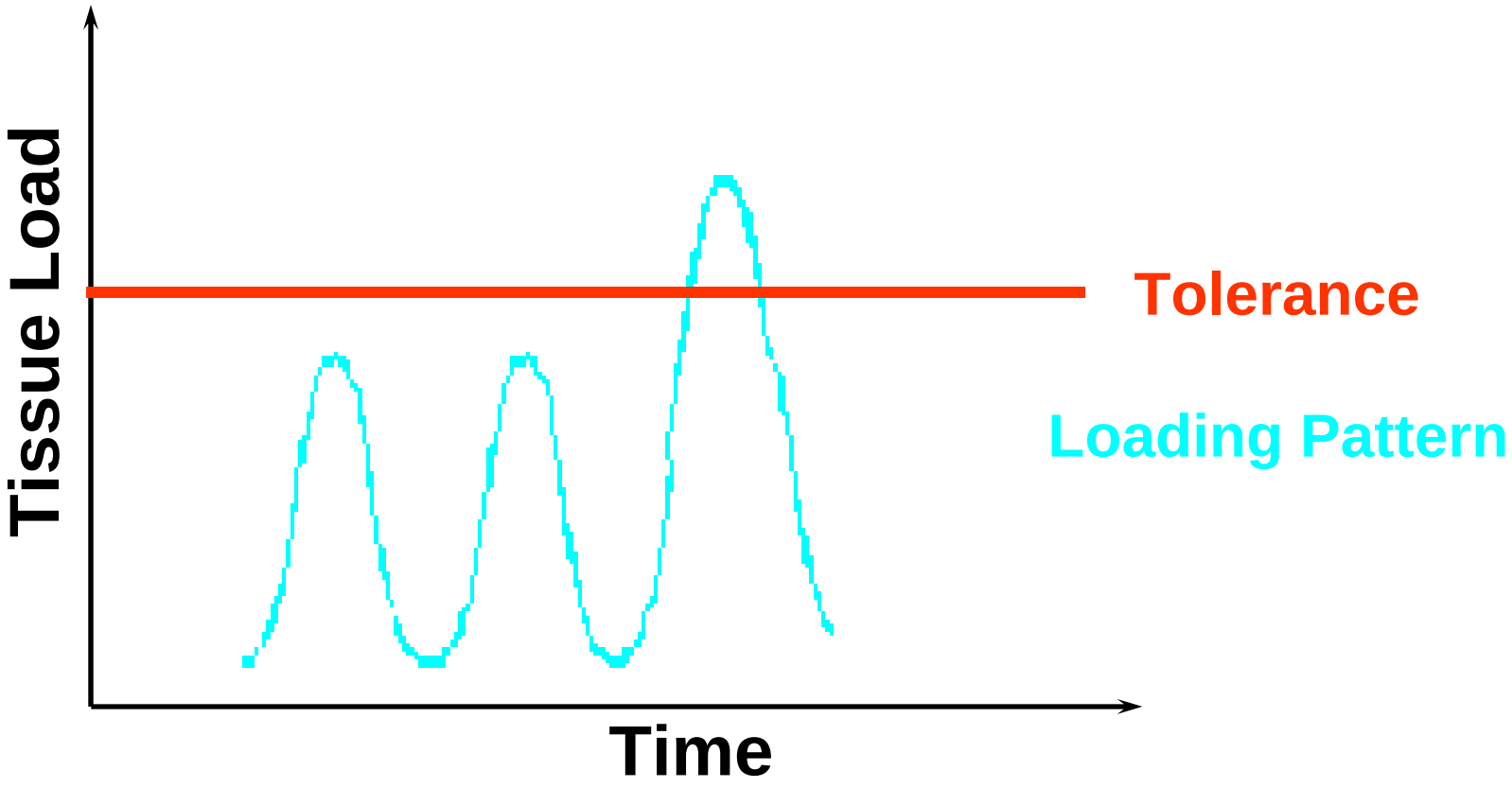

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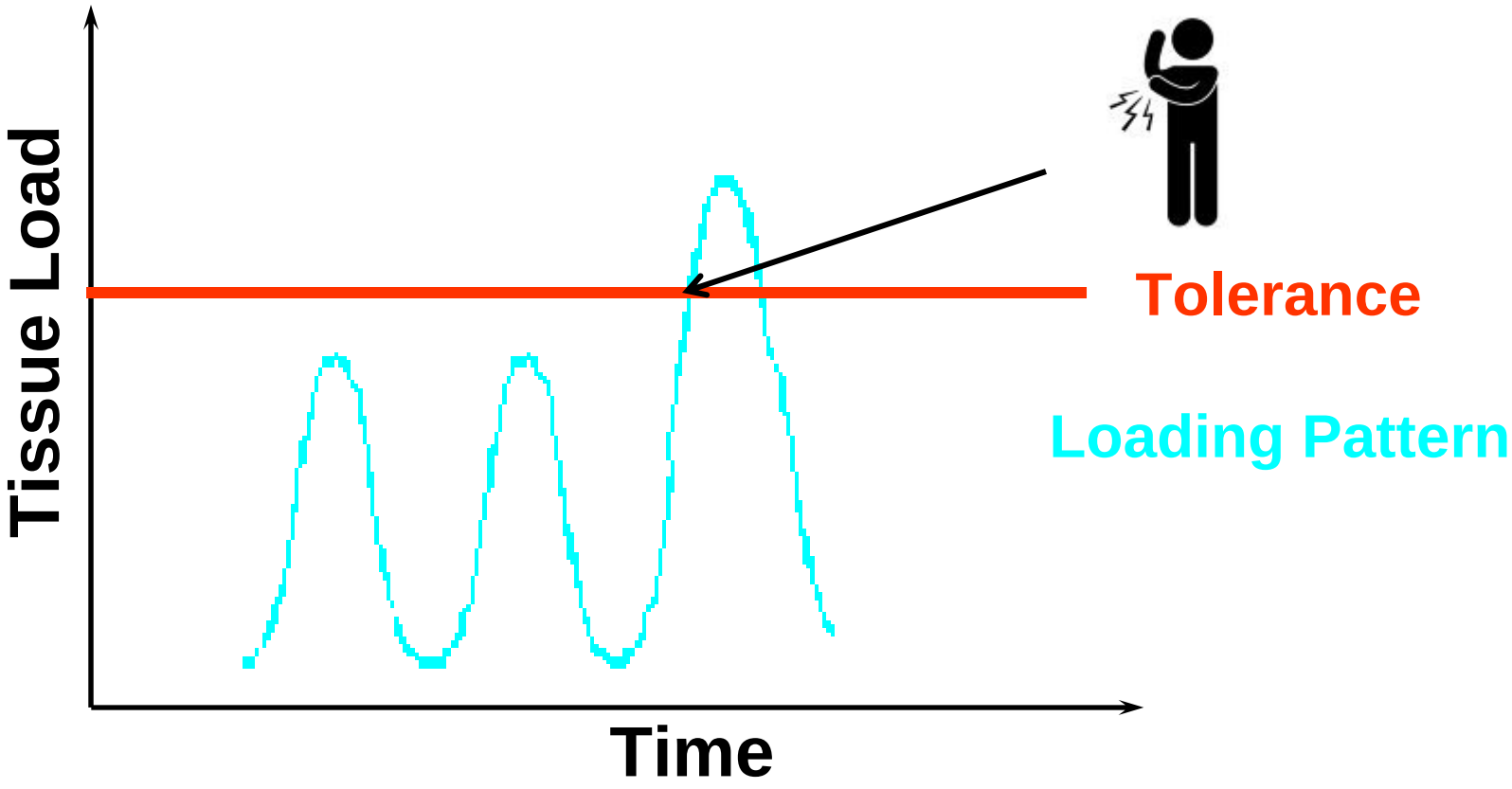


Where to begin?

Now that we know the basic way in which physical demands are placed upon individuals, and how injuries occur, we just need a tool to help guide our assessments.

Where to begin?

There are lots of options:

- RULA and REBA
  - Designed for unpredictable postures in health care
  - http://personal.health.usf.edu/tbernard/HollowHills/REBA.pdf
  - http://personal.health.usf.edu/tbernard/HollowHills/RULA_r1.pdf
- Rodgers Muscle Fatigue Index
  - Assessment of amount of fatigue in muscles during 5 min. of a work pattern.
  - http://personal.health.usf.edu/tbernard/HollowHills/Rodgers_MFA_M20.pdf
- Washington State Tools
  - Hazard and Caution Zone Checklists and Lifting Calculator http://www.lni.wa.gov/Safety/Topics/Ergonomics/ServicesResources/Tools/default.asp
  - Cost calculator: http://www.pshfes.org/Resources/Documents/Ergonomics_cost_benefit_calculator_instructions.pdf
- Liberty Mutual Manual Materials Handling Tables (Risk to the back)
  - http://libertymmhtables.libertymutual.com/CM_LMTablesWeb/taskSelection.do?action=initTaskSelection

Where to begin?

Tools continued…

- NIOSH Lifting Equation (assessing who can lift)
  - http://www.ccohs.ca/oshanswers/ergonomics/niosh/assessing.html
- Worksafe BC auto calculators (Lifting/lowering, pushing/pulling)
  - http://www2.worksafebc.com/calculator/llc/default.htm
  - http://www2.worksafebc.com/ppcc/default.htm
- MAC and ART Tools (Lifting, Carrying, Team Lifting, Seated Work)
  - http://www.hse.gov.uk/pubns/indg383.pdf
- European Agency for Safety and Health (Lifting, Carrying, Team Lifting, Seated Work)

HSE's Approach

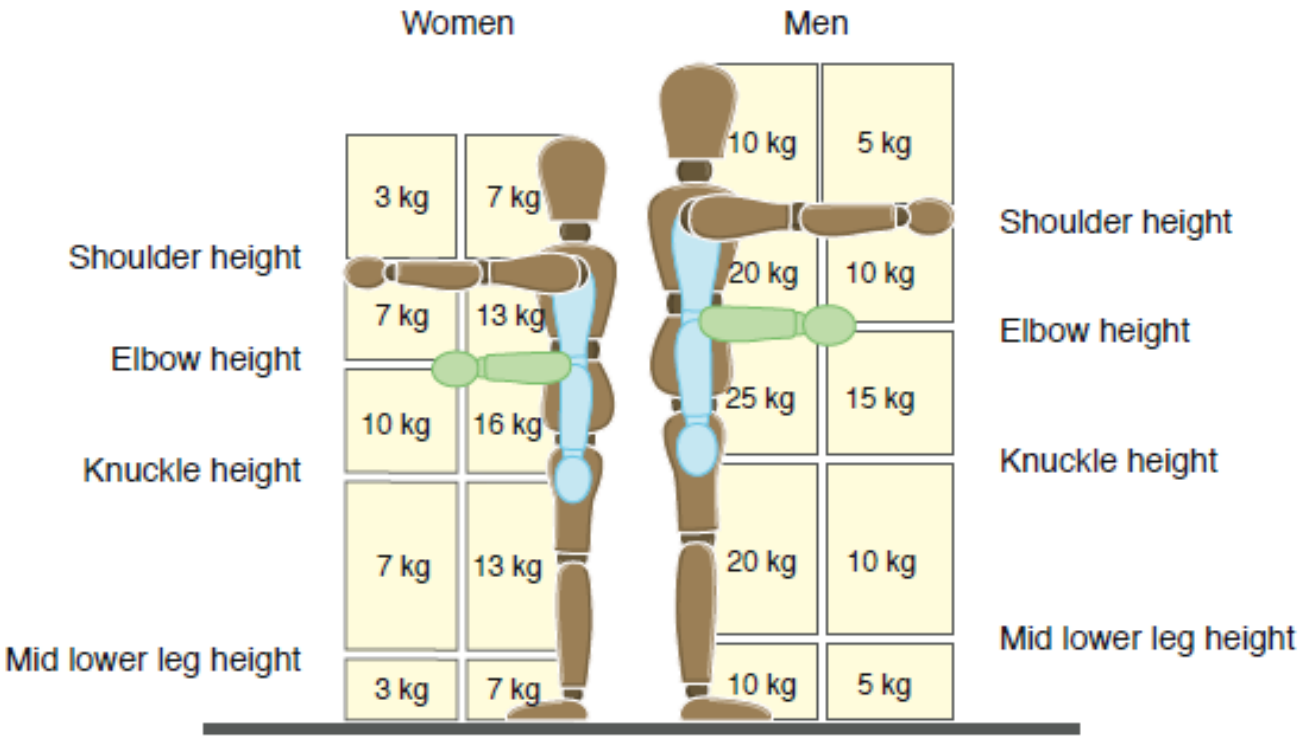
Risk filters exist for various Manual Handling activities:

- Lifting, Lowering, and Carrying
- Pushing and Pulling
  - Guidance based on load weight being pushed
  - Should be altered for slope
- Seated handling
  - Different guidance values for men and women

HSE's Approach

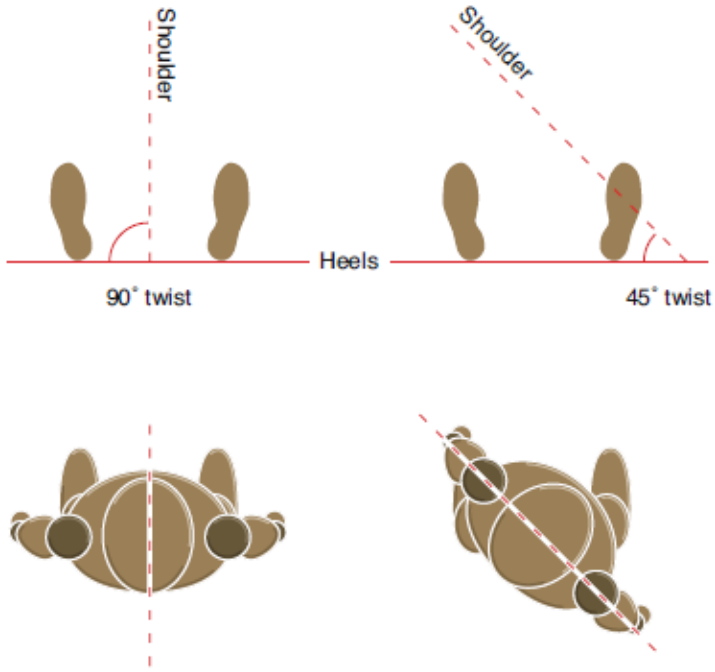
Step 1:

Use of Risk Filters. This is the filter for lifting tasks.



HSE's Approach

Reduction of lifting lowering limits due to twisting and high frequency activities



Twisting:

- reduce limits by 10% if twisting 45^0 or more,
- reduce limits by 20% if twisting 90^0 or more

HSE's Approach

Task:.....			
Activity	For each activity, does the task fall outside the guidelines? Y/N	Are there any other considerations which indicate a problem? Y/N (Indicate what the problem is, if desired.)	Is a more detailed assessment required? Y/N
Lifting and lowering			
Carrying			
Pushing and pulling			
Handling while seated			

HSE's Approach

The use of risk filters should not be considered lifting/carrying/pushing/pulling limits!

These are only used to differentiate between high risk and low risk activities. This will help you use your time more wisely.

Once the high risk activities are taken care of, you should go back and try to improve the other activities.

HSE's Approach

Step 2: Complete a full assessment.

Part of the full assessment can be done with the MAC tool:

- Step 1: Load and Frequency
- Step 2: Posture:
  - Arm distance
  - Trunk twisting and asymmetry
- Step 3: Room to move
- Step 4: Grip
- Step 5: Environment

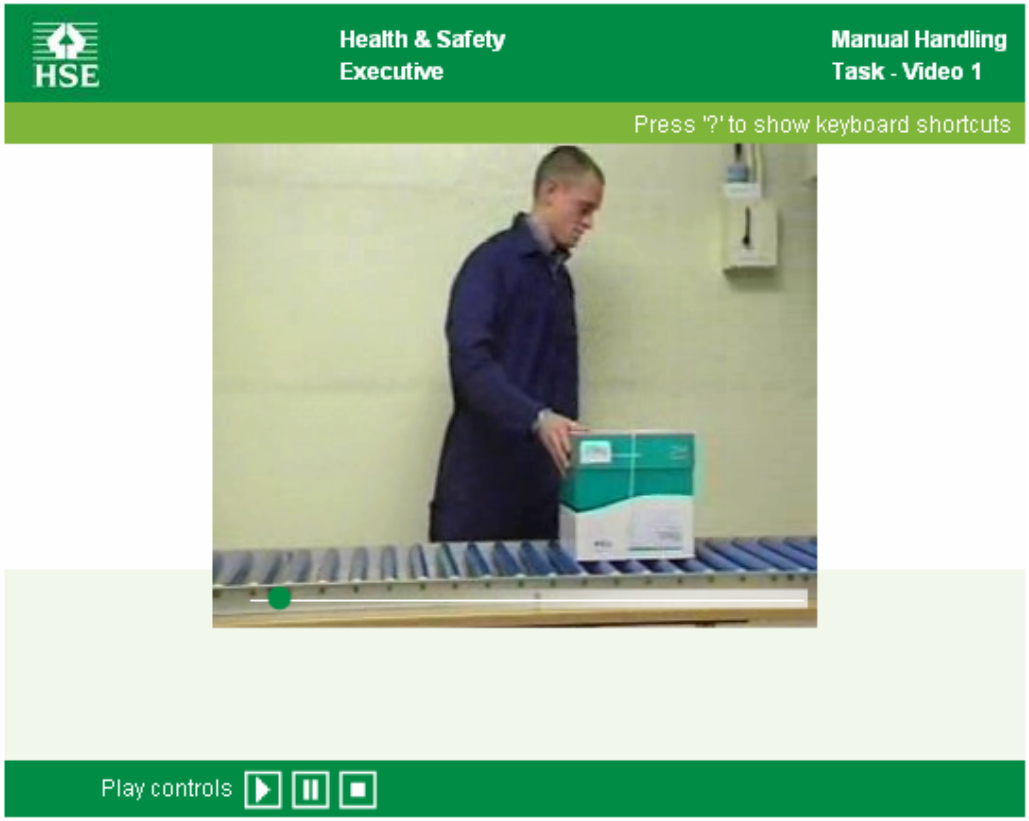
HSE's Approach

Insert the colour band for each of the risk factors in the boxes below, referring to your assessment using the tool.

Risk Factors	Colour Band (G, A, R, or P)			Numerical Score		
	Lift	Carry	Team	Lift	Carry	Team
Load weight and lift/carry frequency						
Hand distance from the lower back						
Vertical lift region						
Trunk twisting/sideways bending Asymmetrical trunk/load *(carrying)*						
Postural constraints						
Grip on the load						
Floor surface						
Other environmental factors						
Carry distance *(carrying only)*						
Obstacles en route *(carrying only)*						
Communication and co-ordination *(team handling only)*						
			Total Score	0	0	0

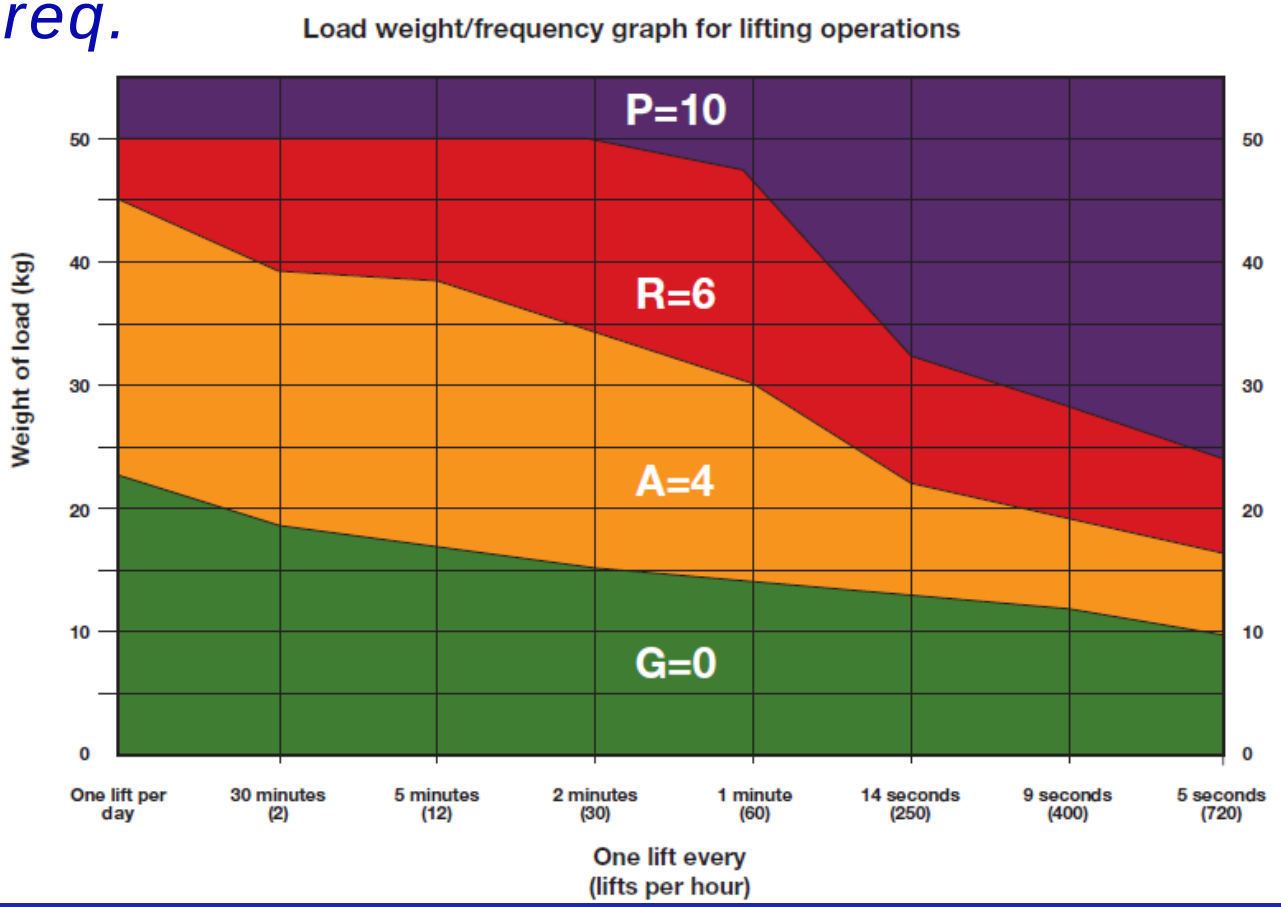
Example

Assume 2 hours per day.



HSE's Approach

a.) Load/Freq.



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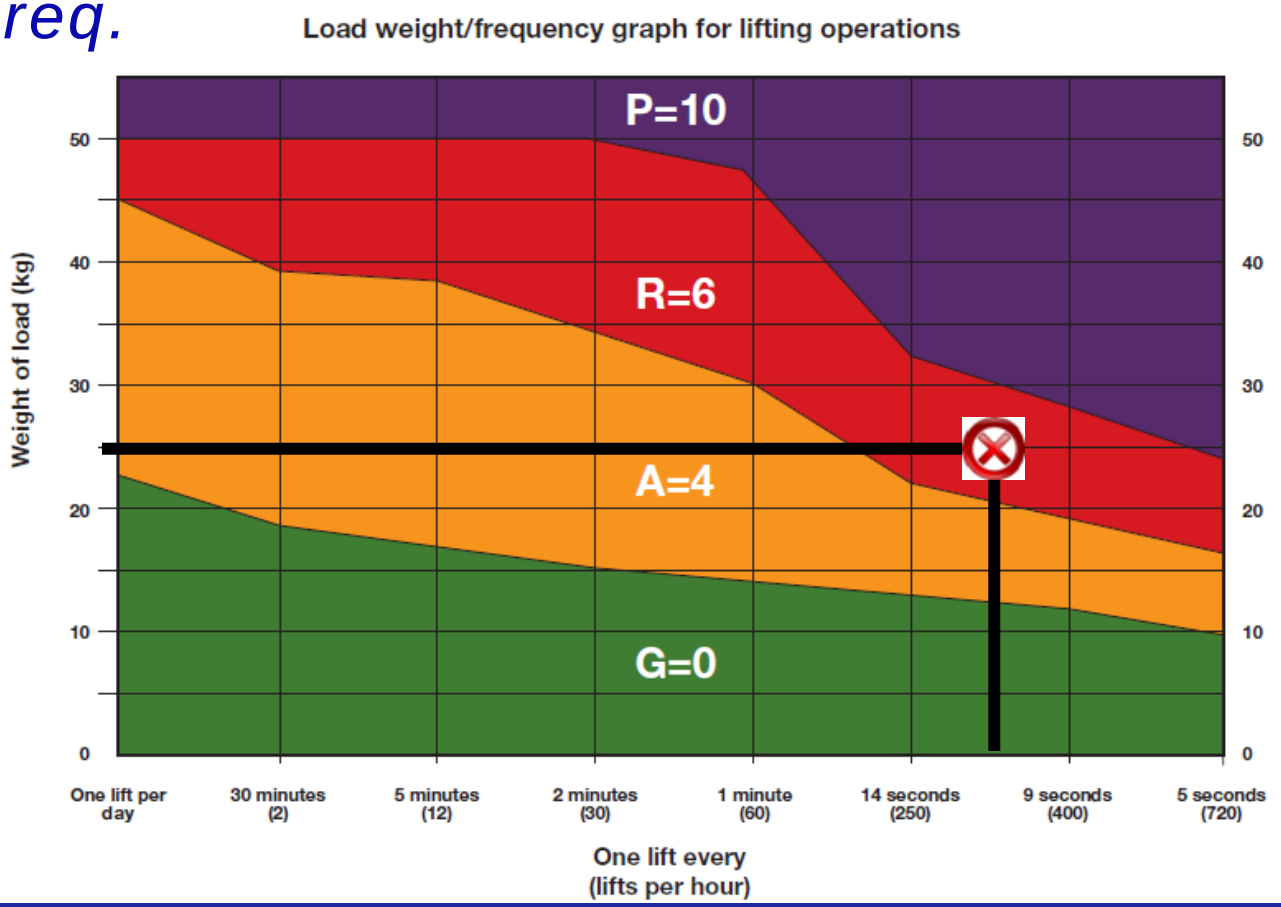


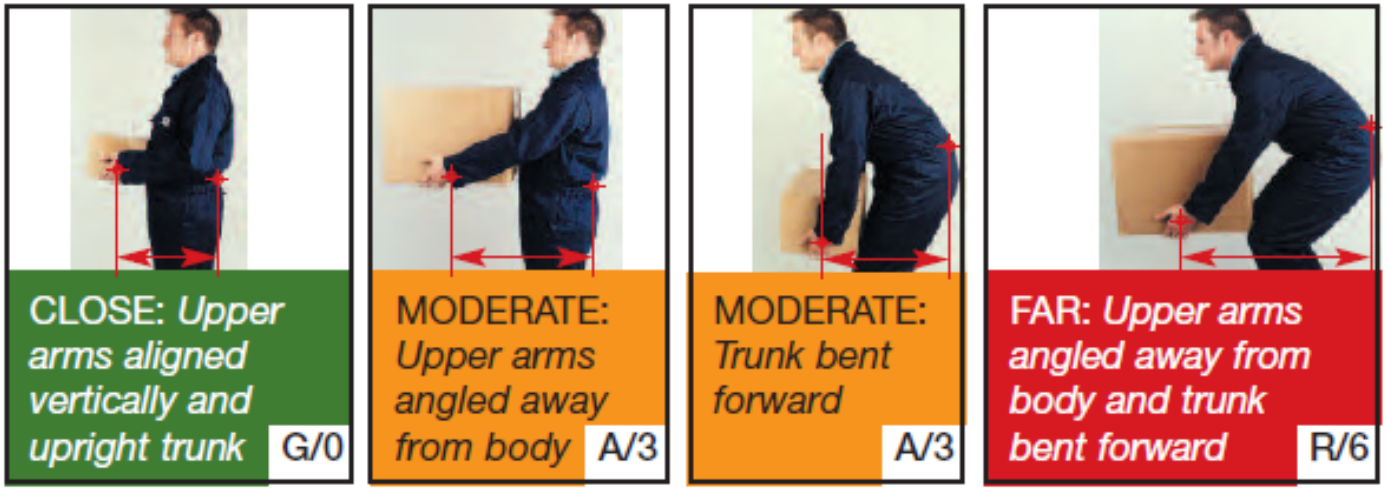
HSE's Approach

Insert the colour band for each of the risk factors in the boxes below, referring to your assessment using the tool.

Risk Factors	Colour Band (G, A, R, or P)			Numerical Score		
	Lift	Carry	Team	Lift	Carry	Team
Load weight and lift/carry frequency	Red			6		
Hand distance from the lower back						
Vertical lift region						
Trunk twisting/sideways bending Asymmetrical trunk/load *(carrying)*						
Postural constraints						
Grip on the load						
Floor surface						
Other environmental factors						
Carry distance *(carrying only)*						
Obstacles en route *(carrying only)*						
Communication and co-ordination *(team handling only)*						
			Total Score	6	0	0

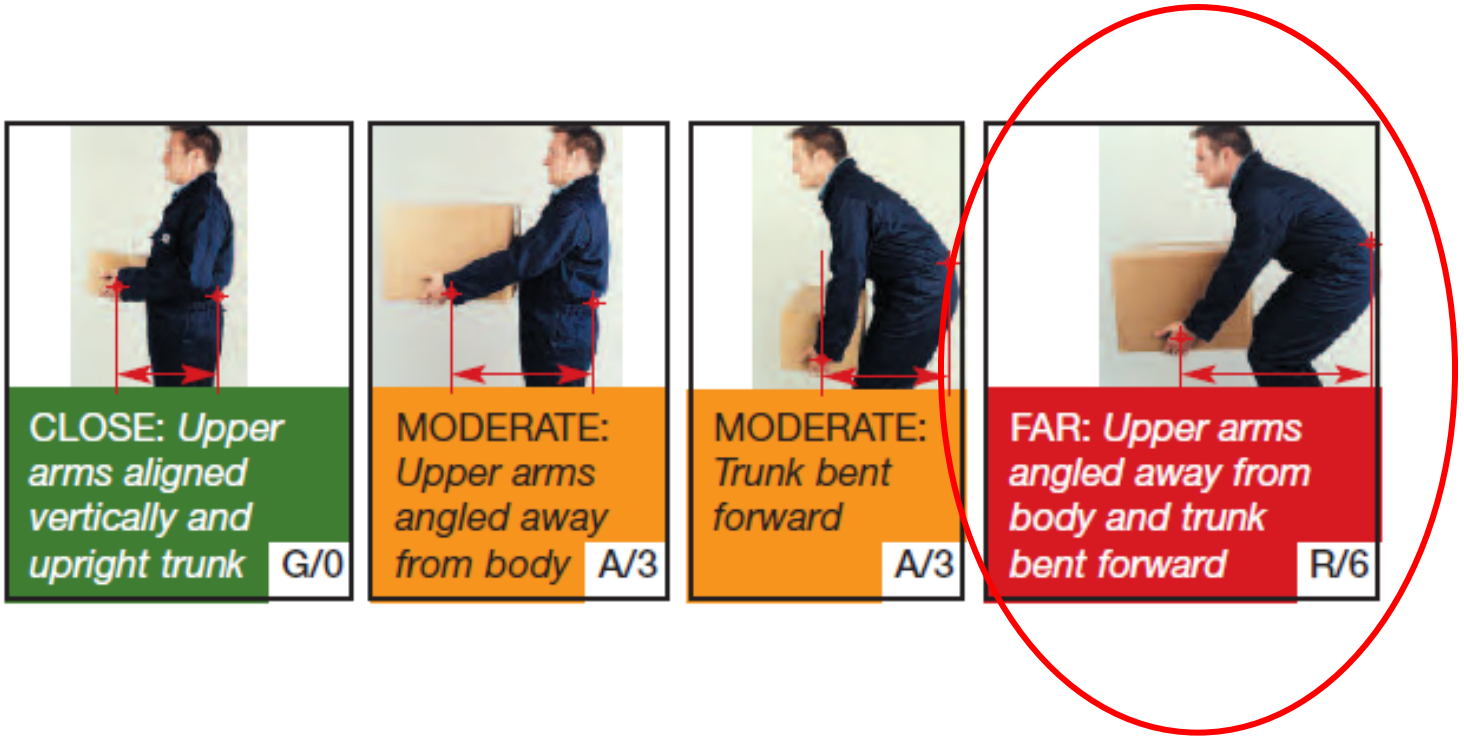
HSE's Approach

b.) Horizontal arm distance.



HSE's Approach

b.) Horizontal arm distance.



HSE's Approach

c.) Vertical arm distance.

HSE's Approach

c.) Vertical arm distance.

HSE's Approach

Insert the colour band for each of the risk factors in the boxes below, referring to your assessment using the tool.

Risk Factors	Colour Band (G, A, R, or P)			Numerical Score		
	Lift	Carry	Team	Lift	Carry	Team
Load weight and lift/carry frequency	Red			6		
Hand distance from the lower back	Red			6		
Vertical lift region	Red			3		
Trunk twisting/sideways bending Asymmetrical trunk/load *(carrying)*						
Postural constraints						
Grip on the load						
Floor surface						
Other environmental factors						
Carry distance *(carrying only)*						
Obstacles en route *(carrying only)*						
Communication and co-ordination *(team handling only)*						
		Total Score		15	0	0

HSE's Approach

d.) Trunk twisting and bending

- Twisting or lateral bending only – amber with a #1
- Twisting and lateral bending – red with a #2

e.) Postural Constraints

- No restriction – green and #0
- Restricted movement – amber and #1
- Severe restriction – red and #3

HSE's Approach

Insert the colour band for each of the risk factors in the boxes below, referring to your assessment using the tool.

Risk Factors	Colour Band (G, A, R, or P)			Numerical Score		
	Lift	Carry	Team	Lift	Carry	Team
Load weight and lift/carry frequency	Red			6		
Hand distance from the lower back	Red			6		
Vertical lift region	Red			3		
Trunk twisting/sideways bending Asymmetrical trunk/load *(carrying)*	Red			2		
Postural constraints	Amber			1		
Grip on the load						
Floor surface						
Other environmental factors						
Carry distance *(carrying only)*						
Obstacles en route *(carrying only)*						
Communication and co-ordination *(team handling only)*						
			Total Score	18	0	0

HSE's Approach

g.) Grip on load

GOOD G/0	REASONABLE A/1	POOR R/2
Containers with well-designed handles or handholds, fit for purpose	Containers with poor handles or handholds	Containers of poor design. Loose parts, irregular objects, bulky or difficult to handle
Loose parts enabling comfortable grip	Fingers to be clamped at 90 degrees under the container	Non-rigid sacks or unpredictable loads

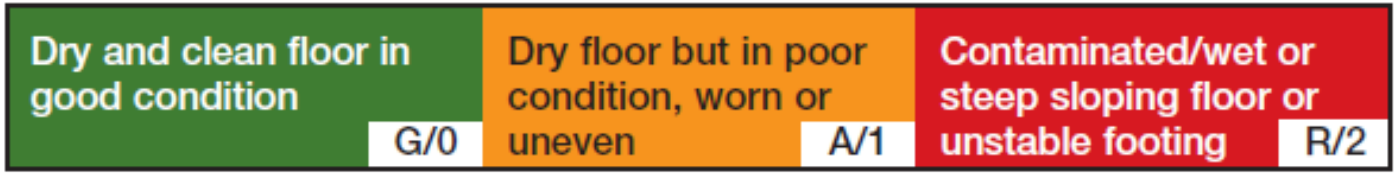
HSE's Approach

g.) Grip on load

GOOD G/0	REASONABLE A/1	POOR R/2
Containers with well-designed handles or handholds, fit for purpose	Containers with poor handles or handholds	Containers of poor design. Loose parts, irregular objects, bulky or difficult to handle
Loose parts enabling comfortable grip	Fingers to be clamped at 90 degrees under the container	Non-rigid sacks or unpredictable loads

HSE's Approach

h.) Floor Surface



i.) Environmental

- Extremes in temperature, strong air movement or poor lighting – score 1
- More than one risk factor – score 2

HSE's Approach

Insert the colour band for each of the risk factors in the boxes below, referring to your assessment using the tool.

Risk Factors	Colour Band (G, A, R, or P)			Numerical Score		
	Lift	Carry	Team	Lift	Carry	Team
Load weight and lift/carry frequency	Red			6		
Hand distance from the lower back	Red			6		
Vertical lift region	Red			3		
Trunk twisting/sideways bending Asymmetrical trunk/load *(carrying)*	Red			2		
Postural constraints	Amber			1		
Grip on the load	Amber			1		
Floor surface	Green			0		
Other environmental factors	Green			0		
Carry distance *(carrying only)*						
Obstacles en route *(carrying only)*						
Communication and co-ordination *(team handling only)*						
			Total Score	19	0	0

HSE's Approach

Summary of MAC tool results:

Overall score: 19

Risk Factors	Score	Reason
Load weight	R = 6	Definite red as clearly in the R=6 category. **Possible load weight solutions**
Hand distance from lower back	R = 6	Poor, not really to do with the environment but more poor lifting technique. **Possible hand distance from lower back solutions**
Vertical lift	R = 3	Lifting from floor level when taking from bottom layer of pallet **Possible vertical list solutions**
Trunk twisting / sideways bending	R = 2	Lots of twisting and sideways bending **Possible trunk twisting / sideways bending solutions**
Postural constraint	A = 1	Slightly restricted between the conveyor, rear wall and pallet **Possible postural constraint solutions**
Grip on load	A = 1	Fingers are clamped at 90° **Possible grip on load solutions**
Floor Surface	G = 0	No problems

European Agency for Safety and Health at Work's Approach

What do they do?

- Work with government, employers and workers to promote risk prevention culture.
- Analyze scientific research and statistics on workplace risk
- Anticipate new and emerging risks
- Identify and share information, good practices, and advice.

European Agency for Safety and Health at Work's Approach

Assessment methodology similar to HSE's approach

- Perform a screening assessment – observational prioritization.
- Perform a more in depth assessment for activities that are high risk in the screen assessment.

European Agency for Safety and Health at Work's Approach

Key-Indicator-Method (KIM)

- Based on a dose model: duration multiplied by intensity. Takes biomechanical, metabolic and individual aspects into account.

- Individual sheets available for
  - Lifting, holding, and carrying
  - pushing and pulling

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Key-Indicator-Method (KIM) – Lift, Hold, Carry

- Step 1: Identify time risk rating
- Step 2: Identify weight risk rating
- Step 3: Identify posture risk rating
- Step 4: Identify working conditions
- Step 5: Evaluate total risk

- Worksheet

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1st step: Determination of time rating points *(Select only one column !)*

Lifting or displacement operations (< 5 s)		**Holding** (> 5 s)		**Carrying** (> 5 m)	
Number on working day	**Time rating points**	*Total duration on working day*	**Time rating points**	*Overall length on working day*	**Time rating points**
< 10	1	< 5 min	1	< 300 m	1
10 to < 40	2	5 to 15 min	2	300 m to < 1km	2
40 to < 200	4	15 min to < 1 hr	4	1 km to < 4 km	4
200 to < 500	6	1 hrs to < 2 hrs	6	4 to < 8 km	6
500 to < 1000	8	2 hrs to < 4 hrs	8	8 to < 16 km	8
≥ 1000	10	≥ 4 hrs	10	≥ 16 km	10
Examples: • *laying bricks,* • placing *workpieces into a machine* • *taking boxes out of a container and putting them onto a conveyor belt*		*Examples:* • *holding and guiding a cast iron slug while working on a wheel stand,* • *operating a hand grinding machine,* • *operating a weed-eater*		*Examples:* • *furniture removal,* • *delivering scaffolding parts to a building site*	

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Time Rating Calculation

- Calculation based upon 1 lift every 9 – 14 seconds
  - = average of 1 lift every 12 seconds.
  - = 5 lifts per minute
  - = 600 lifts in 2 hours.
  - Rating = 500 to 1000 pieces per day = "8"

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1st step: Determination of time rating points *(Select only one column !)*

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2nd step: Determination of rating points of load, posture and working conditions

Effective load[1)] for men	Load rating point	Effective load[1)] for women	Load rating point
< 10 kg	1	< 5 kg	1
10 to < 20 kg	2	5 to <10 kg	2
20 to < 30 kg	4	10 to <15 kg	4
30 to < 40 kg	7	15 to < 25 kg	7
≥ 40 kg	25	≥ 25 kg	25

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2nd step: Determination of rating points of load, posture and working conditions

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≥ 40 kg	25	≥ 25 kg	25

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Load Rating

- Each package is 25 kg.
- The person in the video is a male, therefore use the male column.
- The load score for 25 kg = "4"

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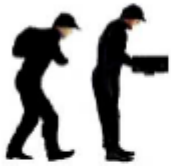
Typical posture, position of load[2)]	Posture, position of load	Posture rating point
	• Upper body upright, not twisted • When lifting, holding, carrying und lowering the load is close to body	1
	• Slightly bending forward or twisting the trunk • When lifting, holding, carrying und lowering load is near to medium to body	2
	• Low bending or far bending forward • Slightly bending forward with simultaneous twisting of trunk • Load far from the body or above shoulder height	4
	• Bending far forward with simultaneous twisting of trunk • Load far from body • Restricted stability of posture when standing • Crouching or kneeling	8

2) To determine the posture rating points the typical posture during manual handling must be used. For example when there are different postures with load a mean value must be used – not occasional extreme values.

European Agency for Safety and Health at Work's Approach

Typical posture, position of load[2)]	Posture, position of load	Posture rating point
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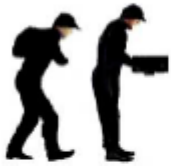	• Slightly bending forward or twisting the trunk • When lifting, holding, carrying und lowering load is near to medium to body	2
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Working Conditions Rating

- Because the individual is constricted, they are forced to twist while lifting.

- Score = "1"

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Summary of KIM tool results:

Overall Score:

- (4 + 8 + 1) x 8 = 104
- Anything above 50 is a concern!

Specific Areas of concern:

- Frequency
- Load weight
- Postures used

Comparison of Tools

MAC Tool

- Advantages
  - Visual
  - Includes grip
  - Detailed posture

- Disadvantages
  - Long
  - Only for specific activities

Comparison of Tools

MAC Tool

- Advantages
  - Visual
  - Includes grip
  - Detailed posture
- Disadvantages
  - Long
  - Only for specific activities

KIM Tool

- Advantages
  - Visual
  - Threshold scores
  - One page
- Disadvantages
  - Posture less descriptive
  - No grip considered

Comparison of Results

MAC Tool

- Problem areas:
  - Weight
  - Frequency
  - Postures

Comparison of Results

MAC Tool

- Problem areas:
  - Weight
  - Frequency
  - Postures

KIM Tool

- Problem areas:
  - Weight
  - Frequency
  - Postures

Summary

- There are a variety of methods available to assess manual material handling risk
- The choice of the method depends on the activity being performed
- Screening methods help to prioritize and focus resources.

Questions?

Contact Information:

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1-800-668-4284 (ext. 4541)

Resources

1. http://kidshealth.org/parent/general/body_basics/bones_muscles_joints.html#

2. *The Health and Safety Executive: Manual Handling Assessment Chart,* http://www.hse.gov.uk/msd/mac/

3. *The Health and Safety Executive. (2008). Manual Handling Assessment Charts. London, England.*

4. *The European Agency for Safety and Health at Work: The Kim Tool – Key Item Method.* http://osha.europa.eu/en/topics/msds/slic/handlingloads/19.htm

5. *European Agency for Safety and Health at Work. (2004).* **Risk Assessment by using Key Item Method in Practice Examples for Assessment and Answers to frequently asked Questions. Bilboa, Spain.**

Resources

6. *Chengular, S.N., Rodgers, S.H., & Bernard, T.E. (2004). Kodak's Ergonomic Design for People at Work. (2nd ed.). Hoboken New Jersey: John Wiley and Sons.*

7. *Hignett, S., McAtamaney, L. (2000) Applied Ergonomics, 31, 201 – 2005.*