REDUCING INJURY AND INCREASING OUTPUT WITH PROPER BODY MECHANICS

Edward G. Mohr, NCTM, MSIE, CPE, CSP (Ret.)

American Massage Therapy Association
National Convention – Ft. Worth, TX

September 28, 2013
Questions

1. How many years have you been doing massage?
2. Average number of massage hours/week?
3. How many suffer pain/soreness when giving a massage?
4. How many suffer pain/soreness even during off hours?
5. How many feel this pain/soreness limits the number of clients you can see in a day/week?
6. How many know a massage therapist who quit the profession due to pain?
Session Agenda

• Speaker Background
• Research – Physical & Economic Impact
• Ergonomics and Massage
• Basic Engineering Principles of Body Mechanics
• Research - Computer Modeling Approach
• Research - Field Study Approach
• Application of Body Mechanics
• Client Positioning for Optimization
• Body Mechanics Practice
• Q & A
Edward G. Mohr, NCTM, CPE, CSP (ret.)

Â 1971 IE Bachelors – GMI (Assembly Operations co-op)
Â 1976 IE Masters – UofM (specializing in Safety & Health)
Â 1977 Industrial Engineer (Advanced facilities planning & layout)
Â 1980 Supervisor: Safety, IH, Ergonomics
Â 1985 Corporate Ergonomics Development Team
Â 1990 Corporate Ergonomics Implementation
Â 1993 GM Ergonomics Laboratory
Â 2003 GM Vehicle Operations and Lab Manager
Â 2005 Retired
Â 2006 Massage Therapy Diploma (Health Enrichment Center)
Â 2006 Nationally Certified in Therapeutic Massage
Â 2008 Advanced Massage Practitioner (H.E.C.)
Â 2008 Assistant Instructor (Health Enrichment Center)
Â 2008 Mohr Massage Concepts, LLC
Â 2010 LaVida Massage Franchise (part-time)
Massage Therapist Demographics

- 267,000 massage therapists in U.S. (AMTA, 2007)
- 15% male - 85% female
- Average time spent in profession – 6.5 years
- Average age – 42 years
- Average time performing (paid) massage – 15 hr/wk
- Turnover in the profession – 20%/year
  (53,400 therapists)
The Need – Injury Data

11% of survey respondents stated avoiding injury was the top challenge facing massage therapists (AMTA, 2008).


- 56% of injuries were “sprains/strains”
- 57% of injury sources were from “worker motion/position”
- 51% of injuries were to the upper extremities (including hand/wrist)
- 16% of injuries were to the trunk
The Need – Injury Data

<table>
<thead>
<tr>
<th>Number of nonfatal occupational injuries and illnesses involving days away from work</th>
<th>Source: National Safety Council, 2006 data for Massage Therapists, based on data from the U.S. Department of Labor, Bureau of Labor Statistics (code 319010)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>Age</td>
</tr>
<tr>
<td>32% Men</td>
<td>47% 25 to 34</td>
</tr>
<tr>
<td>68% Women</td>
<td>32% 35 to 44</td>
</tr>
<tr>
<td></td>
<td>21% 45 to 54</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Injury</td>
<td>Event or Exposure</td>
</tr>
<tr>
<td>56% Strain/Sprain</td>
<td>11% Contact with Object</td>
</tr>
<tr>
<td>11% Carpal Tunnel</td>
<td>26% Overexertion</td>
</tr>
<tr>
<td>22% Soreness, Pain</td>
<td>26% Repetitive Motion</td>
</tr>
<tr>
<td>11% Other</td>
<td>37% Other</td>
</tr>
<tr>
<td>Body Part Affected</td>
<td>Hours Worked</td>
</tr>
<tr>
<td>16% Trunk</td>
<td>10% &lt; 1 hour</td>
</tr>
<tr>
<td>6% Back</td>
<td>0% 1-2 hours</td>
</tr>
<tr>
<td>6% Shoulder</td>
<td>10% 2-4 hours</td>
</tr>
<tr>
<td>35% Upr. Extremities</td>
<td>10% 4-6 hours</td>
</tr>
<tr>
<td>6% Hand</td>
<td>15% 6-8 hours</td>
</tr>
<tr>
<td>19% Wrist</td>
<td>55% Not Reported</td>
</tr>
<tr>
<td>10% Lwr. Extremities</td>
<td></td>
</tr>
<tr>
<td>n=220</td>
<td></td>
</tr>
</tbody>
</table>
The Need – Injury Data

Survey of 161 visually impaired massage therapists in Taiwan (Jang et al, 2006) found 71% suffered from work-related musculoskeletal disorders.

Prevalence rates by body part were:
- 50.3% Finger/thumb
- 31.7% Shoulder
- 28.6% Wrist
- 25.5% Neck
- 23.6% Elbow
- 20.5% Forearm
- 19.3% Back

Taken from Mosby’s Fundamentals of Therapeutic Massage, 5th Edition
The Need – Injury Data

Survey of Australian therapists (Terra Rosa, 2008)

- Most worked 10-20 hours per week
- 70% had received training in posture & self-care
- 90% were currently involved in self-care
- However, pain was reported:
  - 69% Wrist/thumb
  - 59% Neck
  - 54% Shoulder
  - 26% Lower Back

Taken from Mosby's Fundamentals of Therapeutic Massage, 5th Edition
The Need – Injury Data

Å Survey of more than 500 Canadian massage therapists (Albert, et al, 2008)

   - Most state they had received proper training in body mechanics and self-care
   - Prevalence of musculoskeletal pain:
     Å 83% Wrist/thumb
     Å 65% Lower Back
     Å 64% Shoulder

Taken from Mosby’s Fundamentals of Therapeutic Massage, 5th Edition
Economic Impact

Assumptions:
- Poor body mechanics limits the number of daily massages
- Industry average is 15 massages/week, $39 hourly wage
- Working 5 days/week (3 massages/day) for 48 weeks
- Based on above, therapist would make $28,080 /year

Proper body mechanics increases client capability:
- Adding 1 client/day = additional $9,360 = $37,440 /year
- Adding 2 clients/day = additional $18,720 = $46,800 /year
Can Proper Body Mechanics Keep You in the Profession?

Å Assistant Instructor

- 65 years old
- Averages 25-30 hours of massage / week
- Majority of clients have physical issues
- Plans to keep up her current workload for the next 10 years (age 75)
Definition of Ergonomics

A developed applied science that may be used to predict human capabilities and limitations.

When applied to the workplace it can enhance employee comfort, product quality and production efficiency.
The Problem

The harvest diseases reaped by workers in the crafts and trades they pursue, is caused by certain violent and irregular postures of the body, impairing the natural function and causing serious injury.

Ramazini
(The Father of Occupational Medicine)
1717
Scope of Ergonomics Research

Anthropometry
Biomechanics
Physiology

Cognitive
Attention, Perception, Memory
Search
Decision Making

Physical
Control
Communication
Learning

Social
Group Interactions
Scope of Ergonomics Practice

Physical
- Workplaces
- Materials Handling
- Tools
- Equipment
- Environments

Information Systems

Organizations
- Control, Competition, Cooperation
- Groups, Teams, Autonomy, Responsibility

Usability
- HCI
- Facilitators
- Icons and Labels

H16
Cognitive Ergonomics Example

WWII Cockpit

Prior design:
All gauges with Zero at the bottom

Revised design:
All gauges with Normal pointing up
Physical Job Risk Factors

- Repetition
- Force
- Awkward Postures
- Mechanical Stress
- Vibration
- Cold / Heat

High Risk in Combination
Combination of Risks

<table>
<thead>
<tr>
<th>Risk</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>LF</td>
<td>&lt; 1</td>
</tr>
<tr>
<td>LR</td>
<td>4.0</td>
</tr>
<tr>
<td>HF</td>
<td>3.8</td>
</tr>
<tr>
<td>HR</td>
<td>11.8</td>
</tr>
</tbody>
</table>

LF = Low Force  LR = Low Repetition  HF = High Force  HR = High Repetition

Silverstein, et al. 1987
Am. J. Ind. Med. * n=652
Components of Required Force

Total force that a therapist must generate is a function of both:

* Force Required (to work on the client’s problem)

* Posture (the position the therapist assumes)

* Personal Factors
Massage Therapist
Human Variability

- Susceptible Population
  - Prior Injury
  - Genetic Deficiency
  - Reduced Physical Capability

- Survivor Population
  - Genetic Strength
  - Enhanced Physical Capability
  - Self Selection

Propensity for Injury
Maximum Voluntary Contraction (MVC)

Definition: The maximum amount of force that a person can generate in any given posture.

Percent MVC (%MVC)

Definition: The percent of maximum force that a person needs to use in order to generate a desired outcome.
**%MVC Example**

Assume a therapist can generate 40 pounds of force using a good posture, but only 28 pounds of force using a poor posture.

<table>
<thead>
<tr>
<th>Client Requirement</th>
<th>Good Posture</th>
<th>Probable Result</th>
<th>Poor Posture</th>
<th>Probable Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 pounds</td>
<td>25% MVC</td>
<td>No Problem</td>
<td>36% MVC</td>
<td>No problem</td>
</tr>
<tr>
<td>25 pounds</td>
<td>62% MVC</td>
<td>Some Fatigue</td>
<td>89% MVC</td>
<td>Fatigue/Injury</td>
</tr>
<tr>
<td>32 pounds</td>
<td>80% MVC</td>
<td>Fatigue/Injury</td>
<td>114% MVC</td>
<td>Cannot Achieve</td>
</tr>
</tbody>
</table>

Note: Duration and frequency are also factors.
Awkward Postures

- Elbows above mid-torso
- Excessive wrist deviation
- Pinching
- Hand hammering
- Forearm rotation or twisting
- Extreme elbow flexion
- Back flexion, twisting or lateral bending
**POSTURE CHECKLIST**

**GENERAL BODY POSTURE/LEGS**

<table>
<thead>
<tr>
<th>Task</th>
<th>No</th>
<th>Less Than 1/3 Cycle</th>
<th>More Than 1/3 Cycle</th>
<th>Task(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a. Standing stationary</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>1b. Standing stationary on an unpadded floor surface</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>2. Using a foot pedal while standing</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Lying on back or side</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Kneeling</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Knees bent or squatting</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TRUNK POSTURE**

<table>
<thead>
<tr>
<th>Task</th>
<th>No</th>
<th>Less Than 1/3 Cycle</th>
<th>More Than 1/3 Cycle</th>
<th>Task(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. Mild forward bending more than 20°</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Severe forward bending more than 45°</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>8. Backward bending more than 20°</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Twisting or lateral bending more than 20°</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NECK POSTURE**

<table>
<thead>
<tr>
<th>Task</th>
<th>No</th>
<th>Less Than 1/3 Cycle</th>
<th>More Than 1/3 Cycle</th>
<th>Task(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10. Mild forward bending more than 20°</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>11. Severe forward bending more than 45°</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Backward bending more than 20°</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>13. Twisting or lateral bending more than 20°</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Industrial ergonomics job evaluation tool:

**Check:**
Shows moderate degree of exposure, indicating a potential risk

**Star:**
Shows a high degree of exposure, indicating a higher potential risk
### Upper Extremity Checklist (Continued)

**Posture**

<table>
<thead>
<tr>
<th>Posture Description</th>
<th>LEFT HAND</th>
<th>RIGHT HAND</th>
<th>Task(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10. Is a pinch grip used?</td>
<td>○</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>11. Is there wrist deviation?</td>
<td>○</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>12. Is there twisting, rotating, or screwing motion of the forearm?</td>
<td>○</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>13. Is there: a) reaching behind the torso? b) extended forward reach?</td>
<td>○</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>14. Is an elbow used at or above mid-torso level?</td>
<td>○</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

**Tools or Hand-Held Objects**

<table>
<thead>
<tr>
<th>Activity</th>
<th>LEFT HAND</th>
<th>RIGHT HAND</th>
<th>Task(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15. Is vibration from the tool or object transmitted to the operator’s hand?</td>
<td>○</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>16. Does cold exhaust air blow on the hand or wrist?</td>
<td>○</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

---

**Industrial ergonomics job evaluation tool:**

**Check:**
Shows moderate degree of exposure, indicating a potential risk

**Star:**
Shows a high degree of exposure, indicating a higher potential risk
Common Cumulative Trauma Disorder (CTD) Symptoms

- Numbness
- Tingling
- Reduced Range of Motion
- Swelling
- Stiffness
- Weakness
CTD Symptoms – 3 Stages

Stage 1 – Symptoms occur during periods of activity and disappear during periods of rest

Stage 2 – Symptoms become persistent and do not completely disappear during periods of rest. Sleep may be disturbed

Stage 3 – Symptoms become consistent, sleep is disturbed, and most activities cause pain.
### Some Potential Causes of CTD’s

<table>
<thead>
<tr>
<th>Disorder</th>
<th>Potential Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tenosynovitis</td>
<td>Forceful Pinching, Ulnar Deviation, Prolonged Gripping</td>
</tr>
<tr>
<td>Epicondylitis</td>
<td>Rotation of the Forearm</td>
</tr>
<tr>
<td>Biceps Tendonitis</td>
<td>Forceful Flexion of the Forearm</td>
</tr>
<tr>
<td>Trigger Finger</td>
<td>Repeated Finger Flexion, Prolonged Gripping</td>
</tr>
</tbody>
</table>
## Some Potential Causes of CTD’s

<table>
<thead>
<tr>
<th>Disorder</th>
<th>Potential Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carpal Tunnel Syndrome</td>
<td>Repeated Wrist Flexion, Extension or Ulnar Deviation Excessive Pinch Force</td>
</tr>
<tr>
<td>Raynaud’s Phenomenon (Vibration White Finger)</td>
<td>Prolonged Use of Vibrating Tools Cold Exposure</td>
</tr>
<tr>
<td>Rotator Cuff Tendonitis</td>
<td>Working Above Shoulder Level</td>
</tr>
</tbody>
</table>
## Some Potential Causes of CTD’s

<table>
<thead>
<tr>
<th>Disorder</th>
<th>Potential Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>DeQuervains</td>
<td>Repeated Thumb Movements</td>
</tr>
<tr>
<td></td>
<td>Ulnar Deviation</td>
</tr>
<tr>
<td>Thoracic Outlet Syndrome</td>
<td>Repeated or Sustained Elbow Elevation</td>
</tr>
<tr>
<td>Ganglions</td>
<td>Repeated Wrist Manipulations with the Wrist Extended</td>
</tr>
<tr>
<td></td>
<td>Repeated Twisting of the Wrists</td>
</tr>
</tbody>
</table>
Levers & Mechanical Advantage

Å Definition: A rigid mass that rotates around a fixed point (axis of rotation or fulcrum)
Å Movement: Unequal forces acting on the rigid mass
Å Stability: Zero or equal forces acting on the rigid mass

Å In the human body, bones are the levers and joints are the fulcrums
  ï Resistance = body weight plus any external force
  ï Effort = counter force generated by the muscle
Levers & Mechanical Advantage

Å Class 1 – The fulcrum is between the resistance and the effort (L5/S1 disk)

Å Class 2 – The resistance is between the fulcrum and the effort (raising up on toes)

Å Class 3 – The effort is between the fulcrum and the resistance (elbow/forearm)
First Class Lever
(Basic Teeter-Totter)

Equal weights and lever arms
Provide a stable load

150# * 5\(^\circ\) = 750 \text{ ft-lbs}

150# * 5\(^\circ\) = 750 \text{ ft-lbs}
First Class Lever
(Basic Teeter-Totter)

150# * 5\(^\circ\) = 30# * 5\(^\circ\)
750 ft-lbs = 150 ft-lbs

150# * 1.67\(^\circ\) = 30# * 8.33\(^\circ\)
250 ft-lbs = 250 ft-lbs

Adjust the lever arm distance
To balance the load
First Class Lever
(Basic Low Back)

Example: 105 pound female, ~2/3 weight above L5/S1 disk

Weight above L5/S1 disk = 70 pounds (at A,B,C,D)

\[ X = \text{Resultant back muscle force to stabilize the trunk} \]

Position A: \[ X = 105 \text{ pounds} \]
Position B: \[ X = 210 \text{ pounds} \]
Position C: \[ X = 315 \text{ pounds} \]
Position D: \[ X = 420 \text{ pounds} \]
Stress on the Lower Back

The National Institute for Occupational Safety & Health (NIOSH) set a disk compression limit of 770 pounds for manual lifting tasks (1981)
- 870 pounds (3930 N) for males (1991)
- 600 pounds (2689 N) for females (1991)
Compressive Forces on the Low Back

Positive Torque (to the right):
* Body Weight acting at the center of gravity

Negative Torque (to the left):
* Force generated by the back muscles
* Force generated from the core on the diaphragm
Low Back Compression while Bending Over
(Unsupported with No Load in the Hands)

\[ F_c = 3(BW) \cos BA + 0.8(WB)/2 \]

Assume 120 pound person:

- 0 degrees = 48 lbs
- 22.5 degrees = 185 lbs \(3.9 \times\)
- 45.0 degrees = 304 lbs \(6.3 \times\)
- 67.5 degrees = 379 lbs \(7.9 \times\)
- 90.0 degrees = 408 lbs \(8.5 \times\)

Note: Industry Flags:
- >20 deg if > 33%
- >45 deg if > 10%

Bloswick
Twisting

Twisting

Asymmetrical lifting can reduce a person’s lifting capacity by:

- 8.4% if the feet move
- 22% if the feet do not move
- 1991 NIOSH reduction factor (1-.0032*A)
Wrist Deviation

Flexor Tendons
Median Nerve

Carpal Bones
Flexor Tendons

Carpal Ligament
Flexor Tendons
Wrist Deviation

Å Forces on the tendon and intra-wrist structures can be calculated knowing the radius and included angle of tendon contact, the coefficient of friction, and the load in the fingers.

Å For a given load in the hand/fingers:
  - Tendon tension increases as the joint thickness decreases.
  - Load distribution on intra-wrist structures increases as wrist thickness decreases.
  - Total force on the intra-wrist structures increases as the angle of deviation increases.
Wrist Deviation i Normal ROM

Grip Strength Associated with Wrist Deviation

25° Radial = 80%
45° Ulnar = 75%

45° Extension = 75%
45° Flexion = 60%
65° Flexion = 45%
As massage table height gets lower:

- The therapist must bend over more, moving the center of gravity forward, causing increased stress on the low back.
- The wrist angle in extension becomes greater, increasing stress on the intra-wrist structures and reducing grip strength.

With a higher table there is less low back bending and a more normal wrist angle.
Mechanical Advantage - Theory

Whenever joints can be stacked, force is transferred through the adjoining bones, and no rotational movement is created (Fritz, 2004)

Diagram of Stacked Joints (from Fritz, Fundamentals of Therapeutic Massage, 2004, pg. 233)

Note:
Elbow \( \text{ï} \ 180^\circ \) no rotational movement
Shoulder \( \text{ï} \ 90^\circ \) no rotational movement

Majority of force is applied with body weight, requiring minimal muscle force
Mechanical Engineering Basics

Muscles and joints combine to provide rotational movement.

“Moment” is an engineering term used to define rotational movement around an axis (force $\times$ distance).

The diagram shows the forces working on the elbow:

$\mathbf{M} (\text{elbow}) = \mathbf{M} (\text{muscle}) - \mathbf{M} (\text{hand/arm}) - \mathbf{M} (\text{load})$

(from Chaffin, *Occupational Biomechanics*, 1999, pg. 195)
Mechanical Disadvantage

- The human body was designed for movement, not strength capability
- Any force that causes a joint to move (axial rotation) requires a significantly higher muscle force to control the movement of the joint

For a static hold of 20 pounds:

\[ M \text{ (muscle)} = M \text{ (hand/arm)} + M \text{ (load)} \]

\[ F \text{ (muscle)} \times 1.97 = 3.0 \times 5.3 + 20 \times 12.2 \]

\[ F \text{ (muscle)} = (15.9 + 244.0) / 1.97 \]

\[ F \text{ (muscle)} = 132 \text{ pounds} \]
Computer Modeling Comparison

Improper Method

Proper Method

Computer modeling of application methods from University of Michigan 3D-SSPP ver. 5.0.8 - Used with Permission
Computer Analysis

* 50th percentile female anthropometry and joint strength moments
* Both models used a load of 40 pounds applied to the client
* Both models loads were applied at a height of 33.3 in
* Both models applied a downward force angle of 45 degrees (red arrow)
### Computer Analysis

**Proper Method**

- 99% of the selected female population can generate the necessary strength moments at all joints.

**Improper Method**

- Only 60% of the selected female population has the necessary capability at the elbow joint.

- Only 40% of the selected female population has the necessary capability at the ankle joint.

(note: 3D Program is limited in ankle analysis)

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<table>
<thead>
<tr>
<th>Joint Location</th>
<th>Proper (%)</th>
<th>Improper (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ankle</td>
<td>99</td>
<td>40</td>
</tr>
<tr>
<td>Knee</td>
<td>99</td>
<td>86</td>
</tr>
<tr>
<td>Hip</td>
<td>99</td>
<td>98</td>
</tr>
<tr>
<td>Shoulder</td>
<td>99</td>
<td>97</td>
</tr>
<tr>
<td>Elbow</td>
<td>100</td>
<td>60</td>
</tr>
</tbody>
</table>

Summary of analysis results from The University of Michigan 3D Static Strength Prediction Program.
Field Study

Â Tested the strength capability of 18 massage practitioners (normal distribution of experience levels, with a median of 2-3 years)

Â Applied force at 3 heights: 29.0", 34.5", 39.5"

Â Tested 3 postures:
   - Poor – Standing Arm Push
   - Good – Stacked joints, without locking the back knee
   - Best – Stacked joints, with a locked back knee

Â Data collected with an Ergo-FET digital palm gauge
Field Study

5 data points were collected at each of the 3 heights:

- Standing Arm Push
- Standing Arm Push with Counterpressure
- Stacked Joints, not Locking the Knee
- Stacked Joints, with Locked Knee
- Stacked Joints, with Locked Knee and Counterpressure
Table 2: Raw data showing subject's years of massage experience (also see distribution below table), height, and weight. Data within the table are maximum applied forces recorded (in pounds) at the three test heights using the five application methods (A–E). The last three rows contain the average, minimum and maximum force for each column (n = 18).

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Test 1: H = 39.5 inch</th>
<th>Test 2: H = 34.5 inch</th>
<th>Test 3: H = 29.0 inch</th>
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<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
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<tr>
<td>Years</td>
<td>Height (inches)</td>
<td>Weight (lb.)</td>
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<tr>
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<td>62</td>
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<td>63</td>
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<tr>
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<tr>
<td>&gt;5</td>
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<td>173</td>
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</tr>
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<td>21</td>
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<tr>
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<tr>
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<td>60</td>
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<table>
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<tr>
<th>Years of massage experience</th>
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<th>1–2</th>
<th>2–3</th>
<th>3–5</th>
<th>&gt;5</th>
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## Summary Data Table

<table>
<thead>
<tr>
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<th>Composite Averages at all Heights</th>
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<tr>
<td></td>
<td>Standing</td>
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<tr>
<td>Compression Force (Lbs)</td>
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<tr>
<td>Standing Arm Push</td>
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</tr>
<tr>
<td>SAP with C/Pressure</td>
<td></td>
</tr>
<tr>
<td>Standing Arm Push</td>
<td></td>
</tr>
<tr>
<td>Stacked not Locked</td>
<td></td>
</tr>
<tr>
<td>Stacked and Locked</td>
<td></td>
</tr>
</tbody>
</table>
Field Study Results

- With joints stacked, locking the knee increases applied force by 20%
- Compared to a Standing Arm Push, stacked joints with locked knee increases applied force by 34%
- Counterpressure increases applied force:
  - Standing Arm Push (SAP) increases by 53%
  - Stacked with Locked Knee (S&L) increases by 37%
  - Compared to SAP, S&L is higher by 21%
- Proper body mechanics (S&L) generates greater applied forces at all table heights, but has a more significant impact at higher table heights
Summary

Å Job related injuries occur in the massage therapy profession and can limit the number of massages that can be performed (may also account for the high number of therapist leaving the profession each year)

Å The application of proper body mechanics (stacking & locking joints with proper transfer of body weight) will allow the therapist to provide the same amount of force to the client with less effort – validated by 3D Human Computerized Modeling and by a Field Study

Å The application of proper body mechanics will reduce massage therapist’s injury risk and increase the potential for a larger client base with increased earning potential
Calculate Proper Table Height
(start with ½ your height, adjust slightly up for long legs, down for long torso)
Body Mechanics - Stance

- Everything starts with the feet (if aligned, other body parts will fall in place)
- Feet shoulder width apart, toes pointing forward
- Use asymmetric stance (one foot forward, the other back)
- Face the stroke - align toes, hips, shoulders and head
- Heel of the back foot stays on the floor
Correct foot position
(asymmetric stance, shoulder width apart, back heel on the floor)
Correct Placement of the Feet
(use asymmetric stance, do not keep feet together or straddle)
Body Mechanics - Stance

- Decide which forearm/hand to use: usually use the arm that is associated with the direction of the stroke (going left, use the left arm)
- The forward foot is associated with arm used (use left arm, left foot forward)
- Fall into (lean on) the client to generate pressure, do not push with muscles
- When leaning in, front knee does not go past the toe
- Stack joints for best mechanical advantage
Proper body alignment for use of hand and forearm
(front foot for balance, back foot and client point of contact are weight bearing)
90 Degree Contact with Client

(standing and kneeling positions)
REDUCING INJURY & INCREASING OUTPUT WITH PROPER BODY MECHANICS
E.G. MOHR, NCTM, CPE, CSP (ret.)

When hand is removed from client, weight is transferred to toes and back muscles must engage to maintain stability.

Weight can be transferred to front foot prior to removing hand from client, providing stability.
Your stroke should always go "uphill" whenever possible.

Once over the "hill," you lose mechanical advantage and have to push harder to maintain pressure on the client.

Use bolsters to create "hills" for you to lean into (not just for client comfort).
Efficient Use of the Gliding Stroke
(Go Into the Hill)

(gliding downhill, the horizontal component of the force is lost)
Keep the Joints Stacked
(a bent elbow requires effort in the triceps)
Correct Use of Forearm
(keep wrist, hand and fingers relaxed, do not tense up)
Correct Use of Hand
(keep wrist, hand and fingers relaxed, do not tense up)
Proper Applications of Force
(use forearm, supported fingers or fist – do not use your thumb!)
Use Counterpressure to Increase Applied Force

(use the table to increase leverage and the applied pressure)
Improper Applications of Force
(do not use your thumb or elbow!)
Gamekeeper’s Thumb

- Gamekeeper’s Thumb – Chronic condition
  - Observed in 1955, a common condition among gamekeepers and Scottish fowl hunters

- Skier’s Thumb – Acute condition
  - Falling on an outstretched hand

- Abduction injury to the metacarpophalangeal (MCP) joint causing damage to the ulnar collateral ligament (an important stabilizer of the thumb)

- Chronic condition is more difficult to treat because the UCL has lengthened over time

- Develop a weakened ability to grasp objects, tie shoes, tear paper.
Rule of Thumb – Don’t Use It!

- Thumb use is okay for palpation
- Thumb should not be used to generate pressure
REDUCING INJURY & INCREASING OUTPUT WITH PROPER BODY MECHANICS

E.G. MOHR, NCTM, CPE, CSP (ret.)
Use Body Weight to Pull

(do not pull with the arms and shoulder muscles, grasp and lean back)
Practice on Each Other

- Set correct table height
- Determine proper body mechanics
- Find (or create) the “Hills”
- Find the best client position (supine, prone or side lying) for each major muscle group
- Ask for help if you’re unsure
Self Care

Å Neck/Shoulder
   • Don’t use upper body strength to push
   • Need stable core to stabilize scapula

Å Hand/Wrist
   • Stay behind the stroke to reduce wrist angle
   • Don’t tense hand or fingers
   • Avoid use of the thumb to apply pressure

Å Back
   • Maintain a stable spinal line & strong core
   • Don’t bend, twist, over-reach
   • Keep elbow either straight or at 90 degrees
Self Care

Å Knee
  ï Frequently shift weight from foot to foot
  ï Back leg “knee lock” position provides the least compressive forces on the joint capsule

Å Assymetric Stance
  ï Promotes circulation by taking pressure off when alternating legs

Å Environment
  ï Provide enough room to move around table
  ï Adjustable equipment & fresh air

Å Pre & Post Massage
  ï Stretching & self massage
Core Exercises
(draw-in maneuver & supine exercises)
Core Exercises
(prone exercises & ball stabilization exercises)
Counter Push-Up Exercise
(train the serratus anterior muscles)
Where to Go from Here

- If your current mechanics are good, tweak them and continuously improve
- If your current mechanics are not good, don’t try to accomplish everything at once (it’s too frustrating)
- Practice a few concepts for 5 massages, then keep adding new concepts (suggest something like this)
  - First 5 massages concentrate on aligning feet and arms
  - Next 5 massages identify and/or create “hills”
  - Next 5 massages practice staying behind your stroke
  - Next 5 massages try not using your thumbs or tip of elbow
  - Continue to add concepts to your massage
  - Continue to identify bad mechanics and self-correct
In industry, skilled tradespeople take good care of their tools

YOUR BODY IS YOUR TOOL

...take care of it