# Lifting technique and low back loading

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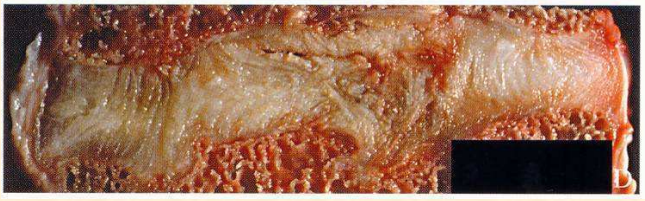
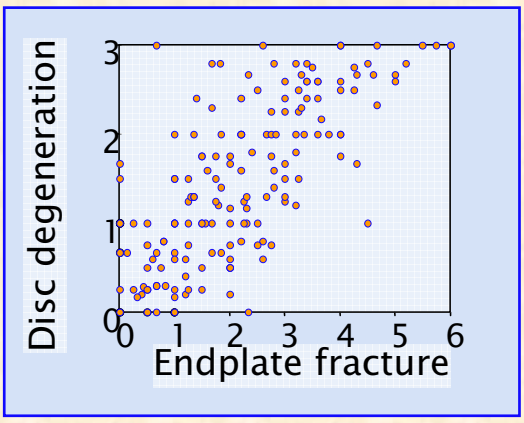
## In vitro research: compressie force => endplate damage

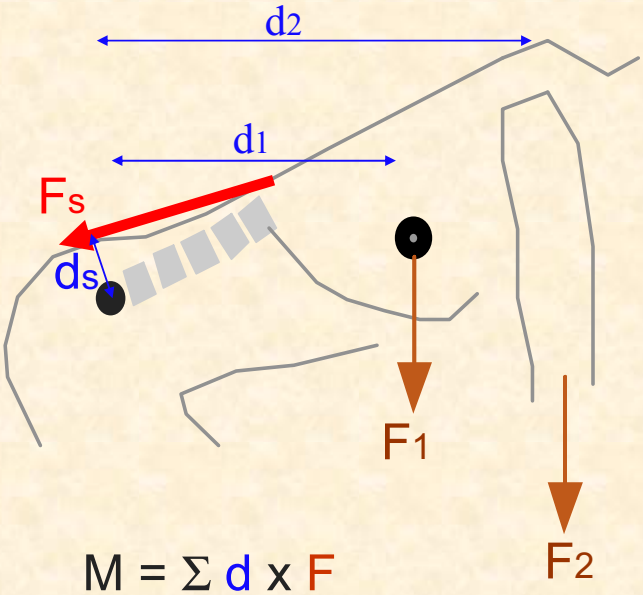
Compression force 2-10 kN

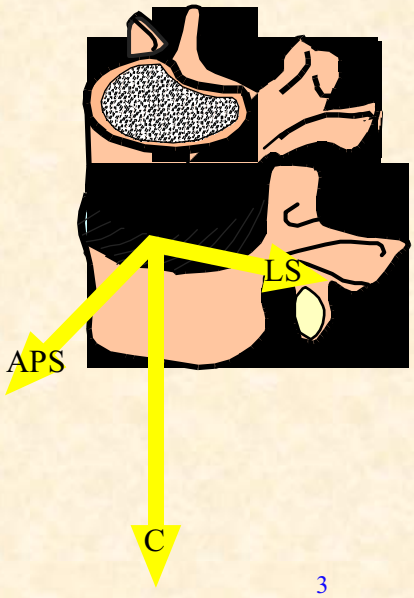
*(Adams, 2002)*





# Why does lifting result in large spine compression forces?



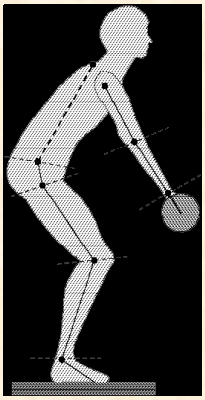

$M = \Sigma\, d \times F$

$F_s = -M / d_s$



# General approach

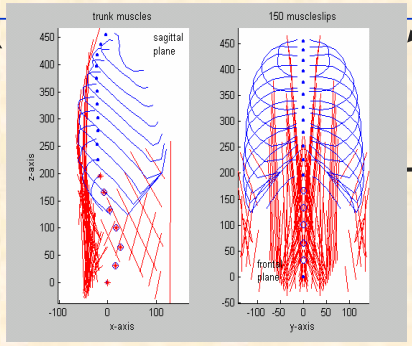
**2D or 3D linked segment model**



groundreaction forces
kinematics
antropometry

EMG

lumbar flexion
net reaction forces
net moments

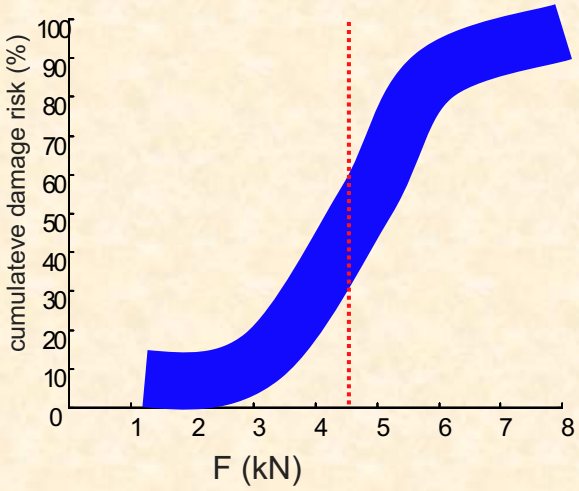



L5-S1
compression forces
shear forces

# How much back load is too much?

Problems:
1. validity compression estimate
2. validity injury threshold

Therefore mainly used for:
1. Comparisonbetween tasks
2. Estimate effect size of a measure




**Can we reduce back load in lifting?**

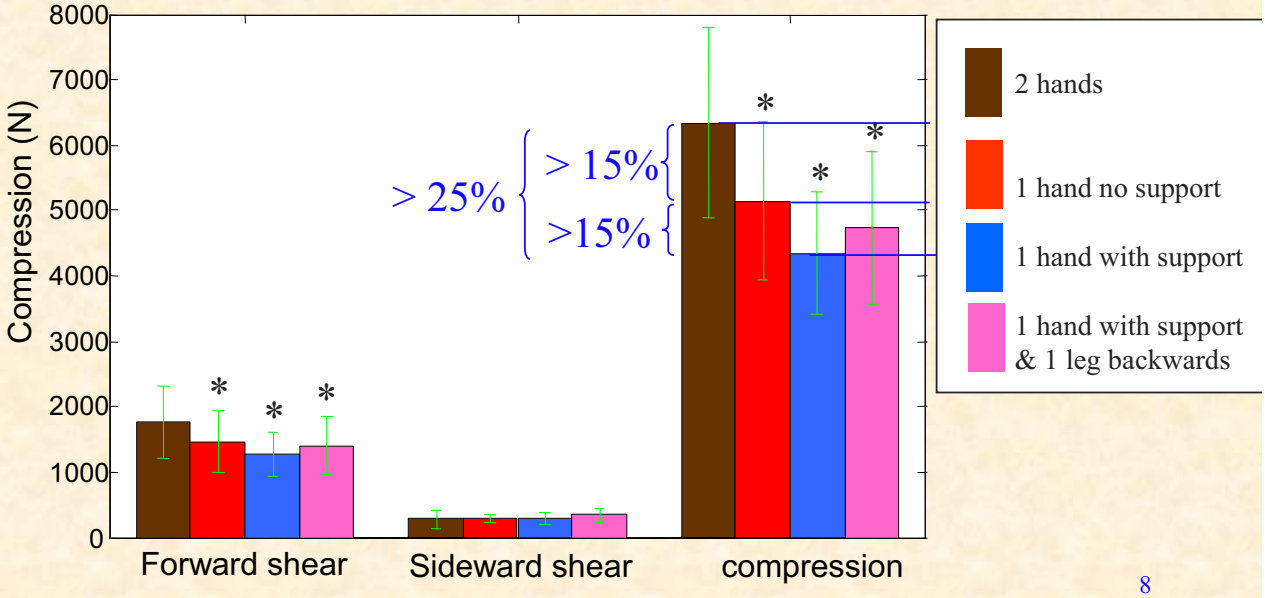


| | Effects | | | |
|---|---|---|---|---|
| factor | < 15% | 15-25% | 25-50% | >50% |
| Load weight reduction | | | | |
| horizontal distance reduction | | | | |
| smoother surface under load | | | | |
| Vertical location upward | | | | |
| Load travel distance reduction | | | | |
| Lifting speed reduction | | | | |
| Asymmetry reduction | | | | |
| Frequency reduction | | | | |
| 2 handed => 1 handed | | | | |
| Support with 1 hand | | | | |
| Better lifting technique | | | | |
| Use handles | | | | |
| Reduce load width | | | | |
| Load knowledge | | | | |

# Lifting over an edge

# Lifting over an edge
# Comparison of 4 techniques

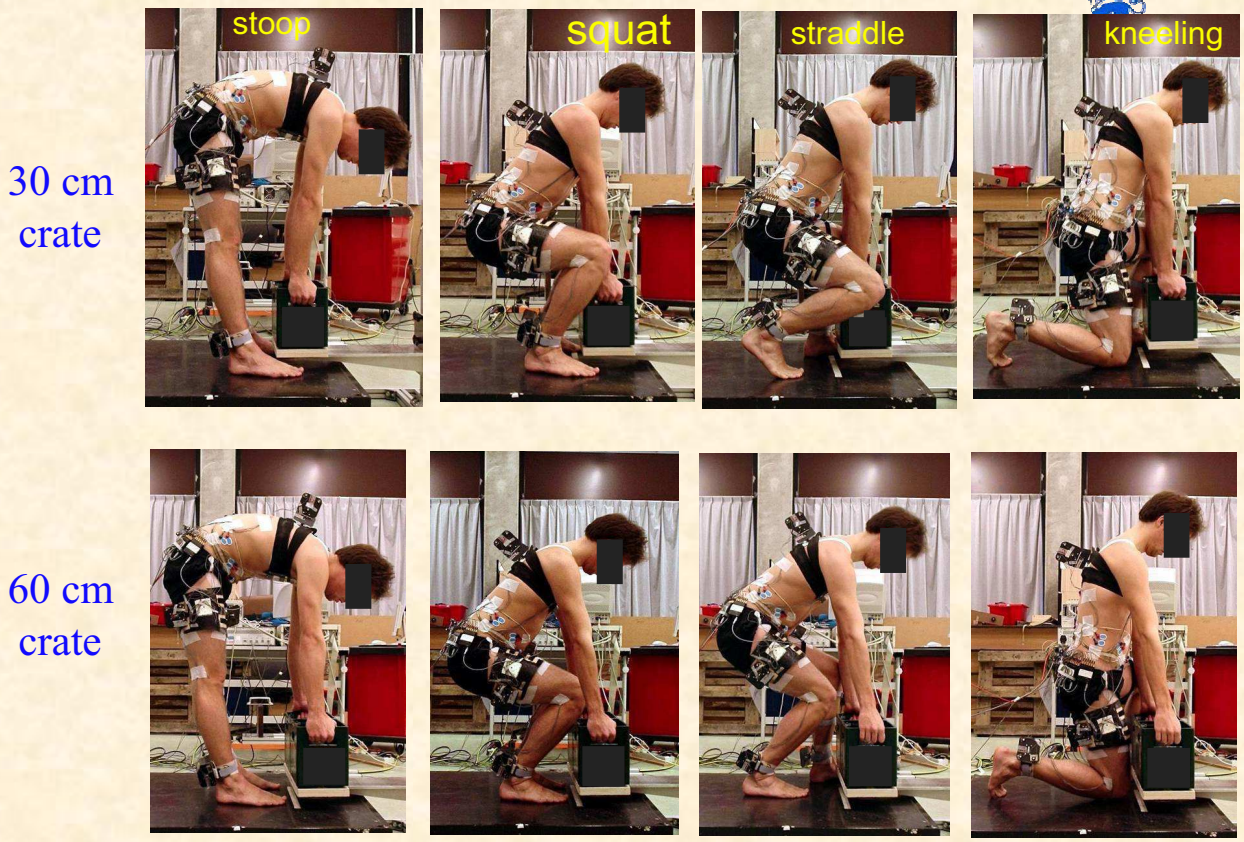
* = significant difference with bar to the left



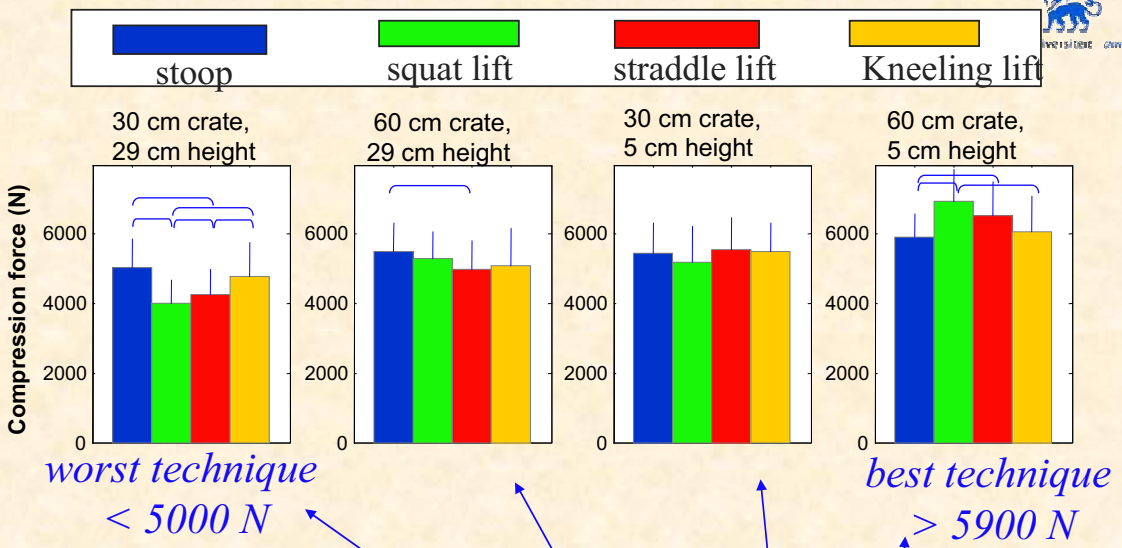



*Kingma et al., J. Biomechanics 2004*

# Comparison between 4 lifting techniques




# Effect of lifting technique




*worst technique*
*< 5000 N*

*best technique*
*> 5900 N*

| max effect lifting technique(%) | 21 | 9 | 6 | 14 |
|---|---|---|---|---|

**conclusions:**

- **Placing 1 foot beside the load is not the solution**
- **best technique depends on lifting condition**

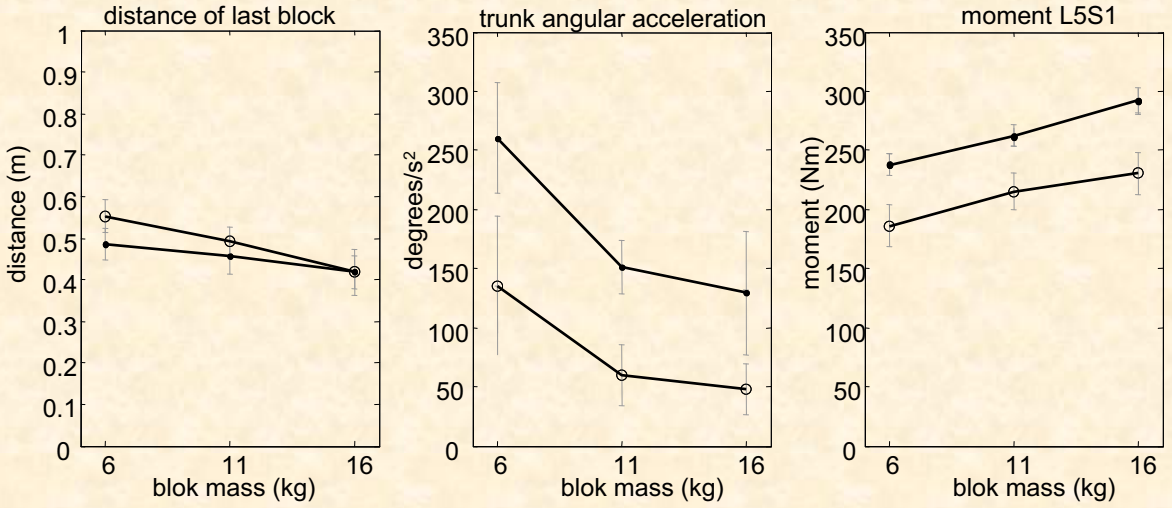
*Kingma et al., Physical Therapy 2006*

| | Back | load | reduction | % |
|---|---|---|---|---|
| factor | < 15% | 15-25% | 25-50% | >50% |
| Load weight reduction | x(floor) | **X** | **x**(hip) | |
| horizontal distance reduction | x(floor) | **X** | **x**(hip) | |
| smoother surface under load | **x**(floor) | | **x**(hip) | |
| Vertical location upward | | **X** | | |
| Load travel distance reduction | X?? | | | |
| Lifting speed reduction | | **X** | | |
| Asymmetry reduction | **X** | | | |
| Frequency reduction | X?? | | | |
| 2 handed => 1 handed | | **X** | | |
| Support with 1 hand | | **X** | | |
| Better lifting technique | **X** | x | | |
| Use handles | x | **X** | | |
| Reduce load width | **X** | **X** | | |
| Load knowledge | **X** | | | |



# reduction of brick weight in construction industry

# reduction of brick weight in construction industry



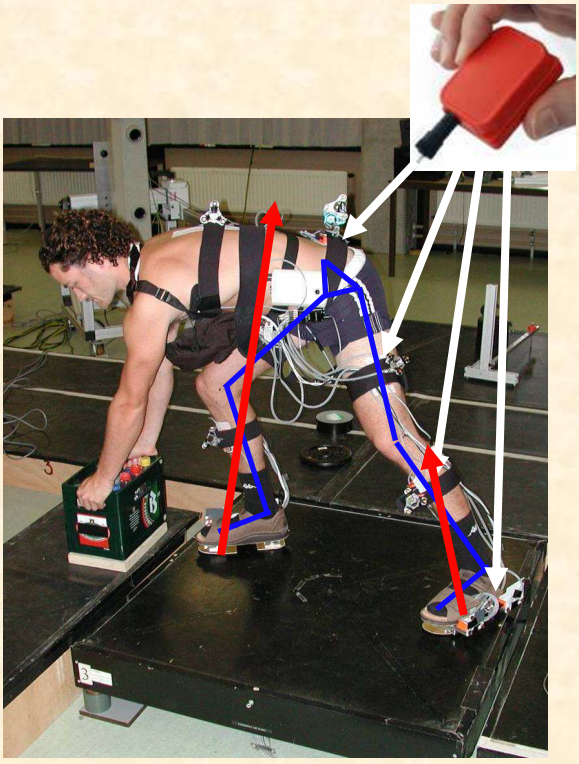

1. workers reached further when brick mass was reduced
2. workers lifted faster when brick mass was reduced
3. the resulting effect of weight reduction is not large
4. Better adapt lifting height

*Faber et al., 2008*



## Towards measuring low back load at the workplace:

# Combining force shoe & Inertial sensors



# Thank you

| | Back load reduction % | | | |
|---|---|---|---|---|
| factor | < 15% | 15-25% | 25-50% | >50% |
| Load weight reduction | x(floor) | **X** | **x**(hip) | |
| horizontal distance reduction | x(floor) | **X** | **x**(hip) | |
| smoother surface under load | **x**(floor) | | **x**(hip) | |
| Vertical location upward | | **X** | | |
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| Load knowledge | **X** | | | |