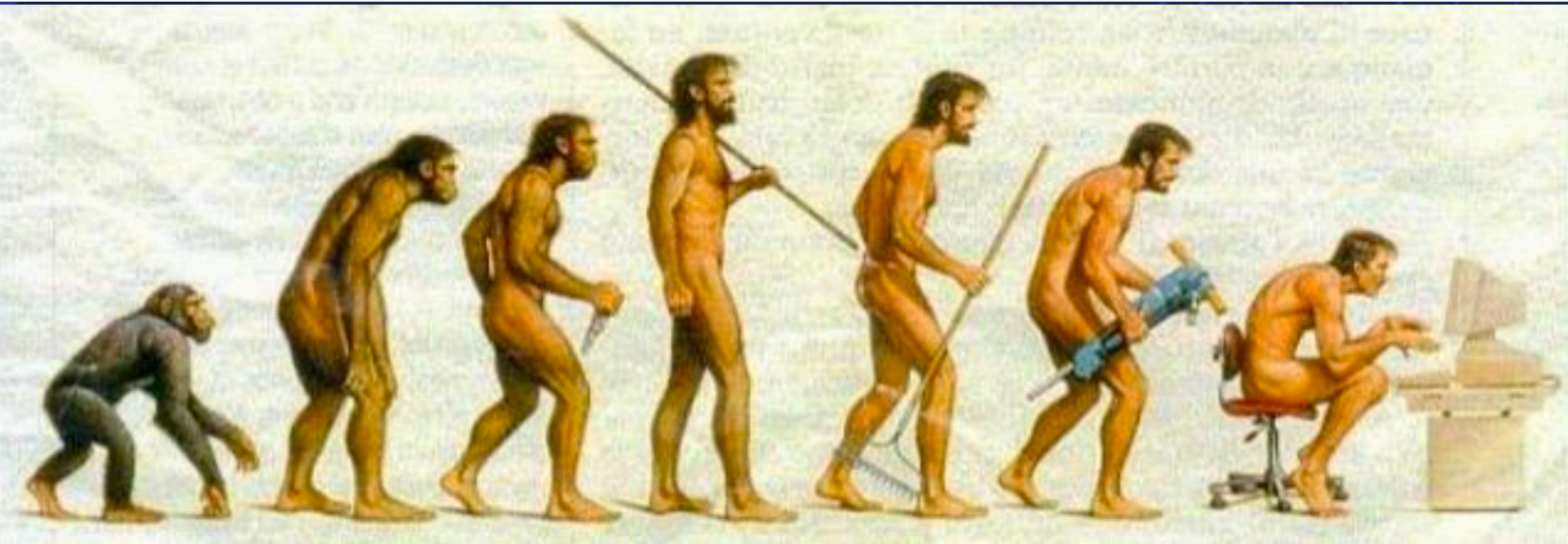


Automatic Assessment of Surgical Ergonomics



Automatic Assessment of Surgical Ergonomics

- Surgery may require the adoption of awkward body postures, static muscular loads
- Increased compressive, shear, and tensile forces on musculoskeletal tissues
- Jobs that require neck flexion greater than 15 to 20 degrees are associated with tension myalgia (Ariens GAM et al. Occup Environ Med. 2001)
- Observational posture studies indicate that surgeons spend >50% of their time in the OR with head in flexion, thus increasing their risk for musculoskeletal disorders of neck (Kant IJ, Int Arch Occup Environ Health, 1992)

Ergonomics benefits the patient too!

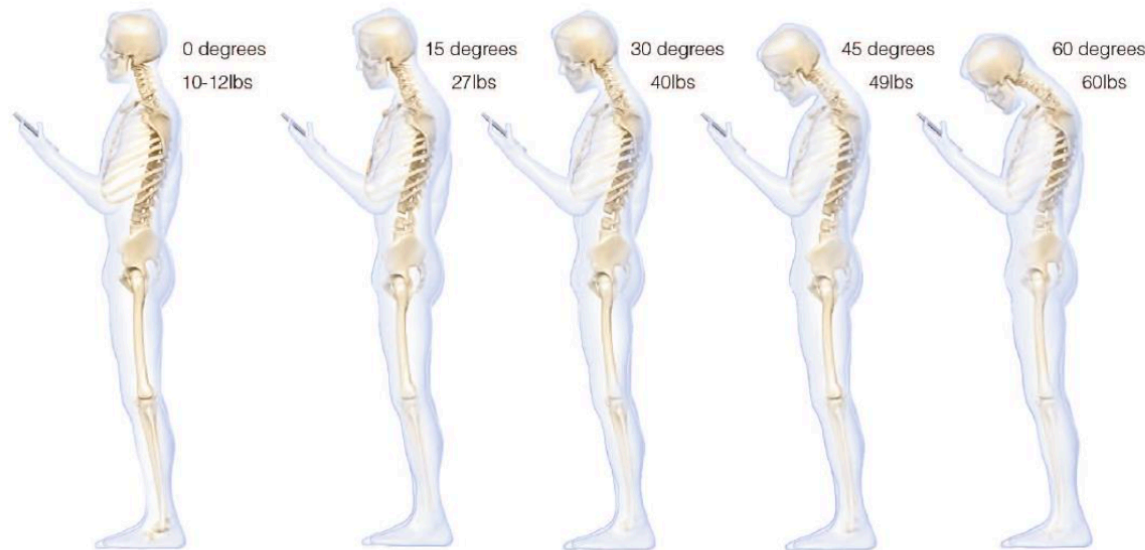
- Suboptimal working postures are associated with poor work efficiency, which can impact costs and patient safety
- An optimized surgical setting has been shown to improve task efficiency and performance







Assessment of Stresses in the Cervical Spine Caused by Posture and Position of the Head




Position	Neutral	15 °	30°	45 °	60 °	90°
Force To Cervical Spine	10-12lbs.	27lbs.	40lbs.	49lbs.	60lbs.	Not Measurable

Figure 1. The weight seen by the spine increases when flexing the neck at varying degrees. An adult head weighs 10-12 pounds in the neutral position. As the head tilts forward the forces seen by the neck surges to 27 pounds at 15 degrees, 40 pounds at 30 degrees, 49 pounds at 45 degrees and 60 pounds at 60 degrees.

Automatic Assessment of Surgical Ergonomics

REBA: Rapid Entire Body Assessment

Validated tool in manufacturing and industry.



ERGONOMICS
EST. 1976

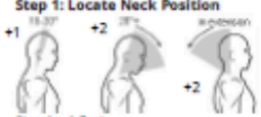
REBA Employee Assessment Worksheet

Task Name: _____

Date: _____


A. Neck, Trunk and Leg Analysis

Step 1: Locate Neck Position




Neck Score:

Step 2: Locate Trunk Position



Trunk Score:

Step 3: Legs



Leg Score:

Step 4: Look-up Posture Score in Table A

Using values from steps 1-3 above, Locate score in Table A

Posture Score A:

Step 5: Add Force/Load Score

If load < 11 lbs.: +0
 If load 11 to 22 lbs.: +1
 If load > 22 lbs.: +2
 Adjust: If shock or rapid build up of force: add +1

Force / Load Score:

Step 6: Score A, Find Row in Table C

Add values from steps 4 & 5 to obtain Score A. Find Row in Table C.

Score A:

Scores


Table A		Neck											
		1				2				3			
Legs		1	2	3	4	1	2	3	4	1	2	3	4
Trunk	1	1	2	3	4	1	2	3	4	3	3	5	6
Posture	2	2	3	4	5	3	4	5	6	4	5	6	7
Score	3	2	4	5	6	4	5	6	7	5	6	7	8
	4	3	5	6	7	5	6	7	8	6	7	8	9
	5	4	6	7	8	6	7	8	9	7	8	9	9

Table B		Lower Arm					
		1			2		
Wrist		1	2	3	1	2	3
Upper Arm	1	1	2	2	1	2	3
Score	2	1	2	3	2	3	4
	3	3	4	5	4	5	5
	4	4	5	5	6	7	
	5	6	7	8	7	8	
	6	7	8	8	8	9	

Score A	Table C											
	Score B											
1	1	1	1	2	3	3	4	5	6	7	7	7
2	1	2	2	3	4	4	5	6	6	7	7	8
3	2	3	3	4	5	6	7	7	8	8	8	8
4	3	4	4	5	6	7	8	8	9	9	9	9
5	4	4	5	6	7	8	8	9	9	9	9	9
6	6	6	7	8	8	9	9	10	10	10	10	10
7	7	7	8	9	9	9	10	10	11	11	11	11
8	8	8	9	10	10	10	10	11	11	11	11	11
9	9	9	10	10	10	10	11	11	11	12	12	12
10	10	10	10	11	11	11	11	12	12	12	12	12
11	11	11	11	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

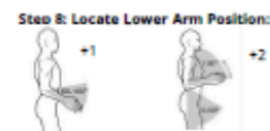
B. Arm and Wrist Analysis

Step 7: Locate Upper Arm Position:



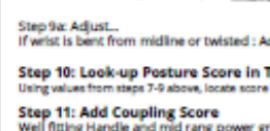
Upper Arm Score:

Step 8: Locate Lower Arm Position:



Lower Arm Score:

Step 9: Locate Wrist Position:



Wrist Score:

Step 10: Look-up Posture Score in Table B

Using values from steps 7-9 above, locate score in Table B

Posture Score B:

Step 11: Add Coupling Score

Well fitting Handle and mid rang power grip, *good*: +0
 Acceptable but not ideal hand hold or coupling acceptable with another body part, *fair*: +1
 Hand hold not acceptable but possible, *poor*: +2
 No handles, awkward, unsafe with any body part, *Unacceptable*: +3

Coupling Score:

Step 12: Score B, Find Column in Table C

Add values from steps 10 & 11 to obtain Score B. Find column in Table C and match with Score A in row from step 6 to obtain Table C Score.

Score B:

Step 13: Activity Score

+1 1 or more body parts are held for longer than 1 minute (static)
 +1 Repeated small range actions (more than 4x per minute)
 +1 Action causes rapid large range changes in postures or unstable base

Table C Score: + Activity Score: = REBA Score:

Scoring

1 = Negligible Risk
 2-3 = Low Risk. Change may be needed.
 4-7 = Medium Risk. Further Investigate, Change Soon.
 8-10 = High Risk. Investigate and Implement Change
 11+ = Very High Risk. Implement Change

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based on Technical note: Rapid Entire Body Assessment (REBA), Ilgwt, McNameey, Applied Ergonomics 31 (2000) 201-205



Automatic Assessment of Surgical Ergonomics

REBA: Rapid Entire Body Assessment

Validated tool in manufacturing and industry.



Automatic Assessment of Surgical Ergonomics

- **What Students Will Do:**
 - Create an algorithm that will automatically identify joints on a body and measure body angles from short video clips.
 - Score the body angle measurements according to the validated REBA scale. Assign a REBA score to the surgeon in each video clip.
- **Deliverables:**
 - A functional algorithm that will automatically assign a REBA score to a large number of surgical videos.
 - Identify the duration of time spent at “dangerous” REBA scores.
 - This can also be in the form of a phone app.
- **Size group: 1-3**
- **Mentors:**
 - Dr. Deepa Galaiya, gdeepa1@jh.edu
 - Dr. Eric Formeister, eforme1@jh.edu
 - Dr. John Carey, jcarey@jhmi.edu

