



UNDERSTANDING MUSCLE MECHANICS – GYM EDITION

JOEL FULFORD

WITH

Keegan
HIRST

MAKING A SINGLE JOINT MOVE?...



...ISOLATION MOVEMENTS ... ONE JOINT!

MAIN TYPES MUSCULAR CONTRACTION

- **Skeletal muscle, tendons & bones** come together to create levers at joints to create movement
- Muscles receive a **contraction stimulus** from the **CNS** to “contract” this is a pulling of the lever.



CONCENTRIC

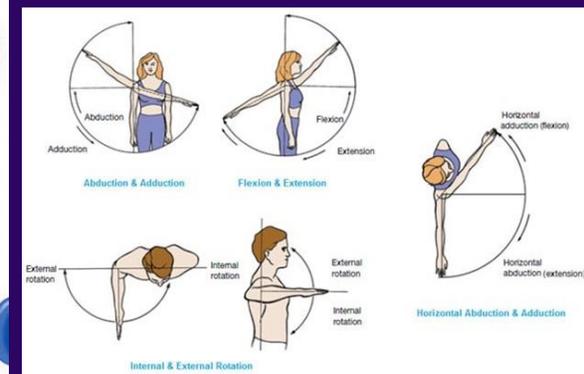
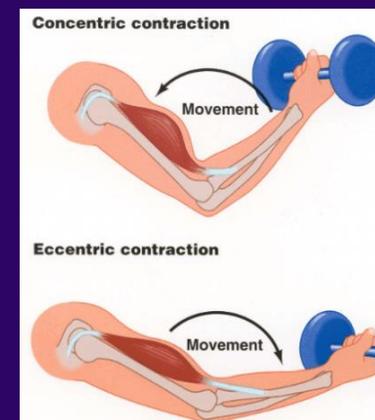
- Muscular **contraction force** overcomes **resistance force** and muscle shortens.
- Joint moves.

ECCENTRIC

- Muscular **contraction force** less than **resistance force** and muscle lengthens.
- Joint moves.

ISOMETRIC

- Muscular **contraction force** equal to **resistance force** and muscle stays same length.
- Joint static.



MAIN TYPES MOVEMENT JOINT MOVEMENT



FLEXION / EXTENSION

- **Flexion** = **bending** of a joint
- **Extension** = **straightening** of a joint
- Contraction in pairs (antagonistic)

ABDUCTION / ADDUCTION

- **Abduction** = movement **away from midline**
- **Adduction** = movement **towards midline**
- (Vertical – Up / Horizontal – Across)

MEDIAL / LATERAL ROTATION

- **Medial** = rotation on the **long axis inwards**
- **Extension** = rotation on the **long axis outwards**



MULTIPLE MUSCLES WORKING TOGETHER?...



...COMPOUND MOVEMENTS ... MORE THAN ONE MUSCLE / JOINT!

COMPOUND MOVEMENTS

- ❑ Compound movements / exercises work several muscle groups at once ... over two or more joints.
- ❑ Joints work together to create unique compound movement patterns (eg. Squat / Hinge / Push / Pull etc ...) we will look at defining these later.
- ❑ The joints involved in compound movements may all be doing different actions (flexion / extension / abduction / adduction / medial rotation / lateral rotation) to produce the movement.



MECHANICS BASICS...



...UPPER BODY COMPOUND MOVEMENT PATTERNS?



VERTICAL MOVEMENT PATTERNS



- ❑ Load is moved **vertically** in relation to the torso.
- ❑ Movement typically **Sagittal** plane OR **Frontal** plane.

PUSH

- ❑ Shoulder abduction and/or flexion **with** extension of the elbow
- ❑ Deltoid / Tricep contraction.

PULL

- ❑ Shoulder adduction and/or extension **with** flexion of the elbow (i.e. pulling).
- ❑ Latissimus Dorsi / Bicep contraction.

HORIZONTAL MOVEMENT PATTERNS



- ❑ Load is moved **horizontally** in relation to the torso.
- ❑ Movement typically **Sagittal** plane OR **Transverse** plane.

PUSH

- ❑ Shoulder flexion and/or horizontal adduction **with** elbow extension
- ❑ Pectoralis / Deltoid / Tricep contraction

PULL

- ❑ Shoulder extension and/or horizontal abduction **with** elbow flexion
- ❑ Lat / Trap/ Bicep contraction.



UPPER BODY COMPOUND MOVEMENT EXERCISES IN THE GYM

- ❑ These exercises are your “**larger**” upper body movements.
- ❑ They typically come **earlier in your session** as they require...
 - Increased **movement complexity** demands.
 - Higher levels of **muscular recruitment**.
 - More susceptible to **technique breakdown** when fatigued.
 - Often used as a more **pure strength focus** (lower reps & higher weight)
 - More **technically demanding** vs isolation exercises.
- ❑ Knowledge of the different muscle groups utilised and therefore mechanically stressed to perform these differing movements can be used to influence program periodisation.



MECHANICS BASICS...



...LOWER BODY COMPOUND MOVEMENT PATTERNS?



SQUAT / KNEE DOMINANT PATTERNS



- ❑ Knee is the dominant lever during the movement.
- ❑ Depending on pattern categorising all squats as knee dominant can be a misdemeanour!
- ❑ Sagittal plane movement pattern.
- ❑ **Knee extension** is dominant movement in this pattern. Through **contraction of the knee extensors... Quadriceps.**

HINGE / HIP DOMINANT PATTERNS



- ❑ Hip is the dominant lever during the movement through a hinge motion typically.
- ❑ Some hip dominant exercises may **NOT** be a hinge **eg. Glute Bridge / High Box Step-Up.**
- ❑ Sagittal plane movement pattern.
- ❑ **Hip extension** is dominant movement in this pattern through **contraction of hip extensors... Glutes / Hamstrings / Spinal Erectors.**

LUNGE / STEP / SPLIT DOMINANT PATTERNS



- ❑ **Uni-lateral crossover between the Hinge & the Squat movement.**
- ❑ Can incorporate all **3 movement planes** (Sagittal / Frontal / Transverse).
- ❑ Knee extension and Hip extension are equal contributors to the movement.



LOWER BODY COMPOUND MOVEMENT EXERCISES IN THE GYM

- ❑ These exercises are your “**larger**” lower body movements.
- ❑ They typically come **earlier in your session** as they require...
 - Increased **movement complexity** demands.
 - Higher levels of **muscular recruitment**.
 - More susceptible to **technique breakdown** when fatigued.
 - Often used as a more **pure strength focus** (lower reps & higher weight)
 - More **technically demanding** vs isolation exercises.
- ❑ Knowledge of the different muscle groups utilised and therefore mechanically stressed to perform these differing movements can be used to influence program periodisation.

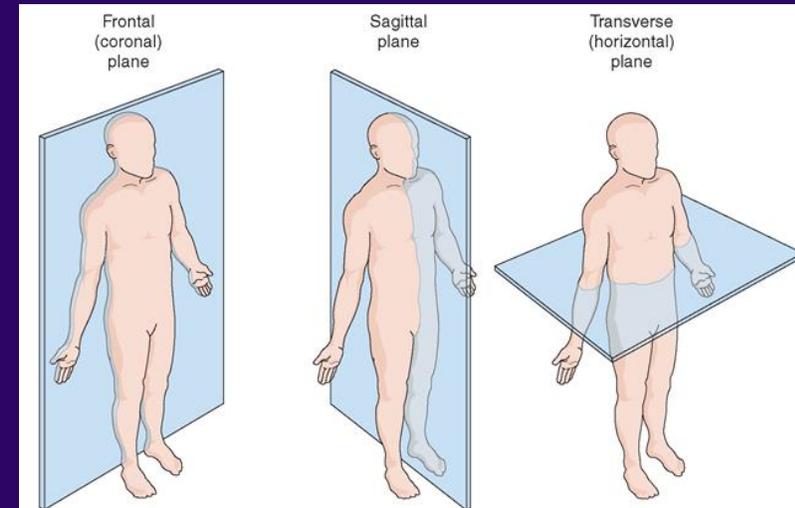
PLANES OF MOVEMENT...

...WHERE DOES MOVEMENT TAKE PLACE?



BIOMECHANICAL PLANES OF MOVEMENT

- ❑ We can define movement of the human body in **three different “planes”** of movement.
- ❑ **Frontal Plane**
- ❑ **Sagittal Plane**
- ❑ **Transverse Plane**
- ❑ Some movements incorporate **just one plane** of movement – but **sometimes this is a combination two or even all three planes** of movement (eg. Arnold Press)
- ❑ If we lay down OR get on a bench the planes don't change!
- ❑ These are important for training periodisation as we cant to **work in all 3 planes to develop proper physical functionality.**





UTILISING CONTRACTION TYPES...



... WE CAN USE DIFFERENT CONTRACTION TYPES TO OVERLOAD

TRAINING TECHNIQUES WHICH UTILISE SPECIFIC TEMPOS

- ❑ The **tempo** of an exercise describes the “speed” or “intent” of the differing contraction components that make up the lift
- ❑ We can specifically **modify** or **prescribe** these to give us certain **accentuated mechanical stimulus in the working muscles**.
- ❑ **CONCENTRIC**: Typically this portion of the lift (primary muscles shortening) **isn't modified** AND is always performed with good “intent”. By this we mean a “hard” or “firm” contraction (lift at speed). This allows for maximal mechanical stimulus in the working muscles. This does not mean form goes out of the window – **CONCENTRIC INTENT WITH TECHNIQUE**.
- ❑ **ECCENTRIC**: In this section of a exercise **primary muscles are contracting, but lengthening** (as resistance is greater than contraction force). We can deliberately make this eccentric component longer in duration – a **SLOW ECCENTRIC TEMPO**. This will **increase mechanical stress** on a muscle during the exercise, leading to greater adaptation response in terms of strength / hypertrophy.
- ❑ **ISOMETRIC**: : In this section of a exercise **primary muscles are contracting, but not changing in length** (as resistance is equal to contraction force). We can deliberately make this isometric component longer in duration – a **PAUSED TEMPO**. This will **increase mechanical stress** on a muscle during the exercise, leading to greater adaptation response in terms of strength / hypertrophy.

TEMPO ANNOTATION



- ❑ We utilise a **numbering system** to make it clear what tempo we want from each exercise.
- ❑ This usually goes in the order of lift components depending on the exercise (first – last).
- ❑ **1)** Eccentric OR Concentric **2)** Pause **3)** Eccentric OR Concentric **4)** Rest Between Reps.
- ❑ **Example: Incline Bench Press – 3111 = 3** seconds Eccentric (Down) / **1** second Pause (At Chest) – **1** second Up (Intent) / **1** seconds Rest between reps.



UTILISING EXERCISE VARIATIONS...



... SMALL "TWEAKS" TO MOVEMENT TECHNIQUE = BIG DIFFERENCE



EXERCISE
VARIATIONS



STANCE



GRIP



- Pronated:** Overhand
- Supinated:** Underhand
- Neutral:** Hammer

- Narrow:** Inside shoulder width
- Standard:** Shoulder width
- Wide:** Outside shoulder width

- Narrow:** Feet inside hip width, more quadricep dominant.
- Natural:** Equally balanced
- Sumo:** Feet outside hip width, more glute dominant / adductor contribution

- Incline:** Angled upwards (high OR low incline)
- Flat:** Bench parallel to floor
- Decline:** Angled downwards (high OR low decline)



CORE...



... THERE IS MORE TO FUNCTIONAL CORE TRAINING THAN GETTING "ABS"



"ANTI" MOVEMENTS FOR A FUNCTIONALLY STRONG CORE



- ❑ Core training can be implemented for **aesthetic reasons** OR to build a **strong trunk** which can meet with the demands of functionally challenging movements – both in the gym & in every day life!
- ❑ This also has a BIG role to play in **building injury robustness...** again both in the gym & in every day life.
- ❑ Focusing on functional core training will also have **concurrent gains in aesthetic abdominal appearance** (if body fat percentage is low enough!)
- ❑ We group and therefore periodise functional core exercises into the following categories:
- ❑ **Anti – Extension:** Build ability to "set the spine" and strength to **prevent it from going into extension (backwards)**. Allows us to look after your back especially when working with load overhead.
- ❑ **Anti – Flexion:** This is the strength ability to **resist the spine going into forced flexion (forwards)**.
- ❑ **Anti – Rotation:** These exercises **strengthen the hip & trunk region in overcoming rotational forces**. Strong ability in anti-extension allows us to better cope with rotational forces put on the body.
- ❑ **Anti – Lateral Flexion:** Strength in anti-lateral flexion means out ability to **resist "bending" of the spine sideways**. This is useful when performing uni-lateral (one sided) movements inside & outside the gym.





PTIQ
TRAINSMART

QUESTIONS?

WITH

Keegan
HIRST