Game Changing Concepts
11/16/18

Kinetic Chain and Core Strength Functional Assessments

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Stretch Shortening Cycle

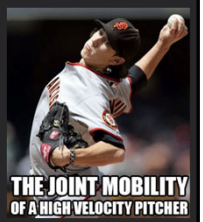
Forces generated from legs hips translate up

Compound effect

****legs→hip→trunk→arm**

Mobility/Strength/Stability needed

Hip/Trunk Separation



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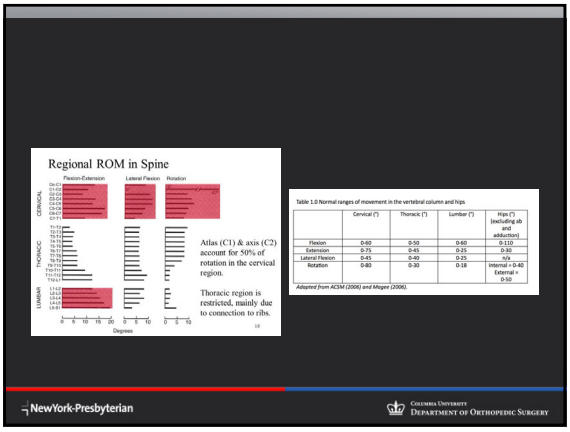
Regional ROM in Spine
Flexion-Extension
Lateral Flexion
Rotation
CERVICAL
THORACIC
LUMBAR
Degrees
Atlas (C1) & axis (C2) account for 50% of rotation in the cervical region.
Thoracic region is restricted, mainly due to connection to ribs.
Table 1.0 Normal ranges of movement in the vertebral column and hips
Cervical (°)
Thoracic (°)
Lumbar (°)
Hips (°) (excluding sb and adduction)
Flexion 0-60 0-50 0-60 0-110
Extension 0-75 0-45 0-25 0-30
Lateral Flexion 0-45 0-40 0-25 n/a
Rotation 0-80 0-30 0-18 Internal = 0-40 External = 0-50
Adapted from ACSM (2006) and Magee (2006).
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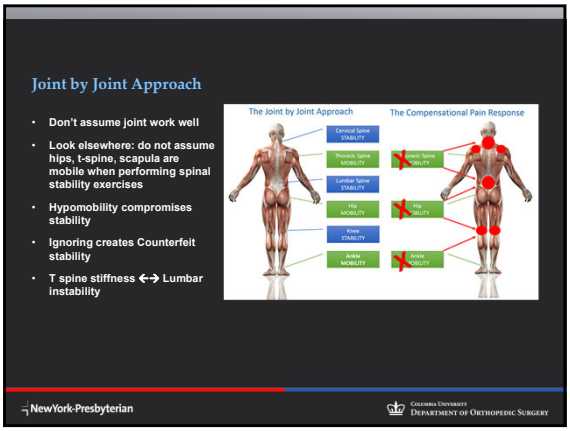
Joint by Joint Approach
Don't assume joint work well
Look elsewhere: do not assume hips, t-spine, scapula are mobile when performing spinal stability exercises
Hypomobility compromises stability
Ignoring creates Counterfeit stability
T spine stiffness ←→ Lumbar instability
The Joint by Joint Approach
The Compensational Pain Response
Cervical Spine STABILITY
Thoracic Spine MOBILITY
Lumbar Spine STABILITY
Hip MOBILITY
Knee STABILITY
Ankle MOBILITY
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Importance in sport
Transfer Maximum amount of energy to the ball or bat
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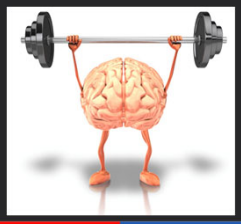
Before our Mind gives us permission to perform a task it asks….Is it safe?



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Notes before Chords

Neutral Spine

Isolate

Integrate into dynamic movement

Functional: correct timing of movement pattern

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Assessment

- **Motion: Passive/Active**
  - Ankle
  - Knees
  - Hips
  - Back
  - Thoracic
- **Strength/Endurance**
  - Planks
  - Hips
  - Trunk Rotatation
- **Dynamic movements**
  - Anterior step down
  - Balance
  - Dynamic sport specific movements
- **Palpation**

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Mobility

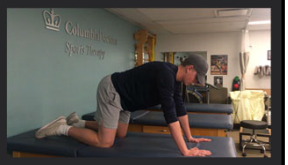
Ankle: half kneeling

Hips: passive active Car's

Lumbar : Cat/Camel

Thoracic: Cat/Camel Rotation

Scapular: side lying, Scapular Cars



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Mobility

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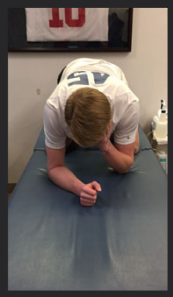

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CARs

Active rotational movements at the outer limits of articular motion

expand limits of joint

ensures all mechanoreceptors are activated

teaches control of outer limits (stability)

induces progressive tissue adaptation in tissue (joint protection) can accommodate diff stresses

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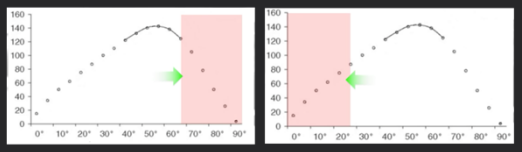
- Teach CNS to control larger ROM's
- Prepare body to function in newly acquired ranges effectively and safely



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Strength/Stability

Progressions

- neutral→ stabilize statically→ dynamically→ increase power (incorporate breathing with stabilization so don't bear down too hard)
- Isolated → integrated (involved extremity) → functional

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Chalmers PN et al. The Relationship Between Pitching Mechanics and Injury: A Review of Current Concepts. Sports Health 2017

The Kinetic Chain in Overhand Pitching: Its Potential Role for performance Enhancement and Injury Prevention

- **Pithing velocity associated with:**
  - forward trunk tilt
  - pelvis angular velocity
  - trunk rotation
- **Decreased forward trunk tilt → less velocity generated**
- **Forward trunk tilt velocity 450 degrees/second ball release**
- **Lateral trunk tilt**

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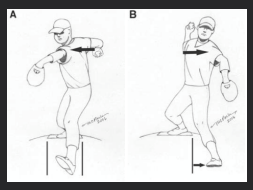
Weber A et al. The Biomechanics of Throwing: Simplified and Cogent. Sports Med Arthrosc Rev. 2014

The Biomechanics of Throwing: Simplified and Cogent

- Pitching motions with early trunk rotation shown to increase valgus torque on the elbow
- But…Why are they rotating early?
  - Hypomobility
  - Decrease dynamic stability
  - Technique
  - Fatigue/Weakness



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Escamilla RF et al. Activity Demands for a Pitcher Approaches Muscular Fatigue During a Simulated Baseball Game. Am J Sports Med. 2007

Pitching Biomechanics as a Pitcher Approaches Muscular Fatigue During a Simulated Baseball Game

- Decrease in vertical trunk positioning from first to last inning
- Insufficient forward trunk tilt → throw too much with the arm
- Decreased forward tilt may affect velocity

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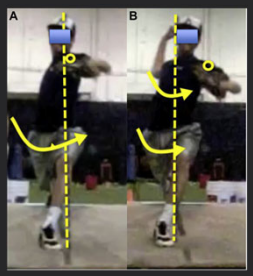
Erickson B. The Impact of Fatigue on Baseball Pitching Mechanics in Adolescent Male Pitchers. J Sci Med Sport. 2016

The Impact of Fatigue on Baseball Pitching Mechanics in Adolescent Male Pitchers

- **Hip to shoulder separation**
  - Decreased from 90% to 40% with pitcher fatigue
- **Fatigue → hips and shoulders rotating together**
- **Places increased torque through shoulder/elbow**



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Role

Stabilize:

Statically vs dynamically Anti Extension, Flexion, Rotation, Lat. Flexion

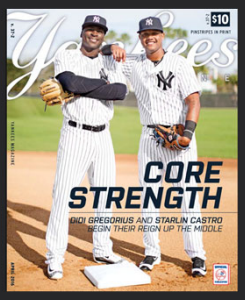
Maintains appropriate stiffness and stability of the spine while allowing for maximum speed with control

Prevent:

breakdown of posture/compensation/injury risk excessive motion

Transmit force

- power developed through hips and transmitted through the core



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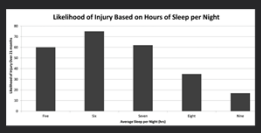
Chronic Lack of Sleep is Associated With Increased Sports Injuries in Adolescent Athletes

Milewski et al 2014

- 77% < 7 hrs per night
- <8 hrs. of sleep
  - 1.7x greater risk of being injures than those > 8hrs



- Sleep affects:
  - Mood
  - Motor function
  - Cognitive functions

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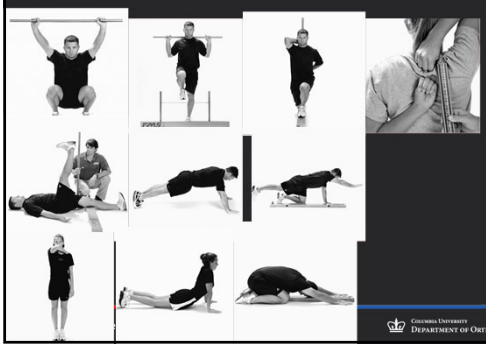
Functional Movement Screen



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Reliability, Validity, and Injury Predictive Value of the Functional Movement Screen

A Systematic Review and Meta-analysis

- **High Interrater and Intrarater Reliability (experience little influence)**
- **Scores ≤ 14**
  - 2.74x greater chance of injury
- **Composite score NOT valid as unitary construct**
  - Diff tests contribute differently to composite score
- **Lacks Validation : lack of standard quantitative value**
  - Flaws in internal and External Validity
- Comparisons with other measure of movement and balance did not find correlation to FMS scores
  - Questioning accuracy/sensitivity of detecting physical abnormalities

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Ref.	Sample	Injury definition	Sensitivity	Specificity
Kiesel *et al*[22]	46 male professional American football players	Athletic performance injury requiring injury reserve and time loss of 3 wk	54%	91%
Chorba *et al*[23]	38 female Division II athletes	Athletic performance injury requiring intervention	58%	74%
O'Connor *et al*[24]	874 male Officer candidates	Any injury: Physical training injury requiring intervention	45%	78%
		Overuse injury: Long term repetitive energy exchange with cumulative microtrauma	12%	90%
		Serious injury: Physical training injury [illegible]	12%	94%
Butler *et al*[25]	108 firefight trainees	Physical training injury with time loss of 3 consecutive days	84%	62%
Warren *et al*[26]	195 male and females Division I athletes	Athletic performance injury requiring intervention	54%	46%
Garrison *et al*[27]	160 male and females Division I athletes	Athletic performance injury requiring intervention, and 24 h missed time or splinting, [illegible]	67%	73%
Hotta *et al*[28]	84 competitive male runners	Physical training injury with time loss of 4 wk	73%	54%
Knapik *et al*[29]	1043 male and female military cadets	Physical training injury	35%	49%
McGill *et al*[30]	53 elite police officer	Back injury not due to specific acute incidents	28%	76%
		All injury	42%	47%

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The Functional Movement Screen and Injury Risk

Association and Predictive Value in Active Men

2476 male soldiers

Cut off point of 14 points:

- Sensitivity: 28-38%
- Specificity: 77-82%

Only 19-52% of soldiers experiencing an injury were correctly labeled as high risk of those scoring ≤14 (misclassifying 48-81%)

"NOT suitable screening tool for identifying those with a higher risk for injuries in this population using composite score"

"FMS to screen for risk of injuries is not recommended in this population"

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Do Functional Movement Screen (FMS) composite scores predict subsequent injury? A systematic review with meta-analysis

- **2018**
- **Moderate evidence against use of FMS as injury prediction test (soccer)**
- **Conflicting evidence in other sports**
- **Low association btw FMS composite and injury**

- **Conclusion**
  - FMS composite is not sufficient to support its use as an injury prediction tool

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Functional movement screen comparison between the preparative period and competitive period in high school baseball players

- **55 HS players**
- **FMS:**
  - Preparative (Feb.)
  - Competitive period (May)
- **Use cutoff score 14 for relationship to injury**

FMS score ≤14?	Injury?		Predictive Value
	YES	NO	
YES	15	6	Sensitivity: 58% Specificity: 79% PPV: 71% NPV: 66% AUC: 69%
NO	11	23	

FMS, Functional Movement Screen; PPV, positive predictive value; NPV, negative predictive value; AUC, area under the curve.

- **"FMS does NOT accurately predict risk of injury in this population"**

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RELATIONSHIP OF PRESEASON MOVEMENT SCREENS WITH OVERUSE SYMPTOMS IN COLLEGIATE BASEBALL PLAYERS

- **Poor Shoulder testing**
  - Increased likelihood of experiencing overuse symptoms
- **Poor score inc chance of overuse**
  - FMS→Preseason
  - SFMA→ Pre and competitive season

- "Due to Wide confidence intervals surrounding the odds ratios the true extent FMS and SFMA are related to increased risk of experiencing overuse symptoms is uncertain"

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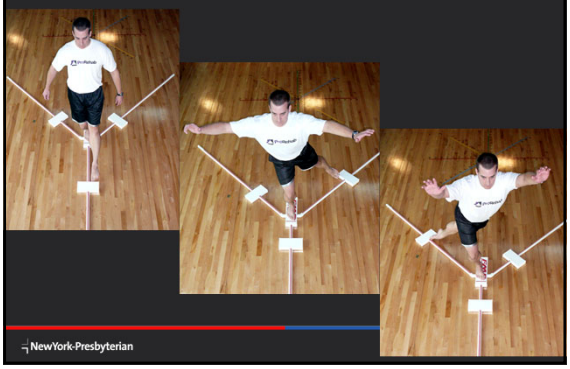
Y balance



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Effect of Long-term Isometric Training on Core/Torso Stiffness

Mcgill 2015

Isometrics vs. Dynamic

Isometric training Superior to Dynamic for enhancing torso stiffness

Increased Stiffness:

- Spine to bear great loads
- Express greater distal limb athleticism

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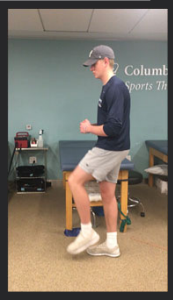
Endurance Times for Low Back Stabilization Exercises: Clinical Targets for Testing and Training From a Normal Database

Ratio of Comparison	Criteria for Good Relationship Between Muscles
Flexion:extension	Ratio less than 1.0
Right-side bridge:left-side bridge	Scores should be no greater than 0.05 from a balanced score of 1.0
Side bridge (each side):extension	Ratio less than 0.75

Lumbopelvic Control and Pitching Performance of Professional Baseball Pitchers

- 75 minor league pitchers
- Single leg balance 2 seconds
- Level Belt

- Better control ranked close to median for MLB pitchers
- Poorer control ranked in bottom 1/3



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Decreased Control:

Less	Higher
innings pitched	WHIP
Strikeouts per inning	Batting Avg
	Walks

	LB ≥ 7 (n = 16)†	LB < 7 (n = 32)†	Effect size	p Value
IP	53.4 ± 42.5	78.9 ± 38.7	0.64	0.043
WHIP	1.584 ± 0.360	1.353 ± 0.251	0.79	0.013
BAA	0.280 ± 0.059	0.260 ± 0.033	0.46	0.133
Kin	0.689 ± 0.160	0.767 ± 0.180	0.45	0.147
(BBin)	0.437 ± 0.279	0.334 ± 0.182	0.47	0.131
Age (y)	22.4 ± 2.3	22.6 ± 2.0	0.11	0.727
Number injured during season	8 of 16	12 of 33		0.362

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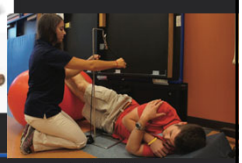
Is there a relation between shoulder dysfunction and core instability?

- KJOC
- Single Leg Balance
- Double Leg Lowering
- Sorensen Test
- Modified Plank Test



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IS THERE A RELATION BETWEEN SHOULDER DYSFUNCTION AND CORE INSTABILITY?

- KJOC
- ***Single Leg Balance***
  - Athletes with shoulder dysfunction had LESS balance vs. healthy athletes
- Balance training should be incorporated as a integral component of core stability

Core stability measure	Athletes with shoulder dysfunction	Normal athletes
Sorenson Test	81.8±(30.7) seconds	70.2 ±(31.4) seconds
Double Leg Lowering Test	9.4 ±(4.9) degrees	8.4 ±(7.5) degrees
Modified Side plank (right)	43 ±(28.6) seconds	35.1±(25.7) seconds
Modified Side plank (left)	52.1±(36.8) seconds	47.4±(41.9) seconds
Single Leg Balance (right)	10.1 ±(5.8) seconds *	18.9±(15.2) seconds
Single Leg Balance (left)	10.1±(6.7) seconds	16.9 ±(13.7) seconds

*significant at p = 0.05

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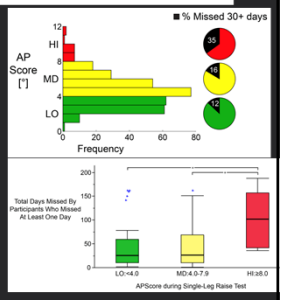
Lumbopelvic control and days missed due to injury in professional baseball pitchers

Lumbopelvic control

Exhibiting Poor Control

- 3x more likely vs Good
- 2.2s more likely vs Mod
- 2x more days missed



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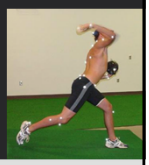
The influence of lumbopelvic control on shoulder and elbow kinetics in elite baseball pitchers

- Poor control of Drive leg
  Increased
  - H adduction torque
  - Elbow valgus torque
- SLS should be used as a screening tool/prehab/rehab



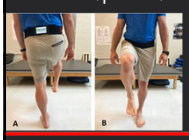


Table III Relationships between drive leg lumbopelvic control and pitching kinetics

Pitching kinetic variable	*r*	*P* value
Shoulder distraction	0.13	.41
Shoulder horizontal abduction torque*	0.44	.003
Shoulder external rotation torque	−0.24	.13
Elbow distraction force	0.07	.66
Elbow valgus torque*	0.46	.002

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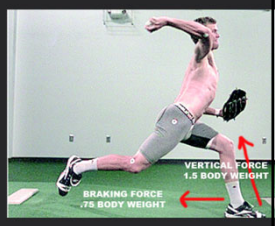
Characteristic Ground-Reaction Forces in Baseball Pitching*

- **Max ER (Stride Leg)**
  - 1.5 x BW Vertical force
  - 0.75x BW braking forces
- **Prior to ball release**
  - 1.75x BW Landing resultant
- **Leg drive correlated w/ wrist velocity**
- **Lead foot anchors the body to balance forces generated**



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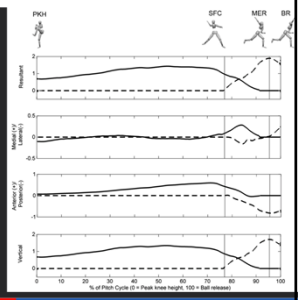
Stride Leg Ground Reaction Forces Predict Throwing Velocity in Adult Recreational Baseball Pitchers

- **Increased Stride Leg Posterior Ground Reaction forces → most predictive of ball velocity**
- **Stride leg provides stability to maximize control of body position**
- **Focus on eccentric loading**



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Bigger Engine Bigger Breaks

- **Quad**
- **Glutes**
- **Anti Flexion**
- **Anti Rotation**
- **Anti Extension**

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Split Squat

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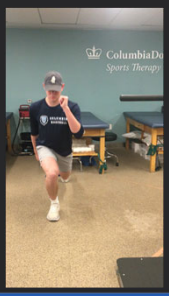
Reverse Lunge



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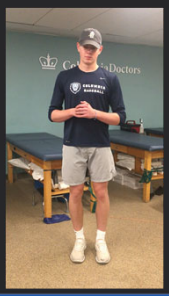
Dynamic Over Stride/Stance Leg



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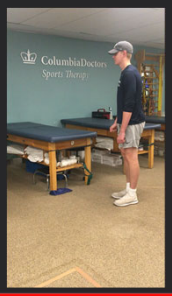
Functional Weight Acceptance



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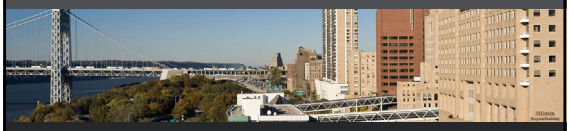
Thank You



AMAZING THINGS ARE HAPPENING HERE

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