

Performance Based Movement Screens

David Sandler, MS, CSCS*D

STRENGTHPRO

www.StrengthPro.com

david@strengthpro.com

Why Do We Test?

- Assess baseline fitness levels
- Monitor client's progress
- Assess program effectiveness
- Set goals and motivation
- Help design the specific program

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Important Test Criteria

- Reliability
 - does the test test what it is supposed to
 - having same results, repeatable
- Validity
 - is this test a good indicator of what it measures
 - specific to the test
- Test and Re -Test
- Tester Ability

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Testing Principles

- Consistency
- Measurability
- Accuracy
- Accountability

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Biomechanical Analysis

- What kind of Movements or Skills
 - Throwing, Hitting, Running, Jumping, Twisting,
- Skill Execution Analysis
 - Repetitive, Non-Repetitive, Sequential
- Break the Skill Down into Phases
 - Preparatory Stage, Initial Movement, Application of Force, Follow Through
- Understand What Can be Tested and Modified

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Testing

- Tests must be reproducible
- Equipment needs
- Staff, athlete's and parents must recognize purpose and importance of tests
- What tests to do:
 - Strength, speed, explosiveness
- All athlete's must be tested before program begins

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Testing

- Get with local coaches
 - what are they going to require of their athletes to make the team, etc.
- Get with professional scouts
 - what are they looking for
- Get with college coaches
 - what is expected of the athletes at the next level

Don't over-train for tests

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Testing

- Once you get results what do you do with them?? Numbers are just that!!
- Needs to be put into an attractive packet
 - this is why they are paying you instead of working out for free at their HS, College, Etc.

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Types of Tests

- Static Time - Muscular Endurance
- Reps - Muscular Strength and/or Endurance
- Cardio Distance - Aerobic and/or Anaerobic
- Power Distance - Anaerobic Power
- Time - Aerobic and/or Anaerobic
- Max Intensity - Anaerobic Threshold
- Speed and/or Agility

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Testing for Sports

- Pro-Agility
- Vertical Jump/ Long Jump
- Flexibility Tests
- 40/60 yard dash
- 1 RM Tests
- Bat speed tests
- Throwing Velocity Tests
- Aerobic Tests
- Shuttle Runs
- Body Comp

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Testing General Population

- Sub-maximal Treadmill/ Bike
- Blood Pressure
- Heart Rate
- Body Comp

•Good numbers just to have, throw a HRM on an athlete to see HRR is a good value, fast, easy way to determine if athlete is in condition to recover during their sport
•As former athlete's we tend to develop our programs, tests around How we used to train and were successful. This is short sided.

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Packet

- Should include:
 - Tests and why you did them
 - Results, and what that indicates
 - Training results you have gotten with other athletes (what they can expect to see in the future with your athlete)
- You should be able to compare averages over time. KEEP A DATA BASE!!!

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Movement Screens

Movement and Technique

- Technical performance of speed and power activities is crucial for optimal physical development
- Technique learning affected by
 - Prior experience
 - Emotional readiness to learn
 - Physical readiness to learn
 - Training plan

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Selecting a Starting Point

- Movement screen testing
 - Determines starting point for strength, speed and power exercise progressions
 - Nine qualitative tests are used to classify participants into one of three levels
 - Most valuable with youth but can also be used for adults

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Selecting a Starting Point

- Movement screen testing
 - Majority of pre teens and early teens will fall into level 2
 - 15% level 1
 - 70% level 2
 - 15% level 3

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The Movement Screen

- Nine tests
 - Step up
 - Box landing
 - Lateral hop landing
 - Lateral hop distance
 - Single leg lying hamstring raise
 - One legged balance T-test
 - Push up hold
 - Modified pull up
 - Lying leg raise
- Total score dictates starting level

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The Movement Screen

- Step up
 - 30 cm step
 - Aligned from shoulder to knee
 - All weight stays on foot on the step
 - No push off the back foot



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The Movement Screen

- Step Up
 - Scoring
 - Pushing off back foot – 2 points
 - Knee tracks inside big toe – 3 points
 - Bending from the waist – 3 points
 - Visible difference between legs – 7 points
 - Additive scores

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The Movement Screen

- Box Landing
 - 30 cm box
 - Knees over toes
 - Trunk upright in athletic ready position
 - Weight on front half of foot
 - 3-5 trials
 - Score based on majority of trials



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The Movement Screen

- Box Landing
 - Scoring
 - Knees pulling in or loss of balance – 3 points
 - Trunk collapses – 5 points
 - Combination – 5 points

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The Movement Screen

- Lateral hop landing
 - Jump as far as possible taking off on one leg landing on the other
 - Stick the landing
 - 3 trials

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The Movement Screen

- Lateral hop landing
 - Scoring
 - Failure to stick landing on 2 of 3 jumps – 2 points
 - Trunk collapsing – 3 points
 - Knee tracking inside big toe – 5 points



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The Movement Screen

- Lateral hop distance
 - Measure distances covered in lateral hop landing test
 - Looking for total distance but more importantly differences between right and left leg
 - Differences of more than 5% increase risk of chronic injury

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The Movement Screen

- Lateral hop distance
 - Scoring
 - $((\text{Right/ Left}) - 1) \times 100 = \text{percent difference}$

Difference	Score
< 3%	0 points
3%-5%	2 points
5%-10%	3 points
10%-15%	5 points
> 15%	7 points

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The Movement Screen

- Single leg lying hamstring raise
 - Measure hamstring flexibility
 - Goniometer needed
 - 3 trials
 - Measure from trochantère through midline of the leg



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The Movement Screen

- Single leg lying hamstring raise
 - Scoring

Angle	Score
>90°	0 points
75°-90°	2 points
60°-75°	3 points
45°-60°	5 points
<45°	7 points

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The Movement Screen

- One legged balance T-test
 - Balance flexibility and kinesthetic sense
 - Straight line from heel to head
 - T at the shoulders
 - Body parallel to the floor
 - Hold for 10s
 - One chance to correct position



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The Movement Screen

- One legged balance T-test
 - Scoring
 - Cannot hold position for 10s – 1 point
 - Failure to get leg or trunk in position – 2 points
 - Failure to get both into position – 3 points
 - Difference between left and right – 5 points



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The Movement Screen

- Push up hold
 - upper body strength measure
 - Thumbs under shoulders
 - 90° at elbows
 - Trunk straight
 - Hold as long as possible



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The Movement Screen

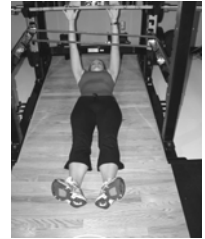
- Push Up hold
 - Scoring

Time	Score
0-10s	7 points
10-20s	5 points
20-30s	3 points
30-40s	2 points
40s+	0 points

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The Movement Screen

- Modified Pull Up
 - Upper body pulling strength
 - Set bar just out of reach
 - String 15 cm below bar
 - 60 cm between fingers
 - Straight body
 - Chest touches string
 - As many pull ups as possible
 - Must maintain position



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The Movement Screen

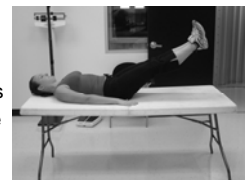
- Modified pull up
 - Scoring

Number	Score
0- 10	5 points
11- 15	3 points
16-20	2 points
21-25	1 point
26+	0 points

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The Movement Screen

- Lying leg raise
 - Core strength
 - Start at legs perpendicular to ground
 - Back tight against floor
 - Lower legs to floor – 15s counts
 - Measure where back lifts
 - Trochanter down midline of leg



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The Movement Screen

- Lying leg raise
 - Scoring

Angle	Score
< 15°	0 points
15°- 45°	2 points
45°-60°	3 points
60°-90°	5 points
Cannot keep back flat	7 points

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The Movement Screen

- Interpreting the results
 - Your score on the test will place you in one of three program categories
 - A lower score indicates fewer areas of weakness and imbalance
 - Level One: Score 40+
 - Some significant problems exist that should be addressed
 - Certain activities/movements are restricted
 - Level Two: 22-39
 - Some problems exist, but activity is not drastically restricted
 - Level Three: 0-21
 - Problems are negligible, no real restrictions on activity

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The Movement Screen

- Level 1 – Focus on
 - Ground based balance activities both single and double legged.
 - Emphasizing the mastery of basic body positions and movements like squatting, running forwards and backwards, shuffling, crawling and climbing.
 - Abdominal strengthening
 - Light weight medicine balls and other light implements like rubber tubing should be used in place of push ups and other body weight exercises.
 - The mechanics of body position change should be emphasized during low speed turns, cuts and corners
 - Landing mechanics from low level boxes or steps
 - Obstacle courses built around climbing over, crawling under and stepping over or around various objects.
- Adolescent and post adolescent subjects should begin a weight training program

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The Movement Screen

- Level 1 – Avoid
 - Rapid changes of direction
 - Single leg jumps
 - Multiple response jumps
 - Olympic style lifts
 - Jumps off higher boxes or objects
 - Single limb isolation strength exercises
 - Equipment based balance training

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The Movement Screen

- Level 2 – Focus on
 - Ground based and equipment based balance drills
 - Free weight and body weight exercises
 - Basics change of direction drills
 - Low level two legged jumps and hops over hurdles
 - Two legged ladder drills
 - Single response jumps onto boxes with landing
 - Flexibility
 - Abdominal strengthening
 - Rotational drills

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The Movement Screen

- Level 2- Avoid
 - Multiple response jumps
 - Single leg jumps and hops
 - Depth jumping
 - Olympic style lifts

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The Movement Screen

- Level 3
 - No restrictions
 - Follow logical progressions from simple to complex, double to single limb and single to multiple response

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Program Considerations

- **Disclaimer:**
 - The guidelines and programming considerations are based on relativity. The term poor for an elite athlete refers to his/her ability as compared to the rest of the team.
 - Exercise selection and progression is based on ability of the specific issue in question. Someone who possesses great upper body strength but weak lower body strength would have a separate “diagnosis” and “prescription” per each area.

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Programming Considerations

- **Level 1 (Score 40+)**
 - Marked Overall Weakness
 - general strengthen is needed
 - Poor Control for Fine Motor Movements
 - general balance/coordination skills needed
 - Poor Activation of Stretch-Shorten Cycle (SSC)
 - eccentric strengthening is needed
 - Poor Flexibility/Range of Joint Motion
 - general stretching program required

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Recommendation

- Overall strategy to improve all areas of fitness and general conditioning through strong progressions with both general and specific exercises

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Programming Considerations

- **Level 2 (Score 22-39)**
 - Specific Areas of Weakness
 - strength training directed at those areas
 - Awkward Mechanics in Movements
 - “clean up” techniques through specific drills
 - Possible Timing Issues for SSC
 - develop progressions to improve eccentric transfer
 - Isolated and/or General Flexibility Issues
 - increase range of motion in specific joints

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Recommendation

- Overall strategy to begin to build explosive strength and speed. Focus on mechanics and execution while developing timing. Exercises should be specific by need.

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Programming Considerations

- **Level 3 (Score 0-21)**
 - May Have Isolated Weakness
 - specific training of area if needed
 - Strong Mechanics
 - develop challenging motor skill drills
 - Good SSC Activation
 - increase drill intensity and volume, focus on skill
 - Flexibility Issues?
 - May have flexibility problems by joint, but may not affect performance – train accordingly

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Recommendation

- Build Strength, Power, and Speed
- Focus on timing and improving coordination, but mostly on repeated ability to produce resisting fatigue and maintaining power.

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Exercise Selection

- **Level 1**
 - Basic Strength Training
 - Emphasize technique, use controlled deliberate movements (2-3 sets of 10 reps)
 - Basic Agility – Balance Drills
 - Emphasize technique and body position using both static and dynamic exercises (basic cuts/movements)
 - Stretch Shorten Cycle Mechanic Training
 - Teach landing progressing the height and/or load of eccentric activity
 - Improve Flexibility
 - General static stretching programming. Use dynamic stretches in warm-ups

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Exercise Selection

- **Level 2**
 - Strength Training
 - Emphasize timing and begin to speed up concentric contraction rate (2-3 sets of 6-8 reps till failure). Work on technique of explosive lifts.
 - Agility – Balance Drills
 - Work on direction change mechanics with body position and “first-step” explosiveness
 - Plyometric Training
 - Develop ability to contract after impact. Increase difficulty of drill as athlete masters each progression
 - Flexibility Training
 - Dynamic, PNF, Active-Isolated methods should be employed by sport requirement

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Exercise Selection

- **Level 3**
 - Strength Training
 - Add explosive exercises to the strength training program (3-5 sets of 3-6 reps explosive)
 - Agility – Balance Drills
 - Advanced drills emphasizing “off-balance” and single-support situations
 - Plyometric Training
 - Increase drop height/intensity, volume and difficulty. Emphasize single leg, backward, lateral movement
 - Flexibility Training
 - Explosive flexibility type movements should be included in the training program

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Sport Analysis

A Testing Tool

Components of Sport Analysis

- Doing a Sport Analysis involves both observation and research
- Most information is available in published studies. If not you will have to find it elsewhere

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Components of Sport Analysis

- **Time Motion Analysis**
 - Analyze video tape of the sport to determine
 - Total playing time
 - Work: Rest intervals
 - Duration of work and rest periods
 - Frequency of skills
 - Type of movement patterns
 - Total work time

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Components of Sport Analysis

- Biomechanical Analysis
 - Maximum forces developed
 - Muscle use patterns (EMG)
 - Velocity and acceleration

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Components of Sport Analysis

- Elite Performance Analysis
 - Research studies that have examined various fitness components of elite performers in the sport
 - Aerobic capacity
 - Strength
 - Flexibility
 - Power
 - Helps set goals and prioritize training

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Components of Sport Analysis

- Injury Analysis
 - Analyze injury patterns in the sport to determine the frequency and type of injury
 - Helps determine which injuries need to be prevented
 - Helps set goals for early phase of strength program

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Designing Your Own Tests

Goals of a Testing Program

- Collect accurate and reproducible data for
 - Improving exercise prescription
 - Describing current fitness levels
 - Developing group norms and standards for comparison
 - Measure effectiveness of a training cycle
 - Research

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Types of Tests

- Lab Tests
 - Controlled environment
 - Measure solely the underlying physiological or biomechanical traits without regard for performance
 - Very accurate and repeatable
 - Expensive, time consuming and often not available
 - Vertical jump on a force platform

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Lab Like Tests

- Combine physiological measures with performance measures
 - HR recovery following a sprint
- Less control of environment
- Accurate and repeatable but less so than lab tests

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Performance Tests

- Measure only a performance not the components that make up the performance (vertical jump, pro agility)
- Good for descriptive or group comparison but not great for prescription
- Simplest and least expensive to implement

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Test Batteries

- No single test tells the whole picture
- Test packages should be selected to assess all underlying physical components that go into an athlete's performance.
- Use the power continuum to help guide your test selection

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Designing Tests

- Must be relevant to the sport
 - Specificity vs general abilities
- Must not be technique dependant
- Ideally measures only one aspect of the sport
- Repeatable
- Implemented the same way each time

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Speed Tests

- Bike Sprint
 - Measures leg turnover
 - Monark bike
 - Video camera or ability to read RPM
 - Done with no load
 - Sprint as fast as possible for 15s
 - Record maximum turnover rate.

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Speed Tests

- Bike Sprint norms

	Speed	Speed/strength	Explosive	Strength's speed	Strength
Men	14.25-16.5	13.75-15.0	13.0-14.25	12.0-13.5	9.0-11.5
Women	14.0-16.0	13.0-14.5	11.0-12.75	11.25-12.75	9.0-11.0

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Speed Tests

- Throw Velocity
 - Measures throwing speed
 - Isolated arm action
 - Full throwing motion
 - High speed video or radar gun
 - If using radar need to be directly in front of the object being measured
 - 5 trials
 - Record the best score

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Speed-Strength Tests

- Sprints
 - 40 yard sprint
 - 10 yard acceleration
 - Stride length test
 - Video camera perpendicular to track
 - Place a cone every meter for a 10 yard segment in the middle of the 40 yard sprint
 - Analyze video to determine number of strides to cover 10 yards.
 - Alternative is to sprint on a cinder track where foot prints will be left and distance for each stride can be measured

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Explosive Power

- Jump testing
 - Vertical, long or lateral
 - Countermovement and static
- Med Ball Throws
 - Seated or standing
 - Vertical or horizontal
 - Variety of weights

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Strength-Speed Tests

- Loaded Vertical jumps
 - Develop force velocity curve
- Barbell throw in a Smith Machine

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Strength Tests

- Need to determine 1RM in order to prescribe weight to be used
- With beginners should only be done after a 4 week technique learning period
- Measured 1RM
 - 4-5 warm up sets followed by 3-4 max attempts
 - weight increased with each set
 - rest 2-3 minutes between attempts

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Strength Tests

- Estimated 1RM
 - Find a weight the client can lift 2-10 times
 - Perform as many reps as possible with that weight
 - use the formula below

$$1 \text{ RM} = (0.033 \times \text{reps}) \times \text{weight} + \text{weight}$$

$$1 \text{ RM} = (0.025 \times \text{reps}) \times \text{weight} + \text{weight}$$

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Using Tests For Training

Data Analysis

- Most important part of testing
- Statistics
 - Correlations
 - Regressions/predictions
- Comparison to published norms
- Test package data must be cross referenced

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Data Analysis

- Look for changes in performance vs previous test or previous year
- Compare to others in the group
- Historical comparisons
 - Comparison to previous teams

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Analyzing Test Packages

- VJ and Static VJ
 - Combined they measure the effectiveness of the stretch shortening cycle
 - >15% difference stretch shortening cycle use is good
 - <15% difference jump power is coming from strength not SSC

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Analyzing Test Packages

- One step VJ and VJ
 - Difference should be at least 15%
 - If one step VJ is lower than VJ eccentric strength is inadequate

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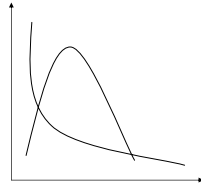
Analyzing Test Packages

- Bike Sprint, Stride length, 40 yard sprint
 - Measures sprint performance and it's components
 - Use 40 as base and then examine stride length and leg turnover to see where there is a weakness

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Analyzing Test Packages

- Loaded jumps and throws
 - Plot force velocity/power curve
 - Where does peak power occur?
 - Does it match with the continuum values for the sport
 - If not adjust training to shift the curve in the appropriate direction



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Analyzing Test Packages

- 1RM and VJ
 - If 1RM is high and VJ is low perform bike sprint test to check speed.
 - If speed is fine check body composition

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Analyzing Test Packages

- Lab tests provide a whole other level of analysis
 - True force and power measures
 - Rate of force development
 - Reactivity
 - Force curves
- Allows for greater insight into the performance

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Planning a Testing Program

- Treat tests like a competition
 - Recovery prior to testing
 - Mental preparation
- Full test batteries performed 3 times per year
- Cycle specific tests every training cycle

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Sources for Norms

- Journal of Strength and Conditioning Research
- Essentials of Strength and Conditioning
- Sports Power (due out in November)
- Sports Speed
- Physiological Tests for Elite Athletes
- Physiological Testing of the High Performance Athlete
- All are available for Human Kinetics Publishing

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Final Thoughts

- Design tests that help you understand your client's needs
- Use your tests to help you build a better program
- Test client's often enough to see results but not too often so that you become a product of training to be better at testing.

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References

- Journal of Strength and Conditioning Research
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