

Shoebox Rehab: Maximizing Outcomes with Limited Resources

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Objectives

- Discuss the concept of periodization and how it applies to PT
- Discuss performance training variables and how they apply to PT
- Discuss how to manipulate training variables to maximize your time and resources
- Discuss ways to challenge the higher level patient

What is the impetus for this talk?

- Legal witness experience
- Insurances are cutting back
- Must be able to progress the higher level patient with limited resources
- Tired of going to courses that have cool toys that I don't have in my toy room!!

What's the impetus for this talk?

- Strength/Conditioning literature vs. PT literature
- "Standard rehabilitation protocol" ??
- Very little data on performance training variables in PT
- I think as a whole, we don't do a great job with training variables
 - Lots of "3x10" or "3x15"

Our "Shoebox"

- About 2000 sq ft
- Bands and balls
- 2 Step sets
- Set of dumbbells
- Agility ladder
- Leg press
- Elliptical, bike, and treadmill
- Weighted balls
- Rebounder
- Balance devices (BOSU, Airex pad)
- Multi-station machine

HISTORY OF RESISTANCE TRAINING MODELS

DeLorme Technique DeLorme JBJS 1945

- 3 sets of 10 with progressive loading during each set
- Resistance increase is based on how many reps performed each set

Daily Adjusted Progressive Resistance Exercise (DAPRE)

- Developed to provide strength after knee surgery
- Key is that on the 3rd and 4th sets, patient performs as many reps as possible
 - 1st set, 50% max performed 10x
 - 2nd set, 75% of max for 6x
 - 3rd set to of max to fatigue

Cordova et al, J Ath Train, 1995

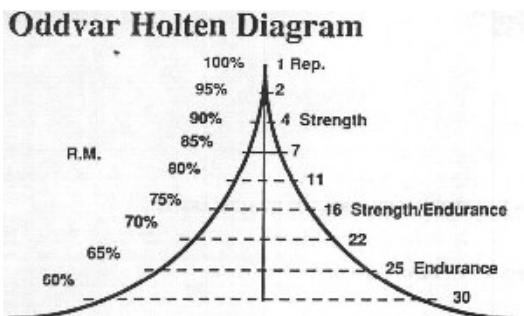
DAPRE

- If lifted only a few times:
 - Weight reduced 5-10 lbs
- If performs 5-6 reps:
 - Weight stays same
- If more than 6 reps:
 - Weight increases 5-10 lbs.

Oddvar Holten

- Norwegian PT
- Developed “Medical Exercise Therapy”
- Utilized “Oddvar Holten Curve” to determine resistance

Holten Diagram



Example

- Let's say the athlete can do 10 lbs for 16 reps (75% on scale)
- Divide $10 / 0.75 = 13.3$ lbs.
- Therefore, the 1 RM for that exercise is roughly 13 lbs.

PERFORMANCE TRAINING VARIABLES

Load

- Amount of weight assigned to an exercise
- Inverse relationship between load and reps performed
- How to increase load as a PT:
 - Based on 1 RM
 - Increasing load based on a targeted rep number
 - Increasing load within a prescribed zone

Volume

- Summation of total reps performed X the resistance
- How a PT can change the volume:
 - Changing number of reps per set
 - Changing number of sets per exercise
 - Change the number of exercises per session

Progressive Overload

- Based on the SAID Principle
- Stress must be increased to produce greater power, force, or endurance
- Should be 2.5-5% per week to avoid overtraining ACSM
- How a PT can progressively overload:
 - Increase resistance
 - Increase training volume
 - Increase sets, reps, or exercises performed
 - Altering rest periods
 - Increasing repetition velocity

Specificity

PERIODIZATION

Periodization

- Periodization is a programmed manipulation of training variables throughout a training cycle
 - Volume, sets, reps, intensity, training frequency
- Based on Selye's "General Adaptation Syndrome"
 - Body will adapt to stressors and meet the demands on the system

Classic/Linear Periodization Bompa,

Matveyev

- Changing exercise volume and load in progressive, predictable cycles
- Most rehab protocols follow this model

Non-linear/Undulating Periodization

Polliquin

- Volume and load are altered daily or within the week
- Phases are much shorter and provide more frequent changes in stimuli
- May be more appropriate for athletic population
 - Accommodates for in-season or for sports w/ multiple competitions

Reverse Linear Periodization Rhea et al.,

J Strength Cond Res 2003

- Follows modifications in load and volume, but in reverse order
 - Increases volume and decreases load
- How might we use this in rehab?

Block Periodization Issurin Sports Med 2010

- Periodization scheme with highly concentrated specialized workloads
- Each cycle has large volume of exercises directed at a minimal number of targeted abilities
- 60-70% of training time is devoted to each specific ability while rest is warm-up/cool down and stretching/recovery

Why?

- Good for athletes who need multiple peaks per year
- Classic periodization has endurance, strength, hypertrophy, power regardless of sport
- Increase in basic abilities in classic program but each declines in competition phase
- Block system allows basic and sport abilities to be maintained throughout year
- Broken down into 2-4 week blocks

Theory

- Minimize target abilities trained
- Balance, strength, agility can't be trained simultaneously
- Contrary to other means of training, the block program doesn't do things like "complex training"
 - Shouldn't work plyometrics and strength train in the same session

Example in a patient s/p ACL reconstruction

- Weeks 0-8 – decrease pain, increase ROM, increase strength, etc
- Weeks 8-10 – Work on proprioception and neuromuscular re-ed in multiple planes
- Weeks 10-14 – Eccentric quad and hamstring strength development
- Weeks 14-16 – Technique development for sport specific impact activities, repeated practice, consistent feedback
 - Sagittal plane emphasis

Example

- Weeks 16-20 – Random practice, plyos/agility drills, progress to frontal and transverse planes
- Weeks 20-24 – Power development, emphasize speed of performance
- Weeks 24-28 – Metabolic training for their sport
- Weeks 28-30 – Restoration phase to prepare for competition/return to sport practice
 - Yoga, footwork drills w/ ladder, dynamic warm ups

Why this may help in rehab...

- Allows shorter phases to focus entirely on one aspect of training
- May help w/ "hitting the wall"
- Higher emphasis on metabolic training towards the end of the cycle

Whoa, whoa whoa! Why all this "strength and conditioning" talk at a PT conference?

- Well, isn't this a huge part of what we do – develop a plan?
- This is just an opportunity to share methods in a related field that you can apply to practice

Periodization in Rehab Literature

- Wong et al, J Ath Train 2009
 - Groups treated for PFPS
 - One group 5x5 w/ 2 minutes rest between sets
 - Other did 4x10 w/ 1 minute rest
 - No difference
- Kell et al, J Strength Cond Res 2009
 - Aerobic training vs. linear periodization in chronic LBP
 - Resistance training group did better than group w/ aerobic training for pain, but both helped other variables

Autoregulatory Progressive Resistance Exercise (APRE)

- Mann et al, J Strength Cond Res 2010
 - Adjusts for the individual athlete's adaptations on a day-to-day or week-to-week basis
 - Can increase at their own pace
 - 10 RM, 6 RM, or 3 RM; 4 sets of each exercise
 - Athlete chooses day to perform said resistance

In this study, athletes showed greater benefit with this approach compared to a classic/linear program

Endurance

- Defined as the ability to resist fatigue or work for prolonged periods of time
- Speed-endurance
- Strength-endurance
- Who might need these?

Endurance Training

- Sets vary anywhere from 25-150 reps
- Very short rest periods
- Very low loads

Strength

- Strength is the ability of the muscle to exert force at a specified velocity
- Patients work in all types of contraction and in multiple planes

Strength

- Low to moderate volume (8-10 sets)
- Repetitions: 1-8
- Load is up to 100% of 1 RM
- Rest periods are 1-3 minutes

Speed-Strength

- Speed of movement overcoming small resistance OR effort rapidly developed to overcome large resistance Verkhoshansky and Siff
- 20% of 1RM with brief duration coupled with resistance exercises of up to 40% 1RM

Strength-Endurance

- Ability to produce muscular tension over a long period of time without decrease in efficiency Verkoshansky and Siff
- 25-50% at moderate tempo (60-120 reps/minute)

Power

- Power is work per unit time, or force X velocity
- Need both heavy and light training to maximize power
- 30% 1RM superior in developing athletic performance Wilson et al, MSSE 1993

Power

- Low to moderate volume (4-8 sets)
- Load is 30% of 1 RM
- Repetitions: 3-6
- Rest periods: Full recovery

Hypertrophy

- Defined as an increase in muscle size
- When do we need this in rehab?
- 8-12 reps per set, 4-6 sets, short rest periods
- Also could go reps to fatigue Bompa
- Thought experiment:
 - What happens when a patients involved quad is symmetrical to what the uninvolved was at initial eval, but the uninvolved is still appreciably larger?

Training for Strength

- Elastic band/Heavy Chains
 - Variable resistance training
- Multi-joint exercises
- For some patients, “place and hold” is an excellent approach
- Eccentric training
 - More effective at increasing total and eccentric strength than concentric training Knuttgen and Kraemer J Appl Sport Sci Res 1987

Training for Power

- *Olympic movements*
 - Excellent way to develop balance, coordination, strength
 - Can use PVC piping, dowel rods, “Body Bar”, or DB’s
- *Plyometric/Ballistic Training*
- *Complex Training*
- “*Heavy/Light*” sets – low rep heavy set, rest 10-20 seconds, followed by lighter weight for 3-5 reps as fast as possible Verkoshansky and Siff

Complex Training

- Performing biomechanically similar high-load weight training with plyometric exercises in the same workout Alves et al, J Strength Cond Res 2010
- Theory centers around *Postactivation Potentiation (PAP)*

PAP Robbins J Strength Cond Res 2005

- Exerted muscle force is increased due to its previous contraction
- Contractile history influences mechanical output of future contractions

Mechanisms of PAP

- Increased excitation of spinal cord, which increases post-synaptic potentials and increased force-generating capacity Grange et al Can J Appl Physiol 1993; Judge Strength Cond J 2009; Sweeney et al, Am J Physiol 1993
- Actin-myosin become more sensitive to calcium released from the sarcoplasmic reticulum during subsequent contractions Rassier et al, J Electromyogr Kinesiol 2002

Complex Training: Application

- Leg press followed by a jump squat
 - 4x6 in leg press, 4 x4 jump squats
- Currently, it's advocated that the patient rest 8-12 minutes prior to performing the plyometric activity Kilduff et al, J Strength Cond Res 2007

Training for Speed

- Two factors:
 - Stride length
 - Running up hill, bounding
 - Stride frequency
 - Assisted sprints, "Fast-leg" drills, run down hill
- Resisted running/Assisted running

Training for Hypertrophy

- Moderate volume (10-12 sets)
- Load is up to 80% of 1 RM
- Repetitions: no more than 12
- Rest periods are no more than 1 minute OR before full recovery

Training for Endurance

- High volume (15 sets) of several exercises
- Repetitions from 15-25 OR for a specific time interval
- Load is 30-50% of 1 RM
- Rest periods are 10-30 seconds

Endurance Clark J Strength Cond Res 2010

- **Mixed Intensity Interval Training**
 - 6 minute intervals
 - 30 seconds sub-max jog, 30 secs 90-100% effort
 - 60 secs submax jogging, 60 secs of 80-90% effort
 - 90 secs of submax jogging, 90 secs of 70-80% effort

Training for Metabolic Capacity

- Three systems:
 - ATP – 2-10 seconds
 - Lactic Acid/Anaerobic – about 10-40 seconds
 - Aerobic – 2-3 minutes to several hours
- Structure exercises and work:rest ratios to match demand for their activity
- Med Balls, Kettlebells, DB complexes, “CrossFit” are a great way to do this

Single v. Multiple Sets

- Trained individuals performing multiple-sets generated significantly greater increases in strength and were superior to single sets
- In untrained individuals, one set resulted in similar gains to multi-set programs
- As progression occurs and gains are realized, need to shift to multi-set

Exercise Structure

- Ascending/Descending
- Pyramid
- Compound Setting
- “Wave” training
- Super-setting
- “Active recovery”
- “Push/Pull”
- Upper Body Push/Lower Body Pull and vice versa
- Complex Training

Ascending/Descending Sets

- Repetition load either progressively increases or decreases
 - X 6, x8, x12, x12; x 12, x10, x8, x6
- Good way to develop strength-endurance
 - Why is that important??

Pyramid Sets

- Set structure in pyramid format
 - x 12, x10, x6, x6, x10, x12
- Also good for strength-endurance and hypertrophy

Compound Setting

- Performing two exercises consecutively for the same muscle group
- Excellent for muscle hypertrophy and endurance
- Example: DB Bench Press followed by Push ups

“Super Setting”

- Performing agonist/antagonist exercises consecutively
- Helps encourage symmetry of training
- Good for endurance, strength, and hypertrophy
- Allows for greater recovery of agonist
 - Allows the patient to go heavier w/ each exercise
- Example: Bicep curl and Tricep extension

“Wave Training”/Heavy Light Sets

- Set structure where the load varies
 - x 4, x12, x4, x12, x4, x12

“Push/Pull”

- Exercises alternate with pushing and pulling movements, performed consecutively
- Helps w/ symmetry
- Great for short workouts
- Can do upper body push/lower body pull or vice versa
- Example: Bench press and Seated row OR Bench press and Deadlift

“Active Recovery”

- Great tool for rehab as it allows the patient to keep moving and doing something constructive while allowing recovery of major muscle groups
- Strength exercise followed by balance/proprioceptive exercise
- Example: Leg press followed by balance exercise w/ rebounder

Plyometrics

- “Ply” = measure, “Metric” = increase
- Stretch-Shortening Cycle
 - Foundation of plyometrics
 - Deceleration followed by rapid acceleration

Physiology of Plyometrics

- Main mechanism is via the muscle spindle
- High stretch rate results in greater concentric contraction
- Three phases:
 - Eccentric
 - Amortization
 - Concentric

Guidelines

- Depth jumps (>18 inches) should not be performed by athletes >220 lbs
- Should not be performed on consecutive days for one muscle group
- Should not be performed when an athlete is fatigued
- Footwear and surface should have good shock absorbing capabilities
- Warm-up should be performed before program

Program Design

- Frequency: 1-3 days/week
- Volume: # of foot contacts
 - 80-100 for beginners, 100-120 for intermediate, 120-140 for advanced
- Intensity: based on height of jumps
- Progression
- Recovery: work/rest ratio
- Direction of motion

Progression

- Step 1:
 - Jump TO box
 - Works on technique
- Step 2:
 - Jump FROM box
 - Teaches muscle to override GTO
- Step 3:
 - Reactive

Guidelines

- Not recommended to perform heavy strength training on the same day as plyometrics for the same muscle groups
- Can combine LE strength with UE plyos and vice versa
- Should have 24-48 hours of recovery between heavy strength training and plyometric workouts

Types of Movements

- Jump
- Hop
- Bound
- Shock

Objective Measurement

- # of Hops/jumps for TIME
- Hops/Jumps for DISTANCE
- Vertical jump height
- Reps to fatigue

Box Jump



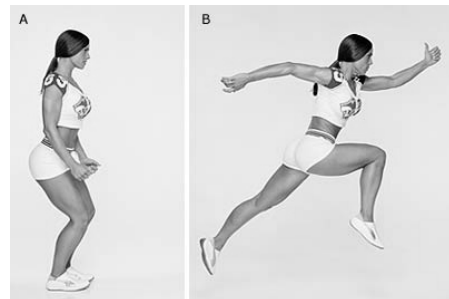
For those of you working with spinal cord injured patients...

- “Supersitting” is non-impact plyometrics that can be done in a wheelchair OR for athletes who require high levels of upper body power and endurance
- Follow diagonal and spiral paths that cross midline of the body
- Developed by Lisa Ericson

Countermovement Jump



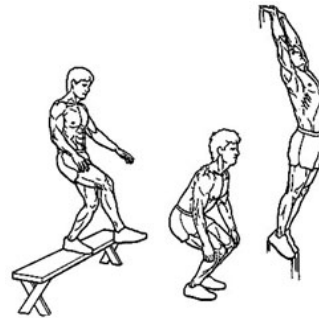
Bounding



Power Skips



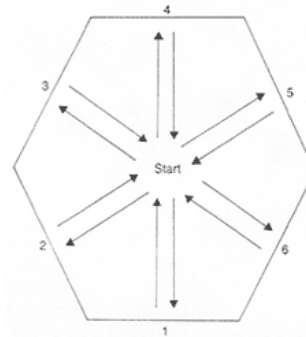
Depth Jump



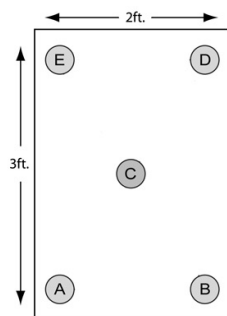
Tuck Jump



Hexagon Drill



Dot Drill



T-Drill

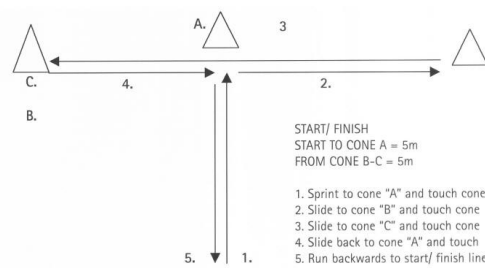
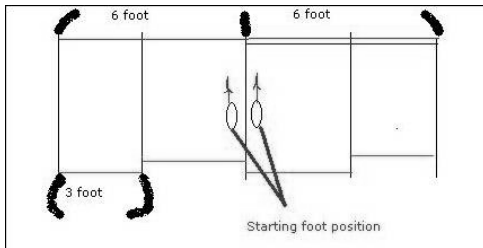
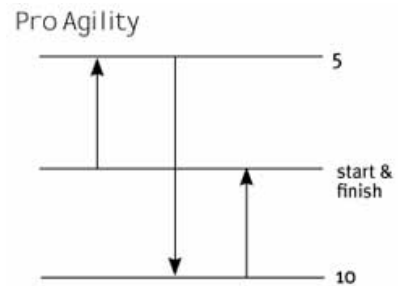


Figure 1: The T-drill

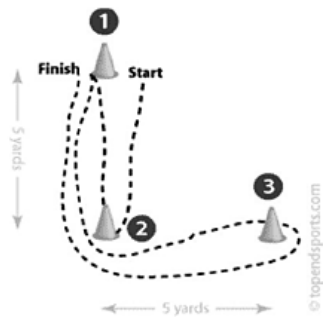
Edgren Side Step



Pro Agility Drill



3 Cone Drill



FUNCTIONAL TESTING

Performance Testing

- Lower Extremity
 - Single leg hop for distance
 - Triple hop for distance
 - Timed 6 M hop
 - Side-to-side hop test
 - Hop series tests
 - M/L hop
 - Figure of 8 hop test

Colby et al, JOSPT 1999; Risberg and Ekland JOSPT 1994; Reid et al, Phys Ther 2003; Wilk JOSPT 1994; Itoh et al, KSSTA 1998; Petschnig et al, JOSPT 1998

Performance Testing

- Upper Extremity
 - One arm hop test
 - Falsone et al, JOSPT 2002
 - Medicine ball chest pass
 - Davis et al, J Strength Cond Res 2008
 - Backward medicine ball throw
 - Clemons et al, J Strength Cond Res 2010

Thank You!