Power Development
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Power
- The ability to develop a high amount of force in a short period of time, termed rate of force development (RFD)
- The muscle’s ability to continue producing force output as its velocity of shortening increases
- Strength increases are specific to the velocity at which you train
- Resistance training should be performed at high speed if the goal is to increase power (Kraemer, Newton 1994)

![Power Curve](image)

**Power Curve**
- Force/Velcity Curve
  - Resistance Training
    - Dynamic Effort - 40-60% 1rm
    - Tendo Fitrodyne Unit
    - Bands/Chains
  - Ballistic Training
    - Approx. 50% 1rm
    - Propulsion into space
    - Jump Squat, Bench throw, MB, PUDS
  - Plyometrics
    - Stretch Shortening Cycle (SSC)

Resistance Training
- Conjugate System
  - Max Effort
  - Repetition
  - Dynamic Effort
    - 40-60% 1rm
    - Focus not only on weight but velocity at which the bar moves
  - Specific Strength
    - Circa Max
    - Absolute Strength
    - Strength-Speed
    - Speed-Strength

Tendo Fitrodyne Unit
- What is it?
  - Device used to measure the speed of the bar
    - Peak Velocity/Power
    - Avg. Velocity/Power
- Why is it important?
- How does it work?

Tendo
- Why
  - Objective Feedback-Communication
  - Specific to Adaptation Desired
  - Prevention of Failure- CNS
  - Autoregulation-Overtraining
  - Competition Intensity
- How
  - Ascending/descending, adjustment by set
  - Same weight repetition, adjustment by velocity
  - 8 x 3 set, adjusted
  - Same weight, repetition adjusted
  - Same weight and reps, multiple sets until there’s a drop off
  - Set total of reps, variable sets
  - Velocity adjustments for bands
  - (Mann 2009)
Coach/Athlete Communication

- **Subjective**
  - "Move Faster!"
  - "That wasn't quick enough!"

- **Objective**
  - No longer the coach's opinion, it is a measurable fact

Important Factors

**Prevention of Failure**

- Failure is very taxing on the CNS
  - If athlete is below 0.3 m/s they generally only have 1-2 reps left
  - One of the biggest benefits is simply ensuring that the athlete is sufficiently recovered
    - (Mann 2009)

**Autoregulation**

- Allows athlete to perform at their best on that given day
  - Pre-Session assessments
    - Tendo: Olympic Lifts, Squat Jumps, Plyo Pushup
    - W/out Tendo: Vertical, broad jump, MI drop
    - Physical/Mental ratings of athlete
  - In-Session
    - Tendo: use velocity to make adjustments
    - Art of coaching

Competition Intensity

- **Flipping the switch**
  - Excitement and intensity of workout

- **Quantifiable feedback**

Velocities

- **Hang Snatch**: 1.35-1.96 m/s
- **Hang Clean**: 1.3-1.4 m/s
- **Bench Press**: 0.8-1.0 m/s
- **Squat**: 0.8-1.0 m/s
- **Speed-‐Strength**: 0.7-0.85 m/s
- **Circa Max**: 0.45-0.58 m/s
- **Absolute Strength**: 0.3-0.35 m/s
  - (Mann 2009)

Bands/Chains

- **Speed-‐Strength**
  - 75% of total load should come from bands and 25% from actual bar weight
  - Velocities adjusted: 1.0-1.3 m/s for squat and bench

- **Strength-‐Speed**
  - 50% of total load should come from bands and 50% from actual bar weight
  - Velocities adjusted: 0.4-0.5 m/s

Purchasing Equipment

- [Sorinex](https://www.sorinex.com)
Ballistic Training

- Ballistic-accelerative, high velocity, actual projection into space
- In 1 rm lift as much as 24% of concentric movement spent decelerating, increased to 52% in 80% of 1 rm lift
- Release of implement limits the amount of deceleration

- 30% resistance produced the greatest increase in force and power over the entire concentric velocity range and also resulted in the greatest increase in maximum mechanical power
- As low as 15% resistance can be used (MB,PUDS)
  - (Kraemer, Newton 1994)

Plyometric Training

- Drop/Depth Jump
  - Jump height will increase as drop height increases but only to a point
  - Golgi tendon organ reflex inhibits muscle action
  - After a period of plyometric training, the inhibitory effects are reduced
  - (Kraemer, Newton 1994)

- Plyometric training increases the overall neural stimulation of the muscle, and thus force output
  - Plyometric Progression
    - Simple to Complex
    - Ground to Elevated
    - General to Specific
    - Bilateral to Unilateral

Power Summary

- Strength increases are specific to the velocity at which you train
- Train the entire Force/Velocity Curve!

Programming and Periodization

The Annual Plan

Progression

- General to Specific
- Simple to Complex
- Weight Room to the Track

10 Fitness Domains

- Cardio R.E.
- Stamina
- Strength
- Flexibility
- Power
- Speed
- Coordination
- Accuracy
- Agility
- Balance

- Top 4
  - Organic: cellular level, improved with training
- Middle 2
  - Both
- Bottom 4
  - Neurological: CNS, Movement patterns, Improved with practice
Energy Systems
- Aerobic or Oxidative
- Anaerobic lactic or Glycolytic
- Anaerobic alactic or Phosphagen

Classification of Sport
- Neural
  - Predominant utilization of anaerobic alactic
  - Sports: Sprinting, jumping, throwing
- Metabolic
  - Predominant demand of aerobic energy system and partially by the anaerobic lactic system
  - Sports: Triathlon, marathon, long-distance running
- Mixed neural-metabolic
  - High demand for and utilization of aerobic and anaerobic energy
  - High demands on CNS and PNS
  - Sports: Middle-distance events, basketball, field hockey, ice hockey, soccer, volleyball, tennis

Effect of Fatigue on Trainability
- Fresh (no fatigue)
  - Pure Speed
  - Acquisition or refinement of new motor patterns
  - Coordination or technical execution at higher specific speed
  - Speed-Strength
  - Maximal Strength
- Low Fatigue
  - Speed endurance (alactic capacity-lactic power)
  - Strength endurance
  - Technical Skill
  - If objective is to stabilize motor pattern under a variety of conditions
- Moderate Fatigue
  - Lactic capacity
  - Aerobic power
  - Specific sub-maximal aerobic endurance
  - Technical Skill
  - If the objective is to stabilize the motor pattern under a variety of conditions
- High Fatigue
  - General aerobic endurance
  - Flexibility

Hierarchy of Competitions
- Train-through
  - Training cycles remained unchanged
- Tune-Up
  - Slight adjustment in training cycle to see how you measure up
- Important
  - Very close to peak
- Major Competitions
  - Arrival of peak

Organization
Cycles
- Macrocycle
  - Yearly Plan
- Mesocycle
  - 4-8 week blocks of training
- Microcycle
  - 7-10 days

Phases
- General Preparatory Phase (GPP)
  - General Physical Preparedness (GPP)
  - Consistency
  - CrossFit
- Specific Preparatory Phase (SPP)
  - Specific Strength
  - Circa-Max, Absolute Strength, Strength-Speed, Speed-Strength
  - Pre-Competition Phase (CP)
  - Competition Phase (CP)
  - Transition or Recovery Phase

Sequence of Activities
- Technical work
  - Learning new skills: after the w-up, before the CNS and PNS are fatigued
- Pure Speed (alactic power)
  - Should be performed on separate days as the above
- Anaerobic lactic
- Anaerobic alactic
- Aerobic
  - Higher quality
  - MAP
  - Lower quality
  - LSD
Coaching Terms

- Skill before speed
- Speed before power and strength
- Power before strength and
- Strength before endurance

Structure

**Exercises**
- Explosive
  - Olympic lifts
  - Hip Dominant
  - Romanian Deadlift (RDL)
- Knee Dominant
  - Back Squat
  - Upper Pull
  - Horizontal
  - Vertical
- Upper Pull
  - Horizontal
  - Vertical

**Session Layout**
- Foam Roller
- Neuromuscular Activation
- Warm-Up
  - Dynamic, Handles
- Pre-Hab
  - Mobility, Stability
  - Workout
  - Weights, conditioning, etc.
  - Pre-Hab
  - Cool Down
  - Static Stretch

Annual Plan

- LTAD
  - Chronological Age
    - Years since birth
  - Physiological Age
    - Rate of maturing
  - Training Age
    - Years in consistent training

Annual Plan

- Linear
  - High Volume/Low Intensity to Low Volume/High Intensity
    - Strength/Power
      - Muscular Endurance
      - Hypertrophy
      - General Strength
      - Specific Strength
      - Circa-Max
      - Absolute Strength
      - Speed-Power
      - Speed-Strength
  - Bilateral to Unilateral

- Non-Linear
  - Flexible (Autoregulation)
    - Analysis of athlete's fatigue status
    - Training for physical performance
    - Choosing, modifying, or switching workout
    - Overall plan for a mesocycle
    - Workouts in a 7-10 cycle can be checked off as accomplished
    - Scheduled
      - Planned rotation of various workout protocols

Programming of Phases

**General Prep Phase**
- General Physical Preparedness
  - CrossFit
  - CVFMHI
  - FAETFMD
  - Mechanics, Consistency, Intensity
- Main Goal:
  - Improve overall fitness

**Fitness=Work Capacity**

**Specific Prep Phase**
- Strength Progression
  - Hypertrophy
  - Circa-Max
  - Absolute Strength
  - Speed-Power
  - Speed-Strength
- Bilateral to Unilateral
Programming of Phases

Pre-Competition Phase
- Ballistic Training
  - Start Approx. 30% resistance
  - Jump Squat, Jumping Split Lunge, Bench Throw
  - Decrease down to very light implements
    - MB, PUDS, Kettlebells

Programming of Phases

Competition Phase
- Weighted Plyos
  - Weighted Vest, light DB or MB
- Body Weight Plyos
  - Plyo Progression
    - Low to High Intensity

Progression-Ratio of Track to Weight Room

General
- Sports Specific Warm-Up
  - PVC drills, footwork
  - p.v.s, accelerations
  - Skips for height, skips for distance
- Strength and Conditioning workout
  - Weight Room, energy system development

Specific
- Strength and Conditioning Warm-Up
  - Plyo
  - Ballistic throws, jumps
- Sports Specific workout
  - Full throws
  - Sprint Events
  - Full approach jumps

USATF Model

- Science Based
- Athlete Focused
- Coach Driven

References
- Pagel, R. Concepts in Throwing
- Pagel, R. Weight Training and Conditioning for the Cross Country and Track and Field Athlete