STRENGTH / CONDITIONING CLINICAL PRACTICE
Chris Kolba, PT, PhD, MHS, CSCS

DISCLAIMER
Strength progression in rehabilitation is time and criterion based, dependent on tissue healing timeframes, patient demographics and clinician evaluation.

BACKGROUND:
The outpatient and sports medicine clinician is responsible for returning their patients to the functional activities they are unable to complete. If the clinician is unfamiliar with strength and power progression they may be limited in optimizing the patient’s full recovery. This has been identified in a few long term studies that reported even after 1-2 years people still lacked strength and power after their injury /surgery and did not return to their activity at the previous level. (7) While many factors may be identified, we should ask ourselves if we have progressed the patients strength and power to its optimal level. This provides the patient with the confidence and reduces the risk of re-injury associated with successful return to sports participation. (1) This document will serve to provide rehab professionals with a frame work to progress strength beyond the subacute phase. It will also serve to fill a gap in our education and clinical practice that will significantly impact patients and their goal of returning to optimal function whether it be for life, work or recreation.

SUMMARY OF RECOMMENDATIONS

Precautions /Contraindications
- Unhealed /inflamed tissue- healing tissue should not be overstressed.
- Contra-indicated movements per post-surgical guidelines.  Ex: bench pressing after anterior shoulder stabilization
- Diabetes, heart disease, osteoporosis – not contraindicated if stable
- Fever / flu like symptoms – not appropriate to lift /exercise
- Postural and technique considerations should be addressed
- Heavy weights in skeletally immature individuals
- Plyometric exercises need to be progressed appropriately and not used for conditioning and endurance.
- See Appendix B

Criteria for progression:
- Pain free range of motion.
- No compensatory motion that would adversely affect performance of selected exercise.
- Appropriate ability to communicate and follow directions.
- Successful completion of previous phase. (Complete light weight exercises prior to moderate weight exercises before progressing to heavy weight).
- No reactive pain or effusion.
- See Appendix A
Phases of progression:
Periodization is the planned manipulation of both work and rest to maximize results and reduce injury. Generally it would involve progressing strength and power training through the phases of general conditioning, hypertrophy, strength and power (max strength).

**Hypertrophy** – working to increase the size of a muscle to prepare for the next phase

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Reps</th>
<th>Sets</th>
<th>Frequency</th>
<th>Rest between sets</th>
</tr>
</thead>
<tbody>
<tr>
<td>50-75% of 1 Rep max (RM)</td>
<td>6-12</td>
<td>3-5</td>
<td>2-3x/wk.</td>
<td>30sec – 1.5min</td>
</tr>
</tbody>
</table>

**Strength - force** production

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Reps</th>
<th>Sets</th>
<th>Frequency</th>
<th>Rest</th>
</tr>
</thead>
<tbody>
<tr>
<td>80-90% of 1 rep max</td>
<td>4-8</td>
<td>3-5</td>
<td>2-3x/wk.</td>
<td>2-5 min</td>
</tr>
</tbody>
</table>

**Power** – The maximal force a muscle can generate

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Reps</th>
<th>Sets</th>
<th>Frequency</th>
<th>Rest</th>
</tr>
</thead>
<tbody>
<tr>
<td>85-95% of 1 rep max</td>
<td>1-4</td>
<td>3-5</td>
<td>2x/wk.</td>
<td>2-5min</td>
</tr>
</tbody>
</table>

*See Appendix A for linear and undulating models of periodization*
Plyometric / Power  Purpose is to decrease amortization phase and increase explosiveness of muscle. Increase rate of force development.

Key Points:
- High eccentric forces
- Higher risk for injury
- Not to be used as conditioning
- Typically performed in beginning of session
- Measure intensity by number of foot contacts for LE and UE contacts /throws

Plyometric Volumes & Frequency per NSCA

<table>
<thead>
<tr>
<th>Plyometric Experience</th>
<th>Volume (contacts/session)</th>
<th>Frequency /week</th>
<th>Rest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginner (no experience)</td>
<td>80-100</td>
<td>1-3 /WK Alt. linear &amp; multidirectional days</td>
<td>45-60 sec between sets 1:5 – 1:10 work/rest ratio</td>
</tr>
<tr>
<td>Intermediate (some experience)</td>
<td>100-120</td>
<td>1-3/WK Alt. linear &amp; multidirectional days</td>
<td></td>
</tr>
<tr>
<td>Advanced (considerable experience)</td>
<td>120 - 140</td>
<td>1-3/WK Alt. linear &amp; multidirectional days</td>
<td></td>
</tr>
</tbody>
</table>

See Appendix B for example of Plyometric Progression
APPENDIX A

Linear Model Periodization  (Essentials of Strength Training and Conditioning. 3rd Edition. 2008)
Utilized when there is adequate time frame of training to complete the phases.
Multiple weeks spent on each phase – Traditionally 4-6 weeks starting in the hypertrophy phase and progressing into strength and then power. This will assist in optimizing the patient’s progression to more appropriately prepare them for return to sport and reduce their risk of re-injury.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Intensity</th>
<th>Reps</th>
<th>Sets</th>
<th>Frequency</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertrophy</td>
<td>50-75% 1RM</td>
<td>10-25</td>
<td>3-5</td>
<td>2-3x/wk.</td>
<td>4-6wks</td>
</tr>
<tr>
<td>Strength</td>
<td>80-90 1RM</td>
<td>4-8</td>
<td>3-5</td>
<td>2-3x/wk.</td>
<td>4-6wks</td>
</tr>
<tr>
<td>Power</td>
<td>85-95% 1RM</td>
<td>1-4</td>
<td>3-5</td>
<td>2-3x/wk.</td>
<td>4-6wks</td>
</tr>
</tbody>
</table>

**Hypertrophy Phase Practical Example**  **Upper Body Exercises**
Warm up: super set Y & T with serratus punches 2-3 x 15

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Sets</th>
<th>Reps</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bench Press/Stand Band Press</td>
<td>3</td>
<td>8-10</td>
<td>Rest 30 sec – 1.5 min</td>
</tr>
<tr>
<td>1 Arm Cable Row (from mid position)</td>
<td>4</td>
<td>8-10</td>
<td>30 sec – 1.5 min</td>
</tr>
<tr>
<td>Shoulder Overhead Press</td>
<td>3</td>
<td>8-10</td>
<td>30 sec – 1.5 min</td>
</tr>
<tr>
<td>B Cable Pull Down</td>
<td>4</td>
<td>8-10</td>
<td>30 sec – 1.5 min</td>
</tr>
</tbody>
</table>

**Clinical Pearl:** Super set Bench with cable row and shoulder press with cable pull down. (Push-Pull super set)

**Strength Phase Practical Example:**  **Leg Exercises**
Warm up: 2-3 rounds Body weight Lunge Walk superset with band or cable resisted side stepping

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Sets</th>
<th>Reps</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barbell squat</td>
<td>4</td>
<td>5 reps</td>
<td>Rest 2-5 min</td>
</tr>
<tr>
<td>Barbell deadlift</td>
<td>4</td>
<td>5 reps</td>
<td>2-5min</td>
</tr>
<tr>
<td>Leg Press</td>
<td>4</td>
<td>5 reps</td>
<td>2-5min</td>
</tr>
<tr>
<td>Modified Deadlift</td>
<td>4</td>
<td>5 reps</td>
<td>2-5min</td>
</tr>
</tbody>
</table>

**Clinical Pearl:** Superset each of above exercises with another balance or opposite muscle group to get more work done in same amount of time.
Ex. Barbell Squat paired with feet on physio ball bridge or balance exercise.
**APPENDIX A Cont.**

**Undulating Model Periodization**  (2 examples)
- Varied intensity each work out throughout week
- Shown to be just as effective as linear model. May be more practical

Utilized for athlete training /competing year round or multi-sport athlete when 4-6 week time frames are not available to follow linear model.

May be more appropriate for later phases of rehab. For example, in a later phase ACL patient attending PT 2x/wk. you might work 1 day using 8 reps for your main exercises and for the second visit of the week work in the 4 repetition range with your exercises. Alternatively, you could work in the 6 or 8 rep range both days and change the exercises you are doing each day.

<table>
<thead>
<tr>
<th>Example 1</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>Strength</td>
<td>4-6 reps</td>
<td>3-5 sets</td>
</tr>
<tr>
<td>Wednesday</td>
<td>Hypertrophy</td>
<td>6-15 reps</td>
<td>3-5 sets</td>
</tr>
<tr>
<td>Friday</td>
<td>Power</td>
<td>1-4 reps</td>
<td>3-5 sets</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Example 2</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>Hypertrophy</td>
<td>6-15 reps</td>
<td>3-5 sets</td>
</tr>
<tr>
<td>Wednesday</td>
<td>Strength</td>
<td>4-6 reps</td>
<td>3-5 sets</td>
</tr>
<tr>
<td>Friday</td>
<td>Power</td>
<td>1-4 reps</td>
<td>3-5 sets</td>
</tr>
</tbody>
</table>
**Appendix B**

Divide plyometric sessions into **linear** plyometrics (floor to box jumps / hurdle jumps / vertical jumps, tuck jumps / anterior single legs hops) and **multidirectional** plyometrics (alt. side-side hops - skaters / lateral jumps over hurdle / single leg lateral hop)

---

**Example of Plyometric Progression**

**Phase 1**
- Focus on mechanics w/ decreased eccentric forces / Quiet landings
- (2x/week 5 sets 5-10 foot contacts = 50 to 100 contacts / week)
- Jump up onto box → SL hop up onto box 5x5-10 4-8in box
- Lateral hop up onto box / Alternating side to side hop w/ hold (Skater hops) 5x5-10

**Phase 2**
- Continue focus on form & technique. Increase eccentric forces by removing box
- (2x/week 5 sets 5-10 foot contacts /session)
- Vertical Jump and stick landing
- Lateral jump over hurdle and stick landing

**Phase 3**
- Add elastic response (2x/week 5 sets 5-10 foot contacts /session)
- Jump over hurdle to vertical jump & stick landing

**Phase 4**
- Plyometrics. Repetitive Jumps (2x/week 5 sets 5-10 foot contacts /session)
- Multiple jumps over hurdles – anterior and laterally. Progress to hops
APPENDIX C
Common multi-joint exercises used in strength training

SQUAT

DEADLIFT
SUMO DEADLIFT

BENCH PRESS
**APPENDIX D**

**Terminology**

**Periodization**
Cycling of volume, intensity and duration to achieve desired goals, reduce injury and plateaus.

**Volume**
Total amount of weight lifted in a training session. Calculated: sets x reps x load

**Intensity /Load**
The amount of weight lifted

**Duration /Frequency**
How many reps or how often

**Set**
A group of repetitions sequentially performed before stopping to rest

**Rep**
The number of times a weight is lifted within a set.

**Super Set**
2 or more exercises working different muscle groups are performed in a row without rest between them.

**Strength**
Force x distance

**Power**
Work divided by time

**Jump**
Double leg take off followed by double leg landing

**Hop**
Single leg take off, landing on same foot

**Bound**
Single leg take off, landing on opposite foot

**Skip**
Single leg take off with two foot contacts
REFERENCES

Texts /Books
Santana, JC. The Essence of Program Design.  2004
Starrett, K., Cordoza, G.  Becoming a Supple Leopard.  2nd edition.  2015.

Articles
