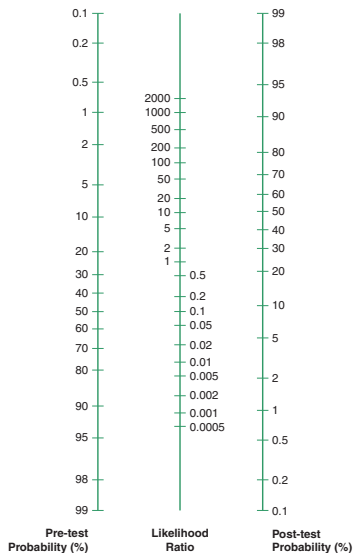


# Orthopaedic Physical Therapy: Nuts and Bolts

## Research Pearls

Positive Likelihood Ratio	Negative Likelihood Ratio	Interpretation
>10	<0.1	Large and often conclusive shift in probability that disorder is present
5–10	0.1–0.2	Moderate shift in probability
2–5	0.2–0.5	Small but sometimes important shifts in probability
1–2	0.5–1	Small and rarely important shift in probability
<b>(κ) Kappa and ICC (Intraclass correlation coefficients)</b>	<0.5	Poor reliability
	0.5–0.75	Moderate reliability
	>0.75	Good reliability



<b>Sensitivity</b>	<b>Test's Ability to Detect Patients with Actual Disorder</b>
<b>SnNout (Sensitivity-Negative-Out)</b>	Test with high sensitivity, good for <b>ruling out</b> disorder if test is negative
<b>Specificity</b>	<b>Test's Ability to Detect Patients Without the Actual Disorder</b>
<b>SpPin (Specificity-Positive-In)</b>	Test with high specificity, good for <b>ruling in</b> a disorder if test is positive
<b>95% Confidence Interval (CI)</b>	Spread of scores within which 95% of the population would be expected to fall
<b>Statistical Significance (p) &lt;0.05</b>	Infers that there is a 95% probability that a true relationship exists between results of the outcome measure

## Drug Identification Quick Reference

★ “Most drug side effects are just a magnification of what it was designed to do!”—*Boissonault*

Suffix	Drug Class
<i>cillin</i> <i>cycline</i> <i>micin</i> <i>mycin</i>	anti-bacterials (Amoxicillin)
<i>barbital</i>	barbiturates (Phenobarbital)
<i>epam</i> <i>olam</i>	benzodiazepines (Diazepam)
<i>lol</i>	beta blockers (Atenolol)
<i>pril</i>	ACE inhibitors (Enalapril)
<i>ipine</i>	calcium channel blockers (Nifedipine)
<i>sartan</i>	angiotensin receptor blockers (Telmesartan)
<i>zosin</i>	alpha blockers (Terazosin)
<i>statin</i>	anti-hyperlipidemic (Lovastatin)
<i>erol</i> <i>phylline</i>	bronchodilators (Albuterol)
<i>sone</i> <i>olone</i>	glucocorticoids (Dexamethasone)
<i>caine</i>	local anesthetic (Lidocaine)
<i>amide</i>	oral hypoglycemics (Acetohexamide)
<i>idine</i>	H <sub>2</sub> blockers (Cimetidine)

Course notes, Boissonault, Medical Screening, 2008.

## Modalities 101

Ultrasound Indications	Duty Cycle	Frequency (MHz)	Intensity (W/cm)	Treatment Time
Soft Tissue Extensibility	Continuous 100%	1–3 depending on depth	1.0–2.5	5–10 min. (usually 8)
Pain Control	100%	1 or 3	0.5–3.0	3–10 min.
Dermal Ulcer	20%	3–3.3	0.8–1.0	5–10 min.
Surgery Incisions	20%	1 or 3–3.3	0.5–0.8	3–5 min.
Epicondylitis	20%	1	1.0–2.0	5–10 min 12Rx over 4–6wk period
Tendon Healing	100%	1 or 3	0.5–1.5	3–5 min.
Bone Fractures	20%	1	0.15	20 min (14–18days)
Carpal Tunnel	25%	1	1.0	15 min.
Phonophoresis	20%	3	0.5–0.75	5–10 min.
Plantar Warts	100%	1	0.6–0.8	10 min.
Herpes Zoster	25%	1	0.8–vertebral col. 0.5 to periphery	1 min. per sound head

Electrical Stimulation Type	Amplitude (mA)	Pulse Rate (pps)	Pulse Duration ( $\mu$ s)	Treatment Duration
TENS (conventional)	Comfort tingle	80–150	50–100	20–60 min
TENS (acupuncture)	Strong tingle	1–10	100–300	20–40 min.
TENS (burst) *all TENS for pain	Comfortable	50–100 cont. or 1:4 on/off	50–200	20–30 min.
IFC (pain/edema)	Comfortable	50–80	50–100	10–30 (20) min.
Russian (strength)	Tetanic contraction	50–70	150–200	20 min (10:50 on/off)
Russian (spasms)	Tetany to tolerance	50–70	50–175	1:1 to 4:12 sec on/off
NMES (moderate to severe atrophy)	Mild contraction (10% MVIC)	3–10	150–200 (small muscles) 200–350 (larger)	10:50 initially, progress to 10:30 sec on/off for 10–20 reps
NMES (minimal to no atrophy)	Strong contraction (50% MVIC)	30–80	Same $\mu$ s for small or large muscles	10:30 initially, progress to 10:10 sec on/off for 10–20 reps
FES (See atrophy for parameters)	Tetanic muscle contraction	Same	Same	With orthotic during functional activity
Iontophoresis (For drug push)	1–4 mA	N/A	N/A	10 min using 4 mA, 40 min using 1 mA

Data from: Cameron M., *Physical Agents in Rehabilitation: From Research to Practice*. Saunders; 2003.

## Resistance Training 101

Delorme Regimen	Oxford Regimen
Determine 10 RM	Determine 10 RM
10 reps @ 50% 10 RM	10 reps @ 100% 10 RM
10 reps @ 75% 10 RM	10 reps @ 75% 10 RM
10 reps @ 100% 10 RM	10 reps @ 50% 10 RM

## Resistance in Pounds of Thera-Band® Resistance Based on Percent Elongation

### Average Force (pounds) for Thera-Band Elastic Bands

% Elongation	Yellow	Red	Green	Blue	Black	Silver	Gold
50%	2	2.5	3	4.5	6.5	8.5	14
100%	3	4	5	7	9.5	13	21.5
150%	4	5	6.5	9	12.5	17	27.5
200%	5	6	8	11	15	21	33.5
250%	6	7	9.5	13.5	17.5	25.5	40

Reprinted with permission from Thera-Band ([www.thera-band.com](http://www.thera-band.com)).

## Learning from the BEST

### Characteristics of an Expert Manual Therapist

- Takes into account the patient's understanding, beliefs, and feelings
- Helps shape a patient in developing and evolving understanding of problems
- Reflection (reflection in action, reflection about action)
- Metacognition
- Well-organized knowledge/clinical patterns
- Ability to generate prognosis
- Ability to control the environment—efficient use of time, ability to focus on patient in busy environment
- Evaluation and use of patient illness and disease data in a context-rich evaluation
- Focused verbal and nonverbal connection with the patient
- Equal importance of teaching to hands-on care
- Confidence in predicting effective patient outcomes based on knowledge of pathology and experience with the course of healing

Adapted from: Jensen GM, Shepard KF, Gwyer J, Hack LM. Attribute Dimensions that Distinguish Master and Novice Physical Therapy Clinicians in Orthopedic Settings. *Phys Ther.* 1992; 72(10): 711–722.

## Clinical Reasoning in a Nutshell

“The process in which the clinician, interacting with significant others (patient, caregivers, health care team members), structures meaning, goals, and health management strategies based on clinical data, patient choices, and professional judgment and knowledge.”

Hypothesis categories to be considered in evaluating a patient as a *whole* person:

1. Activity and participation capability or restriction
2. Patient perspectives on their experience
3. Pathobiological mechanisms (phase of healing, pain mechanisms)
4. Physical impairments and associated structure or tissue source
5. Contributing factors
  - environmental
  - behavioral
  - biomechanical
  - psychosocial
  - physical
  - hereditary
6. Precautions and contraindications
7. Management and treatment
8. Prognosis

## Ten Steps for Clinical Reasoning

1. Ultimate goal of clinical reasoning is **learning** for the clinician and the patient
2. **Prepare** for experiential learning by **intentionally attending to** and **reflecting upon** your own current knowledge and skills, past experiences, and learning related to the current patient and the clinical problem
3. **Organize** your knowledge base (use differential diagnosis tables, but consider them as flexible and changeable)
4. In gathering information, ensure that you have gathered information in the 8 hypothesis categories
5. **Cognition**—Purposeful thought applied to perception, analysis, synthesis, and evaluation of relevant information
6. **Cognition**—Link information to your experience, knowledge base, current best relevant evidence
7. **Reassess**—Important for detecting errors in reasoning
8. **Reflection in action**—Reflect while treating or testing; constantly engage past learning
9. **Metacognition**—Think about your thinking, used to detect errors or link information (reflect on and compare existing knowledge with evolving clinical situation)
10. **Reflection on action**—Reflection that takes place away from immediate demands of clinical practice

## Tissue Healing

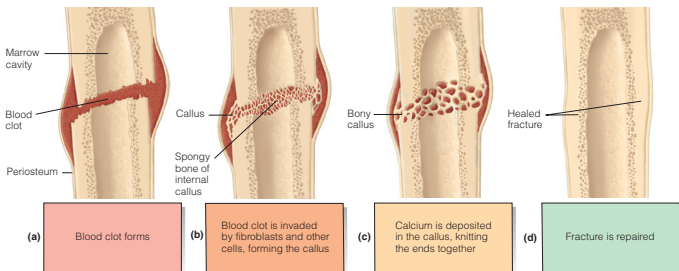
### Bone

Days 1–3	Day 3 to 2 Weeks	2–6 Weeks	3 Weeks to 6 Months	6 Weeks to 1 Year
Hematoma formation	Fibrocartilage formation	Callus formation <i>Radiographic evidence of healing (about day 13)</i>	Ossification	Consolidation/ remodeling

### Tissue Healing Summary

Exercise-induced muscle soreness	0–3 days
Muscle strain	I = 0–2 weeks II = 4 days–3 months III = 3 weeks–6 months
Ligament sprain	I = 0–3 days II = 3 weeks–6 months III = 5 weeks–1 year
Tendon	Tendonitis = 3 weeks–7 weeks Lacerations = 5 weeks–6 month
Articular cartilage repair	2 months–2 years
Ligament graft	2 months–2 years

Adapted from Axe MJ, Snyder-Mackler L. Operative and postoperative management of the knee. In: Wilmarth MA, ed. *Orthopaedic Section Independent Study Course 15.3, Postoperative Management of Orthopaedic Surgeries*. La Crosse, Wis: Orthopaedic Section, APTA Inc. 2005; 17, 2005 Dec.



**FIGURE 1-1** Stages in Fracture Repair

Chiras, Daniel C. *Human Biology, Sixth Edition*. © 2008 Jones & Bartlett Publishers, LLC

## Connective Tissue: Tendon and Ligament Healing

Days 1–6	Days 3–20	6 Months–1 Year
<b>Inflammation Phase</b>	<b>Proliferation Phase</b> <b>Collagen and ground substance production</b>	<b>Maturation Phase</b> <b>Type III to Type I collagen</b>
Observe for cardinal signs of inflammation <ul style="list-style-type: none"> <li>• <i>Calor</i>—Heat</li> <li>• <i>Rubor</i>—Redness</li> <li>• <i>Tumor</i>—Swelling</li> <li>• <i>Dolor</i>—Pain</li> <li>• <i>Functio laesa</i>—Loss of function</li> </ul>	Observe for decreasing <ul style="list-style-type: none"> <li>• <i>Inflammation</i></li> <li>• <i>Pain</i></li> <li>• <i>Continued decreased ROM</i></li> <li>• <i>Loss of function</i></li> <li>• <i>Muscle atrophy</i></li> <li>• <i>Strength loss</i></li> </ul>	Observe for decreasing <ul style="list-style-type: none"> <li>• <i>Inflammation</i></li> <li>• <i>Decreasing pain</i></li> <li>• <i>Increasing ROM</i></li> <li>• <i>Improving of function</i></li> <li>• <i>Muscle atrophy</i></li> <li>• <i>Strength loss</i>→gain</li> </ul>

## Muscle Healing

Begins 15 Min. Post Injury Phase Is Most Evident 4–8 Hours Post Injury	< 3 Hours Post Injury	Within 18 Hours Post Injury	Up to 1 Year Post Injury
Degeneration phase	Inflammatory Phase	Fibroplastic Phase	Maturation Phase
	Neutrophils (PMN) arrive first Macrophages within 6 hours	<b>Satellite cell activation</b> —Mononucleated reserve cells —Only source of new fiber formation in muscle —Activated by damaged muscle fibers releasing endogenous mitogen within 18 hours of injury <b>Stimulated by growth factors</b> —Laminin —Macrophage-produced factors <b>Regeneration</b> —Intact basal lamina acts as scaffold for new myotubes —Myoblasts proliferate and fuse —Myotubes seen within 3–5 days post injury —New fibers form within same basal lamina —Eventually split up to become separate fibers —Nerves reinnervate at the neuromuscular junction —Re-vascularization continues from periphery inwards	Myotubes mature into muscle fibers (myofibers).  Single myofibers can regenerate with complete return to function.  Entire muscles can regenerate —usually surviving peripheral cells start regeneration first.

## Movement Analysis and Rehabilitation

“The impairments of soft tissues induced by repeated movements and sustained postures eventually cause a joint to develop a susceptibility to movement in a specific direction.”

*Adapted from Sahrman S. Movement Impairment Syndromes. Mosby; 2002.*

1. Observe symptomatic movement.
2. Analyze movement for faulty biomechanics.
3. Hypothesize whether problem appears rooted in Directional Susceptibility to Movement (DSM).
  - Excess mobility
  - Hypomobility
  - Poor motor control
4. Objectively test faulty movement.
5. Correct movement impairment: the “failed” test motion becomes the home exercise.

✚ In the “**DSM/Signs**” column of each of the differential diagnosis tables, you will find the impaired movements that are most commonly associated with that particular pathology.



## Treatment-Based Classifications (TBC)

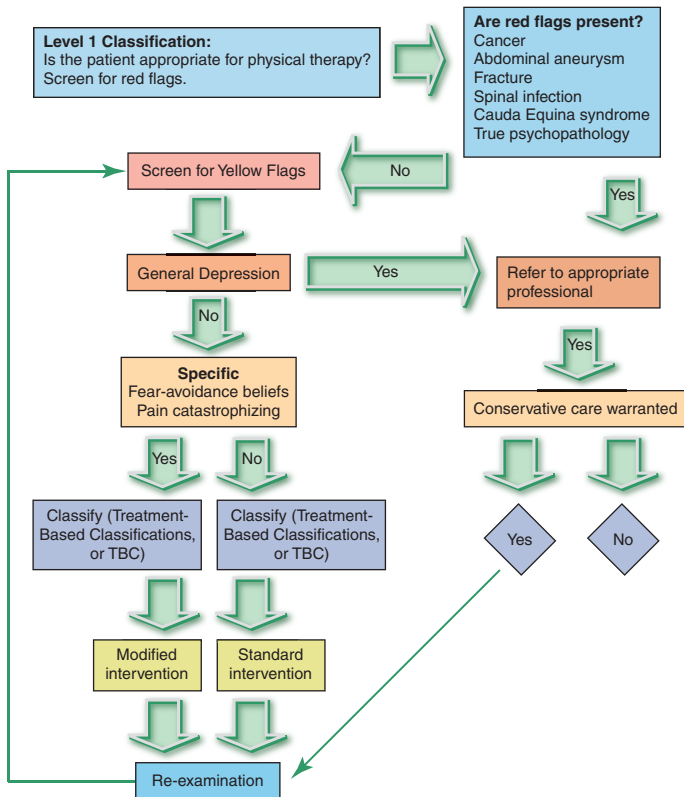
There is good emerging evidence that placing a patient based on his or her impairments found during the objective exam into the most appropriate TBC will result in improved care.<sup>1-6</sup>

### Nine Key Thoughts Related to TBCs

1. The **lumbar spine TBC is reliable and is validated.**<sup>1-8</sup>
2. The **cervical spine TBC has been proposed.**<sup>2</sup>
3. The remainder of the TBCs for each joint chapter has been *proposed by the author based on relevant studies.*
4. Each treatment-based category is intentionally broad to allow for flexibility of treatment styles and choice.
5. It is likely that a patient will fit multiple categories, but ideal to treat prioritized by the most significant impairment related to the patient's dysfunction.
6. It is likely that if a patient demonstrates very high disability scores and high pain scores (VAS) that they would be appropriately placed in a pain control category.
7. If a patient demonstrates high fear avoidance scores (FABQW>35), modified education and intervention is recommended.
8. As a patient's impairments progress and change during the rehabilitation process, it is appropriate for the patient to fit new treatment-based categories.
9. I believe that treatment-based categories, though broad in definition, are a step in the right direction for helping our profession become more uniform in our impairment-based treatment selection.

## References

1. Brennan GP, Fritz JM, Hunter SJ, Thackeray A, Delitto A, Erhard RE. Identifying subgroups of patients with acute/subacute "nonspecific" low back pain: Results of a randomized clinical trial. *Spine*. 2006;31:623-631.
2. Childs JD, et al. Proposal of a classification system for patients with neck pain. *J Orthop Sports Phys Ther*. 2004;34:686-700.
3. Delitto A, Erhard RE, Bowling RW. A treatment-based classification approach to low back syndrome: Identifying and staging patients for conservative treatment. *Phys Ther*. 1995;75:470-485; discussion 485-479.
4. Fritz JM, Delitto A, Erhard RE. Comparison of classification-based physical therapy with therapy based on clinical practice guidelines for patients with acute low back pain: A randomized clinical trial. *Spine*. 2003;28:1363-1371; discussion 1372.
5. Fritz JM, et al. Subgrouping patients with low back pain: Evolution of a classification approach to physical therapy. *J Orthop Sports Phys Ther*. 2007;37(6):290-302.
6. Fritz JM, Brennan GP, Clifford SN, Hunter SJ, Thackeray A. An examination of the reliability of a classification algorithm for subgrouping patients with low back pain. *Spine*. 2006;31:77-82.
7. Fritz JM, George S. The use of a classification approach to identify subgroups of patients with acute low back pain: Interrater reliability and short-term treatment outcomes. *Spine*. 2000;25:106-114.
8. Heiss DG, Fitch DS, Fritz JM, Sanchez WJ, Roberts KE, Buford JA. The interrater reliability among physical therapists newly trained in a classification system for acute low back pain. *J Orthop Sports Phys Ther*. 2004;34:430-439.



Global Algorithm for Screening and Classification into Treatment-Based Categories

Adapted from George SZ. AAOMPT preconference course "Psychological Influence on Musculoskeletal Pain: A Clinical Update for the Practicing Manual Therapist," 2008.

## Physical Therapy Evaluation in a Nutshell

### Give Patient

Medical screening intake forms/Region-specific screening forms/Appropriate functional disability questionnaires

### Ask and Listen

Subjective Exam/Body Chart	
<b>Red and Yellow Flag Screening</b>	General health screening questions and review of system questions
Severity	How limited is the patient's function?
Irritability	How much activity brings on the symptoms? How bad does it get (0–10)? How long does it linger?
Nature	Hypothetical source structures
Stage	Stage of healing
Stability	Reproducibility of the symptoms; is patient improving or getting worse (0–100%)?

### Observe, Test, and Measure

#### Objective exam

Use of appropriate objective testing to screen for non-musculoskeletal pathology that requires referral

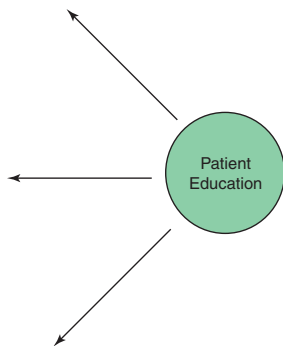
Observe patient posture, aggravating movements, directional susceptibility to movement.

Clear possible involved joints (use of high-sensitivity tests ☹).

Implicate possible involved tissue (use of high specificity tests ☺).

Use most valid and reliable special tests.

Measure impairments objectively.



**Think, Then Act*****Intervention***

Based on the treatment-based classification as determined by the impairments  
observed during subjective and objective testing

Based on the measured impairments to be addressed

Supported by available clinical prediction rules

Home exercise program driven by the impairments to be addressed