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Evidence to Outcomes: Patient-Centered PT/OT Care Pathways After Total Knee Arthroplasty (TKA)

Speakers:
- **Pam Dibblee, PT, DPT, OCS, FAAOMPT , Intermountain Health**
- **Trent Brown, MOT, OTR/L, ATP, CFPS, CGCP, BCG, Department of Health and Human Services**

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Meet Our Speakers

Trent Brown, MOT, OTR/L, ATP, CFPS, CGCP, BCG
Trent is a practicing therapist in Utah and is 1 of 75 credentialed holders of a board certification in gerontology (BCG) from the AOTA. Trent also holds a certification as an assistive technology professional (ATP) from RESNA. Currently, he is employed by the Department of Health and Human Services to develop, implement, and operate health care quality improvement programs for the state of Utah. Trent has over 20 years of clinical experience in skilled nursing, transitional care, acute, outpatient, and home health. Recently, he served as the VP for the UOTA where he co-authored SB 131 and HB 188 advancing OT practice in the state of Utah and has received multiple awards for his clinical, academic, and legislative work. Trent is an Adjunct Professor at the University of Utah and has been teaching their department since 2007. He is well traveled having provided courses all over the country to thousands of clinicians on a myriad of topics including joint arthroplasty, core strengthening, documentation, aging, legislation, and fall reduction. Trent Brown is also a reviewer for the Journal of Topics in Geriatric Rehabilitation.

Pam Dibblee, PT, DPT, OCS, FAAOMPT
Pam has over 30 years' experience in Orthopedic physical therapy, spending more than 20 years with Intermountain Health. She completed her BS in Biology from the University of Iowa and Physical Therapy degree from the University of Illinois Chicago and DPT from Regis University in Denver in 2010. Pam is board certified in Orthopedics, a Fellow of the American Academy of Orthopedic Manual Therapists and assists in teaching in the Fellowship program at Regis University. Her role at Intermountain Health includes training therapists on best practice, standardizing care, compliance, and quality improvement in the outpatient setting. She remains active in-patient care weekly. She currently serves on the board of APTA Orthopedic in a director position. Pam has presented nationally on neck and back pain, joint replacement, and shoulder conditions.

Evidence to Outcomes: Patient-Centered PT/OT Care Pathways After Total Knee Arthroplasty (TKA)

Trent Brown, MOT, OTR/L, ATP, CFPS, CGCP, BCG

Objectives

1. Apply current evidence and guideline recommendations to build a setting-specific post-TKA care pathway
2. Differentiate “standard protocol” vs “patient-specific variability,” using risk stratification to right-size PT/OT frequency and intensity
3. Design high-value sessions that reliably progress function (gait, stairs, transfers, sit-stand capacity, endurance) while addressing ROM, strength, swelling, pain, and adherence

Objectives

4. Design high-value OT sessions that accelerate independence and safety in ADLs/IADLs, equipment use, home setup, coping strategies, and habit formation.
5. Use shared decision making to align goals, visit plan, and home program with patient preference, risks, and resources, while maintaining clinical integrity and skilled justification.
6. Select and implement a core outcomes set and set realistic targets by setting and phase of recovery.
7. Connect clinical outcomes to business outcomes and identify leader levers that improve both.

The Evidence Landscape

- **Does therapy yield better outcomes after TKA?**
  - Thwin et al., (2024) “Physical Therapy does not confer additional benefit in terms of functional scores, ROM or ambulatory distance.”
  - Hamilton et al., (2020) “OP led rehab was not superior to a single PT review and home exercised based regimen.”
  - Chaudhry (2023) Met-analysis of 1,884 cases over 11 RCT’s: “Supervised PT does not confer clinically significant benefits over unsupervised HEP following TKA.”
  - Alrawashdeh et al. (2021) “Rehabilitation programs do not result in systematic improvement in clinical outcomes over one-size-fits all approaches after TKA.”
  - Zhao et al. (2023) “Home-based rehab and HEP after TKA is an effective, safe, and cost-effective alternative to OP.”
  - Liu et al. (2024) “A HEP could be a more efficient and cost-effective component of TKA.”

But… is it therapy, or the way we do therapy?

Diaz-Ledezma et al. (2024) “Specific PT programs should be individualized.”

The Evidence Landscape

- **Does therapy yield better outcomes after TKA?**

  But… is it therapy? Or the way we do therapy post TKA?

  - Konnyu et al., (2022) looked at specific rehab protocols (66 articles reviewed)
    - 44 of the articles contained protocols primarily doing strength and flexibility
    - 21 completed task-specific training (ADL's, IADL's, stooping, reaching, etc.)
    - 29 provided patient education
    - 17 provided balance-motor-learning agility (proprioception)
    - 24 provided targeted aerobic endurance

"There is lack of evidence to adequately guide rehabilitation practice for TKA. This leads to a challenge of using evidence to inform a clinical practice guideline for TKA rehabilitation."

*In 2019, APTA put together an extensive practice guideline for PT management of TKA. It is 618 pages long

The Evidence Landscape

- **What works?**
  - Home Health is as effective as OP following TKA (what can your patient afford?) (Oldrini et al., 2025)
  - High velocity (HV) training increases mobility due to preferential stimulation of Type II fibers (exercise takes place in 1 second or less) (Dutta et al., 2024)
    - HV reduce quad impairment and enhance static and dynamic balance (ADL performance)
  - Methodology focused on gradual strengthening (closed chain more effective) yielded better results 1 year post
  - Quad strengthening through multiple avenues with a focus on volitional (force controlled by CNS) force production (TKA quad 24% weaker than healthy quad)
  - Balance impairment in functional environments that were "pleasant" and included agility and perturbation with multi-tasking (cognitive component)
  - Psychosocial recovery **must** be addressed (confidence, coping mechanisms, social)

  All environments (HH, IP, OP, etc.) can be beneficial. Telehealth also yields good outcomes. What can your patient afford and what is convenient? It's all Patient driven! That is the key!

The Evidence Landscape

- **Dosage (Pam will discuss)**
  - Benes et al., (2024) studied the relationship between number of sessions and attended outcomes during the first 12 weeks after surgery
    - **Most outcomes were achieved by 6 weeks (approximately 11-18) visits**
    - ADL outcomes, pain outcomes, and QOL declined or did not improve after 18 visits
    - Patients attending > 18 sessions had the lowest outcomes (likely have more comorbidities)
    - Patients attending < 8 sessions had the highest outcomes (likely the healthiest)

    Those attending therapy > 18 sessions "may be overutilizing healthcare resources without additional benefit"

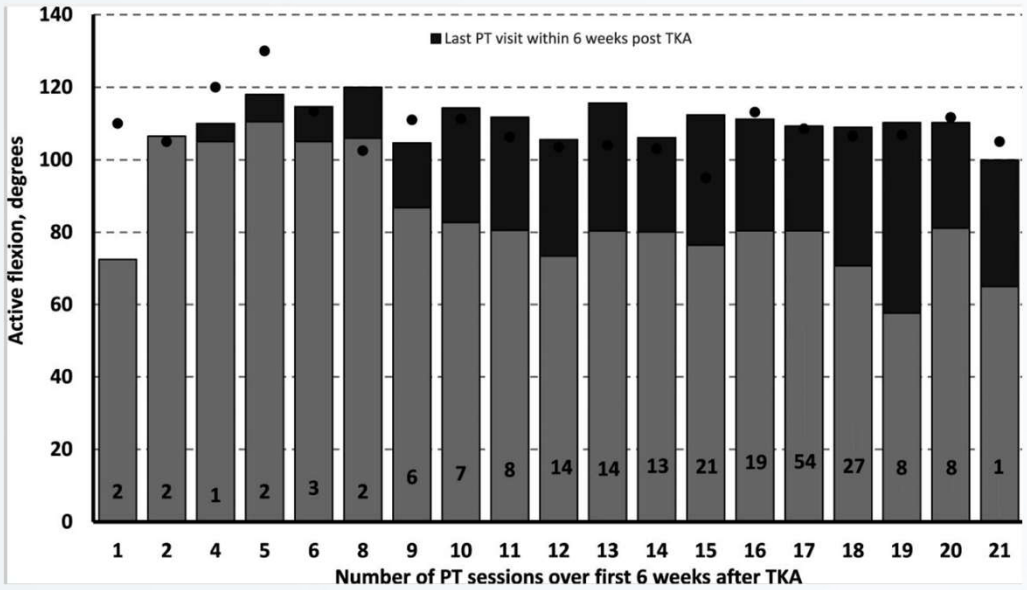
The Evidence Landscape

- **Dosage**

Black dot = pre-surgery ROM

Light gray = ROM immediately post surgery

Black = ROM post 6 weeks



Protocol after TKA (OT emphasis)

General Information:

Functional verses textbook ROM for normal function

What is required for normal function?

Activity	ROM needed
Tie shoe with flat foot on floor	106* flexion
Independent sitting	93*
Lifting object from floor	117* (straight back) / bent at hips 71*
Ascending stairs	83-105*
Descending stairs	86-107*
Walking	60*
Running	103*

(Clarkson, 2000)

Protocol after TKA (OT emphasis)

General Information:

An article by Hyodo, et al. (2017) looked at ROM required for ADL's with a cross-sectional study

No	Tasks	Knee flexion/extension			
		Flex	SD	Ext	SD
1	Putting on pants (sitting, dominant)	✖119	8	−42	11
2	Putting on pants (standing, dominant)	115	8	✖−1	2
3	Putting on pants (standing, non-dominant)	24	10	−1	2
4	Putting on shoes (knee)	84	10	−55	12
5	Putting on shoes (ankle)	103	6	−71	9
6	Tying shoelaces (right)	77	9	−73	11
7	Tying shoelaces (left)	78	9	−75	10
8	Wiping buttocks (right)	79	10	−71	10
9	Wiping buttocks (left)	79	9	−75	9

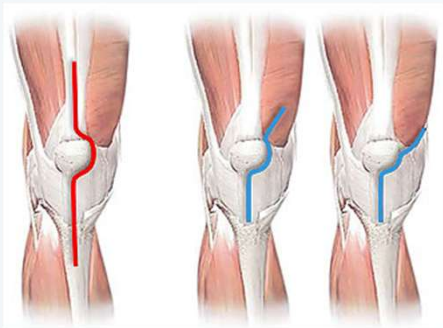
No	Tasks	Knee flexion/extension			
		Flex	SD	Ext	SD
10	Getting in the bath (40 cm, front, dominant)	125	8	✖−1	1
11	Getting in the bath (40 cm, front, non−dominant)	126	7	−1	1
12	Getting in the bath (40 cm, side, dominant)	124	7	−1	1
13	Getting in the bath (40 cm, side, non-dominant)	126	8	−1	1
14	Getting in the bath (50 cm, front, dominant)	128	7	−1	1
15	Getting in the bath (50 cm, front, non-dominant)	126	7	−1	2
16	Getting in the bath (50 cm, side, dominant)	124	7	−1	1
17	Getting in the bath (50 cm, side, non-dominant)	126	7	−1	1
18	Getting out of the bath (dominant)	✖143	8	−1	1
19	Getting out of the bath (non-dominant)	77	36	−1	1

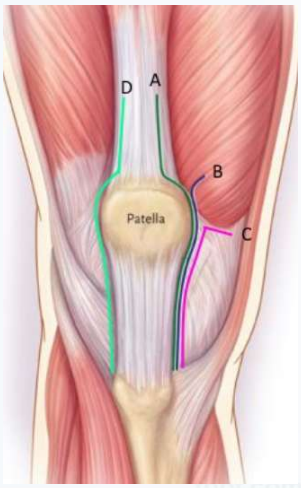
Protocol after TKA (OT emphasis)

Education: What surgical technique was used?

Do they know? Do you know? (hint: read the surgical report…it says a lot)

- Incision type may dictate pain:
  - anteromedial incisions (parapatellar - A or midvastus - B)
  - lateral parapatellar approach (D)
  - subvastus (C)



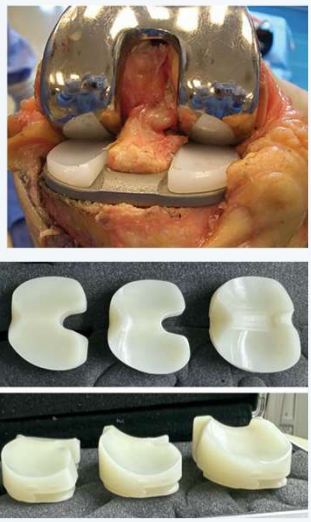


Protocol after TKA (OT emphasis)

Education: What Component(s) was used?

Do they know? Do you know? (hint: read the surgical report…it says a lot)

- PCL retaining
- Bi-Cruciate Retaining (BCR)
- Posterior-Stabilized (PS)
- Ultra Congruent
- Medial Congruent



Protocol after TKA (OT emphasis)

3 Phase Protocol:

- Phase 1 (Pain/Infection Phase): Day 0 - 3
- Phase 2 (Motion Phase): Day 3 – Week 6
- Phase 3 (Function Phase): Week 7 - 12
- Current evidence is suggesting to move away from a rigid timeframe to a criteria driven protocol:
  - Criteria to advance from phase 1:
    - Quad contraction and/or ability to perform SLR (NMES may be appropriate)
    - Knee AROM -10* to 80*
    - Pain and inflammation are “minimal” (appropriate for 3 days post)
    - SBA to Mod I with transfers and bed mobility
    - Mobility of at least 100’ with AD

Protocol after TKA (OT emphasis)

3 Phase Protocol:

- Current evidence is suggesting to move away from a rigid timeframe to a criteria driven protocol:
  - **Criteria to advance from phase 2** (Day 3 or 4 – Week 6):
    - AROM > or = 115* or within 10% pre-TKA
    - Voluntary quad control as exhibited during closed chain activities and ADL’s
    - I with ambulation community distances (approx. 800’) without AD (this may not always be the case)
    - Pain < 4/10 with mobility and ADL’s and minimal to no inflammation
  - **Criteria to advance from phase 3** (week 7-12):
    - AROM with minimal to no pain
    - 4 to 4+/5 strength based on MMT
    - I with mobility (or PLOF)
    - Step over step stair climbing

Protocol after TKA (OT emphasis)

3 Phase Protocol:

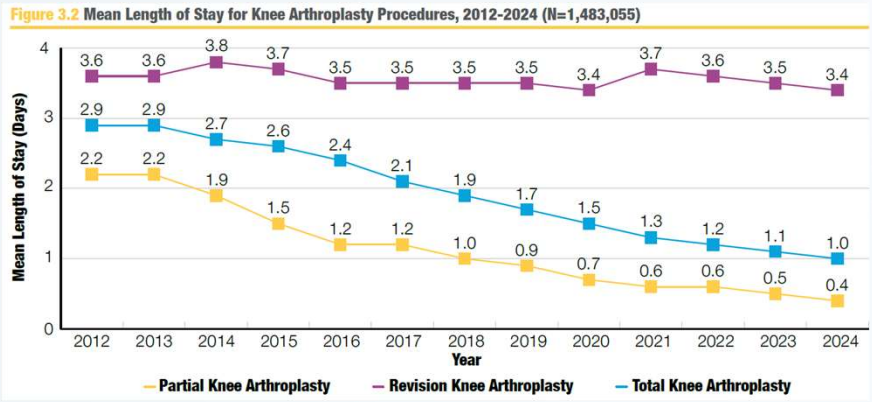
- Phase 1 (Pain/Infection Phase): Day 0 - 3
  - Treatment:
    - Extensive closed chain (WB) activities to stimulate the quad, AROM, and imitate **function**
    - Education **(knowing is half the battle)** read the surgical report with your patient
    - Pacing (starting slow may be okay) Coping (in combination with motion) Pain (little research has been done post TKA at home outside of “exercise”)
    - Adaptive Equipment (home set-up)
    - Transfer Training

Protocol after TKA (OT emphasis)

3 Phase Protocol:

- Phase 1 (Pain/Infection Phase): Day 0 - 3
  - Treatment:
    - Pain (little research has been done post TKA at home outside of “exercise”)

LOS had dramatically declined in the past decade (pain control)



Protocol after TKA (OT emphasis)

3 Phase Protocol:

- Phase 1 (Pain/Infection Phase): Day 0 - 3
  - Treatment:
    - Pain (SDD = 48% of all TKA, 93% = HH or OP, 41% = SNF prior to 2010)
  - Multimodal analgesia with fewer side effects than “opioid-only” protocols
  - Musculoskeletal pain = nonsteroidal anti-inflammatory drugs
  - Nerve pain = gabapentinoids and local anesthetics and nerve blocks
    - Knee = Spinal, adductor canal, femoral nerve
    - Hip = spinal
    - Shoulder = suprascapular and interscalene
  - Surgical pain = acetaminophen and/or opioids

(Karam et al., 2021)

Protocol after TKA (OT emphasis)

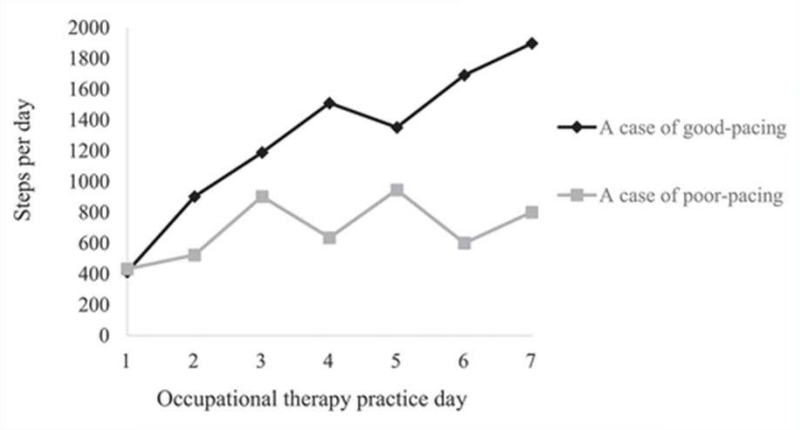
3 Phase Protocol:

- Phase 1 (Pain/Infection Phase): Day 0 - 3
  - Treatment:
    - Pacing
  - Hiraga et al., (2020) looked at psychological factors that induce chronic pain and inactivity post 1-week TKA. Specifically, how did these patients perform on the COPM (OT functional assessment), pain, anxiety, depression, and pain self-efficacy.
    - 2 groups: “poor pacing” and “good pacing”
    - 33% demonstrated poor pacing = less physical activity, significantly higher walking pain, anxiety, and depression
    - “poor pacing” was determined by reduced daily activity, steps taken, and general COPM performance through a daily journal

Protocol after TKA (OT emphasis)

3 Phase Protocol:

- Phase 1 (Pain/Infection Phase): Day 0 - 3
  - Treatment:
    - Pacing



Protocol after TKA (OT emphasis)

3 Phase Protocol:

- Phase 1 (Pain/Infection Phase): Day 0 - 3
  - Treatment:
    - Pacing

Variable	Good-pacinggroup (n = 20)	Poor-pacinggroup (n = 10)
COPM performance (points)	7.9 ± 1.6	7.1 ± 2.1
COPM satisfaction (points)	8.2 ± 1.6	7.0 ± 2.0
HADS anxiety (points)	2.2 ± 2.1	5.6 ± 3.1
HADS depression (points)	2.2 ± 2.2	6.0 ± 4.2
NRS walk pain (points)	3.2 ± 1.7	4.5 ± 2.0

Protocol after TKA (OT emphasis)

3 Phase Protocol:

- Phase 1 (Pain/Infection Phase): Day 0 - 3
  - Treatment:
    - Coping
  - Hara et al., (2022) analyzed post TKA QOL, pain, depression, hospital anxiety, falls, and VAS using a “coping list”. OT’s (other professions may provide) providing coping skills to their patients found significant outcomes in all areas.

Pain Coping List

Let's describe the measures that can alleviate the pain and anxiety situation as much as possible and the measure that you make unconsciously.

"Procedure"

Situations	Cope	Result
(Example) It hurts from morning.	(Example) Stretch.	(Example) Pain is reduced.

Protocol after TKA (OT emphasis)

Case A	Case B	Case C	Case D	Case E
Take a deep breath	Taking medicine	Icing	Icing	Icing
calm down	Rehabilitation	Be positive	Taking medicine	Talk about pain
Prepare	Stretch	Have a goal	Hot pack l	Contact with family
Disperse feelings	Rest	Rehabilitation	TV set	Medication management
Have room	Icing	Listen to music	Eat sweets	Be positive
Think good	Looking out	Relaxation	Distract attention from pain	Get sleep
Not think of anything	Listen to music	Walking	Rehabilitation	Blame someone
Distract attention	Hot pack	Medication management	Stretch	Talk to people
Relax	Talk to the patient	Talk to a nurse	Take a break	Eat what you like
Icing	Phone with family	Inhale the outside air	Don’t think about pain	Watch TV
Positioning	Think about what you want to eat	Strength training	Encourage yourself	Become defiant
Stretch	Think about life after discharge	To sew		Positioning
Strength training	Schedule	Take a bath		Ignore pain

	Pre-OT	Post-OT	p-value	Effect size (r)
COPM-performance	2.4±1.5	8.6±1.2	0.01**	1.2
COPM-satisfaction	2.2±1.6	8.6±1.3	0.01**	1.2
NRS	6.4±2.1	1.4±1.4	0.01**	1.1
HADS depression	8.4±2.9	1.6±1.0	0.01**	1.2
HADS anxiety	6.2±2.3	3±1.1	0.03*	1.0
EQ-5D	0.5±0.2	0.8±0.1	0.02*	1.1
EQ-5D VAS	61±18.5	80±8.9	0.14	0.7
MFES	93.6±27.0	118±17.4	0.12	0.7
PDAS	26.2±10.3	11.2±9.0	0.05*	0.9

“Elderly people with pain do not understand the pain and they give up on their painful situation. Using coping skills will lead to smooth goal achievement and improve pain management and QOL after d/c.”

Protocol after TKA (OT emphasis)

3 Phase Protocol:

- Phase 1 (Pain/Infection Phase): Day 0 - 3
  - Treatment:
    - Adaptive Equipment/Home set-up
  - > 50% home modifications and AE/DME are rejected
  - AE/DME "substantially more successful when education and training is completed in the home by a trained professional."
  - Home modifications and AE as a single intervention have no positive effect on fall reduction
  - When home modifications/AE are accompanies with 6 "therapy or education" sessions, the results are different
    - Improved ADL, self-rated, and satisfaction with ADL performance
    - 91% adherence rate 12-months post

(Stark et al., 2018) (Hamm et al., 2016)

Protocol after TKA (OT emphasis)

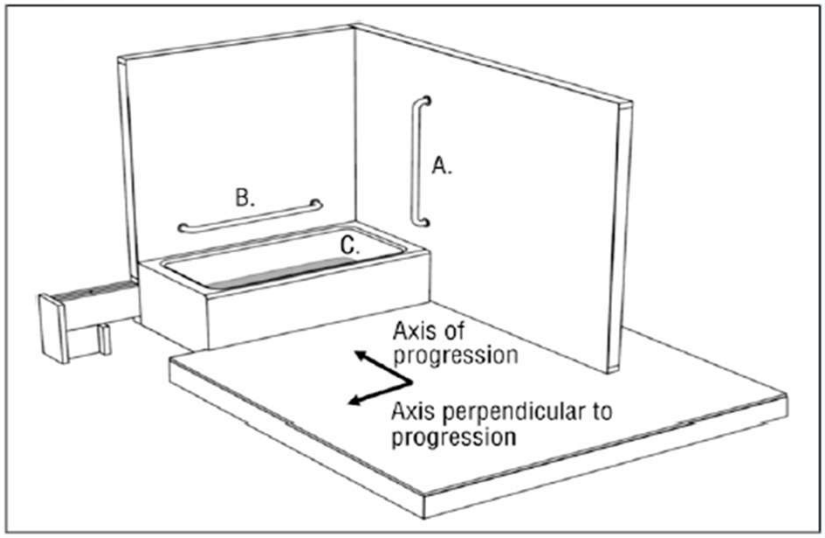


Figure 1. Schematic showing the orientations of the axis of progression and perpendicular (lateral) axis and the locations of the vertical grab bar (A), horizontal grab bar (B), and bath mat (C).

(Stark et al., 2018)

Protocol after TKA (OT emphasis)

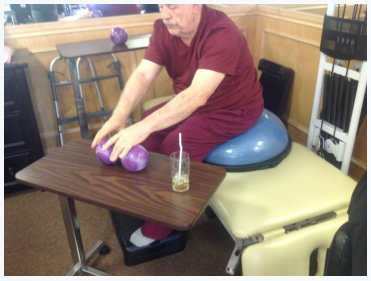
3 Phase Protocol:

- Phase 1 (Pain/Infection Phase): Day 0 – 3
  - Treatment
    - Adaptive Equipment/Home set-up

Protocol after TKA (OT emphasis)

3 Phase Protocol:

- Phase 1 (Pain/Infection Phase): Day 0 - 3
  - Treatment:
    - Extensive closed chain (WB) activities to stimulate the quad, AROM, and imitate **function**



Protocol after TKA (OT emphasis)

3 Phase Protocol:

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Protocol after TKA (OT emphasis)

3 Phase Protocol:

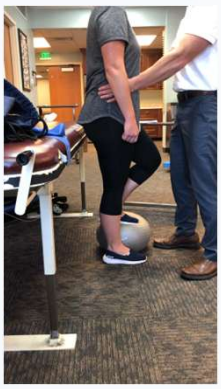
- Phase 2 (Motion Phase): Day 3 – Week 6
  - Treatment:
    - Extensive closed chain (WB) activities to stimulate the quad, AROM, and imitate **function**
    - Increase strength to knee flexor/extensor groups (NMES)
    - Increase body spatial awareness with operative extremity during ADL's
    - Gait: d/c assistive device when appropriate (flat surfaces first week and progress to dynamic surfaces
    - Joint Mobilization (week 3 or 4) for tissue repair and contracture reduction

Protocol after TKA (OT emphasis)

3 Phase Protocol:

- Phase 2 (Motion Phase): Day 3 – Week 6
  - Treatment:
    - Extensive closed chain (WB) activities to stimulate the quad, AROM, and imitate **function**

Knee Flexion with 8 – 10* during midstance and standing



Protocol after TKA (OT emphasis)

3 Phase Protocol:

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  - Treatment:
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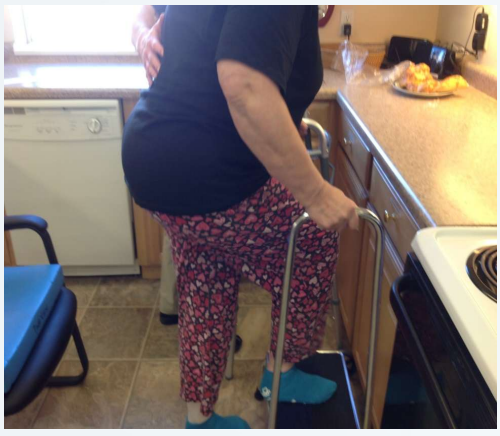
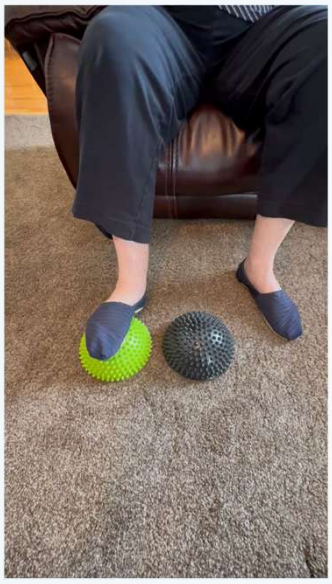


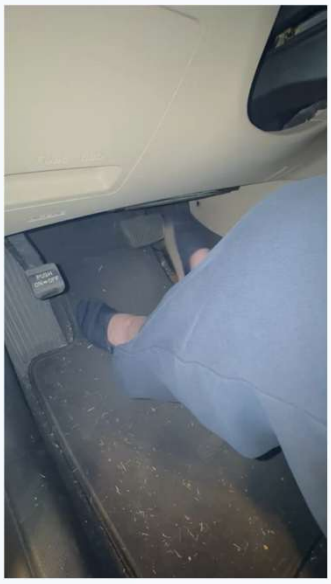
Protocol after TKA (OT emphasis)

3 Phase Protocol:

- Phase 2 (Motion Phase): Day 3 – Week 6
  - Treatment:
    - Increase strength to knee flexor/extensor groups (NMES)

Type II fiber flexion/extension (reaction time/speed)





Protocol after TKA (OT emphasis)

3 Phase Protocol:

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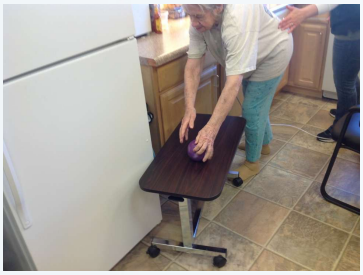
  - Treatment:
    - Increase body spatial awareness with operative extremity during ADL's



Protocol after TKA (OT emphasis)

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Protocol after TKA (OT emphasis)

3 Phase Protocol:

- Phase 2 (Motion Phase): Day 3 – Week 6
  - Treatment:
    - Increase body spatial awareness with operative extremity during ADL's
    - TUGManual

$$\left(\frac{\text{Dual Task} - \text{Single Task}}{\text{Single Task}}\right) \times 100\% = \text{Dual Task Cost}$$

$$\left(\frac{40 - 30}{30}\right) \times 100\% = 33.3\%$$


Dual Task Cost: $\frac{12 - 8 = 4}{8}$ **x 100% =**

0.5 x 100% = 50% DTC

Protocol after TKA (OT emphasis)

Final thoughts: Recovery takes the right approach

- An article by Pua, et al. (2019) looked at predicting knee ROM, pain, and walking 6 months post TKA
  - ROM: knee extension = 7* (worsened over time)
  - ROM: knee flexion at 118*
  - Predictors: pre-op knee flexion/extension (age, diabetes, preoperative walking limitations)
  - Pain: 83% claimed “moderate” pain post 6 months
  - Predictors: pre-op pain (depression, knee flexion range, race)
  - Walking: 50% reported inability to walk > 15 minutes
  - Predictors: age (no assistive device preoperatively, depression, bi-lateral knee pain)
- Osmanski-Zenk et al., (2026) “Mental health correlates with function and QOL. In addition, depression, anxiety and psychological distress will yield less favorable outcomes at 3 months and 12 months post-op TKA.”

The Landscape Continues to Evolve

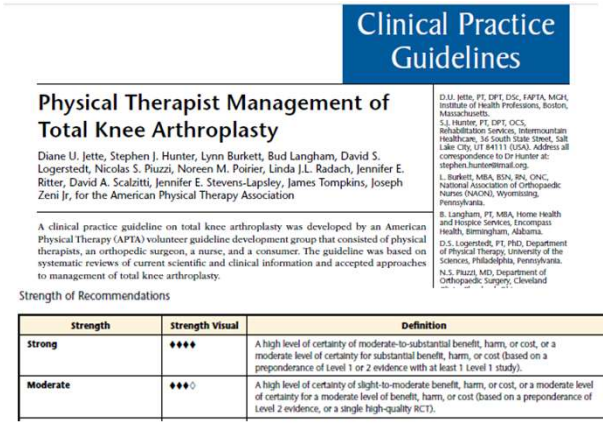
TKA

- Long hospital stays with inpatient rehab
- Shift toward shorter LOS and increased Home Health
- ASC/Outpatient in a bed
- Visit limitations, virtual care
- "Bundles"

CPG

APTA

- TKA CPG
  - Should have supervised physical therapy management
  - Pre-operative exercise
  - Motor function training
  - NMES
  - Should NOT use CPM
- Revision out in the next few months



Clinical Practice Guidelines

Physical Therapist Management of Total Knee Arthroplasty

Diane U. Jette, Stephen J. Hunter, Lynn Burkett, Bud Langham, David S. Logerstedt, Nicolas S. Piuzzi, Noreen M. Poirier, Linda J.L. Radach, Jennifer E. Ritter, David A. Scalzitti, Jennifer E. Stevens-Lapsley, James Tompkins, Joseph Zeni Jr, for the American Physical Therapy Association

A clinical practice guideline on total knee arthroplasty was developed by an American Physical Therapy (APTA) volunteer guideline development group that consisted of physical therapists, an orthopedic surgeon, a nurse, and a consumer. The guideline was based on systematic reviews of current scientific and clinical information and accepted approaches to management of total knee arthroplasty.

Strength of Recommendations

Strength	Strength Visual	Definition
Strong	♦♦♦♦	A high level of certainty of moderate-to-substantial benefit, harm, or cost, or a moderate level of certainty for substantial benefit, harm, or cost (based on a preponderance of Level 1 or 2 evidence with at least 1 Level 1 study).
Moderate	♦♦♦◊	A high level of certainty of slight-to-moderate benefit, harm, or cost, or a moderate level of certainty for a moderate level of benefit, harm, or cost (based on a preponderance of Level 2 evidence, or a single high-quality RCT).

Jette 2020

Risk Stratification

TKA

- Risk stratification drives setting, frequency and intensity
- Comorbidities
  - DM
  - BMI
  - Chronic Pain
  - Hx of smoking
- Age
- Gender
- Race/ethnicity

Core Outcome Set

Evaluation Essentials

Why do we use Patient Reported Outcome Measures (PROMS)

- An assessment of the patient's experience of illness (symptoms, functioning, well-being)
- Enhances patient engagement in their health care
- Facilitates discussion of values and goals
- Facilitates treatment decisions
- Affects reimbursement for services through Merit-based Incentive Payment Systems (MIPS)
- Informs practice individually, for individual clinics, and system wide

(Lavallee et al., 2016)

Patient Reported Outcomes Measures

PROMs

- Common tools
  - Knee Injury and Osteoarthritis Outcome Score (KOOS Jr)
  - Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC)
  - Knee Outcome Survey ADL's (KOS)
- PROMs help focus conversations on the patient and their concerns

Knee Outcome Survey Activities of Daily Living Scale (ADLS).
Symptoms: To what degree does each of the following symptoms affect your level of activity? (check one answer on each line)

	I do not have the symptom	I have the symptom, but it does not affect my activity	The symptom affects my activity slightly	The symptom affects my activity moderately	The symptom affects my activity severely	The symptom prevents me from all daily activity
Pain						
Stiffness						
Swelling						
Giving way, buckling, or shifting of the knee						
Weakness						
Limping						

Functional Limitations With Activities of Daily Living: How does your knee affect your ability to: (check one answer on each line)

	Activity is not difficult	Activity is minimally difficult	Activity is somewhat difficult	Activity is fairly difficult	Activity is very difficult	I am unable to
Walk						
Go up stairs						
Go down stairs						
Stand						
Kneel on front of your knee						
Squat						
Sit with your knee bent						
Rise from a chair						

Range of Motion

Objective Measures-Knee ROM

- Pre-operative ROM is predictive of post-operative ROM
- Consider higher level monitoring of patients with pre-operative ROM restrictions
- Understand you patient's "demands"

Bade 2014, Zeni 2010

Strength

Objective Measures

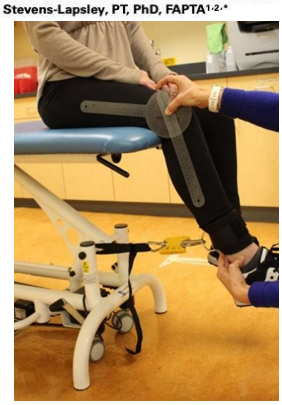
- Quadricep activation
- Lag
- Dynamometer testing

Capin 2022, Kittelseon 2013

PTJ: Physical Therapy & Rehabilitation Journal | *Physical Therapy*, 2022;102:1–10
https://doi.org/10.1093/ptj/pzac033
Advance access publication date March 30, 2022
Perspective

Total Knee Arthroplasty Assessments Should Include Strength and Performance-Based Functional Tests to Complement Range-of-Motion and Patient-Reported Outcome Measures

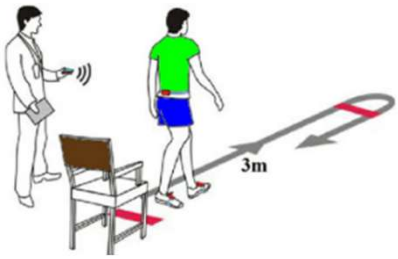
Jacob J. Capin, PT, DPT, PhD[1-2-3], Michael J. Bade, PT, DPT, PhD[1-2], Jason M. Jennings, MD, DPT[4-5], Lynn Snyder-Mackler, PT, ScD, FAPTA[6], Jennifer E. Stevens-Lapsley, PT, PhD, FAPTA[1-2,*]



Functional Tests

Objective Measures

- Timed Up and Go (TUG)



FALL RISK CRITERIA: >/=12 sec
(CDC STEADI)
> 24 predictive of falls within 6 months after hip fracture
≥ 30 predictive of requiring assistive device for ambulation and being dependent in ADLs

Healthy Adults:
- **Age 60-69:** 8.1 seconds
- **Age 70-79:** 9.2 seconds
- **Age 80-89:** 11.2 seconds

TKA:
- **Healthy adult:** 5.6 seconds
- **Pre TKA:** 8.9 seconds
- **1 month post:** 14.6 seconds
- **3 month post:** 9.78 seconds

Functional Tests

Objective measures

- 30 seconds Sit to Stand

FALL RISK CRITERIA:
- 60-64 men<14, women <12
- 65-69 men <12, women<11
- 70-74 men <12, women <10
- 75-79 men<11, women<10
- 80-84 men <10, women<9
- 85-89 men <8, women<8
- 90-94 men<7, women<4

<8 associated with lower level of function

MCID in Hip OA: score of +5 considered major improvement. Score of +4 or less is considered unimportant change.

Interventions

Post TKA

TKA Rehab Practice Guideline

Phase	Treatment (Examples)	Compliance Measures	Milestones
I (0-4 Weeks) Visits 1-6	**ROM:** bike 5-10' no resistance; wall slides; passive knee ext. stretch; seated/prone bag hang; patellar mobilizations **Strength:** SAQ, counter minisquats, clams, glute squeezes, s/l hip ADD **Balance:** multi-directional stepping, weight shifting, side-stepping (UE support PRN) **NMES** (per protocol)	Measure: • Pain and disability • AROM/PROM Interventions: • ROM • Volitional strength • Balance/Agility • NMES (per protocol) Implement home stretch program (bag hang)	• Complete 3x8 reps without fatigue • Pain at rest <4/10 • AROM/PROM <10-90 • Independent with mobility in and out of home
II (2-6 Weeks) Visits 8-14	**ROM:** bike 5-10' no resistance, moving seat lower, add resistance when full rotation at lowest seat; wall slides; passive knee ext. stretch, seated/prone bag hang; patellar mobilizations **Strength:** LAQ, SLR, clams, s/l hip ABD, step-ups/side step ups/side step up-overs, heel raises, hamstring curls, TKE **Balance:** marching, backward walking, forward lunges (decrease UE support) **NMES** (per protocol)	Measure: • Pain and disability • AROM/PROM Interventions: • ROM • Volitional strength • Balance/Agility • NMES (per protocol) Implement home stretch program (bag hang)	• AROM/PROM 0° to > 105° • Minimal pain and swelling • Voluntary quad control or 0° knee extension lag • Heel strike/push off w/ least restrictive device • Start focus on TKE in stance phase of gait • Obtain baseline isometric quadriceps index and activation with a superimposed electrical stimulation burst at the end of week 4
III (5-8 Weeks) Visits 12-18	**ROM:** Same as Phase II with lower seat/increased duration **Strength:** resisted LAQ/hamstring curls, 4-way hip, ball squats, step ups/overs (increase height if good concentric/eccentric control) **Balance:** balance board, forward lunging, SLS EO (progress surface), grape vine, figure 8 (progress volume/speed) **NMES** (per protocol)	Measure: • Pain and disability • AROM/PROM Interventions: • ROM • Volitional strength • Balance/Agility • NMES (per protocol) Document patient compliance with bag hang	• Consistent with carryover of AROM 0° to >115° • Collaborate with surgeon if by 4-6 weeks post-op carryover of AROM in flexion is less than 10°-15° from initial outpatient PT evaluation measurement.
IV (7-10 Weeks) Visits 12-18	**ROM:** As previous until milestones achieved **Strength:** machine leg extension/curls, ball bridges, 4-way hip, leg press, calf press, ball squats w/ hold **Balance:** Star excursion, SLS EC, side shuffles, grape vine, figure 8 walking, bkwd walking (progress volume/speed) **NMES** (per protocol)	Measure: • Pain and disability • AROM/PROM Interventions: • ROM • Volitional strength • Balance/Agility • NMES (per protocol) Document patient compliance with bag hang	• AROM 0-120° • Walk foot over foot up and downstairs without assistive device • Unlimited walking distance with normalized gait and least restrictive device • Quadriceps strength at 70% strength of uninvolved side

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Variation in Practice

How many and which exercises?

- Variability in the number and type of exercises in terminal phase of rehab post TKA (Oatis, 2014)
- Only interventions consistently reported were ROM and Quadricep exercise
  - No uniformity in type of exercise
  - No uniformity in resistance or progressions
  - No records described the volume or intensity of the interventions

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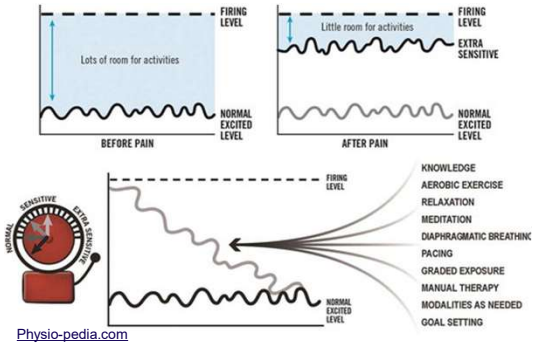
Pain Management

TKA

- Varies based on the individual
- Ice/Elevation
- Manual therapy (Argut 2021)
- Pain Neuroscience Education/psychologically informed therapy (Bhaita 2020, Cai 2018)



Physio-pedia.com

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Range of Motion

TKA

- Knee ROM does NOT predict function
- High volume until benchmarks are achieved
- Follow up with functional activities that use full ROM
- Extension
  - LLLD stretching
  - QS for motor control
  - Walking with emphasis on extension at stance phase

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ROM

TKA

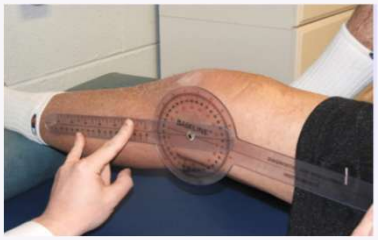
- Flexion
  - Passive stretch-to tolerance
  - Assisted
  - Active movement
    - Cycling
    - Squatting
  - Monitor for substitutions





Arthrofibrosis

TKA




- Early recognition and communication
- Understanding benchmarks
  - 2 weeks: 10-90
  - 6 weeks: <5 extension and >105 flexion
  - Expand MT time within session and increase ROM dosage at home
- Treatment
  - Manage the swelling and pain
  - Low Load Long Duration Stretching (LLLD)
- When to be concerned
  - Lack of carry over between session
  - Increasing pain with decreasing motion
  - Lack of compliance by patient
  - Signs and symptoms of infection

PD1

ROM vs Strength

TKA

- Knee ROM milestones
- Knee flexion and extension ROM do NOT predict performance
- Perception of function is correlated to pain-influences PROM's
- Objective functional tests only slightly higher than pre-op levels despite improved PROMs
- Quadriceps strength
  - Functional mobility-sit to stand, stairs, walking speed

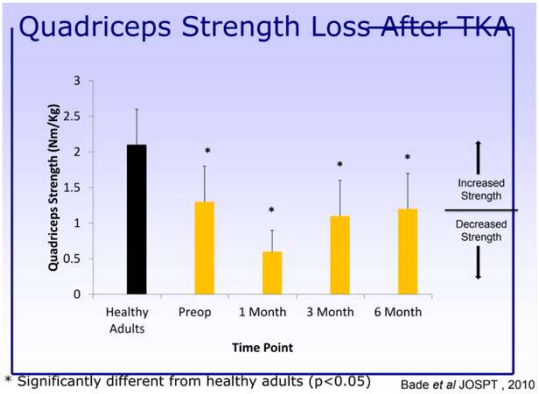
(Yoshida 2007, Mizner 2005)

Strength

Why?

- Quadricep weakness is more strongly related to functional performance than pain or ROM after TKA (Yoshida 2007, Mizner 2005)
- 28-39% deficit in Quad strength compared to healthy adults 1-2 years post TKA (Walsh 1998, Silva 2003)
- Long term deficits in strength and function compared to healthy adults:
  - 40% deficits in quad strength
  - 30%deficits in walking distance
  - 105% deficit in stair climb speed

(Bade 2010, Mizner 2005)



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PD1 Add citations
Pam Dibblee, 2026-04-08T14:08:11.934

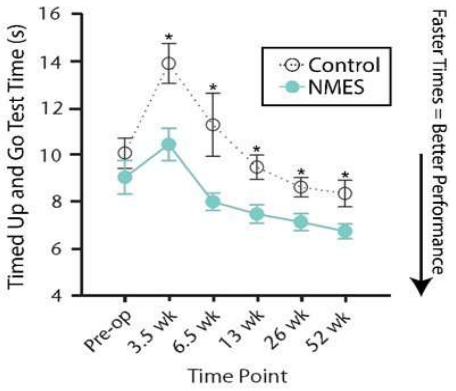
NMES

TKA

- NMES after TKA is a part of PT clinical practice guideline
- NMES after TKA improves functional recovery (TUG) in the short and long term, through one year

Neuromuscular Electrical Stimulation (NMES) ♦♦♦◊

Physical therapists should use NMES for patients who have undergone TKA to improve quadriceps strength, gait performance, performance-based outcomes, and patient-reported outcomes. *Evidence Quality: High; Recommendation Strength: Moderate.*



Stevens-Lapsley et al., 2012; Jette et al., 2020

Clinical Implementation- Strength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Resistance and intensity of strengthening exercise	♦♦♦◊	Physical therapists should design, implement, teach, and progress patients who have undergone TKA in high-intensity strength training and exercise programs during the early postacute period (ie, within 7 days after surgery) to improve function, strength, and ROM.

Design, Implement, Teach and Progress

- Targeted Load/dose
  - 2-3 sets
  - 8-12 reps
- Measure to assess progress
  - Dynamometer
  - 30 sec Sit to Stand
  - Stair Climb test
  - Functional test that is appropriate for the patients PLOF
- Quadriceps, hamstrings, Gastroc/Soleus, hip musculature (Pozzi 2020, Bade 2011)

PD1

Strength

Design, Implement, Teach and Progress

- Progressions
- Tailor to the individual
- "2 left in the tank"
- "More than 8, increase the weight“
- Soreness rules
  - Sore>2 hours
  - Decrease ROM >5
  - Increase in swelling
  - Increase in pain>2 points



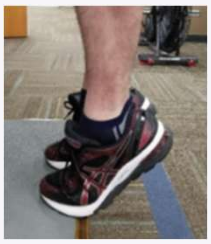





Strength

Don't forget Hamstrings, Hip, Calf

- Calf Raise
- Hamstring
  - Leg curls
  - Hip hinge RDL>staggered RDL
- Hip
  - Bridge
  - Step up/down
  - Lunges







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PD1 Need pics of Strength progressions
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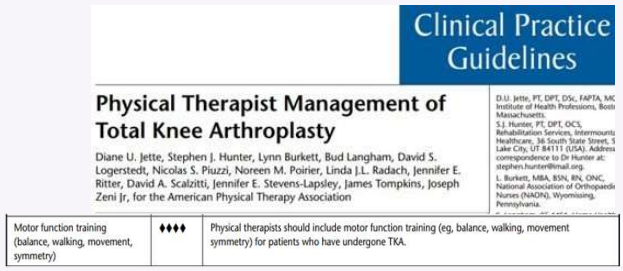
Clinical implementation-Motor Function

Strong Recommendation

- Balance, Walking Movement Symmetry
  - Movement symmetry
  - Dynamic Stability



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Motor function training (balance, walking, movement, symmetry)	♦♦♦♦	Physical therapists should include motor function training (eg, balance, walking, movement symmetry) for patients who have undergone TKA.

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Motor Function Training

Balance, Walking Movement Symmetry

- Motor function training
  - Weightbearing
  - Loading
  - Multidirectional
  - Functional
- Feedback
  - External cues
  - Task Practice
  - Knowledge of performance

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PD1 Need pics of balance, motor control exercises
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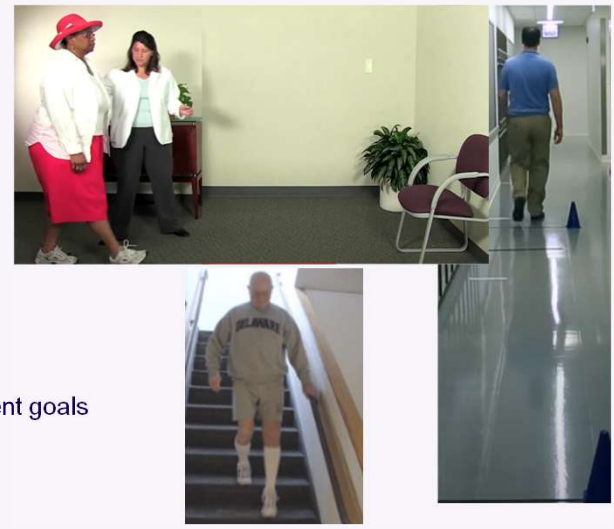
Motor Function Training



Evaluating Outcomes

- Measurement helps us demonstrate value
- Measures to assess progress
  - TUG
  - Gait speed (10M walk test)
  - Stair climb
  - Higher Level functional tests based on patient goals
    - Y balance
    - Step down test

Effective
Person Centered
Affordable

$$\text{Value} = \frac{\text{Outcome}}{\text{Cost}}$$

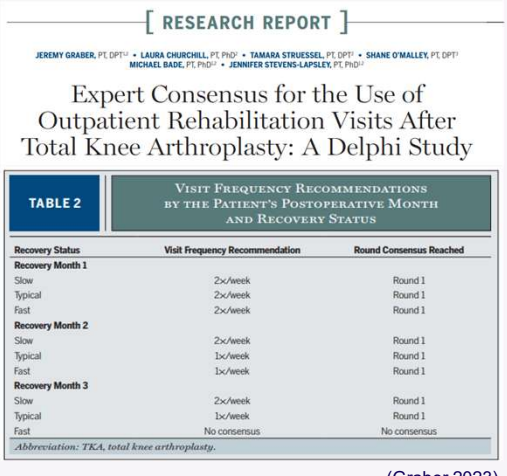
Outcome= Clinical Outcome
+
Patient Reported Outcome
+
Patient Experience

Shared Decision Making

Patient Centered Care

- All clinical decisions should be guided by patient preference and values (Institute of Medicine)
- "An approach where clinicians and patients share the best available evidence when faced with the task of making decisions and where patients are supported to consider option to achieve informed preferences" (Elwyn, 2010)
- Variability in decision making strategies (Graber, 2022)
  - Flexibility with fidelity (Kendall, 2018)
  - Prescriptive vs collaborative

How Many Visits?



[RESEARCH REPORT]

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MICHAEL BADE, PT, PhD[2,3] • JENNIFER STEVENS-LAPSLEY, PT, PhD[1,2]

Expert Consensus for the Use of Outpatient Rehabilitation Visits After Total Knee Arthroplasty: A Delphi Study

TABLE 2 Visit Frequency Recommendations by the Patient's Postoperative Month and Recovery Status

Recovery Status	Visit Frequency Recommendation	Round Consensus Reached
Recovery Month 1		
Slow	2×/week	Round 1
Typical	2×/week	Round 1
Fast	2×/week	Round 1
Recovery Month 2		
Slow	2×/week	Round 1
Typical	1×/week	Round 1
Fast	1×/week	Round 1
Recovery Month 3		
Slow	2×/week	Round 1
Typical	1×/week	Round 1
Fast	No consensus	No consensus

Abbreviation: TKA, total knee arthroplasty.

(Graber 2023)

Outpatient Physical Therapy

- Utilization
  - Frequency
  - Duration
- Value in the visit
  - Concerns of the patient about progress, pain or limitations
  - Questions from the patient
  - Regular reassessment to demonstrate functional gain and drive treatment decisions

Right Level of Care for the Right Patient at the Right Time

Clinicians

- Team based approach with patient involvement
- Dosage
  - Visit frequency/duration
  - Intensity of exercise
- Setting selection:
  - In person
  - Virtual-check ins, progressions, adherence
  - Hybrid-progressions, problem solving

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Value: What does the patient who is sitting in front of me need today?

- **Effective**
  - Guideline based
  - Consistent measurement
  - Adequate progression/load
- **Person centered**
  - Shared decision making
  - Collaborative goal setting and intervention selection
- **Affordable**
  - Minimize "waste" with in sessions
  - Maximize your skill and knowledge

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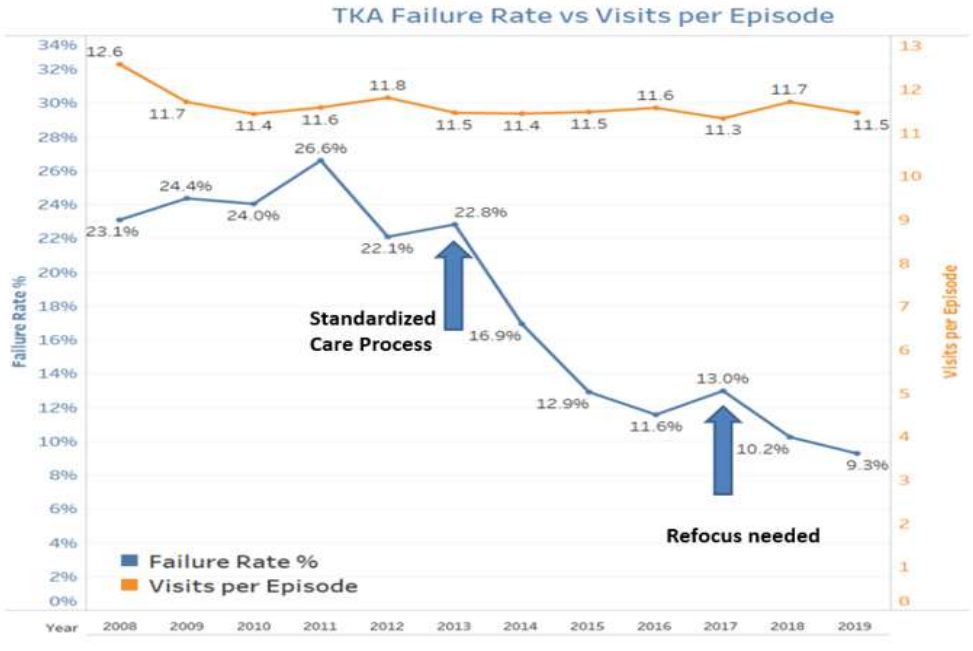
Total Knee Guideline Implementation

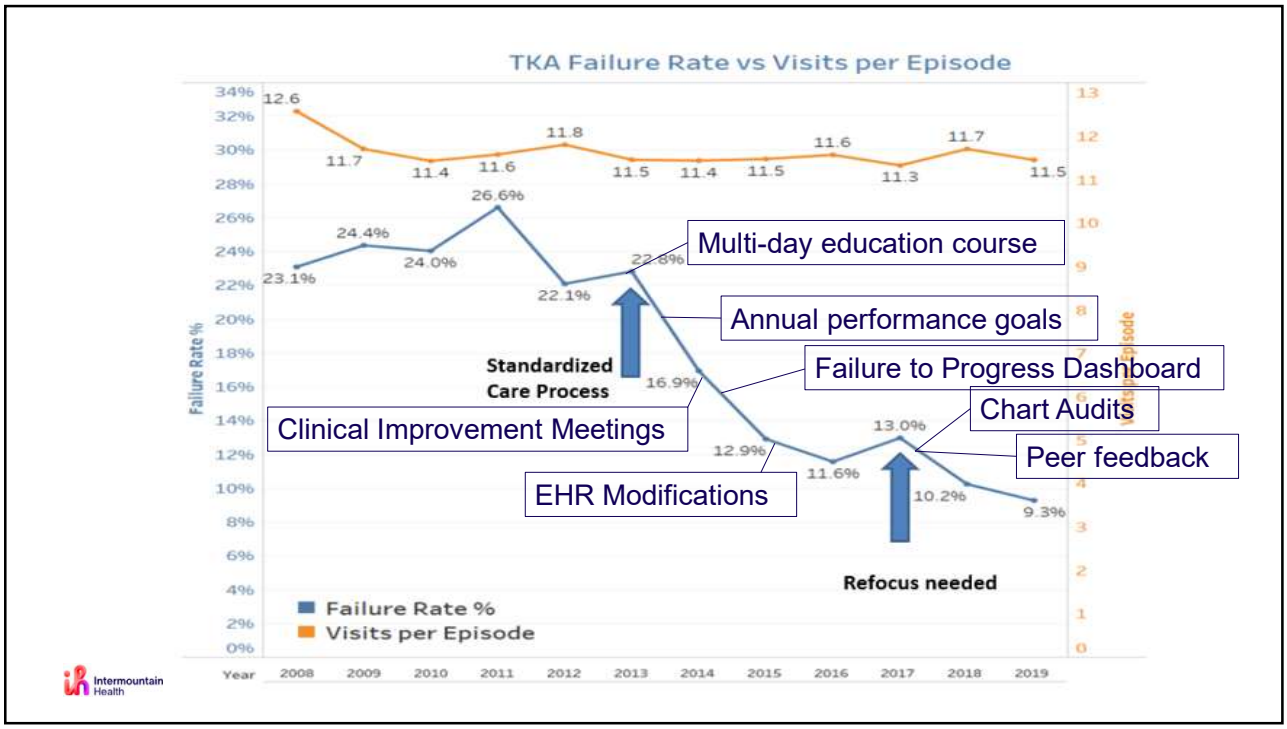
J Orthop Sports Phys Ther. 2022 Dec 12;1-26. doi: 10.2519/jospt.2022.11369. Online ahead of print.

Improved Outcomes Following a Care Guideline Implementation: Part 1 of an Analysis of 12,355 Patients after Total Knee Arthroplasty

Kate Minick [1], Stephen J Hunter [1], Jacob J Capin [2 3 4], Jennifer Stevens-Lapsley [2 4], Gregory Snow [5], Devyn Woodfield [6], Pam Dibblee [1], Gerard Brennan [1]

- **Objective**: To describe the standardization of care to reduce the proportion of patients who FTP
- **Methods**:
  - Continuous Quality Improvement Design
  - Care guideline initiated in 2013
  - Knee Outcome Survey – Activities of Daily Living (KOS-ADL) measured at every visit
  - Logistic regression to compare the proportion of patients who did not progress on the KOS-ADL in a non–care guideline group (2008-2012) to a care guideline group (2014-2019)





Total Knee Guideline Implementation

Variation in outcomes and number of visits following care guideline implementation: Part 2 of an Analysis of 12,355 patients after total knee arthroplasty

Jacob J Capin [1 2 3 4], Kate Minick [5], Jennifer E Stevens-Lapsley [1 3], Greg Snow [5], Devyn Woodfield [5], Pam Dibblee [5], Gerard Brennan [5], Stephen J Hunter [5]

- **Objective**: To describe the variation in outcomes and number of visits before and after implementing a care guideline for total knee arthroplasty rehabilitation
- **Methods**:
  - Bayesian hierarchical linear regression models using the KOS-ADL change score and number of PT visits as the response variables, controlling for relevant predictor variables
  - Also compared the ratio of the standard deviations of the KOS-ADL change scores and the number of PT visits within and between clinics.

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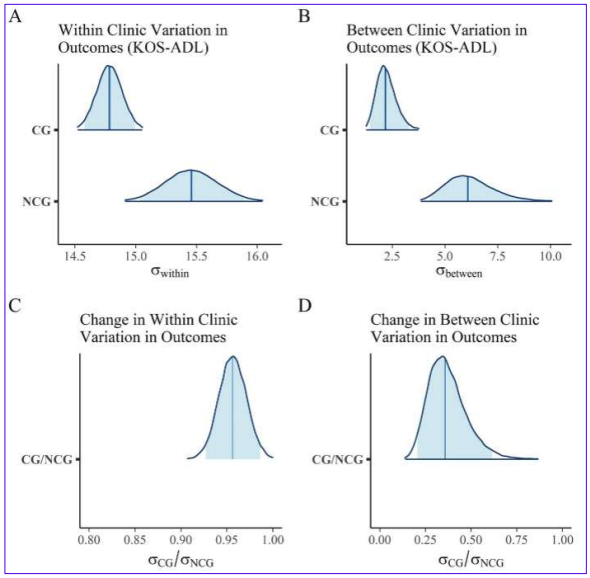

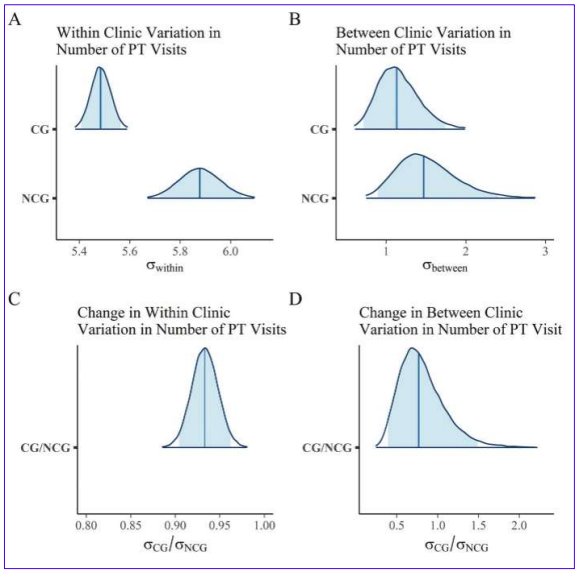

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Leader Levers

- Standardization with allowed personalization
  - Clear care pathways anchored in evidence
  - Flexibility to adapt based on risk and goals
- Clinician enablement
  - Clinical coaching
  - Practice patterns and documentation aligned to payer expectations/bundles/value-based metrics
  - EHR tools that support guideline concordant care
- Continuous improvement
  - Develop a learning loop to monitor progress and identify opportunities
  - Help front line be curious

Summary

- Focus on Function
  - ROM benchmarks are important
  - Strength=function
- Understand the patient's needs and expectations and modify care accordingly
- Provide "Value" within each session and across the episode
  - Measure what you are doing-PROMS, functional tests
  - Evidence informed approach-minimizing unwarranted variation
  - Patient centered approach-shared decision making
  - Consider appropriate dosage-exercise intensity and visits

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