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A Pedaling-Based Three Exercise Protocol Was Superior to a Non-Pedaling Ten Exercise Protocol for Post-Operative Rehabilitation After Total Knee Replacement in a Randomized Controlled Trial

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- A Pedaling-Based Protocol was Superior to a Ten Exercise Non-Pedaling Protocol for Post-Operative Rehabilitation after Total Knee Replacement in a **Randomized Controlled Trial**
- Christopher Vertullo, MBBS, PhD, FRACS(Orth)



Disclosure:

- •Larissa Sattler: No conflicts to disclose
- •Wayne Hing: No conflicts to disclose
- •Christopher Vertullo:
 - •Held shares in: Nil
 - •Received royalties from: Nil
 - •Done consulting work for: Nil
 - •Given paid presentations for: Zimmer, Smith & Nephew

Background

- inpatient setting and early period after discharge following Total Knee Replacement
- acute postoperative period

•There is a lack in research into the optimal exercise protocols in both the acute

•Pedaling is recommended by clinicians for TKR for rehabilitation, however, there has been no investigation into its utility in the acute postoperative setting.

•Therefore, we performed a RCT trial evaluating the efficacy of pedaling in the



Methods

- •Sixty TKR patients were randomized to receive postoperative physical therapy involving either a:
 - 3-exercise pedaling (pedaling-based) <u>OR</u> 10-exercise, non-pedaling (multi-exercise) protocol

- •Outcomes were assessed at 2 days, 2 weeks, and 4 months
- Including tests of physical function, patient-reported outcomes, and other perioperative measures.





Recruitment

Randomised to a PT group

Outcomes Superior

P=<0.05

6 Minute Walk distance



10 Exercise, Non-Pedaling (Multi-exercise) Protocol

ANKLE PUMPS



Bend ankles up and down, alternating feet. Repeat <u>10</u> times. Do <u>2</u> sessions per day.

HEEL RAISE WITH TOWEL ROLL UNDER KNEE



Lying on back with rolled towel (about 6 inches wide) under knee, slowly straighten knee to fully extended (straight) position. Hold 3-5 seconds, then relax. Repeat with other knee.

Repeat <u>10</u> times. Do <u>2</u> sessions per day.

KNEE/CALF STRETCH



Sit with knee straight and theraband or towel looped around foot. Gently pull on towel and push knee down into bed until stretch is felt behind knee.

Hold 30 seconds.

Repeat 5 times Do 2 sessions per day.

THIGH MUSCLE CONTRACTION



With leg out straight tighten quadriceps by pushing back of knee into surface. Hold 3-5 seconds. 10 reps per set, 2 sets per day

STRAIGHT LEG RAISE



Keep operated leg as straight as possible and tighten muscles on top of thigh. Slowly lift straight leg off the bed and hold 3-5 seconds. Lower it, keeping muscles tight. Relax.

Repeat <u>10</u> times. Do <u>2</u> sessions per day.

HEEL SLIDE KNEE BENDS



Bend knee and pull heel toward buttocks. Repeat <u>10</u> times. Do <u>2</u> sessions per day.



3 Exercise Pedaling (Pedaling-based) Protocol

Heel - Toe Walking



Take a step and land with heel on floor.

Bike Pedaling



Place hands on seat or arms of chair for support and turn pedals backwards and forwards until able to comfortably achieve a full rotation.

Repeat 30 revolutions. Do 2 sessions per day. Stretching: Hamstring/Calf – Theraband



While lying safely in bed.With knee straight, loop theraband around foot.Gently pull on theraband until stretch is felt in hamstring/calf.Hold __30__ seconds.

Repeat 5 times per set. Do 2 sessions per day.

Baseline Preoperative Characteristics

Characteristic	Standard Multi-Exercise Protocol (N = 30)	Pedaling-Based Protocol (N = 30
Age* (yr)	66.0 ± 8.7	66.8 ± 6.7
Sex†		
Male	18 (60%)	22 (73%)
Female	12 (40%)	8 (27%)
BMI* (kg/m ²)	29.4 ± 4.4	29.3 ± 4.3
Oxford Knee Score*	22.2 ± 5.4	25.8 ± 6.7
Lysholm score*	45.4 ± 13.9	50.6 ± 18.8
Knee flexion‡ (°)	110.0 (90.0-110.0)	110.0 (85.0-120.0)
ASA Physical Status classification ⁺		
	2 (7%)	2 (7%)
	19 (63%)	21 (70%)
	9 (30%)	7 (23%)

*The values are given as the mean and standard deviation. [†]The values are given as the number, with the percentage in parentheses. [‡]The values are given as the median, with the range in parentheses.



Results of *Functional Outcome Measures* (Physical and Patient-Reported) at All Time Points

	Multi-I	Exercise Protocol	Pe	daling-Based Protocol		
Outcome	No.	Measured Value*	No.	Measured Value*	Mean Difference (95% CI)	
6-min walk test† (m)						
2 days	30	187.0 ± 67.0	30	252.9 ± 73.5	65.8 (29.4 to 102.2)	
2 wk	30	348.6±81.8	30	390.2 ± 94.2	41.6 (4.0 to 87.2)	
4 mo	28	488.3 ± 89.7	28	514.0 ± 78.5	25.7 (19.5 to 70.9)	
10-m walk test (m/sec)						
2 days	30	0.60 (0.20 to 1.10)§	30	0.70 (0.50 to 1.50)§		
2 wk	30	1.05 (0.70 to 1.70)§	30	1.15 (0.70 to 2.30)§		
4 mo	28	1.50 ± 0.25	28	1.54 ± 0.24	0.04 (0.01 to 0.12)	
Timed Up & Go test (sec)						
2 days	30	23.9 (12.6 to 54.3)§	30	19.3 (9.4 to 40.2)§		
2 wk	30	10.7 (6.4 to 24.4)§	30	10.0 (5.7 to 18.5)§		
4 mo	28	7.1 ± 1.3	28	6.9 ± 1.3	0.2 (-0.05 to 0.9)	
Knee flexion (°)						
2 days	30	90 (50 to 110)§	30	90 (80 to 115)§		
2 wk	30	93 (70 to 150)§	30	95 (80 to 125)§		
4 mo	28	110.4 ± 9.1	28	113.0 ± 10.4	2.7 (2.6 to 7.9)	
Oxford Knee Score						
2 days	30	20.2 ± 7.4	30	24.7 ± 8.5	4.5 (0.34 to 8.6)	
2 wk	30	23.1 ± 7.9	30	28.8 ± 7.6	5.6 (1.6 to 9.7)	
4 mo	28	37.6±4.8	28	39.3 ± 6.1	1.7 (1.3 to 4.6)	
EQ-5D score						
2 days	30	12.1 ± 3.1	30	11.1 ± 3.5	1.0 (–0.7 to 2.7)	
2 wk	30	10.4 ± 2.6	30	9.0 ± 2.2	1.3 (0.1 to 2.6)	
4 mo	28	7.0 (5.0 to 11.0)§	28	6.0 (5.0 to 11.0)§		
EQ-5D VAS						
2 days	30	60 (10 to 95)§	30	80 (25 to 100)§		
2 wk	30	75 (50 to 97)§	30	88 (40 to 100)§		
4 mo	28	88 (50 to 100) §	28	90 (75 to 100)§		

*The values are given as the mean and standard deviation, except where otherwise noted. †Primary outcome measure. ‡Significant difference (p < 0.05). §The values are given as the median, with the range in parentheses.



Results: *Functional Outcome Measures*

- 0.001).
- weeks or 4 months.
- = 0.007)
- weeks, and p = 0.044 at 4 months).

•For the primary outcome, the Six Minute Walk Test (6MWT), the Pedaling group walked further at 2 days postoperatively (mean difference, 66 m; p =

•Secondary outcomes, the Timed Ten Meter Walk (10MWT) and the Timed Up and Go (TUG) tests were faster in the pedaling-based group at 2 days (p =0.016 for 10MWT, and p = 0.020 for TUG), but did not differ significantly at 2

•The Oxford Knee Score was significantly better for the pedaling group at 2 days (mean difference, 4.5; p = 0.034) and at 2 weeks (mean difference, 5.6; p

•The EQ-5D score was also significantly better at 2 weeks (mean difference, 1.3; p = 0.037), and the VAS component of the EQ-5D was significantly better for the pedaling group at all time points (p = 0.031 at 2 days, p = 0.050 at 2





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Results of *Perioperative Measures and Pain and Satisfaction* Scales at Indicated Time Points

	Mult	Multi-Exercise Protocol		Pedaling-Based Protocol	
Outcome	No.	Median (Range)	No.	Median (Range)	Р
LOS (days)	30	3.0 (2.0 to 6.0)	30	2.5 (2.0 to 5.0)	0
Readiness for discharge† (days)	30	2.0 (1.0 to 4.0)	30	2.0 (1.0 to 4.0)	0.
As-needed analgesia (mg oxycodone)					
2 days	30	10.0 (0.0 to 40.0)	30	5.0 (0 to 60.0)	C
Pain threshold‡					
2 days	30	2.0 (1.0 to 4.0)	30	2.0 (1.0 to 5.0)	C
Satisfaction with protocol \S					
2 days	30	1.0 (1.0 to 2.0)	30	1.0 (1.0 to 3.0)	C
2 wk	30	1.0 (1.0 to 2.0)	30	1.0 (1.0 to 3.0)	C
Compliance with home-exercise program					
2 wk	30	100 (55 to 100)	30	100 (50 to 100)	C

*Significant difference (p < 0.05). †Difference indicated by mean ranks: pedaling protocol (24.1) was better than standard protocol (36.9); U = 257.00. ‡Likert scale: high pain threshold 1 (strongly agree) to 5 (strongly disagree). §Likert scale: satisfaction with protocol 1 (very satisfied) to 5 (very dissatisfied).



Results: Perioperative Measures, Pain and Satisfaction

- •Length of Stay (LOS) was shorter for the pedaling-based group, by a half-day (median of 2.5 compared with 3.0 days; p = 0.024).
- •Analgesic consumption, home-exercise-program compliance, self-reported pain threshold, and satisfaction with the exercise protocol were similar between the 2 groups.

Conclusion

- •A pedaling-based physical therapy protocol after TKR was superior to a standard multi-exercise protocol in the acute postoperative period.
- •The multi-exercise protocol was not superior for any outcome measure at any time point.



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