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Supplementary appendix

van der Graaff SJA, *et al. Br J Sports Med* 2022; 56:870–876. doi: 10.1136/bjsports-2021-105059

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STARR-trial Physical Therapy Protocol

Phase	Goal	Activities
I	Reduce knee effusion	Explanation and education about meniscal injury; advice for daily activities and to stay in 'pain free range of motion'
		Exercises (partial weight bearing) within 'pain free range of motion', e.g. walking, cross-training, cycling
IIa	Optimize range of motion	Transfers: sit and to stand Cycling Optional: stair walking (patient dependent)
		Homework: Extension and flexion -Straighten and bend the knee Practicing simple daily activities -Squat, step up, pelvic bridge
IIb	Optimize coordination and muscle function	To maintain / improve gait -Active dynamic gait To improve muscle function of the quadriceps To train proprioception
		Homework: Pursue full (passive) extension Practicing simple daily activities -Squat, step up, pelvic bridge
III	Stimulate activities in daily living and return to sport	Dependent on patients preferences / background / work situation: daily life or sport specific exercises
		<u>Daily life-specific exercises :</u> Walking and turning Kneeling, squatting, lifting Practicing complex, multiple transfers Practicing complex daily activities (e.g. turn + reach)
		<u>Sport-specific exercises :</u> Extended gait training (goal: increase of intensity), e.g. dribbling – skippings Jumping
		Homework: Practicing complex, multiple transfers Practicing complex daily activities (e.g. turn + reach)

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Home exercises for meniscal tear

Ask your physical therapist for advice and support

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Walking on a treadmill

- Start with walking
- Hold the rails if necessary
- Ask your physical therapists for advice on speed and technique

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Cycling on an exercise bike

- Adjust the bike to achieve a comfortable position
- Ask your physical therapist for advice on the cycling speed and changing the saddle height to increase bending of your knee

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Get up from a chair (squat)

- Use a chair on a flat floor
- Sit down with a straight back with your knees in a 90 degrees angle
- Put your arms straight out (figure 1)
- Keep your knees pointing forwards, avoid a knocked knee position (figure 3)
- Stand up, while keeping your knees and arms pointing forwards, until your legs are straight (figure 2)
- Repeat this exercise 15 times, two to three times a day
- When you succeed in this exercise, adjust the exercise by placing the foot of your injured leg slightly backwards (see figure 4) and perform the exercise in the same way

Figure 1

Figure 2

Figure 3

Figure 4

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Straighten the leg (extension)

- Use a bench approximately 40 centimeters high
- Place your hands on the bench, shoulder width apart, with your knees bent
- Elevate your uninjured leg (figure 1) while keeping your hands on the bench
- Pay attention to your knees, keep them pointing forwards, don't let your knees knock (figure 5)
- Straighten the injured leg (standing leg), while keeping your hands on the bench (figure 2)
- Repeat this exercise 10 times, two to three times a day
- When you succeed in this exercise, adjust the exercise by using a lower bench (20 centimeters) and perform the exercise in the same way (figure 3 and 4)

Figure 1

Figure 2

Figure 3

Figure 4

Figure 5

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Step-up

- Use a bench or chair at knee-height (if this is too hard, use a lower bench or chair)
- Stand in front of the bench
- Keep your uninjured leg straight on the floor and place your injured leg on the bench while bending your injured knee (figure 1)
- Step up onto the bench, by straightening your injured leg and elevating your uninjured leg to 90 degrees. Pay attention to your injured leg, it has to be straightened completely.
- Pay attention to the knee of your injured leg, it has to point forwards, not go into a knocked knee position (figure 3)
- Keep your back straight and keep looking forwards (figure 4)
- Repeat this exercise 10 times, two to three times a day

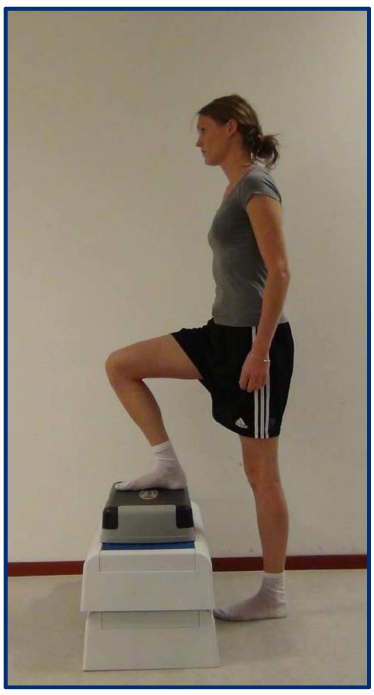

Figure 1

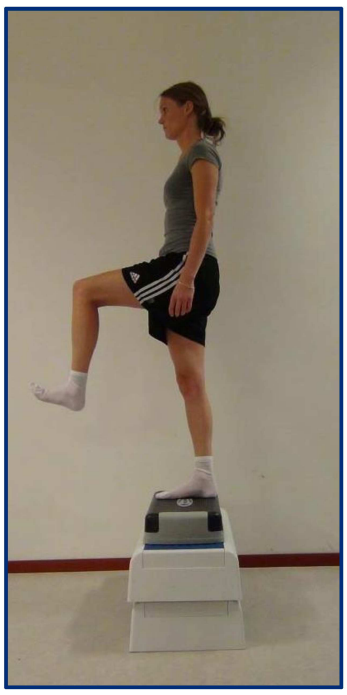

Figure 2

Figure 3

Figure 4

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Pelvic bridge

- Lay down with your arms at your sides
- Bend your knees to an angle of 110 degrees (figure 1)
- Keep your feet flat on the floor
- Keep your head on the floor
- Lift your pelvis, while keeping your feet, arms and head on the floor (figure 2)
- Keep your upper legs in a straight line with your belly
- Hold this position for 5 seconds
- Repeat this exercise 15 times, two to three times a day, for three weeks in a row
- After 3 weeks and when you succeed in this exercise, you can adjust the exercise by straightening the injured leg and placing your arms in front of you (figure 3). Repeat this exercise 15 times, two or three times a day

Figure 1

Figure 2

Figure 3

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Turn and reach

- Use a weight or water bottle of 0.5 to 1 kilograms
- Stand with your legs hip-width apart and place the weight on the side of the injured leg
- Move your uninjured leg back, with your toes still touching the floor (figure 1)
- Reach down with your arm from the uninjured side to the weight, while slightly bending your injured leg (figure 2)
- Grab the weight and straighten your injured leg, while keeping your uninjured leg with the toes on the floor (figure 3) until you are in the starting position again
- Repeat this exercise 10 times, two to three times a day
- When you can easily do in this exercise, make it harder by lifting your uninjured leg of the floor during the exercise (figure 4, 5 and 6)

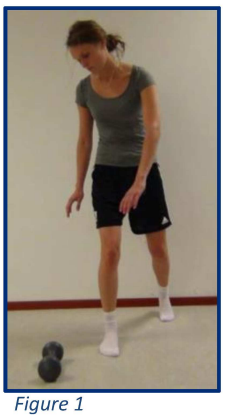
Figure 1


Figure 2

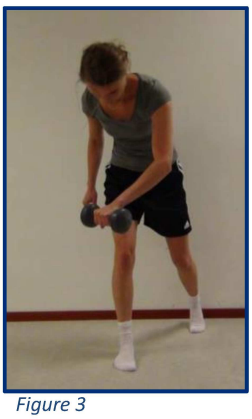
Figure 3

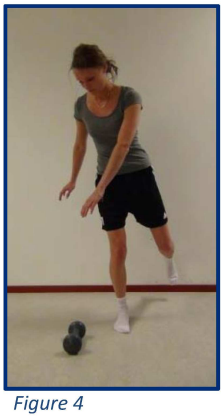
Figure 4

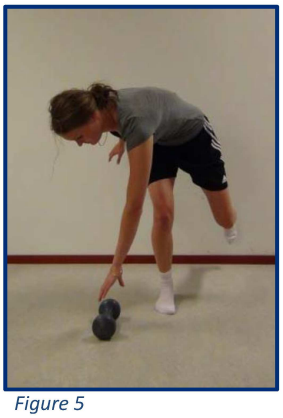
Figure 5


Figure 6

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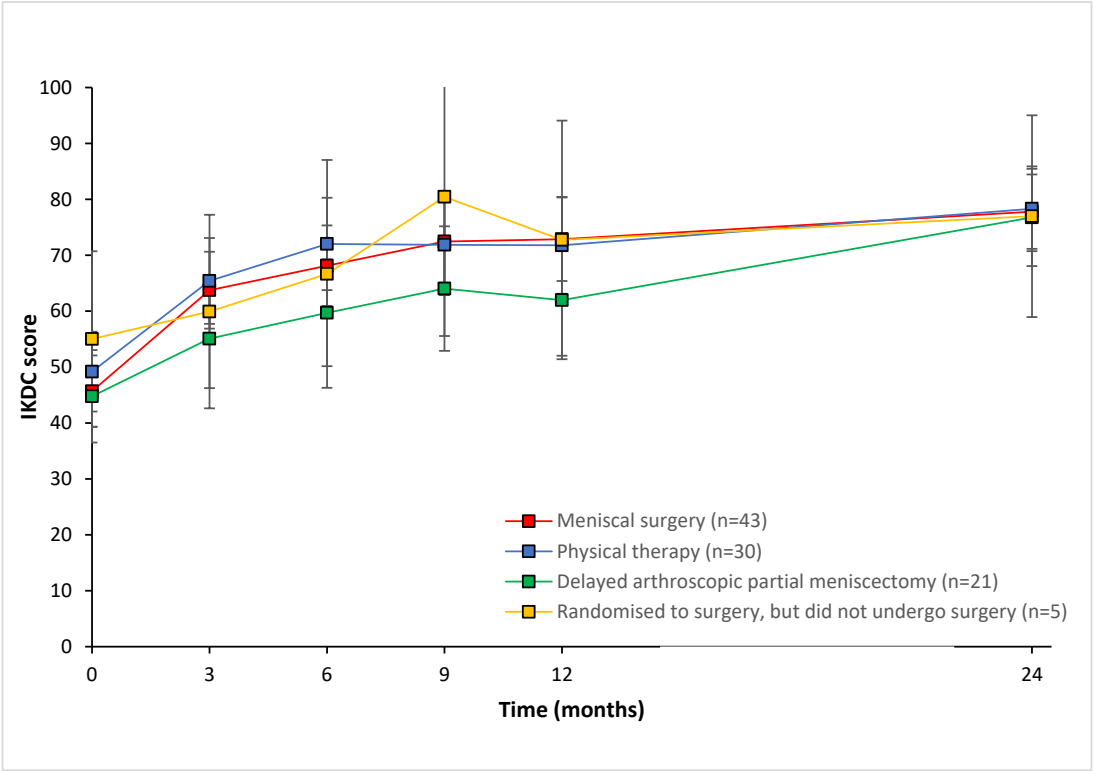
Supplementary Figure 1. Estimated IKDC score* for as treated analyses per measurement period



	baseline	3 months	6 months	9 months	12 months	24 months
Meniscal surgery (n=43)	46 (39 to 52)	64 (57 to 71)	68 (61 to 75)	72 (64 to 81)	73 (65 to 80)	78 (71 to 84)
Physical therapy (n=30)	49 (42 to 56)	65 (58 to 73)	72 (64 to 80)	72 (63 to 81)	72 (63 to 80)	78 (71 to 86)
Delayed arthroscopic partial menisectomy (n=21)	45 (37 to 53)	55 (46 to 64)	60 (50 to 69)	64 (53 to 75)	62 (52 to 72)	77 (68 to 85)
Randomised to surgery, but did not undergo surgery (n=5)	55 (39 to 71)	60 (43 to 77)	67 (46 to 87)	80 (56 to 105)	73 (51 to 94)	77 (59 to 95)
Primary outcome available, %	*98*	*77*	*70*	*63*	*75*	*91*

* adjusted for surgeon

Error bars represent 95% confidence intervals

Supplementary Table 1. Secondary outcomes* for as randomized analyses during follow-up

	Arthroscopic partial meniscectomy	Physical therapy	Between group difference
KOOS baseline			
pain	54.1 (48.2; 60.1)	59.5 (53.8; 65.2)	
symptoms	55.6 (49.7; 61.5)	62.9 (57.3; 68.5)	
ADL	61.3 (55.0; 67.6)	68.9 (62.9; 75.0)	
sport	30.2 (22.4; 38.0)	34.9 (27.4; 42.4)	
QoL	33.7 (28.0; 39.3)	35.4 (30.0; 40.8)	
KOOS 24 months			
pain	85.7 (79.0; 92.4)	83.8 (77.4; 90.2)	1.9 (-5.7; 9.6)
symptoms	81.8 (75.4; 88.2)	81.4 (75.2; 87.5)	0.5 (-6.6; 7.5)
ADL	92.0 (86.6; 97.5)	89.2 (84.1; 94.4)	2.8 (-3.3; 8.9)
sport	70.1 (60.5; 79.7)	69.3 (60.1; 78.6)	0.8 (-12.5; 14.0)
QoL	67.2 (59.1; 75.3)	65.8 (58.0; 73.6)	1.4 (-9.3; 12.0)
NRS rest			
baseline	3.9 (3.1; 4.6)	2.9 (2.2; 3.7)	
3 months	1.8 (1.1; 2.5)	1.6 (0.9; 2.2)	0.3 (-0.5; 1.0)
6 months	2.0 (1.2; 2.8)	1.3 (0.6; 2.1)	0.6 (-0.3; 1.6)
9 months	1.8 (0.8; 2.7)	1.5 (0.7; 2.4)	0.2 (-0.8; 1.3)
12 months	1.5 (0.6; 2.4)	1.7 (0.9; 2.6)	-0.2 (-1.2; 0.8)
24 months	1.2 (0.4; 1.9)	1.2 (0.5; 2.0)	-0.1 (-0.8; 0.7)
NRS activity			
baseline	6.6 (5.9; 7.3)	6.2 (5.5; 6.8)	
3 months	4.0 (3.2; 4.8)	3.8 (3.1; 4.6)	0.1 (-0.9; 1.1)
6 months	3.6 (2.7; 4.6)	2.9 (2.0; 3.8)	0.8 (-0.5; 2.0)
9 months	2.8 (1.7; 3.8)	3.1 (2.1; 4.0)	-0.3 (-1.7; 1.1)
12 months	2.4 (1.4; 3.3)	3.4 (2.5; 4.3)	-1.0 (-2.2; 0.2)

24 months	2.8 (1.9; 3.7)	2.4 (1.5; 3.3)	0.4 (-0.8; 1.5)
Lysholm			
baseline	66.9 (61.3; 72.5)	70.0 (64.7; 75.3)	
12 months	88.0 (82.3; 93.7)	83.0 (77.5; 88.4)	5.0 (-1.9; 11.9)
24 months	89.4 (84.8; 93.9)	88.3 (83.6; 93.1)	-1.0 (-6.2; 4.1)
WOMET			
baseline	38.1 (31.9; 44.4)	42.6 (36.6; 48.5)	
3 months	59.8 (51.9; 67.6)	59.4 (52.0; 66.8)	0.4 (-8.7; 9.5)
6 months	62.7 (54.8; 70.7)	65.8 (58.2; 73.4)	-3.1 (-12.4; 6.2)
9 months	71.9 (63.2; 80.7)	66.2 (58.2; 74.3)	5.7 (-4.8; 16.3)
12 months	70.8 (62.3; 79.3)	65.3 (57.1; 73.5)	5.5 (-4.9; 16.0)
24 months	71.9 (63.5; 80.2)	75.6 (67.6; 83.7)	-3.8 (-13.8; 6.2)
Tegner**			
baseline	6.5 (5.9; 7.1)	6.4 (5.8; 7.0)	
3 months	3.8 (3.2; 4.5)	3.8 (3.2; 4.4)	0.0 (-0.8; 0.9)
6 months	4.6 (3.9; 5.4)	4.1 (3.4; 4.8)	0.6 (-0.4; 1.6)
9 months	5.0 (4.2; 5.8)	5.3 (4.5; 6.1)	-0.3 (-1.4; 0.8)
12 months	5.5 (4.8; 6.3)	4.4 (3.6; 5.1)	1.1 (0.1; 2.2)
24 months	5.4 (4.7; 6.1)	5.0 (4.4; 5.7)	0.3 (-0.6; 1.3)
Satisfaction with knee function			
baseline			
24 months	71.6 (63.7; 79.6)	70.1 (62.4; 77.8)	1.5 (-9.3; 12.3)

Data is presented as mean and 95% confidence interval between parentheses.
* adjusted for surgeon
** Tegner baseline score is pre-trauma score
Percentage of outcome available per time point: baseline 98%, 3 months 77%, 6 months 70%, 9 months 63%, 12 months 75%, 24 months 91%.