Handgrip exercise

AVF and AVG

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February 9, 2019

Exercise in vascular access of CKD patients

- K/DOQI recommended that pre- and postoperative exercise are helpful to improve vascular access maturation.
  - Increase hyperemia and muscle mass
  - Enhance vein prominence
  - Decrease superficial fat

- Preoperative exercise increase in venous diameters and is significantly related to an increase in AVF maturation.

Upper extremity exercise training programs

- Tools
  - Rubber rings
  - Elastic bands
  - Soft ball
  - Tennis ball
  - Dumbbell
  - Hand grip
  - Manual pressure with isometric exercise
  - Tourniquet with isometric exercise
- Type of exercise
  - Isometric exercise
  - Isotonic exercise
- No report of adverse effects of the exercise on the maturation of AVF.
- There is still lack of evidence support the efficacy of UE exercises over draining vein diameter, wall thickness, and blood flow rate in the maturation process of AVF in CKD patients.

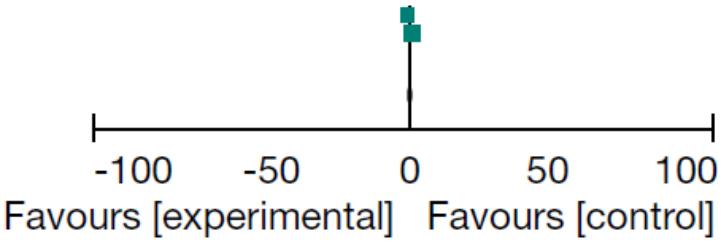
Study	Design	Participants	Intervention	Outcome measures
Kim (2012)	Quasi-experimental	*n*=26 Age: 50–70 years Gender: 13 male, 13 female	Upper limb exercises (12 haemodialysis patients who do not have a normal range of static intra access pressure vein Material: ball, rubber band and massage 3–4 times a day Control: Upper limb exercises (14 patients who have a normal range of static intra access pressure vein score)	■ Reduction of the risk of arteriovenous fistula stenosis
Salimi et al (2013)	Randomised controlled trial	*n*=50 Age (mean): 51.12 Gender: 40 male, 10 female	Isometric exercises (ball, halter, flex-band and the tourniquet) 4 times a week for 4 weeks Control: simple exercises to open and close the fingers	■ The fistula maturation: vein diameter, wall thickness, distance and taxa vein anastomosis of blood skin
Kong et al (2014)	Randomised controlled trial	*n*=18 Age (mean): 63.9 Gender: 6 male, 12 female	Handshake exercise with grip, three sets of 10 repetitions twice in the morning and twice in the afternoon (Handgrip) Exercises with soft ball for 4 weeks, three sets of 10 repetitions twice in the morning and twice in the afternoon	■ Size of the cephalic vein, blood flow volume ■ Grip strength, clamping force (forceps and palmar) and circumference of the forearm

Fuzari et al. Int J Ther Rehabil. 2017;24(3):98-104.

UE exercise and vein diameter

Figure 3. Forest plot draining vein diameter (mm)

Study	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Mean difference IV, Random, 95% CI
Kong (2014)	7	1.3	10	7.4	1.2	8	43.7%	-0.40 [-1.56, 0.76]
Salimi (2013)	7.68	1.23	25	6.73	1.21	25	56.3%	0.95 [0.27, 1.63]
Total (95% CI)			35			33	100.0%	0.36 [-0.95, 1.67]



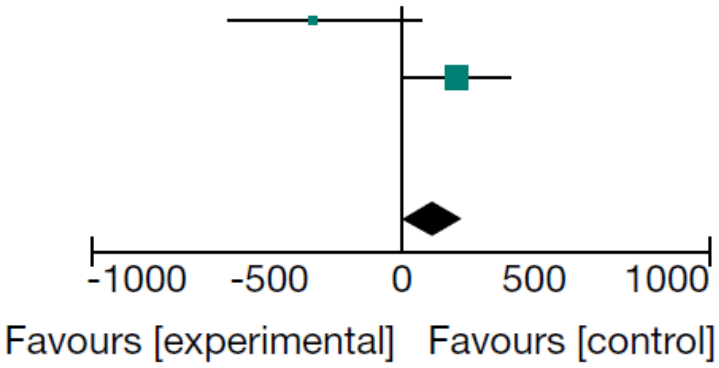
Heterogeneity: Tau²=0.68; Chi²=3.89; degree of freedom=1 (P = 0.05); I²=74%; Test for overall effect: Z=0.54 (P=0.59); SD: standard deviation; IV: intravenous; CI: confidence interval

Fuzari et al. Int J Ther Rehabil. 2017;24(3):98-104.

UE exercise and blood flow rate

Figure 4. Forest plot blood flow rate (ml/min)

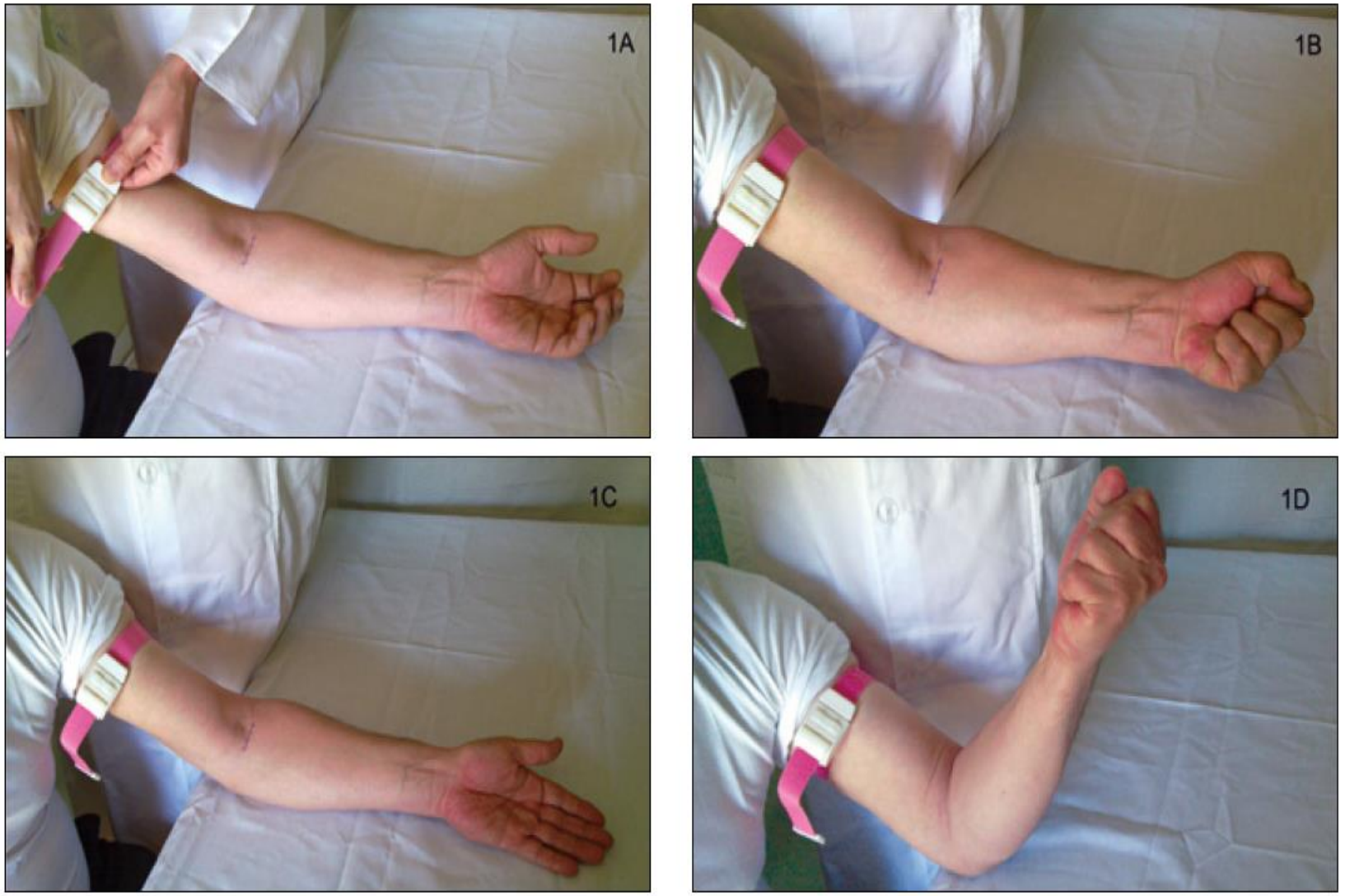
Study	Experimental Mean	SD	Total	Control Mean	SD	Total	Weight	Mean difference IV, Fixed, 95% CI
Kong (2014)	575.8	375.5	10	861.5	458	8	8.1%	-285.70 [-679.26, 107.86]
Salimi (2013)	870.32	246	25	727.92	167.09	25	91.9%	142.40 [25.83, 258.97]
Total (95% CI)			35			33	100.0%	107.87 [-3.90,219.64]



Heterogeneity: Chi² = 4.18, degree of freedom=1 (P=0.04); I²=76% Test for overall effect: Z=1.89 (P=0.06); SD: standard deviation; IV: intravenous; CI: confidence interval

Fuzari et al. Int J Ther Rehabil. 2017;24(3):98-104.

Day 1: rest and elevate the operated arm
Day 2-3:



Salimi et al. J Vasc Access. 2013;14(3):239-44.

Salimi et al., 2013:

- RCT of postoperative exercise (brachiocephalic AVF: a side to end anastomosis)
- 2 groups:
  - Control group: simple open-close hand exercise (isotonic exercise)
  - Exercise group: structured exercise program (isometric exercise)
- 4 times/day (morning, noon, afternoon, night)
- 2 weeks

Day 4-5

Day 6-10

Day 11-13

Salimi et al. J Vasc Access. 2013;14(3):239-44.

Duration of exercise?

Parameter	Assessment time	Case	Control	P-value
Draining vein diameter (mm)	Pre-exercise	5.36±1.02	5.10±1.17	0.39
	Post-exercise	7.68±1.23	6.73±1.21	0.009
Vein wall thickness (mm)	Pre-exercise	0.28±0.05	0.31±0.07	0.10
	Post-exercise	0.53±0.10	0.47±0.10	0.04
Skin-vein distance (mm)	Pre-exercise	4.54±1.22	4.24±1.39	0.42
	Post-exercise	2.59±0.77	2.44±0.89	0.52
Vein area (mm)	Pre-exercise	0.24±0.09	0.21±0.09	0.28
	Post-exercise	0.47±0.13	0.39±0.12	0.02
BFR (mL/min)	Pre-exercise	439.80±181.81	411.44±187.01	0.58
	Post-exercise	870.32±246	727.92±167.09	0.02

All results are presented as mean±SD. Pre-exercise study was performed in the first 24 hours after the procedure. Post-exercise study was performed two weeks after the procedure. BFR, blood flow rate

Salimi et al. J Vasc Access. 2013;14(3):239-44.

GD Grip (GD Co., Incheon, Korea).


Soft Ball (MCS Co., Xiamen, China)

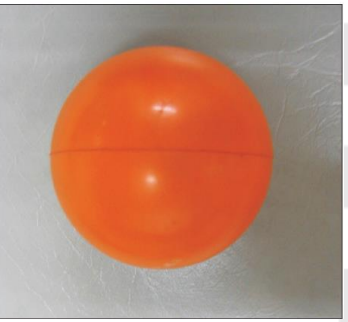
Kong et al., 2014:

- RCT of postoperative exercise (2 groups)
- Control group (n=8): simple open-close hand exercise (isotonic exercise)
  - Squeeze soft ball
  - 10 squeezes/set, 3 sets (1-minute-rest interval)
- Exercise group (n=10): structured exercise program (isotonic exercise)
  - Squeeze hand grip tool: resistance at 10 RM
  - 10 squeezes/set, 3 sets (1-minute-rest interval)
- All patients exercised
  - 4 times/day (2 times in the morning and 2 times in the afternoon)
  - Exercise everyday
  - 4 weeks

Kong et al. Ann Rehabil Med. 2014;38(5):648-57

GD Grip (GD Co., Incheon, Korea).

	Before exercise	After exercise	p-value
Pinch strength (kg)			
Tip pinch	2.4±0.9	3.2±1.0	0.005*
Palmar pinch	3.0±1.2	3.8±1.1	0.005*
Lateral pinch	3.4±1.2	4.5±1.1	0.005*
Grip strength (kg)	10.8±5.3	16.7±6.1	0.008*
Circumference (cm)	22.0±0.8	22.7±0.9	0.005*
Vessel size (mm)	5.5±0.7	7.0±1.3	0.017*
Blood flow velocity (cm/sec)	27.0±30.8	34.9±26.1	0.093
Blood flow volume (mL/min)	299.3±330.9	575.8±375.5	0.012*



Soft Ball (MCS Co., Xiamen, China)

	Before exercise	After exercise	p-value
Pinch strength (kg)			
Tip pinch	2.4±0.6	2.6±0.6	0.017*
Palmar pinch	3.7±1.0	3.9±0.8	0.066
Lateral pinch	4.5±1.3	5.1±1.3	0.021*
Grip strength (kg)	13.0±4.8	16.6±5.3	0.057
Circumference (cm)	23.2±1.9	23.6±2.1	0.024*
Vessel size (mm)	5.6±1.3	7.4±1.2	0.018*
Blood flow velocity (cm/sec)	20.3±18.9	43.7±18.6	0.091
Blood flow volume (mL/min)	241.7±224.6	861.5±458.0	0.043*

Values are expressed as mean±standard deviation

*p<0.05, significant difference between before and after exercise.

Kong et al. Ann Rehabil Med. 2014;38(5):648-57

Type of exercise? Volume of exercise?

	Percentage increase (%)		
	GD Grip	Soft Ball	p-value
Pinch Strength (kg)			
Tip Pinch	36.6±24.3	12.2±9.0	0.034*
Palmar Pinch	36.7±56.7	10.1±19.2	0.012*
Lateral Pinch	40.7±27.9	18.1±21.4	0.122
Grip Strength (kg)	80.2±76.0	39.7±47.0	0.315
Circumference (cm)	3.3±2.5	1.7±1.4	0.237
Vessel size (mm)	30.0±21.0	33.5±12.9	0.779
Blood flow velocity (cm/sec)	194.99±198.5	592.5±701.8	0.536
Blood flow volume (mL/min)	304.7±181.4	1176.5±1391.3	1.000

Values are expressed as mean±standard deviation
*$p<0.05$, significant difference between two groups.

Kong et al. Ann Rehabil Med. 2014;38(5):648-57

1. Elbow Flexion-Extension

2 sets of 10 repetitions every day

2. Wrist Flexion-Extension

2 sets of 10 repetitions every day

3. Hand Open-Close

2 sets of 25 repetitions every day

Fontseré et al., 2016:

- RCT of postoperative exercise (proximal and distal AVF localizations)
- 2 groups: exercise and control
- Arm and hand exercises (isotonic exercise)
- Exercise everyday
- 4 weeks

Fontseré et al. Hemodial Int. 2016;20(2):306-14.

4 weeks after the experiment

		Ultrasonographic maturation		
		No	Mature	Total
Clinical maturation	No	7	1	8 (11.6%)
	Mature	8	53	61 (88.4%)
Total		15 (21.7%)	54 (78.3%)	69

The kappa coefficient was good (0.539, 95% confidence interval: 0.283–0.795).

Intensity of exercise?

	Randomization group		
Variable	Control (n = 31)	Exercise (n = 38)	P
Venous diameter (mm)	6.46	6.33	0.732
Increase in venous diameter (mm)	2.48	2.08	0.300
Venous depth (mm)	2.49	2.43	0.850
AVF flow (brachial arterial flow)	1328.1	1324.9	0.985
Increase in AVF flow	431.3	388.7	0.742
Handgrip (kg)	21.60	24.68	0.182
Increase in handgrip (kg)	−0.87	+1.65	<0.001
Clinical maturation	80.6%	94.7%	0.069
Ultrasonographic maturation	74.2%	81.6%	0.459

Fontseré et al. Hemodial Int. 2016;20(2):306-14.

Challenge questions of exercise program on AVF maturation

- **Duration ?**
- **Type ?**
- **Volume ?**
- **Intensity ?**

Thank you for your attention