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Hand function in patients with distal radius factures after home-based kinaesthetic motor imagery training

Dear Editor,

The effect of limb immobilization on the brain after a distal radial fracture (DRF) might be partly responsible for postinjury functional impairment. Conversely, motor imagery (MI) might diminish neural changes due to immobilization (Meugnot et al., 2015). This (non-blinded) randomized-controlled trial assessed whether women with a DRF who performed kinaesthetic MI training during cast immobilization had better short-term functional outcomes than controls receiving cast immobilization only.

For this study, conducted between 2011 and 2020 (ethically approved METc2011/102), eligible patients were women (45–75 years) with a DRF treated with closed reduction and cast immobilization, without pre-existent upper extremity disorders and with sufficient MI ability (score on Vividness of Motor Imagery Questionnaire $\leq$72 points). They were randomly allocated to the MI or control group. We did not inform the controls about MI. A sample size calculation yielded a total sample size of 52 participants using the F-test family (repeated measures analysis of variance (RM ANOVA), between-within interaction): effect size 0.2, alpha 5%, power 80%.

One week after cast application (T0), participants in the MI group received verbal and written instructions about the MI protocol, while controls only received general information. Cast immobilization was continued for 3–5 weeks (median 4.0, Table 1). All participants were contacted by phone once a week to monitor their recovery and compliance to the MI training. The first measurements (T1) took place directly after cast removal, and the second (T2) 2 weeks later.

All participants received finger mobilization instructions. Only MI participants were instructed to perform kinaesthetic MI at home four times each day, between T0–T1. MI consisted of 10 repetitions of imagining: (1) making a fist and slowly knocking on the table making exaggerated movements, mimicking flexion-extension; (2) a horizontal line with two dots at each end drawn on the tabletop, and that you touch the dots with the thumb and little finger, mimicking radial-ulnar deviation; (3) turning a key in a keyhole, mimicking pronation–supination. This set was repeated three times. Participants registered the number of times they performed MI training.

The Patient-Rated Wrist Evaluation (PRWE) was the primary outcome variable. Secondary outcomes were strength, range of motion (ROM) and pain. We measured strengths using a digital Jamar and pinch grip dynamometer (H500 Hand Kit, Biometrics Ltd, Newport, UK). These measurements included grip force, three-jaw chuck pinch, key pinch and two-point pinch. The averages of three measurements were used. Active flexion, extension, radial deviation, ulnar deviation, pronation and supination were measured once using a digital goniometer (R500 Range of Motion Kit, Biometrics Ltd, Newport, UK). Strength and ROM were measured in the non-affected hand as reference. Finally, pain intensity and relief were measured using visual analogue scales (VAS).

Differences between the two groups on PRWE scores, Δstrength and ΔROM (unaffected–affected) were analysed by (robust) linear regression, with the variables mentioned above as outcome and group as a predictor (intention-to-treat). The analyses were adjusted as the MI group had their dominant hands affected more often. Mann–Whitney *U*-tests were applied to determine differences in VAS pain and relief scores.

Forty-three out of 66 patients giving consent were included: 24 in the MI and 19 in the control group. The main reasons for exclusion were surgery and drop-out before the study started. Study groups did not differ regarding patient and fracture characteristics, except that more dominant hands were affected in the MI group (75% versus 53%, Table 1). Descriptive statistics for grip strength and ROM at T1 and T2 (raw scores instead of change scores) are presented in Online Table S1.

No significant differences between groups were found in any outcome variables at T1 and T2 (Table 1), which indicates that MI did not influence

Table 1. Comparison of the MI and control group on baseline characteristics (T0), PRWE, VAS, ROM, grip and pinch strength at T1 and T2.

	T0									
	MI	*N*	Control	*N*						
Age, years (mean, SD)	58.7 (7.5)	24	58.8 (6.7)	19						
Immobilization time, weeks (median, IQR)	4.0 (4.0–4.0)	24	4.0 (4.0–4.0)	19						
Time T1–T2, days (median, IQR)	14.0 (14.0–19.3)	24	14.0 (14.0–23.0)	19						
Fracture type (*n*, %)		24		19						
Extra-articular	18 (75%)		16 (84%)							
Intra-articular	6 (25%)		3 (16%)							
AO classification	—	24		19						
23A	16 (67%)		14 (74%)							
23B	2 (8%)		2 (11%)							
23C	6 (25%)		3 (16%)							
Dominant hand affected (*n*, %)	18 (75%)	24	10 (53%)	19						
Hand dominance (*n*, %)		24		19						
Right	20 (83%)		17 (89%)							
Left	3 (13%)		2 (11%)							
Bimanual	1 (4%)		0 (0%)							
MI adherence[a], % (median, IQR)	92 (85–95)		NA							
	T1					T2				
	MI	*N*	Control	*N*	*p*-value	MI	*N*	Control	*N*	*p*-value
PRWE score (mean, SD)	48.0 (23.2)	20	44.3 (19.4)	15	0.450	35.3 (20.7)	20	32.4 (19.2)	19	0.917
VAS Pain score[b] (median, IQR)	4.0 (2.0–18.0)	23	10.0 (2.5–23.5)	19	0.477	8.5 (3.3–15.3)	22	9.0 (3.0–13.5)	19	0.990
VAS Pain relief score[b] (median, IQR)	78 (49.0–90.0)	23	69.0 (48.0–90.5)	19	0.742	81.5 (37.0–86.3)	22	67.0 (35.0–81.0)	19	0.346
ΔROM[c], °(mean, SD)										
Extension	26 (17)	21	35 (14)	19	0.082	14 (13)	22	18 (16)	18	0.377
Flexion	36 (21)	21	39 (12)	19	0.740	22 (15)	22	16 (22)	19	0.627
Pronation	12 (14)	21	8 (20)	18	0.500	3 (13)	21	4 (12)	19	0.688
Supination	26 (26)	21	24 (22)	18	0.885	21 (23)	21	16 (22)	19	0.469
Radial deviation	7 (8)	21	6 (7)	19	0.332	4 (7)	22	3 (5)	19	0.289
Ulnar deviation	13 (8)	21	9 (6)	19	0.077	8 (8)	22	9 (6)	19	0.519
ΔStrength[c], kg (mean, SD)										
Power grip	15.2 (5.7)	21	15.6 (3.6)	16	0.685	10.5 (5.8)	22	11.5 (5.0)	19	0.346
Key pinch	2.6 (1.2)	21	2.9 (1.3)	18	0.390	1.7 (1.2)	22	2.2 (1.5)	19	0.163
Three-jaw pinch	3.6 (1.7)	21	3.4 (1.2)	17	0.897	2.2 (1.4)	22	2.4 (1.5)	19	0.428
Two-point pinch	2.2 (1.0)	21	1.9 (0.9)	17	0.492	1.0 (1.2)	22	1.4 (1.1)	19	0.085

MI: motor imagery; *N*: number; SD: standard deviation; IQR: interquartile range; PRWE: Patient-Rated Wrist Evaluation; VAS: visual analogue scale; AO: Arbeitsgemeinschaft für Osteosynthesefragen; ROM: range of motion.

[a]Adherence was calculated as the actual number of MI sessions, divided by the number of training sessions that should have been done according to protocol.

[b]Tested with the Mann–Whitney *U*-test.

[c]For range of motion and strength, the differences between the unaffected and affected side are reported; a lower score representing better outcome.

functional outcomes or pain within 2 weeks after immobilization.

A limitation is the limited number of participants caused by our institution's change in policy to shift focus toward complex care. The absence of statistically significant effects does not necessarily mean that no effects of MI exist. However, the 95% confidence intervals of the regression coefficient of the PRWE did not contain the minimal clinically important change reported in similar populations (McCreary et al., 2020). So, we are 95% confident that in the population from which we recruited our sample, the difference between the groups is so small that it is not meaningful to the patient. Another limitation lies in the moment of inclusion. Due to the acute nature of the injury, patients could only be included 1 week after the immobilization started. Since cortical reorganization occurs within several days (Meugnot et al., 2015), the most considerable cortical changes might already have taken place before inclusion, limiting the effectiveness of the MI training. Finally, there is no consensus about the best MI protocol. Different protocols (Online Table S2) might be responsible for contrasting findings reported in the literature (Dilek et al., 2018; Korbus and Schott, 2020).

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Ethical approval This study and amendments were reviewed and approved by the Institutional Review Board (METc2011/102), and conforms to the Declaration of Helsinki.

Informed consent All participants gave written informed consent.

Trial registration number This study has been registered on August 13, 2013 in Clinicaltrials.gov, number NCT01921062.

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Supplemental material Supplemental material for this article is available online.

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An uncommon clinical presentation of polydactyly

Dear Editor,

Preaxial polydactyly (PPD) is the second most prevalent type of hand polydactyly after postaxial polydactyly, occurring in 0.8 to 2.3 per 10,000 live births (Ekblom et al., 2010). It has a range of presentations graded by the Wassel-Flatt criteria and may involve duplication of the metacarpal or phalangeal components of the hand. Polydactyly may be associated with multiple genetic syndromes but can also occur in isolation. We report an atypical presentation of neonatal PPD involving the thumb.

A 6-day-old full-term female with an uncomplicated birth history was brought by her father for evaluation of a $3 \times 2 \times 2$ cm tense, violaceous mass involving radial aspect of her right thumb, due to