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Intensive orthosis-based home training of the upper limb leads to pronounced improvements in patients in the chronic stage after brain lesions

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BACKGROUND

Recovery of hand function after central brain lesions is often insufficient especially in patients who cannot actively extend their fingers[1,2]. Here, the aim was to test whether self-administered training with a dynamic training orthosis (DTO), supporting hand and finger extension, is feasible to actively improve the handfunction in patients after brain lesion.

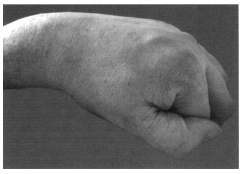


Fig. 1 Effective therapy options are scarce for patients who cannot actively extend their fingers

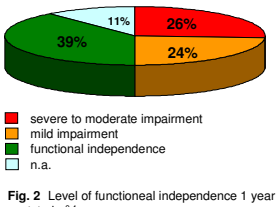


Fig. 2 Level of functioneal independence 1 year poststroke[3,4].

METHODS

13 patients with upper limb (UL) hemiparesis in the chronic stage (Table 1) with initial severe impairment of UL function, i.e. inability to actively extend fingers and wrist, were trained over five consecutive days to don and use a dynamic training orthosis (Fig. 2) for a daily self-administered training at home thereafter.
Primary outcome was upper limb active range of motion, evaluated with the Fugl-Meyer assessment (UEFMA) at baseline, before, immediately after (post), 4 weeks follow-up (4wFU) and 3 months (3mFU) after initial training phase.

Patient Number	Years of Age	Site of lesion	Months since lesion	FMA Score at baseline (total 66)
1	60	MCA left	9	16
2	78	MCA left	30	25
3	25	MCA, right	14	39
4	49	MCA right	12	20
5	72	MCA right	75	24
6	43	MCA right	12	24
7	47	MCA right	36	22
8	45	MCA right	72	17
9	49	(TBI), left hem.	60	24
10	46	MCA left	24	15
11	54	MCA left	120	24
12	68	MCA left	24	27
13	38	MCA left	7	18
MEAN	51,8		38,1	22,7
STDEV	14,5		34,1	6,2

Table 1 Patient characteristics

Fig. 2 Dynamic training orthosis (DTO), supporting wrist and finger extension

RESULTS

A) Self-administered intensive daily DTO training

Fig. 3-6 All of the patients learned to put on the DTO independently or with little help of one relative and administered the individually tailored traininig schedule for at least one hour per day.
Fig. 7 Time of training and successful grasping and reaching movements were documented in the training log.

B) Improvements in the total upper extremity section of Fugl-Meyer Score (UEFMA)

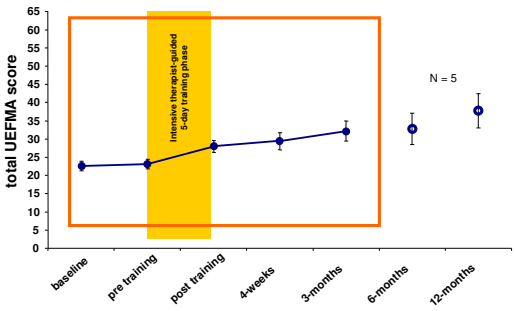


Fig. 8 Average score of total UEFMA
Patients showed a stable non-functional level prior to the onset of DTO training (UEFMA 23.2±6.9, baseline – pre training: z=-.170, p=.87).

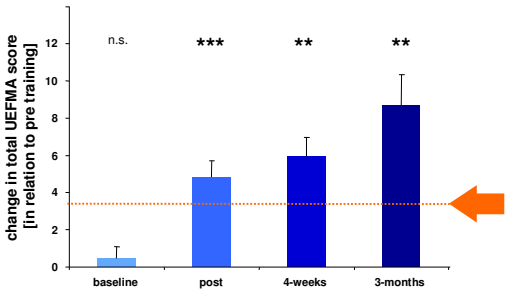
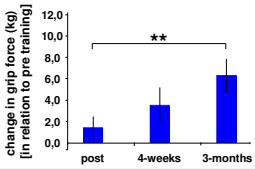


Fig. 9 Change in total UEFMA
All patients improved significantly over time (X^2 = 21.767, df = 4, p<.001). Improvement in the UEFMA was significant at all time points compared to the functional level before training (post 27.9±1.6 p<.001, 4wFU 29.4±2.3 p<.01, 3mFU 32.2±2.7 p<.01).

C) Grip force

Fig. 10
Grip force changed significantly over time in the affected but not in the non-affected hand. Friedman Test (pre, post, 4wFU, 3mFU); affected $X^2(3)$ =15.414; p=.001; non-affected $X^2(3)$ =4.015; p=.260



D) Change in Action Research Arm Test (ARAT)

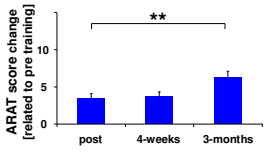


Fig. 11
ARAT score changed significantly over time. Friedman Test (pre, post, 4wFU, 3mFU) $X^2(3)$ =13.826; p<.01.

CONCLUSION

Patients with stable moderate to severe impairment of UL function after receiving common neurorehabilitative therapy can substantially further improve their hand function with intensive self-initiated and regularly supervised DTO-based home training.

References

[1] Sunderland, A. et al. (1989) *J Neurol. Neurosurg. Psychiatry.* 52(11):1267-72
[2] Wade, D.T. et al. (1983) *J Neurol. Neurosurg. Psychiatry.* 46(6): 521-4
[3] Kolominsky-Rabas, P. (2004) *Gesundheitsberichterstattung (GBE) des Bundes.* Interdisziplinäres Zentrum für Public Health der Universität Erlangen (IZPH).
[4] Dietl, M. (2009) *Fortschr Neurol Psychiatr.* 2009 Dec;77(12):714-9.