Increased Throwing Velocity and External Rotational Strength in Overhead Athletes After Completion of a 6-week Shoulder-Pacemaker Strength Training Protocol – A Randomized Controlled Trial

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DISCLOSURE OF INTEREST INFORMATION

All authors have no conflict of interest to declare.

BACKGROUND

Neuromuscular Electrical Stimulation-Enhanced Physical Therapist Intervention for Functional Posterior Shoulder Instability (Type B1): A Multicenter Randomized Controlled Trial

Philipp Moroder [1], Katrin Karpinski [2], Doruk Akgün [2], Victor Danzinger [2], Christian Gerhardt [3], Thilo Patzer [4], Mark Tauber [5], Mathias Wellmann [6], Markus Scheibel [1][2], Pascal Boileau [7], Simon Lambert [8], Giuseppe Porcellini [9], Laurent Audige [1]

Shoulder-Pacemaker Treatment Concept for Posterior Positional Functional Shoulder Instability: A Prospective Clinical Trial

Philipp Moroder [1], Fabian Plachel [1], Heiko Van-Vliet [2], Christiane Adamczewski [3], Victor Danzinger [1]

- The **successful application** of **Shoulder Pacemaker (SPM)** protocols using motion-triggered neuromuscular electrical stimulation (NMES) for **treatment-resistant functional posterior shoulder instability** has been demonstrated.

- **Rapid improvement** in subjective patient reported outcome measurements (PROMs), sustained at two-year follow-up (FU), have been presented with an improved response **in young and more athletic patients**.

OBJECTIVE

To evaluate the impact of a 6-week SPM training protocol in healthy, elite level handball players on external rotational strength and throwing velocity.
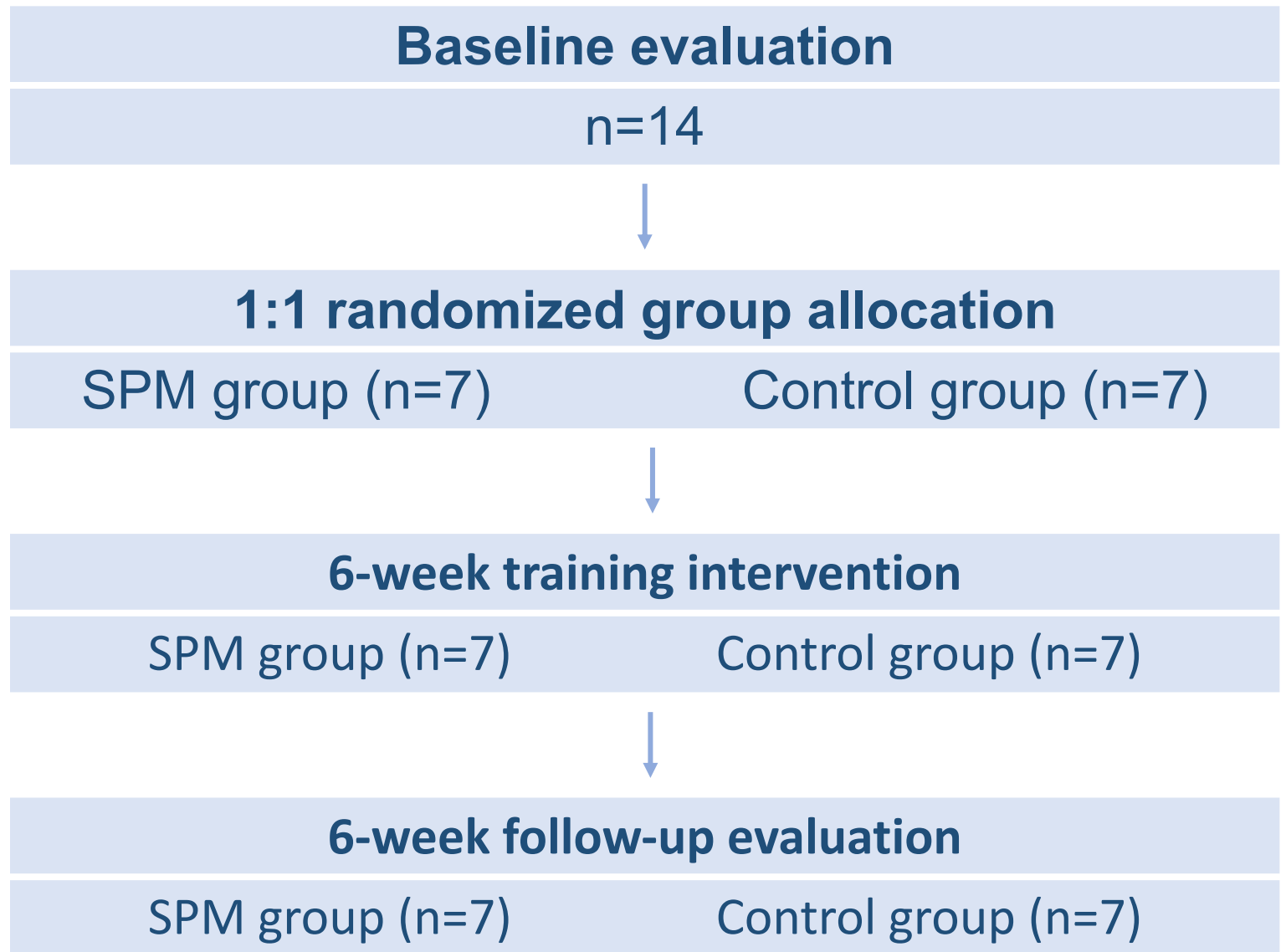
HYPOTHESIS

It is hypothesized that a **6-week SPM training protocol** in elite level **handball players** leads to an **increase in throwing velocity** due to improved external rotational (ER) shoulder strength and motor ability.

METHODS

- Prospective randomized controlled trial

- 14 male healthy handball player (Austrian 1. league team)

- 1:1 randomized group allocation (examiner blinded)

- Exclusion criteria
  - History of shoulder instability (Type I or II)
  - Existing pain syndrome (pain at rest/during motion impeding training)
 - Recent shoulder surgery (<1 year)

METHODS

Baseline evaluation

n=14

1:1 randomized group allocation

SPM group (n=7)   Control group (n=7)

6-week training intervention

SPM group (n=7)   Control group (n=7)

6-week follow-up evaluation

SPM group (n=7)   Control group (n=7)

METHODS

Baseline + 6-week follow-up evaluation

SPM and Control group

- **Clinical examination** to rule out type I or II shoulder instability

- **Performance testing**
  - Handball throwing velocity
  - Isometric dynamometer IR/ER strength
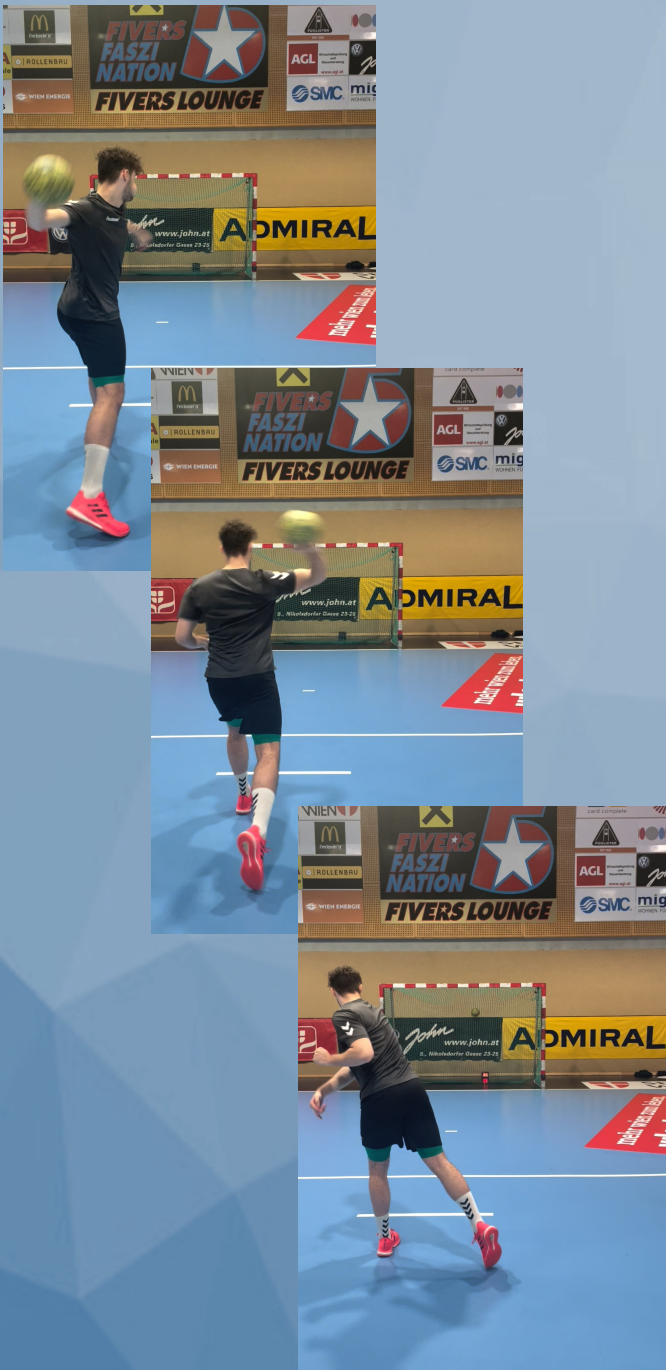
Performance testing

Handball throwing velocity

- Standing 7-m throw measured by radar gun

  1. Standardized W-UP
  2. **Maximum throwing velocity** (maximal strength)
     - 5 throws, 30-seconds rest
  3. 5-minutes rest
  4. **Endurance throwing velocity** (endurance strength)
     - 10 throws, maximum 5-seconds rest

Performance testing

Isometric dynamometer IR and ER shoulder strength

- Hand-held dynamometer

- 3 repetitions

- maximum effort for 5-seconds

- 30-seconds rest in between each repetition

Training intervention (6 weeks)

SPM group

- SPM protocol: 3/week, 30 minutes

	Level 1	Level 2	Level 3
Sets x repetitions	3 x 20	3 x 20	3 x 20
Excersise 1	Arm supported row	Front raises in 45°	Front raises (thumbs up)
Excersise 2	Parallel resistance front raises	Crossbody resistance band raises	Cross body 'tennis forhand' swing
Excersise 3	Rear dealt fly	Single arm resistance band row	Underhand 'volleyball serve' swing

Control group

- Conventional team strength training program (no SPM)

RESULTS

Table 1 - Demographic and Baseline Characteristics

	SPM group	Control group	p-value
Male sex, n (%)	7 (100%)	7 (100%)	.999
Age, y	19.7 ±2 (18-24)	19.6 ±1 (19-21)	.878
Height, m	1.9 ±0.1 (1.8-1.9)	1.9 ±0.04 (1.8-1.9)	.677
Weight, kg	84.0 ±18 (64.0-120.0)	91.4 ±11 (82.0-120.0)	.356
BMI	21.1 ±10 (20.4-32.2)	26.4 ±3 (23.5-32.0)	.210
Arm span, m	1.9 ±6 (1.9-2.0)	1.9 ±6 (1.8-2.0)	.879

Data presented as mean ±SD (range), unless otherwise specified. Statistically significant values are marked bold.

RESULTS

Table 2 – Throwing velocity at baseline and final follow-up

		SPM group	Control group	p-value
Endurance throwing velocity (km*h^{-1})	Baseline[1]	87.6 ±5	92.1 ±4	
	FU[1]	90.5 ±7	93.0 ±5	
	Difference[1]	2.9 ±3	0.9 ±3	.244
	p-value	.056	.440	
	n improved[2]	6 (100%)	2 (29%)	**.004**
Maximum throwing velocity (km*h^{-1})	Baseline[1]	89.3 ±6	92.4 ±3	
	FU[1]	92.8 ±8	97.5 ±4.5	
	Difference[1]	3.6 ±2	5.1 ±4	.387
	p-value	**.004**	**.014**	
	n improved[2]	6 (100%)	7 (100%)	.899

[1]Data presented as mean ±SD; [2]Data presented as n (%). Statistically significant values are marked bold.

RESULTS

Table 3 – ER/IR shoulder strength testing at baseline and final follow-up

		SPM group	Control group	p-value
ER strength in 90° (kg)	Baseline[1]	18.2 ±4	22.9 ±3	
	FU[1]	19.6 ±4	22.6 ±4	
	Difference[1]	1.4 ±1	-0.2 ±2	.061
	p-value	**.016**	.740	
	n improved[2]	7 (100%)	3 (43%)	**.015**
IR strength in 90° (kg)	Baseline[1]	18.7 ±6	21.2 ±6	
	FU[1]	19.9 ±4	22.4 ±2	
	Difference[1]	1.17 ±5	1.2 ±4	.986
	p-value	.577	.478	
	n improved[2]	3 (43%)	4 (57%)	.593

[1]Data presented as mean ±SD; [2]Data presented as n (%). Statistically significant values are marked bold.