



Gait and balance parameters improvements in adolescents with developmental disorders after an 8-week Aquatic Therapy Program

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-  **Activities of Daily Life (ADL): walking, balance, obstacle avoidance, sit-to-stand, stair ascending/descending ...**
-  **ADLs can be assessed biomechanically**
-  **Data can be retrieved from force plates, EMG recordings, video analysis, goniometers, accelerometers...**

- 🌊 The main interest was to assess possible alterations in ADLs execution by children between 7-15 years old after Aquatic Therapy Programs (AqTP) including various therapeutic interventions such as Bad Ragaz, Water Specific Therapy and Clinical Ai Chi
- 🌊 A previously published review reported that mix intervention types are a common ground for Aquatic Therapy in children

 **Purpose of the study:**

⇒ **to present the alterations in key biomechanical gait and balance parameters in four case studies after AqTP**

Case study #1:

- ⇒ A.S. (13.1 yrs, 1.79 m, 75.8kg, 23.7 kg/m²)
- ⇒ slow starter - mental impairment
- ⇒ Parental consent ✓

 **Case study #2:**

- ⇒ T.S. (14.9 yrs, 1.74 m, 61.9 kg, 20.4 kg/m²)
- ⇒ Loose ligaments
- ⇒ Parental consent ✓

Case study #3:

- ⇒ K.P. (15.5 yrs, 1.58 m, 65.8 kg, 26.4 kg/m²)
- ⇒ Congenital scoliosis - lumbar vertebrae synostosis
- ⇒ Parental consent ✓

Case study #4:

- ⇒ L.M. (6.4 yrs, 1.28 m, 25.3 kg, 15.4 kg/m²)
- ⇒ Frontal lobe dysfunction – mental impairment
- ⇒ Slow speech response
- ⇒ Parental consent ✓

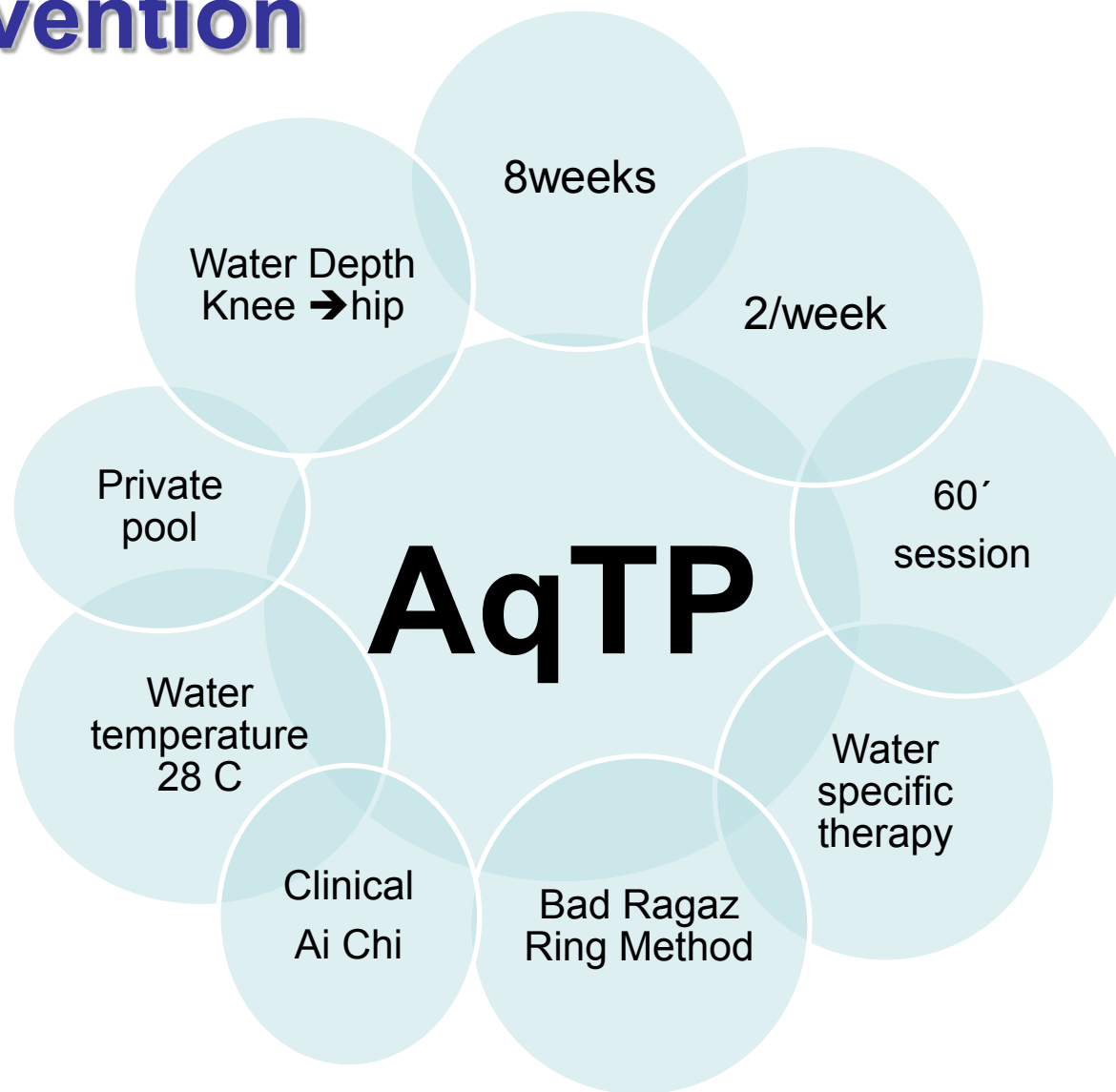


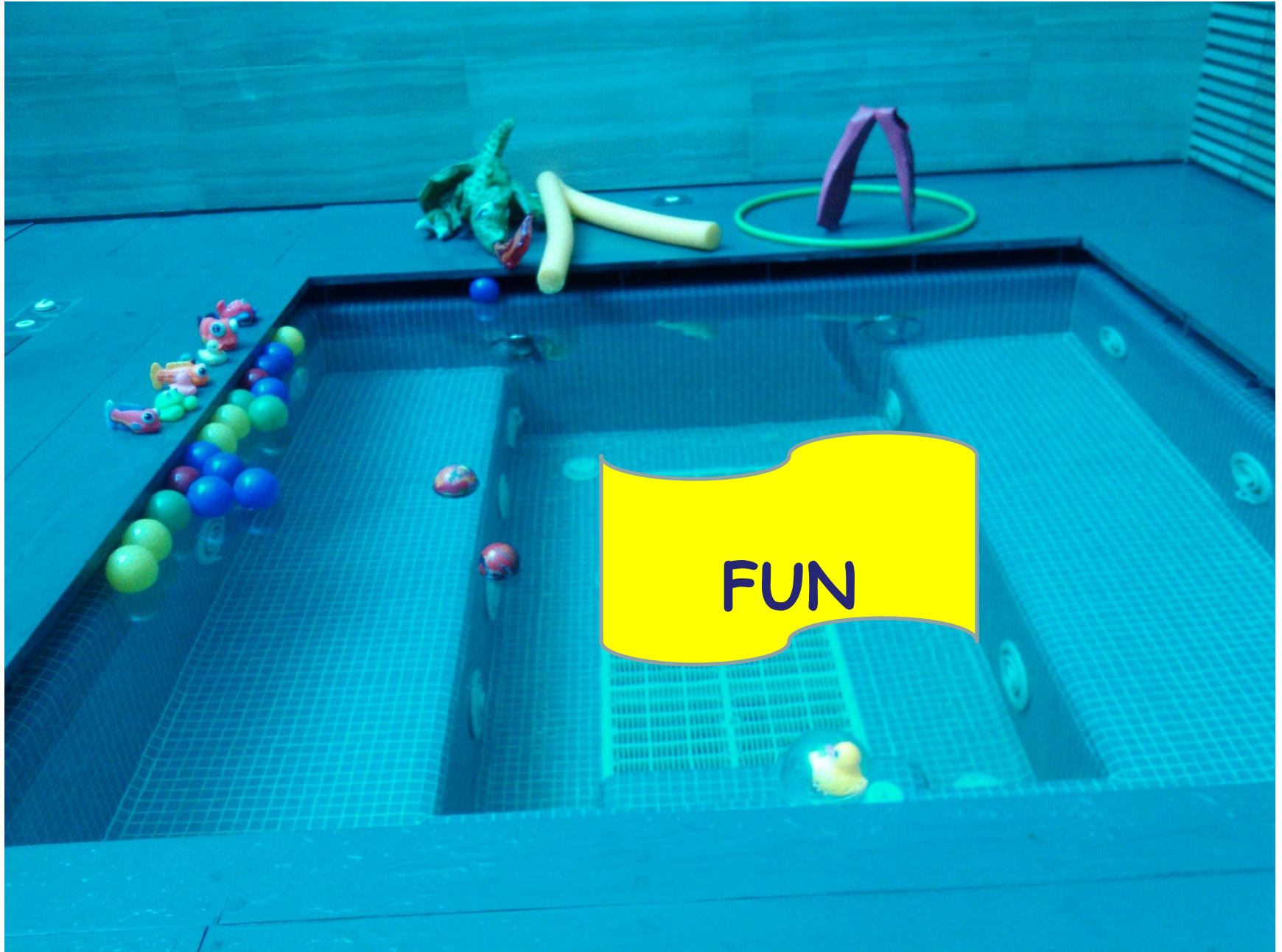
Methodological approach:

- ① clinical evaluation
- ② initial biomechanical assessment
- ③ implementation of an 8-week ATP
- ④ post-intervention biomechanical assessment



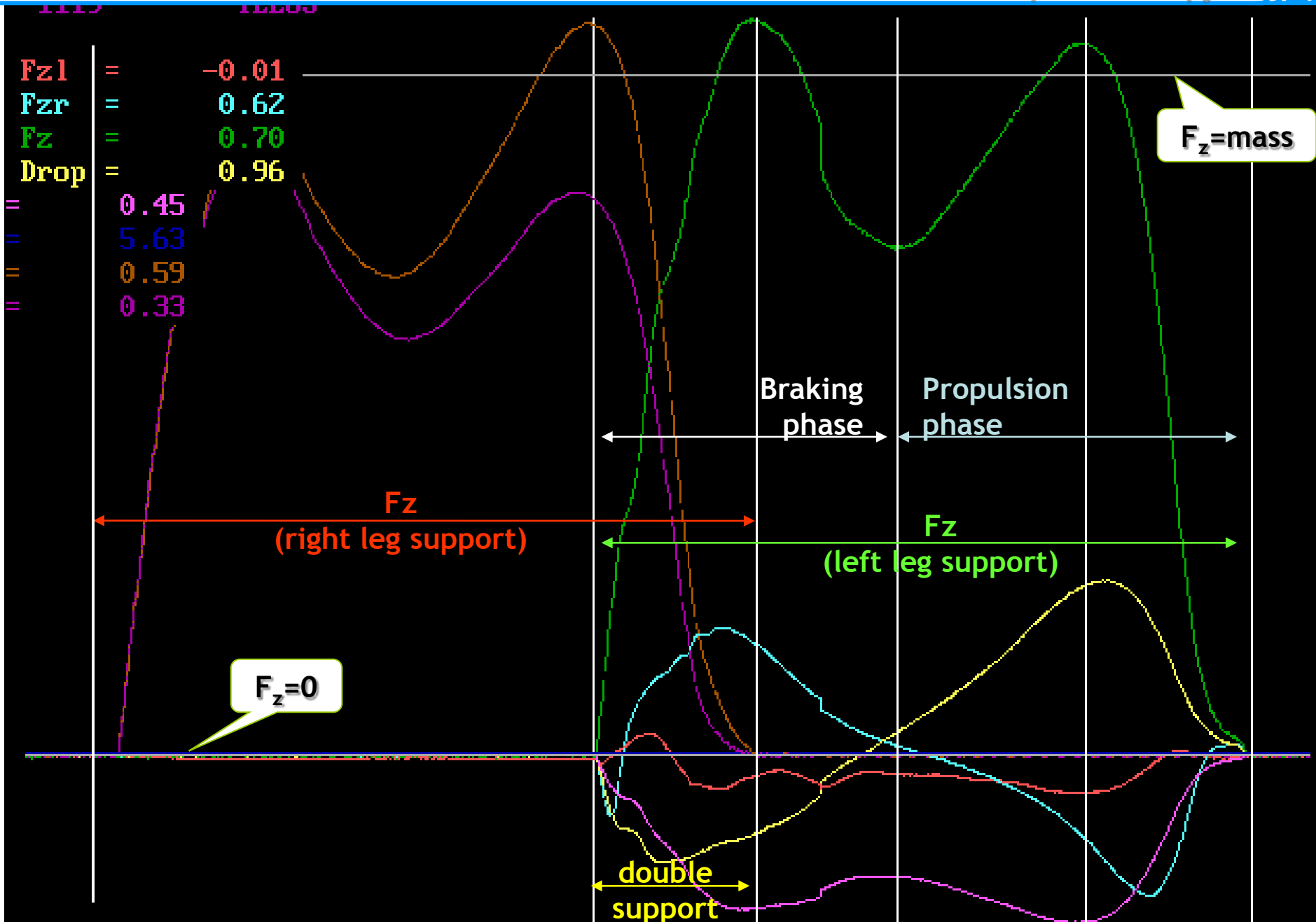
Intervention





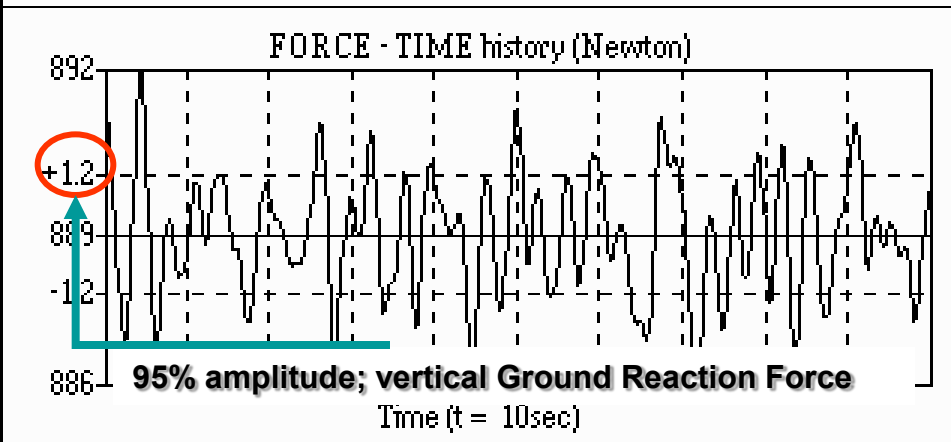
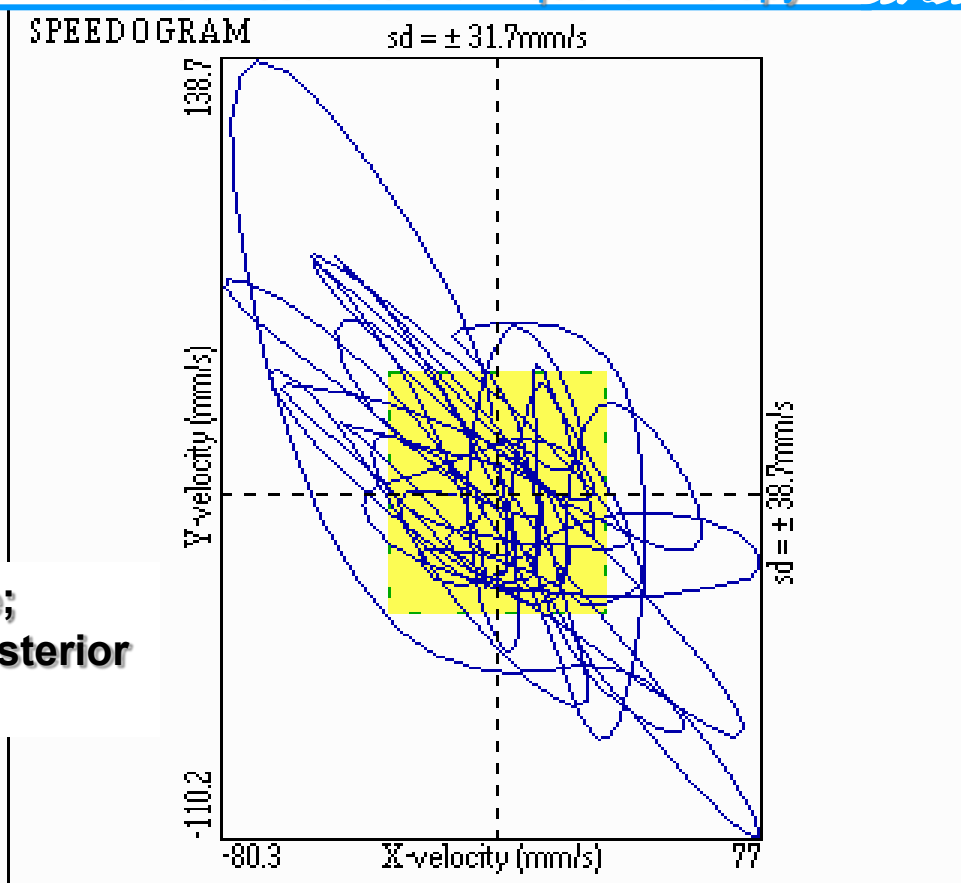
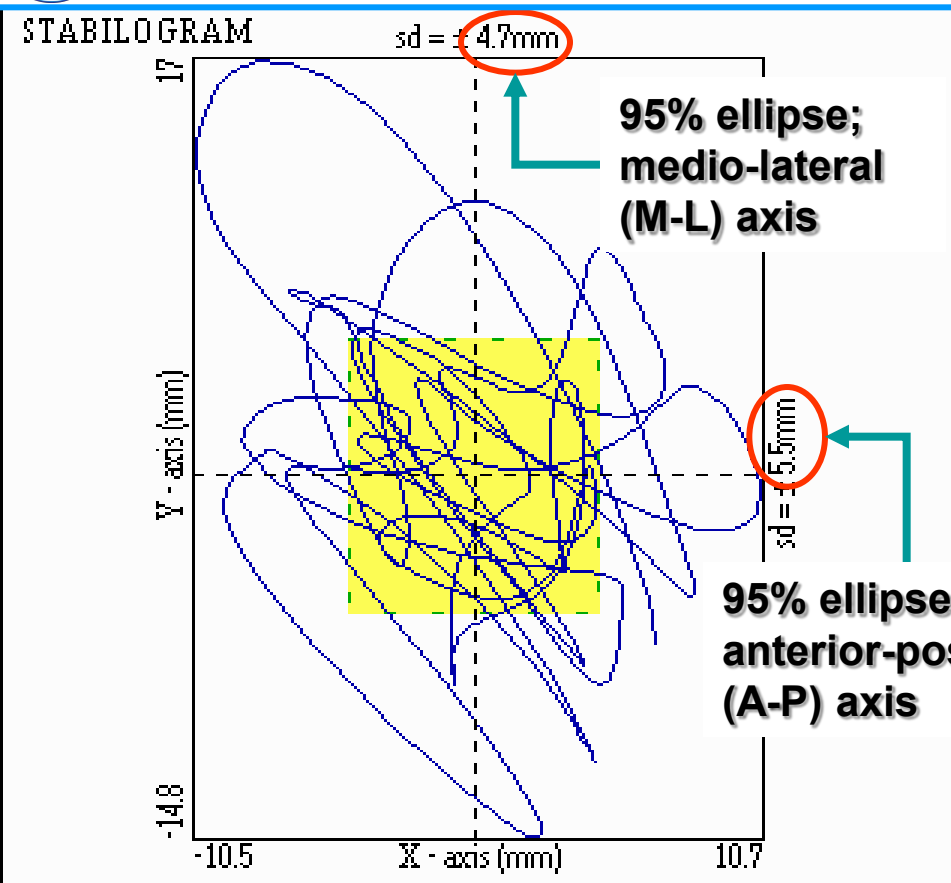
Biomechanical Analysis: Gait

- ⇒ 3 successful trials (averaged)
- ⇒ Ground reaction forces from 2 force plates
- ⇒ AMTI OR6-5-1 force-plate (AMTI, Newton, MA)
- ⇒ custom made force-plate (©: Iraklis A. Kollias)
- ⇒ S_f : 1kHz



Biomechanical Analysis: Balance

- ⇒ bipedal upright posture, single support, Romberg Balance Tests (open/closed eyes)
- ⇒ duration: 10sec
- ⇒ Separate force data collection for each leg
- ⇒ 2D-DELTA Stabilometer (©: Iraklis A. Kollias)
- ⇒ S_f : 50Hz



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DATA -File: c:\balance\229x10\15376a. -Time: 01-19-2011\19:40:54

8191 aU marker: 10sec (50 Hz)

Stabilogram Surface (mm²) [all = 676.7] [sd = 105.6]

S-magnitude (% of total)

90%	(F 30.1%)	(X 30.9%)	(Y 21.1%)
95%	(F 58.6%)	(X 56.6%)	(Y 49.2%)
99%	(F 91.4%)	(X 89.8%)	(Y 88.3%)

Statistical Analysis:

- **Due to the limited number of participants, descriptive statistics were utilized for presenting pre- and post-intervention differentiations in the examined biomechanical parameters**



RESULTS

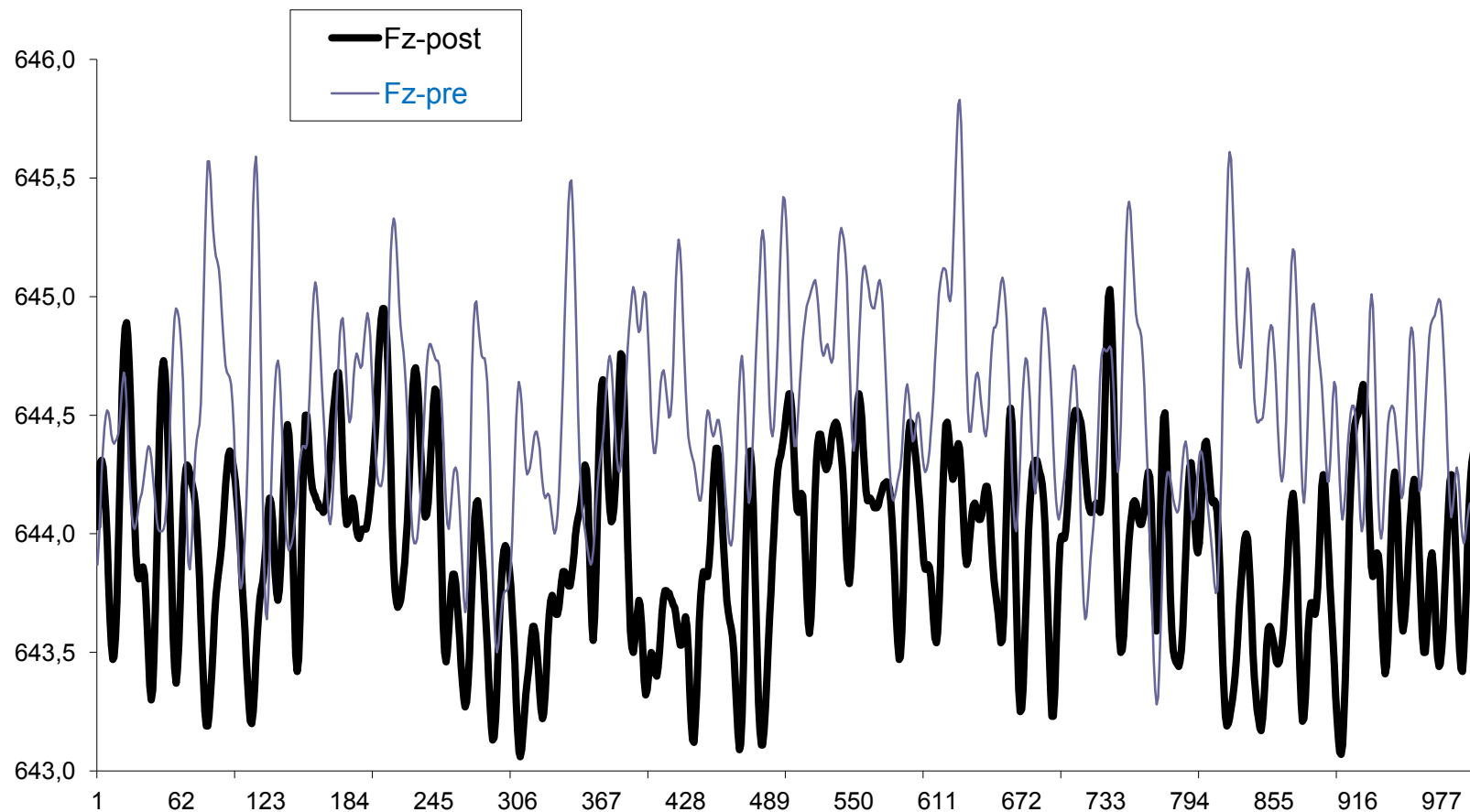
Balance tests

95% ellipse [quite stance]

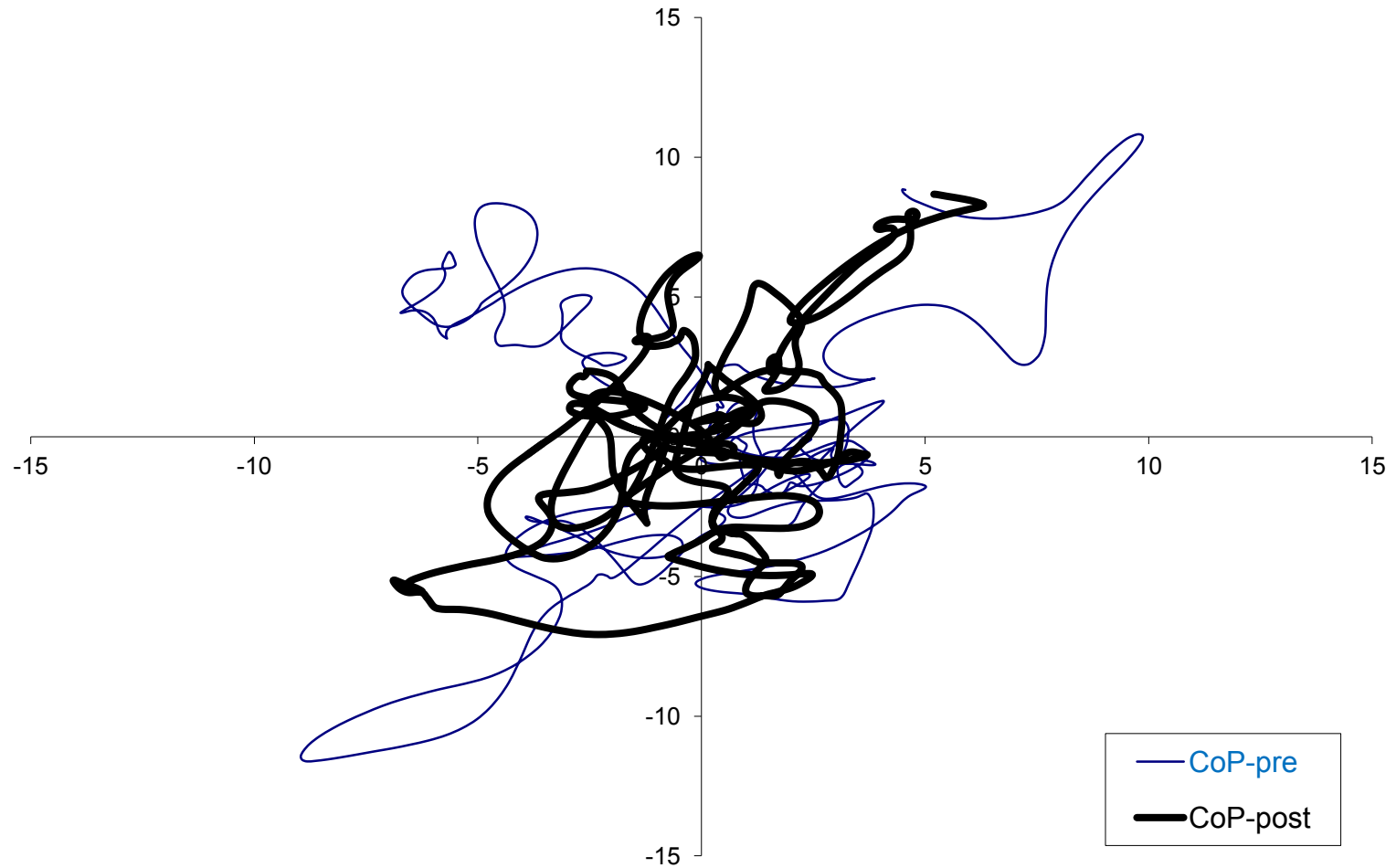
sub	X-axis: pre (mm)	X-axis: post (mm)	% Δ x(post-pre)	Y-axis: pre (mm)	Y-axis: post (mm)	% Δ y(post-pre)	
cs#1	5.3	3.2	-39.6	4.9	2.6	-46.9	
cs#2	5.3	3.2	-39.6	7.3	3.9	-46.6	
cs#3	3.7	2.4	-35.1	4.1	3.5	-14.6	
cs#4	5.7	3.1	-45.6	8.9	4.3	-51.7	
			mean: -40.0%				mean: -40.0%



balance tests: quiet stance - vGRF

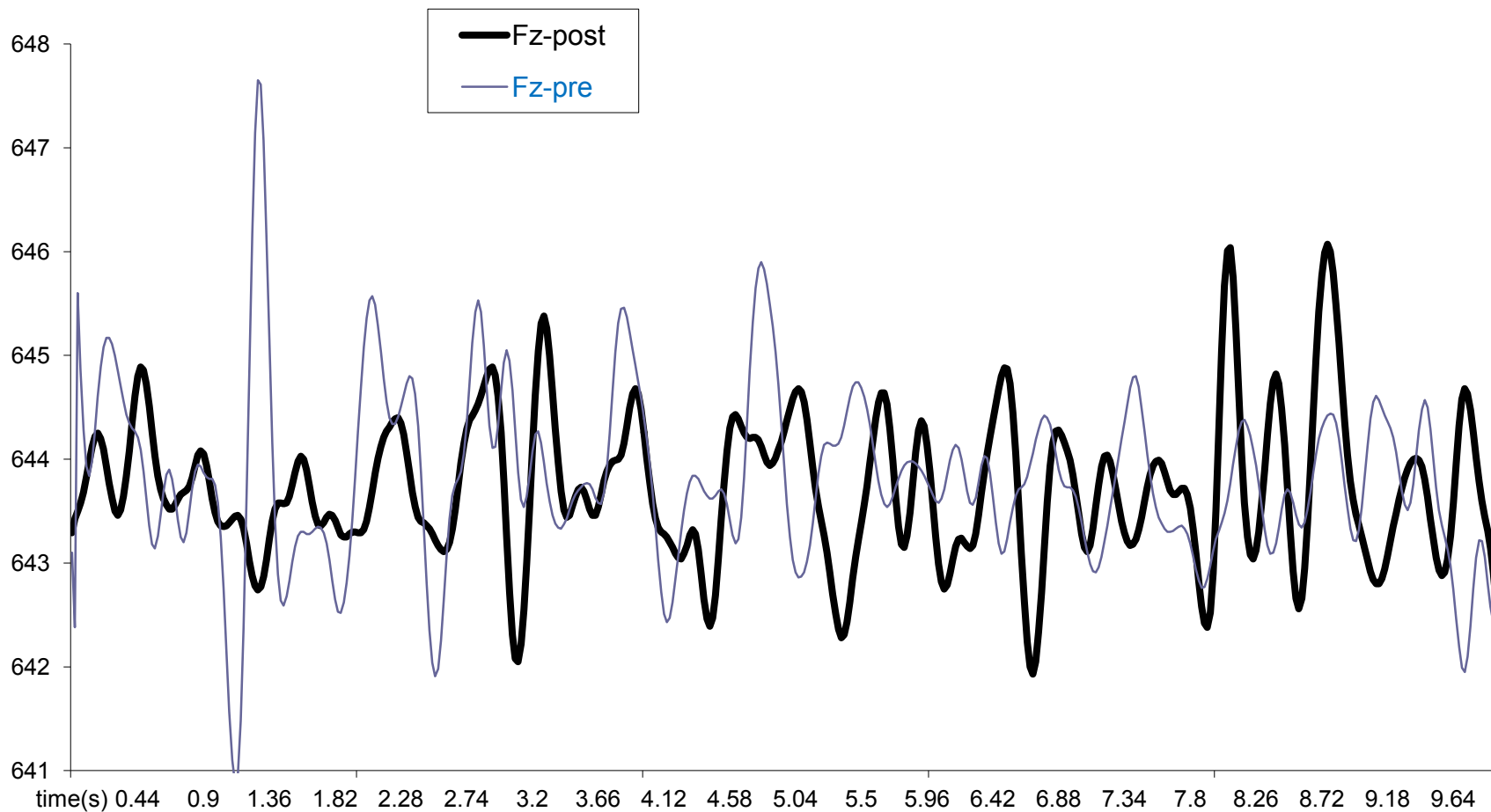


balance tests: quiet stance – Center of Pressure

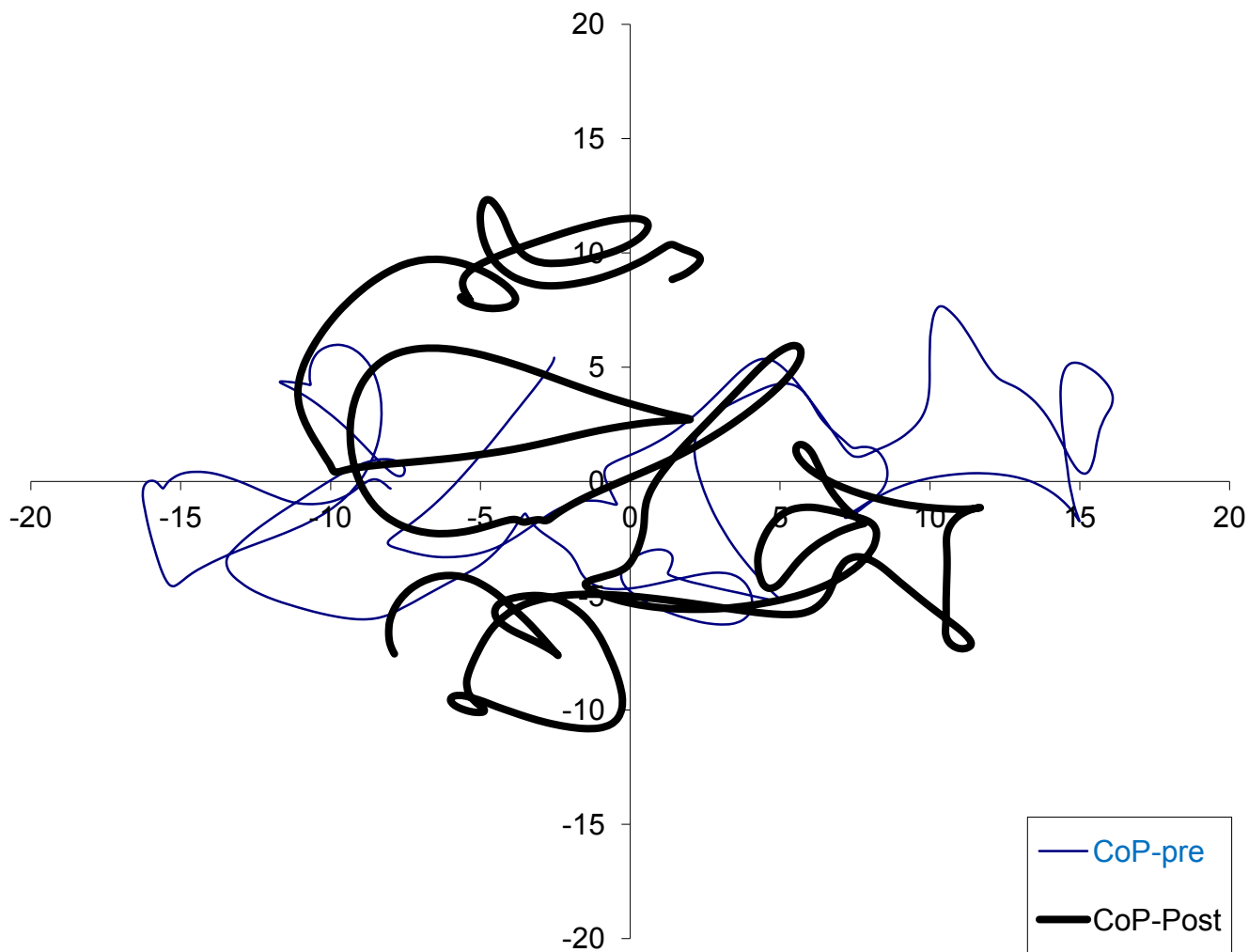




balance tests: Romberg Tandem - vGRF

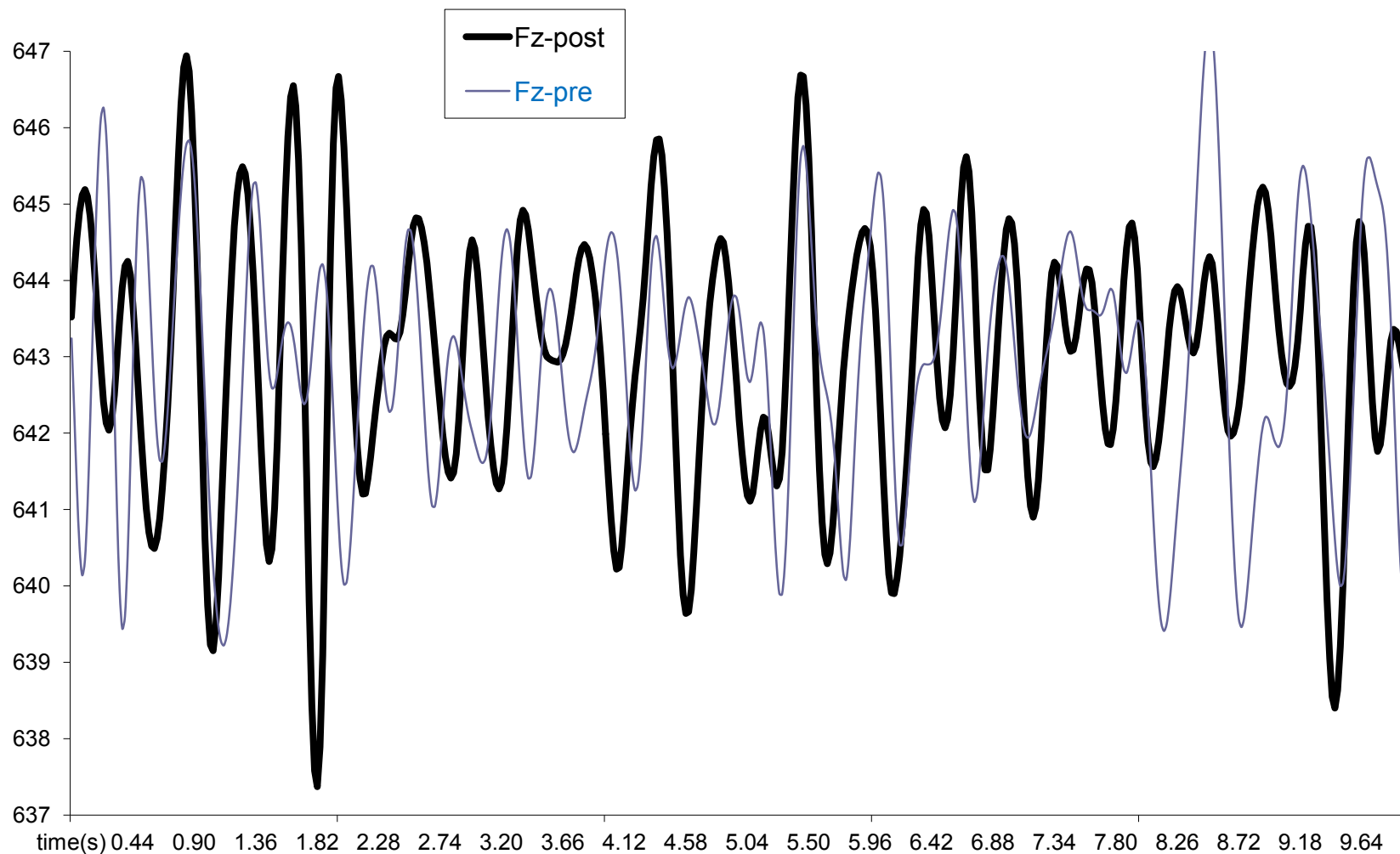


balance tests: Romberg Tandem – CoP

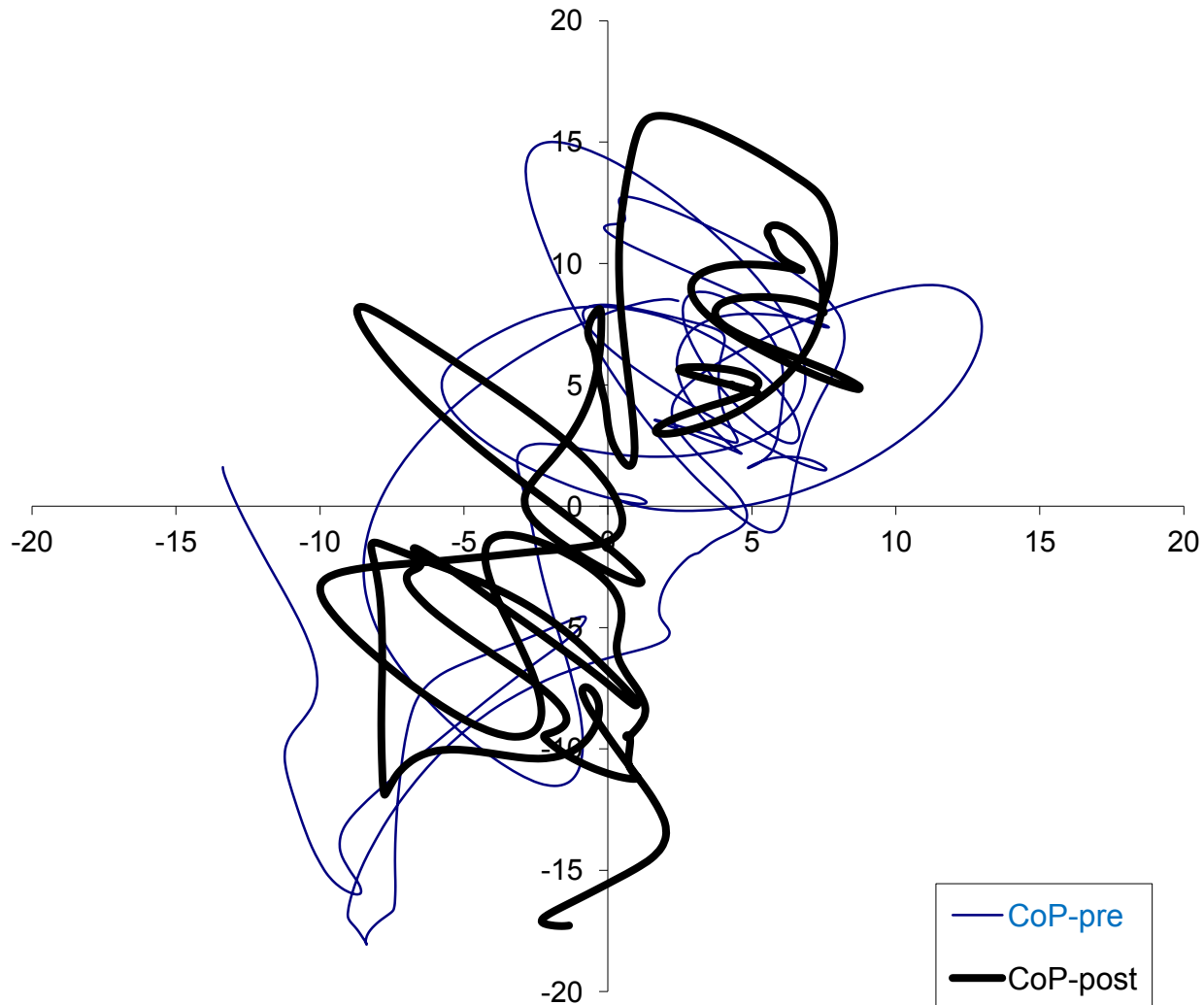




balance tests: Single Support - vGRF



balance tests: Single Support – CoP





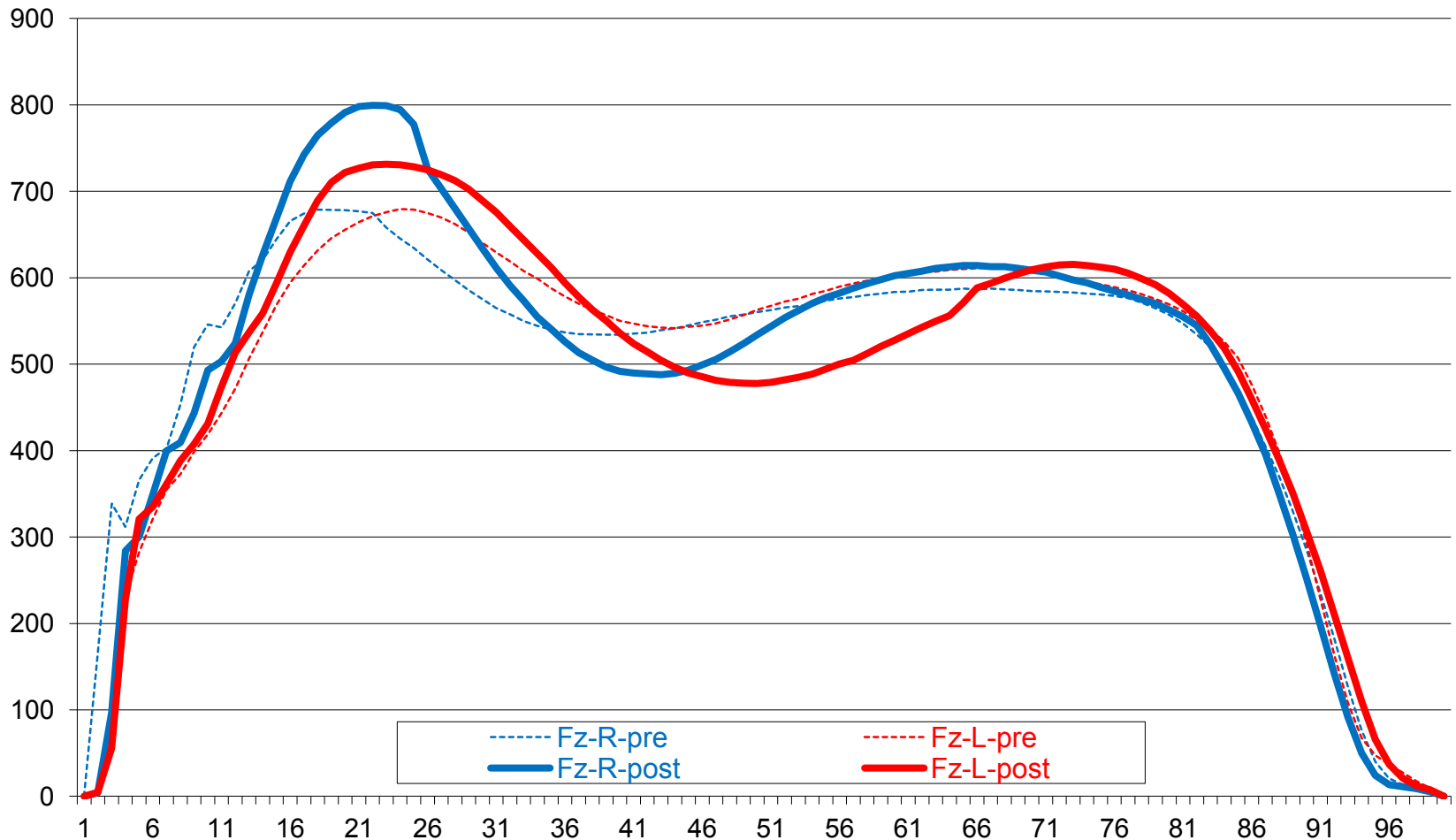
Gait analysis

 pre- and post- intervention comparisons (%)

sub	Tcontact	Tdouble sup	TFzBraking	TFzMin	T%braking	TFzPropult	FzBraking	FzPropult	Impulse
S1	2.7	-19.8	-36.3	-36.4	12.7	24.9	0.9	-2.6	19.4
S2	-3.9	12.4	11.4	-17.3	4.9	8.4	14.1	12.7	14.0
S3	-23.3	15.6	6.8	-15.1	15.4	8.0	6.8	12.4	39.0
S4	-47.7	40.1	26.7	-18.8	-21.3	21.0	29.3	27.4	0.0
mean:	-18.1	12.1	2.1	-21.9	2.9	15.6	12.8	12.5	18.1

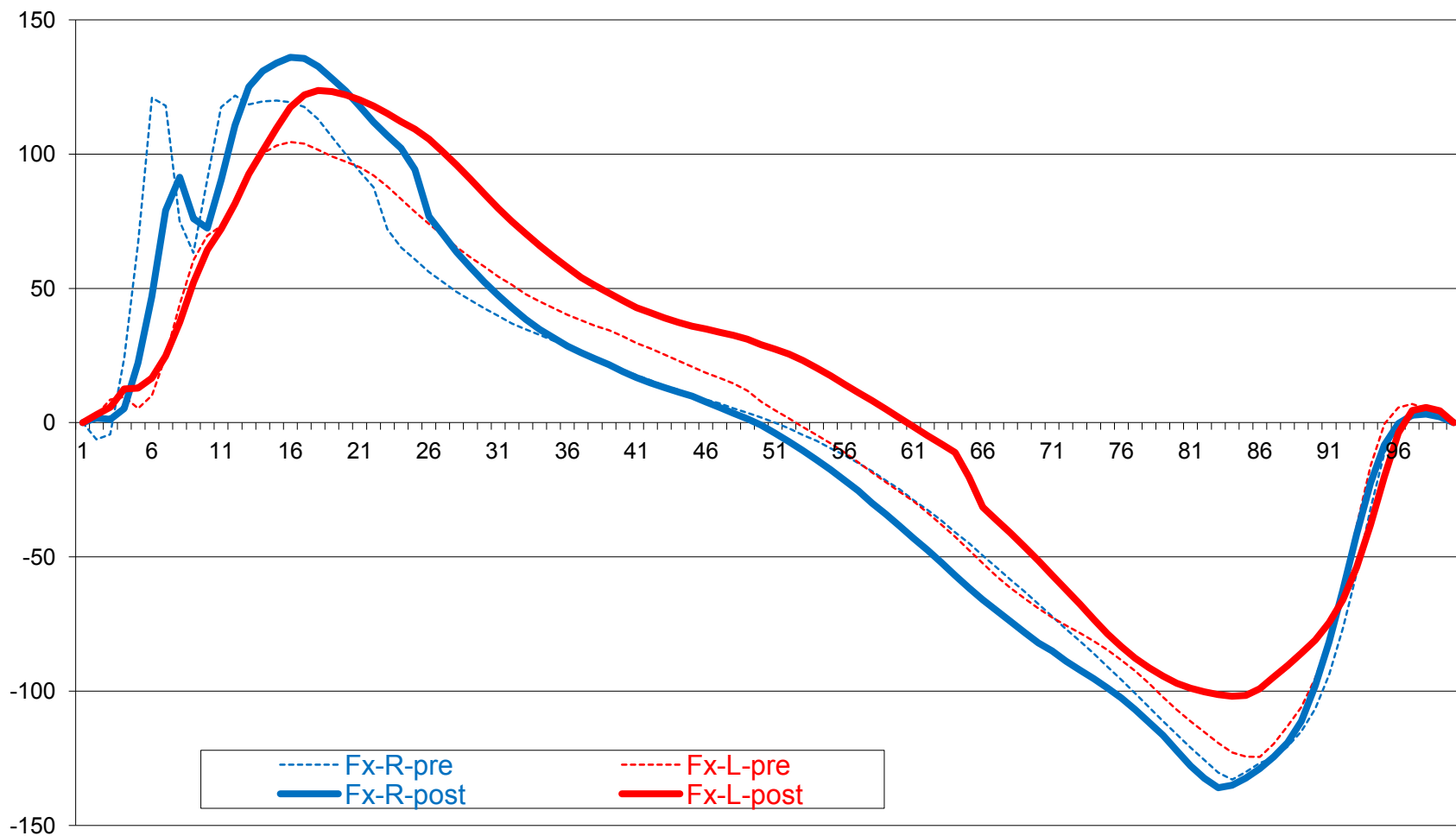


Ground Reaction Forces: vertical



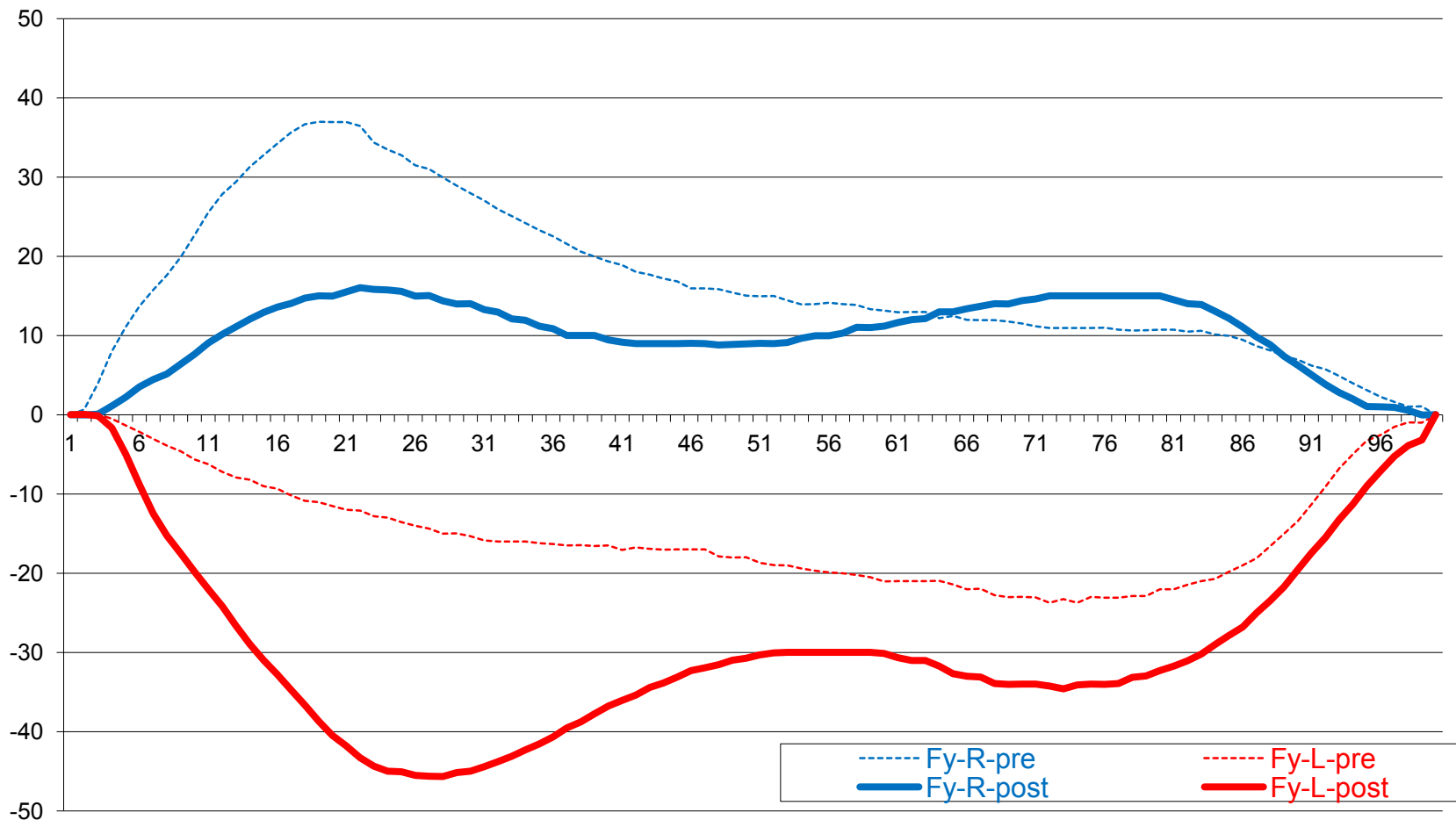


Ground Reaction Forces: anteroposterior direction





Ground Reaction Forces: mediolateral direction





Results summary: pre-post comparisons

 M-L & A-P stability:  40% in quiet stance balance

  18% faster step time

  2% elongation of braking phase

  10% time to reach maximum vGRF

  9% [\times body mass] vGRF at heel contact



Discussion

The Aquatic Therapy program that was implemented:

-  improved proprioception ability
-  established a smoother GRF walking pattern
-  established a more optimal heel-to-toe transition
-  did not result in improvements single stance balance test performance

AAA.

All About Aquatics



Aquatic Therapy NETWORK of Greece



All About Aquatics



4 different cases studies

Every cases different but the common factor was

The disorders and the deficits of the children were

Diagnosis:

1. Disorders on the frontal lobe and low mentality
2. Congenital scoliosis and lumbar vertebrae were added
3. Patella dislocation during football training
4. Slow starter



Gait analysis

GAIT PARAMETERS pre-post comparison cs#4	RIGHT LEG				LEFT LEG			
	PRE		POST		PRE		POST	
	Force	Time	Force	Time	Force	Time	Force	Time
<u>Conduct time (T)</u>		1015		↓ 617		996		↓ 521
Double Support		26%		13.48		23.2%		32.58
<u>F_zmax (braking phase)</u>	103.2	26%	↑ 108.98	25.98	98.2%	25.8%	↑ 1278	18.98
<u>F_zmin</u>	89.5%	41.2%	93.58	40.78	93.6%	34.1%	688	40.58
<u>Change of Direction</u>		59.8%		↓ 52.58		55.8%		↓ 43.98
<u>F_zmax (propulsion)</u>	95.6%	59.8%	↑ 97.48	52.58	99.1%	58.2%	↑ 105.38	70.48
mean ratio F _z /BW	71.1%		81.98		74.9%		84.68	

(%) FORCE = reference: body mass

(%) TIME = reference: conduct time



Conclusion

