

# STRUCTURAL CHANGES OF CORTICAL THICKNESS AFTER BOTULINUM TOXIN TREATMENT (BONT) ASSOCIATED TO MOTOR RE-LEARNING TECHNIQUES (MRT) IN PATIENTS WITH CERVICAL DYSTONIA (CD). A LONGITUDINAL NEUROIMAGING STUDY.

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## INTRODUCTION

Previous neurophysiological and magnetic resonance imaging (MRI) studies in focal dystonia, in particular cervical dystonia, have reported changes in cerebral reorganization, connectivity and grey matter volume in pre-post frontal areas after BoNT injections<sup>1,2</sup>.

## SUBJECT

In this study, we analyze, in a group of CD patients, whether the combination of BoNT and MRT treatment can influence brain morphometric features in pre and post-central cortical areas.

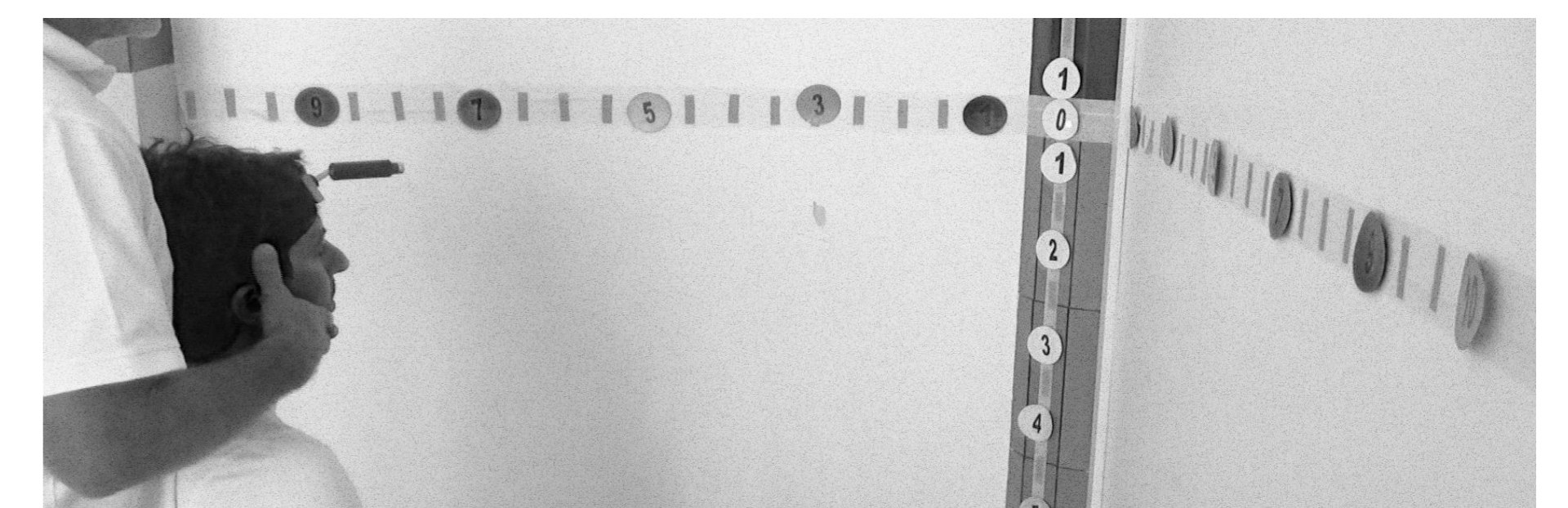
## MATERIALS AND METHODS

7 CD patients (3M, mean age 56.4±11.7 years) underwent BoNT injections in dystonic neck muscles associated with MRT (18 sessions, 3 times a week) consisting in combined sensori-motor exercises to obtain a tailored rehabilitation program by using sensory biofeedback (visual, acoustic and vibratory) associated with some devices (inclinometer, goniometer, laser) which help the patient to improve kinematic and proprioceptive consciousness and to re-learn correct head, neck and trunk posture and movements. Moreover the program consisted in exercises involving reconstruction of motor mental images to improve the motor control of axis and the ability to move and interact with the space by recording, updating and storing the position of the body.

The outcome measures were Toronto Western Spasmodic Torticollis Rating Scale (TWSTRS) and MRI acquisition at three time points: BoNT injection (T0), maximum BoNT effect (T1, mean 46,4±5,6 days after T0) and follow-up (T2, mean 37.9±14.8 days after T1). From T0 to T1 patients underwent MRI study.

### MRI data acquisition (1.5 T Siemens Avanto scanner)

MRI acquisition (1.5 T Siemens Avanto) included standard sequences excluding major brain abnormalities and a High-resolution 3D-T1 image to perform cortical volumetric measurements.



### Data analysis

Cortical parcellation and measurements within each parcellated area (volume, area, cortical thickness and curvature) were performed with the Freesurfer image analysis suite (<http://surfer.nmr.mgh.harvard.edu/>).

T0 vs T1 analyses have been performed using Wilcoxon Rank test statistic for paired samples and were described using circular representation (Fig 1)<sup>3,4</sup>. The clinical data were assessed by the Wilcoxon signed rank Test.

## RESULTS

TWSTRS total score shows a significative improvement at T1 and prolonged effect for pain domain at T2 (W-value=0) compared to T0.

MRI group data show changes in cortical measurements between T0 and T1, mostly involving bilateral frontal, parietal and cingulated cortices (see Fig 1 and Fig 2).

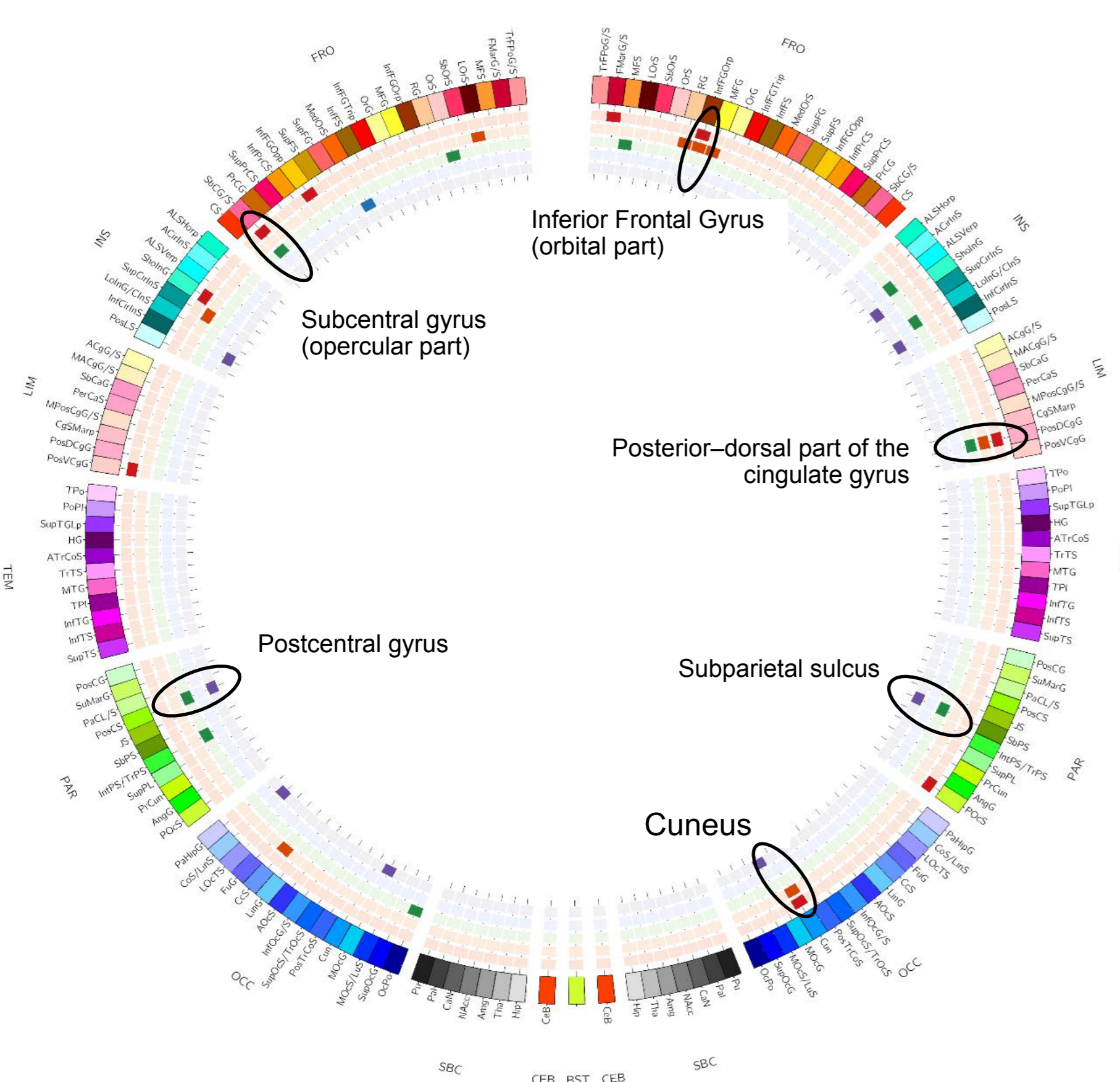


Fig. 1- Circular representation of statistically significant differences between T0 and T1 in cortical measurements only. Coloured part indicates a p-value < 0.05 computed using Wilcoxon test for paired samples. Each section represents a different cortical parcellated area, while each ring represents specific measures (starting from the most external: volume, area, cortical thickness, cortical curvature, node degree).

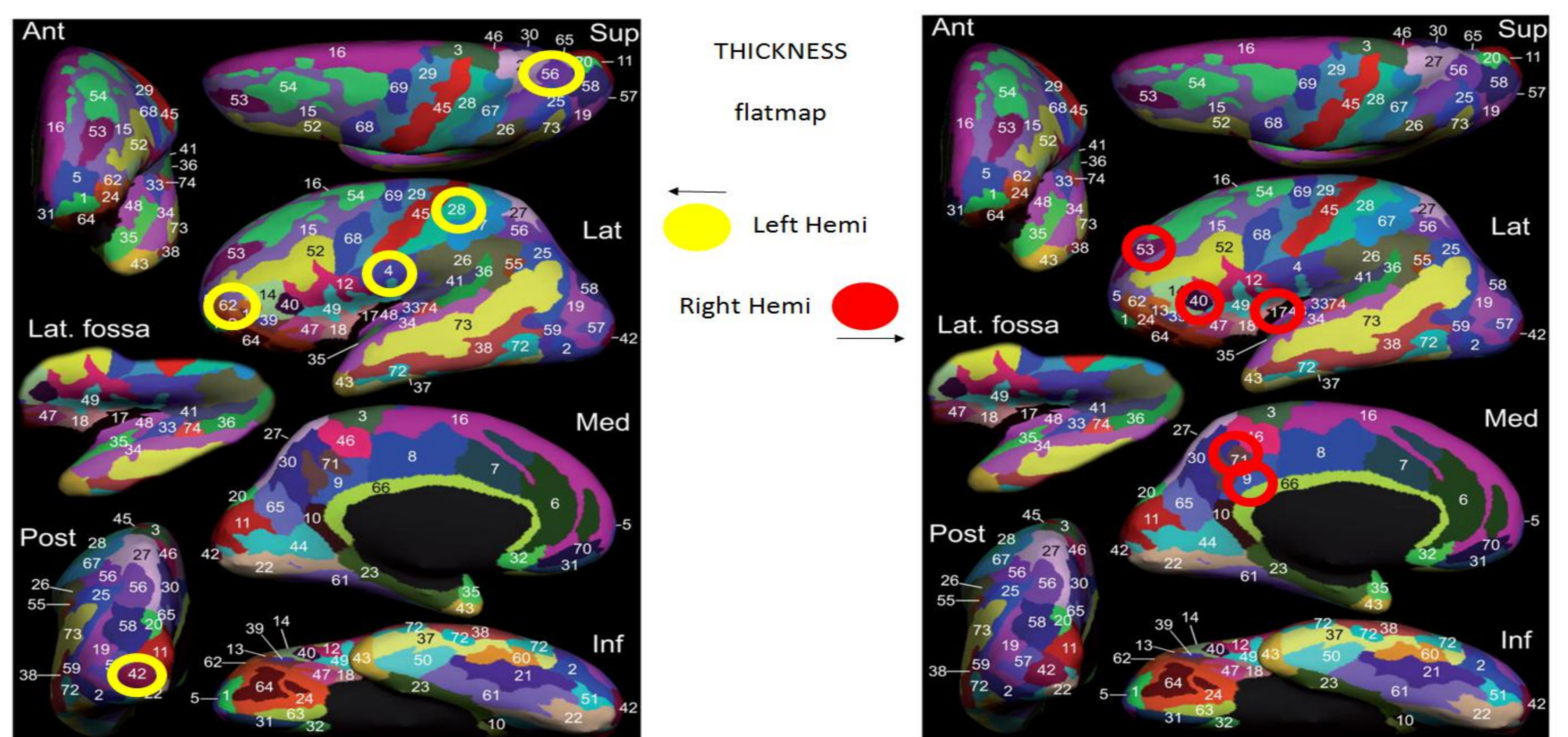


Fig. 2 - Thickness changes between T0 and T1 (Wilcoxon Test, p<0.05) on a flatmap (3). Yellow circles represents areas that changes in the left hemisphere, while red circles areas of the right hemisphere.

56 - Intraparietal sulcus and transverse parietal sulci (↑)  
42 - Occipital pole (↓)  
62 - Lateral orbital sulcus (↑)  
28 - Postcentral gyrus (↑)  
4 - Subcentral gyrus and sulcus (↑)

40 - Anterior lateral sulcus (↑)  
17 - Insular gyrus and sulcus (↑)  
53 - Middle frontal sulcus (↑)  
9 - Posterior cingulate (↑)  
71 - Subparietal sulcus (↑)

## CONCLUSIONS

A combined BoNT and MRT treatment revealed to improve motor functioning and pain in patients with CD as suggested by changes of clinical scales. MRI parameters confirm those of previous studies about grey matter volume changes in sensori-motor areas after BoNT treatment; moreover data showed short term grey matter changes in frontal areas involved in attention, learning processes and motor programming and in posterior cingulate associative areas after BoNT and MRT combined treatment. Ulterior studies are needed to see long term effects of the mentioned treatments.

## REFERENCES

[1] Delnooz CCS, et al. Neurobiology of Disease 2015; 73:327-333. [2] Delnooz CCS, et al. PLOS ONE 2013; 8(5): e62877. [3] Destrieux C, et al. Neuroimage 2010; 53(1): 1-15. [4] Irimia A, et al. Neuroimage 2012; 60(2): 1340-1351.