

Curvature Correction in Elements Software: Spinal Cord dose impact in SBRT

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Purpose

To evaluate the impact on spinal cord dose-volume, comparing cases of spinal SBRT with and without application of spinal curvature correction, using Elements-BrainLab's image registration tool.

Materials and Methods

10 (ten) cases of spinal SBRT treated at the Real Hospital Português (Recife, Brazil) were analyzed before the spinal curvature correction tool acquisition (Elements, BrainLab). Two contours for the same organ at risk (spinal cord) were compared evaluating dose-volume. Two different image sets were used:

- Original Spinal (1): The original contouring, registration of planning CT image and T2-weighted MRI (registration also performed in Elements, but without curvature correction).
- CS Spinal (2): The Curvature Spinal contouring, registration of planning CT image and T2-weighted MRI (performed in Elements with curvature correction).

Two experts delineated the *Spinal CS*, maintaining the lower and upper limits of the original volume. Images were imported to Eclipse software and a new contour was copied to the planning CT image, to evaluate and compare the spinal cord dose-volume for the respective SBRT planning. Maximum point dose and $D_{0,03\text{ cc}}$, $D_{0,5\text{ cc}}$, $D_{1\text{ cc}}$ dose-volumes were compared and then relative doses were analyzed.

The **Figure 1** summarize the **Methods**.

Results

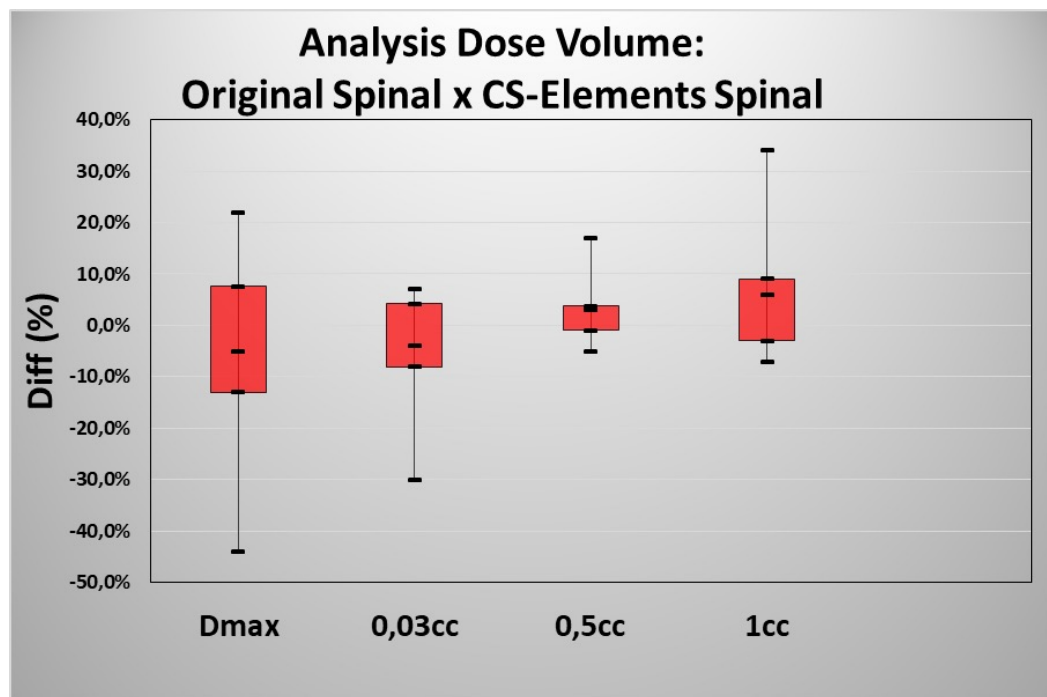


Figure 4: Dose-Volume Impact of Curvature Correction

Table 1: Maximum Difference Dose that was found in each one of the analysed cases

Case 01	16,6 %	D1 cc
Case 02	22,0 %	Maximum Point Dose
Case 03	33 %	Maximum Point Dose
Case 04	44,0 %	Maximum Point Dose
Case 05	8,7 %	D1cc
Case 06	8,0 %	Maximum Point Dose
Case 07	14,0 %	Maximum Point Dose
Case 08	12,0 %	Maximum Point Dose
Case 09	2,7 %	D1 cc
Case 10	3,1 %	D1 cc

Table 1 shows in which of the analyzed points the greatest difference was found

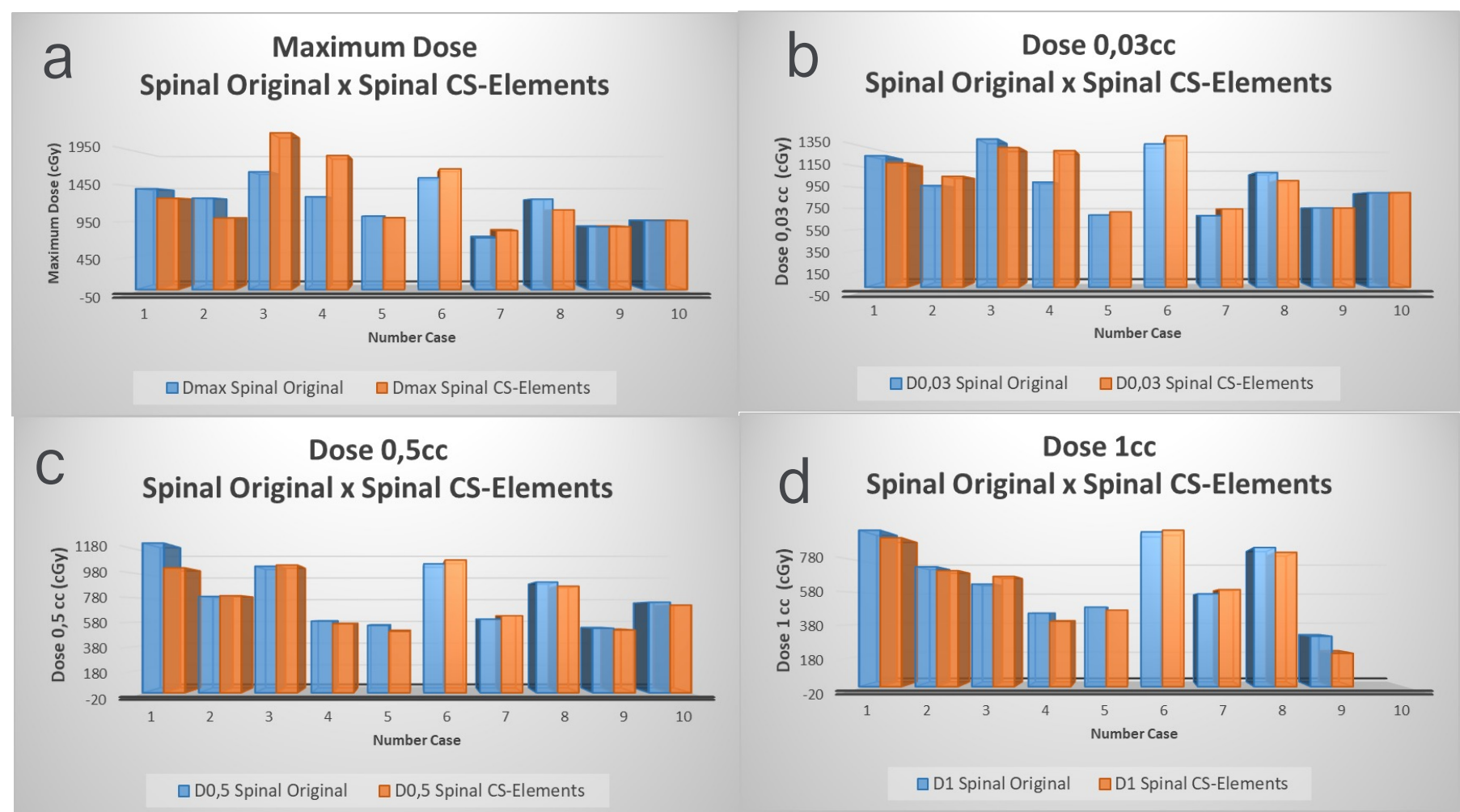
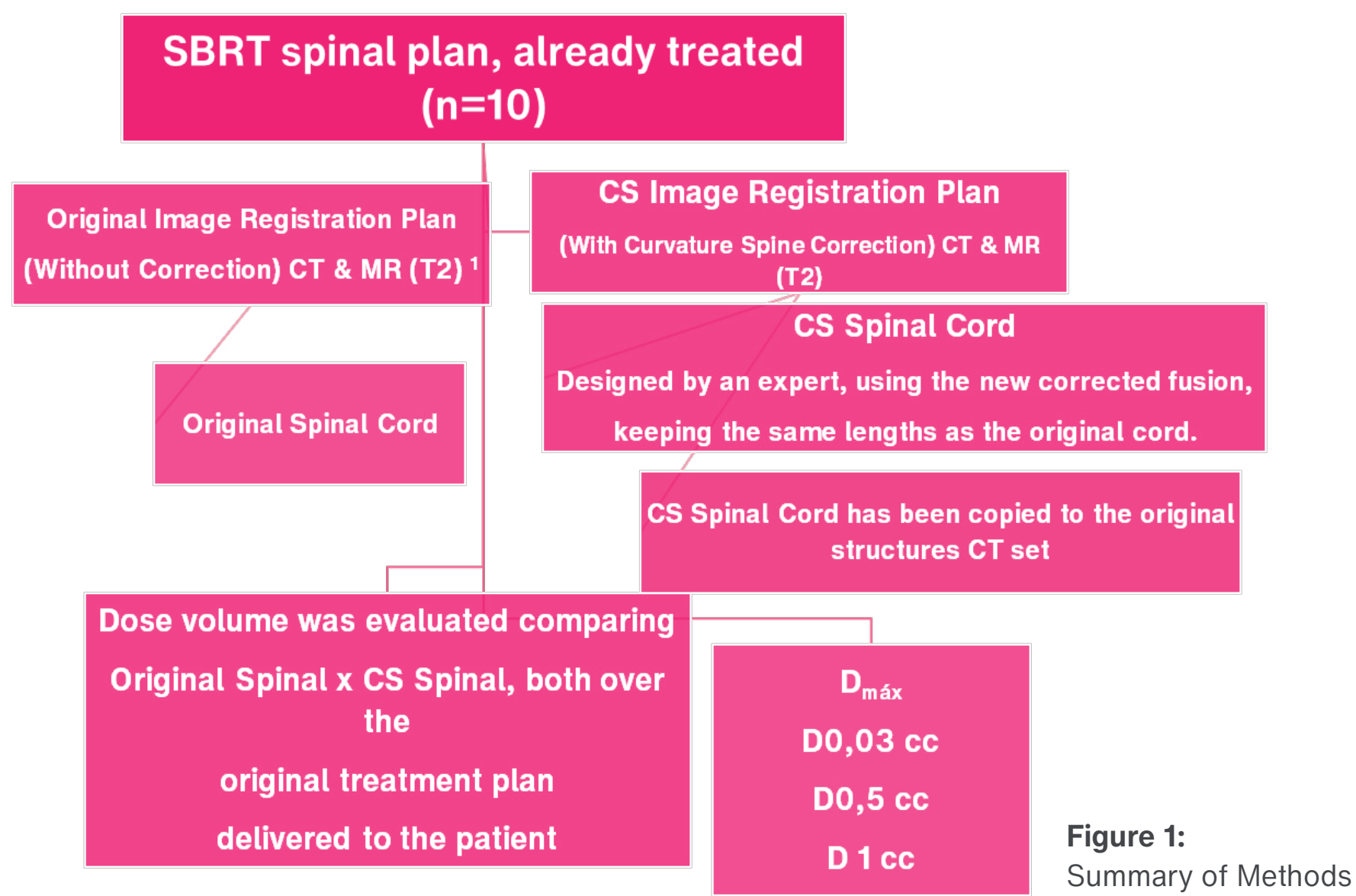


Figure 2: Comparison of the Dose Volume between Original Spinal x CS-Elements Spinal

Significant differences were found when we evaluated each one of the registrations (with or without curvature correction): In spinal contouring (**Figure 3**: cases 03, 05, 06 and 09) and maximum point dose / $D_{1\text{ cc}}$ (**Table 1**). A relative difference of up to 44% at the maximum point dose, depending on patient's anatomies and positions were observed. In Cervical and upper thoracic regions, the correction occurred more expressively. The dose impact is showed in **Figures 2** and **Figure 4**.

In cases that were necessary a higher dose gradient (better falloff), because of spinal cord proximity to the tumor, these differences have a greater impact and may change the treatment planning (treatment dose reduction or hypofractionation) and improve procedure accuracy. In the future, we need to establish a quantitative parameter that evaluates the degree of curvature correction that the software applied, establish more clinical impact criteria and increase sampling.

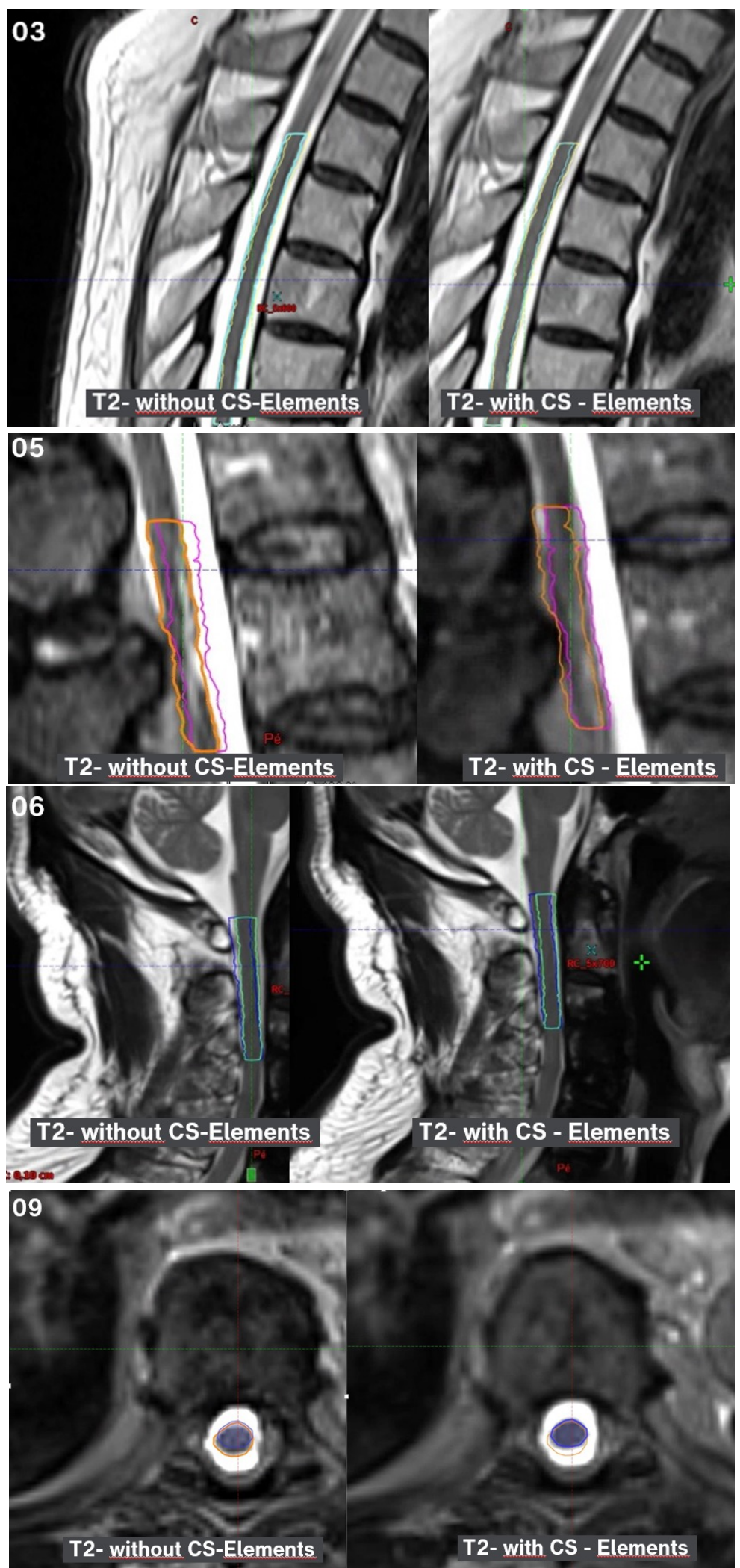


Figure 3: T2 image registration /contouring of Original Spinal x CS-Elements Spinal registration, qualitatively showing the differences. Number 03, 05, 06 and 09 are used to identify the case.

Conclusion: It was found clinically significant differences in the image records after application of curvature correction, evidencing the importance of using this tool to improve the accuracy and safe of spinal SBRT treatments.