Background: The re-irradiation of locally recurrent rectal cancer presents challenges due to the proximity of critical organs such as bowel. Ion beam therapy, specifically carbon ions radiotherapy (CIRT) have some advantage for the favorable relative biological effectiveness and physical dose distribution providing a highly conformal dose distribution while minimizing normal tissue damage.

Aim: To report our experience on feasibility and toxicity of carbon-ion radiotherapy (CIRT) in previously irradiated patients with locally recurrent rectal cancer.

Methods:
Between August 2014 and February 2017, a total of 10 patients (M:F= 8:2) with a median age of 58.5 years (range: 46-78) were treated with CIRT as re-irradiation for locally recurrent rectal cancer at CNAO. All patients had a history of, at least, a surgery for rectal adenocarcinoma. Except a case in which external beam radiotherapy (EBRT) was delivered for a prostatic cancer (total dose: 76 Gy), the previous pelvic EBRT ranged from 45 Gy to 50.4 Gy. Moreover, 1 patient received brachytherapy boost (total dose: 20 Gy) after pelvic EBRT and 1 patient, at time of the first recurrence, underwent to re-irradiation with stereotactic radiotherapy (30 Gy in 6 fractions).
Seven (70%) relapses were located in the presacral, 1 in perineal, 1 in perianal and 1 in pre-coccygeal region. 3 patients received spacer implantation prior to CIRT to secure adequate distance between bowel and tumor. Toxicity was scored according to CTCAE 4.0 scale.

Results:
The median interval between the two courses of radiotherapy was 89.3 months (range: 13.8 - 138.2). Median total dose of CIRT was 60 GyRBE (range: 35-76.8) and was administered in a median number of 16 fractions (range: 15-20) over 4 weeks (from 3 to 4.8 Gy RBE/fraction). All patients completed the scheduled treatment course. Median follow-up was 20 months. Acute toxicity was mild and mainly neuropathic: grade 2 (G2) neuropathic pain in 1 (10%) and G1 in 2 (20%) patients. The major late toxicities were peripheral neuropathy (20%, G2). No G≥3 acute/late reaction nor pelvic infections were observed. Four patients experienced local progression after CIRT with a median local-Disease Free Survival (DFS) of 13.08 months (range: 2.5–42.5). Five patients were diagnosed with systemic progression with a median metastasis-DFS of 13 months (range: 3.5–40). The estimated 1-year-local disease free survival was 79%.

Conclusions: CIRT for locally recurrent rectal cancer is safe and effective with an acceptable rate of morbidity of normal tissue. More data and longer follow-up are required to investigate the long-term disease control and to determine late effects.