Purpose: The onset time of tumor repopulation remains an unsolved issue for cervical cancer, although 3~4 weeks have been assumed. The purpose of this study is to determine the onset time (T₀) of cervical cancer based on an outcome analysis.

Method and Materials: A total of 80 patients with cervical cancer (stages IB2-IVa) were included in this study. Four sequential magnetic resonance imaging (MRI) scans were performed before, during and after radiation therapy (RT). The median follow-up time was 5.5 years (range 0.2–9.4 years). A kinetic model incorporating effects of radiation cell killing, dead-cell resolving, and tumor repopulation, was introduced to analyze tumor regression data measured by the MRI scans. A series of the onset time (T₀) has been tested for outcome prediction. The derived radiobiological parameters, including cell surviving fraction of 2 Gy (S₂) and dead-cell resolving half-time (T₁/2), were correlated with clinical outcome using the Mann-Whitney rank-sum test.

Results: Both the model parameters, S₂ and T₁/2, derived from regression data, correlated significantly with clinical outcome (p<0.0001). The corresponding p-values for outcome prediction were obtained as a function of the onset time. The optimal value of the onset time for best outcome prediction was T₀=19 days, with an uncertainty range of (14, 35) days. The outcome prediction power of T₁/2 was superior to that of S₂ and more sensitive to the onset time of tumor repopulation.

Conclusion: The onset time of accelerated repopulation of cervical cancer was directly derived from the clinical data using a kinetic model. Our study showed that accelerated repopulation does exist in RT for cervical cancer and has a relatively short onset time. Therefore dose escalation is necessary to compensate the effects of RT protraction.