The influence of shielding on the biological effectiveness of accelerated particles for the induction of chromosome damage

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Several experiments were conduced aimed at studying the influence of shielding on biological effectiveness of high-energy ions. Chromosome damage was assessed in human peripheral blood lymphocytes after *in vitro* exposure to the either ^{28}Si (490 or 600 MeV/n), ^{48}Ti (1000 MeV/n), or ^{56}Fe (600, 1000, or 5000 MeV/n). LET values for these ions ranged from approximately 50 to 174 keV/μm and doses ranged from 10 to 200 cGy. The effect of aluminum or polyethylene shielding on the induction of chromosome aberrations was investigated for each ion. Chromosome exchanges were measured using fluorescence *in situ* hybridization (FISH) with whole chromosome probes in cells collected 48-56 hours after irradiation using a chemical-induced premature chromosome condensation (PCC) technique. The yield of chromosomal aberrations increased linearly with dose. The relative biological effectiveness (RBE) for the primary beams, estimated from the initial slope of the dose response curve for total chromosomal exchanges with respect to γ-rays, ranged from 14 to 35. The RBE values increased with LET, to a maximum for the 1 GeV/n Fe ions with LET of 150 keV/μm, and decreased with further increase in LET. When the LET of the primary beam was in the region of increasing RBE (below approximately 100 keV/μm), the addition of shielding material increased the effectiveness per unit dose. However, shielding decreased the effectiveness per unit dose when the LET of the primary particle beam was higher than150 keV/μm.