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The Assessment of the Capping Tendency of the Tablet during The Pharmaceutical Tabletting Using Finite Element Analysis in Computational Modelling Tools

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The pharmaceutical powder compression cycle can be subdivided into several stages, which are associated with numerous complex mechanisms. The rearrangement and densification of particles, inter-particle interaction and friction, elastic and plastic deformation of particles, and particle fragmentation are more important to study to get a proper idea about the tabletting process and occurring issues during the process. The present study focuses on the assessment of the capping problem using computer modelling of the pharmaceutical powder compression and consolidation process using the finite element analysis (FEA) method implementing the Drucker–Prager Cap (DPC) model. The simulation studies were conducted for the well-known pharmaceutical excipient Avicel PH 102. The computer simulation revealed that when the friction coefficient (μ) > 0.2, the elastic recovery of the powder bed is increased, which will lead to excess dilation during the decompression and may cause the capping problem during the tabletting. Further, it was observed that pressure distribution throughout the powder bed was influenced by the lubrication level of the powder and the geometry of the tooling. The inhomogeneity of the stress and density distribution may lead to poor consolidation of the tablet and damage during the decompression stage. This simulation study indicates that the ideal friction coefficient value for the AvicelPH 102 is μ = 0.15 under this compaction parameter (punch size, R-value of CF tablet etc.). The variation of the DCP parameters due to relative density changes during the compression process is not assessed in this study. The conducted simulation study shows finite element analysis tool can be successfully implemented to resolve the capping issues occurring with the particular pharmaceutical formulation and can reduce the necessity of conducting a huge amount of analysis works to optimise formulation in the preformulation stages.

Keywords: *Drucker–Prager Cap (DPC) model, capping issues, powder compaction*