The goal of this study is to quantify changes in knee joint contact behavior following varying degrees of the medial partial meniscectomy. A previously validated 3D finite element model was used to simulate 11 different meniscectomies. The accompanying changes in the contact pressure on the superior surface of the menisci and tibial plateau were quantified as was the axial strain in the menisci and articular cartilage. The percentage of medial meniscus removed was linearly correlated with maximum contact pressure, mean contact pressure, and contact area. The lateral hemi-joint was minimally affected by the simulated medial meniscectomies. The location of maximum strain and location of maximum contact pressure did not change with varying degrees of partial medial meniscectomy. When 60% of the medial meniscus was removed, contact pressures increased 65% on the remaining medial meniscus and 55% on the medial tibial plateau. These data will be helpful for assessing potential complications with the surgical treatment of meniscal tears. Additionally, these data provide insight into the role of mechanical loading in the etiology of post-meniscectomy osteoarthritis.