For a bielliptic curve of genus three, we consider the quotient of its symmetric square by the bielliptic involution, which is a surface of Kodaira dimension one. We will discuss the Torelli problem for surfaces obtained by this way. The period map for the second cohomology has one dimensional fibers, and the general fiber consists of two connected components, which is explained by the duality of the Prym varieties for bielliptic curves of genus three. The period map for the total cohomology has finite fibers, and the general fiber consists of twelve points. Moreover, by adding the information of the Hodge structure of the canonical divisor, we have a generic Torelli theorem for these surfaces.