The $A^1A_u(S_1) - X^1A_g(S_0)$ LIF spectrum of biacetyl ($\text{CH}_3\text{C} (= \text{O})\text{C} (= \text{O})\text{CH}_3$) shows a long progression in the torsional vibrations of the two methyl tops. The $S_1$ torsional level pattern can be qualitatively understood using local mode ideas applied to the two equivalent methyl rotors and symmetry ideas from the $G_{36}$ group. For the present rotational analysis, we assigned a $G_{36}$ symmetry species, two local-mode torsional quantum numbers, and rotational quantum numbers $J_K_v, K_\pi$ to each observed torsion-rotation level. Transitions were globally fit with a two-equivalent-top computer program, which uses the molecular principal axis system, a free-rotor basis set for each top, a symmetric-top basis set for the rotational functions, and a single-step diagonalization procedure. The program is similar to our two-inequivalent-top program for N-methylacetamide. Last year, we refit 179 previously published rotational lines involving 7 torsional tunneling sublevels with zero or one quantum of torsional excitation in the $S_1$ state of biacetyl, using 14 parameters (5 for $S_0$, 9 for $S_1$) to obtain a standard deviation of 0.0041 cm$^{-1}$. We have now extended that fit by adding 131 unpublished lines involving 5 tunneling sublevels with two quanta of torsional excitation, using 19 parameters to obtain a standard deviation of 0.0040 cm$^{-1}$. Including transitions with still higher torsional excitation leads to a degraded standard deviation. We thus suspect that a number of higher-order terms describing top-top-overall-rotation interactions are missing from the present model, but the possibility of misassignments in the higher-energy regions must also be considered.