Supplementary Table 5. The Overview Summarizes the Causal Genes across Different Types of OA in Various Brain Tissues by TWAS

| | Accumbens BG | Anterior cingulate cortex | Caudate basal ganglia | Cerebellar hemisphere | Cerebellum | Cervical SC | Cortex | Frontal Cortex | Hippocampus | Putamen BG |
|---|---|---|---|---|---|---|---|---|---|---|
| **Knee** | UQCC1, NQO1, RPL36P4, HLA-DOA, SMG1P7, MARVELD3, EXOSC6, CLEC18A, PDXDC2P, MYO5A, GATD1-DT, ZSCAN26, SLC35E2B, BLTP3A, SNRPC, SPPL2A, GPRC5B, TMEM219, PFDN6, BTN3A2, SLC35G2, ATG12, ZNF19, HLA-K, ASB16-AS1, MAEA, CPNE1, LINC02166, CORO7, EDEM2, TPPP, NT5C3B, MMP24OS, HAS3, POLR1HASP, INVS, ZNF603P, PPIP5K2, YPEL3, UVSSA, COX5A, HLA-DPB1, MIR181A2HG, PMVK, ITGA2, C4A, NUDC, DCST2, ZSCAN31, TMOD3, WDR12, TRAF1, LINC02447, TMEM88B, KIF8BP2, UROS, ZKSCAN3, ATP5MC1P1, ZSCAN23, CARF, CCDC146 | ERGIC3, RNF212, CLEC18A, PDXDC2P, EXOSC6, SMG1P7, GATD1-DT, SNRPC, INO80IE, BLTP3A, CPNE1, UVSSA, HLA-DPB2, MARVELD1, PRDM5, LINC02611, PNPLA2, MAEA, HLA-K, ZNF603P, BTN3A2, CD164L2, MMP24OS, CABIN1, NCK1-DT, CDIP1, MPL, CORO7, PRANCR, ZSCAN23, SUMF2, LINC02166, BAK1, RPL36P4, C4A, TDRD5, UROS, CYP21A1P, PINLYP, VARS2, ZSCAN31, CD247 | GDF5, UQCC1, AARS1, NFS1, ABCB9, MAPK3, EXOSC6, UVSSA, PDXDC2P, SLC35E2B, GATD1-DT, CLEC18A, SNRPC, BLTP3A, CPNE1, TBX6, TOR2P1, CSK, HLA-V, RPL36P4, CORO7, ERGIC3, INO80IE, MPL SRD5A3-AS1, HFE, SMG1P7, MVP-DT, DHX32, ATG12, TPPP, ABT1, HORMAD2-AS1, SLC35G2, MMP24OS, BTN3A2, DGAP9, NT5C3B, MYO5A, INVS, PLOD1, ZSCAN26, MTRFR, FLOT1, TESK2, NS2D, CYP21A1P, BCAP29, SLC39A10, PMS2P9, VASN, SUMF2, ZNF603P, DCST2, TSGA10, MEOX2, C4A, POLR1HASP, NUDC, ASB16-AS1, UROS, LINC02447, TMEM88B, TRAF1, DMGDH, CYSTM1, MIR181A2HG, COG4, OTOF, HLA-K, KHK | CEP250, CLEC18A, KMT5A, FER1L4, EXOSC6, SMG1P7, MARVELD3, TSKU, BLTP3A, MYO5A, PDXDC2P, BCAP29, GATD1-DT, OET3, PDZD1, HCG24, PTPN9M2, INO80IE, TPPP, RPL36P4, PCCB, MCU, AKR1A1, SLIRP2, HLA-K, ZSCAN26, CPNE1, PMS2P9, UROS, HLA-DPA1, HLA-DPB2, NUDC, TBX6, CDIP1, KCTD13-DT, ATG12, CORO7, MMP24OS, ABT1, LYG1, POLR1HASP, PGBD1, NCK1-DT, ADAMTS15, PRSS16, NMRAL1, TRPM7, ASB16-AS1, ARHGAP27P2, SCAMP2, ILRUN, ZRSR2P1, TESK2, COG5, TRPC6AP, SUMF2, MANEA, ZNF603P, ASB16, RBM26, SPAG4, CYP21A1P, YPEL3, TRAF1, AGAP1, TMEM88B, LY6K, RGS19, TXNL4B, GDPD3, COL21A1, TDRD5 | HLA-DPA1, OGFOD2, EIF6, CPNE1, MAPK3, AARS1, EXOSC6, SMG1P7, KMT5A, MARVELD3, PDXDC2P, TRPM7, GATD1-DT, BLTP3A, MYO5A, PDPR, RPL36P4, SNRPC, INO80IE, PITPNM2, AKR1A1, OET3, SLC35E2B, TESK2, GSS, FGFR3, ENDOV, MCU, HMOX2, LYG1, KDELR2, CCDC82, MICU1, PBDD1, ZSCAN26, WDR46, UVSSA, PCBP2P1, NCK1-DT, MPL, MANEA, ASB16-AS1, HCG24, TPPP, HLA-DPB2, KCNMB4, NPPB14P, MMP24OS, HIP1R, TERF2, RASSF7, SAPCD1-AS1, COG5, LYG2, ZNF603P, MPHOSPH9, DGKQ, PCGF3, BCCIP, ASB16, DENR, SPAG4, UROS, ZNF602P, TCP10L, NAMA, CYP21A1P, RGS19, FLOT1, THUMPD3, CCDC144CP, ZKSCAN8, PRSS16, NMT1, RNF212, ORST1P, HLA-K, ABT1, BTN3A2, SUMF2, ZKSCAN8P2, NNT-AS1, SPATA33, TBX6, TMEM88, ARHGAP27P2, OPRL1, ZBSRD2P1, SYT11, TRAF1, TEDC1, PMS2P9, CXQL1, SLC38A7, NMRAL1, ATG12 | AARS1, ASB16-AS1, BLTP3A, BRDHP2, BTN3A2, C4B, CCDC162P, CLEC18A, CLEC18C, COG4, CORO7, CPNE1, CYSTM1, DDX55, DTNA, ERGIC3, EXOSC6, FER1L4, FEZ2, FLOT1, GATD1-DT, GPR75, HCP5B, HLA-DPA1, HLA-K, HSD17B8, ICA1L, ILF3-DT, ILRUN, INO80IE, INVS, KRT17P6, LINC02166, LINC02611, LY6D, LYG1, LYRM2, MAST2, MICU1, MMP24OS, MPL MTFP1, NT5C3B, NUDC, PI4K, PIXDC2P, PGBD1, PMS2P9, PNPLA2, PRANCR, RNF212, SLC35E2B, SLX1B, SMC3P1, SMG1P5, SMG1P7, SNRPC, SPATA33-AS1, SPDYE18, SUMF2, TBX6, TCP10L, TMEM88B, TRAF1, TRAF3, TXNDC9, UQCC1, UVSSA, WWP2, ZKSCAN8P2, ZMAT5, ZNF19, ZNF512B, ZNF603P, ZSCAN23, ZSCAN31 | GDF5, UQCC1, PDXDC2P, RNF212, KMT5A, SNRPC, EXOSC6, SMG1P7, SPON2, CLEC18A, GATD1-DT, MAPK3, BLTP3A, INO80IE, HLA-K, RPL36P4, CORO7, SF3B3, CCDC184, TMEM106C, LINC01976, LY6D, ICA1L, ZSCAN26, TPPP, ASB16-AS1, PNPLA2, OGFOD2, CPNE1, NT5C3B, SPPL2A, HLA-DOA, MMP24OS, MSH5, BTN3A2, MYO5A, SULT1A3, PRANCR, ZKSCAN3, SRP19, HSD17B8, PCCB, THUMPD3, PI4K, PIXDC2P, PGBD1, PMS2P9, PNPLA2, PRANCR, RNF212, SLC35E2B, SLX1B, SMC3P1, SMG1P5, SMG1P7, SNRPC, SPATA33-AS1, SPDYE18, SUMF2, TBX6, TCP10L, TMEM88B, TRAF1, TRAF3, TXNDC9, UQCC1, UVSSA, WWP2, ZKSCAN8P2, ZMAT5, ZNF19, ZNF512B, ZNF603P, ZSCAN23, ZSCAN31 | UQCC1, GDF5, WWP2, PDXDC2P, BLTP3A, COG4, AP1G1, AARS1, EXOSC6, SMG1P7, CLEC18A, LYG1, GATD1-DT, COL11A2, SNRPC, RPL36P4, HLA-K, DBMP21., PIGV, BRDHP2, MYO5A, ERGIC3, ZKSCAN3, C16orf58, KMT5A, MMP24OS, TBX6, BTN3A2, RPA1, UVSSA, CORO7, LYRM2, NT5C3B, CPNE1, C4A, SPPL2A, SRP19, LNC02611, ZNF603P, HCP5B, CTSA, LY6K, TMEM88, PI4K4A1, POLR1HASP, PIDD1, TRAF1, CYP21A1P, NMT1, ZSCAN26 | GDF5, CEP250, PAFAH1B1, PDXDC2P, CLEC18A, AP1G1, ASPHD1, SMG1P7, EXOSC6, GATD1-DT, FAM149B1, TPPP, SNRPC, HLA-V, BLTP3A, NQO1, INO80IE, LTBP1, ABCB9, SF3B3, TBX6, GDPD3, BTN3A2, KCNK3, MSH5, DTNA, CPNE1, ASB16-AS1, MPL GABBR1, HLA-K, CORO7, MMP24OS, NT5C3B, LYSSA, MYO5A, BRDHP2, ZKSCAN3, LY6K, RPL23AP1, BCAP29, INVS, SNRNP35, NUDC, TMEM88, PLOD1, PMS2P9, ZSCAN26, NMT1, ZNF603P, CAB39L, LYRM2, C4A, HORMAD2-AS1, P3H4, RPL36P4, LNCOC1, ZSCAN31, ZSCAN9, TESK2, C5orf54, LINC02447, TRAF1, PEAK1, UROS, CYP21A1P, CCDC62, KHK, SIRT6, PCCB, MISP3 |
| **Hip** | TSEN15, SUPT3H, GLTD1, RAD9A, GNL3, TRIOBP, ZDHHC24, CCS, BBS1, CTSF, TMEM50B, PSMG1, DNAJC28, RPH3D2, GLYCTK, FAM167A, ALG12, GCAT STK25, FAM85B, ANAPC4, PIP4K2A, MAP3K11, NTN5, ITIH1, SUND1, CTSW, EIF1AD, KANSL1-AS1, ITIH4, LINC00623, CYBSA, ARHGAP27, LRRC37A4P, DND1P1, MAPT-IT1, MAPKBIP1P2, OVOL1, AK9, GET1, RPL10P19, DE16, TMIE, BRWD1-AS2, UPB1, RN7SL417P, WDR71, MAPT-AS1, GOLGASL10, LINC02210, PSMF1 | TSEN15, SUPT3H, ITIH4, CTSF, TMEM50B, GNL3, ALG12, GOLGAP2P7, CDT1, LACTB, FAM85B, H2BP1, ANAPC4, LINC02210, LINC00623, KANSL1-AS1, LRRC37A4P, MAPKBIP1P2, DND1P1, TMEM129, NOX4, REEP1, GLYCTK, FAM86B3P, ZBTB24-DT, ACOT2, WTIP, RPL10P19, PLEKHO1 | NISCH, SUPT3H, GNL3, TSEN15, TRIOBP, CTSF, DPP3, ITIH4, PLEC, TMEM50B, ZDHHC24, BAP1, ANAPC4, UBE2Q2P16, ALG12, OVOL1, FUT2, ADAMTSL3, OMA1, ASB18, FAM85B, H2BP1, RBP7A, REEP3, CIQTNF4, GOLGAP2P10, LINC02210, KANSL1-AS1, ARHGAP27, MAPKBIP1P2, LRRC37A4P, DND1P1, TEX261, UBQLN1-AS1, LINC00933, HDLBP, HOXB2, SBGAP2C, DEFB1P0D, DEF6, LINC02716, NMB, AK9, UPB1, TOR1B, CTSB, | TSEN15, NEK4, SUPT3H, PPM1M, GNL3, SFMBT1, ZDHHC24, CDK9, HSD17B7P2, ZNRD2-DT, CTSF, ERC2, ZBED4, TACC3, H1-0, CFL1, UBQLN1-AS1, PLEC, SEC1P, ADAMTSL3, CHRNB1, HIP4, RNU4-39P, CD164, OVOL1, LRRC8A, FAM86B3P, EPN3, ZNF236, MAP3K11, LINC00623, H2BP1, KANSL1-AS1, DND1P1, MAPKBIP1P2, MAPT-IT1, SPPL2C, PSMC3, LRRC37A4P, PLEKHM1, GET1, RAD9A, ALG1L13P, NTN5, LCA5L, MAPKBIP1P1, ENPP7P1, ZCRB1, LRFN4, FAM215B, RPS20P22, FAM85B, PC, ZMIZ1, PI4K2B, SPOCK2, MEIS1-AS3 | SUPT3H, NEK4, GNL3, PPM1M, TSEN15, AP5B1, GARNL3, CTSF, ZDHHC24, GALR3, TMEM50B, NKX3-2, RAD9A, FAM76B, GCAT, MAP3K11, TARS2, ZNF76, ZBED4, PI4K2B, PLEC, ADAMTSL3, HOXB-AS1, PIP4K2A, HOXB2, OVOL1, MICALL1, LINC01042, HOXB3, KANSL1-AS1, SFMBT1, ITIH4, EPN3, ANAPC4, MAPT, LINC00623, KTN1, LINC02210, DND1P1, MAPT-IT1, SPPL2C, TAF11, TAX1BP1, MAPKBIP1P2, MAPT-AS1, BBS1, PLEKHM1, ZNF236, H2BP1, ERC2, GLYCTK, NTN5, HIP4, FAM27B, GET1, UBQLN1-AS1, CEP57, TLR9, KRTAP26, ARHGAP27P2, HSD17B7P2, DE16, KCNK7, FAM86B3P, ALG1L13P, LRRC37A1P, ENPP7P1, ZDHHC8, UPB1, TNFSF12, USP17L7 | GNL3, GCAT, COLGALT2, TRIOBP, ITIH4, CTSF, MTCH2, FBN2, TMEM85B, ZDHHC24, PPM1M, TCP11, FBK, ARNT, CRELD2, POLR2F, ANAPC4, FAM85B, PLEC, OMA1, KANSL1-AS1, DND1P1, MAPT-AS1, CRHR1, GLI4, H2BP1, AK9, GET1, LINC02210, LRRC37A4P, UBQLN1-AS1, VAMP3, LINC01022, ABHD16, BRP9, HDLBP, ZSCAN2, PIP4K2A, TMEM176B, NEK4, MSRA, MAPKBIP1P1 | PPP2R5CP, SUPT3H, SPCS1, GNL3, RAD9A, COLGALT2, TWF2-DT, TRIOBP, ZDHHC24, CTSF, NEK4, MYO6, BBS1, PLEC, TMEM50B, GOLGAP2P10, BANF1, ANAPC4, LRRC41, ITIH4, PIP4K2A, MOV10L1, DNM1P51, TMEM129, PPM1M, FAM85B, MAMSTR, ALG1L13P, ALG12, GLYCTK, PTPRJ, SMPD2, LINC00623, NTN5, OVOL1, PSRC1, FAM86B3P, MAPKBIP1P1, AGBL2, MTCH2, LINC02210, KANSL1-AS1, LRRC37A4P, MAPKBIP1P2, DND1P1, SPPL2C, SBGAP2C, UBE2Q2P16, RNASEH2C, PPM1M, UBQLN1-AS1, RRP7BP, REEP3, P3H2-AS1 | SPCS1, SUPT3H, MYO6, GNL3, BBS1, ZDHHC24, TMEM50B, HMGN1, ANAPC4, MAP3K11, DNM1P51, TMEM129, PPM1M, PLEC, FUBP3, TSEN15, CRHR1, LRRC37A4P, MAPKBIP1P2, KANSL1-AS1, DND1P1, ITIH4, FAM85B, LINC02210, LINC02716, COA6-AS1, RRP7BP, BRWD1-AS2, H2BP1, LINC02798, | TSEN15, SUPT3H, TRIOBP, GNL3, NISCH, CTSF, ZDHHC24, TMEM50B, ITIH4, ALG12, PLEC, CTNNBL1, ANAPC4, OMA1, HMGB1P49, GET1, MAMSTR, FUT2, GOLGAP2P10, FBK, RPS12, MICALL1, PIP4K2A, FAM86B3P, SLC35G5, TNFSF12, GLYCTK, LINC00623, LCN1, MAPKBIP1P2, DND1P1, LINC02210, KANSL1-AS1, MAPT-AS1, HDLBP, LRRC37A4P, CYBSR3, RNASEH2C, H2BP1, C6orf62, MSRA, WDR71, MAPKBIP1P1, TOR1B, RRP7BP, FAM85B, LRRC37A2, AK9, NOP53, | SUPT3H, GNL3, RAD9A, ITIH4, TCP11, DPP3, PTPRJ, CTSF, ZDHHC24, FBN2, TMEM50B, TRIOBP, ADAMTSL3, PLEC, ALG12, FAM167A, ANAPC4, NTN5, CHST1, LRRC43, FAM85B, REEP3, CCS, BBS1, ZDBF2, FUT2, LINC00623, SHMT1, KANSL1-AS1, LRRC37A4P, CRHR1, MAPT-AS1, MAPKBIP1P2, DND1P1, AFF1, UBQLN1-AS1, CTSB, ZCRB1, GET1, OMA1, HLA-DPB2, APP, RNASEH2C, SBGAP2C, HDLBP, TOP3MT, PIP4K2A, LINC02210, ER11, CUBN, PSMF1, RRP7BP, TEX264, MTMR2, |
| **Finger** | ERP27, PDE6H, HLA-DQB1-AS1, HLA-DQB1, HLA-DRB6 | HLA-DRB6 | | | | | TBX2, HLA-DRB6 | | | HLA-DRB6, HLA-DQB1-AS1, |
| **Hand** | SMARCA4, RUNX2, DBNDD1 | | PRSS35, MESD, CR1, MAFTRR, ANKRD7, HLA-DQA2 | | | | | MAFTRR | HLA-DQA2, MAN2C1, IGFL1P1, MAFTRR | |
| **Thumb** | | | SNAP47, TRMT44, SLC36A4-AS1, CLEC12A | | | SNAP47 | SNAP47 | SNAP47 | SNAP47, ZNHIT6 | SNAP47 |
| **Spine** | RNF123, INO80D, HAPLN4, GMPPB, DMAC2 | RNF123, GMPPB, ALKBH5, DMAC2, RBM6, MST1R, NDUFS1, B9D2 | MDM1, GMPPB, UBA7, NDUFS1, INO80D, DMAC2 | RFC3, INKA1, RNF123, INO80D, GPX1, NDUFS1, GMPPB, EXOSC5, MST1R | RNF123, EXOSC5, GMPPB, INKA1, B3GNT8, INO80D | RNF123, MST1R, GMPPB, APEH | MST1R, RNF123 | GMPPB, GPX1, RNF123, INO80D, NDUFS1 | | |
| **Knee/Hip** | CCDC184, HMGN1, NFU1, COLGALT2, NTSDC1 | MAPK3 | TACC3, PSMC3, PSMG1, FAM167A, COLGALT2, CHST3 | RPL31P12, NFU1, COLGALT2 | COLGALT2, RPL31P12, PSMG1, PSMC3, TACC3, MIX23 | PSMG1, NAALAD2 | C17orf67, CCDC184, MAPK3, PSMG1 | HCG4 | SMG1P5, COLGALT2, NAALAD2 | HMGN1, PSMG1, COLGALT2, NOX4, PSMC3 |
| **Knee/Finger** | TBX2-AS1 | | | | TBX2 | | TBX2-AS1 | | | TBX2 |
| **Knee/Hand** | | | | SPRY4 | | | | ILF3-DT, SMG6, MAN2C1 | SPATA33 | |
| **Knee/Thumb** | | | | | | | | PRDM5 | | |
| **Knee/Spine** | | | MST1R | PCGF3 | | | | KNTC1 | | |
| **Hip/Finger** | | | ECRG4 | | | | | | | |
| **Hip/Hand** | | TARS2 | | | | | | | | |
| **Hip/Spine** | | PPM1M | | | | | | | | |
| **Finger/Hand** | H2AJ | PDE6H | ERP27 | | | | | | | |
| **Knee/Hip/Hand** | HLA-V | | | | | | | DGKE, PSMG1 | HMGN1 | |
| **Knee/Hip/Spine** | | | | | MOCS2-DT | | | | | |
| **Hip/Thumb/Hand** | | | | | | | | | TGFA | |
| **Knee/Thumb/Hand** | | | CARM1 | | SPRY4 | | | | | |
| **Knee/Hip/Thumb/Hand** | | TGFA | TGFA | | | | | TGFA | | |
| **Knee/Finger/Thumb/Hand** | | | | | | | | SMARCA4 | | |