

The Claims:

1. An in vitro method for assessing the status of a transplanted organ in a transplant recipient, comprising:
 - 5 (i) collecting a biological sample from a transplant recipient, a subject who has received an organ transplant from a donor;
 - (ii) identifying one or more markers of genomic DNA of the recipient having a homozygous genotype, referred as recipient-derived marker sequences by screening
 - 10 a panel of markers from said sample, using recited primer pairs;
 - (iii) identifying said one or more markers from the transplant donor in the recipient and having heterozygous genotype, referred as donor-derived marker sequences, by analyzing circulating cell-free nucleic acids in the sample of the transplant recipient
 - 15 using digital droplet PCR with recited primer pairs;
 - (iv) calculating a ratio of the donor-derived marker sequences to recipient-derived marker sequences expressed in terms of percent; and
 - 20 (v) assessing the status of the transplanted organ by comparing the calculated percent to a predefined cut off value,
 - wherein the markers are rs2493132, rs6667487, rs553921764, rs4233335, rs10900556, rs1449265, rs7603052, rs1317808, rs2229813, rs4851521, rs7653603,
 - 25 rs6791557, rs7652776, rs9131, rs352007, rs1818782, rs4701997, rs251022, rs714459, rs1801020, rs2842949, rs657941, rs805294, rs2523860, rs2766535, rs1554497, rs35024671, rs7794745, rs15775, rs2002792, rs2575694, rs756627, rs1800392, rs11794980, rs10738924, rs1197943, rs4405241, rs2704522, rs1512705, rs10734083, rs1073525, rs668393, rs1522662, rs481235, rs2277312, rs2043055,
 - 30 rs10841697, rs657197, rs9554250, rs7328030, rs1626923, rs978511, rs741761, rs10162971, rs12449089, rs7193058, rs11866418, rs4323, rs2159132, rs150384, rs3909244, rs12459052, rs67233828, rs3918251, rs2327088, rs1051266, rs2742630, rs1801198, rs6609533, rs2298065, and S1.No. 71;
 - 35 wherein each of the markers is identified by a pair of primers comprising nucleic acid sequences as follows: rs2493132 is identified by a pair of primers comprising

nucleic acid sequences SEQ ID NO: 1 and 2, rs6667487 by primers having SEQ ID NO: 3 and 4, rs553921764 by primers having SEQ ID NO: 5 and 6, rs4233335 by primers having SEQ ID NO: 7 and 8, rs10900556 by primers having SEQ ID NO: 9 and 10, rs1449265 by primers having SEQ ID NO: 11 and 12, rs7603052 by primers having SEQ ID NO: 13 and 14, rs1317808 by primers having SEQ ID NO: 15 and 16, rs2229813 by primers having SEQ ID NO: 17 and 18, rs4851521 by primers having SEQ ID NO: 19 and 20, rs7653603 by primers having SEQ ID NO: 21 and 22, rs6791557 by primers having SEQ ID NO: 23 and 24, rs7652776 by primers having SEQ ID NO: 25 and 26, rs9131 by primers having SEQ ID NO: 27 and 28, rs352007 by primers having SEQ ID NO: 29 and 30, rs1818782 by primers having SEQ ID NO: 31 and 32, rs4701997 by primers having SEQ ID NO: 33 and 34, rs251022 by primers having SEQ ID NO: 35 and 36, rs714459 by primers having SEQ ID NO: 37 and 38, rs1801020 by primers having SEQ ID NO: 39 and 40, rs2842949 by primers having SEQ ID NO: 41 and 42, rs657941 by primers having SEQ ID NO: 43 and 44, rs805294 by primers having SEQ ID NO: 45 and 46, rs2523860 by primers having SEQ ID NO: 47 and 48, rs2766535 by primers having SEQ ID NO: 49 and 50, rs1554497 by primers having SEQ ID NO: 51 and 52, rs35024671 by primers having SEQ ID NO: 53 and 54, rs7794745 by primers having SEQ ID NO: 55 and 56, rs15775 by primers having SEQ ID NO: 57 and 58, rs2002792 by primers having SEQ ID NO: 59 and 60, rs2575694 by primers having SEQ ID NO: 61 and 62, rs756627 by primers having SEQ ID NO: 63 and 64, rs1800392 by primers having SEQ ID NO: 65 and 66, rs11794980 by primers having SEQ ID NO: 67 and 68, rs10738924 by primers having SEQ ID NO: 69 and 70, rs1197943 by primers having SEQ ID NO: 71 and 72, rs4405241 by primers having SEQ ID NO: 73 and 74, rs2704522 by primers having SEQ ID NO: 75 and 76, rs1512705 by primers having SEQ ID NO: 77 and 78, rs10734083 by primers having SEQ ID NO: 79 and 80, rs1073525 by primers having SEQ ID NO: 81 and 82, rs668393 by primers having SEQ ID NO: 83 and 84, rs1522662 by primers having SEQ ID NO: 85 and 86, rs481235 by primers having SEQ ID NO: 87 and 88, rs2277312 by primers having SEQ ID NO: 89 and 90, rs2043055 by primers having SEQ ID NO: 91 and 92, rs10841697 by primers having SEQ ID NO: 93 and 94, rs657197 by primers having SEQ ID NO: 95 and 96, rs9554250 by primers having SEQ ID NO: 97 and 98, rs7328030 by primers having SEQ ID NO: 99 and 100, rs1626923 by primers having SEQ ID NO: 101 and 102, rs978511 by primers having SEQ ID NO: 103 and 104, rs741761 by primers having SEQ ID NO: 105 and 106, rs10162971 by primers having SEQ ID NO: 107 and 108, rs12449089 by primers having SEQ ID NO: 109 and 110, rs7193058 by primers having SEQ ID NO: 111 and 112, rs11866418 by primers having SEQ ID NO: 113 and 114, rs4323 by primers having SEQ ID NO: 115 and 116, rs2159132 by primers having SEQ ID NO: 117 and 118, rs150384 by primers having SEQ ID NO: 119 and 120, rs3909244 by primers having SEQ ID NO: 121 and 122, rs12459052 by primers having SEQ ID NO: 123 and 124, rs67233828 by primers having SEQ ID NO: 125 and 126,

rs3918251 by primers having SEQ ID NO: 127 and 128, rs2327088 by primers having SEQ ID NO: 129 and 130, rs1051266 by primers having SEQ ID NO: 131 and 132, rs2742630 by primers having SEQ ID NO: 133 and 134, rs1801198 by primers having SEQ ID NO: 135 and 136, rs6609533 by primers having SEQ ID NO: 137 and 138, rs2298065 by primers having SEQ ID NO: 139 and 140, and S1.No. 71 by primers having SEQ ID NO: 141 and 142.

2. The in vitro method according to claim 1, wherein the identified markers are ranged between 3 and 9 with a minimum of 3 markers per recipient and wherein average of the markers, measured as absolute copy numbers (copies/ μ l), is determined and expressed as percentage of donor-derived ccfDNA markers to the recipient derived markers.
3. The in vitro method according to claim 1, wherein the cut off value for monitoring the status of the transplanted organ of the transplant recipient varies with the transplant type and is the range of 0.1% to 15%.
4. The in vitro method according to claim 1, wherein the biological sample is selected from whole blood, plasma, serum or urine.
5. The in vitro method according to claim 1, wherein the transplant is selected from an organ transplant or a skin / tissue transplant.
6. The in vitro method according to claim 1, wherein the organ transplant is selected from one of kidney transplant, heart transplant, liver transplant, pancreas transplant, lungs transplant, intestine transplant, bone marrow or thymus transplant or a combination of more than one organ transplant.
7. An in vitro method of monitoring the status of a transplanted organ in transplant recipients comprising assessing the transplant organ status of the transplant recipients by the in vitro method according to claim 1 for a plurality of times, thereby monitoring the transplant organ status

8. The in vitro method according to claim 7, wherein the monitoring of the transplant organ status of the transplant recipients is performed until the rejection of the organ occurs.
- 5 9. The in vitro method according to claim 7, wherein the frequency of assessing the transplant organ status of the transplant recipients is a function of time determined based on the transplanted organ and the ratio of the donor derived marker sequences to the recipient-derived marker sequences expressed in terms of percent over time.