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(71) Applicant: **Two Cells Co., Ltd**
Hiroshima-shi, Hiroshima 732-0811 (JP)

(72) Inventors:
- **KATO, Yukio,**
  Nat.University of Corp. Hiroshima University
  Hiroshima-shi, Hiroshima 734-8551 (JP)
- **KAWAMOTO, Takeshi,**
  Nat.University of Corp. Hiroshima University
  Hiroshima-shi, Hiroshima 734-8551 (JP)
- **TSUJI, Koichiro**
  Hiroshima-shi, Hiroshima 732-0811 (JP)
- **IGARASHI, Akira**
  Hiroshima-shi, Hiroshima 732-0814 (JP)
- **SHIMIZU, Masakazu**
  Kyoto-shi, Kyoto 606-8304 (JP)

(74) Representative: **Müller, Frithjof E.**
Müller Hoffmann & Partner
Patentanwälte
Innere Wiener Strasse 17
81667 München (DE)

(54) METHOD FOR DISTINGUISHING MESENCHYMAL STEM CELL USING MOLECULAR MARKER AND USE THEREOF

(57) Disclosed is a method for distinguishing a mesenchymal stem cell comprising, using at least one gene selected from the genes having the nucleotide sequences indicated by the accession numbers shown in Table 1 as a distinguish marker, detecting the difference in expression of the distinguish marker between a mesenchymal stem cell and a connective tissue cell to distinguish the mesenchymal stem cell from the connective tissue cell. This method enables to distinguish an undifferentiated mesenchymal stem cell from other connective tissue cell such as fibroblasts, osteoblasts, chondrocytes and adipose cells with good accuracy. A mesenchymal stem cell given by this method or a composition comprising the mesenchymal stem sell can be used as a therapeutic for use in the regenerative medicine.

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Description

TECHNICAL FIELD

[0001] The present invention relates to a method for detecting, distinguishing, and separating mesenchymal stem cells, especially, to a method for distinguishing mesenchymal stem cells from connective tissue cells such as fibroblasts, osteoblasts, chondrocytes, adipose cells, etc. by using a gene marker, a protein marker, and/or the like marker for detecting mesenchymal stem cells, the markers being expressed in a different way in mesenchymal stem cells and in the other connective tissue cells.

BACKGROUND ART

[0002] Mesenchymal stem cells are present in mammalian marrows etc. and known as pluripotential stem cells, which can differentiate into adipose cells, cartilage cells, and bone cells. Due to its pluripotency, mesenchymal stem cells are highly expected as transplantation material for use in regenerative medicine for many kinds of tissues. That is, the use of mesenchymal stem cell enables "regenerative medicine by cell transplantation" for regenerating lost tissues lost due to diseases or impairment and have not been able to be regenerated by a conventional remedy method. More specifically, therapeutic treatments have been started or planed, which are for example, transplantation of marrow mesenchymal stem cells to a patient of lower limb ischemia (Buerger's disease), transplantation of marrow mesenchymal stem cells to a patient of a periodontal disease, transplantation of marrow mesenchymal stem cells to a patient of osteoarthritis, transportation of amniotic epithelium sheet to burn injured portion, transportation of amniotic stem cells to a patient of diabetes mellitus, and the other transplantation.

[0003] In order to use mesenchymal stem cells for regenerative medicine, the stem cells should be collected from a living tissue and then multiplied without differentiation, and the multiplied and undifferentiated stem cells should be induced to differentiate to desired cells in order to prepare tissue for the regenerative medicine.

[0004] The inventors of the present invention have reported a method of easily collecting mesenchymal stem cells by separating mesenchymal stem cells from an oral cavity tissue, which method is safe for an individual from which the mesenchymal stem cells are collected (see Patent Citation 1). Moreover, the inventors of the present invention have reported a culturing method, which can give a significantly larger amount of mesenchymal stem cells than can a conventional culturing method. The culturing method having been reported by the inventors of the present invention is based on a fact found by the inventors that mesenchymal stem cells can be multiplied at a dramatically fast rate by culturing the mesenchymal stem cells in the presence of an extracellular matrix of a basement membrane or in a medium containing fibroblast growth factor (FGF) etc. and this culturing method can multiply mesenchymal stem cells without the differentiating ability thereof (see Patent Citation 2).

[0005] These arts are not enough to make the regenerative medicine using the mesenchymal stem cells practically applicable. To speak specifically, for the preparation of the tissue for regenerative medicine by inducing the differentiation of the cultured and multiplied mesenchymal stem cells to desired cells, the cultured cells should be confirmed beforehand that they are mesenchymal stem cells. That is, it is necessary to develop a method of detecting and distinguishing the mesenchymal stem cells after the culturing and multiplication.

[0006] To solve this technical problem, the inventors of the present invention have developed a method of effectively identifying and separating mesenchymal stem cells and fibroblast, which are morphologically similar and thus difficult to be distinguish, the method using a gene maker and/or a protein marker for detecting mesenchymal stem cells (see Patent Citation 3).

[Patent Citation 1]
Japanese Patent Application Publication, Tokukai, No. 2003-52365 (published on February 25, 2003).
[Patent Citation 2]
Japanese Patent Application Publication, Tokukai, No. 2003-52360 (published on February 25, 2003).
[Patent Citation 3]
Japanese Patent Application Publication, Tokukai, No. 2005-27579 (published on February 3, 2005).

DISCLOSURE OF INVENTION

[Technical Problems]

[0007] As described above, mesenchymal stem cells, which differentiate to bones, cartilages, fats, muscles, tendons/ligaments, nerves, etc., have been highly expected to be applicable to the regenerative medicine as cells for transplantation to remedy impairment of these tissues. Conventionally, the confirmation of the mesenchymal stem cells can be

carried out *in vitro* or by providing the differentiation ability thereof *in vivo*. The practical use of the tissue regenerative medicine of the mesenchymal stem cells cannot be attained without exact, accurate, and easy method to confirm that the cells are mesenchymal stem cells and the mesenchymal stem cells keep its pluripotentcy.

[0008] It is true that the method disclosed in Patent Citation 3 is sufficient to identify and distinguish the mesenchymal stem cells and fibroblast. However, bone marrows etc. contain many other connective tissue cells other than fibroblasts, such as osteoblasts, chondrocytes, adipose cells, etc.

[0009] Therefore, the art to distinguish the mesenchymal stem cells from fibroblast is not enough to realize practical regenerative medicine using the mesenchymal stem cells. Accordingly, there have been a high demand to develop an art to distinguish and separate the undifferentiated mesenchymal stem cells from the other connective tissue cells such as fibroblasts, osteoblasts, chondrocytes, adipose cells, etc. with exactness, accuracy, and easiness. The development of the art will be beneficial for the regenerative medicine because the art can distinguish the mesenchymal stem cells that keep the pluripotentcy thereof, from the undifferentiated mesenchymal stem cells mass-produced.

[0010] The present invention was accomplished in view of the aforementioned problem. An object of the present invention is to provide a method of exactly and accurately distinguishing and/or separating mesenchymal stem cells from the connective tissue cells such as fibroblasts, osteoblasts, chondrocytes, adipose cells, etc., and use of the same method.

[Technical Solution]

[0011] The inventors of the present invention diligently worked to attain the object. The inventors studied expression profiles of genes in mesenchymal stem cells and connective tissue cells such as fibroblasts and others. As a result, the inventors newly found that there are genes whose expression is specific to mesenchymal stem cells but whose expressions in the connective tissue cells such as fibroblast and others are clearly different from the expression in mesenchymal stem cells. Based on this novel finding, the present invention was accomplished. The present invention, based on this novel finding, encompass the following inventions.

(1) A method of distinguishing mesenchymal stem cells, including:

distinguishing the mesenchymal stem cells from connective tissue cells by detecting a difference between expression in the mesenchymal stem cells and expression in the connective tissue cells by using a distinguishing marker(s), the distinguishing marker(s) being at least one of genes having the base sequences identified with accession numbers listed in Table 1 a to 1j.

[Table 1a]

Classification 1	Gene symbol	Gene title	Genbank number
ATP/GTP binding -1	BRIP1	BRCA1 interacting protein C-terminal helicase 1	NM_032043
ATP/GTP binding -2	PASK	PAS domain containing serine/threonine kinase	NM_015148
ATP/GTP binding -3	RAC2	ras-related C3 botulinum toxin substrate 2 (rho family, small GTP binding protein Rac2)	NM_002872
ATP/GTP binding -4	KIF18A	kinesin family member 18A	NM_031217
ATP/GTP binding -5	NEK7	NIMA (never in mitosis gene a)-related kinase 7	NM_133494
ATP/GTP binding -6	ARL4C	ADP-ribosylation factor-like	NM_005737
ATP/GTP binding -7	EDEM1	ER degradation enhancer, mannosidase alpha-like 1	NM_014674
ATP/GTP binding -8	CAMK2D	calcium/calmodulin-dependent protein kinase (CaM kinase) II delta	NM_172127
Classification 2	Gene symbol	Gene title	Genbank number
binding -1	PDE5A	phosphodiesterase 5A, cGMP-specific	NM_001083
binding -2	RGS4	regulator of G-protein signalling 4	NM_005613
binding -3	EGFL3	EGF-like-domain, multiple 3	NM_001409
binding -4	FHL2	four and a half LIM domains	NM_001450

(continued)

Classification 2	Gene symbol	Gene title	Genbank number
binding -5	HRB2	HIV-1 rev binding protein 2	NM_007043
binding -6	CAPZA1	capping protein (actin filament) muscle Z-line, alpha 1	NM_006135
binding -7	PAPPA2	pappalysin 2	NM_020318
binding -8	LOXL2	lysyl oxidase-like 2	NM_002318
binding -9	LOX	lysyl oxidase	NM_002317
binding -10	ADAMTS5	ADAM metallopeptidase with thrombospondin type 1 motif, 5 (aggrecanase-2)	NM_007038

[Table 1b]

Classification 3	Gene symbol	Gene title	Genbank number
cell growth and/or maintenance-1	CCND1	cyclin D1 (PRAD1: parathyroid adenomatosis 1)	NM_053056
cell growth and/or maintenance-2	CDC25A	cell division cycle 25A	NM_001789
cell growth and/or maintenance-3	IER3	immediate early response 3	NM_052815
cell growth and/or maintenance-4	BCL2	B-cell CLL/lymphoma 2	NM_000633
cell growth and/or maintenance-5	NALP1	NACHT, leucine rich repeat and PYD containing 1	NM_033004
cell growth and/or maintenance-6	PAK3	p21 (CDKN1A)-activated kinase 3	NM_002578
cell growth and/or maintenance-7	PODXL	podocalyxin-like	NM _001018 111
cell growth and/or maintenance-8	CCL26	chemokine (C-C motif) ligand 26	NM_006072
cell growth and/or maintenance-9	FBLN1	fibulin 1	NM_006486
cell growth and/or maintenance-10	LAMA1	laminin, alpha 1	NM_005559
cell growth and/or maintenance-11	NTNG1	netrin G1	NM_014917

[Table 1c]

Classification 4	Gene symbol	Gene title	Genbank number
cytokine -1	GDF15	growth differentiation factor 15	NM_004864
cytokine -2	IL6	interleukin 6 (interferon, beta 2)	NM_000600
cytokine -3	CTGF	connective tissue growth factor	NM_001901
cytokine -4	VEGF	vascular endothelial growth factor	NM_001025 366
cytokine -5	VEGFC	vascular endothelial growth factor C	NM_005429
cytokine -6	HGF	hepatocyte growth factor (hepapoietin A; scatter	NM_000601
Classification 5	Gene symbol	Gene title	Genbank number
cytoskeleton-1	KRT19	keratin 19	NM 002276
cytoskeleton-2	KRTAP1-5	keratin associated protein 1-	NM 031957
cytoskeleton-3	KRTAP2-1	keratin associated protein 2-	BC012486
cytoskeleton-4	KRTHA4	keratin, hair, acidic, 4	NM_021013

(continued)

Classification 5	Gene symbol	Gene title	Genbank number
cytoskeleton-5	CKAP2	cytoskeleton associated protein 2	NM_018204
cytoskeleton-6	KRTAP1-1	keratin associated protein 1-	NM 030967
cytoskeleton-7	KRT18	keratin 18	NM 000224
cytoskeleton-8	KAP2.1B	keratin associated protein 2.1B	AJ406929
cytoskeleton-9	SSH1	slingshot homolog 1 (Drosophila)	NM_018984
Classification 6	Gene symbol	Gene title	Genbank number
enzyme-1	LXN	latexin	NM 020169
enzyme-2	IFI30	interferon, gamma-inducible protein 30	NM 006332
enzyme-3	CPA4	carboxypeptidase A4	NM 016352

[Table 1d]

Classification 7	Gene symbol	Gene title	Genbank number
extracellular matrix-1	CHI3L1	chitinase 3-like 1 (cartilage glycoprotein-39)	NM_001276
extracellular matrix-2	KRT23	keratin 23 (histone deacetylase inducible)	NM_015515
extracellular matrix-3	FLG	filaggrin	NM 002016
extracellular matrix-4	ADAMTS1	a disintegrin-like and metalloprotease (reprolysin type) with thrombospondin type 1 motif, 1	NM_006988
extracellular matrix-5	FRMD5	FERM domain containing 5	NM_001031 729
Classification 8	Gene symbol	Gene title	Genbank number
growth factor or receptor-1	IGFBP1	insulin-like growth factor binding protein 1	NM_000596
growth factor or receptor-2	CFI	complement factor I	NM_000204
growth factor or receptor-3	ESM1	endothelial cell-specific molecule 1	NM_007036
growth factor or receptor-4	F2RL1	coagulation factor II (thrombin) receptor-like 1	NM_005242
growth factor or receptor-5 or	MET	met proto-oncogene (hepatocyte growth factor receptor)	NM_000245
growth factor or receptor-6	HTR7	5-hydroxytryptamine (serotonin) receptor 7 (adenylate cyclase-coupled)	NM_000872
growth factor or receptor-7	IGFBP3	insulin-like growth factor binding protein 3	NM_001013 398

[Table 1e]

Classification 9	Gene symbol	Gene title	Genbank number
membrane -1	ABHD2	abhydrolase domain containing 2	NM_007011
membrane -2	ITGA2	integrin, alpha 2 (CD49B, alpha 2 subunit of VLA-2 receptor)	NM_002203
membrane -3	LAMA3	laminin, alpha 3	NM 198129
membrane -4	NETO2	neuropilin (NRP) and tolloid (TLL)-like 2	NM_018092

(continued)

Classification 9	Gene symbol	Gene title	Genbank number
membrane -5	NTN4	netrin 4	NM_021229
membrane-6	PTGER1	prostaglandin E receptor 1 (subtype EP1), 42kDa	NM_000955
membrane -7	EPHB2	EPH receptor B2	NM 017449
membrane -8	SFRP1	secreted frizzled-related protein 1	NM_003012
membrane -9	CD33L3	CD33 antigen-like 3	NM 213602
membrane -10	GLIPR1	GLI pathogenesis-related 1 (glioma)	NM_006851
membrane -11	UGCG	UDP-glucose ceramide glucosyltransferase	NM_003358
membrane -12	ADORA1	adenosine A1 receptor	NM 000674
Classification 10	Gene symbol	Gene title	Genbank number
membrane binding protein-1	ANXA10	annexin A10	NM 007193
membrane binding protein-2	RARRES1	retinoic acid receptor responder (tazarotene induced) 1	NM_206963
membrane binding protein-3	HNT	neurotrimin	NM_016522
membrane binding protein-4	CNINAP3	contactin associated protein-	NM_033655 like 3

[Table 1f]

Classification 11	Gene symbol	Gene title	Genbank number
protein binding -1	SYT1	synaptotagmin I	NM 005639
protein binding -2	MLF1	myeloid leukemia factor 1	NM 022443
protein binding -3	CDCP1	CUB domain-containing protein 1	NM_022842
protein binding -4	KIAA0746	KIAA0746 protein	NM_015187
protein binding -5	PSCDBP	pleckstrin homology, Sec7 and coiled-coil domains, binding protein	NM_004288
protein binding -6	SKI	v-ski sarcoma viral oncogene homolog (avian)	NM_003036
protein binding -7	SNX25	sorting nexin 25	NM_031953
protein binding -8	CDH6	cadherin 6, type 2, K-cadherin (fetal kidney)	NM_004932
protein binding -9	DCBLD2	discoidin, CUB and LCCL domain containing 2	NM_080927
protein binding -10	ENG	endoglin (Osler-Rendu-Weber syndrome 1)	NM_000118

[Table 1g]

Classification 12	Gene symbol	Gene title	Genbank number
protein modification-1	SH3RF1	SH3 domain containing ring finger 1	NM_020870
protein modification-2	SMLTRF2	SMAD specific E3 ubiquitin protein ligase 2	NM_022739
protein modification-3	TFPI2	tissue factor pathway inhibitor 2	NM_006528
protein modification-4	ITGB3	integrin, beta 3 (platelet glycoprotein IIIa, antigen CD61)	NM_000212

(continued)

Classification 12	Gene symbol	Gene title	Genbank number
protein modification-5	MYPN	myopalladin	NM_032578
protein modification-6	LRP2BP	LRP2 binding protein	NM_018409
protein modification-7	HECW2	HECT, C2 and WW domain containing E3 ubiquitin protein ligase 2	NM_020760
protein modification-8	PKIA	protein kinase (cAMP-dependent, catalytic) inhibitor alpha	NM_006823
Classification 13	Gene symbol	Gene title	Genbank number
signal molecule-1	LVPD1	LY6/PLAUR domain containing 1	NM_144586
signal molecule-2	GATA6	GATA binding protein 6	NM_005257
signal molecule-3	RAB27B	RAB27B, member RAS	NM_004163
signal molecule-4	SOX11	SRY (sex determining region Y)-box 11	NM_003108
signal molecule-5	ARHGAP2	Rho GTPase activating 2 protein 22	NM_021226

[Table 1h]

Classification 14	Gene symbol	Gene title	Genbank number
transcription-1	ETV1	ets variant gene 1	NM_004956
transcription-2	ETV5	ets variant gene 5 (ets-related molecule)	NM_004454
transcription-3	FOXP1	forkhead box P1	NM_ 032682
transcription-4	HMGA2	high mobility group AT-hook 2	NM_003483
transcription-5	KLF12	Kruppel-like factor 12	NM_007249
transcription-6	PRDM16	PR domain containing 16	NM_022114
transcription-7	SIM2	single-minded homolog 2 (Drosophila)	NM_009586
transcription-8	SUHW2	suppressor of hairy wing homolog 2 (Drosophila)	NM_080764
transcription-9	ENO1	enolase 1	NM_001428
transcription-10	MITF	microphthalmia-associated transcription factor	NM_198159
transcription-11	TCF3	transcription factor 3 (E2A immunoglobulin enhancer binding factors E12/E47)	NM_003200
transcription-12	SMYD3	SET and MYND domain containing 3	NM_022743

[Table 1i]

Classification 15	Gene symbol	Gene title	Genbank number
transport-1	ATP6V1G3	ATPase, H+ transporting, lysosomal 13kDa, V1 subunit G isoform 3	NM_133262
transport-2	KCTD16	potassium channel tetramerisation domain containing 16	NM_020768
transport-3	NUPL1	nucleoporin like 1	NM_014089
transport-4	SLC14A1	solute carrier family 14 (urea transporter), member 1 (Kidd blood group)	NM_015865

(continued)

Classification 15	Gene symbol	Gene title	Genbank number
transport-5	SLC16A4	solute carrier family 16 (monocarboxylic acid transporters), member 4	NM_004696
transport-6	SLC4A4	solute carrier family 4, sodium bicarbonate cotransporter, member 4	NM_003759
transport-7	SLC9A7	solute carrier family 9 (sodium/hydrogen exchanger), isoform 7	NM_032591
transport-8	TRPC4	transient receptor potential cation channel, subfamily C, member 4	NM_016179
transport-9	MCFD2	multiple coagulation factor deficiency 2	NM_139279
transport-10	SLC26A4	solute carrier family 26, member 4	NM_000441
transport-11	MCOLN3	mucolipin 3	NM 018298
transport-12	SLC25A37	solute carrier family 25, member 37	NM_016612
transport-13	SLC30A7	solute carrier family 30 (zinc transporter), member 7	NM_133496

[Table 1j]

Classification 16	Gene symbol	Gene title	Genbank number
others -1	FLJ38725	hypothetical protein FLJ38725	NM_153218
others -2	KIAA1913	KLAA1913	NM_052913
others -3	PHLDB2	pleckstrin homology-like domain, family B, member 2	NM_145753
others -4	PLCXD2	phosphatidylinositol-specific phospholipase C, X domain containing 2	NM_153268
others -5	SAMD3	sterile alpha motif domain containing 3	NM_001017 373
others -6	ZNF423	zinc finger protein 423	NM_015069
others -7	FLJ33996	hypothetical protein FLJ33996	NM_175894. 2
others -8	PLEKHK1	pleckstrin homology domain containing, family K member 1	NM_145307
others -9	PTOV1	prostate tumor overexpressed gene 1	NM_017432
others -10	FAM40B	family with sequence similarity 40, member B	NM_020704
others -11	ABI3BP	ABI gene family, member 3 (NESH) binding protein	NM_015429
others -12	NHS	Nance-Horan syndrome (congenital cataracts and dental anomalies)	NM_198270
others -13	DTL	denticleless homolog (Drosophila)	NM_016448
others -14	C1GALT1	core 1 synthase, glycoprotein-N- acetylgalactosamine 3-beta-	NM_020156
others -15	CPNE8	copine VIII	NM_153634
others -16	TMEM49	transmembrane protein 49	NM_030938

(2) The method as set forth in (1), wherein the distinguishing marker(s) is at least one of the genes listed the classifications 6, 7, 8, 10, and 13 in Tables 1a to 1j.

(3) The method as set forth in (2), wherein the distinguishing markers are a combination of one or more genes from each of the classifications 6, 7, 8, 10, and 13 in Tables 1a to 1j.

(4) The method as set forth in any one of (1) to (3), wherein the distinguishing marker is at least one of the genes listed

in Table 2.

Gene symbol	Gene title	Genbank number
CHI3L1	chitinase 3-like 1 (cartilage glycoprotein-39)	NM_001276
FLG	filaggrin	NM_002016
CFI	complement factor I	NM_000204
ANXA10	annexin A10	NM_007193
LYPDC1	LY6/PLAUR domain containing 1	NM_144586
GATA6	GATA binding protein 6	NM_005257

(5) The method as set forth in any one of (1) to (4), wherein the detection of the difference in the expressions of the distinguishing markers is carried out by detecting expression of the gene or expression of a protein encoded by the gene.
(6) A microarray for distinguishing mesenchymal stem cells, the microarray including at least one of (a) to (d) immobilized thereon:

(a) at least one of genes having the base sequences identified with the accession numbers listed in Tables 1a to 1j;
(b) an antisense chain of at least one of genes having the base sequences identified with the accession numbers listed in Tables 3a to 3j;
(c) a partial base sequence of (a) or (b); and
(d) a polynucleotide that is capable of hybridizing, under stringent conditions, with a polynucleotide having the base sequence described in any one of (a) to (c).

(7) An antibody, being inducible with a polypeptide described in (e) or (f), and bindable specifically with the polypeptide specifically:

(e) a polypeptide encoded by any one of the genes having the base sequences identified with the accession numbers listed in Tables 1a to 1j; and
(f) a partial polypeptide of the polypeptide described in (e).

(8) A kit for distinguishing and separating mesenchymal stem cells, including any one of (g) to (i):

(g) a microarray as set forth in (6);
(h) an antibody as set forth in claim (7); and
(i) a probe for detecting whether the distinguishing marker gene for mesenchymal stem cells is expressed or not, the distinguishing marker gene comprising a polynucleotide, which, under strigent condition, hybridizes with a gene or a partial sequence thereof, the gene having a base sequence identified with the accession number listed in any one of Tables 1a to 1j.

(9) A method for distinguishing and separating mesenchymal stem cells, the method including:

separating the mesenchymal stem cells distinguished by a method as set forth in any one of (1) to (5).

(10) A cell-containing composition including:

mesenchymal stem cells separated by a method as set forth in (9); or
a multiplied culture of the mesenchymal stem cells.

(11) A drug for regenerative medicine, including:

a cell-containing composition as set forth in (10).

(12) A distinguishing marker for distinguishing mesenchymal stem cells, the distinguishing marker being at least one of genes having the base sequences identified with the accession numbers listed in Tables 1a to 1j.
(13) A distinguishing marker for distinguishing mesenchymal stem cells, the distinguishing marker being at least one of polypeptides encoded by genes having the base sequences identified with the accession numbers listed in Tables 1a to 1j.
(14) A method of judging whether a sample provider has been developed a disease related with mesenchymal stem cells or whether the sample provider has a possibility of developing the disease in the future, the method judging by treating a sample, which is separated *in vivo* from the sample provider, with any one or more of:

a method as set forth in any one of (1) to (5);
a microarray as set forth in (6);
an antibody as set forth in (7);
a kit as set forth in (8); and
a distinguishing marker as set forth in (12) or (13).

(15) A drug for regenerative medicine, the drug suppressing undifferentiating property of mesenchymal stem cells and comprising siRNA for a gene or a partial sequence thereof, the gene having any one of the base sequences identified with the accession numbers listed in Tables 1a to 1j.

[Effect of the Invention]

[0012] In the method of the present invention for distinguishing mesenchymal stem cells and the use thereof, the distinguishing marker is a gene whose expression pattern in undifferentiated mesenchymal stem cells is clearly different from expression pattern thereof in fibroblasts, osteoblasts, chondrocytes and adipose cells, etc. This makes it possible to distinguish and/or separate, e.g., undifferentiated mesenchymal stem cells contained in marrow from the connective tissue cells exactly accurately, and easily.
[0013] Thus, according to the present invention, it is possible to overcome the problems hindering the application of undifferentiated mesenchymal stem cells to the regenerative medicine, the mesenchymal stem cells being pluripotential and being capable of differentiating to bone, cartilages, fats, muscles, tendons/ligaments, nerves, etc. That is, according to the present invention, it is possible to overcome the problem in distinguishing undifferentiating mesenchymal stem cells from other cells such as fibroblasts and connective tissue cells. Thus, the present invention can make a great contribution to regenerative medicine using mesenchymal stem cells.
[0014] Moreover, mesenchymal stem cells used by the method of distinguishing the mesenchymal stem cells, and composition containing the same can be applied to a drug for regenerative medicine.

BRIEF DESCRIPTION OF DRAWINGS

[0015]

Fig. 1 a view schematically illustrating a flow of procedure of a present Example.
Fig. 2 is a view illustrating result of analysis to analyze a difference in expression of genes between mesenchymal stem cells (MSC) and other connective tissues by using a DNA microarray in a present Example.

BEST MODE FOR CARRYING OUT THE INVENTION

[0016] The present invention makes it possible to construct a method of effectively distinguishing and separating mesenchymal stem cells from other cell groups such as connective tissue cells (such as fibroblasts, osteoblasts, chondrocytes, adipose cells) etc. by using a DNA microarray to detect, as a distinguishing marker, a gene that is specifically expressed in undifferentiated stem cells. Use of the present invention makes it possible to perform a qualitative inspection of mesenchymal stem cells multiplied in vitro (on whether the mesenchymal stem cells have differentiation ability or not). This contributes to the practical application of the regenerative medicine using mesenchymal stem cells.
[0017] In the following, characteristic features of the present invention, that is, a method of distinguishing mesenchymal stem cells will be described firstly together with explanation on distinguishing/separating marker, microarray, and antibody to be used in the method. Finally, various applied technologies will be described herein such as distinguishing/ separating

method, cell-containing compositions (which further contain cell secreta (growth factor or the like) preferably), drugs for regenerative medicine, distinguishing/ separating kit, and the like.

[0018] In this DESCRIPTION, the term "polypeptide" is exchangeable with "peptide" or "protein". The polypeptide in the present invention may be a polypeptide isolated from a natural source, produced recombinantly, or synthesized chemically.

[0019] In this DESCRIPTION, the term "polynucleotide" is exchangeable with "gene", "nucleic acid", or "nucleic acid molecule", and intends to mean a polymer of nucleotides. Moreover, what is meant by the term "gene" encompass not only DNA but also RNA (e.g., mRNA). In this DESCRIPTION, the term "base sequence" is exchangeable with "gene sequence", "nucleic acid sequence" or "nucleotide sequence", and the "base sequence" is expressed as a sequence of deoxyribonucleotide (abbreviated as A, G, C, and T).

<1. Method of Distinguishing Mesenchymal Stem Cells>

[0020] A method according to the present invention for distinguishing mesenchymal stem cells comprises the step of distinguishing mesenchymal stem cells from the connective tissue cells by detecting a difference between expressions in mesenchymal stem cells and the connective tissue cells by using a distinguishing marker, which is at least one of genes having the base sequences identified with the accession numbers shown in Tables 1a to 1j above. The method according to the present invention is not particularly limited in terms of specific arrangements such as other steps, conditions, materials to use, devices to use, etc.

[0021] On Tables 1a to 1j, 139 genes are classified into sixteen classifications according to molecular functions of proteins encoded by the genes, referring to Gene Ontology (GO) of the European Bioinformatics Institute.

[0022] Classification 1 is a category for ATP-GTP binding proteins, and 8 kinds of genes with 8 accession numbers belong thereto. Moreover, Classification 2 is a category for binding proteins, and 10 kinds of genes with 10 accession numbers belong thereto. In this DESCRIPTION and Tables, "binding-1 ~ 10" means "DNA/metal ion/collagen binding-1~10". Classification 3 is a category for factors relating to cell growth factor or maintenance, and 11 kinds of genes with 11 accession numbers belong thereto.

[0023] Classification 4 is a category for cytokine, and 6 kinds of genes with 6 accession numbers belong thereto. Classification 5 is a category for cytoskeleton, and 9 kinds of genes with 9 accession numbers belong thereto. Classification 6 is a category for enzymes, and 3 kinds of genes with 3 accession numbers belong thereto.

[0024] Classification 7 is a category for extracellular matrix or cytoskeleton, and 5 kinds of genes with 5 accession numbers belong thereto. Classification 8 is a category for growth factors or receptors, and 7 kinds of genes with 7 accession numbers belong thereto.

[0025] Classification 9 is a category for membrane, and 12 kinds of genes with 12 accession numbers belong thereto. Classification 10 is a category for membrane binding proteins, and 4 kinds of genes with 4 accession numbers belong thereto.

[0026] Classification 11 is a category for factors relating to protein binding, and 10 kinds of genes with 10 accession numbers belong thereto. Classification 12 is a category for factors relating to protein modification, and 8 kinds of genes with 8 accession numbers belong thereto. Classification 13 is a category for factors relating to signal transduction, and 5 kinds of genes with 5 accession numbers belong thereto.

[0027] Classification 14 is a category for transcription factors, and 12 kinds of genes with 12 accession numbers belong thereto. Classification 15 is a category for factors relating to intercellular transport, and 13 kinds of genes with 13 accession numbers belong thereto.

[0028] Classification 16 is a category for other factors not belonging to any of the above classification, and 16 kinds of genes with 16 accession numbers belong thereto. The categories are classified according to open information disclosed in NCBI.

[0029] As described above, the gene groups listed on Tables 1a to 1j are classified in terms of the molecular functions of the proteins encoded by the genes. The use of these genes as distinguishing markers makes it possible to distinguish mesenchymal stem cells from the connective tissue cells by referring to the function or activity of the genes in mesenchymal stem cells and the connective tissue cells. More specifically, for example, if a factor relating to a particular extracellular matrix is expressed at a high expression level in mesenchymal stem cells, while the expression level of the factor is not so high in the connective tissue cells, then the use of a gene belonging to Classification 7 will make it possible to distinguish mesenchymal stem cells easily and exactly.

[0030] Moreover, it is advantageous that these genes, which can be used as the distinguishing markers, can be also utilized as markers of mesenchymal stem cells to distinguish them in terms of molecular function.

[0031] On Tables 1a to 1j, genes are listed in abbreviation in the column of "Gene symbol". general names and other information of the genes are listed in the column of "Gene title", and the accession numbers in Genbank are listed in the column of "Genbank number". For some genes (such as Transcript variant) that are given plural accession numbers, the scope of the present invention, needless to say, encompasses all genes represented with all the accession numbers.

[0032] Moreover, what is meant by the term "connective tissue" in this DESCRIPTION is all supporting and connective tissues encompassing cartilaginous tissue and osseous tissue. The supporting tissues collectively mean the connective tissue in a narrow sense, and specially differentiated connective tissue (cartilaginous tissue, osseous tissue, blood, and lymph). The term "connective tissue" may mean the supporting tissue in a broad sense. Ontogenically, the connective tissue is derived from "mesoblast (or from ectoderm in some cases)" and has functions of supporting an internal structures inside a body. Moreover the term "connective tissue cells" mean cell constructing the supporting and connective tissues. Example of immobilized cells encompass fibroblasts, reticular cells, adipose cells. Example of mobile cells encompass macrophages (histiocyte or macrophage), mast cells, plasma cells, lymphoid cells, granulocytes. Examples of immobilized cells constructing the cartilaginous tissue encompass chondrocytes. Examples of cells constructing osseous tissue encompass Osteoblasts and Osteocytes. It is preferable that the present invention be adopted to distinguish mesenchymal stem cells from fibroblasts, osteoblasts, chondrocytes, and adipose cells (which are collectively referred to as "connective tissue cells" hereinafter") among the various cells mentioned above.

[0033] Moreover, the gene groups listed in Tables 1a to 1j, which are used as "distinguishing markers" in the present invention, are genes that have been proved, by an analysis using DNA microarray to study expression profiles in undifferentiated mesenchymal stem cells, fibroblasts, osteoblasts, chondrocytes and adipose cells, that that they have an ability to show significant differences in expression levels between undifferentiated mesenchymal stem cells and other cell groups.

[0034] Referring to the difference in the expression level caused by the gene groups, it is possible to distinguish the undifferentiated mesenchymal stem cells from fibroblasts, osteoblasts, chondrocytes, and adipose cells easily, exactly, and accurately. The base sequence of the gene groups in Tables 1 and the amino acid sequence information of the proteins encoded by the gene groups have been publicly known. Especially, the base sequence information of the gene groups are available from the gene data base in the Genbank referring to the accession numbers listed in Tables 1a to 1j.

[0035] Moreover, among the genes listed in Tables 1a to 1j, these genes are preferable which satisfy the criterions as described in later-described Examples. For example, genes having high "Fold Average" and "Expression level" are preferably used solely or in combination. Furthermore, it is preferable to use such a gene as a marker that have "Fold Average" of 2 or more, and/or "Expression level" of 0.5 or more.

[0036] Moreover, the distinguishing marker is preferably at least one of the genes that belong to the classifications 6, 7, 8, 10, and 13 in Tables 1a to 1j.

[0037] The genes that belong to the classifications 6, 7, 8, 10, and 13 in Tables 1a to 1j show greatly different expression patterns especially between mesenchymal stem cells and the connective tissue cells. Most of the genes that belong to the classifications 6, 7, 8, 10, and 13 in Tables 1a to 1j show higher expression level in mesenchymal stem cells. Because of this, the gene that belong to the classifications 6, 7, 8, 10, and 13 in Tables 1a to 1j are preferably applicable as the distinguishing markers. Moreover, the use of such a gene that have a high expression level and show rather stable results with different individuals make it possible to distinguish mesenchymal stem cells exactly.

[0038] It is more preferable to use, in combination, one or more gene selected from each classification 6, 7, 8, 10, and 13 in Tables 1a to 1j, that is, to select at least one gene each from the classifications 6, 7, 8, 10, and 13 and to use the genes as the distinguishing marker in combination. By selecting at least one gene from the 5 classifications, it is possible to check the expression pattern for the gene(s) of each of the 5 classifications. This makes it possible to distinguish mesenchymal stem cells more exactly and more accurately.

[0039] Moreover, it is especially preferable that at least one gene selected from the genes listed in Table 2 be used as the distinguishing marker.

[0040] Table 2 lists 6 genes that are especially preferable among the 139 genes listed in Tables 1a to 1j. The 6 genes show especially greatly different expression patterns between mesenchymal stem cells and the connective tissue cells. Moreover, the 6 genes exhibit high expression levels. Because of these, the 6 genes are most preferably applicable as the distinguishing markers. Moreover, the use of such a small number of marker makes it possible to distinguish mesenchymal stem cells in a more user-friendly manner and with a lower cost.

[0041] Furthermore, it is possible to use, in combination, genes belonging to the same one of the 16 classification. For example by using, as the distinguishing marker, a combination of genes belonging to the classification relating to the transcription factor, it is possible to perform evaluation on protein synthesis specific to mesenchymal stem cells even at an early stage of the protein synthesis, or the like property. Moreover, by using a combination of genes belonging to the classification relating to the cell skeleton, it is possible to perform evaluation on protein production (such as production of keratins) etc. characteristic to mesenchymal stem cells, or the like property. Furthermore, by using a combination of genes belonging to the classification relating to growth factors, it is possible to perform evaluation on growth factor production etc. in the cells, or the like property. Moreover, by using a combination of genes belonging to the classification relating to extracellular matrix, it is possible to perform evaluation on adhesiveness of the cells, or the like property. Moreover, by using a combination of genes belonging to the classification relating to signal transduction, it is possible to perform evaluation on responsibility to extracellular stimulus, or the like property. Moreover, by using a combination of genes relating to the transportation, it is possible to evaluate a state of the intracellular transportation, or the like property.

[0042] As described above, the effects characteristic to the categories can be attained by using in combination the distinguishing markers classified in the categories respectively. Thus, such a combination of the distinguishing markers classified in the categories respectively is very useful and make it possible to distinguish mesenchymal stem cells more exactly and accurately.

[0043] Moreover, apart from the applications described above, it is possible to perform comprehensive analysis, which covers each characteristic of the classifications, by selecting at least one gene from each of 16 classifications (but may be not from the other classifications). In this case, it is sufficient for the distinguishing markers that they include at least one gene from each classification. Especially, the use of a maker with a high "Evaluation Level" described in Examples later, or the use of a greater number of markers will allow distinguishing or analyzing mesenchymal stem cells more exactly and accurately, thereby attaining a more reliable distinguishing method. Thus, the combination of the distinguishing markers is preferable to include the distinguishing markers having higher "Evaluation Levels", and to include as many the distinguishing markers as permitted.

[0044] Moreover, the detection of the difference in the expression levels of the distinguishing markers can be carried out by detecting the expression of the genes or the expression of he protein encoded by the genes. More specifically, the present invention can distinguish mesenchymal stem cells from the connective tissue cells by detecting the difference in the expression levels of the distinguishing marker genes as described above, which occurs between mesenchymal stem cells and the connective tissue cells. Thus, the present invention includes a distinguishing marker for mesenchymal stem cells, the distinguishing marker being one of the genes having the base sequences identified with the accession numbers listed in Tables 1a to 1j.

[0045] In the present invention, the detection of the expression of the gene groups acting as the distinguishing marker can be performed suitably by a conventionally known method that is applicable to detection of expression of known genes. For example, the detection of the gene groups of the distinguishing markers can be carried out by using a microarray, on which at least one of the followings (a) to (d) are immobilized, for distinguishing mesenchymal stem cells:

(a) at least one of genes having the base sequences identified with the accession numbers listed in Tables 1a to 1j;
(b) an antisense chain of at least one of genes having the base sequences identified with the accession numbers listed in Tables 1a to 1j;
(c) a partial base sequence of (a) or (b); and
(d) a polynucleotide that is capable of hybridizing, under stringent conditions, with a polynucleotide having the base sequence described in any one of (a) to (c).

The microarray may be any type of conventionally known microarray such as the DNA microarray of Affymetrix US, a Stanford type DNA microarray, a DNA microarray on which oligonucleotides are directly synthesized chemically on a silica substrate by using fabricating technique, which is used in the semiconductor production. The microarray in the present invention is not particularly limited in terms of its specific size, shape, system, etc.

With the microarray for distinguishing mesenchymal stem cells, it is possible to perform comprehensive and systematic analysis on the expression of the gene groups of many distinguishing markers, and thus it is possible to distinguish mesenchymal stem cells from the connective tissue cells very easily, exactly, and accurately. As such, the microarray for distinguishing mesenchymal stem cells is highly useful. The present invention, therefore, includes the microarray for distinguishing mesenchymal stem cells.

In other words, the method according to the present invention for distinguishing mesenchymal stem cells is preferably arranged such that plural distinguishing markers are used as indicators. Especially, it is preferable to use a combination of plural kinds of distinguishing markers whose expression in mesenchymal stem cells is sufficiently different from that in other cell groups and whose expression level is high. For example, appropriate combinations of CHI3L1, FLG, KRTAP1-5, RGS4, HNT, SLC14A1, IFI30, ZNF423, LXN, whose Fold Average and Expression level are high are preferable.

Moreover, apart from the microarray for distinguishing mesenchymal stem cells, it is possible to use, for example, the northern blotting technique in order to detect the expression of the gene groups of the distinguishing markers according to the present invention. Moreover, in order to detect and distinguish the expression of the gene of the distinguishing marker according to the present invention, a detection probe can be used, which detects a distinguishing marker gene having a base sequence that hybridizes, under stringent conditions, with the whole or part of the DNA sequence of the gene of the distinguishing marker according to the present invention.

It is possible to carry out the detection of the expression of the genes in the mesenchymal stem cells and the connective tissue cells by using the detection probe. For example, a DNA probe of an appropriate length is prepared from a DNA sequence of a gene of a well-known distinguishing marker and labeled with, for example, fluorescence. This DNA probe is hybridized with the analyte, thereby to carry out the detection of mesenchymal stem cells. The detection probe may be a probe for detecting a distinguishing marker gene constituted with the whole or part of an antisense chain of a base sequence of a gene of a well-known marker.

The "stringent conditions for the hybridization of the DNA sequence of the marker gene" with the base sequence of

the present invention for preparation of the DNA probe are, for example, to carry out the hybridization at 42°C followed by washing treatment at 42°C with a buffer solution containing 1 × SSC (0.15M NaCl, 0.015M sodium citrate) and 0.1% SDS (Sodium dodecyl sulfate), or more preferably to carry out the hybridization at 65°C followed by washing treatment at 65°C with a buffer solution containing 0.1 × SSC and 0.1% SDS (Sodium dodecyl sulfate). Other various factors than the temperature condition would influence the stringency of the hybridization. It is possible for a person skilled in the art to attain stringency equivalent to the exemplified stringency of the hybridization by combining the various factors.

The detection of the expression of the gene of the distinguishing marker in the analyte cells may be preceded by quantitative PCR or semi-quantitative PCR in order to amplify the genes of the analyte cells. The quantitative PCR or semi-quantitative PCR may be RT-PCR (reverse PCR). The quantitative PCR or semi-quantitative PCR is carried out with a pair of sense primer and antisense primer for amplifying the marker gene of the present invention.

Moreover, the method according to the present invention for distinguishing mesenchymal stem cells can be carried out easily by the Invader (Registered Trademark) technique. For example, the method according to the present invention for distinguishing mesenchymal stem cells can be carried out in the following manner: A signal probe, which is designed to have (i) a sequence that hybridizes specifically with the sequence of the distinguishing marker, and (ii) a site cleaved by an enzyme, is reacted with total RNA (or cDNA) extracted from the analyte cells, Invader (Registered Trademark) Oligo, Cleavase (Registered Trademark) Enzyme, and FRET Probe at a predetermined temperature and for a predetermined period (for example, at 63°C for 2 hours). The following literatures may be referred to for concrete experimental methods and conditions to carry out the method appropriately. Literatures: (i) T. J. Griffin et al., Proc Natl Acad Sci U S A 96, 6301-6 (1999), (ii) M. W. Kaiser et al., J Biol Chem 274, 21387-94 (1999), (iii) V. Lyamichev et al., Nat Biotechnol 17, 292-6 (1999), (iv) R. W. Kwiatkowski et al., Mol Diagn 4, 353-64 (1999), (v) J. G. Hall et al., Proc Natl Acad Sci U S A 97, 8272-7 (2000), (vi) M. Nagano et al., J Lipid Res 43, 1011-8 (2002), (vii) etc. The use of the invader technique would eliminate the need of gene amplification, and thus can be performed fast and at low costs. The use of a commercially-available invader kit makes it more easy to carry out the present invention.

Moreover, the method according to the present invention for distinguishing stem cells may be carried out by in situ hybridization. For example, molecular hybrid of the sample of the analyte cells on a slide glass may be directly formed by using the distinguishing marker or a material labeled with a part of the sequence thereof may be used as a probe. More specifically, a thin specimen (paraffin segment, frozen segment, etc.) of the analyte cell is prepared on a slide glass and hybridized with the labeled probe. Then, the specimen is exposed after the probe is washed away and a photographic emulsion is applied on the specimen in the same manner as in the northern hybridization technique. After development, the hybridized portion is identified from silver particle distribution. The following literatures may be referred to for concrete experimental methods and conditions to carry out the method appropriately. Literatures: (i) "in situ hybridization technique (July, 1995), edited by Toshiyuki FURUSHO and You IMURA, published by Kanehara & Co., Ltd., pages 932 to 937, and (ii) "Analysis of gene expression by in situ hybridization technique" "Gene Engineering Experiments (May, 1991), written by Shintaro NOMURA, published by Japan Radioisotope Association, pages 221 to 232., (iii) etc. There are two types of the *in situ* hybridization technique: one adopts auto radiography to detect a site at which a DNA probe labeled with a radio isotope (mainly 3H) is located, and the other adopts fluorescent microscopy to detect fluorescent signal from the labeled DNA probe. Either technique is applicable to the present invention.

In case where the detection of the expression of the gene of the distinguishing maker according to the present invention is carried out by detecting the protein encoded by the gene, distinguishing mesenchymal stem cells may be carried out by detecting the expression of the distinguishing marker protein in mesenchymal stem cells and connective tissue cells with an antibody prepared from the protein, which antibody binds with the protein specifically. Therefore, distinguishing marker for distinguishing mesenchymal stem cells is included, which is any one of polypeptides encoded by the genes having the base sequences identified with the accession numbers listed in Tables 1a to 1j. Moreover, an antibody is included, which is inducible with a polypeptide described in (e) or (f) and bindable specifically with the polypeptide:

(e) a polypeptide encoded by any one of the genes having the base sequences identified with the accession numbers listed in Tables 1a to 1j; and

(f) a partial polypeptide of the polypeptide described in (e).

The antibody may be a polyclonal antibody or a monoclonal antibody. For example, by any standard method conventionally known in the art, the antibody may be prepared against an antigen that is a whole or partial sequence of the polypeptide encoded by the gene of the distinguishing marker of the present invention.

[0046] For example, the monoclonal antibody may be prepared in any method. For example, the monoclonal antibody may be obtained from antibody-producing hybridoma prepared by fusing mouse splenetic lymphocytes and mouse-derived myelocytes, each of which are obtained from a mouse immune with the antigen. The hybridoma may be prepared

by any conventionally known method such as hybridoma technique (Kohler, G. and Milstein, C., Nature 256, 495-497 (1975)), trioma technique, human B-cell hybridoma technique (Monoclonal Antibodies and Cancer Therapy, Alan R Liss, Inc., 77-96(1985)).

[0047] The antigen is not particularly limited, provided that it is a polypeptide. The antigen may be an antigenic protein, which is formed by binding an antigen determinant substance with a carrier protein. More specifically, the antibody cannot be produced if the antigen is a hapten, which does not have an ability of inducing the antibody production etc. However, the antibody production can be induced by immunizing with antigenic protein prepared by covalent bonding the antigen with a carrier, which is a bio-macromolecule such as a heterogeneous protein. The carrier is not particularly limited and various proteins conventionally known in this field such as ovalbumin, γglobulin, hemocyanin, etc. may be the carrier. Moreover, the monoclonal antibody may be produced transgenically or by the like method.

[0048] Moreover, the preparation of the polyclonal antibody may be carried out by purifying an antibody component from a body fluid of an experimental animal inoculated and sensitized with the antibody. Moreover, the animal to be immunized may be a conventionally known experimental animal such as a mouse, rat, rabbit, monkey, hours, etc., and is not particularly limited. Moreover, the inoculation and sensitization with the antigen may be carried out with intervals or quantities which are adopted in a standard method known in this art.

[0049] Immunologic measuring methods for well-known antibodies may be adopted to detect the expression of the protein of the distinguishing marker in the analyte cells by using the antibody according to the present invention. Immunologic measuring methods may be a known immunologic measuring method such as RIA method, ELISA method, fluorescent antibody technique, etc. Moreover, besides the above methods, western blotting technique, enzyme immunoassay, observation of coagulation, precipitation, hemoclastic reaction caused by the antibody, morphological detecting methods such as tissue immunostaining, cell immunostaining may be adopted, if necessary.

[0050] In the present invention, the detection of the difference in the expression levels of one distinguishing marker may be performed to distinguish mesenchymal stem cells from the result thereof. In order to distinguish mesenchymal stem cells more exactly and more accurately, it is preferable that the differences of the expression levels of plural distinguishing markers be used as indicators. This is another reason why the use of the microarray for distinguishing mesenchymal stem cells is preferable in the case where the difference in the expression levels of one distinguishing marker is used as the indicator.

<2. Method of Distinguishing and Separating Mesenchymal Stem Cells>

[0051] The method according to the present invention for distinguishing and separating should include the step of separating mesenchymal stem cells identified by the method of distinguishing the mesenchymal stem cells as described in Item <I>, and is not particularly limited in terms of specific arrangements such as steps other than this step, conditions, materials to use, apparatuses to use, etc.

[0052] In the present invention, the separation of mesenchymal stem cells may be carried out by using a Fluorescence-Activated Cell Sorter (FACS), for example. More specifically, mesenchymal stem cells are labeled with the antibody according to the present invention by fluorescent antibody technique. Then, whether or not the polypeptide of the distinguishing marker of mesenchymal stem cells is expressed in the analyte cells is detected. Referring to the detection, mesenchymal stem cells are distinguished and separated. The labeling of undifferentiated mesenchymal stem cells by the fluorescent antibody technique can be done by direct fluorescent antibody technique, or indirect fluorescent antibody technique. In the direct fluorescent antibody technique, an antibody, which specifically binds with the polypeptide of the distinguishing marker according to the present invention, is labeled with fluorescent, and then binds with mesenchymal stem cells, in which the antigen is expressed, thereby to label mesenchymal stem cells. In the indirect fluorescent antibody technique, mesenchymal stem cells, in which the antibody is express, bind with an unlabelled specific antibody of the present invention. And then, a labeled secondary antibody (anti-immune globulin antibody) is bound thereto. The mesenchymal stem cells labeled in these manner can be examined and separated by flow cytometry. The separated sample may be collected via a filter and obverted via epifluorescent microscope for confirmation.

[0053] Moreover, apart from FACS, the separation can be done by a Magnetic Cell Sorting (MACS) system. MACS uses an antibody labeled with a magnetized microbeads instead of fluorescent labeling. The targeted cells are specifically labeled with the antibody labeled by the magnetized microbeads for MASC, and then applied to a separating column disposed to a strong permanent magneto. A strong magnetic field produced in the separating column holds the magnetically labeled cell in the separating column but lets the unlabeled cells pass through the separating column. The cells held in the separating column is eluted from the separating column by removing the separating column out of the strong magnetic field. Thereby, mesenchymal stem cells are separated.

[0054] Furthermore, the method of the present invention may include the step of concentrating the sample by using a membrane filter or condensation prior to the step of separating by FACS, MACS, or the like.

<3. Distinguishing/Separating Kit>

[0055] A kit according to the present invention for distinguishing/ separating mesenchymal stem cells should comprise any one of materials described respectively in (g) to (i), and is not particularly limited in terms of other materials, constituent components, etc.:

(g) the above-described microarray for distinguishing mesenchymal stem cells;
(h) the above-described antibody; and
(i) the probe for detecting whether the distinguishing marker gene for mesenchymal stem cells is expressed or not, the distinguishing marker gene comprising a polynuleotide, which, under strigent condition, hybridizes with a gene or a partial sequence thereof, the gene having a base sequence identified with the accession number listed in any one of Tables 1a to 1j.

[0056] The kit is for easily performing the method of distinguishing mesenchymal stem cells described in Item <1>, or the method of distinguishing/separating mesenchymal stem cells described in Item <2>. The kit can be easily commercialized by comprising any one of materials described respectively in (g) to (i).

[0057] Moreover, as described above, it is preferable for greater exactness and accuracy to perform the above methods with plural ones of the distinguishing markers listed in Tables 1a to 1j. Thus, it is preferable for the kit according to the present invention to comprising plural ones of the distinguishing markers. For example, as described in Item <I>, various combination of the genes may be selected and used as a distinguishing marker kit.

[0058] As described above, the combination of the distinguishing markers makes it possible to distinguish and separate mesenchymal stem cells more exactly and accurately compared with the single use of the distinguishing marker.

<4. Cell-containing compositions and Drugs of Regenerative medicine>

[0059] A cell-containing composition according to the present invention should comprise mesenchymal stem cells separated by the method of distinguishing and separating mesenchymal stem cell described in Item <2>, or mesenchymal stem cells thus obtained and then multiplied. The cell-containing composition according to the present invention is not particularly limited in terms of other arrangements such as compositional arrangement (buffer liquid, culture liquid, or the like), cell number, etc. Moreover, the cell-containing composition according to the present invention preferably contains a secreta (e.g., growth factor, or the like) secreted from cells contained in the cell-containing composition.

[0060] The cell-containing composition comprises undifferentiated mesenchymal stem cells capable of differentiating to bones, cartilages, fats, muscles, tendons/ligaments, nerves, etc. Thus, the cell-containing composition can be used as a drug (pharmaceutical composition) for regenerative medicine. That is, a drug according to the present invention for regenerative medicine is not limited particularly in terms of other specific arrangements, provided that it comprises the cell-containing composition. For example, the use of the drug may be such that the undifferentiated mesenchymal stem cells are differentiated to cells of a kind as suitable for the use, and then used. More specifically, this may be carried out in such a manner that the mesenchymal stem cells are differentiated to osteoblasts, chondrocytes and adipose cells, muscle cells, nerve cells, etc. by using a differentiation inducing material such as a cytokine or the like, and then the differentiated calls are administered to a patient to be treated with the regenerative medicine. Therefore, the present invention encompasses drugs for regenerative medicine containing a cell composition obtained by differentiation of the undifferentiated mesenchymal stem cells, apart from the drugs containing the undifferentiated mesenchymal stem cells.

[0061] Moreover, administration conditions of the drug for regenerative medicine in actual clinical applications may be determined as appropriate by animal experiments or the like performed as standard methods in this field. That is, the conditions suitable for prevention or therapeutic effects may be determined via animal experiments to study the administration conditions such as dosage, administration intervals, administration routes, etc. The drug for regenerative medicine can be utilized as a drug for "regenerative medicine by cell transplantation" which regenerates a tissue lost by a disease or impairment and resumes a function, which tissue cannot be regenerated by a conventional therapeutic method.

[0062] The drug for regenerative medicine is not limited to treatment of a particular disease, symptom, clinical profile, or the like, provided that the drug is used for the purpose of "regenerative medicine by cell transplantation". More specific examples of the drug for regenerative medicine include transplantation of marrow mesenchymal stem cells to a patient of lower limb ischemia (Buerger's disease), transplantation of marrow mesenchymal stem cells to a patient of a periodontal disease, transplantation of marrow mesenchymal stem cells to a patient of osteoarthritis, transportation of amniotic epithelium sheet to burn injured portion, transportation of amniotic stem cells to a patient of diabetes mellitus, and the other transplantation.

[0063] The drug for regenerative medicine may be used as a composition by mixed with a pharmaceutically allowable carrier. Examples of the carrier encompass sterilized water, physiological saline, buffers, plant oil, emulsifiers, suspending

agents, salts, stabilizers, preservatives, surfactants, release controllers, other proteins (BSA etc.), transfection reagents (encompassing lipofection reagents, liposome, and the like), and the like. Moreover, the following carriers are applicable in the present invention: extracellular matrixes such as glucose, lactose, gum Arabic, gelatin, mannitol, starch paste, magnecium trisilicate, talc, corn starch, keratin, colloid silica, potato starch, urea, hyaluronic acid, collagen, etc.; polylactose, calcium phosphate carrier, etc.

[0064] The drug may have any form. For example, the drug may have forms of solution (injection-type), microcapsule, tablet, and the like. The drug may be administered systematically or locally. The local administration is preferable if the systematic administration is side effective or is not so effective as the local administration.

[0065] Moreover, the drug may be administered to a patient in any way and the administration may be, for example, surgical, percutaneous, transbronchial, muscular, interperitoneal, intravenous, intra-articular, subdermal, medullary, intracerebroventricular, or oral. The drug may be systematically administered or locally. The local administration to lesion section is preferable if the systematic administration is side effective. Dosage and the way of administration may be varied depending on weight, age, and symptom of the patient, therapeutic purpose, and tissue mobility of the active constituents of the drug, and the other factors. A person skilled in the art can arbitrarily select the dosage and the way of administration.

[0066] The therapeutic treatment targets human basically, but may target pet animals (pets) apart from human. Examples of the pet animals encompass non-human mammals such as mice, rats, rabbits, cats, dogs, monkeys, horses, sheep, cows, etc. and other spinal animals.

[0067] Moreover, the drug according to the present invention is preferably arranged such that the mesenchymal stem cells or cells differentiated from the mesenchymal stem cells, which are contained therein, be derived from the individual targeted by the therapeutic treatment. However, for the sake of mass production and the other factors, the drug according to the present invention may be arranged such that the mesenchymal stem cells or cells differentiated from the mesenchymal stem cells, which are contained therein, be not derived from the individual targeted by the therapeutic treatment (that is, allogeneic cell). In this arrangement, the immune reaction should be inhibited by a standard method such as use of an immune reaction inhibitor or the like.

<5. Other Use>

[0068] It has not been understood which part of the body mesenchymal stem cells are present *in vivo* (e.g., in marrow). However, the use of the antibody according to the present invention makes it possible to study which part of the body the mesenchymal stem cells are present. Therefore, the technique of the present invention can be applied to development of new medicines or the like. More specifically, if it is understood how the mesenchymal stem cells move or migrate to the lesion section in vivo, it is possible to develop a medicine to contain an active constituent for promoting movement or migration of the mesenchymal stem cell to the lesion.

[0069] By using, solely or in combination, a method according to the present invention for distinguishing mesenchymal stem cells, a microarray according to the present invention for distinguishing mesenchymal stem cells, an antibody according to the present invention, and a kit according to the present invention for distinguishing/ separating mesenchymal stem cells, it is also possible to judge whether a mesenchymal stem cell-related disease has been developed or whether there is a possibility that such a mesenchymal stem cell-related disease will be developed. This judging method is applicable to both prevention and diagnosis of the diseases.

[0070] Applying the present invention to treating a sample separated from a living body is preferred to applying the present invention to treating a human body directly. The sample separated from the living body can be obtained from the human body by a standard method in this field. Examples of such a sample encompass cells (which encompass mesenchymal stem cells) obtained from marrow liquids, peripheral bloods, cord bloods, adipose tissues, periosteum, muscles, synovial membrane, oral cavity tissue. Especially, it is preferable that the biosample contain mesenchymal stem cells be obtained by any one of the methods disclosed in Patent Citations 1 to 3. It is preferable that the sample contain mesenchymal stem cells.

[0071] This judging method can be applied to judging whether an examined person has developed a disease or how much possibility of developing the disease in the future the examined person has, for example, by finding the gene expression profiles of the distinguishing marker of the mesenchymal stem cells in a healthy person and a patient of the disease in advance and comparing an expression profile of the mesenchymal stem cell in the examined person (patient) with the gene expression profiles of the healthy person and the patient of the disease to find which of the gene expression profiles of the healthy person and patient the expression profile of the examined person (patient) is similar. In this DESCRIPTION, the "healthy person" is a person who does not have the disease to be examined, and the "patient of the disease2 is a person who has the disease. The method according to the present invention for judging whether a disease has been developed or not, may use the method for distinguishing mesenchymal stem cells or the like in other manners than the above arrangement, and may be appropriately modified to use a standard method in this field as of filing of the present application.

[0072] The "disease related with mesenchymal stem cells" encompasses any diseases which are caused (that is, "regeneration impairment syndromes) caused in relation to the mesenchymal stem cells such as conventionally known abnormality in mesenchymal stem cells or in differentiation from mesenchymal stem cells. For example, the disease may be a disease targeted by "regenerative medicine by cell transplantation" to regenerate a tissue lost by a disease or impairment and thereby to regain the function, a disease caused by a quantitative reduction in mesenchymal stem cells (abnormality in the number of cells or the like abnormality) or by a qualitative degradation in mesenchymal stem cells (abnormality in the differentiation ability or the like abnormality), that is, by shortage of supply of mesenchymal stem cells, and the like disease. Specific examples of the disease encompass lower limb ischemia (Buerger's disease), periodontal disease, osteoarthritis, intractable skin disease, diabetes, osteoporosis, ischemic heart disease, liver disease, kidney disease, neurodegenerative (Alzheimer disease etc.), and the like.

[0073] Osteoarthritis is an example of the disease caused by the shortage of the supply of mesenchymal stem cells. It is deduced that osteoarthritis is caused by quantitative abnormality in mesenchymal stem cell in vivo (more specifically, reduction in the number of the mesenchymal stem cells) due to various factors such as aging, life style, etc. Thus, it is expected that the use of the distinguishing method according to the present invention or the like makes it possible to grasp the quantitative change in mesenchymal stem cell *in vivo* so as to judge whether a disease has been developed or not and so as to prevent the development of the disease. That is, the quantitative change in mesenchymal stem cells can be detected by using the distinguishing method according to the present invention, the distinguishing marker, or the like. Thus, it is expected that the use of this technique makes it possible to diagnose whether or not there is a possibility of developing a disease that is caused by the shortage of the supply of mesenchymal stem cells. More specifically, for example, a biosample is obtained from the examined person (patient) on a regular basis (at intervals of a few months to few years) to be examined on the quantitative change in mesenchymal stem cells in the biosample by using the distinguishing method of the present invention or the like. The result of the examination of the examined person is compared with the results of examinations in quantitative changes in the mesenchymal stem cells in a healthy person and a patient of osteoarthritis. The examinations of the healthy person and the patient of the disease are performed in advance and in the same manner as the examination of the examined person. The comparison allows exact and accurate diagnosis of whether the examined person has developed osteoarthritis, or has a possibility of developing osteoarthritis in the future.

[0074] Moreover, the present invention encompasses drugs for regenerative medicine for suppressing undifferentiating property of mesenchymal stem cells, the drugs comprising siRNA corresponding to the genes having the base sequences identified with the accession numbers listed in Tables 1a to 1j, or to the partial sequences thereof. They are drugs for reducing the undifferentiating property of the mesenchymal stem cell by using RNAi. In other words, the drugs are drugs for regenerative medicine for suppressing the undifferentiating property of mesenchymal stem cell by using RNAi/siRNA by using the genes having the base sequences identified with the accession numbers listed in Tables 1a to 1j, or to the partial sequences thereof.

[0075] With the drug for regenerative medicine, it is possible to suppress the undifferentiating property of mesenchymal stem cells certainly and efficiently. Thus, the drug for regenerative medicine is highly beneficial for the regenerative medicine.

[0076] The embodiments of the present invention are described in further detail via the following Examples. Needless to say, the present invention is not limited to these Examples. The invention being thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the following claims.

[Example]

[0077] In the present Examples, the following cells were examined in their gene expression profiles: three lines of human fibroblasts (hereinafter, may be referred to as "FB"), three lines of mesenchymal stem cells (hereinafter, may be referred to as "MSC"), three lines of osteoblasts (hereinafter, may be referred to as "OS"), three lines of chondrocytes (hereinafter, may be referred to as "CH"), three lines of adipose cells (hereinafter, may be referred to as "AD"). The osteoblasts, chondrocytes, and adipose cells were prepared by differentiation from the mesenchymal stem cells in vitro.

(0) Differentiation and Collection of Total RNA

[0078] Firstly, mesenchymal stem cells were differentiated to adipose cells, chondrocytes, or osteoblasts, and then total RNA was collected. More specifically, these differentiations were carried out as follows.

(0-1) Differentiation to Adipose Cells and Collection of RNA

[0079] Media having the following compositions were used as basal medium, adipose differentiation inducing medium, and adipose differentiation maintenance medium.

- Adipose Differentiation Inducing Medium
  Basal Medium: DMEM (Sigma: D5796, high glucose = 4500mg/L)
  Additives: 10% (V/V) FBS (Hyclone, Lot No.: ANC18139) Penicillin-Streptomycin (Sigma: P0781)
  The followings were added freshly (to add the quantities in two weeks).
  Insulin: 10 μg/mL (10 mg/mL acetic acid aqueous solution stock) (Wako: 090-03446)
  Dexamethason: 1μM (10mM EtOH stock) (Sigma: D4902)
  Indomethacin: 200μM (2000 mM DMSO stock) (Wako: 097-02471)
  3-isobutyl-1-methylxanthine: 500μM (1000mM DMSO stock) (Wako: 537-72353)

- Adipose Differentiation Maintenance Medium
  Basal Medium: DMEM (Sigma:#D-5796, high glucose=4500mg/L)
  Addition: 10% (V/V) FBS (Hyclone, Lot No.: ANC 18139)
  Penicillin-Streptomycin (Sigma: P0781)
  The following was added freshly (to add the quantities in two weeks).
  Insulin: 10 μg/mL (10 mg/mL acetic acid aqueous solution stock) (Wako: 090-03446)

[0080] After two weeks were past, L-glutamine: 2mM (200mM PBS stock) (Sigma: G3126) was added to the medium. After that, the addition thereof was repeated every two weeks.

[0081] After MSC became confluent, the MSC was cultured for 11 days in total by repeating 2-day incubation in the adipose differentiation inducing medium and three-day incubation in the adipose differentiation maintenance medium via medium replacement. Then, total RNA was collected. The medium replacement is carried out by dropping a new medium gently to a surface of 10% residue of an old medium. All the additives were freshly added when the media were replaced.

[0082] The RNA extraction after the adipose differentiation was carried out in the following manner. Firstly, the cells were prepared via 11-day adipose differentiation (in ϕ 100mm dish). Next, the medium was removed by suction, and the cells were washed with PBS twice. Then, the cell was homogenized with TRIzol (Registered Trademark) (4000 μL/ϕ 100mm dish) by using a 21G needle and 1ml syringe. After that, chloroform was added thereto in a 1/4 quantity thereof, the culture was stirred by Vortex, and then stood still for 20 minutes at room temperatures. Next, the culture was centrifuged at 14000 rpm for 20 minutes at room temperatures (Tomy, MCX-150). Then, a supernatant thereof was transferred into Eppendorf tube, in which 70% EtOH (prepared with RNas free water) of a quantity equivalent to the supernatant was added thereafter. Then, 700μl of a sample thus prepared was applied into a RNesay (registered trademark) Mini column, and vacuum was applied to the column (Qiagen, QIAvac 24). This was repeated until the whole sample was consumed (2 column/one ϕ 100mm dish). The above process was carried out according to the Manual attached to the RNeasy kit. Finally, RNA purification was carried out with a kit (#1906) produced by Ambion.

(0-2) Differentiation to chondrocyte and Collection of RNA

[0083] The chondrocyte differentiation inducing medium had the following composition.

- Chondrocyte Differentiation Inducing Medium
  αMEM (Sigma:#4526)
  Penicillin Streptomycin: (Sigma: #P0781)
  L-glutamine: 2mM (stock sol 200 mM PBS) (Sigma: #G3126)
  Dexamethason: 10^{-7} M (stock sol 1 M EtOH) (Sigma: #D-1756)
  Ascorbate 2-phosphate: 50μg/ml (stock sol 50 mg/ml MQ) (Sigma: #A-8960)
  D-(+)-glucose: 4.5 g/l (stock sol 450 g/l) (Sigma: #G-8769)
  Pyruvate: 100μg/ml (stock sol 100 mg/ml MQ) (Sigma: #28-4020-2)
  ITS-plus: 1 %% (V/V) (insulin 6.25 μg/ml, transferring 6.25 μg/ml, selenous acid 6.25 μg/ml, linoleic acid 5.33 μg/ml, bovine serum albumim 1.25 mg/ml) (BD: #354352)
  TGF-β3: 10 ng/ml (stock sol 10 μg/ml HCl 4 mM, HSA or BSA 1mg/ml) (Pepro Tec ECL Ltd #100-36)

[0084] The chondrocyte differentiation inducing medium of the quantity was added in two weeks. Moreover, TGF-β3 was not added initially: it was added freshly at medium replacement.

[0085] Culturing in the chondrocyte differentiation was carried out by pellet incubation technique. More specifically, the culturing was carried out with the inoculation in a density of 2.5×10^5 cells/tube, and an initial quantity of the chondrocyte differentiation medium of 0.5ml per tube. After the inoculation, the medium was centrifuged (500g $\times$ 5min). Then, from Day 0 on which the cells were inoculated, the medium was incubated for 28 days via medium replacement performed every 3 days. The first medium replacement reduced the quantity to 1ml per tube.

[0086] RNA extraction was carried out in the following manner. Firstly, the cells were prepared via 28-day chondrocyte differentiation (6 pellets or more). Then, the medium was removed by suction, and then 0.4ml of PBS was added in the pellets, and then sucked. After 0.2ml of TRIzol (Registered Trademark) (Invitrogen: 15596-018) was added to each tube, grinding extraction was performed with pellet pestle and silica powder. Then, it was further added in a quantity of 0.8ml/tube, and the extracted was transferred to tubes. Then, the extracted was treated with chloroform and ethanol. After that, it was treated with RNeasy kit. Thereafter, the process of the extraction was identical with that of the adipose differentiation.

(0-3) Differentiation to Osteoblast and Collection of RNA

[0087] The osteoblast differentiation inducing medium had the following composition.

- Basal Medium

  · DMEM (Sigma D6046)
  · FBS (Hyclone) (Bovine Fetal serum) of 10% Final Concentration
  · Antibiotic: penicillin- streptmycin (Sigma:P0781)

- Osteoblast Differentiation Inducing Medium

  · DMEM (Sigma D6046 containing glucose 1000mg/L)
  · FBS (Hyclone) of 10% Final Concentration · Dexamethason (Sigma D-1756) of 10^{-7}M Final Concentration
  · β-glycerophosphate (Tokyo Chemical Industry Co., Ltd. G-0195) of 1 0 mM Final Concentration
  · Ascorbate 2-phosphate (Sigma: A-8960) of 50μg/ml Final Concentration added every two weeks
  · L-glutamine of 2mM Final Concentration added every two weeks
  · Antibiotic: penicillin- streptmycin (Sigma:P0781)

[0088] As a referential literature, referred to was "Osteogenic differentiation of purified culture-expanded human, mesenchymal stem cell in vitro." Jaiswal N. J. et al., Cell Biochem. 64, 295-312, 1997.

[0089] Firstly, a surface of a culture plate was soaked with 0.01% Collagen type 1 solution (functional peptide IFP9660) overnight. After the solution was removed therefrom, the plate was washed with PBS (phosphate buffered saline) twice. Next, the cells were inoculated on the basal medium for mesenchymal stem cells (10000 cell/cm^2). After the cells were incubated to be confluent (in 2 to 3 days after the inoculation), the medium was replaced with the osteoblast differentiation inducing medium (Day 0). After 28-day incubation from Day 0 replacing the osteoblast differentiation inducing medium every 3 days, total RNA was collected. The collection of total RNA was carried out in the same manner as in the adipose cells.

[0090] An outline of the flow of the experiment after the collection of total RNA is illustrated in Fig. 1.

(1) cDNA/cRNA Synthesis

[0091] Firstly, double stranded cDNA was synthesized from the sample RNA using T7 oligo dT primer. Next, cRNA was synthesized from the double stranded cDNA by in vitro Transcription reaction. In the synthesis of cRNA, the sample was labeled by incorporating biotin-labeled ribonucleotide therein.

(2) Hybridization

[0092] Next, the biotin-labeled cRNA was fragmented and hybridized with GeneChip (Registered Trademark: Affymetrix) probe array.

(3) Fluorescent Labeling

[0093] After the array hybridized overnight was washed, streptoavidin - phycoerythrin was added therein thereby labeling the sample with fluorescent.

(4) Scanning/Data Analysis

[0094] Finally, the fluorescent-labeled array was scanned to capture a non-photographic image, which was then analyzed by special analysis software so as to perform signal digitalization and expression analysis.

[0095] The steps (1) to (4) were done by analysis service provided from KURABO, using the DNA microarray "GeneChip (registered trademark)" produced by Affymetrix. See the homepage of KURABO at the following address: http: //www.bio.kurabo.co.jp/idensi/genechip/genechiptop.htm The analysis service performs the analysis of a provided sample RNA with GeneChip (registered trademark). Because a person skilled in the art can understand the steps (2) to (4) by referring to the URL and KURABO's analysis service, the explanations on the steps (2) to (4) are omitted here.

[0096] In the present Example, the GeneChip (registered trademark) was Human Genome U 133 Plus 2.0 Arrays (HG-U 133 Plus 2.0). Moreover, the GeneChip analysis conditions of the analysis service in the present Example were as follows.

[0097] Biotin-labeled target was prepared initially with 2μg of total RNA. Its analysis protocol is described in One-cycle Target Labeling, GeneChip Expression Analysis Technial Manual, 701021 Rev.5, Section 2 Eukaryotic Sample and Array Processing, Chapter 1 Eukaryotic Target Preparation.

[0098] Analysis protocol of the hybridization/ scanning is described in GeneChip Expression Analysis Technial Manual, 701021 Rev.5, Section 2 Eukaryotic Sample and Array Processing, Chapter 2 Eukaryotic Target Hybridization. A hybridization oven used herein was Hybridization Oven 640 110V (Affymetrix 800138). A washing/staining apparatus used herein was Fluidies Station 450 (Affymetrix 00-0079). A scanner used herein was GeneChip Scanner 3000 (Affymetrix 00-0074). Software used herein was GeneChip Operating Software ver 1.1 (Affymetrix 690036).

[0099] Analysis protocol of analysis and digitalization of the scanned image is described in GeneChip Expression Analysis Technial Manual, 701021 Rev.5, Section 2 Eukaryotic Sample and Array Processing, Chapter 3 Washing, Staining, and Scanning. Software used herein was GeneChip Operating Software ver1.1. Algorism used herein was Statistical. Analysis parameters at creating a CIIP file were Scaling Factor; 1, Target Value; 500, Detection Call; Alpha1=0.05, Alpha2=0.065, and Tau=0.015.

[0100] The data of analysis and digitalization of the scanned image was obtained by the scanning/data analysis of (4) and processed by "GeneSpring" (Product Name, Trademark) so as to prepare a gene list or the like. See http://www.silicongenetics.com/cgi/SiG.cgi/Products/GeneSpri ng/index.smf) for "GeneSpring", which is gene analysis software produced by Silicon Genetics. The software "GeneSpring" was used according to the manual attached therewith.

[0101] That is, gene expression profiles of various genes related to 54675 human genes (probes) were analyzed in the present Example. More specifically, RNAs were collected from cells of 15 lines and analyzed with the DNA microarray in terms of the expression levels for 54675 human genes (probes). The 15 lines were 3 lines of mesenchymal stem cells (MSC) having the ability of differentiating to various cells, 3 lines of the cells (OS) obtained from the bone differentiation of MSC, 3 lines of the cells (CH) obtained from the cartilage differentiation, 2 lines of the cells (AD) obtained from the adipose differentiation, and 3 lines of fibroblasts (FB) derived from skin and gingiva, which fibroblasts did not have the ability of differentiating to various cells.

[0102] The analysis results are illustrated in Fig. 2. Each curves represents one gene (probe) in Fig. 2 (that is, there are 54675 curves in Fig. 2) where the vertical axis represents the gene expression intensities and the horizontal axis represents cells, which are, from the left, AD (3 lines) obtained from the adipose differentiation, CH (3 lines) obtained from obtained from the cartilage differentiation, FB (3 lines) of skin and gingiva, stem cells MSC (3 lines), and OS (3 lines) from bone differentiation. It should be noted that the same kind of cells such as the left most 2 lines of AD obtained from adipose differentiation tend to show the same expression level, and thus tend to be plotted in parallel with each other.

[0103] Moreover, when Fig. 2 is shown in color, the curves are colored according to the expression in such a way that red represents genes expressed at high levels in MSC, blue represents genes expressed at low levels in MSC, and yellow represents genes expressed at medium levels in MSC. When Fig. 2 is shown in black and white, this information is not given.

[0104] The genes in red in 3 lines of MSC in the middle but on the right side of Fig. 2 but show low expression intensities in other cell types are applicable as undifferentiating markers specific to MSC. That is, genes having such expression profiles that "the expression level is high in MSC but low in the other cells" were selected and identified as the undifferentiating markers specific to MSC, the markers being capable of differentiating mesenchymal stem cells from bone, cartilage, adipose, and fibroblast. The selection of the distinguishing markers specific to MSC was carried out as follows.

[0105] Firstly, before the selection of the distinguishing markers specific to MSC, preprocess was carried out referring to flag information obtained from the analysis result of GeneChip (registered trademark). More specifically, genes indicated with flag information indicating expression of gene, that is, flag information "present call" or "margenal call" were selected. This was done because a gene with a low expression level in MSC would not allow to be detected exactly and accurately even if the expression thereof was different from that of the other genes.

[0106] Then, from among the genes satisfying the preprocess conditions, the distinguishing markers specific to MSC were selected. More specifically, this experiment examined and compared the expressions of various genes in the 5

types of cells: MSC, OS (obtained from the bone differentiation from MSC), CH (obtained from the cartilage differentiation from MSC), AD (obtained from the adipose differentiation from MSC), and FB. In this way, five relative expression intensities in the 5 types of cells were obtained per gene. One of the criterions for the selection was whether a difference between the expression level in MSC and a lowest one of the expression levels of the four cells other than MSC was 2 or more.

[0107] In other words, the one of the criterions selected genes whose expression level in MSC was double or greater than that in AD, that in CH, that in FB, and that in OS. This is because the difference being at least double makes it possible to distinguish MSC from other cells exactly and accurately. That is, a gene whose expression level in MSC is double or greater than those in the other cells can be used as the marker practically.

[0108] The thus calculated difference between the expression in MSC and those in the other cells can be an indicator to concretely express how intensely the expression of a gene is expressed in MSC than in the other cells. Thus, "the difference of 2 or greater" was set as one of the criterion for the selection. That is, one purpose of the present invention is to find a distinguishing marker for selecting undifferentiated mesenchymal stem cells specifically. Thus, the marker should be expressed at a remarkably greater expression level in mesenchymal stem cells than in the other cells. Because of this, the criterion for the selection was set as such.

[0109] Another criterion was "the expression level of the gene in MSC is high". This is because a small absolute value of the expression level in mesenchymal stem cells would make it difficult to detect the gene exactly and accurately or would lead to large errors. That is, it was considered that the candidates of the distinguishing markers should have a large absolute expression level. Thus, the another criterion was set, which is "the gene has an expression level of 0.5 or greater in MSC".

[0110] One hundred thirty nine genes, which satisfied the criterions, were selected as the distinguishing markers of undifferentiated MSC. Tables 3a to 3e show the 139 distinguishing markers and the evaluation thereof on the criterions in the selection.

[Table 3a]

Classification 1	Gene symbol	Genbank number	Fold Average	Expression level
ATP/GTP binding -1	BRIP1	NM_032043	4.7	0.2
ATP/GTP binding -2	PASK	NM_015148	9.4	0.3
ATP/GTP binding -3	RAC2	NM_002872	13.6	1.0
ATP/GTP binding -4	KIF18A	NM_031217	4.8	0.4
ATP/GTP binding -5	NEK7	NM_133494	2.9	34.2
ATP/GTP binding -6	ARL4C	NM_005737	3.7	8.6
ATP/GTP binding -7	EDEM1	NM_014674	2.6	1.9
ATP/GTP binding -8	CAMK2D	NM_172127	2.7	4.2
Classification 2	Gene symbol	Genbank number	Fold Average	Expression level
binding -1	PDE5A	NM_001083	7.0	0.8
binding -2	RGS4	NM_005613	25.8	9.7
binding -3	EGFL3	NM_001409	7.1	0.7
binding -4	FHL2	NM_001450	4.4	41.6
binding -5	HRB2	NM_007043	4.4	7.6
binding -6	CAPZA1	NM_006135	2.3	30.9
binding -7	PAPPA2	NM_020318	4.8	0.3
binding -8	LOXL2	NM_002318	10.8	4.0
binding -9	LOX	NM_002317	4.7	9.7
binding -10	ADAMTS5	NM_007038	3.4	5.6

(continued)

Classification 2	Gene symbol	Genbank number	Fold Average	Expression level
Classification 3	Gene symbol	Genbank number	Fold Average	Expression level
cell growth and/or maintenance-1	CCND1	NM_053056	6.1	19.2
cell growth and/or maintenance-2	CDC25A	NM_001789	4.7	0.1
cell growth and/or maintenance-3	IER3	NM_052815	6.8	8.5
cell growth and/or maintenance-4	BCL2	NM_000633	5.0	0.3
cell growth and/or maintenance-5	NALP1	NM_033004	6.3	5.6
cell growth and/or maintenance-6	PAK3	NM_002578	12.8	0.3
cell growth and/or maintenance-7	PODXL	NM_001018111	6.8	0.7
cell growth and/or maintenance-8	CCL26	NM_006072	7.7	0.4
cell growth and/or maintenance-9	FBLN1	NM_006486	0.4	4.2
cell growth and/or maintenance-10	LAMA1	NM_005559	4.5	0.8
cell growth and/or maintenance-11	NTNG1	NM_014917	5.0	0.1

[Table 3b]

Classification 4	Gene symbol	Genbank number	Fold Average	Expression level
cytokine -1	GDF15	NM_004864	4.4	3.0
cytokine -2	IL6	NM_000600	14.9	3.9
cytokine -3	CTGF	NM_001901	5.6	60.6
cytokine -4	VEGF	NM_001025366	4.5	24.4
cytokine -5	VEGFC	NM_005429	4.1	9.8
cytokine -6	HGF	NM_000601	6.5	0.7
Classification 5	Gene symbol	Genbank number	Fold Average	Expression level
cytoskeleton-1	KRT19	NM_002276	130.0	1.7
cytoskeleton-2	KRTAP1-5	NM_031957	29.8	14.5
cytoskeleton-3	KRTAP2-1	BC012486	9.5	1.8
cytoskeleton-4	KRTHA4	NM_021013	20.8	1.1
cytoskeleton-5	CKAP2	NM_018204	4.8	0.1
cytoskeleton-6	KRTAP1-1	NM_030967	38.1	2.5
cytoskeleton-7	KRT18	NM_000224	30.2	2.1
cytoskeleton-8	KAP2.1B	AJ406929	18.7	0.3
cytoskeleton-9	SSH1	NM_018984	3.0	6.7
Classification 6	Gene symbol	Genbank number	Fold Average	Expression level
enzyme-1	LXN	NM_020169	10.1	7.6
enzyme-2	IFI30	NM_006332	11.0	5.5
enzyme-3	CPA4	NM_016352	8.1	1.0
Classification 7	Gene symbol	Genbank number	Fold Average	Expression level
extracellular matrix-1	CHI3L1	NM_001276	158.5	25.7
extracellular matrix-2	KRT23	NM_015515	4.0	0.1
extracellular matrix-3	FLG	NM_002016	284.4	8.8
extracellular matrix-4	ADAMTS1	NM_006988	7.2	6.9
extracellular matrix-5	FRMD5	NM_001031729	23.8	2.1

[Table 3c]

Classification 8	Gene symbol	Genbank number	Fold Average	Expression level
growth factor or receptor-1	IGFBP1	NM_000596	5.8	0.3
growth factor or receptor-2	CFI	NM_000204	28.7	1.7
growth factor or receptor-3	ESM1	NM_007036	11.4	0.7
growth factor or receptor-4	F2RL1	NM_005242	4.1	0.4
growth factor or receptor-5	MET	NM_000245	7.3	1.1
growth factor or receptor-6	HTR7	NM_000872	3.7	0.2

(continued)

Classification 8	Gene symbol	Genbank number	Fold Average	Expression level
growth factor or receptor-7	IGFBP3	NM_001013398	3.4	90.7
Classification 9	Gene symbol	Genbank number	Fold Average	Expression level
membrane -1	ABHD2	NM_007011	4.5	2.1
membrane -2	ITGA2	NM_002203	7.7	2.2
membrane -3	LAMA3	NM_198129	6.6	1.3
membrane -4	NETO2	NM_018092	7.9	4.9
membrane -5	NTN4	NM_021229	5.5	6.5
membrane -6	PTGER1	NM_000955	5.2	0.5
membrane -7	EPHB2	NM_017449	12.4	0.4
membrane -8	SFRP1	NM_003012	0.4	0.6
membrane -9	CD33L3	NM_213602	11.9	1.3
membrane -10	GLIPR1	NM_006851	4.8	6.8
membrane -11	UGCG	NM_003358	4.2	14.2
membrane -12	ADORA1	NM_000674	3.5	0.5

[Table 3d]

Classification 10	Gene symbol	Genbank number	Fold Average	Expression level
membrane binding protein-1	ANXA10	NM_007193	24.5	1.2
membrane binding protein-2	RARRES1	NM_206963	7.2	0.5
membrane binding protein-3	HNT	NM_016522	13.1	16.0
membrane binding protein-4	CNTNAP3	NM_033655	22.3	1.2
Classification 11	Gene symbol	Genbank number	Fold Average	Expression level
protein binding -1	SYT1	NM_005639	6.5	0.1
protein binding -2	MLF1	NM_022443	4.6	0.1
protein binding -3	CDCP1	NM_022842	17.4	0.9
protein binding -4	KIAA0746	NM_015187	6.1	4.2
protein binding -5	PSCDBP	NM_004288	4.1	0.2
protein binding -6	SKI	NM_003036	3.0	2.8
protein binding -7	SNX25	NM_031953	2.9	3.1
protein binding -8	CDH6	NM_004932	4.5	0.7
protein binding -9	DCBLD2	NM_080927	10.4	3.9
protein binding -10	ENG	NM_000118	3.2	8.7
Classification 12	Gene symbol	Genbank number	Fold Average	Expression level
protein modification-1	SH3RF1	NM_020870	3.4	4.9

(continued)

Classification 12	Gene symbol	Genbank number	Fold Average	Expression level
protein modification-2	SMURF2	NM_022739	5.0	19.7
protein modification-3	TFPI2	NM_006528	5.8	11.5
protein modification-4	ITGB3	NM_000212	8.1	0.3
protein modification-5	MYPN	NM_032578	4.8	0.3
protein modification-6	LRP2BP	NM_018409	5.6	4.8
protein modification-7	HECW2	NM_020760	5.2	3.1
protein modification-8	PKIA	NM_006823	4.3	0.5
Classification 13	Gene symbol	Genbank number	Fold Average	Expression level
signal molecule-1	LYPD1	NM_144586	29.6	0.9
signal molecule-2	GATA6	NM_005257	27.8	3.2
signal molecule-3	RAB27B	NM_004163	10.1	0.8
signal molecule-4	SOX11	NM_003108	23.6	0.2
signal molecule-5	ARHGAP22	NM_021226	9.1	3.3

[Table 3e]

Classification 14	Gene symbol	Genbank number	Fold Average	Expression level
transcription-1	ETV1	NM_004956	6.9	3.6
transcription-2	ETV5	NM_004454	3.4	2.1
transcription-3	FOXP1	NM_032682	3.5	8.6
transcription-4	HMGA2	NM_003483	6.2	4.4
transcription-5	KLF12	NM_007249	5.2	0.4
transcription-6	PRDM16	NM_022114	8.1	0.7
transcription-7	SIM2	NM_009586	3.8	0.4
transcription-8	SUHW2	NM_080764	4.6	0.1
transcription-9	ENO1	NM_001428	3.7	0.3
transcription-10	MITF	NM_198159	0.7	0.6
transcription-11	TCF3	NM_003200	3.2	0.2
transcription-12	SMYD3	NM_022743	3.0	7.5
Classification 15	Gene symbol	Genbank number	Fold Average	Expression level
transport-1	ATP6V1G3	NM_133262	3.9	0.3
transport-2	KCTD16	NM_020768	5.8	0.4
transport-3	NUPL1	NM_014089	4.0	0.9
transport-4	SLC14A1	NM_015865	22.3	6.5
transport-5	SLC16A4	NM_004696	5.6	5.1

(continued)

Classification 15	Gene symbol	Genbank number	Fold Average	Expression level
transport-6	SLC4A4	NM_003759	6.6	0.4
transport-7	SLC9A7	NM_032591	7.3	0.6
transport-8	TRPC4	NM_016179	27.0	0.3
transport-9	MCFD2	NM_139279	3.7	10.0
transport-10	SLC26A4	NM_000441	4.1	0.3
transport-11	MCOLN3	NM_018298	3.1	0.6
transport-12	SLC25A37	NM_016612	2.2	4.2
transport-13	SLC30A7	NM_133496	2.7	3.5
Classification 16	Gene symbol	Genbank number	Fold Average	Expression level
others -1	FLJ38725	NM_153218	7.7	1.8
others -2	KIAA1913	NM_052913	7.2	20.2
others -3	PHLDB2	NM_145753	4.3	0.7
others -4	PLCXD2	NM_153268	7.2	0.3
others -5	SAMD3	NM_001017373	5.3	0.6
others -6	ZNF423	NM_015069	10.9	7.1
others -7	FLJ33996	NM_175894.2	13.6	0.2
others -8	PLEKHK1	NM_145307	5.0	0.1
others -9	PTOV1	NM_017432	3.2	0.0
others -10	FAM40B	NM_020704	5.4	0.4
others -11	ABI3BP	NM_015429	4.7	21.0
others -12	NHS	NM_198270	4.4	0.4
others -13	DTL	NM_016448	4.1	0.8
others -14	C1GALT1	NM_020156	3.8	2.9
others -15	CPNE8	NM_153634	3.1	1.0
others -16	TMEM49	NM_030938	1.2	10.1

[0111] In Tables 3a to 3e, the "Classification", "Gene symbol", "Genbank number" are same as in Tables 1a to 1j. The "Fold Average" indicates how high the expression of the gene was in comparison with the other cells. That is, the "Fold Average" is one of the criterions. In the present invention, a gene having "Fold Average" of 2 or more was judged as being preferable.

[0112] Moreover, the "Expression level" indicates how high the expression level was in MSC. This "Expression level" is one of the criterions. In the present invention, a gene having "Expression level" of 0.5 or more was judged as being preferable.

[0113] The "Fold Average" was calculated as follows. In the present Example, the relative expression levels in the 5 kinds of cells were obtained per gene. The expression level in MSC was compared with the other 4 expression levels. The "Fold Change" was a division of the expression level in MSC over another expression level. An average of the Fold changes of the cells was the "Fold Average". For example, if the expression level in MSC is 4.2, the expression level is OS is 0.3, the expression level in CH is 0.4, the expression level in AD is 1.5, and the expression level in FB is 1.3, then the "Fold Change" is MSC/OS = 14.0. The fold changes of each cells were obtained in the same manner and the average of the fold changes was calculated as "Fold Average".

[0114] The 139 genes listed in Tables 3a to 3d, which met the criterions, can be used as the distinguishing marker of the present invention. Those one of the genes which met the two criterions are especially preferable.

[0115] Therefore, the expression of each of these genes in MSC is different from the expression thereof in the other connective tissue cells (FB, OS, CH, AD). That is, the genes are expressed specifically only in MSC but so weekly in the other connective tissue cells that the other connective tissue cells can be distinguished from MSC. Thus, the use of the gene expression as the distinguishing marker makes it possible to distinguish MSC solely and specifically.

INDUSTRIAL APPLICABILITY

[0116] As described above, undifferentiated mesenchymal stem cells can be differentiated to bone, cartilages, fats, muscles, tendons/ligaments, nerves, etc. Undifferentiated mesenchymal stem are expected as transplantation cells for remedying impairment of these tissues in regenerative medicine. To be applied to regenerative medicine, it is necessary to exactly, accurately and easily check that the cells are mesenchymal stem cells and that the mesenchymal stem cells are pluripotential. The present invention is a technical solution to this technical problem, and thus can make a great contribution to practical application of the regenerative medicine. The present invention is not only academically remarkable but also applicable to a wide range of industries including health industries, pharmaceutical industries, and the like.

Claims

1. A method of distinguishing mesenchymal stem cells, comprising:

distinguishing the mesenchymal stem cells from connective tissue cells by detecting a difference between expression in the mesenchymal stem cells and expression in the connective tissue cells by using a distinguishing marker(s),
the distinguishing marker(s) being at least one of genes having the base sequences identified with accession numbers listed in Table 1a to 1j.

[Table 1a]

Classification 1	Gene symbol	Gene title	Genbank number
ATP/GTP binding-1	BRIP1	BRCA1 interacting protein C-terminal helicase 1	NM_032043
ATP/GTP binding -2	PASK	PAS domain containing serine/threonine kinase	NM_015148
ATP/GTP binding -3	RAC2	ras-related C3 botulinum toxin substrate 2 (rho family, small GTP binding protein Rac2)	NM_002872
ATP/GTP binding -4	KIF18A	kinesin family member 18A	NM_031217
ATP/GTP binding -5	NEK7	NIMA (never in mitosis gene a)-related kinase 7	NM_133494
ATP/GTP binding -6	ARL4C	ADP-ribosylation factor-like 4C	NM_005737
ATP/GTP binding -7	EDEM1	ER degradation enhancer, mannosidase alpha-like 1	NM_014674
ATP/GTP binding -8	CAMK2D	calcium/calmodulin-dependent protein kinase (CaM kinase) II delta	NM_172127
Classification 2	Gene symbol	Gene title	Genbank number
binding -1	PDE5A	phosphodiesterase 5A, cGMP-specific	NM_001083
binding -2	RGS4	regulator of G-protein signalling 4	NM_005613
binding -3	EGFL3	EGF-like-domain, multiple 3	NM_001409
binding -4	FHL2	four and a half LIM domains	NM_001450
binding -5	HRB2	HIV-1 rev binding protein 2	NM 007043
binding -6	CAPZA1	capping protein (actin filament) muscle Z-line, alpha 1	NM_006135
binding -7	PAPPA2	pappalysin 2	NM_020318
binding -8	LOXL2	lysyl oxidase-like 2	NM_002318
binding -9	LOX	lysyl oxidase	NM_002317

(continued)

Classification 2	Gene symbol	Gene title	Genbank number
binding -10	ADAMTS5	ADAM metallopeptidase with thrombospondin type 1 motif, 5 (aggrecanase-2)	NM_007038

[Table 1b]

Classification 3	Gene symbol	Gene title	Genbank number
cell growth and/or maintenance-1	CCND1	cyclin D1 (PRAD1: parathyroid adenomatosis 1)	NM_053056
cell growth and/or maintenance-2	CDC25A	cell division cycle 25A	NM_001789
cell growth and/or maintenance-3	IER3	immediate early response 3	NM_052815
cell growth and/or maintenance-4	BCL2	B-cell CLL/lymphoma 2	NM_000633
cell growth and/or maintenance-5	NALP1	NACHT, leucine rich repeat and PYD containing 1	NM_033004
cell growth and/or maintenance-6	PAK3	p21 (CDKN1A)-activated kinase 3	NM_002578
cell growth and/or maintenance-7	PODXL	podocalyxin-like	NM_001018 111
cell growth and/or maintenance-8	CCL26	chemokine (C-C motif) ligand 26	NM_006072
cell growth and/or maintenance-9	FBLN1	fibulin 1	NM_006486
cell growth and/or maintenance-10	LAMA1	laminin, alpha 1	NM_005559
cell growth and/or maintenance-11	NTNG1	netrin G1	NM_014917

[Table 1c]

Classification 4	Gene symbol	Gene title	Genbank number
cytokine -1	GDF15	growth differentiation factor 15	NM_004864
cytokine -2	IL6	interleukin 6 (interferon, beta 2)	NM_000600
cytokine -3	CTGF	connective tissue growth factor	NM_001901
cytokine -4	VEGF	vascular endothelial growth factor	NM_001025 366
cytokine -5	VEGFC	vascular endothelial growth factor C	NM_005429
cytokine -6	HGF	hepatocyte growth factor (hepapoietin A; scatter	NM_000601
Classification 5	Gene symbol	Gene title	Genbank number
cytoskeleton-1	KRT19	keratin 19	NM_002276
cytoskeleton-2	KRTAP1-5	keratin associated protein 1-	NM_031957
cytoskeleton-3	KRTAP2-1	keratin associated protein 2-	BC012486
cytoskeleton-4	KRTHA4	keratin, hair, acidic, 4	NM_021013
cytoskeleton-5	CKAP2	cytoskeleton associated protein 2	NM_018204
cytoskeleton-6	KRTAP1-1	keratin associated protein 1-	NM_030967
cytoskeleton-7	KRT18	keratin 18	NM_000224
cytoskeleton-8	KAP2.1B	keratin associated protein 2.1B	AJ406929
cytoskeleton-9	SSH1	slingshot homolog 1 (Drosophila)	NM_018984

(continued)

Classification 5	Gene symbol	Gene title	Genbank number
Classification 6	Gene symbol	Gene title	Genbank number
enzyme-1	LXN	latexin	NM_020169
enzyme-2	IFI30	interferon, gamma-inducible protein 30	NM_006332
enzyme-3	CPA4	carboxypeptidase A4	NM_016352

[Table 1d]

Classification 7	Gene symbol	Gene title	Genbank number
extracellular matrix-1	CHI3L1	chitinase 3-like 1 (cartilage glycoprotein-39)	NM_001276
extracellular matrix-2	KRT23	keratin 23 (histone deacetylase inducible)	NM_015515
extracellular matrix-3	FLG	filaggrin	NM_002016
extracellular matrix-4	ADAMTS1	a disintegrin-like and metalloprotease (reprolysin type) with thrombospondin type 1 motif, 1	NM_006988
extracellular matrix-5	FRMD5	FERM domain containing 5	NM_001031 729
Classification 8	Gene symbol	Gene title	Genbank number
growth factor or receptor-1	IGFBP1	insulin-like growth factor binding protein 1	NM_000596
growth factor or receptor-2	CFI	complement factor I	NM_000204
growth factor or receptor-3	ESM1	endothelial cell-specific molecule 1	NM_007036
growth factor or receptor-4	F2RL1	coagulation factor II (thrombin) receptor-like 1	NM_005242
growth factor or receptor-5	MET	met proto-oncogene (hepatocyte growth factor receptor)	NM_000245
growth factor or receptor-6	HTR7	5-hydroxytryptamine (serotonin) receptor 7 (adenylate cyclase-coupled)	NM_000872
growth factor or receptor-7	IGFBP3	insulin-like growth factor binding protein 3	NM_001013 398

[Table 1e]

Classification 9	Gene symbol	Gene title	Genbank number
membrane-1	ABHD2	abhydrolase domain containing 2	NM_007011
membrane -2	ITGA2	integrin, alpha 2 (CD49B, alpha 2 subunit of VLA-2 receptor)	NM_002203
membrane -3	LAMA3	laminin, alpha 3	NM_198129
membrane -4	NETO2	neuropilin (NRP) and tolloid (TLL)-like 2	NM_018092
membrane -5	NTN4	netrin 4	NM_021229
membrane -6	PTGER1	Prostaglandin E receptor 1 (subtype EP1), 42kDa	NM_000955
membrane -7	EPHB2	EPH receptor B2	NM_017449
membrane -8	SFRP1	secreted frizzled-related protein 1	NM_003012
membrane -9	CD33L3	CD33 antigen-like 3	NM_213602

(continued)

Classification 9	Gene symbol	Gene title	Genbank number
membrane -10	GLIPR1	GLI pathogenesis-related 1 (glioma)	NM_006851
membrane -11	UGCG	UDP-glucose ceramide glucosyltransferase	NM_003358
membrane -12	ADORA1	adenosine A1 receptor	NM_000674
Classification 10	Gene symbol	Gene title	Genbank number
membrane binding protein-1	ANXA10	annexin A10	NM_007193
membrane binding protein-2	RARRES1	retinoic acid receptor responder (tazarotene induced) 1	NM_206963
membrane binding protein-3	HNT	neurotrimin	NM_016522
membrane binding protein-4	CNTNAP3	contactin associated protein-like 3	NM_033655

[Table 1f]

Classification 11	Gene symbol	Gene title	Genbank number
protein binding-1	SYT1	synaptotagmin I	NM_005639
protein binding -2	MLF1	myeloid leukemia factor 1	NM_022443
protein binding -3	CDCP1	CUB domain-containing protein 1	NM_022842
protein binding -4	KLAA0746	KIAA0746 protein	NM_015187
protein binding -5	PSCDBP	pleckstrin homology, Sec7 and coiled-coil domains, binding protein	NM_004288
protein binding -6	SKI	v-ski sarcoma viral oncogene homolog (avian)	NM_003036
protein binding -7	SNX25	sorting nexin 25	NM_031953
protein binding -8	CDH6	cadherin 6, type 2, K-cadherin (fetal kidney)	NM_004932
protein binding -9	DCBLD2	discoldin, CUB and LCCL domain containing 2	NM_080927
protein binding -10	ENG	endoglin (Osler-Rendu-Weber syndrome 1)	NM_000118

[Table 1g]

Classification 12	Gene symbol	Gene title	Genbank number
protein modification-1	SH3RF1	SH3 domain containing ring finger 1	NM_020870
protein modification-2	SMURF2	SMAD specific E3 ubiquitin protein ligase 2	NM_022739
protein modification-3	TFPI2	tissue factor pathway inhibitor 2	NM_006528
protein modification-4	ITGB3	integrin, beta 3 (platelet glycoprotein IIIa, antigen CD61)	NM_000212
protein modification-5	MYPN	myopalladin	NM_032578
protein modification-6	LRP2BP	LRP2 binding protein	NM_018409
protein modification-7	HECW2	HECT, C2 and WW domain containing E3 ubiquitin protein ligase 2	NM_020760
protein modification-8	PKIA	protein kinase (cAMP-dependent, catalytic) inhibitor alpha	NM_006823

(continued)

Classification 13	Gene symbol	Gene title	Genbank number
signal molecule-1	LYPD1	LY6/PLAUR domain containing 1	NM_144586
signal molecule-2	GATA6	GATA binding protein 6	NM_005257
signal molecule-3	RAB27B	RAB27B, member RAS oncogene family	NM_004163
signal molecule-4	SOX11	SRY (sex determining region Y)-box 11	NM_003108
signal molecule-5	ARHGAP2 2	Rho GTPase activating protein 22	NM_021226

[Table 1h]

Classification 14	Gene symbol	Gene title	Genbank number
transcription-1	ETV1	ets variant gene 1	NM_004956
transcription-2	ETV5	ets variant gene 5 (ets-related molecule)	NM_004454
transcription-3	FOXP1	forkhead box P1	NM_032682
transcription-4	HMGA2	high mobility group AT-hook 2	NM_003483
transcription-5	KLF12	Kruppel-like factor 12	NM_007249
transcription-6	PRDM16	PR domain containing 16	NM_022114
transcription-7	SIM2	single-minded homolog 2 (Drosophila)	NM_009586
transcription-8	SUHW2	suppressor of hairy wing homolog 2 (Drosophila)	NM_080764
transcription-9	ENO1	enolase 1	NM_001428
transcription-10	MITF	microphthalmia-associated transcription factor	NM_198159
transcription-11	TCF3	transcription factor 3 (E2A immunoglobulin enhancer binding factors E12/E47)	NM_003200
transcription-12	SMYD3	SET and MYND domain containing 3	NM_022743

[Table 1i]

Classification 15	Gene symbol	Gene title	Genbank number
transport-1	ATP6V1G3	ATPase, H+ transporting, lysosomal 13kDa, V1 subunit G isoform 3	NM_133262
transport-2	KCTD16	potassium channel tetramerisation domain containing 16	NM_020768
transport-3	NUPL1	nucleoporin like 1	NM_014089
transport-4	SLC14A1	solute carrier family 14 (urea transporter), member 1 (Kidd blood group)	NM_015865
transport-5	SLC16A4	solute carrier family 16 (monocarboxylic acid transporters), member 4	NM_004696
transport-6	SLC4A4	solute carrier family 4, sodium bicarbonate cotransporter, member 4	NM_003759
transport-7	SLC9A7	solute carrier family 9 (sodium/hydrogen exchanger), isoform 7	NM_032591
transport-8	TRPC4	transient receptor potential cation channel, subfamily C, member 4	NM_016179
transport-9	MCFD2	multiple coagulation factor deficiency 2	NM_139279

(continued)

Classification 15	Gene symbol	Gene title	Genbank number
transport-10	SLC26A4	solute carrier family 26, member 4	NM_000441
transport-11	MCOLN3	mucolipin 3	NM 018298
transport-12	SLC25A37	solute carrier family 25, member 37	NM_016612
transport-13	SLC30A7	solute carrier family 30 (zinc transporter), member 7	NM_133496

[Table 1j]

Classification 16	Gene symbol	Gene title	Genbank number
others -1	FLJ38725	hypothetical protein FLJ38725	NM_153218
others -2	KIAA1913	KIAA1913	NM_052913
others -3	PHLDB2	pleckstrin homology-like domain, family B, member 2	NM_145753
others -4	PLCXD2	phosphatidylinositol-specific phospholipase C, X domain containing 2	NM_153268
others -5	SAMD3	sterile alpha motif domain containing 3	NM_001017 3 73
others -6	ZNF423	zinc finger protein 423	NM_015069
others -7	FLJ33996	hypothetical protein FLJ33996	NM_175894. 2
others -8	PLEKHK1	pleckstrin homology domain containing, family K member 1	NM_145307
others -9	PTOV1	prostate tumor overexpressed gene 1	NM_017432
others -10	FAM40B	family with sequence similarity 40, member B	NM_020704
others -11	ABI3BP	ABI gene family, member 3 (NESH) binding protein	NM_015429
others -12	NHS	Nance-Horan syndrome (congenital cataracts and dental anomalies)	NM_198270
others -13	DTL	denticleless homolog (Drosophila)	NM_16448
others -14	C1GALT1	core 1 synthase, glycoprotein-N- acetylgalactosamine 3-beta-	NM_020156
others -15	CPNE8	copine VIII	NM_153634
others -16	TMEM49	transmembrane protein 49	NM_030938

2. The method as set forth in claim 1, wherein the distinguishing marker(s) is at least one of the genes listed the classifications 6, 7, 8, 10, and 13 in Tables 1a to 1j.

3. The method as set forth in claim 2, wherein the distinguishing markers are a combination of one or more genes from each of the classifications 6, 7, 8, 10, and 13 in Tables 1a to 1j.

4. The method as set forth in any one of claim 1 to 3, wherein the distinguishing marker is at least one of the genes listed in Table 2.

Gene symbol	Gene title	Genbank number
CHI3L1	chitinase 3-like 1 (cartilage glycoprotein-39)	NM_001276
FLG	filaggrin	NM_002016
CFI	complement factor I	NM_000204

(continued)

Gene symbol	Gene title	Genbank number
ANXA10	annexin A10	NM_007193
LYPDC1	LY6/PLAUR domain containing 1	NM_144586
GATA6	GATA binding protein 6	NM_005257

5. The method as set forth in any one of claims 1 to 4, wherein the detection of the difference in the expressions of the distinguishing markers is carried out by detecting expression of the gene or expression of a protein encoded by the gene.

6. A microarray for distinguishing mesenchymal stem cells, the microarray comprising at least one of (a) to (d) immobilized thereon:

(a) at least one of genes having the base sequences identified with the accession numbers listed in Tables 3a to 3j;
(b) an antisense chain of at least one of genes having the base sequences identified with the accession numbers listed in Tables 3a to 3j;
(c) a partial base sequence of (a) or (b); and
(d) a polynucleotide that is capable of hybridizing, under stringent conditions, with a polynucleotide having the base sequence described in any one of (a) to (c).

[Table 3a]

Classification 1	Gene symbol	Gene title	Genbank number
ATP/GTP binding -1	BRIP1	BRCA1 interacting protein C-terminal helicase 1	NM_032043
ATP/GTP binding -2	PASK	PAS domain containing serine/threonine kinase	NM_015148
ATP/GTP binding -3	RAC2	ras-related C3 botulinum toxin substrate 2 (rho family, small GTP binding protein Rac2)	NM_002872
ATP/GTP binding -4	KIF18A	kinesin family member 18A	NM_031217
ATP/GTP binding -5	NEK7	NIMA (never in mitosis gene a)-related kinase 7	NM_133494
ATP/GTP binding -6	ARL4C	ADP-ribosylation factor-like	NM_005737
ATP/GTP binding -7	EDEM1	ER degradation enhancer, mannosidase alpha-like 1	NM_014674
ATP/GTP binding -8	CAMK2D	calcium/calmodulin-dependent protein kinase (CaM kinase) II delta	NM_172127
Classification 2	Gene symbol	Gene title	Genbank number
binding -1	PDE5A	phosphodiesterase 5A, cGMP-specific	NM_001083
binding -2	RGS4	regulator of G-protein signalling 4	NM_005613
binding -3	EGFL3	EGF-like-domain, multiple 3	NM_001409
binding -4	FHL2	four and a half LIM domains	NM_001450 2
binding -5	HRB2	HIV-1 rev binding protein 2	NM_007043
binding -6	CAPZA1	capping protein (actin filament) muscle Z-line, alpha 1	NM_006135
binding -7	PAPPA2	pappalysin 2	NM_020318
binding -8	LOXL2	lysyl oxidase-like 2	NM_002318
binding -9	LOX	lysyl oxidase	NM_002317
binding -10	ADAMTS5	ADAM metallopeptidase with thrombospondin type 1 motif, 5 (aggrecanase-2)	NM_007038

[Table 3b]

Classification 3	Gene symbol	Gene title	Genbank number
cell growth and/or maintenance-1	CCND1	cyclin D1 (PRAD1: parathyroid adenomatosis 1)	NM_053056
cell growth and/or maintenance-2	CDC25A	cell division cycle 25A	NM_001789
cell growth and/or maintenance-3	IER3	immediate early response 3	NM_052815
cell growth and/or maintenance-4	BCL2	B-cell CLL/lymphoma 2	NM_000633
cell growth and/or maintenance-5	NALP1	NACHT, leucine rich repeat and PYD containing 1	NM_033004
cell growth and/or maintenance-6	PAK3	p21 (CDKN1A)-activated kinase 3	NM_002578
cell growth and/or maintenance-7	PODXL	podocalyxin-like	NM_001018 111
cell growth and/or maintenance-8	CCL26	chemokine (C-C motif) ligand 26	NM_006072
cell growth and/or maintenance-9	FBLN1	fibulin 1	NM_006486
cell growth and/or maintenance-10	LAMA1	laminin, alpha 1	NM_005559
cell growth and/or maintenance-11	NTNG1	netrin G1	NM_014917

[Table 3c]

Classification 4	Gene symbol	Gene title	Genbank number
cytokine -1	GDF15	growth differentiation factor	NM_004864
cytokine -2	IL6	interleukin 6 (interferon, beta 2)	NM_000600
cytokine -3	CTGF	connective tissue growth factor	NM_001901
cytokine -4	VEGF	vascular endothelial growth factor	NM_001025 366
cytokine -5	VEGFC	vascular endothelial growth factor C	NM_005429
cytokine -6	HGF	hepatocyte growth factor (hepapoietin A; scatter	NM_000601
Classification 5	Gene symbol	Gene title	Genbank number
cytoskeleton-1	KRT19	keratin 19	NM_002276
cytoskeleton-2	KRTAP1-5	keratin associated protein 1-	NM_031957
cytoskeleton-3	KRTAP2-1	keratin associated protein 2-	BC012486
cytoskeleton-4	KRTHA4	keratin, hair, acidic, 4	NM_021013
cytoskeleton-5	CKAP2	cytoskeleton associated protein 2	NM_018204
cytoskeleton-6	KRTAP1-1	keratin associated protein 1-	NM_030967
cytoskeleton-7	KRT18	keratin 18	NM_000224
cytoskeleton-8	KAP2.1B	keratin associated protein 2.1B	AJ406929
cytoskeleton-9	SSH1	slingshot homolog 1 (Drosophila)	NM_018984
Classification 6	Gene symbol	Gene title	Genbank number
enzyme-1	LXN	latexin	NM_020169
enzyme-2	IFI30	interferon, gamma-inducible protein 30	NM_006332

(continued)

Classification 6	Gene symbol	Gene title	Genbank number
enzyme-3	CPA4	carboxypeptidase A4	NM_016352

[Table 3d]

Classification 7	Gene symbol	Gene title	Genbank number
extracellular matrix-1	CHI3L1	chitinase 3-like 1 (cartilage glycoprotein-39)	NM_001276
extracellular matrix-2	KRT23	keratin 23 (histone deacetylase inducible)	NM_015515
extracellular matrix-3	FLG	filaggrin	NM_002016
extracellular matrix-4	ADAMTS1	a disintegrin-like and metalloprotease (reprolysin type) with thrombospondin type 1 motif, 1	NM_006988
extracellular matrix-5	FRMD5	FERM domain containing 5	NM_001031 729
Classification 8	Gene symbol	Gene title	Genbank number
growth factor or receptor-1	IGFBP1	insulin-like growth factor binding protein 1	NM_000596
growth factor or receptor-2	CFI	complement factor I	NM_000204
growth factor or receptor-3	ESM1	endothelial cell-specific molecule 1	NM_007036
growth factor or receptor-4	F2RL1	coagulation factor II (thrombin) receptor-like 1	NM_005242
growth factor or receptor-5	MET	met proto-oncogene (hepatocyte growth factor receptor)	NM_000245
growth factor or receptor-6	HTR7	5-hydroxytryptamine (serotonin) receptor 7 (adenylate cyclase-coupled)	NM_000872
growth factor or receptor-7	IGFBP3	insulin-like growth factor binding protein 3	NM_001013 398

[Table 3e]

Classification 9	Gene symbol	Gene title	Genbank number
membrane -1	ABHD2	abhydrolase domain containing 2	NM_007011
membrane -2	ITGA2	integrin, alpha 2 (CD49B, alpha 2 subunit of VLA-2 receptor)	NM_002203
membrane -3	LAMA3	laminin, alpha 3	NM_198129
membrane -4	NETO2	neuropilin (NRP) and tolloid (TLL)-like 2	NM_018092
membrane -5	NTN4	netrin 4	NM_021229
membrane -6	PTGER1	prostaglandin E receptor 1 (subtype EP1), 42kDa	NM_000955
membrane -7	EPHB2	EPH receptor B2	NM_017449
membrane -8	SFRP1	secreted frizzled-related protein 1	NM_003012
membrane -9	CD33L3	CD33 antigen-like 3	NM_213602
membrane -10	GLIPR1	GLI pathogenesis-related 1 (glioma)	NM_006851
membrane -11	UGCG	UDP-glucose ceramide glucosyltransferase	NM_003358
membrane -12	ADORA1	adenosine A1 receptor	NM_000674

(continued)

Classification 10 l	Gene symbo	Gene title	Genbank number
membrane binding protein-1	ANXA10	annexin A10	NM_007193
membrane binding protein-2	RARRES1	retinoic acid receptor responder (tazarotene induced) 1	NM_206963
membrane binding protein-3	HNT	neurotrimin	NM_016522
membrane binding protein-4	CNTNAP3	contactin associated protein-like 3	NM_033655

[Table 3f]

Classification 11	Gene symbol	Gene title	Genbank number
protein binding -1	SYT1	synaptotagmin I	NM_005639
protein binding -2	MLF1	myeloid leukemia factor 1	NM_022443
protein binding -3	CDCP1	CUB domain-containing protein 1	NM_022842
protein binding -4	KIAA0746	KIAA0746 protein	NM_015187
protein binding -5	PSCDBP	pleckstrin homology, Sec7 and coiled-coil domains, binding protein	NM_004288
protein binding -6	SKI	v-ski sarcoma viral oncogene homolog (avian)	NM_003036
protein binding -7	SNX25	sorting nexin 25	NM_031953
protein binding -8	CDH6	cadherin 6, type 2, K-cadherin (fetal kidney)	NM_004932
protein binding -9	DCBLD2	discoidin, CUB and LCCL domain containing 2	NM_080927
protein binding -10	ENG	endoglin (Osler-Rendu-Weber syndrome 1)	NM_000118

[Table 3g]

Classification 12	Gene symbol	Gene title	Genbank number
protein modification-1	SH3RF1	SH3 domain containing ring finger 1	NM_020870
protein modification-2 SMURF2		SMAD specific E3 ubiquitin protein ligase 2	NM_022739
protein modification-3	TFPI2	tissue factor pathway inhibitor 2	NM_006528
protein modification-4	ITGB3	integrin, beta 3 (platelet glycoprotein IIIa, antigen CD61)	NM_000212
protein modification-5	MYPN	myopalladin	NM_032578
protein modification-6	LRP2BP	LRP2 binding protein	NM 018409
protein modification-7	HECW2	HECT, C2 and WW domain containing E3 ubiquitin protein ligase 2	NM_020760
protein modification-8	PKIA	protein kinase (cAMP-dependent, catalytic) inhibitor alpha	NM_006823
Classification 13	Gene symbol	Gene title	Genbank number
signal molecule-1	LYPD1	LY6/PLAUR domain containing 1 domain	NM_144586
signal molecule-2	GATA6	GATA binding protein 6	NM_005257
signal molecule-3	RAB27B	RAB27B, member RAS oncogene family	NM_004163

(continued)

Classification 13	Gene symbol	Gene title	Genbank number
signal molecule-4	SOX11	SRY (sex determining region Y)-box 11	NM_003108
signal molecule-5	ARHGAP2 2	Rho GTPase activating protein 22	NM_021226

[Table 3h]

Classification 14	Gene symbol	Gene title	Genbank number
transcription-1	ETV1	ets variant gene 1	NM_004956
transcription-2	ETV5	ets variant gene 5 (ets-related molecule)	NM_004454
transcription-3	FOXP1	forkhead box P1	NM_032682
transcription-4	HMGA2	high mobility group AT-hook 2	NM_003483
transcription-5	KLF12	Kruppel-like factor 12	NM_007249
transcription-6	PRDM16	PR domain containing 16	NM_022114
transcription-7	SIM2	single-minded homolog 2 (Drosophila)	NM_009586
transcription-8	SUHW2	suppressor of hairy wing homolog 2 (Drosophila)	NM_080764
transcription-9	ENO1	enolase 1	NM_001428
transcription-10	MITF	microphthalmia-associated transcription factor	NM_198159
transcription-11	TCF3	transcription factor 3 (E2A immunoglobulin enhancer binding factors E12/E47)	NM_003200
transcription-12	SMYD3	SET and MYND domain containing 3	NM_022743

[Table 3i]

Classification 15	Gene symbol	Gene title	Genbank number
transport-1	ATP6V1G3	ATPase, H+ transporting, lysosomal 13kDa, V1 subunit G isoform 3	NM_133262
transport-2	KCTD16	potassium channel tetramerisation domain containing 16	NM_020768
transport-3	NUPL1	nucleoporin like 1	NM_014089
transport-4	SLC14A1	solute carrier family 14 (urea transporter), member 1 (Kidd blood group)	NM_015865
transport-5	SLC16A4	solute carrier family 16 (monocarboxylic acid transporters), member 4	NM_004696
transport-6	SLC4A4	solute carrier family 4, sodium bicarbonate cotransporter, member 4	NM_003759
transport-7	SLC9A7	solute carrier family 9 (sodium/hydrogen exchanger), isoform 7	NM_032591
transport-8	TRPC4	transient receptor potential cation channel, subfamily C, member 4	NM_016179
transport-9	MCFD2	multiple coagulation factor deficiency 2	NM_139279
transport-10	SLC26A4	solute carrier family 26, member 4	NM_000441
transport-11	MCOLN3	mucolipin 3	NM 018298
transport-12	SLC25A37	solute carrier family 25, member 37	NM_016612

(continued)

Classification 15	Gene symbol	Gene title	Genbank number
transport-13	SLC30A7	solute carrier family 30 (zinc transporter), member 7	NM_133496

[Table 3j]

Classification 16	Gene symbol	Gene title	Genbank number
others -1	FLJ38725	hypothetical protein FLJ38725	NM_153218
others -2	KIAA1913	KIAA1913	NM_052913
others -3	PHLDB2	pleckstrin homology-like domain, family B, member 2	NM_145753
others -4	PLCXD2	phosphatidylinositol-specific phospholipase C, X domain containing 2	NM_153268
others -5	SAMD3	sterile alpha motif domain containing 3	NM_001017 373
others -6	ZNF423	zinc finger protein 423	NM_015069
others -7	FLJ33996	hypothetical protein FLJ33996	NM_175894.2
others -8	PLEKHK1	pleckstrin homology domain containing, family K member 1	NM_145307
others -9	PTOV1	prostate tumor overexpressed gene 1	NM_017432
others -10	FAM40B	family with sequence similarity 40, member B	NM_020704
others -11	ABI3BP	ABI gene family, member 3 (NESH) binding protein	NM_015429
others -12	NHS	Nance-Horan syndrome (congenital cataracts and dental anomalies)	NM_198270
others -13	DTL	denticleless homolog (Drosophila)	NM_016448
others -14	C1GALT1	core 1 synthase, glycoprotein-N-acetylgalactosamine 3-beta-	NM_020156
others -15	CPNE8	copine VIII	NM_153634
others -16	TMEM49	transmembrane protein 49	NM_030938

7. An antibody, being inducible with a polypeptide described in (e) or (f), and bindable specifically with the polypeptide specifically:

(e) a polypeptide encoded by any one of the genes having the base sequences identified with the accession numbers listed in Tables 4a to 4j; and
(f) a partial polypeptide of the polypeptide described in (e).

[Table 4a]

Classification 1	Gene symbol	Gene title	Genbank number
ATP/GTP binding -1	BRIP1	BRCA1 interacting protein C-terminal helicase 1	NM_032043
ATP/GTP binding -2	PASK	PAS domain containing serine/threonine kinase	NM_015148
ATP/GTP binding-3	RAC2	ras-related C3 botulinum toxin substrate 2 (rho family, small GTP binding protein Rac2)	NM_002872
ATP/GTP binding -4	KIF18A	kinesin family member 18A	NM_031217
ATP/GTP binding -5	NEK7	NIMA (never in mitosis gene a)-related kinase 7	NM_133494
ATP/GTP binding -6	ARL4C	ADP-ribosylation factor-like 4C	NM_005737
ATP/GTP binding -7	EDEM1	ER degradation enhancer, mannosidase alpha-like 1	NM_014674

(continued)

Classification 1	Gene symbol	Gene title	Genbank number
ATP/GTP binding -8	CAMK2D	calcium/calmodulin-dependent protein kinase (CaM kinase) II delta	NM_172127
Classification 2	Gene symbol	Gene title	Genbank number
binding -1	PDE5A	phosphodiesterase 5A, cGMP-specific	NM_001083
binding -2	RGS4	regulator of G-protein signalling 4	NM_005613
binding -3	EGFL3	EGF-like-domain, multiple 3	NM_001409
binding -4	FHL2	four and a half LIM domains 2	NM_001450
binding -5	HRB2	HIV-1 rev binding protein 2	NM 007043
binding -6	CAPZA1	capping protein (actin filament) muscle Z-line, alpha 1	NM_006135
binding -7	PAPPA2	pappalysin 2	NM_020318
binding -8	LOXL2	lysyl oxidase-like 2	NM_002318
binding -9	LOX	lysyl oxidase	NM_002317
binding -10	ADAMTS5	ADAM metallopeptidase with thrombospondin type 1 motif, 5 (aggrecanase-2)	NM_007038

[Table 4b]

Classification 3	Gene symbol	Gene title	Genbank number
cell growth and/or maintenance-1	CCND1	cyclin D1 (PRAD1: parathyroid adenomatosis 1)	NM_053056
cell growth and/or maintenance-2	CDC25A	cell division cycle 25A	NM_001789
cell growth and/or maintenance-3	IER3	immediate early response 3	NM_052815
cell growth and/or maintenance-4	BCL2	B-cell CLL/lymphoma 2	NM_000633
cell growth and/or maintenance-5	NALP1	NACHT, leucine rich repeat and PYD containing 1	NM_033004
cell growth and/or maintenance-6	PAK3	p21 (CDKN1A)-activated kinase 3	NM_002578
cell growth and/or maintenance-7	PODXL	podocalyxin-like	NM_001018 111
cell growth and/or maintenance-8	CCL26	chemokine (C-C motif) ligand 26	NM_006072
cell growth and/or maintenance-9	FBLN1	fibulin 1	NM_006486
cell growth and/or maintenance-10	LAMA1	laminin, alpha 1	NM_005559
cell growth and/or maintenance-11	NTNG1	netrin G1	NM_014917

[Table 4c]

Classification 4	Gene symbol	Gene title	Genbank number
cytokine -1	GDF15	growth 15 differentiation factor	NM_004864
cytokine -2	IL6	interleukin 6 (interferon, beta 2)	NM_000600
cytokine -3	CTGF	connective tissue growth factor	NM_001901
cytokine -4	VEGF	vascular endothelial growth factor	NM_001025 366
cytokine -5	VEGFC	vascular endothelial growth factor C	NM_005429

(continued)

Classification 4	Gene symbol	Gene title	Genbank number
cytokine -6	HGF	hepatocyte growth factor (hepapoietin A; scatter	NM_000601
Classification 5	Gene symbol	Gene title	Genbank number
cytoskeleton-1	KRT19	keratin 19	NM_002276
cytoskeleton-2	KRTAP1-5	keratin associated protein 1-	NM_031957
cytoskeleton-3	KRTAP2-1	keratin associated protein 2-	BC012486
cytoskeleton-4	KRTHA4	keratin, hair, acidic, 4	NM_021013
cytoskeleton-5	CKAP2	cytoskeleton associated protein 2	NM_018204
cytoskeleton-6	KRTAP1-1	keratin associated protein 1-	NM_030967
cytoskeleton-7	KRT18	keratin 18	NM_000224
cytoskeleton-8	KAP2.1B	keratin associated protein 2.1B	AJ406929
cytoskeleton-9	SSH1	slingshot homolog 1 (Drosophila)	NM_018984
Classification 6	Gene symbol	Gene title	Genbank number
enzyme-1	LXN	latexin	NM_020169
enzyme-2	IFI30	interferon, gamma-inducible protein 30	NM_006332
enzyme-3	CPA4	carboxypeptidase A4	NM_016352

[Table 4d]

Classification 7	Gene symbol	Gene title	Genbank number
extracellular matrix-1	CHI3L1	chitinase 3-like 1 (cartilage glycoprotein-39)	NM_001276
extracellular matrix-2	KRT23	keratin 23 (histone deacetylase inducible)	NM_015515
extracellular matrix-3	FLG	filaggrin	NM_002016
extracellular matrix-4	ADAMTS1	a disintegrin-like and metalloprotease (reprolysin type) with thrombospondin type I motif, I	NM_006988
extracellular matrix-5	FRMD5	FERM domain containing 5	NM_001031 729
Classification 8	Gene symbol	Gene title	Genbank number
growth factor or receptor-1	IGFBP1	insulin-like growth factor binding protein 1	NM_000596
growth factor or receptor-2	CFI	complement factor I	NM_000204
growth factor or receptor-3	ESM1	endothelial cell-specific molecule 1	NM_007036
growth factor or receptor-4	F2RL1	coagulation factor II (thrombin) receptor-like 1	NM_005242
growth factor or receptor-5	MET	met proto-oncogene (hepatocyte growth factor receptor)	NM_000245
growth factor or receptor-6	HTR7	5-hydroxytryptamine (serotonin) receptor 7 (adenylate cyclase-coupled)	NM_000872
growth factor or receptor-7	IGFBP3	insulin-like growth factor binding protein 3	NM_001013 398

[Table 4e]

Classification 9	Gene symbol	Gene title	Genbank number
membrane -1	ABHD2	abhydrolase domain containing 2	NM_007011
membrane -2	ITGA2	integrin, alpha 2 (CD49B, alpha 2 subunit of VLA-2 receptor)	NM_002203
membrane -3	LAMA3	laminin, alpha 3	NM_198129
membrane -4	NETO2	neuropilin (NRP) and tolloid (TLL)-like 2	NM_018092
membrane -5	NTN4	netrin 4	NM_021229
membrane -6	PTGER1	prostaglandin E receptor 1 (subtype EP1), 42kDa	NM_000955
membrane -7	EPHB2	EPH receptor B2	NM_017449
membrane -8	SFRP1	secreted frizzled-related protein 1	NM_003012
membrane -9	CD33L3	CD33 antigen-like 3	NM_213602
membrane -10	GLIPR1	GLI pathogenesis-related 1 (glioma)	NM_006851
membrane -11	UGCG	UDP-glucose ceramide glucosyltransferase	NM_003358
membrane -12	ADORA1	adenosine A1 receptor	NM_000674
Classification 10	Gene symbol	Gene title	Genbank number
membrane binding protein-1	ANXA10	annexin A10	NM_007193
membrane binding protein-2 binding	RARRES1	retinoic acid receptor responder (tazarotene induced) 1	NM_206963
membrane binding protein-3	HNT	neurotrimin	NM_016522
membrane binding protein-4	CNTNAP3	contactin associated protein-like 3	NN_033655

[Table 4f]

Classification 11	Gene symbol	Gene title	Genbank number
protein binding -1	SYT1	synaptotagmin I	NM_005639
protein binding -2	MLF1	myeloid leukemia factor 1	NM_022443
protein binding -3	CDCP1	CUB domain-containing protein 1	NM_022842
protein binding -4	KIAA0746	KIAA0746 protein	NM_015187
protein binding -5	PSCDBP	pleckstrin homology, Sec7 and coiled-coil domains, binding protein	NM_004288
protein binding -6	SKI	v-ski sarcoma viral oncogene homolog (avian)	NM_003036
protein binding -7	SNX25	sorting nexin 25	NM_031953
protein binding -8	CDH6	cadherin 6, type 2, K-cadherin (fetal kidney)	NM_004932
protein binding -9	DCBLD2	discoidin, CUB and LCCL domain containing 2	NM_080927
protein binding -10	ENG	endoglin (Osler-Rendu-Weber syndrome 1)	NM_000118

[Table 4g]

Classification 12	Gene symbol	Gene title	Genbank number
protein modification-1	SH3RF1	SH3 domain containing ring finger 1	NM_020870
protein modification-2	SMURF2	SMAD specific E3 ubiquitin protein ligase 2	NM_022739
protein modification-3	TFPI2	tissue factor pathway inhibitor 2	NM_006528
protein modification-4	ITGB3	integrin, beta 3 (platelet glycoprotein IIIa, antigen CD61)	NM_000212
protein modification-5	MYPN	myopalladin	NM_032578
protein modification-6	LRP2BP	LRP2 binding protein	NM_018409
protein modification-7	HECW2	HECT, C2 and WW domain containing E3 ubiquitin protein ligase 2	NM_020760
protein modification-8	PKIA	protein kinase (cAMP-dependent, catalytic) inhibitor alpha	NM_006823
Classification 13	Gene symbol	Gene title	Genbank number
signal molecule-1	LYPD1	LY6/PLAUR domain containing 1	NM_144586
signal molecule-2	GATA6	GATA binding protein 6	NM_005257
signal molecule-3	RAB27B	RAB27B, member RAS oncogene family	NM_004163
signal molecule-4	SOX11	SRY (sex determining region Y)-box 11	NM_003108
signal molecule-5	ARHGAP22	Rho GTPase activating protein 22	NM_021226

[Table 4h]

Classification 14	Gene symbol	Gene title	Genbank number
transcription-1	ETV1	ets variant gene 1	NM_004956
transcription-2	ETV5	ets variant gene 5 (ets- related molecule)	NM_004454
transcription-3	FOXP1	forkhead box P1	NM_032682
transcription-4	HMGA2	high mobility group AT-hook 2	NM_003483
transcription-5	KLF12	Kruppel-like factor 12	NM_007249
transcription-6	PRDM16	PR domain containing 16	NM_022114
transcription-7	SIM2	single-minded homolog 2 (Drosophila)	NM_009586
transcription-8	SUHW2	suppressor of hairy wing homolog 2 (Drosophila)	NM_080764
transcription-9	ENO1	enolase 1	NM_001428
transcription-10	MITF	microphthalmia-associated transcription factor	NM_198159
transcription-11	TCF3	transcription factor 3 (E2A immunoglobulin enhancer binding factors E12/E47)	NM_003200
transcription-12	SMYD3	SET and MYND domain containing 3	NM_022743

[Table 4i]

Classification 15	Gene symbol	Gene title	Genbank number
transport-1	ATP6V1G3	ATPase, H+ transporting, lysosomal 13kDa, VI subunit G isoform 3	NM_133262

(continued)

Classification 15	Gene symbol	Gene title	Genbank number
transport-2	KCTD16	potassium channel tetramerisation domain containing 16	NM_020768
transport-3	NUPL1	nucleoporin like 1	NM_014089
transport-4	SLC14A1	solute carrier family 14 (urea transporter), member 1 (Kidd blood group)	NM_015865
transport-5	SLC16A4	solute carrier family 16 (monocarboxylic acid transporters), member 4	NM_004696
transport-6	SLC4A4	solute carrier family 4, sodium bicarbonate cotransporter, member 4	NM_003759
transport-7	SLC9A7	solute carrier family 9 (sodium/hydrogen exchanger), isoform 7	NM_032591
transport-8	TRPC4	transient receptor potential cation channel, subfamily C, member 4	NM_016179
transport-9	MCFD2	multiple coagulation factor deficiency 2	NM_139279
transport-10	SLC26A4	solute carrier family 26, member 4	NM_000441
transport-11	MCOLN3	mucolipin 3	NM_018298
transport-12	SLC25A37	solute carrier family 25, member 37	NM_016612
transport-13	SLC30A7	solute carrier family 30 (zinc transporter), member 7	NM_133496

[Table 4j]

Classification 16	Gene symbol	Gene title	Genbank number
others -1	FLJ38725	hypothetical protein FLJ38725	NM_153218
others -2	KIAA1913	KIAA1913	NM_052913
others -3	PHLDB2	pleckstrin homology-like domain, family B, member 2	NM_145753
others -4	PLCXD2	phosphatidylinositol-specific phospholipase C, X domain containing 2	NM_153268
others -5	SAMD3	sterile alpha motif domain containing 3	NM_001017 373
others -6	ZNF423	zinc finger protein 423	NM_015069
others -7	FLJ33996	hypothetical protein FLJ33996	NM_175894. 2
others -8	PLEKHK1	pleckstrin homology domain containing, family K member 1	NM_145307
others -9	PTOV1	Prostate tumor overexpressed gene 1	NM_017432
others -10	FAM40B	family with sequence similarity 40, member B	NM_020704
others -11	ABI3BP	ABI gene family, member 3 (NESH) binding protein	NM_015429
others -12	NHS	Nance-Horan syndrome (congenital cataracts and dental anomalies)	NM_198270
others -13	DTL	denticleless homolog (Drosophila)	NM_016448
others -14	C1GALT1	core 1 synthase, glycoprotein-N-acetylgalactosamine 3-beta-	NM_020156
others -15	CPNE8	copine VIII	NM _53634
others -16	TMEM49	transmembrane protein 49	NM_030938

8. A kit for distinguishing and separating mesenchymal stem cells, comprising any one of (g) to (i):

(g) a microarray as set forth in claim 6;
(h) an antibody as set forth in claim 7; and
(i) a probe for detecting whether the distinguishing marker gene for mesenchymal stem cells is expressed or not, the distinguishing marker gene comprising a polynuleotide, which, under strigent condition, hybridizes with a gene or a partial sequence thereof, the gene having a base sequence identified with the accession number listed in any one of Tables 5a to 5j.

[Table 5a]

Classification 1	Gene symbol	Gene title number	Genbank
ATP/GTP binding -1	BRIP1	BRCA1 interacting protein C-terminal helicase 1	NM_032043
ATP/GTP binding -2	PASK	PAS domain containing serine/threonine kinase	NM_015148
ATP/GTP binding -3	RAC2	ras-related C3 botulinum toxin substrate 2 (rho family, small GTP binding protein Rac2)	NM_002872
ATP/GTP binding -4	KIF18A	kinesin family member 18A	NM_31217
ATP/GTP binding -5	NEK7	NIMA (never in mitosis gene a)-related kinase 7	NM_133494
ATP/GTP binding -6	ARL4C	ADP-ribosylation factor-like 4C	NM_005737
ATP/GTP binding -7	EDEM1	ER degradation enhancer, mannosidase alpha-like 1	NM_014674
ATP/GTP binding -8	CAMK2D	calcium/calmodulin-dependent protein kinase (CaM kinase) II delta	NM_172127
Classification 2	Gene symbol	Gene title	Genbank number
binding -1	PDE5A	phosphodiesterase 5A, cGMP-specific	NM_001083
binding -2	RGS4	regulator of G-protein signalling 4	NM_005613
binding -3	EGFL3	EGF-like-domain, multiple 3	NM_01409
binding -4	FHL2	four and a half LIM domains	NM_001450 2
binding-5	HRB2	HIV-1 rev binding protein 2	NM_07043
binding -6	CAPZA1	capping protein (actin filament) muscle Z-line, alpha 1	NM_006135
binding -7	PAPPA2	pappalysin 2	NM_020318
binding -8	LOXL2	lysyloxidase-like2	NM_002318
binding -9	LOX	lysyl oxidase	NM_002317
binding -10	ADAMTS5	ADAM metallopeptidase with thrombospondin type 1 motif, 5 (aggrecanase-2)	NM_007038

[Table 5b]

Classification 3	Gene symbol	Gene title	Genbank number
cell growth and/or maintenance-1	CCND1	cyclin D1 (PRAD1: parathyroid adenomatosis 1)	NM_053056
cell growth and/or maintenance-2	CDC25A	cell division cycle 25A	NM_001789
cell growth and/or maintenance-3	IER3	immediate early response 3	NM_052815
cell growth and/or maintenance-4	BCL2	B-cell CLL/lymphoma 2	NM_000633
cell growth and/or maintenance-5	NALP1	NACHT, leucine rich repeat and PYD containing 1	NM_033004
cell growth and/or maintenance-6	PAK3	p21 (CDKN1A)-activated kinase 3	NM_002578

(continued)

Classification 3	Gene symbol	Gene title	Genbank number
cell growth and/or maintenance-7	PODXL	podocalyxin-like	NM_001018 111
cell growth and/or maintenance-8	CCL26	chemokine (C-C motif) ligand 26	NM_006072
cell growth and/or maintenance-9	FBLN1	fibulin 1	NM_006486
cell growth and/or maintenance-10	LAMA1	laminin, alpha 1	NM_005559
cell growth and/or maintenance-11	NTNG1	netrin G1	NM_014917

[Table 5c]

Classification 4	Gene symbol	Gene title	Genbank number
cytokine -1	GDF15	growth differentiation factor	NM_004864
cytokine -2	IL6	interleukin 6 (interferon, beta 2)	NM_000600
cytokine -3	CTGF	connective tissue growth factor	NM_001901
cytokine -4	VEGF	vascular endothelial growth factor	NM_001025 366
cytokine -5	VEGFC	vascular endothelial growth factor C	NM_005429
cytokine-6	HGF	hepatocyte growth factor (hepapoietin A; scatter	NM_000601
Classification 5	Gene symbol	Gene title	Genbank number
cytoskeleton-1	KRT19	keratin 19	NM_002276
cytoskeleton-2	KRTAP1-5	keratin associated protein 1-	NM_031957
cytoskeleton-3	KRTAP2-1	keratin associated protein 2-	BC012486
cytoskeleton-4	KRTHA4	keratin, hair, acidic, 4	NM_021013
cytoskeleton-5	CKAP2	cytoskeleton associated protein 2	NM_018204
cytoskeleton-6	KRTAP1-1	keratin associated protein 1-	NM_030967
cytoskeleton-7	KRT18	keratin 18	NM_000224
cytoskeleton-8	KAP2.1B	keratin associated protein 2.1B	AJ406929
cytoskeleton-9	SSH1	slingshot homolog 1 (Drosophila)	NM_018984
Classification 6	Gene symbol	Gene title	Genbank number
enzyme-1	LXN	latexin	NM_020169
enzyme-2	IFI30	interferon, gamma-inducible protein 30	NM_006332
enzyme-3	CPA4	carboxypeptidase A4	NM_016352

[Table 5d]

Classification 7	Gene symbol	Gene title	Genbank number
extracellular matrix-1	CHI3L1	chitinase 3-like 1 (cartilage glycoprotein-39)	NM_001276
extracellular matrix-2	KRT23	keratin 23 (histone deacetylase inducible)	NM_015515
extracellular matrix-3	FLG	filaggrin	NM_002016
extracellular matrix-4	ADAMTS1	a disintegrin-like and metalloprotease (reprolysin type) with thrombospondin type 1 motif, 1	NM_006988
extracellular matrix-5	FRMD5	FERM domain containing 5	NM_001031 729

(continued)

Classification 8	Gene symbol	Gene title	Genbank number
growth factor or receptor-1	IGFBP1	insulin-like growth factor binding protein 1	NM_000596
growth factor or receptor-2	CFI	complement factor I	NM_000204
growth factor or receptor-3	ESM1	endothelial cell-specific molecule 1	NM_007036
growth factor or receptor-4	F2RL1	coagulation factor II (thrombin) receptor-like 1	NM_005242
growth factor or receptor-5	MET	met proto-oncogene (hepatocyte growth factor receptor)	NM_000245
growth factor or receptor-6	HTR7	5-hydroxytryptamine (serotonin) receptor 7 (adenylate cyclase-coupled)	NM_000872
growth factor or receptor-7	IGFBP3	insulin-like growth factor binding protein 3	NM_001013 398

[Table 5e]

Classification 9	Gene symbol	Gene title	Genbank number
membrane -1	ABHD2	abhydrolase domain containing 2	NM_007011
membrane -2	ITGA2	integrin, alpha 2 (CD49B, alpha 2 subunit of VLA-2 receptor)	NM_002203
membrane -3	LAMA3	laminin, alpha 3	NM_198129
membrane -4	NETO2	neuropilin (NRP) and tolloid (TLL)-like 2	NM_018092
membrane -5	NTN4	netrin 4	NM_021229
membrane -6	PTGER1	prostaglandin E receptor 1 (subtype EP1), 42kDa	NM_000955
membrane -7	EPHB2	EPH receptor B2	NM_017449
membrane -8	SFRP1	secreted frizzled-related protein 1	NM_003012
membrane -9	CD33L3	CD33 antigen-like 3	NM_213602
membrane-10	GLIPR1	GLI pathogenesis-related 1 (glioma)	NM_006851
membrane -11	UGCG	UDP-glucose ceramide glucosyltransferase	NM_003358
membrane -12	ADORA1	adenosine A1 receptor	NM_00674
Classification 10	Gene symbol	Gene title	Genbank number
membrane binding protein-1	ANXA10	annexin A10	NM_007193
membrane binding protein-2	RARRES1	retinoic acid receptor responder (tazarotene induced) 1	NM_206963
membrane binding protein-3	HNT	neurotrimin	NM_016522
membrane binding protein-4	CNTNAP3	contactin associated protein-like 3	NM_033655

[Table 5f]

Classification 11	Gene symbol	Gene title	Genbank number
protein binding -1	SYT1	synaptotagmin I	NM_005639
protein binding -2	MLF1	myeloid leukemia factor 1	NM_022443

(continued)

Classification 11	Gene symbol	Gene title	Genbank number
protein binding-3	CDCP1	CUB domain-containing protein 1	NM_022842
protein binding -4	KIAA0746	KIAA0746 protein	NM_015187
protein binding -5	PSCDBP	pleckstrin homology, Sec7 and coiled-coil domains, binding protein	NM_004288
protein binding -6	SKI	v-ski sarcoma viral oncogene homolog (avian)	NM_003036
protein binding -7	SNX25	sorting nexin 25	NM_031953
protein binding -8	CDH6	cadherin 6, type 2, K-cadherin (fetal kidney)	NM_004932
protein binding -9	DCBLD2	discoidin, CUB and LCCL domain containing 2	NM_080927
protein binding -10	ENG	endoglin (Osler-Rendu-Weber syndrome 1)	NM_000118

[Table 5g]

Classification 12	Gene symbol	Gene title	Genbank number
protein modification-1	SH3RF1	SH3 domain containing ring finger 1	NM_020870
protein modification-2	SMURF2	SMAD specific E3 ubiquitin protein ligase 2	NM_022739
protein modification-3	TFPI2	tissue factor pathway inhibitor 2	NM_006528
protein modification-4	ITGB3	integrin, beta 3 (platelet glycoprotein IIIa, antigen CD61)	NM_000212
protein modification-5	MYPN	myopalladin	NM 032578
protein modification-6	LRP2BP	LRP2 binding protein	NM_018409
protein modification-7	HECW2	HECT, C2 and WW domain containing E3 ubiquitin protein ligase 2	NM_020760
protein modification-8	PKIA	protein kinase (cAMP-dependent, catalytic) inhibitor alpha	NM_006823
Classification 13	Gene symbol	Gene title	Genbank number
signal molecule-1	LYPD1	LY6/PLAUR domain containing 1	NM_144586
signal molecule-2	GATA6	GATA binding protein 6	NM_005257
signal molecule-3	RAB27B	RAB27B, member RAS oncogene family	NM_004163
signal molecule-4	SOX11	SRY (sex determining region Y)-box 11	NM_003108
signal molecule-5	ARHGAP2 2	Rho GTPase activating protein 22	NM_021226

[Table 5h]

Classification 14	Gene symbol	Gene title	Genbank number
transcription-1	ETV1	ets variant gene 1	NM_004956
transcription-2	ETV5	ets variant gene 5 (ets-related molecule)	NM_004454
transcription-3	FOXP1	forkhead box P1	NM_032682
transcription-4	HMGA2	high mobility group AT-hook 2	NM_003483
transcription-5	KLF12	Kruppel-like factor 12	NM_007249

(continued)

Classification 14	Gene symbol	Gene title	Genbank number
transcription-6	PRDM16	PR domain containing 16	NM_022114
transcription-7	SIM2	single-minded homolog 2 (Drosophila)	NM_009586
transcription-8	SUHW2	suppressor of hairy wing homolog 2 (Drosophila)	NM_080764
transcription-9	ENO1	enolase 1	NM_001428
transcription-10	MITF	microphthalmia-associated transcription factor	NM_198159
transcription-11	TCF3	transcription factor 3 (E2A immunoglobulin enhancer binding factors E12/E47)	NM_003200
transcription-12	SMYD3	SET and MYND domain containing 3	NM_022743

[Table 5i]

Classification 15	Gene symbol	Gene title	Genbank number
transport-1	ATP6V1G3	ATPase, H+ transporting, lysosomal 13kDa, V1 subunit G isoform 3	NM_133262
transport-2	KCTD16	potassium channel tetramerisation domain containing 16	NM_020768
transport-3	NUPL1	nucleoporin like 1	NM_014089
transport-4	SLC14A1	solute carrier family 14 (urea transporter), member 1 (Kidd blood group)	NM_015865
transport-5	SLC16A4	solute carrier family 16 (monocarboxylic acid transporters), member 4	NM_004696
transport-6	SLC4A4	solute carrier family 4, sodium bicarbonate cotransporter, member 4	NM_003759
transport-7	SLC9A7	solute carrier family 9 (sodium/hydrogen exchanger), isoform 7	NM_032591
transport-8	. TRPC4	transient receptor potential cation channel, subfamily C, member 4	NM_016179
transport-9	MCFD2	multiple coagulation factor deficiency 2	NM_139279
transport-10	SLC26A4	solute carrier family 26, member 4	NM_000441
transport-11	MCOLN3	mucolipin 3	NM 018298
transport-12	SLC25A37	solute carrier family 25, member 37	NM_016612
transport-13	SLC30A7	solute carrier family 30 (zinc transporter), member 7	NM_133496

[Table 5j]

Classification 16	Gene symbol	Gene title	Genbank number
others -1	FLJ38725	hypothetical protein FLJ38725	NM_153218
others -2	KIAA1913	KIAA1913	NM_052913
others -3	PHLDB2	pleckstrin homology-like domain, family B, member 2	NM_145753
others -4	PLCXD2	phosphatidylinositol-specific phospholipase C, X domain containing 2	NM_153268
others -5	SAMD3	sterile alpha motif domain containing 3	NM_001017 373

(continued)

Classification 16	Gene symbol	Gene title	Genbank number
others -6	ZNF423	zinc finger protein 423	NM_015069
others -7	FLJ33996	hypothetical protein FLJ33996	NM_175894 2
others -8	PLEKHK1	pleckstrin homology domain containing, family K member 1	NM_145307
others -9	PTOV1	prostate tumor gene 1 overexpressed gene 1	NM_017432
others -10	FAM40B	family with sequence similarity 40, member B	NM_020704
others -11	ABI3BP	ABI gene family, member 3 (NESH) binding protein	NM_015429
others -12	NHS	Nance-Horan syndrome (congenital cataracts and dental anomalies)	NM_198270
others -13	DTL	denticleless homolog (Drosophila)	NM_016448
others -14	C1GALT1	core 1 synthase, glycoprotein-N- acetylgalactosamine 3-beta-	NM_020156
others -15	CPNE8	copine VIII	NM_153634
others -16	TMEM49	transmembrane protein 49	NM_030938

9. A method for distinguishing and separating mesenchymal stem cells, the method comprising:

separating the mesenchymal stem cells distinguished by a method as set forth in any one of claims 1 to 5.

10. A cell-containing composition comprising:

mesenchymal stem cells separated by a method as set forth in claim 9; or
a multiplied culture of the mesenchymal stem cells.

11. A drug for regenerative medicine, comprising:

a cell-containing composition as set forth in claim 10.

12. A distinguishing marker for distinguishing mesenchymal stem cells, the distinguishing marker being at least one of genes having the base sequences identified with the accession numbers listed in Tables 6a to 6j.

[Table 6a]

Classification 1	Gene symbol	Gene title	Genbank number
ATP/GTP binding -1	BRIP1	BRCA1 interacting protein C-terminal helicase 1	NM_032043
ATP/GTP binding -2	PASK	PAS domain containing serine/threonine kinase	NM_015148
ATP/GTP binding -3	RAC2	ras-related C3 botulinum toxin substrate 2 (rho family, small GTP binding protein Rac2)	NM_002872
ATP/GTP binding -4	KIF18A	kinesin family member 18A	NM_031217
ATP/GTP binding -5	NEK7	NIMA (never in mitosis gene a)-related kinase 7	NM_133494
ATP/GTP binding -6	ARL4C	ADP-ribosylation factor-like	NM_005737
ATP/GTP binding -7	EDEM1	ER degradation enhancer, mannosidase alpha-like 1	NM_014674
ATP/GTP binding -8	CAMK2D	calcium/calmodulin-dependent protein kinase (CaM kinase) II delta	NM_172127

(continued)

Classification 2	Gene symbol	Gene title	Genbank number
binding -1	PDE5A	phosphodiesterase 5A, cGMp-specific	NM_001083
binding -2	RGS4	regulator of G-protein signalling 4	NM_005613
binding -3	EGFL3	EGF-like-domain, multiple 3	NM_001409
binding -4	FHL2	four and a half LIM domains	NM_001450
binding -5	HRB2	HIV-1 rev binding protein 2	NM_007043
binding -6	CAPZA1	capping protein (actin filament) muscle Z-line, alpha 1	NM_006135
binding -7	PAPPA2	pappalysin 2	NM_020318
binding -8	LOXL2	lysyl oxidase-like 2	NM_002318
binding -9	LOX	lysyl oxidase	NM_002317
binding -10	ADAMTS5	ADAM metallopeptidase with thrombospondin type 1 motif, 5 (aggrecanase-2)	NM_007038

[Table 6b]

Classification 3	Gene symbol	Gene title	Genbank number
cell growth and/or maintenance-1	CCND1	cyclin D1 (PRAD1: parathyroid adenomatosis 1)	NM_053056
cell growth and/or maintenance-2	CDC25A	cell division cycle 25A	NM_001789
cell growth and/or maintenance-3	IER3	immediate early response 3	NM_052815
cell growth and/or maintenance-4	BCL2	B-cell CLL/lymphoma 2	NM_000633
cell growth and/or maintenance-5	NALP1	NACHT, leucine rich repeat and PYD containing 1	NM_033004
cell growth and/or maintenance-6	PAK3	p21 (CDKN1A)-activated kinase 3	NM_002578
cell growth and/or maintenance-7	PODXL	podocalyxin-like	NM_001018 111
cell growth and/or maintenance-8	CCL26	chemokine (C-C motif) ligand 26	NM_006072
cell growth and/or maintenance-9	FBLN1	fibulin 1	NM_006486
cell growth and/or maintenance-10	LAMA1	laminin, alpha 1	NM_005559
cell growth and/or maintenance-11	NTNG1	netrin G1	NM_014917

[Table 6c]

Classification 4	Gene symbol	Gene title	Genbank number
cytokine -1	GDF15	growth differentiation factor 15	NM_004864
cytokine -2	IL6	interleukin 6 (interferon, beta 2)	NM_000600
cytokine-3	CTGF	connective tissue growth factor	NM_001901
cytokine -4	VEGF	vascular endothelial growth factor	NM_001025 366
cytokine -5	VEGFC	vascular endothelial growth factor C	NM_005429
cytokine -6	HGF	hepatocyte growth factor (hepapoietin A; scatter	NM_000601

(continued)

Classification 5	Gene symbol	Gene title	Genbank number
cytoskeleton-1	KRT19	keratin 19	NM_002276
cytoskeleton-2	KRTAP1-5	keratin associated protein 1-	NM_031957
cytoskeleton-3	KRTAP2-1	keratin associated protein 2-	BC012486
cytoskeleton-4	KRTHA4	keratin, hair, acidic, 4	NM_021013
cytoskeleton-5	CKAP2	cytoskeleton associated protein 2	NM_018204
cytoskeleton-6	KRTAP1-1	keratin associated protein 1-	NM_030967
cytoskeleton-7	KRT18	keratin 18	NM_000224
cytoskeleton-8	KAP2.1B	keratin associated protein 2.1B	AJ406929
cytoskeleton-9	SSH1	slingshot homolog 1 (Drosophila)	NM_018984
Classification 6	Gene symbol	Gene title	Genbank number
enzyme-1	LXN	latexin	NM_020169
enzyme-2	IFI30	interferon, gamma-inducible protein 30	NM_006332
enzyme-3	CPA4	carboxypeptidase A4	NM 016352

[Table 6d]

Classification 7	Gene symbol	Gene title	Genbank number
extracellular matrix-1	CHI3L1	chitinase 3-like 1 (cartilage glycoprotein-39)	NM_001276
extracellular matrix-2	KRT23	keratin 23 (histone deacetylase inducible)	NM_015515
extracellular matrix-3	FLG	filaggrin	NM_002016
extracellular matrix-4	ADAMTS1	a disintegrin-like and metalloprotease (reprolysin type) with thrombospondin type 1 motif, 1	NM_006988
extracellular matrix-5	FRMD5	FERM domain containing 5	NM_001031
Classification 8	Gene symbol	Gene title	Genbank number
growth factor or receptor-1	IGFBP1	insulin-like growth factor binding protein 1	NM_000596
growth factor or receptor-2	CFI	complement factor I	NM_000204
growth factor or receptor-3	ESM1	endothelial cell-specific molecule 1	NM_007036
growth factor or receptor-4	F2RL1	coagulation factor II (thrombin) receptor-like 1	NM_005242
growth factor or receptor-5	MET	met proto-oncogene (hepatocyte growth factor receptor)	NM_000245
growth factor or receptor-6	HTR7	5-hydroxytryptamine (serotonin) receptor 7 (adenylate cyclase-coupled)	NM_000872
growth factor or receptor-7	IGFBP3	insulin-like growth factor binding protein 3	NM_001013 398

[Table 6e]

Classification 9	Gene symbol	Gene title	Genbank number
membrane -1	ABHD2	abhydrolase domain containing 2	NM_007011

(continued)

Classification 9	Gene symbol	Gene title	Genbank number
membrane -2	ITGA2	integrin, alpha 2 (CD49B, alpha 2 subunit of VLA-2 receptor)	NM_002203
membrane -3	LAMA3	laminin, alpha 3	NM_198129
membrane -4	NETO2	neuropilin (NRP) and tolloid (TLL)-like 2	NM_018092
membrane -5	NTN4	netrin 4	NM_021229
membrane -6	PTGER1	prostaglandin E receptor 1 (subtype EP1), 42kDa	NM_000955
membrane -7	EPHB2	EPH receptor B2	NM_017449
membrane -8	SFRP1	secreted frizzled-related protein 1	NM_003012
membrane -9	CD33L3	CD33 antigen-like 3	NM_213602
membrane-10	GLIPR1	GLI pathogenesis-related 1 (glioma)	NM_006851
membrane -11	UGCG	UDP-glucose ceramide glucosyltransferase	NM_003358
membrane -12	ADORA1	adenosine A1 receptor	NM_000674
Classification 10	Gene symbol	Gene title	Genbank number
membrane binding protein-1	ANXA10	annexin A10	NM_007193
membrane binding protein-2	RARRES1	retinoic acid receptor responder (tazarotene induced) 1	NM_206963
membrane binding protein-3	HNT	neurotrimin	NM_016522
membrane binding protein-4	CNTNAP3	contactin associated protein-like 3	NM_033655

[Table 6f]

Classification 11	Gene symbol	Gene title	Genbank number
protein binding -1	SYT1	synaptotagmin I	NM_005639
protein binding -2	MLF1	myeloid leukemia factor 1	NM_022443
protein binding -3	CDCP1	CUB domain-containing protein 1	NM_022842
protein binding -4	KIAA0746	KIAA0746 protein	NM_015187
protein binding -5	PSCDBP	pleckstrin homology, Sec7 and coiled-coil domains, binding protein	NM_004288
protein binding -6	SKI	v-ski sarcoma viral oncogene homolog (avian)	NM_003036
protein binding -7	SNX25	sorting nexin 25	NM_031953
protein binding -8	CDH6	cadherin 6, type 2, K-cadherin (fetal kidney)	NM_004932
protein binding -9	DCBLD2	discoidin, CUB and LCCL domain containing 2	NM_080927
protein binding -10	ENG	endoglin (Osler-Rendu-Weber syndrome 1)	NM_000118

[Table 6g]

Classification 12	Gene symbol	Gene title	Genbank number
protein modification-1	SH3RF1	SH3 domain containing ring finger 1	NM_020870

(continued)

Classification 12	Gene symbol	Gene title	Genbank number
protein modification-2	SMURF2	SMAD specific E3 ubiquitin protein ligase 2	NM_022739
protein modification-3	TFPI2	tissue factor pathway inhibitor 2	NM_006528
protein modification-4	ITGB3	integrin, beta 3 (platelet glycoprotein IIIa, antigen CD61)	NM_000212
protein modification-5	MYPN	myopalladin	NM_032578
protein modification-6	LRP2BP	LRP2 binding protein	NM_018409
protein modification-7	HECW2	HECT, C2 and WW domain containing E3 ubiquitin protein ligase 2	NM_020760
protein modification-8	PKIA	protein kinase (cAMP-dependent, catalytic) inhibitor alpha	NM_006823
Classification 13	Gene symbol	Gene title	Genbank number
signal molecule-1	LYPD1	LY6/PLAUR domain containing 1	NM_144586
signal molecule-2	GATA6	GATA binding protein 6	NM_005257
signal molecule-3	RAB27B	RAB27B, member RAS oncogene family	NM_004163
signal molecule-4	SOX11	SRY (sex determining region Y)-box 11	NM_003108
signal molecule-5	ARHGAP2 2	Rho GTPase activating protein 22	NM_021226

[Table 6h]

Classification 14	Gene symbol	Gene title	Genbank number
transcription-1	ETV1	ets variant gene 1	NM_004956
transcription-2	ETV5	ets variant gene 5 (ets-related molecule)	NM_004454
transcription-3	FOXP1	forkhead box P1	NM_032682
transcription-4	HMGA2	high mobility group AT-hook 2	NM_003483
transcription-5	KLF12	Kruppel-like factor 12	NM_007249
transcription-6	PRDM16	PR domain containing 16	NM_022114
transcription-7	SIM2	single-minded homolog 2 (Drosophila)	NM_009586
transcription-8	SUHW2	suppressor of hairy wing homolog 2 (Drosophila)	NM_080764
transcription-9	ENO1	enolase 1	NM_001428
transcription-10	MITF	microphthalmia-associated	NM_198159
transcription-11	TCF3	transcription factor 3 (E2A immunoglobulin enhancer binding factors E12/E47)	NM_003200
transcription-12	SMYD3	SET and MYND domain containing 3	NM_022743

[Table 6i]

Classification 15	Gene symbol	Gene title	Genbank number
transport-1	ATP6V1G3	ATPase, H+ transporting, lysosomal 13kDa, V1 subunit G isoform 3	NM_133262
transport-2	KCTD16	potassium channel tetramerisation domain containing 16	NM_020768

(continued)

Classification 15	Gene symbol	Gene title	Genbank number
transport-3	NUPL1	nucleoporin like 1	NM_014089
transport-4	SLC14A1	solute carrier family 14 (urea transporter), member 1 (Kidd blood group)	NM_015865
transport-5	SLC16A4	solute carrier family 16 (monocarboxylic acid transporters), member 4	NM_004696
transport-6	SLC4A4	solute carrier family 4, sodium bicarbonate cotransporter, member 4	NM_003759
transport-7	SLC9A7	solute carrier family 9 (sodium/hydrogen exchanger), isoform 7	NM_032591
transport-8	TRPC4	transient receptor potential cation channel, subfamily C, member 4	NM_016179
transport-9	MCFD2	multiple coagulation factor deficiency 2	NM_139279
transport-10	SLC26A4	solute carrier family 26, member 4	NM_000441
transport-11	MCOLN3	mucolipin 3	NM_018298
transport-12	SLC25A37	solute carrier family 25, member 37	NM_016612
transport-13	SLC30A7	solute carrier family 30 (zinc transporter), member 7	NM_133496

[Table 6j]

Classification 16	Gene symbol	Gene title	Genbank number
others -1	FLJ38725	hypothetical protein FLJ38725	NM_153218
others -2	KIAA1913	KLAA1913	NM_052913
others -3	PHLDB2	pleckstrin homology-like NM_145753 domain, family B, member 2	
others -4	PLCXD2	phosphatidylinositol-specific phospholipase C, X domain containing 2	NM_153268
others -5	SAMD3	sterile alpha motif domain containing 3	NM_001017 373
others -6	ZNF423	zinc finger protein 423	NM_015069
others -7	FLJ33996	hypothetical protein FLJ33996	NM_175894. 2
others -8	PLEKHK1	pleckstrin homology domain containing, family K member 1	NM_145307
others -9	PTOV1	prostate tumor overexpressed gene 1	NM_017432
others -10	FAM40B	family with sequence similarity 40, member B	NM_020704
others -11	ABI3BP	ABI gene family, member 3 (NESH) binding protein	NM_015429
others -12	NHS	Nance-Horan syndrome (congenital cataracts and dental anomalies)	NM_198270
others -13	DTL	denticleless homolog (Drosophila)	NM_016448
others -14	C1GALT1	core 1 synthase, glycoprotein-N-acetylgalactosamine 3-beta-	NM_020156
others -15	CPNE8	copine VIII	NM_153634
others -16	TMEM49	transmembrane protein 49	NM_030938

13. A distinguishing marker for distinguishing mesenchymal stem cells, the distinguishing marker being at least one of polypeptides encoded by genes having the base sequences identified with the accession numbers listed in Tables 7a to 7j.

[Table 7a]

Classification 1	Gene symbol	Gene title	Genbank number
ATP/GTP binding -1	BRIP1	BRCA1 interacting protein C-terminal helicase 1	NM_032043
ATP/GTP binding -2	PASK	PAS domain containing serine/threonine kinase	NM_015148
ATP/GTP binding -3	RAC2	ras-related C3 botulinum toxin substrate 2 (rho family, small GTP binding protein Rac2)	NM_002872
ATP/GTP binding -4	KIF18A	kinesin family member 18A	NM_031217
ATP/GTP binding -5	NEK7	NIMA (never in mitosis gene a)-related kinase 7	NM_133494
ATP/GTP binding -6	ARL4C	ADP-ribosylation factor-like	NM_005737
ATP/GTP binding -7	EDEM1	ER degradation enhancer, mannosidase alpha-like 1	NM_014674
ATP/GTP binding -8	CAMK2D	calcium/calmodulin-dependent protein kinase (CaM kinase) II delta	NM_172127
Classification 2	Gene symbol	Gene title	Genbank number
binding -1	PDE5A	phosphodiesterase 5A, cGMP-specific	NM_001083
binding -2	RGS4	regulator of G-protein signalling 4	NM_005613
binding -3	EGFL3	EGF-like-domain, multiple 3	NM_001409
binding -4	FHL2	four and a half LIM domains 2	NM_001450
binding -5	HRB2	HIV-1 rev binding protein 2	NM_007043
binding -6	CAPZA1	capping protein (actin filament) muscle Z-line, alpha 1	NM_006135
binding -7	PAPPA2	pappalysin 2	NM_020318
binding -8	LOXL2	lysyl oxidase-like 2	NM_002318
binding -9	LOX	lysyl oxidase	NM_002317
binding -10	ADAMTS5	ADAM metallopeptidase with thrombospondin type 1 motif, 5 (aggrecanase-2)	NM_007038

[Table 7b]

Classification 3	Gene symbol	Gene title	Genbank number
cell growth and/or maintenance-1	CCND1	cyclin D1 (PRAD1: parathyroid adenomatosis 1)	NM_053056
cell growth and/or maintenance-2	CDC25A	cell division cycle 25A	NM_001789
cell growth and/or maintenance-3	IER3	immediate early response 3	NM_052815
cell growth and/or maintenance-4	BCL2	B-cell CLL/lymphoma 2	NM_000633
cell growth and/or maintenance-5	NALP1	NACHT, leucine rich repeat and PYD containing 1	NM_033004
cell growth and/or maintenance-6	PAK3	p21 (CDKN1A)-activated kinase 3	NM_002578
cell growth and/or maintenance-7	PODXL	podocalyxin-like	NM_001018 111
cell growth and/or maintenance-8	CCL26	chemokine (C-C motif) ligand 26	NM_006072
cell growth and/or maintenance-9	FBLN1	fibulin 1	NM_006486

(continued)

Classification 3	Gene symbol	Gene title	Genbank number
cell growth and/or maintenance-10	LAMA1	laminin, alpha 1	NM _005559
cell growth and/or maintenance-11	NTNG1	netrin G1	NM_014917

[Table 7c]

Classification 4	Gene symbol	Gene title	Genbank number
cytokine -1	GDF15	growth 15 differentiation factor	NM_004864
cytokine -2	IL6	interleukin 6 (interferon, beta 2)	NM_000600
cytokine -3	CTGF	connective tissue growth factor	NM_001901
cytokine -4	VEGF	vascular endothelial growth factor	NM_001025 366
cytokine -5	VEGFC	vascular endothelial growth factor C	NM_005429
cytokine -6	HGF	hepatocyte growth factor (hepapoietin A; scatter	NM_000601
Classification 5	Gene symbol	Gene title	Genbank number
cytoskeleton-1	KRT19	keratin 19	NM_002276
cytoskeleton-2	KRTAP1-5	keratin associated protein 1-	NM_031957
cytoskeleton-3	KRTAP2-1	keratin associated protein 2-	BC012486
cytoskeleton-4	KRTHA4	keratin, hair, acidic, 4	NM_021013
cytoskeleton-5	CKAP2	cytoskeleton associated protein 2	NM_018204
cytoskeleton-6	KRTAP1-1	keratin associated protein 1-	NM_030967
cytoskeleton-7	KRT18	keratin 18	NM_000224
cytoskeleton-8	KAP2.1B	keratin associated protein 2.1B	AJ406929
cytoskeleton-9	SSH1	slingshot homolog 1 (Drosophila)	NM_018984
Classification 6	Gene symbol	Gene title	Genbank number
enzyme-1	LXN	latexin	NM_020169
enzyme-2	IFI30	interferon, gamma-inducible protein 30	NM_006332
enzyme-3	CPA4	carboxypeptidase A4	NM_016352

[Table 7d]

Classification 7	Gene symbol	Gene title	Genbank number
extracellular matrix-1	CHI3L1	chitinase 3-like 1 (cartilage glycoprotein-39)	NM_001276
extracellular matrix-2	KRT23	keratin 23 (histone deacetylase inducible)	NM_015515
extracellular matrix-3	FLG	filaggrin	NM_002016
extracellular matrix-4	ADAMTS1	a disintegrin-like and metalloprotease (reprolysin type) With thrombospondin type 1 motif, 1	NM_006988
extracellular matrix-5	FRMD5	FERM domain containing 5	NM_001031
Classification 8	Gene symbol	Gene title	Genbank number
growth factor or receptor-1	IGFBP1	insulin-like growth factor binding protein 1	NM_000596

(continued)

Classification 8	Gene symbol	Gene title	Genbank number
growth factor or receptor-2	CFI	complement factor I	NM_000204
growth factor or receptor-3	ESM1	endothelial cell-specific molecule 1	NM_007036
growth factor or receptor-4	F2RL1	coagulation factor II (thrombin) receptor-like 1	NM_005242
growth factor or receptor-5	MET	met proto-oncogene (hepatocyte growth factor receptor)	NM_000245
growth factor or receptor-6	HTR7	5-hydroxytryptamine (serotonin) receptor 7 (adenylate cyclase-coupled)	NM_000872
growth factor or receptor-7	IGFBP3	insulin-like growth factor binding protein 3	NM_001013 398

[Table 7e]

Classification 9	Gene symbol	Gene title	Genbank number
membrane -1	ABHD2	abhydrolase domain containing 2	NM_007011
membrane -2	ITGA2	integrin, alpha 2 (CD49B, alpha 2 subunit of VLA-2 receptor)	NM_002203
membrane -3	LAMA3	laminin, alpha 3	NM_198129
membrane -4	NETO2	neuropilin (NRP) and tolloid (TLL)-like 2	NM_018092
membrane -5	NTN4	netrin 4	NM_021229
membrane -6	PTGER1	prostaglandin E receptor 1 (subtype EP1), 42kDa	NM_000955
membrane -7	EPHB2	EPH receptor B2	NM_017449
membrane -8	SFRP1	secreted frizzled-related protein 1	NM_003012
membrane -9	CD33L3	CD33 antigen-like 3	NM_213602
membrane -10	GLIPR1	GLI pathogenesis-related 1 NM_ (glioma)	006851
membrane -11	UGCG	UDP-glucose ceramide glucosyltransferase	NM_003358
membrane -12	ADORA1	adenosine A1 receptor	NM_000674
Classification 10	Gene symbol	Gene title	Genbank number
membrane binding protein-1	ANXA10	annexin A10	NM_007193
membrane binding protein-2	RARRES1	retinoic acid receptor responder (tazarotene induced) 1	NM_206963
membrane binding protein-3	HNT	neurotrimin	NM_016522
membrane binding protein-4	CNTNAP3	contactin associated protein-like 3	NM_033655

[Table 7f]

Classification 11	Gene symbol	Gene title	Genbank number
protein binding -1	SYT1	synaptotagmin I	NM_005639
protein binding -2	MLF1	myeloid leukemia factor 1	NM_022443
protein binding -3	CDCP1	CUB domain-containing protein 1	NM_022842

(continued)

Classification 11	Gene symbol	Gene title	Genbank number
protein binding -4	KIAA0746	KIAA0746 protein	NM_015187
protein binding -5	PSCDBP	pleckstrin homology, Sec7 and coiled-coil domains, binding protein	NM_004288
protein binding -6	SKI	v-ski sarcoma viral oncogene homolog (avian)	NM_003036
protein binding -7	SNX25	sorting nexin 25	NM_031953
protein binding -8	CDH6	cadherin 6, type 2, K-cadherin (fetal kidney)	NM_004932
protein binding-9	DCBLD2	discoidin, CUB and LCCL domain containing 2	NM_080927
protein binding -10	ENG	endoglin (Osler-Rendu-Weber syndrome 1)	NM_000118

[Table 7g]

Classification 12	Gene symbol	Gene title	Genbank number
protein modification-1	SH3RF1	SH3 domain containing ring finger 1	NM_020870
protein modification-2	SMURF2	SMAD specific E3 ubiquitin protein ligase 2	NM_022739
protein modification-3	TFPI2	tissue factor pathway inhibitor 2	NM_006528
protein modification-4	ITGB3	integrin, beta 3 (platelet glycoprotein IIIa, antigen CD61)	NM_000212
protein modification-5	MYPN	myopalladin	NM_032578
protein modification-6	LRP2BP	LRP2 binding protein	NM_018409
protein modification-7	HECW2	HECT, C2 and WW domain containing E3 ubiquitin protein ligase 2	NM_020760
protein modification-8	PKIA	protein kinase (cAMP-dependent, catalytic) inhibitor alpha	NM_006823
Classification 13	Gene symbol	Gene title	Genbank number
signal molecule-1	LYPD1	LY6/PLAUR domain containing 1	NM_144586
signal molecule-2	GATA6	GATA binding protein 6	NM_005257
signal molecule-3	RAB27B	RAB27B, member RAS oncogene family	NM_004163
signal molecule-4	SOX11	SRY (sex determining region Y)-box 11	NM_003108
signal molecule-5	ARHGAP2 2	Rho GTPase activating protein 22	NM_021226

[Table 7h]

Classification 14	Gene symbol	Gene title	Genbank number
transcription-1	ETV1	ets variant gene 1	NM_004956
transcription-2	ETV5	ets variant gene 5 (ets-related molecule)	NM_004454
transcription-3	FOXP1	forkhead box P1	NM_032682
transcription-4	HMGA2	high mobility group AT-hook 2	NM_003483
transcription-5	KLF12	Kruppel-like factor 12	NM_007249
transcription-6	PRDM16	PR domain containing 16	NM_022114

(continued)

Classification 14	Gene symbol	Gene title	Genbank number
transcription-7	SIM2	single-minded homolog 2 (Drosophila)	NM_009586
transcription-8	SUHW2	suppressor of hairy wing homolog 2 (Drosophila)	NM_080764
transcription-9	ENO1	enolase 1	NM_001428
transcription-10	MITF	microphthalmia-associated transcription factor	NM_198159
transcription-11	TCF3	transcription factor 3 (E2A immunoglobulin enhancer binding factors E12/E47)	NM_003200
transcription-12	SMYD3	SET and MYND domain containing 3	NM_022743

[Table 7i]

Classification 15	Gene symbol	Gene title	Genbank number
transport-1	ATP6V1G3	ATPase, H+ transporting, lysosomal 13kDa, V1 subunit G isoform 3	NM_133262
transport-2	KCTD16	potassium channel tetramerisation domain containing 16	NM_020768
transport-3	NUPL1	nucleoporin like 1	NM_014089
transport-4	SLC14A1	solute carrier family 14 (urea transporter), member 1 (Kidd blood group)	NM_015865
transport-5	SLC16A4	solute carrier family 16 (monocarboxylic acid transporters), member 4	NM_004696
transport-6	SLC4A4	solute carrier family 4, sodium bicarbonate cotransporter, member 4	NM_003759
transport-7	SLC9A7	solute carrier family 9 (sodium/hydrogen exchanger), isoform 7	NM_032591
transport-8	TRPC4	transient receptor potential cation channel, subfamily C, member 4	NM_016179
transport-9	MCFD2	multiple coagulation factor deficiency 2	NM_139279
transport-10	SLC26A4	solute carrier family 26, member 4	NM_000441
transport-11	MCOLN3	mucolipin 3	NM_018298
transport-12	SLC25A37	solute carrier family 25, member 37	NM_016612
transport-13	SLC30A7	solute carrier family 30 (zinc transporter), member 7	NM_133496

[Table 7j]

Classification 16	Gene symbol	Gene title	Genbank number
others -1	FLJ38725	hypothetical protein FLJ38725	NM_153218
others -2	KIAA1913	KIAA1913	NM 052913
others -3	PHLDB2	pleckstrin homology-like domain, family B, member 2	NM_145753
others -4	PLCXD2	phosphatidylinositol-specific phospholipase C, X domain containing 2	NM_153268
others 5	SAMD3	sterile alpha motif domain containing 3	NM_001017 373
others -6	ZNF423	zinc finger protein 423	NM_015069

(continued)

Classification 16	Gene symbol	Gene title	Genbank number
others -7	FLJ33996	hypothetical protein FLJ33996	NM_175894. 2
others -8	PLEKHK1	pleckstrin homology domain containing, family K member 1	NM_145307
others -9	PTOV1	prostate tumor overexpressed gene 1	NM_017432
others -10	FAM40B	family with sequence similarity 40, member B	NM_020704
others -11	ABI3BP	ABI gene family, member 3 (NESH) binding protein	NM_015429
others -12	NHS	Nance-Horan syndrome (congenital cataracts and dental anomalies)	NM_198270
others -13	DTL	denticleless homolog (Drosophila)	NM_016448
others -14	C1GALT1	core 1 synthase, glycoprotein-N- acetylgalactosamine 3-beta-	NM_020156
others -15	CPNE8	copine VIII	NM 153634
others -16	TMEM49	transmembrane protein 49	NM 030938

14. A method of judging whether a sample provider has been developed a disease related with mesenchymal stem cells or whether the sample provider has a possibility of developing the disease in the future, the method judging by treating a sample, which is separated *in vivo* from the sample provider, with any one or more of:

a method as set forth in any one of claims 1 to 5;
a microarray as set forth in claim 6;
an antibody as set forth in claim 7;
a kit as set forth in claim 8; and
a distinguishing marker as set forth in claim 12 or 13.

15. A drug for regenerative medicine, the drug suppressing undifferentiating property of mesenchymal stem cells and comprising siRNA for a gene or a partial sequence thereof, the gene having any one of the base sequences identified with the accession numbers listed in Tables 8a to 8j.

[Table 8a]

Classification 1	Gene symbol	Gene title	Genbank number
ATP/GTP binding -1	BRIP1	BRCA1 interacting protein C-terminal helicase 1	NM_032043
ATP/GTP binding -2	PASK	PAS domain containing serine/threonine kinase	NM_015148
ATP/GTP binding -3	RAC2	ras-related C3 botulinum toxin substrate 2 (rho family, small GTP binding protein Rac2)	NM_002872
ATP/GTP binding -4	KIF18A	kinesin family member 18A	NM_031217
ATP/GTP binding -5	NEK7	NIMA (never in mitosis gene a)-related kinase 7	NM_133494
ATP/GTP binding -6	ARL4C	ADP-ribosylation factor-like 4C	NM_005737
ATP/GTP binding -7	EDEM1	ER degradation enhancer, mannosidase alpha-like 1	NM_014674
ATP/GTP binding -8	CAMK2D	calcium/calmodulin-dependent protein kinase (CaM kinase) II delta	NM_172127
Classification 2	Gene symbol	Gene title	Genbank number
binding -1	PDE5A	phosphodiesterase 5A, cGMP-specific	NM_001083
binding -2	RGS4	regulator of G-protein signalling 4	NM_005613
binding -3	EGFL3	EGF-like-domain, multiple 3	NM_001409

(continued)

Classification 2	Gene symbol	Gene title	Genbank number
binding -4	FHL2	four and a half LIM domains 2	NM_001450
binding -5	HRB2	HIV-1 rev binding protein 2	NM 007043
binding -6	CAPZA1	capping protein (actin filament) muscle Z-line, alpha 1	NM_006135
binding -7	PAPPA2	pappalysin 2	NM_020318
binding -8	LOXL2	lysyl oxidase-like 2	NM_002318
binding -9	LOX	lysyl oxidase	NM_002317
binding -10	ADAMTS5	ADAM metallopeptidase with thrombospondin type 1 motif, 5 (aggrecanase-2)	NM_007038

[Table 8b]

Classification 3	Gene symbol	Gene title	Genbank number
cell growth and/or maintenance-1	CCND1	cyclin D1 (PRAD1: parathyroid adenomatosis 1)	NM_053056
cell growth and/or maintenance-2	CDC25A	cell division cycle 25A	NM_001789
cell growth and/or maintenance-3	IER3	immediate early response 3	NM_052815
cell growth and/or maintenance-4	BCL2	B-cell CLL/lymphoma 2	NM_000633
cell growth and/or maintenance-5	NALP1	NACHT, leucine rich repeat and PYD containing 1	NM_033004
cell growth and/or maintenance-6	PAK3	p21 (CDKN1A)-activated kinase 3	NM_002578
cell growth and/or maintenance-7	PODXL	podocalyxin-like	NM_001018 111
cell growth and/or maintenance-8	CCL26	chemokine (C-C motif) ligand 26	NM_006072
cell growth and/or maintenance-9	FBLN1	fibulin 1	NM_006486
cell growth and/or maintenance-10	LAMA1	laminin, alpha 1	NM_005559
cell growth and/or maintenance-11	NTNG1	netrin G1	NM_014917

[Table 8c]

Classification 4	Gene symbol	Gene title	Genbank number
cytokine -1	GDF15	growth differentiation factor	NM_004864
cytokine-2	IL6	interleukin 6 (interferon, beta 2)	NM_000600
cytokine -3	CTGF	connective tissue growth factor	NM_001901
cytokine -4	VEGF	vascular endothelial growth factor	NM_001025 366
cytokine -5	VEGFC	vascular endothelial growth factor C	NM_005429
cytokine -6	HGF	hepatocyte growth factor (hepapoietin A; scatter	NM_000601
Classification 5	Gene symbol	Gene title	Genbank number
cytoskeleton-1	KRT19	keratin 19	NM_002276
cytoskeleton-2	KRTAP1-5	keratin associated protein 1-	NM_031957
cytoskeleton-3	KRTAP2-1	keratin associated protein 2-	BC012486

(continued)

Classification 5	Gene symbol	Gene title	Genbank number
cytoskeleton-4	KRTHA4	keratin, hair, acidic, 4	NM_021013
cytoskeleton-5	CKAP2	cytoskeleton associated protein 2	NM_018204
cytoskeleton-6	KRTAP1-1	keratin associated protein 1-	NM_030967
cytoskeleton-7	KRT18	keratin 18	NM_000224
cytoskeleton-8	KAP2.1B	keratin associated protein 2.1B	AJ406929
cytoskeleton-9	SSH1	slingshot homolog 1 (Drosophila)	NM_018984
Classification 6	Gene symbol	Gene title	Genbank number
enzyme-1	LXN	latexin	NM_020169
enzyme-2	IFI30	interferon, gamma-inducible protein 30	NM_006332
enzyme-3	CPA4	carboxypeptidase A4	NM_016352

[Table 8d]

Classification 7	Gene symbol	Gene title	Genbank number
extracellular matrix-1	CHI3L1	chitinase 3-like 1 (cartilage glycoprotein-39)	NM_001276
extracellular matrix-2	KRT23	keratin 23 (histone deacetylase inducible)	NM_015515
extracellular matrix-3	FLG	filaggrin	NM_002016
extracellular matrix-4	ADAMTS1	a disintegrin-like and metalloprotease (reprolysin type) With thrombospondin type 1 motif, 1	NM_006988
extracellular matrix-5	FRMD5	FERM domain containing 5	NM_001031
Classification 8	Gene symbol	Gene title	Genbank number
growth factor or receptor-1	IGFBP1	insulin-like growth factor binding protein 1	NM_000596
growth factor or receptor-2	CFI	complement factor I	NM_000204
growth factor or receptor-3	ESM1	endothelial cell-specific molecule 1	NM_007036
growth factor or receptor-4	F2RL1	coagulation factor II (thrombin) receptor-like 1	NM_005242
growth factor or receptor-5	MET	met proto-oncogene (hepatocyte growth factor receptor)	NM_000245
growth factor or receptor-6	HTR7	5-hydroxytryptamine (serotonin) receptor 7 (adenylate cyclase-coupled)	NM_000872
growth factor or receptor-7	IGFBP3	insulin-like growth factor binding protein 3	NM_001013 398

[Table 8e]

Classification 9	Gene symbol	Gene title	Genbank number
membrane -1	ABHD2	abhydrolase domain containing 2	NM_007011
membrane -2	ITGA2	integrin, alpha 2 (CD49B, alpha 2 subunit of VLA-2 receptor)	NM_002203
membrane -3	LAMA3	laminin, alpha 3	NM_198129
membrane-4	NETO2	neuropilin (NRP) and tolloid (TLL)-like 2	NM_018092

(continued)

Classification 9	Gene symbol	Gene title	Genbank number
membrane -5	NTN4	netrin 4	NM_021229
membrane -6	PTGER1	prostaglandin E receptor 1 (subtype EP1), 42kDa	NM_000955
membrane -7	EPHB2	EPH receptor B2	NM_017449
membrane -8	SFRP1	secreted frizzled-related protein 1	NM _003012
membrane -9	CD33L3	CD33 antigen-like 3	NM_213602
membrane -10	GLIPR1	GLI pathogenesis-related 1 (glioma)	NM_006851
membrane -11	UGCG	UDP-glucose ceramide glucosyltransferase	NM_003358
membrane -12	ADORA1	adenosine A1 receptor	NM_000674
Classification 10	Gene symbol	Gene title	Genbank number
membrane binding protein-1	ANYA10	annexin A10	NM_007193
membrane binding protein-2	RARRES1	retinoic acid receptor responder (tazarotene induced) 1	NM_206963
membrane binding protein-3	HNT	neurotrimin	NM_016522
membrane binding protein-4	CNTNAP3	contactin associated protein-like 3	NM_033655

[Table 8f]

Classification 11	Gene symbol	Gene title	Genbank number
protein binding -1	SYT1	synaptotagmin I	NM_005639
protein binding -2	MLF1	myeloid leukemia factor 1	NM_022443
protein binding -3	CDCP1	CUB domain-containing protein 1	NM_022842
protein binding -4	KIAA0746	KIAA0746 protein	NM_015187
protein binding -5	PSCDBP	pleckstrin homology, Sec7 and coiled-coil domains, binding protein	NM_004288
protein binding -6	SKI	v-ski sarcoma viral oncogene homolog (avian)	NM_003036
protein binding -7	SNX25	sorting nexin 25	NM_031953
protein binding -8	CDH6 cadherin (fetal kidney)	cadherin 6, type 2, K-	NM_004932
protein binding -9	DCBLD2	discoidin, CUB and LCCL domain containing 2	NM_080927
protein binding -10	ENG	endoglin (Osler-Rendu-Weber syndrome 1)	NM_000118

[Table 8g]

Classification 12	Gene symbol	Gene title	Genbank number
protein modification-1	SH3RF1	SH3 domain containing ring finger 1	NM_020870
protein modification-2	SMURF2	SMAD specific E3 ubiquitin protein ligase 2	NM_022739
protein modification-3	TFPI2	tissue factor pathway inhibitor 2	NM_006528

(continued)

Classification 12	Gene symbol	Gene title	Genbank number
protein modification-4	ITGB3	integrin, beta 3 (platelet glycoprotein IIIa, antigen CD61)	NM_000212
protein modification-5	MYPN	myopalladin	NM_032578
protein modification-6	LRP2BP	LRP2 binding protein	NM_018409
protein modification-7	HECW2	HECT, C2 and WW domain containing E3 ubiquitin protein ligase 2	NM_020760
protein modification-8	PKIA	protein kinase (cAMP-dependent, catalytic) inhibitor alpha	NM_006823
Classification 13	Gene symbol	Gene title	Genbank number
signal molecule-1	LYPD1	LY6/PLAUR domain containing 1	NM_144586
signal molecule-2	GATA6	GATA binding protein 6	NM_005257
signal molecule-3	RAB27B	RAB27B, member RAS oncogene family	NM_004163
signal molecule-4	SOX11	SRY (sex determining region Y)-box 11	NM_003108
signal molecule-5	ARHGAP2 2	Rho GTPase activating protein 22	NM_021226

[Table 8h]

Classification 14	Gene symbol	Gene title	Genbank number
transcription-1	ETV1	ets variant gene 1	NM_004956
transcription-2	ETV5	ets variant gene 5 (ets-related molecule)	NM_004454
transcription-3	FOXP1	forkhead box P1	NM_032682
transcription-4	HMGA2	high mobility group AT-hook 2	NM_003483
transcription-5	KLF12	Kruppel-like factor 12	NM_007249
transcription-6	PRDM16	PR domain containing 16	NM_022114
transcription-7	SIM2	single-minded homolog 2 (Drosophila)	NM_009586
transcription-8	SUHW2	suppressor of hairy wing homolog 2 (Drosophila)	NM_080764
transcription-9	ENO1	enolase 1	NM_001428
transcription-10	MITF	microphthalmia-associated transcription factor transcription factor	NM_198159
transcription-11	TCF3	transcription factor 3 (E2A immunoglobulin enhancer binding factors E12/E47)	NM_003200
transcription-12	SMYD3	SET and MYND domain containing 3	NM_022743

[Table 8i]

Classification 15	Gene symbol	Gene title	Genbank number
transport-1	ATP6V1G3	ATPase, H+ transporting, lysosomal 13kDa, V1 subunit G isoform 3	NM_133262
transport-2	KCTD16	potassium channel tetramerisation domain containing 16	NM_020768
transport-3	NUPL1	nucleoporin like 1	NM_014089

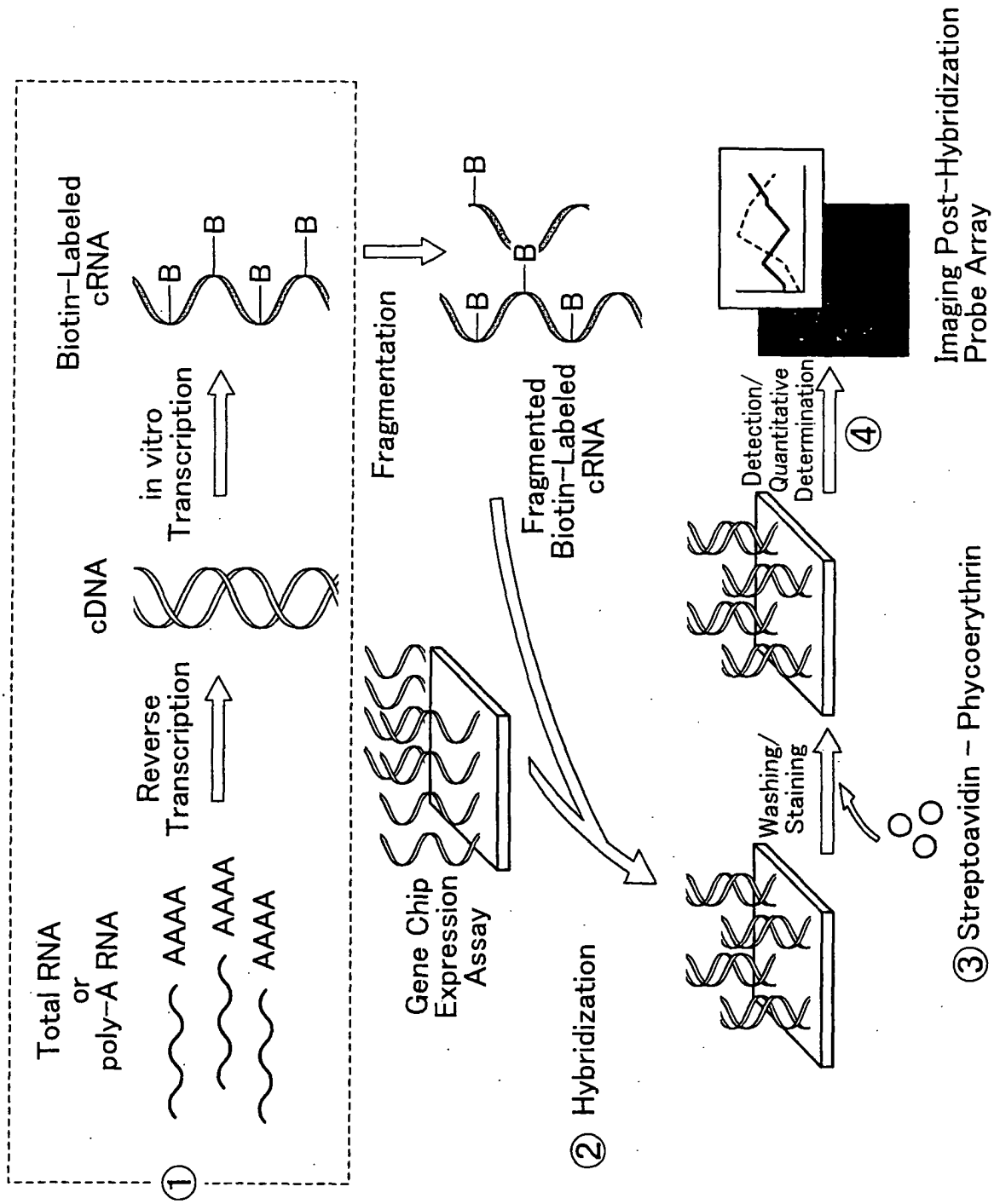
(continued)

Classification 15	Gene symbol	Gene title	Genbank number
transport-4	SLC14A1	solute carrier family 14 (urea transporter), member 1 (Kidd blood group)	NM_015865
transport-5	SLC16A4	solute carrier family 16 (monocarboxylic acid transporters), member 4	NM_004696
transport-6	SLC4A4	solute carrier family 4, sodium bicarbonate cotransporter, member 4	NM_003759
transport-7	SLC9A7	solute carrier family 9 (sodium/hydrogen exchanger), isoform 7	NM_032591
transport-8	TRPC4	transient receptor potential cation channel, subfamily C, member 4	NM_016179
transport-9	MCFD2	multiple coagulation factor deficiency 2	NM_139279
transport-10	SLC26A4	solute carrier family 26, member 4	NM_000441
transport-11	MCOLN3	mucolipin 3	NM_018298
transport-12	SLC25A37	solute carrier family 25, member 37	NM_016612
transport-13	SLC30A7	solute carrier family 30 (zinc transporter), member 7	NM_133496

[Table 8j]

Classification 16	Gene symbol	Gene title	Genbank number
others -1	FLJ38725	hypothetical protein FLJ38725	NM_153218
others -2	KIAA1913	KIAA1913	NM_052913
others -3	PHLDB2	pleckstrin homology-like domain, family B, member 2	NM_145753
others -4	PLCXD2	phosphatidylinositol-specific phospholipase C, X domain containing 2	NM_153268
others -5	SAMD3	sterile alpha motif domain containing 3	NM_001017 373
others -6	ZNF423	zinc finger protein 423	NM_015069
others -7	FLJ33996	hypothetical protein FLJ33996	NM_175894. 2
others -8	PLEKHK1	pleckstrin homology domain containing, family K member 1	NM_145307
others -9	PTOV1	prostate tumor overexpressed gene 1	NM_017432
others -10	FAM40B	family with sequence similarity 40, member B	NM_020704
others -11	ABI3BP	ABI gene family, member 3 (NESH) binding protein	NM_015429
others -12	NHS	Nance-Horan syndrome (congenital cataracts and dental anomalies)	NM_198270
others -13	DTL	denticleless homolog (Drosophila)	NM_016448
others -14	C1GALT1	core 1 synthase, glycoprotein-N-acetylgalactosamine 3-beta-	NM_020156
others -15	CPNE8	copine VIII	NM_153634
others -16	TMEM49	transmembrane protein 49	NM_030938

FIG. 1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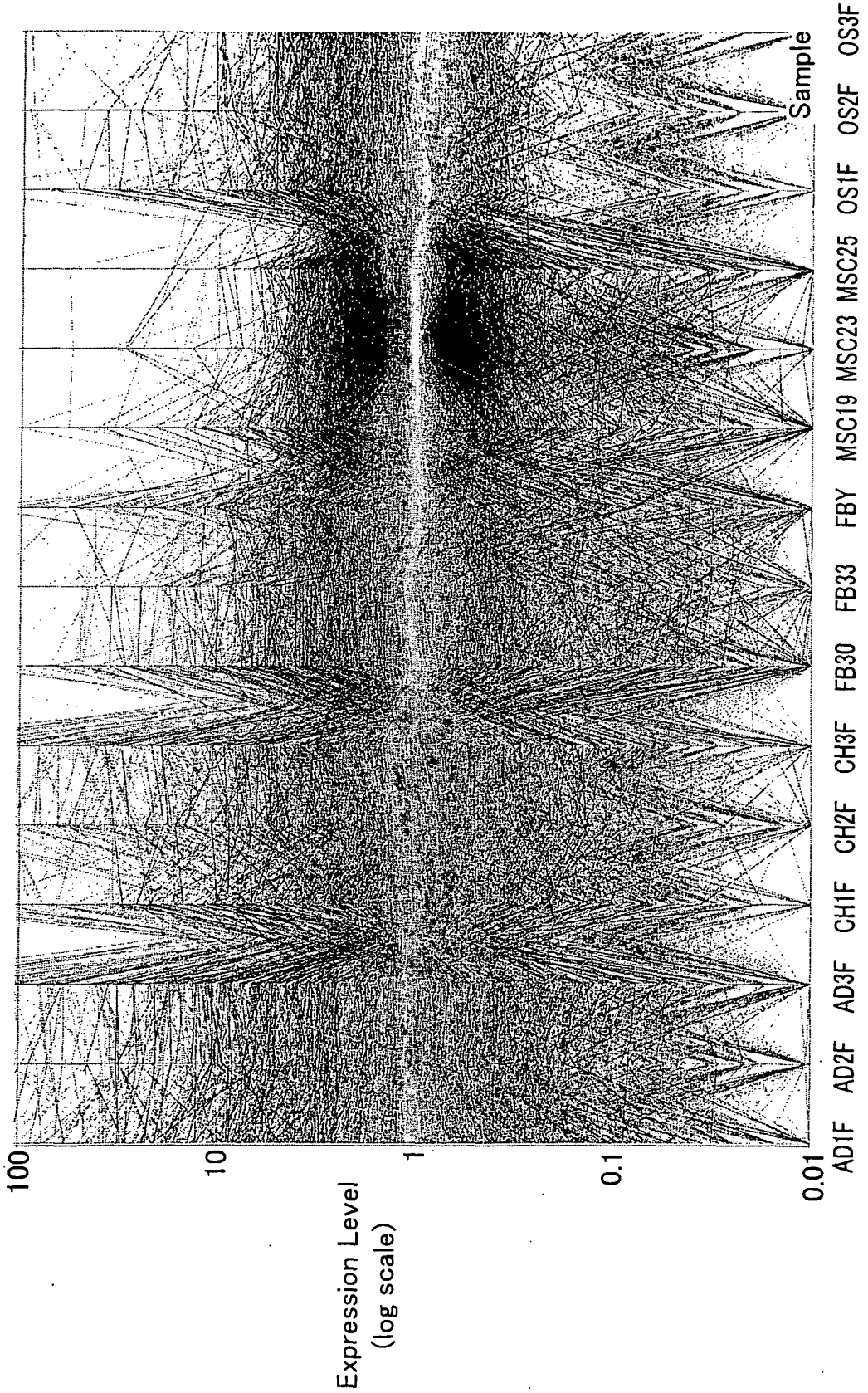
or
poly-A RNA
AAAA
AAAA
AAAA
①
Reverse
Transcription
cDNA
in vitro
Transcription
Biotin-Labeled
cRNA
B
Fragmentation
Fragmented
Biotin-Labeled
cRNA
Gene Chip
Expression
Assay
② Hybridization
Washing/
Staining
③ Streptoavidin - Phycoerythrin
Detection/
Quantitative
Determination
④
Imaging Post-Hybridization
Probe Array

FIG. 2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1
0.1
0.01
Expression Level
(log scale)
AD1F AD2F AD3F CH1F CH2F CH3F FB30 FB33 FBY MSC19 MSC23 MSC25 OS1F OS2F OS3F
Sample

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2006/306658

A. CLASSIFICATION OF SUBJECT MATTER
C12N15/00(2006.01), ***C07K16/18***(2006.01), ***C07K16/22***(2006.01), ***C07K16/24***(2006.01), ***C07K16/28***(2006.01), ***C07K16/40***(2006.01), ***C07K16/44***(2006.01), ***C12M1/00***(2006.01), ***C12N5/06***(2006.01), ***C12N15/09***(2006.01),
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C12N15/00-15/90, C12N1/00-7/08, C07K16/00-16/48, C12M1/00, C12Q1/00-1/70, *G01N33/53*(2006.01), *G01N37/00*(2006.01), A61L27/00, C07K14/00-14/825, C12N9/00-9/99

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2006
Kokai Jitsuyo Shinan Koho	1971-2006	Toroku Jitsuyo Shinan Koho	1994-2006

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
BIOSIS/MEDLINE/WPIDS(STN), JMEDPlus(JDream2), JSTPlus(JDream2), GenBank/EMBL/DDBJ/GeneSeq

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X/Y	JP 2004-290189 A (Japan Science and Technology Agency, Yukio KATO, Two Cells Co., Ltd.), 21 October, 2004 (21.10.04), & WO 2004/081174 A2	1,5-9,12,13/ 2-4,10,11,15
Y	CONNOR, J.R. et al., "Human cartilage glycoprotein 39(HC gp-39) mRNA expression in adult and fetal, chondrocytes, osteoblasts and osteocytes by in-situ hybridization.", Osteoarthritis and Cartilage (2000), Vol.8, pages 87 to 95	2-4
Y	Akira IGARASHI et al., "Saisei Iryo ni Okeru Ishokuyo Kanyokei Kansaibo no Kentei no Juyosei to Kentei Hoho no Kento", Saisei Iryo, 10 February, 2005 (10.02.05), Vol.4, special extra issue, page 115	10,11,15

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"&" document member of the same patent family

Date of the actual completion of the international search 13 June, 2006 (13.06.06)	Date of mailing of the international search report 27 June, 2006 (27.06.06)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2006/306658

Continuation of A. CLASSIFICATION OF SUBJECT MATTER
(International Patent Classification (IPC))

C12Q1/04(2006.01), ***C12Q1/68***(2006.01), ***G01N33/53***(2006.01), ***G01N37/00***(2006.01), *A61L27/00*(2006.01), *C07K14/47*(2006.01), *C07K14/475*(2006.01), *C07K14/52*(2006.01), *C07K14/54*(2006.01), *C07K14/705*(2006.01), *C07K14/81*(2006.01), *C12N9/10*(2006.01), *C12N9/12*(2006.01), *C12N9/50*(2006.01)

(According to International Patent Classification (IPC) or to both national classification and IPC)

Form PCT/ISA/210 (extra sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2006/306658

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. [X] Claims Nos.: 14
because they relate to subject matter not required to be searched by this Authority, namely:
The invention of claim 14 relates to a method for the determination of the development or the risk of development of a disease associated with a mesenchymal stem cell in a subject by utilizing the inventions of claims 1 to 8, 12
(continued to extra sheet)

2. [ ] Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. [ ] Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. [ ] As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. [ ] As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. [ ] As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. [ ] No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest
the
[ ] The additional search fees were accompanied by the applicant's protest and, where applicable, payment of a protest fee..
[ ] The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

Form PCT/ISA/210 (continuation of first sheet (2)) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2006/306658

Continuation of Box No.II-1 of continuation of first sheet(2)

and 13 on a sample isolated from a living body (i.e., the subject; a supplier of the sample). However, reviewing the description, this invention appears to be directed to a human disease and relates to a method for determination of a disease in a supplier of an isolated sample, this invention is recognized to be a method for diagnosis of a human. Thus, the invention of claim 14 relates to a subject matter which this international searching authority is not required, under the provisions of PCT Article 17(2)(a)(i) and PCT Rule 39.1(v), to search.

Form PCT/ISA/210 (extra sheet) (April 2005)

REFERENCES CITED IN THE DESCRIPTION

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- Section 2 Eukaryotic Sample and Array Processing. One-cycle Target Labeling, GeneChip Expression Analysis Technial Manual **[0097]**
- Section 2 Eukaryotic Sample and Array Processing. GeneChip Expression Analysis Technial Manual **[0098] [0099]**

专利名称(译)	使用分子标记区分间充质干细胞的方法及其用途		
公开(公告)号	EP1870455A1	公开(公告)日	2007-12-26
申请号	EP2006730606	申请日	2006-03-30
[标]申请(专利权)人(译)	智再如股份有限公司		
申请(专利权)人(译)	两个小区CO.，LTD.		
当前申请(专利权)人(译)	两个小区CO.，LTD.		
[标]发明人	KATO YUKIO NAT UNIV OF CORP HIROSHIMA UNIV KAWAMOTO TAKESHI NAT UNIV OF CORP HIROSHIMA UNIV TSUJI KOICHIRO IGARASHI AKIRA SHIMIZU MASAKAZU		
发明人	KATO, YUKIO, NAT.UNIVERSITY OF CORP. HIROSHIMA UNIVERSITY KAWAMOTO, TAKESHI, NAT.UNIVERSITY OF CORP. HIROSHIMA UNIVERSITY TSUJI, KOICHIRO IGARASHI, AKIRA SHIMIZU, MASAKAZU		
IPC分类号	C12N15/00 C07K16/18 C07K16/22 C07K16/24 C07K16/28 C07K16/40 C07K16/44 C12M1/00 C12N5/06 C12N15/09 C12Q1/04 C12Q1/68 G01N33/53 G01N37/00 A61L27/00 C07K14/47 C07K14/475 C07K14/52 C07K14/54 C07K14/705 C07K14/81 C12N5/077 C12N5/0775 C12Q1/6881		
CPC分类号	C12Q1/6881 C12Q2600/158 G01N33/56966 G01N33/6845		
优先权	2005104563 2005-03-31 JP		
其他公开文献	EP1870455A4		
外部链接	Espacenet		

摘要(译)

本发明公开了一种区分间充质干细胞的方法，该方法包括使用选自具有表1中所示的登录号所示的核苷酸序列的基因的至少一种基因作为区分标记，检测区分标记之间的区别标记的差异。间充质干细胞和结缔组织细胞，以区分间充质干细胞和结缔组织细胞。该方法能够以良好的准确度区分未分化的间充质干细胞与其他结缔组织细胞如成纤维细胞，成骨细胞，软骨细胞和脂肪细胞。通过该方法给出的间充质干细胞或包含间充质干的组合物可以用作再生医学中使用的治疗剂。