

Correction of Dystrophin Expression in Cells from Duchenne Muscular Dystrophy Patients through Genomic Excision of Exon 51 by Zinc Finger Nucleases

David G. Ousterout¹, Ami M. Kabadi¹, Pratiksha I. Thakore¹, Pablo Perez-Pinera¹, Matthew T. Brown¹, William H. Majoros⁴, Timothy E. Reddy^{2,5}, Charles A. Gersbach¹⁻³

¹Department of Biomedical Engineering, Duke University, Durham, North Carolina, United States of America, 27708

²Center for Genomic and Computational Biology, Duke University, Durham, North Carolina, United States of America, 27708

³Department of Orthopaedic Surgery, Duke University Medical Center, Durham, North Carolina, United States of America, 27710

⁴Program in Computational Biology and Bioinformatics, Duke University, Durham, North Carolina, United States of America, 27708

⁵Department of Biostatistics and Bioinformatics, Duke University Medical Center, Durham, North Carolina, United States of America, 27710

* Address for correspondence:

Charles A. Gersbach, Ph.D.

Department of Biomedical Engineering

Room 136 Hudson Hall, Box 90281

Duke University

Durham, NC 27708-0281

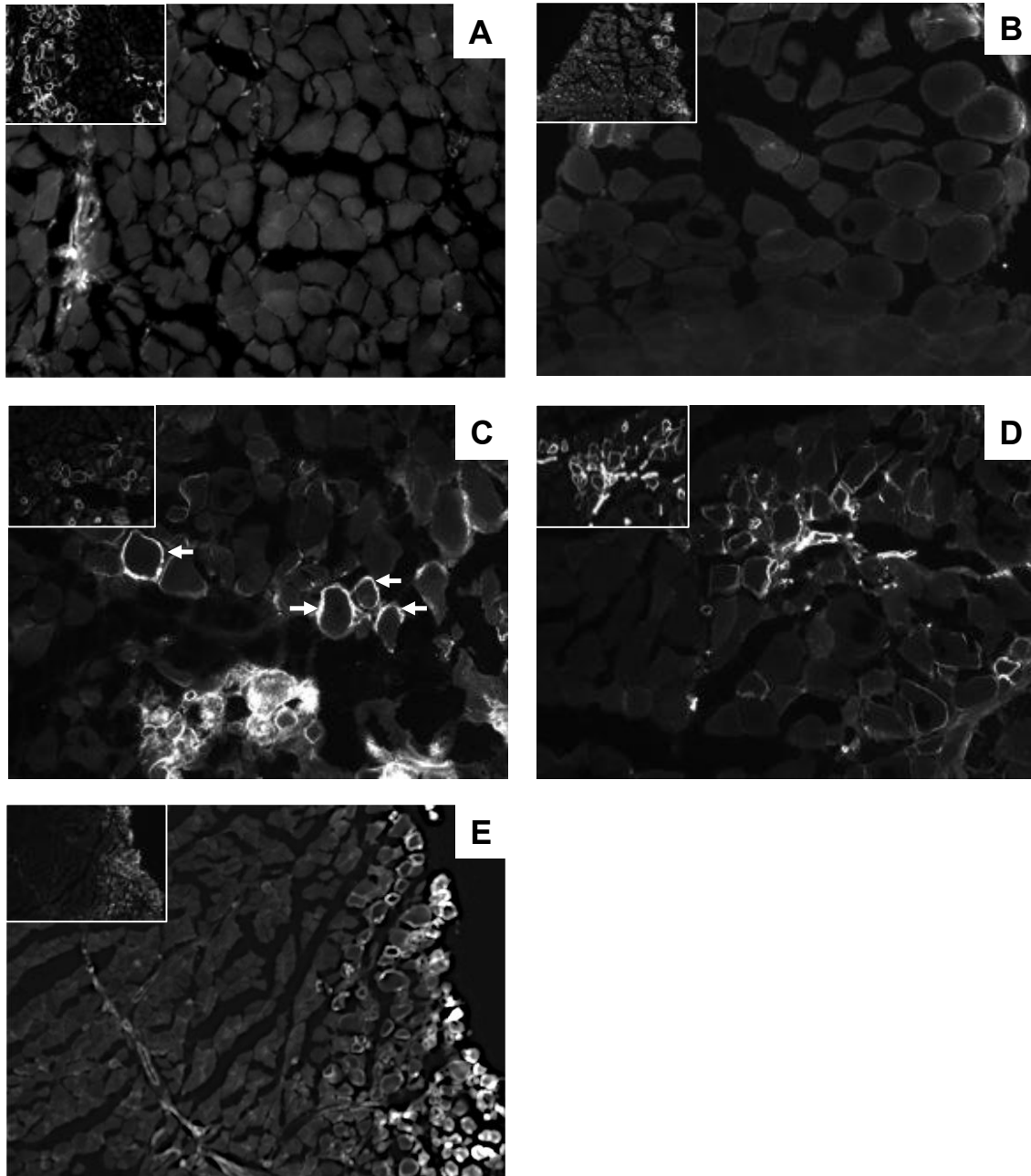
Phone: 919-613-2147

Fax: 919-668-0795

Email: charles.gersbach@duke.edu

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Supplementary Figure 1: Additional immunofluorescence images probing human dystrophin expression. Serial sections from regions stained with anti-human spectrin are shown inset in top left. (A-B) Sections from muscles injected with untreated human DMD myoblasts. (C-E) Sections from muscles injected with clonally derived DMD myoblasts carrying a deletion of exon 51 to that corrects the dystrophin reading frame. White arrows indicate examples of dystrophin positive fibers.

ZFN target	Target site	Spacer length (bp)
DZF-1	5'-CAA ACT AGA AAT GCC ATC TTCCTT GAT GTT GGA GGT ACC TGC 3'-GTT TGA TCT TTA CGG TAG AAGGAA CTA CAA CCT CCA TGG ACG	6
DZF-2	5'-ATG ATC ATC AAG CAG AAG GTATGA GAA AAA ATG ATA AAA GTT 3'-TAC TAG TAG TTC GTC TTC CATACT CTT TTT TAC TAT TTT CAA	6
DZF-3	5'-GAC TGT TAC TCT GGT GAC ACAACCT GTG GTT ACT AAG GAA ACT 3'-CTG ACA ATG AGA CCA CTG TGTTGGA CAC CAA TGA TTC CTT TGA	7
DZF-4	5'-CTT TAC CAC TTC CAC AAT GTATATG ATT GTT ACT GAG AAG GCT 3'-GAA ATG GTG AAG GTG TTA CATATAC TAA CAA TGA CTC TTC CGA	7
DZF-5	5'-CAC ATT CAC ATT CAC AATATA GTT ATG GAT ATG GAT GTA 3'-GAG TAA GTG TAA GTG TTATAT CAA TAC CTA TAC CTA CAT	6
DZF-6	5'-AAC TTC ACC AAT TCCATA GGA ATA AAA GTA ATT TGA 3'-TTG AAG TGG TTA AGGTAT CCT TAT TTT CAT TAA ACT	6
DZF-7	5'-AAC CCC ATC AAAAAAGT GGG GGA AGG 3'-TTG GGG TAG TTTTCA CCC CCT TCC	7
DZF-8	5'-ATC ATC TCC TCTGGTG GAT GAG GCT 3'-TAG TAG AGG AGACCAC CTA CTC CGA	7
DZF-9	5'-ATC TGC CCA TGACT GGC GCA GGG 3'-TAG ACG GGT ACTGA CCG CGT CCC	5
DZF-10	5'-GCC ATC TTC CTTGAT GTT GGA GGT 3'-CGG TAG AAG GAACTA CAA CCT CCA	6
DZF-11	5'-TGC TTC AGC CTCCTGA GTA GCT GGG 3'-ACG AAG TCG GAGGACT CAT CGA CCC	7
DZF-12	5'-GCC TCA GCC TCCCAA GTG GTG GGA 3'-CGG AGT CGG AGGGTTT CAC CAC CCT	7
DZF-13	5'-CTC AGC CTC CCAA GTG GTG GGA 3'-GAG TCG GAG GGTTT CAC CAC CCT	5

Supplementary Table 1: Summary of target sites for ZFNs in this study.

Triplet target	Helix sequence	Source
TGC	QRNALAG	ZiFiT F3 ID #631
TCT	QQRSLVG	ZiFiT F3 ID #790

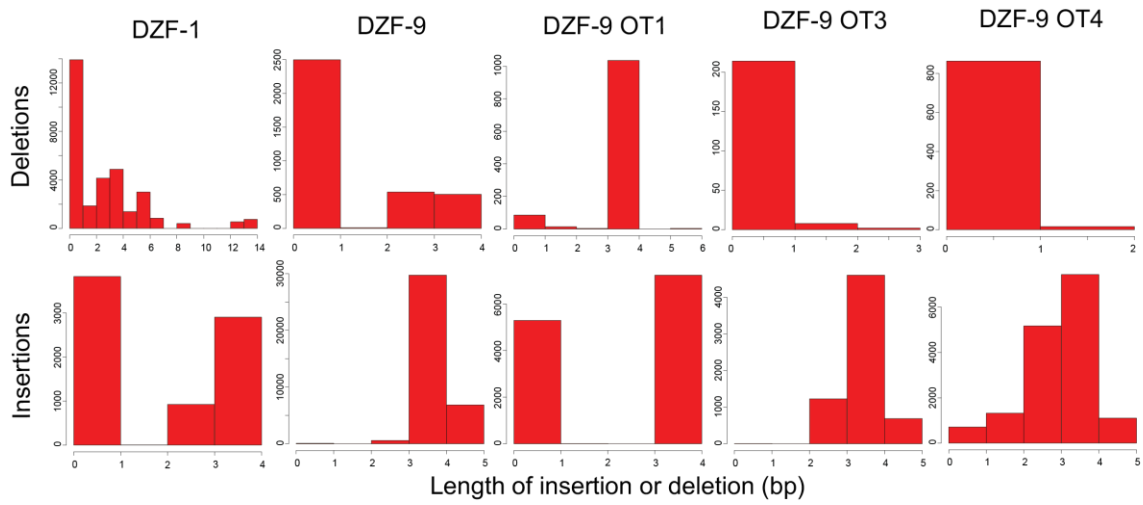
Supplementary Table 2: Sequences of eMA zinc finger modules to supplement published Barbas modules.

DZF-1 L6/R6									
Top ten with spacers of 6-7 (optimal for this linker)									
OT#	HS	Spacer	MM	Left Site	Right Site	Chr	Chr Region	Region	Gene
1	L/R	6	5/4	CcAACTtGAgATGCCAgC	GgTGTgGGAGGTcgaTGC	chr12	121465217	Intron	OASL
2	L/L	7	6/2	CtAgCaAGAAGTcCCTTC	GATGGCAtcTCTActTTG	chr2	164675298	Intergenic	-
3	L/L	7	4/3	CAAACtAtAAGTGCCgTg	GATGtCAaTtAtAGTTTg	chr6	3268596	Intergenic	-
4	L/R	6	6/6	attACTtctAATGCCATC	GATaTTGGAGATataTtt	chr11	73441555	Intron	RAB6A
5	L/R	7	6/6	CAAgaacctAATGCCATC	GtcGgaGGAGTACCccc	chr12	349901	Intron	SLC6A13
6	L/L	7	6/4	CAAaggAGAAATGCCAag	GATGGCtcTtaaAGTTgc	chr14	87103919	Intergenic	-
7	R/R	7	6/6	GCAaactCCTCCAACAag	GATGTTGGAAagACaaaC	chr8	141637370	Intron	EIF2C2
8	R/L	6	6/5	cCAGaTACCcCcttaATC	GcTGGcATgTCTeccTTG	chr1	220550165	Intergenic	-
DZF-9									
Top ten with spacers of 5-6 (optimal for this linker)									
OT#	HS	Spacer	MM	Left Site	Right Site	Chr	Chr Region	Region	Gene
1	R/L	6	1/0	CCCTGccc	TGGGCAGAT	chr6	12015411	Intron	HIVEP1
2	L/R	6	1/0	ATCTGCCCA	GGCGCAGtG	chr4	58293132	Intergenic	-
3	R/L	6	1/0	CCCTGCGCC	gGGGCAGAT	chr18	76473917	Intergenic	-
4	L/R	5	1/0	ATCTGCCCA	GGCGCAagg	chr17	8113802	Intron	AURKB
5	L/R	5	1/0	ATCTGCCCA	GGCcCAGGG	chr7	128034911	Intron	IMPDH1
6	R/L	6	1/0	CCCTGgGCC	TGGGCAGAT	chr10	80912948	Intron	ZMIZ1
7	R/L	5	1/0	CCCTGaGCC	TGGGCAGAT	chr4	1595869	Intergenic	-
8	L/R	6	1/0	ATCTGCCCA	GGCtCAGGG	chr18	74383767	Intergenic	-

Supplementary Table 3: PROGNOS ZFN v2.0 output

Name	Untreated					Treated				
	Indel Rate	Total Fragments	Deletion Rate	Insertion Rate	Mismatch Rate	Indel Rate	Total Fragments	Deletion Rate	Insertion Rate	Mismatch Rate
DZF1-ON	0.00019	297376	0.00019	0.00011	0.0254	0.14112	275038	0.11332	0.02781	0.03581
DZF1-OT1	7.00E-05	392992	6.00E-05	2.00E-05	0.02629	5.00E-05	359847	3.00E-05	1.00E-05	0.02705
DZF1-OT2	0.00013	367911	0.00013	1.00E-05	0.0227	0.00022	304631	0.00022	3.00E-05	0.02474
DZF1-OT3	0.00016	306797	0.00016	0	0.02259	0.00015	242962	0.00015	2.00E-05	0.01974
DZF1-OT4	0	4	0	0	0	0	0	0	0	0
DZF1-OT5	0.00062	373972	0.00062	2.00E-05	0.02818	0.00128	384875	0.00127	3.00E-05	0.02746
DZF1-OT6	6.00E-05	382279	6.00E-05	1.00E-05	0.02677	8.00E-05	421802	8.00E-05	3.00E-05	0.02671
DZF1-OT7	0.00017	253294	0.00017	2.00E-05	0.02339	0.00016	385648	0.00016	1.00E-05	0.02519
DZF1-OT8	0.00013	331031	0.00013	0	0.01842	0.00016	374451	0.00016	3.00E-05	0.01869
DZF9-ON	0.00035	283889	0.00027	9.00E-05	0.02109	0.16438	247862	0.01432	0.15009	0.02759
DZF9-OT1	0.00031	368970	0.00027	0.00011	0.02059	0.03653	374476	0.00302	0.03352	0.01934
DZF9-OT2	0.33649	211	0.04739	0.30806	0.22275	0.0098	816	0	0.0098	0.02206
DZF9-OT3	0.00069	410574	0.00069	0	0.01957	0.02129	316583	0.00071	0.0206	0.01867
DZF9-OT4	0.00027	365973	0.00025	2.00E-05	0.02126	0.04189	396372	0.00222	0.0397	0.02002
DZF9-OT5	0.00104	406244	0.00104	3.00E-05	0.02447	0.0013	424538	0.0013	2.00E-05	0.02564
DZF9-OT6	0.00046	390369	0.00045	4.00E-05	0.01783	0.00192	422006	0.00052	0.00141	0.01933
DZF9-OT7	0.00022	54247	0.00022	0	0.01989	9.00E-05	90803	9.00E-05	0	0.02159
DZF9-OT8	0.00071	378717	0.0007	0.00059	0.9989	0.00051	380580	0.00051	0.00044	0.99877

Supplementary Table 4: Summary of deep sequencing data. The DMD myoblasts were transfected with constructs encoding the DZF-1 or DZF-9 ZFNs. The frequency of indel formation at each target site (ON, bold) and eight of the top ten predicted off-target sites (OT1-8) was determined by deep sequencing. Two off-target sites (DZF1-OT4 and DZF9-OT2) did not produce reads that met filtering criteria.



Supplementary Figure 2. Distribution of indel size in DMD myoblasts treated with DZF-1 or DZF-9 as determined by deep sequencing.

Primer name	Primer sequence	Notes
CelI-DZF-1/3/10-F	GAGTTTGGCTCAAATGTTACTCTT	Forward Surveyor primer for DZF-1, DZF-3 and DZF-10
CelI-DZF-1/3/10-R	GGGAAATGGTCTAGGAGAGTAAAGT	Reverse Surveyor primer for DZF-1, DZF-3 and DZF-10
CelI-DZF-5-F	CCTCAGTGTAAATCCATTTGGTAAAA	Forward Surveyor primer for DZF-5
CelI-DZF-6-F	CAAAGTTGTGCTGAAGGTATTTAGG	Forward Surveyor primer for DZF-6
CelI-DZF-5/6-R	CTGCTACTTACTGGGAATTTGACAT	Reverse Surveyor primer for DZF-5 and DZF-6
CelI-DZF-7-F	AACCATTGGAATTTACAGGATGAT	Forward Surveyor primer for DZF-7
CelI-DZF-7-R	GGCTGAGTTAAATGGTATTTCTGG	Reverse Surveyor primer for DZF-7
CelI-DZF-8-F	ACTTGCACCTCATTCTAATTGTGA	Forward Surveyor primer for DZF-8
CelI-DZF-8-R	CCTCCTACCTGAATGTTAGAGACAA	Reverse Surveyor primer for DZF-8
CelI-DZF-9-F	GATGCAAGAGATAGAGCAGTGAGA	Forward Surveyor primer for DZF-9
CelI-DZF-9-R	GTTTGGAAAAAGACAGAAAGGAAG	Reverse Surveyor primer for DZF-9
CelI-DZF-11-F	CCAATGACTTAAGGTTTCTTCACA	Forward Surveyor primer for DZF-11
CelI-DZF-11-R	CTGAATCATGTGATGAAAAAGACCA	Reverse Surveyor primer for DZF-11
CelI-DZF-12/13-F	CCAACATGAGACTTCTTTTTGTTT	Forward Surveyor primer for DZF-12 and DZF-13
CelI-DZF-12/13-R	AGCTGGAATATGCTTTTACTTTCC	Reverse Surveyor primer for DZF-12 and DZF-13
Dys-E44-F	TGGCGCGTTTTCATTAT	Forward RT-PCR primer binding in exon 44
Dys-E52-R	TTCGATCCGTAATGATTGTTCTAGCC	Reverse RT-PCR primer binding in exon 52
SSA-fwd	CTAGCAAAAATAGGCTGTCCC	Forward primer to construct SSA luciferase
SSA-luc-DZF-1-rev	GAGGAGGAATTCAGCAGGTACCTCCAACATCAAGGA AGATGGCATTTCTAGTTTGGTCACATAGGACCTCTC ACACACAG	Reverse primer to construct SSA luciferase
SSA-luc-DZF-2-rev	GAGGAGGAATCCAACCTTTTATCATTTTTTCTCATA CCTTCTGCTTGATGATCATCTCACATAGGACCTCTC ACACACAG	Reverse primer to construct SSA luciferase
SSA-luc-DZF-3-rev	GAGGAGGAATTCAGTTTCTTAGTAACACAGGTT GTGTACCAGAGTAACAGTCTTCACATAGGACCTCT CACACACAG	Reverse primer to construct SSA luciferase
SSA-luc-DZF-4-rev	GAGGAGGAATCAAGCCTTCTCAGTAACAATCATAT ACATGTGGAAGTGGTAAAGATCACATAGGACCTCT CACACACAG	Reverse primer to construct SSA luciferase
SSA-luc-DZF-5-rev	GAGGAGGAATTCATACATCCATATCCATAACTATAT TGTGAATGTGAATGTGTTACATAGGACCTCTCACA CACAG	Reverse primer to construct SSA luciferase
SSA-luc-DZF-6-rev	GAGGAGGAATTCATCAAATTTACTTTTATTCCTATGG AATTGGTGAAGTTTTACATAGGACCTCTCACACAC AG	Reverse primer to construct SSA luciferase
DZF1-OT-1-F	CATGCTAGCTCCTACAAAGCACTG	Forward Surveyor primer for DZF-1 off-target site 1
DZF1-OT-1-R	GGGAAATGGTACTGAAGAAGACG	Reverse Surveyor primer for DZF-1 off-target site 1
DZF1-OT-2-F	CTGTGCTGCCTATTGCTTTCTGTC	Forward Surveyor primer for DZF-1 off-target site 2
DZF1-OT-2-R	CTGGTTGTGTGCCTAGTGATGG	Reverse Surveyor primer for DZF-1 off-target site 2
DZF1-OT-3-F	CCCATTACTGCATTTGCGGTCTTG	Forward Surveyor primer for DZF-1 off-target site 3
DZF1-OT-3-R	TCAACCTTGCTGCACGGAG	Reverse Surveyor primer for DZF-1 off-target site 3

DZF1-OT-4-F	CCTCTTCTCTGGGATCTGTGAGT	Forward Surveyor primer for DZF-1 off-target site 4
DZF1-OT-4-R	GAGAACCCAATGTAATGTGTCTACTGAGC	Reverse Surveyor primer for DZF-1 off-target site 4
DZF1-OT-5-F	AAAGACACCTTTTCTGCCCTCACG	Forward Surveyor primer for DZF-1 off-target site 5
DZF1-OT-5-R	GTGCCAGCCCAATTCTTTCTTGTGC	Reverse Surveyor primer for DZF-1 off-target site 5
DZF1-OT-6-F	GGTCTGGTCCAAGCAATTCTG	Forward Surveyor primer for DZF-1 off-target site 6
DZF1-OT-6-R	CGCCCGCCAGATTTGTCTA	Reverse Surveyor primer for DZF-1 off-target site 6
DZF1-OT-7-F	CCACACACACAGGACACTGATC	Forward Surveyor primer for DZF-1 off-target site 7
DZF1-OT-7-R	CCAGAAGGCAGCCACTAGAAAC	Reverse Surveyor primer for DZF-1 off-target site 7
DZF1-OT-8-F	CTAGAATTACAGGCGTGAGCCACT	Forward Surveyor primer for DZF-1 off-target site 8
DZF1-OT-8-R	GCAGCTGAGTTGCAGGCATAAG	Reverse Surveyor primer for DZF-1 off-target site 8
DZF9-OT-1-F	ACGTTCTGGGAAACACAGGG	Forward Surveyor primer for DZF-9 off-target site 1
DZF9-OT-1-R	CCACCAAAGGCAGTCCATAAAC	Reverse Surveyor primer for DZF-9 off-target site 1
DZF9-OT-2-F	GCACAGGGTACACCCCATTAAC	Forward Surveyor primer for DZF-9 off-target site 2
DZF9-OT-2-R	AGTCTCTCCATCCCCGAGGT	Reverse Surveyor primer for DZF-9 off-target site 2
DZF9-OT-3-F	CTGGTTTCTGCACCACATATTGCC	Forward Surveyor primer for DZF-9 off-target site 3
DZF9-OT-3-R	CACATGGCCCGCAGGAGAAA	Reverse Surveyor primer for DZF-9 off-target site 3
DZF9-OT-4-F	AAAAGGGAGCAGGTGAGCACAC	Forward Surveyor primer for DZF-9 off-target site 4
DZF9-OT-4-R	GGGGGAATTTGGGGAAACTTTCCT	Reverse Surveyor primer for DZF-9 off-target site 4
DZF9-OT-5-F	TGAGTCAGATGGCCAGGGA	Forward Surveyor primer for DZF-9 off-target site 5
DZF9-OT-5-R	CTTGAGCCTCCACAGGTGA	Reverse Surveyor primer for DZF-9 off-target site 5
DZF9-OT-6-F	TGGACTGAGGGAACCCCTCT	Forward Surveyor primer for DZF-9 off-target site 6
DZF9-OT-6-R	CAGATTTCCAGGGAAGCTCG	Reverse Surveyor primer for DZF-9 off-target site 6
DZF9-OT-7-F	GCGCGCTCGGGTGAAAAATTAAG	Forward Surveyor primer for DZF-9 off-target site 7
DZF9-OT-7-R	TCCCCTTCTCCACCTCCAG	Reverse Surveyor primer for DZF-9 off-target site 7
DZF9-OT-8-F	GGCTCCCCTCTTGTAAATGTTG	Forward Surveyor primer for DZF-9 off-target site 8
DZF9-OT-8-R	AGTGAGGACGATGACCAGCG	Reverse Surveyor primer for DZF-9 off-target site 8
DZF1-ON-miseq-R	GTCTCGTGGGCTCGGAGATGTGTATAAGAGACAGag agaaagccagtcggttaagtctt	Deep seq primers
DZF1-OT1-miseq-F	TCGTGGCAGCGTCAGATGTGTATAAGAGACAGTAG GAAACAAGGAACAGGCTTCTA	Deep seq primers
DZF1-OT1-miseq-R	GTCTCGTGGGCTCGGAGATGTGTATAAGAGACAGTT TATGGATTGGCTGTATTAAGCA	Deep seq primers
DZF1-OT2-miseq-F	TCGTGGCAGCGTCAGATGTGTATAAGAGACAGCTT TTTCCGAAATTTTACCTTT	Deep seq primers
DZF1-OT2-miseq-R	GTCTCGTGGGCTCGGAGATGTGTATAAGAGACAGTG AACTCATGTTGCTTGATTTT	Deep seq primers
DZF1-OT3-miseq-F	TCGTGGCAGCGTCAGATGTGTATAAGAGACAGtg tggttcttttaggattaag	Deep seq primers
DZF1-OT3-miseq-R	GTCTCGTGGGCTCGGAGATGTGTATAAGAGACAGag aagggaagacgatgaaataaca	Deep seq primers
DZF1-OT4-miseq-F	TCGTGGCAGCGTCAGATGTGTATAAGAGACAGgtc acagaatcctaggcttgaca	Deep seq primers
DZF1-OT4-miseq-R	GTCTCGTGGGCTCGGAGATGTGTATAAGAGACAGat	Deep seq primers

	catttgatttcttttgtctcttcc	
DZF1-OT5-miseq-F	TCGTCGGCAGCGTCAGATGTGTATAAGAGACAGAAA CCAAATCAACAAACAGATGAA	Deep seq primers
DZF1-OT5-miseq-R	GTCTCGTGGGCTCGGAGATGTGTATAAGAGACAGTT TTCAAAGGGAAAGTAAACCTTG	Deep seq primers
DZF1-OT6-miseq-F	TCGTCGGCAGCGTCAGATGTGTATAAGAGACAGCAC TCCATGGTTCTTATGTCAGAG	Deep seq primers
DZF1-OT6-miseq-R	GTCTCGTGGGCTCGGAGATGTGTATAAGAGACAGAC TCTTCCTTGTCACAGTAATGTC	Deep seq primers
DZF1-OT7-miseq-F	TCGTCGGCAGCGTCAGATGTGTATAAGAGACAGCAC TATCAAAGCCAAAAAGAAACA	Deep seq primers
DZF1-OT7-miseq-R	GTCTCGTGGGCTCGGAGATGTGTATAAGAGACAGTT GTCAGGTTTGCCCTTATTGAGTA	Deep seq primers
DZF1-OT8-miseq-F	TCGTCGGCAGCGTCAGATGTGTATAAGAGACAGatt taccaagtgcattcatctttt	Deep seq primers
DZF1-OT8-miseq-R	GTCTCGTGGGCTCGGAGATGTGTATAAGAGACAGct tttagaggggatttttcttctgctg	Deep seq primers
DZF9-ON-miseq-F	TCGTCGGCAGCGTCAGATGTGTATAAGAGACAGCAG ATAGATGTTCTTCAGGTGGTG	Deep seq primers
DZF9-ON-miseq-R	GTCTCGTGGGCTCGGAGATGTGTATAAGAGACAGCT GAAGCATATTCAGAGGATGATG	Deep seq primers
DZF9-OT1-miseq-F	TCGTCGGCAGCGTCAGATGTGTATAAGAGACAGATA ACTGGAGTAGCCACAGTAGCA	Deep seq primers
DZF9-OT1-miseq-R	GTCTCGTGGGCTCGGAGATGTGTATAAGAGACAGTA AAGTATCGCATCAGGCTACAAA	Deep seq primers
DZF9-OT2-miseq-F	TCGTCGGCAGCGTCAGATGTGTATAAGAGACAGTCT TTAGTAGAGACGGGGTTTTCAC	Deep seq primers
DZF9-OT2-miseq-R	GTCTCGTGGGCTCGGAGATGTGTATAAGAGACAGAC TGGTCTCGTGATCTGCCTAC	Deep seq primers
DZF9-OT3-miseq-F	TCGTCGGCAGCGTCAGATGTGTATAAGAGACAGTAA ATAGGCTTTGCAGTACCTTCC	Deep seq primers
DZF9-OT3-miseq-R	GTCTCGTGGGCTCGGAGATGTGTATAAGAGACAGTT TTCACTGCTGACAGTTTTATCC	Deep seq primers
DZF9-OT4-miseq-F	TCGTCGGCAGCGTCAGATGTGTATAAGAGACAGctg ctatcgtccctacctcctt	Deep seq primers
DZF9-OT4-miseq-R	GTCTCGTGGGCTCGGAGATGTGTATAAGAGACAGgg agagtagcagtgccctggac	Deep seq primers
DZF9-OT5-miseq-F	TCGTCGGCAGCGTCAGATGTGTATAAGAGACAGTAC TTAAGCCCTGTGCCTCAGTTT	Deep seq primers
DZF9-OT5-miseq-R	GTCTCGTGGGCTCGGAGATGTGTATAAGAGACAGAG CCAGAAACGATACTTCAGGTT	Deep seq primers
DZF9-OT6-miseq-F	TCGTCGGCAGCGTCAGATGTGTATAAGAGACAGatc ctaggacttccctgacagc	Deep seq primers
DZF9-OT6-miseq-R	GTCTCGTGGGCTCGGAGATGTGTATAAGAGACAGct acaaggaggagggtccttattc	Deep seq primers
DZF9-OT7-miseq-F	TCGTCGGCAGCGTCAGATGTGTATAAGAGACAGcca agccggagcctcctctg	Deep seq primers
DZF9-OT7-miseq-R	GTCTCGTGGGCTCGGAGATGTGTATAAGAGACAGgt gacctgtgaatcggtttatct	Deep seq primers
DZF9-OT8-miseq-F	TCGTCGGCAGCGTCAGATGTGTATAAGAGACAGaag tgctacaaagagctccactg	Deep seq primers
DZF9-OT8-miseq-R	GTCTCGTGGGCTCGGAGATGTGTATAAGAGACAGca cctctgacaatatgaggatttg	Deep seq primers
Universal i5 primer	AATGATACGGCGACCACCGAGATCTACACTCGTCGG CAGCGTC	Universal primer for deep seq library
BC1	CAAGCAGAAGACGGCATAACGAGATACATCGGTCTCG TGGGCTCGG	Barcode primer
BC2	CAAGCAGAAGACGGCATAACGAGATTGGTCAGTCTCG TGGGCTCGG	Barcode primer
BC3	CAAGCAGAAGACGGCATAACGAGATCACTGTGTCTCG TGGGCTCGG	Barcode primer
BC4	CAAGCAGAAGACGGCATAACGAGATATTGGGCTCTCG TGGGCTCGG	Barcode primer

Supplementary Table 5: Primers used in this study

Supplementary sequences for ZFNs used in this study:

DZF-1 left ZFN

ATGGACTACAAAGACCATGACGGTGATTATAAAGATCATGACATCGATTACAAGGATGACGATGACAAGATGGCCCCCAA
GAAGAAGAGGAAGGTGGGCCGCCCTCGAGCCCGGGGAAAAGCCATATAAATGCCCGAGTGCGGCAAAATCATTAGCAGAA
AGGACGCCCTGAGAGGCCACCAGCGCACCCATACCGGGGAGAAAACCTTACAAGTGCCCCGAGTGCGGCAAGAGTTTCAGC
CACAGGACCACCTGACAAACCACAGAGGACCCACACCGGGGAAAAGCCATATAAATGCCCGAGTGCGGCAAAATCATT
CAGCCAGAGAAAACGCCCTGGCCGGCCACCAGCGCACCCATACCGGGGAAAACCTTATAAGTGTCCCGAGTGCGGCAAGA
GTTTCAGTACAAAAACGCACTTCAGAAATCATCAGAGGACACATACCGGGGAAAACCGTACAAGTGTCTGAGTGCGGG
AAGAGTTTCTCCGATCCGGGCCACTTAGTAAGACATCAGAGGACACATACCGGGGAGAAAGCCCTATAAATGTCCAGAATG
TGAAAAGTCTTTAGCACGTGAGGAACTTAGTAAGACACCAGCGAACTCATACCGGTGCGGCGCCCGCCGCTGGTGA
AGAGCGAGCTGGAGGAGAAGAAGTCCGAGCTGCGGCACAAGTGAAGTACGTGCCCCACGAGTACATCGAGCTGATCGAG
ATCGCCAGGAACCCACCCAGGACCGCATCTGGAGATGAAGGTGATGGAGTTCTTCATGAAGGTGTACGGCTACAGGGG
AGAGCACCTGGGCGGAAGCAGAAAACCTGACGGCGCCATCTATACAGTGGGCAGCCCCATCGATTACGGCGTGATCGTGG
ACACAAAGGCCCTACAGCGGCGGTACAATCTGCCTATCGGCCAGGCCGACGAGATGGAGAGATACGTGGAGGAGAACCAG
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DZF-1 right ZFN

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DZF-2 left ZFN

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DZF-2 right ZFN

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DZF-3 left ZFN

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DZF-3 right ZFN

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DZF-4 left ZFN

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DZF-4 right ZFN

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DZF-5 left ZFN

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DZF-5 right ZFN

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DZF-6 left ZFN

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DZF-6 right ZFN

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DZF-7 left ZFN

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DZF-7 right ZFN

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DZF-8 left ZFN

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DZF-8 right ZFN

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AGCTGGAGGAGAAGAAGTCCGAGCTGCGGCACAAGCTGAAGTACGTGCCCCACGAGTACATCGAGATCGAGATCGCG
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GAGATCAACTTCTGA

DZF-9 left ZFN

ATGGACTACAAAGACCATGACGGTGATTATAAAGATCATGACATCGATTACAAGGATGACGATGACAAGATGGCCCCAA
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CTCCCGATCCGATCATCTCTCACTCCATCTGAAGACACACTTGCAGGGATCCAGCTGGTGAAGAGCGAGCTGGAGGAGA
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CAGGACCCGATCCTGGAGATGAAGGTGATGGAGTTCTTCATGAAGGTGTACGGCTACAGGGGAGAGCACCTGGCGGAAG
CAGAAAGCCTGACGGCGCCATCTATACAGTGGGCAGCCCCATCGATTACGGCGGTGATCGTGGACACAAAGCCCTACAGCG
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CAACTACAAGGCCAGCTGACCAGGCTGAACCGCAAAAACCACTGCAATGGCGCCGTGCTGAGCGTGGAGGAGCTGCTGA
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TGA

DZF-9 right ZFN

ATGGACTACAAAGACCATGACGGTGATTATAAAGATCATGACATCGATTACAAGGATGACGATGACAAGATGGCCCCAA
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TGA

DZF-10 left ZFN

ATGGACTACAAAGACCATGACGGTGATTATAAAGATCATGACATCGATTACAAGGATGACGATGACAAGATGGCCCCAA
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CAAGGGCAACTACAAGGCCAGCTGACCAGGCTGAACCGCAAAAACCACTGCAATGGCGCCGTGCTGAGCGTGGAGGAGC
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AACTTCTGA

DZF-10 right ZFN

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CAAGGGCAACTACAAGGCCAGCTGACCAGGCTGAACCACATCACCACCTGCAATGGCGCCGTGCTGAGCGTGGAGGAGC
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AACTTCTGAT

DZF-11 left ZFN

ATGGACTACAAAGACCATGACGGTGATTATAAAGATCATGACATCGATTACAAGGATGACGATGACAAGATGGCCCCAA
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GAGATCAACTTCTGA

DZF-11 right ZFN

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GAGATCAACTTCTGA

DZF-12 left ZFN

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GAGATCAACTTCTGA

DZF-12 right ZFN

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GAGATCAACTTCTGA

DZF-13 left ZFN

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TTCTGA

DZF-13 right ZFN

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TGA