

Figure S1: Primer sequence

Primer name	Primer sequence (5'-3')	Primer function
<i>sox11a</i> -g1-F	TGTAATACGACTCACTATA ggtcgctttatgtgccgg GTTTTAGAGCTAGAAAT	gRNA synthesis
<i>sox11a</i> -g2-F	TGTAATACGACTCACTATA ggctgtcttcaccagtct GTTTTAGAGCTAGAAAT	
<i>sox11b</i> -g1-F	TGTAATACGACTCACTATA gggtcgtttgatgtggccgg GTTTTAGAGCTAGAAAT	
<i>sox11b</i> -g2-F	TGTAATACGACTCACTATA gggtcgtttgatgtggccgg GTTTTAGAGCTAGAAAT	
gRNA-R	AAAAAAAGCACCGACTCGGTGCCAC	
<i>sox11a</i> -F	ACTTCGCCTCCTCCGCGCAA	real-time PCR
<i>sox11a</i> -R	AGCCCAGGCTGCCCTCGCTA	
<i>sox11b</i> -F	ATGGCTGACTACCCCGACT	
<i>sox11b</i> -R	GCTGCTTTGACACTTTTGC	
<i>p2rx4b</i> -F	CTTTGGAATCCGCTTTGACG	
<i>p2rx4b</i> -R	AGGTTAAGAAGGGCAAGAGC	
<i>calhm2</i> -F	GTGATTGAACGCCAGCTACA	
<i>calhm2</i> -R	TATGCCTCCTGCTGATAGCC	
<i>mctp2b</i> -F	CTCCAGAGTGCCCTCAGATA	
<i>mctp2b</i> -R	GCACCTTCACACAGACTGAT	
<i>rcn3</i> -F	ATAATGAAGCCCGGCATCTC	
<i>rcn3</i> -R	TTTGGTGAGATCCTCTCCGT	
<i>s100a11</i> -F	ACAAGCTTGGTCAAATCCCA	
<i>s100a11</i> -R	AGAACTCCATGAACGTCAGC	
<i>chrm2a</i> -F	TGTCCAGCATCATGTCCTCA	
<i>chrm2a</i> -R	AGGTACAGCCACTCAGATCG	
<i>slc8a4a</i> -F	AAGAAGAGGTGGCCAAGATG	
<i>slc8a4a</i> -R	CAGCGCAAGGTTAGTCTTCT	
<i>aldh7a1</i> -F	GAAGAGTGTCCGCTGGTTA	
<i>aldh7a1</i> -R	CAAACGCTCCTCCAATCTCA	
<i>matn1</i> -F	TTGCCAAGAAGCTGCAAATC	
<i>matn1</i> -R	CTCTTCGTCACAGCTTCCAA	
<i>and1</i> -F	CTGATCCGCAACAGGAGAAA	
<i>and1</i> -R	CTCTGCAACTCCGTCTTTGT	
<i>crtap</i> -F	AAATTTGGCCTCGACGATGA	
<i>crtap</i> -R	GGCATGAACTTCTGTTTGGC	
<i>dlx4a</i> -F	ATCCAGGAGCTTACCTACCC	

<i>dlx4a</i> -R	CGTTCAGCCGTATTTCTCCA		
<i>twist1a</i> -F	GTCAACATCCCCTAACGCA		
<i>twist1a</i> -R	CTCCTTCCAGTGAGTTCAGC		
<i>twist1b</i> -F	TTCTCGGTTTGGAGGATGGA		
<i>twist1b</i> -R	AGCTCACGGTTTGACCATTT		
<i>sec23a</i> -F	CCCGAGTATGAGAACTCCG		
<i>sec23a</i> -R	CGTGCTCAGTGTCGATGTAG		
<i>osc</i> -F	ATCAGCTGACACAGAAGCGA		
<i>osc</i> -R	GGCGGTGATGATTCCAGACG		
<i>runx2a</i> -F	GACCATGGTGGAGATCATAGC		
<i>runx2a</i> -R	GGGTTCGTGAATACTGTGATTG		
<i>runx2b</i> -F	AGAGCTTCACCCTGACGATTAC		
<i>runx2b</i> -R	AGGTACGATGGGTATGTCTGGT		
<i>ctsk</i> -F	GTAACGAGAGGGCACTGAC		
<i>ctsk</i> -R	TTCCTTGTTGCAGTTTGGGT		
<i>entpd5a</i> -F	TGAAGAGTGGAGCTTTGGTG		
<i>entpd5a</i> -R	GATGCTGCTTCCTTTGACCT		
<i>coll1a1a</i> -F	TCTGCTGGATCAGCTGGTAA		
<i>coll1a1a</i> -R	CAATTTCTCCATTGCGACCAC		
<i>akt2</i> -F	AAGAAGCTCGTTCACCCTT		
<i>akt2</i> -R	GGTCTGTGCAGTGAATCAT		
<i>atp6v1h</i> -F	CAGGTTATTGCCGTCGCA		
<i>atp6v1h</i> -R	TGTTTACCACCCAGCTGTTC		
β -actin-F	ATGCCCTCGTGCTGTTTTTC		
β -actin-R	GCCTCATCTCCACATAGGA		
Probe- <i>and1</i> -F	GATGTACCTGCAGCACCTTG		Probe synthesis
Probe- <i>and1</i> -R	TAATACGACTCACTATAGGG CATACCCGACGAAACATTCA		
Probe- <i>crtap</i> -F	CTTTTCCGTTTGCGTCC		
Probe- <i>crtap</i> -R	TAATACGACTCACTATAGGG ACTGCGTTCTTCAGGTCATT		
Probe- <i>sec23a</i> -F	ACCAGCCTGCTGAGCTACTT		
Probe- <i>sec23a</i> -R	TAATACGACTCACTATAGGG TCCCTGCTAATGCCATTTTA		
Probe- <i>coll10a1a</i> -F	ACCAGCCTTACTCCGTGAAA		
Probe- <i>coll10a1a</i> -R	TAATACGACTCACTATAGGG TCCAGGTTTCCCTGAAGGTC		
<i>sox11a</i> -HMRA-F1	TGATGAAAGCGAATTCATGG	Genotyping	
<i>sox11a</i> -HMRA-R1	CTGGAGACTGTTCCATGATC		
<i>sox11b</i> -HMRA-F1	CGAGGAGAGCGAAATGATGGCTTG		
<i>sox11b</i> -HMRA-R1	CGCATTTCATGGGTCGTTTGATGTG		

Figure S2: The conservation of *sox11* in various species.

zb sox11a	MVQQTDNSETDSMSREATDSDESEFMVSINPDWCKTATGHIKRPMAFMVWSKIERRKIMEQSPDMHNAEISKRLGKRWKML	82
zb sox11b	MVQQTDNSETDSMSREATDSDESEFMVSINPDWCKTATGHIKRPMAFMVWSKIERRKIMEQSPDMHNAEISKRLGKRWKML	87
medaka sox11a	MVQQTDNSETDSMSREATDSDESEFMVSINPDWCKTATGHIKRPMAFMVWSKIERRKIMEQSPDMHNAEISKRLGKRWKML	87
rat sox11	MVQQAESSEAESNLPRDALDTESEEMACSPVALDESDDPWCKTASGHIKRPMAFMVWSKIERRKIMEQSPDMHNAEISKRLGKRWKML	90
mice sox11	MVQQAESSEAESNLPRDALDTESEEMACSPVALDESDDPWCKTASGHIKRPMAFMVWSKIERRKIMEQSPDMHNAEISKRLGKRWKML	90
human sox11	MVQQAESSEAESNLPRDALDTESEEMACSPVALDESDDPWCKTASGHIKRPMAFMVWSKIERRKIMEQSPDMHNAEISKRLGKRWKML	90
zb sox11a	KDSEKIPFIREAERLRLKHMADYPDYKYRPPKPKLDSSSKPSAPSPKCSKT.....SKS...SKKCKKPKANKTGSKSS	155
zb sox11b	KDSEKIPFIREAERLRLKHMADYPDYKYRPPKPKLDSSSKPSAPSPKCSKT.....SKS...SKKCKKPKANKTGSKSS	162
medaka sox11a	KDSEKIPFIREAERLRLKHMADYPDYKYRPPKPKLDSSSKPSAPSPKCSKT.....SKS...SKKCKKPKANKTGSKSS	157
rat sox11	KDSEKIPFIREAERLRLKHMADYPDYKYRPPKPKLDSSSKPSAPSPKCSKT.....SKS...SKKCKKPKANKTGSKSS	165
mice sox11	KDSEKIPFIREAERLRLKHMADYPDYKYRPPKPKLDSSSKPSAPSPKCSKT.....SKS...SKKCKKPKANKTGSKSS	165
human sox11	KDSEKIPFIREAERLRLKHMADYPDYKYRPPKPKLDSSSKPSAPSPKCSKT.....SKS...SKKCKKPKANKTGSKSS	180
zb sox11a	...SHGYGDEYAFK.....SKKVSKTVHIKSEFTDEDDDDSEEDSRVRVKEEEDD.....EFA	207
zb sox11b	RASIQDCRFNVFT.....NLKVTKS...IKRELDDDDDDDDDDDEEDDEDE.....EH	213
medaka sox11a	...AHSYGDDCVFK.....VAKT.....VKSELDDDDDDDEEDDEEDDE.....LRP	204
rat sox11	GAGKAAQPGDCG.....AGKAAKCVFLDDDDDEEDDEDEDELDLQLRPKPDADDDDDPAHSHLLPFPAAQQPPOLLRR	235
mice sox11	GAGKAAQPGDCA.....AGKAAKCVFLDDDDDEEDDEDEDELDLQLRPKPDADDDDDPAHSHLLPFPAAQQPPOLLRR	235
human sox11	GAGKAAQSGDYGAGDDYVLGSLRVSGGGGCAKTVKCVFLDDDDDDDEEDDEDELDLQIQKQEPDEEDEFPHQQLLPFPQQ...PSOLLRR	269
zb sox11a	INVAKVPASPTLSSSESEEGASMYEVR.....NRRLYYNFKNITKQSTMY...PAS.....VSPASSRSVSTSSSSSEDA	275
zb sox11b	IRLHNVPASPTLSSSESEEGASMYEVR.....NRRLYYNFKNITKQSTMY...PAS.....VSPASSRSVSTSSSSSEDA	290
medaka sox11a	INVAKVPASPTLSSSESEEGASMYEVR.....NRRLYYNFKNITKQSTMY...PAS.....VSPASSRSVSTSSSSSEDA	282
rat sox11	MSVAKVPASPTLSSSESEEGASMYEVR.....NRRLYYNFKNITKQSTMY...PAS.....VSPASSRSVSTSSSSSEDA	313
mice sox11	MSVAKVPASPTLSSSESEEGASMYEVR.....NRRLYYNFKNITKQSTMY...PAS.....VSPASSRSVSTSSSSSEDA	313
human sox11	INVAKVPASPTLSSSESEEGASMYEVR.....NRRLYYNFKNITKQSTMY...PAS.....VSPASSRSVSTSSSSSEDA	358
zb sox11a	DDLEFDLSESLNFASSAQSS...ELGQ.N.TSGNLSLSLVDKLELSEFSEGLSGSHFEPDYCTPELSEMIAGDWLEANFSDLVFT	353
zb sox11b	DDLEFDLSESLNFASSAQSS...ELGQ.N.TSGNLSLSLVDKLELSEFSEGLSGSHFEPDYCTPELSEMIAGDWLEANFSDLVFT	367
medaka sox11a	DDLEFDLSESLNFASSAQSS...ELGQ.N.TSGNLSLSLVDKLELSEFSEGLSGSHFEPDYCTPELSEMIAGDWLEANFSDLVFT	358
rat sox11	DDLEFDLSESLNFASSAQSS...ELGQ.N.TSGNLSLSLVDKLELSEFSEGLSGSHFEPDYCTPELSEMIAGDWLEANFSDLVFT	394
mice sox11	DDLEFDLSESLNFASSAQSS...ELGQ.N.TSGNLSLSLVDKLELSEFSEGLSGSHFEPDYCTPELSEMIAGDWLEANFSDLVFT	394
human sox11	DDLEFDLSESLNFASSAQSS...ELGQ.N.TSGNLSLSLVDKLELSEFSEGLSGSHFEPDYCTPELSEMIAGDWLEANFSDLVFT	440

Figure S3: The second line of *sox11a*^{m/m} mutant and *sox11b*^{m/m} mutant

A: The target site of *sox11a*^{m/m} mutant line.

CTCGATAAACCCAGACTGGTGCAAGACAGCCACCGGACACATA
 CTCGATAAACCCAGAC-----AGCCACCGGACACATA -11bp

B: The amino sequence of Sox11a

MVQQTDNSETDSMSREATDSDESEFMVSINPDWCKTAT
 GHIKRPMAFMVWSKIERRKIMEQSPDMHNAEISKRLG
 KRWKMLKDSEKIPFIREAERLRLKHMADYPDYKYRPPK
 KPKLDSSSKPSAPSPKCSKTSSKSSKKCPKPKANKTGSK
 SSSHGYGDEYAFKSTKVSKTVHIKSEFTDEDDDDSEED
 SRVRVKEEEDPIRAYNVAKVPASPTLSSSTESEGASMYE
 EVRNNRLYYNFKNITKQSTMYPASVSPASSRSVSTSSSS
 EDADDLLFDFSLNFASSAQSSSELGSQLPGNLSLSLVDKE
 LESFSEGLSGSHFEPDYCTPELSEMIAGDWLEANFSDLV
 FTY*

C: A frameshift mutation of *sox11a*^{m/m} mutant

MVQQTDNSETDSMSREATDSDESEFMVSINPD SHRTHK
 ATDERVHGVV*

D: The target site of *sox11b*^{m/m} mutant line.

GGTGCCACCGAAACCGACTGGTGCAAGACAGCCACCGGCCACAT
GGTGCCACCGAAACCG--ACTGGTGCAAGACAGCCACCGGCCACAT -1bp

E: The amino sequence of Sox11b

MVQQTDHSETESSVSRETTDTEESEMMACSPVPPKPDW
CKTATGHIKRPMNAFMetVWSKIERRKIMEQSPDMHNAEI
SKRLGKRWKMLKDSEKIPFIREAERLRLQHMADYPDYK
YRPKKKPKLDSSSKPAVQSPEKISKSVKAAAGKKCAKPK
PSKPGNITARASTQDCRFNYVFTNLKVTKSIKRELTDDDE
DDDDDDDDDDDEEDDYEDEEHIRLHNPASPTLSSAAES
EHGASMYEESRHTSATHGSRLFYNFKNITKQSAAYPASV
SPASSFRSVSSSSSSSSSEDSDDLVDLDFSLNLAAGSHTADL
GNTSGNLCLSLVDKDLDSFSEGLGSHFEPDYCTPELS
EMIAGDWLEANFSDLVFTY*

F: A frameshift mutation of *sox11b*^{m/m} mutant

MVQQTDHSETESSVSRETTDTEESEMMACSPVPPKPTGA
RQPPATSNDP*

Figure S4: The production process of *sox11a*^{m/m}*sox11b*^{m/m} double mutant.

<i>sox11a</i> ^{+/+} <i>sox11b</i> ^{+/+}	<i>sox11a</i> ^{+/+} <i>sox11b</i> ^{m/+}	<i>sox11a</i> ^{m/+} <i>sox11b</i> ^{+/+}	<i>sox11a</i> ^{m/+} <i>sox11b</i> ^{m/+}
<i>sox11a</i> ^{+/+} <i>sox11b</i> ^{m/+}	<i>sox11a</i> ^{+/+} <i>sox11b</i> ^{m/m}	<i>sox11a</i> ^{m/+} <i>sox11b</i> ^{m/+}	<i>sox11a</i> ^{m/+} <i>sox11b</i> ^{m/m}
<i>sox11a</i> ^{m/+} <i>sox11b</i> ^{+/+}	<i>sox11a</i> ^{m/+} <i>sox11b</i> ^{m/+}	<i>sox11a</i> ^{m/m} <i>sox11b</i> ^{+/+}	<i>sox11a</i> ^{m/m} <i>sox11b</i> ^{m/+}
<i>sox11a</i> ^{m/+} <i>sox11b</i> ^{m/+}	<i>sox11a</i> ^{m/+} <i>sox11b</i> ^{m/m}	<i>sox11a</i> ^{m/m} <i>sox11b</i> ^{m/+}	<i>sox11a</i> ^{m/m} <i>sox11b</i> ^{m/m}

Figure S5: The ratio of *sox11a*^{m/m} mutant with curved spine (*****P*<0.0001).

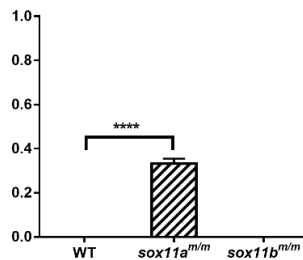


Figure S6: The expression level of *sox11a* in WT and *sox11b*^{m/m} mutant (**P*<0.05).

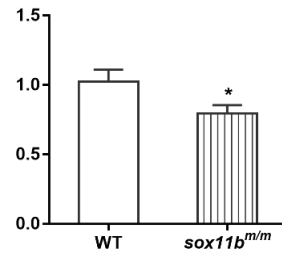


Figure S7: The expression level of *sox11b* in WT and *sox11a^{m/m}* mutant ($P < 0.01$).**

