

ICSI results, FR and clinical pregnancy rate amongst men with and without Y chromosome deletions

Study	Year	YCM	N subjects (MOLGY <sup>†</sup> , SOLGY <sup>‡</sup> , AZOY <sup>§</sup> , OATY <sup>¶</sup> , SOLG <sup>††</sup> , AZO <sup>‡‡</sup> , OAT <sup>§§</sup> )	Sperm retrieval (%)	Metaphase II oocytes	FR <sup>¶¶</sup>	Embryo transfers	Cleaved embryo rate <sup>†††</sup>	Clinical pregnancy rate <sup>†††</sup>	Live birth rate/ET	Birth defect rate/ET	Note
Silber <i>et al.</i> (12)	1998	ΔAZFc	10 AZOY; 4 SOLGY	5/10 [50] TESE AZOY; 6/6 [100] <sup>‡</sup> ejaculation	157	89/157 [57]	N/A	55/89 [62]	5/16 [31] couples ongoing or delivered pregnancy; 42% clinical pregnancy rate/ET (for Y-deleted)	N/A	N/A	Total of 14 patients, but 2 patients went through 2 cycles each
		ΔAZFc (6D– 6F) and beyond	5 AZOY	0/5 [0] TESE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	–
		–	41 AZO	22/41 [54] TESE	290	123/290 [42]	N/A	76/123 [62]	12/41 [29] couples ongoing or delivered pregnancy; 50% clinical pregnancy rate/ET (for Y-intact)	N/A	N/A	–
		–	26 SOLG	26/26 [100] ejaculate	312	200/312 [64]	N/A	113/200 [56]	12/26 [46] couples ongoing or delivered pregnancy; 50% clinical pregnancy rate/ET (for Y-intact)	N/A	N/A	–
Rossato <i>et al.</i> (13)	1998	Complete ΔAZFa; partial ΔAZFb (except	1 SOLGY (3.7×10 <sup>6</sup> and 5.3×10 <sup>6</sup> cells/mL)	1/1 [100] ejaculate	8	5/8 [63]	4	4/5 [80]	0/4 [0]	N/A	N/A	–

		RBM1, RBM2); partial $\Delta$ AZFc (only sY146, sY149)										
Kleiman <i>et al.</i> (14)	1999	$\Delta$ AZFc	1 AZOY	2/2 [100] multiple-sample TESE (three ICSI attempts; collected sperm twice)	Cycle 1: 4; cycle 2: 9; cycle 3: 8	Cycle 1*: 3/4 [75]; cycle 2*: 2/9 [22]; cycle 3*: 6/8 [75]	Cycle 1: 3; cycle 2: 2; cycle 3: 6	N/A	3/11 [27], *triplet pregnancy	3/11 [27], *triplet pregnancy	-	-
Page <i>et al.</i> (15)	1999	$\Delta$ AZFc (sY205, sY254, sY624, sY602, sY202, sY158)	2 cryptozoospermic; 1 AZOY	Originally, 0/3 [0] ejaculate; after semen centrifugation and extensive searching, 2/3 [67] ejaculate; 1/1 [100] TESE	$\geq 71$ (number of oocytes retrieved not specified for man #3, only number of oocytes injected)	29/59 [59]	24	N/A	5/24 [21]; two pregnancies were twins, last was singleton	4/24 [17]	1 Pulmonary atresia and right ventricular hypoplasia; 1 gastric reflux (resolved at 3 months)	One fetus died shortly after birth due to pulmonary atresia and right ventricular hypoplasia
Chang <i>et al.</i> (16)	1999	$\Delta$ AZFc	1 AZOY	1/1 [100] ejaculate	9	3/9 [33]	3	3/3 [100]	N/A	1/3 [33]	N/A	-
van Golde <i>et al.</i> (17)	2001	$\Delta$ AZFc	8 SOLGY	7/8 [88] ejaculate	8.1 $\pm$ 4 oocytes/oocyte retrieval (mean $\pm$ SD)	55 $\pm$ 7 [41, 69] (mean $\pm$ SEM)	17	N/A	3/17 [18]	3/17 [18]	N/A	-
		-	107 SOLG	-	9.6 $\pm$ 4.9 oocytes/ooc	70 $\pm$ 2 [67, 74]	230	N/A	73/230 [32]	60/230 [26] <sup>p</sup>	N/A	-



		ΔAZFc (ΔsY202, ΔsY243)	2 AZOY	0/2 [0] TESE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-							
		ΔAZFc (except sY158 and sY159)	2 AZOY	2/2 [100] TESE; [only one patient attempted ICSI]	20	6/20 [30]	5 mixed embryos and blastocys ts	Cycle 1: 60%, cycle 2: 75%	0/5 [0]	N/A	N/A	-							
Choi <i>et al.</i> (21)	2004	ΔAZFa	1 AZOY	0/1 [0] TESE	102 injected oocytes	42/102 [41]	7	N/A	4/7 [57]	3/7 [43]	N/A	-							
		ΔAZFb	1 AZOY	0/1 [0] TESE								-							
		Partial ΔAZFb (ΔsY143)	1 AZOY	1/1 [100] TESE								Partial ΔAZFb had a biochemical pregnancy, but # ET unknown							
		ΔAZFbc	2 AZOY	0/2 [0] TESE								-							
		ΔAZFc	6 AZOY	6/7 [86] TESE								All clinical pregnancies occurred for AZFc, but unknown how many ET							
		ΔAZFc	6 SOLGY	6/6 [100] ejaculate								149 injected oocytes	80/149 [54]	14	N/A	5/14 [36]	3/14 [21]	N/A	-
		-	23 AZO	15/24 [63] TESE								197 injected oocytes	104/197 [53]	13	N/A	9/13 [69]	N/A	N/A	-
-	30 SOLG	30/30 [100] ejaculate	290 injected oocytes	181/290 [62]	30	N/A	15/30 [50]	N/A	N/A	-									
de Llanos	2005	ΔAZFc (Δgr/gr)	1 AZOY	0/1 [0]	-	-	-	-	-	-	-	-							

<i>et al.</i> (22)		ΔAZFc (Δgr/gr only)	11 SOLGY (ICSI data only available for four participants)	11/11 [100]	73	47/73 [64]	14/47 [30]	N/A	5/14 [36]	N/A	N/A	–
<i>Kihaile et al.</i> (23)	2005	ΔAZFa (except sY14, sY18, sY78)	1 AZOY	0/1 [0] TESE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	–
		ΔAZFabc (except sY14, sY18, sY78, sY143)	1 AZOY	0/1 [0] TESE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	–
		ΔAZFc (except sY158, sY159)	2 AZOY 3 SOLGY	2/2 [100] AZOY TESE; 3/3 [100] SOLGY ejaculate	108	60.1%±17.9% (mean ± SD)	8	87.6%±14.5% (mean ± SD)	3/8 [38]	N/A	N/A	–
		–	11 Oligozoospermic	N/A	269	71.6%±15.7% (mean ± SD)	21	85.1±9.4 (mean ± SD)	9/21 [43]	N/A	N/A	–
<i>Stouffs et al.</i> (24)	2005	ΔAZFa	1 AZOY	0/1 [0] TESE	–	–	–	–	–	–	–	Combined cryptozoospermia (<0.1×10 <sup>6</sup> ) and SOLG together
		ΔAZFb	2 AZOY; 1 SOLGY	0/3 [0] TESE	–	–	–	–	–	–	–	
		ΔAZFc	16 AZOY; 11 SOLGY (16 of these attempted 40 ICSI cycles)	10/17 [59] TESE	379	209/379 [55]	32	N/A	7/32 [22]	5 (delivery or ongoing), but 3 babies; what to do here?	–	
		ΔAZFbc	5 AZOY	0/5 [0] TESE	–	–	–	–	–	–	–	



		-	385 AZO	188/385 [49]	N/A	N/A	N/A	N/A	91/185 [48] (clinical pregnancies/patients sperm retrieved)	N/A	N/A	-
Plotton <i>et al.</i> (27)	2010	Partial $\Delta$ AZFb; $\Delta$ sY142, $\Delta$ sY143, $\Delta$ sY1197, $\Delta$ sY1192, $\Delta$ G34984 (PRY); partial $\Delta$ AZFc ( $\Delta$ DAZ1, $\Delta$ DAZ2); deletion of palindrome P3 with extion to u1 region; G1-g3 inversion	1 OATY	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Natural pregnancy occurred during investigations
Gamber <i>a et al.</i> (28)	2010	$\Delta$ AZFc	1 AZOY	1/1 [100] TESE	6	3/6 [50] excellent quality (does this mean that it could be >3, but only 3 were "excellent"?)	3	N/A	3/3 [100] *triplets	3/3 [100] *triplets	N/A	-
Kilic <i>et al.</i> (29)	2010	$\Delta$ sY127, $\Delta$ sY134 (of AZFb); mosaicism 45X	1 AZOY	1/1 [100] TESE	N/A	N/A	3	N/A	0/3 [0] (assuming all three embryos were transferred)	0/3 [0] (assuming all three embryos)	N/A	-

		(5%)/46XY (95%) by cytogenetic analysis								were transferred)		
		ΔsY127, ΔsY134 (of AZFb); ΔsY254, ΔsY255 (of AZFc); 45,X (45%)/ 46XY (55%) mosaicism	1 AZOY	0/1 [0] TESE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	–
Mateu <i>et al.</i> (30)	2010	ΔAZFc	5 SOLGY; 1 AZOY	N/A	13 (median) No. oocytes	61%	N/A	N/A	60%	3 No. live births	N/A	–
		–	9 SOLG; 1 AZO	N/A	11 (median) No. oocytes	60%	N/A	N/A	67%	9 No. live births	N/A	–
Shi <i>et al.</i> (31)	2011	Duplication in Yp11.2 which contains <i>AMELY</i> , <i>PRKY</i> and <i>TBL1Y</i> genes, and five <i>TTYs</i> ( <i>TTY16</i> , <i>TTY12</i> , <i>TTY18</i> , <i>TTY19</i> and <i>TTY11</i> ; ΔsY124, ΔsY127 (Partial ΔAZFb); (deletion	1 OATY	2/2 [100] ejaculate	–	–	2 embryos first ICSI cycle; 2 embryos second ICSI cycle	–	–	2/2 [100] first ICSI, both preterm but did not survive (immature lung development) [2004]; 2/2 [100] second ICSI [2007]	–	–



		included whole P5, P4 and <i>DYZ19</i> regions); the final karyotype was interpreted as: 46XY, arr cgh; Yp11.2 ( <i>AMELY</i> → <i>TTT Y11</i> ) .2, Yq11.22 ( <i>XKRY</i> → <i>RPS4 Y2</i> ) · 0										
Kim <i>et al.</i> (32)	2012	ΔAZFa	5 AZOY	No sperm successfully collected	–	–	–	–	–	–	–	–
		ΔAZFb	7 AZOY; 1 SOLGY	No sperm successfully collected	–	–	–	–	–	–	–	–
		ΔAZFc	28 AZOY; 26 SOLGY; 1 MOLGY (5–20×10 <sup>6</sup> sperm/mL)	23 couples attempted ICSI;  14 pts TESE  9 pts ejaculate	18.7±8.5 (mean ± SD) no. retrieved oocytes; 488 total	318/488 [65]	33	–	13/33 [39]	13/33 [39]	–	–
		ΔAZFabc	9 AZOY	No sperm successfully collected	–	–	–	–	–	–	–	–

		ΔAZFbc	24 AZOY	No sperm successfully collected	–	–	–	–	–	–	–	–
Liu <i>et al.</i> (33)	2013	ΔAZFc	143 SOLGY (based upon mean sperm concentration); 1.1×10 <sup>6</sup> sperm/cc (mean sperm concentration); 124/143 [87] patients had karyotype tested; n (115/143 tested pts had 46XY [80]); (9/143 [6] abnormal karyotype)	Ejaculate	1,834; 15.71±8.644 (mean ± SD)	1,133/1,834 [62]	110	1203/1280 [94]	36/110 [33]	29/110 [26] delivery rate (birth of liveborn or stillborn)	0	Some of the patients have abnormal karyotype (inversions, etc.)
		–	143 MOLG (based upon mean sperm concentration); 10.55 ×10 <sup>6</sup> sperm/cc	Ejaculate	1,700; 15.70±8.441 (mean ± SD)	1,153/1,700 [68]	117	1,144/1,299 [88]	39/117 [33]	30/117 [26] delivery rate (birth of liveborn or stillborn)	0	–
Choi <i>et al.</i> (34)	2013	ΔAZFbc	25 AZOY; 4 OATY	0/9 [0] AZOY TESE; N/A OATY ejaculate	N/A	–	–	–	–	2/3 [67] OATY (patient/patient attempted ICSI); 0/17 [0] AZOY (patient/patient attempted ICSI)	–	–
		ΔAZFc	58 AZOY; 23 OATY	8/21 [38] AZOY TESE; N/A OATY ejaculate	N/A	N/A	N/A	N/A	N/A	8/46 [17] AZOY (patient/patient attempted	–	–

										ICSI); 9/16 [56] OATY			
		–	130 AZO	21/82 [26] AZO; N/A	N/A	N/A	N/A	N/A	N/A	23/138 [17]	N/A	–	
		–	49 OAT	OAT ejaculate	N/A	N/A	N/A	N/A	N/A	total patients/patients attempted ICSI	N/A	–	
Sen <i>et al.</i> (35)	2015	gr/gr	18 AZOY; 33 (S)OLGY	N/A	N/A	N/A [77]	28	N/A	3/10 [30] men; not ET	N/A	N/A	10 men attempted ICSI	
		b1/b3	1 AZOY; 2 (S)OLGY										
		b2/b3	1 AZOY; 1 (S)OLGY										
		gr/gr	8 control	N/A	N/A	N/A [78]	734	N/A	59/230 [26] men; NOT ET	N/A	N/A	ET done in 230 men, though 239 attempted ICSI	
		b1/b3	2 control										
		b2/b3	6 control										
Zhu <i>et al.</i> (36)	2015	Location of deletion not stated	27 AZOY	14/27 [52] TESE	228	154/228 [68]	14; 2.21±0.43 (mean ± SD)	137/154 [89]	7/14 [50]	5/7 [71] (2/7 miscarriage rate; 2/7 multiple rate)	–	–	
		Location of deletion not stated	43 (S)OLGY (sperm concentration not stated)	43/43 [100] ejaculate	670	468/670 [70]	43; 2.19±0.39 (mean ± SD)	420/468 [89]	25/43 [58]	20/25 [80] (5/25 miscarriage rate; 6/25 multiple rate)	N/A	–	
		–	28 AZO	N/A	408	307/408 [74]	28; 2.18±0.39 (mean ± SD)	291/307 [95]	16/28 [57]	12/16 [75] (4/16 miscarriage rate; 2/16 multiple rates)	N/A	–	

		–	86 (S)OLG (sperm concentration not stated)	N/A	1,263	958/1,263 [76]	86; 2.15±0.36 (mean ± SD)	903/958 [94]	51/86 [59]	45/51 [88] (6/51 miscarriage rate; 14/51 multiple rate)	N/A	–
Zhu <i>et al.</i> (37)	2015	ΔAZFc (ΔsY152)	3 AZOY; 3 SOLGY; 6 MOLGY	Inclusion criteria required successfully obtained sperm by TESE or masturbation; total attempts N/A	11.50±5.71 (mean ± SD)	171/250 [68]	26; 2.38±0.57 (mean ± SD)	155/171 [91]	12/26 [46]	11/26 [42] delivery rate per transfer; 3/12 [25] multiple rate; 2/11 [18] preterm rate; 1/12 [8] miscarriage rate	N/A	Exclusion criteria: complete fertilization failure in the previous ICSI treatment
		ΔAZFc	31 AZOY; 14 SOLGY 4	Inclusion criteria required successfully obtained sperm by TESE or masturbation; total attempts N/A	11.90±6.67 (mean ± SD)	582/824 [71]	70; 2.29±0.46 (mean ± SD)	532/582 [91]	38/70 [54]	31/70 [44] delivery rate per transfer; 8/38 [21] multiple rate; 5/32 [16] preterm rate; 7/38 [18] miscarriage rate	N/A	–
		–	21 AZO; 15 SOLG; 14 MOLGY	Inclusion criteria required successfully obtained sperm by TESE or masturbation	11.67±7.11 (mean ± SD)	636/849 [75] (/total # oocytes injected)	73; 2.42±0.50 (mean ± SD)	599/636 [94]	40/73 [55]	34/73 [47] delivery rate per transfer; 10/40 [25] multiple rate; 7/34 [21] preterm rate; 6/40 [15]	N/A	–

				n; total attempts N/A						miscarriage rate		
Ko <i>et al.</i> (38)	2016	ΔAZFbc; (46XY/45X (33:1) and 45X/46X, idic(Y (q11.2) (12:18)	2 AZOY	0/2 [0] TESE or mTESE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	–
		ΔAZFabc; 46X, der(Y). ish i(Y)(p10)(pter+ +, SRY++)	1 AZOY	0/1 [0] TESE or mTESE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	–
		ΔAZFc	6 AZOY	3/6 [50] TESE or mTESE	40	11/40 [28]	N/A	N/A	N/A	N/A	N/A	–
		–	61 AZO	28/61 [46] TESE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	–
Schwarz er <i>et al.</i> (11)	2016	ΔAZFb	1	0/1 [0] TESE (multilocular or micro- TESE, type not stated)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	–
		ΔAZFbc	2	0/2 [0] TESE (multilocular or micro- TESE, type not stated)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	–
		ΔAZFc	20	10/20 [50]; 2/8 [25] multilocular TESE; 8/12	Unknown, but 2.3 cycles mean carried out	N/A	N/A	N/A	2/6 [33] patients attempted ICSI (not specified if clinical or biochemical pregnancy)	1/2 [50]	N/A	–

				[67] micro-TESE	for 6 of the 10 couples								
		ΔAZFc + other chromosomal disorder	2	0/2 [0] TESE (multilocular or micro-TESE, type not stated)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-
Liu <i>et al.</i> (39)	2017	ΔAZFb (ΔsY127, ΔsY134, ΔsY143)	1 MOLGY	1/1 [100] ejaculate	200; 10.19±8.57 (mean ± SD)	104/200 [52]	25	95/104 [91]	6/25 [24]	6/24 [25]	0	-	
		ΔAZFc (ΔsY152)	1 MOLGY	1/1 [100] ejaculate								-	
		ΔAZFc (ΔsY152, ΔsY254, ΔsY255, ΔsY157)	2 MOLGY	2/2 [100] ejaculate									-
		ΔAZFc (ΔsY152, ΔsY254, ΔsY255)	12 MOLGY	12/12 [100] ejaculate									-
		-	26 MOLG	N/A	336; 12.23±6.56 (mean ± SD)	278/336 [83]	30	241/278 [87]	13/30 [43]	13/53 [25]	0	-	
Goncalves <i>et al.</i> (40)	2017	ΔAZFa	N/A	N/A	71	46/71 [65]	35	44/46 [96]	1/35 [3]	1/35 [3]	0	-	
		ΔAZFb (some partial, some complete)	-	N/A	55	30/55 [55]	19	26/30 [87]	2/19 [11]	0/19 [0]	0	-	



oligoasthenoteratozoospermic without a YCM; <sup>¶¶</sup>, percentage of the total number of metaphase II oocytes injected; <sup>†††</sup>, percentage of the total number of embryos; <sup>‡‡‡</sup>, defined as the ratio of clinical pregnancies and number of ETs; <sup>a</sup>, total of 14 patients, but 2 patients went through 2 cycles each; <sup>b</sup>, Including two cycles with an ongoing pregnancy, but with unknown outcome at the closing date of data collection. ICSI, intracytoplasmic sperm injection; FR, fertilization rate; YCM, Y chromosome microdeletion; AZF, azoospermic factor; ICSI, intracytoplasmic sperm injection; microTESE, microdissection testicular sperm extraction; ET, embryo transfer.