

Author Year; Country Score Research Design Total Sample Size	Methods	Outcome
<p>Bechoua et al. 2013; France Case Series Level 5 N=19</p>	<p><b>Population:</b> 19 men with SCI (6 quadriplegics, 13 paraplegics, mean age=25.2±5.6 years) who underwent sperm cryopreservation from 1995 to 2011.</p> <p><b>Treatment:</b> Two groups were outlined based on sperm retrieval method: antegrade ejaculation group (n=10) and surgical sperm retrieval (SSR) group (n=9).</p> <p><b>Outcome Measures:</b> Samples was analyzed according to the guidelines of the World Health Organization. Pregnancy outcomes in the 8 couples who chose to undergo Intra Cytoplasmic Sperm Injection (ICSI) were assessed.</p>	<ol style="list-style-type: none"> <li>1. Fertilization rates were 57 and 55% in the antegrade ejaculation and SSR groups respectively.</li> <li>2. The embryo's cleavage rates were 90 and 93% in the antegrade ejaculation and SSR groups respectively.</li> <li>3. Within the 8 couples that received ICSI, 5 couples achieved pregnancy.</li> <li>4. Pregnancy rates per couple were 50% and 75% in the antegrade ejaculation and SSR groups respectively.</li> </ol>
<p>Leduc 2012; Canada Case series Level 5 N=31 (couples)</p>	<p><b>Population:</b> 31 couples with male partners with SCI and fertility disorder as result from SCI; mean(SD) age: SCI men 29.7(4.8) yrs, range 23-48, female partners 29.3(4.8) yrs, range 25-41; mean(SD) DOI: 7.6(6) yrs, range 1-29; 10 cervical, 20 thoracic, 1 lumbar.</p> <p><b>Treatment:</b> Semen samples obtained by manual stimulation (n=10, including 6 treated by sc physostigmine), penile vibratory stimulation (PVS) (n=4), electroejaculation (EEJ) (n=5), and testicular sperm extraction (n=12). Assisted reproductive technique (ART) selected according to sperm parameters (IVI, IUI, IVF).</p> <p><b>Outcome measures:</b> Sperm parameters (count, motility), number of pregnancies, births, and paternities, pregnancy rate/cycle.</p>	<ol style="list-style-type: none"> <li>1. Among the 10 couples treated with intravaginal insemination, 9 pregnancies occurred among 7 couples.</li> <li>2. No pregnancies resulted from intrauterine insemination (2 cases).</li> <li>3. Among the 18 couples treated with IVF, 12 pregnancies were reported among 10 couples.</li> <li>4. The pregnancy rate/cycle was 43%.</li> <li>5. Following these assisted reproductive techniques (ARTs) the pregnancy rate reached 55%.</li> <li>6. Overall 20 men with SCI (64% of the group) became fathers to at least one child.</li> </ol>
<p>Kathiresan et al. 2011; USA Retrospective analysis Level 5 N=82</p>	<p><b>Population:</b> 82 male patients with SCI and their female partners; mean(SD) age 36.1(0.7) yrs, mean time after injury 0.8 yrs (range 0.7-34.0 yrs).</p> <p><b>Treatment:</b> 45 couples performed intravaginal insemination (IVI); intrauterine insemination (IUI) was performed in 57 couples.</p> <p><b>Outcome Measures:</b> Method of sperm retrieval, sperm quality, occurrence of pregnancy, live birth, pregnancy rate (PR), pregnancy losses, multiple gestations, total motile sperm count (TMSC).</p>	<ol style="list-style-type: none"> <li>1. Of the 45 couples with IVI, 17 couples had 20 pregnancies with 3 couples achieving pregnancy twice (16 through penile vibratory stimulation; 1 through electroejaculation; and 3 through masturbation). Eighteen live births occurred.</li> <li>2. Average time from male partner's first semen analysis to time of pregnancy was 6.9(1.25) mos. The mean antegrade TMSC in men achieving vs. not achieving pregnancy was not statistically significant: 90.1(30.8) million (range 2.6-425.7 million) vs. 76.5(21.0) million (range 0.3-544.5 million).</li> <li>3. 57 couples underwent IUI, where 14 couples had 19 pregnancies and 21 live births (1 twin and 1 triplet pregnancy occurred, both by IUI cycles stimulated by gonadotropins). Cycle fecundity was 7.9% (19 pregnancies of</li> </ol>

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		241 cycles). Semen collected by PVS (6 pregnancies) and EEJ (13).
McGuire et al. 2011; Ireland Retrospective review (case series) Level 5 N=31	<p><b>Population:</b> 31 men (mean age 35 yrs, range 24-49), 29 with acquired spinal cord injury (complete lesion (n=18), incomplete lesion (n=11). Injury levels: C3-C7; T1-T5; T11-L3), 2 with congenital spinal abnormality.</p> <p><b>Treatment:</b> EES done with Seager model rectal probe. Electroejaculatory stimulation (EES) – n= 27 (87%) underwent EES once, n= 4 (13%) underwent EES several times.</p> <p><b>Outcome measures:</b> The Mann-Whitney U test, semen analysis (volume, density, motility, normal morphology and live sperm); pregnancy rate</p>	<ol style="list-style-type: none"> <li>1. Of the 25 patients whose partners underwent insemination with the EES semen, 9 (36%) became pregnant. All pregnancies resulted in live births.</li> <li>2. One patient developed autonomic dysreflexia necessitating stopping EES before obtaining any ejaculate. No other side effects or complications were reported.</li> <li>3. 30 patients produced antegrade, retrograde, or both types of ejaculate</li> </ol>
Hibi et al. 2008; Japan Post-test Level 4 N=8	<p><b>Population:</b> 8 participants with cervical SCI and neurogenic anejaculation (age 26-46 yrs, mean 35.6).</p> <p><b>Treatment:</b> Retrograde vasal sperm aspiration (ReVSA).</p> <p><b>Outcome Measures:</b> Presence of motile sperm.</p>	<ol style="list-style-type: none"> <li>1. Motile sperm was recovered in all participants who underwent ReVSA (11 procedures total).</li> <li>2. The retrieved sperm concentration was <math>109.4(64.7) \times 10^6</math> /mL (range 31.2-156.3 <math>\times 10^6</math> /mL).</li> <li>3. The retrieved motility of sperm was 69.8%(16.8) (range 50-91%).</li> <li>4. Clinical pregnancies were achieved in 8 cases.</li> </ol>
Kanto et al. 2008; Japan Case control Level 3 N=56	<p><b>Population:</b> 22 men with SCI (age 21-41); data on 34 men with obstructive azoospermia was obtained retrospectively for control.</p> <p><b>Treatment:</b> Testicular sperm extraction (TESE); if unsuccessful, microdissection TESE was performed, followed by intracytoplasmic injection (ICSI).</p> <p><b>Outcome Measures:</b> Fertilization; pregnancy.</p>	<ol style="list-style-type: none"> <li>1. TESE successfully retrieved sperm in 19 participants with SCI.</li> <li>2. ICSI resulted in a fertilization rate of 236 of 364 (64.8%) in SCI couples and 14/19 achieved pregnancy.</li> <li>3. In couples with obstructive azoospermia, ICSI resulted in a fertilization rate of 435 of 567 (77%) and 29/34 achieved pregnancy.</li> <li>4. Pregnancy rate was significantly higher in couples with SCI using fresh testicular sperm-ICSI compared to frozen-thawed sperm-ICSI.</li> </ol>
Engin-Üstün et al. 2006; Turkey Case series Level 4 N=44	<p><b>Population:</b> Men with SCI and partner; median age 26.0-29.5 yrs, range 20-31; 4 cervical, 38 thoracic, 2 lumbar.</p> <p><b>Treatment:</b> Retrieval by electro-ejaculation (EE), testicular sperm extraction (TESE) or prostatic massage (PM).</p> <p><b>Outcome Measures:</b> Fertilization rate, pregnancy rate, live birth rate, sperm counts, sperm motility.</p>	<ol style="list-style-type: none"> <li>1. Fertilization, pregnancy and live birth rates were same between 3 methods.</li> <li>2. Sperm count and sperm motility were the same between EE and PM method.</li> </ol>

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Shieh et al. 2003; Taiwan Post-test Level 4 N=10	<p><b>Population:</b> 10 men with SCI and partner; Age: range 27-37 yrs; Injury level: C6-T12, 9 incomplete and 1 complete, 9 paraplegia &amp; 1 tetraplegia; Time since injury: range 4-20 yrs.</p> <p><b>Treatment:</b> If semen sample from electroejaculation (EE) was of fair quality, then 3 cycles of intrauterine insemination prior to intracytoplasmic sperm injection treatment (ICSI). If semen samples were poor, ICSI was suggested. If no sperm from EE, surgical retrieval of sperm was performed.</p> <p><b>Outcome Measures:</b> Pregnancy rates.</p>	<ol style="list-style-type: none"> <li>7 clinical pregnancies achieved, 2 of which ended with spontaneous abortion. 1 couple accomplished pregnancy by ICSI with cryopreserved sperm from vasal aspiration.</li> <li>The fertilization and pregnancy rates of ICSI cycles using sperm from men with SCI were comparable to men without SCI.</li> <li>One couple attained pregnancy by using donor sperm.</li> <li>The cumulative successful pregnancy rate per couple was 80%.</li> </ol>
Heruti et al. 2001; Israel Post-test Level 4 N=84	<p><b>Population:</b> 84 men with SCI, 49 couples; Age: range 19-45 yrs; Injury level: cervical (34.5%), thoracic (59.5%), lumbar (5.9%); Impairment grade: AIS A (n=63), B (n=15), C (n=5), D (n=1); Time since injury: range 4 months-34 yrs.</p> <p><b>Treatment:</b> Electroejaculation followed by intrauterine insemination for 3 trials (10million sperm/cc). If this did not result in fertilization, intracytoplasmic sperm injection and IVF.</p> <p><b>Outcome Measures:</b> Volume, sperm count, motility, morphology, total motile sperm count, conception.</p>	<ol style="list-style-type: none"> <li>Ejaculation occurred in 98.6% of patients, with sperm in 88% of patients and enough viable sperm in 54.8%.</li> <li>Antegrade semen parameters had significantly better sperm count, morphology and motility than retrograde samples.</li> <li>No significant improvements were seen in seminal parameters after repeated ejaculations.</li> <li>69.2% overall pregnancy rate/couple. 33% (5/15) after intrauterine insemination, 70% (14/20) after IVF.</li> <li>26 live births (n=12 singletons, n=5 twins, n=1 triplets) and 4 abortions.</li> </ol>
Ohl et al. 2001; USA Post-test Level 4 N=121	<p><b>Population:</b> 121 couples (87 men with SCI and partner).</p> <p><b>Treatment:</b> Electroejaculation followed by intrauterine insemination (IUI) was the route of sperm delivery. If not successful after 3-6 cycles of IUI, GIFT (gamete intrafallopian transfer) or IVF procedures were recommended.</p> <p><b>Outcome Measures:</b> Pregnancy success and pregnancy outcomes.</p>	<ol style="list-style-type: none"> <li>52/121 became pregnant, 39 by IUI alone.</li> <li>All patients undergoing IVF had significantly higher cycle fecundity than did those undergoing IUI.</li> <li>The rates of spontaneous abortion and multiple gestations were 23% and 12%, respectively.</li> </ol>
Pryor et al. 2001; USA Prospective controlled trial Level 2 N=11	<p><b>Population:</b> 11 men with SCI and their partner; Injury level: tetraplegia.</p> <p><b>Treatment:</b> Electrical stimulation or vibratory stimulation followed by 1) intrauterine insemination of partner 24 hour after Luteinizing Hormone surge (n=5), 2) 50 mg clomiphene citrate &amp; hCG, followed by insemination after 32-34 hours (n=5), or 3) same as #2, except 38-40 hour delay (n=10).</p> <p><b>Outcome Measures:</b> Fertility rates, seminal parameters.</p>	<ol style="list-style-type: none"> <li>No pregnancies with protocol 1 or 2. 6/10 patients became pregnant with protocol 3, which has the longest delay between drug administration and insemination.</li> </ol>

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Schatte et al. 2000; USA Post-test Level 4 N=17	<p><b>Population:</b> 10 men with SCI (7 non-SCI related anejaculation); mean age 38.9 yrs.</p> <p><b>Treatment:</b> Electroejaculation and intracytoplasmic sperm injection (ICSCI) and results compared to 620 ICSI cycles for non-SCI male infertility with normal ejaculation.</p> <p><b>Outcome Measures:</b> Pregnancy rate.</p>	<ol style="list-style-type: none"> <li>1. ICSI resulted in a median fertilization of 60%, 15% pregnancies per cycle and 29% pregnancies per couple.</li> <li>2. Pregnancy rates were lower for the anejaculation group compared to the severe male factor group.</li> </ol>
Taylor et al. 1999; Australia Post-test Level 4 N=19	<p><b>Population:</b> 19 men with SCI; Age: range 24-44 yrs; Injury level: C4-C9 (n=9), T4-T12/L1 (n=10), 12 complete and 7 incomplete; Time since injury: range 1-24 yrs.</p> <p><b>Treatment:</b> Sperm was extracted through vibrator application or electroejaculation followed by assisted reproductive treatments (intrauterine insemination, gamete intrafallopian transfer, in vitro fertilization and embryo transfer, intracytoplasmic sperm injection).</p> <p><b>Outcome Measures:</b> Seminal parameters, pregnancy rates (intrauterine insemination, gamete intrafallopian transfer, intracytoplasmic sperm injection).</p>	<ol style="list-style-type: none"> <li>1. 14/19 achieved at least 1 pregnancy.</li> <li>2. Methods used: Intrauterine insemination 12% (11/92), gamete Intrafallopian transfer 38.9% (8/18), intracytoplasmic sperm injection 19.2% (5/21).</li> <li>3. In patients with incomplete lesions vibratory stimulation was more frequently successful (4/7) 53%.</li> <li>4. Complete lesions required more advanced procedures to achieve pregnancy, (7/12) 58% required electroejaculation.</li> </ol>
Brinsden et al. 1997; UK Post-test Level 4 N=35	<p><b>Population:</b> 35 men with SCI and their female partners; Age: (men) range 24-47 yrs, (female) range 21-43 yrs; Injury level: C5-L1; Time since injury: range 1-27 yrs.</p> <p><b>Treatment:</b> Trans-rectal electroejaculation with in-vitro fertilization. 71 IVF cycles were used.</p> <p><b>Outcome Measures:</b> Pregnancies, fertilization rate, motile sperm count.</p>	<ol style="list-style-type: none"> <li>1. Pregnancy rates: 18 total (14 were fresh embryo transfers, 4 were frozen embryo transfers).</li> <li>2. Pregnancy rate per treatment cycle was 21.2% (18/35).</li> <li>3. Overall clinical pregnancy rate per stimulated IVF treatment was 25.4% (18/71).</li> </ol>
Chung et al. 1997; USA Post-test Level 4 N=27	<p><b>Population:</b> 24 men with SCI, 3 men with retroperitoneal dissection; Age: range 4-48 yrs; Time since injury: range 3-25 yrs.</p> <p><b>Treatment:</b> Electrostimulation and nifedipine (10mg) for prophylaxis of autonomic dysreflexia.</p> <p><b>Outcome Measures:</b> Ejaculation rates, pregnancy rates, seminal parameters.</p>	<ol style="list-style-type: none"> <li>1. 7 pregnancies in 13 couples with a total of 56 intrauterine insemination, 2 spontaneous abortions, 4 live births, 1 ongoing twin pregnancy.</li> </ol>
Hultling et al. 1997; Sweden Post-test Level 4 N=25	<p><b>Population:</b> 22 men with SCI and female partner; Age (men): range 25-51 yrs, (female): range 21-38 yrs; Injury level: C2-L3; Time since injury: range 3-33 yrs.</p> <p><b>Treatment:</b> Vibratory or electrical stimulation followed by IVF.</p> <p><b>Outcome Measures:</b> Conception.</p>	<ol style="list-style-type: none"> <li>1. Pregnancy rate: 16/25 pregnancies occurred leading to 11 deliveries.</li> <li>2. n=9 singletons, n=2 sets of twins; n=4 miscarriages during the first or second trimester (1 case of intrauterine death in week 31 of gestation).</li> <li>3. Pregnancy occurred in all groups of patients in the AIS scale A-D from injuries from C2-L2.</li> <li>4. Clinical pregnancy rate was 31% and the cumulative pregnancy rates up to four cycles were 56%.</li> </ol>

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<p>Sonksen et al. 1997; Denmark Case series Level 5 N=28</p>	<p><b>Population:</b> 28 men with SCI and female partner; Age (men): range 24-43 yrs, (female): mean 29 yrs, range 19-39 yrs; Injury level: C2-L4; Time since injury: range 1-22 yrs. <b>Treatment:</b> Males with SCI: vibratory stimulation or electroejaculation. Female partners: assisted reproductive techniques (vaginal self-insemination at home, intrauterine insemination, in vitro fertilization with or without intracytoplasmic sperm injection). <b>Outcome Measures:</b> Ejaculation rates, seminal parameters, pregnancy rates.</p>	<ol style="list-style-type: none"> <li>1. All men were able to ejaculate, 22 by vibratory stimulation (all with lesion above T10), 6 by electroejaculation.</li> <li>2. 4/16 achieved pregnancy and had healthy babies. This was achieved by home vibratory stimulation and self-insemination within 2 years.</li> <li>3. All couples that had children had significantly higher median motile sperm per ejaculate (105 million vs. 10 million).</li> <li>4. Overall 9/28 couples (32%) achieved 10 pregnancies with a delivery of 9 healthy babies.</li> </ol>
<p>Nehra et al. 1996; USA Case Series Level 4 N=78</p>	<p><b>Population:</b> 78 men with SCI (33 couples); Age: range 23-44 yrs; Injury level: 37 cervical, 41 thoracic. <b>Treatment:</b> Retrospective review of electrical stimulation followed by cervical self-insemination, intrauterine insemination, in vitro fertilization, or gamete intrafallopian transfer. <b>Outcome Measures:</b> Sperm quality, pregnancy rates.</p>	<ol style="list-style-type: none"> <li>1. Vibratory stimulation achieved ejaculation in 20/37 cervical patients, 14/26 at or above T10 and 0/15 below T10.</li> <li>2. Pregnancy rates: 17/27 achieved pregnancy (10 with vibratory stim, 7 with electroejaculation).</li> <li>3. 5/8 achieved self-home insemination with PVS.</li> <li>4. 17/27 couples were successful at conception (5 self-insemination, 5 intrauterine insemination and 7 assisted reproductive techniques).</li> <li>5. 20 live births in 14 couples.</li> </ol>
<p>Brackett et al. 1995; USA Case series Level 4 N=23</p>	<p><b>Population:</b> 23 (21 with SCI) men and partner; Age: range 26-42 yrs; Injury level: cervical (n=7), thoracic (n=12), lumbar (n=2); Time since injury: range 2-28 yrs. <b>Treatment:</b> Vibrostimulation or electroejaculation with ovulation induction by clomiphene citrate or gonadotropins and intrauterine insemination (IUI). <b>Outcome measures:</b> Pregnancy and live births.</p>	<ol style="list-style-type: none"> <li>1. Six pregnancies (7 live births) occurred in 60 cycles of IUI (cumulative pregnancy rate 26%).</li> <li>2. Six couples who failed after a total of 33 IUI cycles, and 1 couple with no previous IUI cycles initiated 10 cycles of in vitro fertilization, resulting in 5 pregnancies (pregnancy rate 71%): 1 live birth, 1 ongoing pregnancy, 1 ectopic pregnancy, 2 spontaneous abortions.</li> </ol>
<p>Dahlberg et al. 1995; Finland Post-test Level 4 N=63</p>	<p><b>Population:</b> Men with SCI and 35 female partners; Age: range 21-42 yrs; Level of injury: C1-C5 to L1-L2. <b>Treatment:</b> Sperm was extracted through vibrator application, drug application (Nifedipine 10-30mg), and electroejaculation or sperm aspiration from the vas deferens. Sperm was then introduced by insemination or IVF. <b>Outcome Measures:</b> Live births.</p>	<ol style="list-style-type: none"> <li>1. Fertility rates: of 35 males seeking pregnancy, 29 could produce viable sperm.</li> <li>2. Live births: n=24 children from 18/35 couples). Miscarriages: n=4.</li> </ol>

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Pryor et al. 1995; USA Post-test Level 4 N=6	<p><b>Population:</b> 6 men with SCI; Age: range 30-35 yrs; Injury level: C4-C7; Time since injury: 6-18 yrs.</p> <p><b>Treatment:</b> Vibratory stimulation (using 4,200rpm for 5-45min, with 5 min breaks every 5 min) followed by intrauterine inseminations.</p> <p><b>Outcome Measures:</b> Pregnancy rates.</p>	<ol style="list-style-type: none"> <li>1. Pregnancies occurred in 5/6 of the partners. 2 partners delivered healthy boys, 1 partner miscarried at 9 wks.</li> <li>2. One couple has completed second vibratory stimulation without conception and will try again.</li> </ol>
Hultling et al. 1994; Sweden Post-test Level 4 N=12	<p><b>Population:</b> 12 men with SCI and female partner; Age: range 27-38 yrs; Injury level: C4-L3; Time since injury: range 4-33 yrs.</p> <p><b>Treatment:</b> Vibratory stimulation and, if necessary, physostigmine and/or electroejaculation followed by IVF.</p> <p><b>Outcome Measures:</b> Seminal parameters, pregnancy rates.</p>	<ol style="list-style-type: none"> <li>1. Pregnancy rates: 7 pregnancies in 6 couples, 3 spontaneous abortions, 2 live births, 2 ongoing pregnancies.</li> </ol>
Buch & Zorn 1993; USA Post-test Level 4 N=18	<p><b>Population:</b> 18 men with SCI; Age range 22-43 yrs; Injury level: C5-T12; Impairment grade: AIS A (n=12), B-D (n=6); Time since injury: range 2-22 yrs.</p> <p><b>Treatment:</b> Rectal probe electroejaculation (RPE).</p> <p><b>Outcome Measures:</b> Sperm retrieval, sperm quality, live births.</p>	<ol style="list-style-type: none"> <li>1. After fertility testing, 6/18 men proceeded to use RPE in effort to conceive. Sperm obtained in 16/18 cases.</li> <li>2. Ejaculate total sperm count=306 million (good), but motility (22%) was poor.</li> <li>3. Adequate sperm retrieval after processing yielded normal sperm penetration assay in 4/16 (25%) cases in which sperm was obtained.</li> <li>4. Live births in 2/6 couples attempting conception.</li> </ol>
Lucas et al. 1991; UK Post-test Level 4 N=14	<p><b>Population:</b> 12 men with SCI, 2 men without SCI (diabetes); mean age 34.6 yrs, range 25-46; Injury level: C5-T10.</p> <p><b>Treatment:</b> Electrical stimulator (up to 35V, 900mA, 50Hz).</p> <p><b>Outcome Measures:</b> Fertility rates, seminal parameters, pregnancy rates.</p>	<ol style="list-style-type: none"> <li>1. Seminal parameters: volume obtained: a few drops to 5.5ml, % of progressive motility: 0-60%, and sperm concentration: 0-260 million/ml.</li> <li>2. 1 pregnancy recorded (father: T10 paraplegia, 8 yrs post-injury, 54million/ml, 30% motility) resulted in a singleton with no genetic abnormalities.</li> </ol>