

Table 14. Sperm Retrieval

Author Year; Country Score Research Design Total Sample Size	Methods	Results
Raviv et al. 2013 Israel Case control Level 3 N=32 (couples)	<p>Population: 32 couples with male partner with SCI referred to IVF after repeated trials of electroejaculation (EEJ) or penile vibratory stimulation (PVS) and full andrological evaluation; mean(SD) time since injury until assisted reproductive procedure 7.6(2.1) yrs, range 5–16; Patient subgroups: obstructive azoospermia (n=19), non-obstructive azoospermia (n=6), severe oligozoospermia (n=7).</p> <p>Treatment: Testicular sperm aspiration (TESA) for sperm extraction. Open testicular sperm extraction (TESE) was performed only after a negative TESA attempt.</p> <p>Outcome measures: clinical pregnancy and live birth rates.</p>	<ol style="list-style-type: none"> 1. A total of 106 testicular procedures were performed. Sperm was found in 95 cycles (89.6%). 2. Average metaphase II (MII) oocyte number was 11.0(4.2), an average of 5.1(2.3) oocytes became normally fertilized after Intra Cytoplasmic Sperm Injection (ICSI) (fertilization rate 57.1%). 3. On average, 2.7(1.2) embryos were replaced. The clinical pregnancy rate was 32/106 (30.2%) per cycle and 19/32 (59.3%) per couple. The live birth rate was 62.5% (20/32).
Čechová et al. 2014 Czech Republic Post Test Level 4 N=20	<p>Population: 20 males (mean age=30.8 years old, age range=20-44 years old); level of injury 13 cervical and 7 thoracic; average time since injury to PVS= 64 months; 7 patients had PVS for more than 3.5 years and 13 patients had PVS less than 3.5 years.</p> <p>Treatment: Participants were divided into two groups: Group 1 had 7 patients who were more than 3.5 years since their injuries and Group 2 had 13 patients who were less than 3.5 years since injury. PVS was performed using the Ferticare Multicept.</p> <p>Outcome Measures: Evaluate the effectiveness and safety of penile vibrostimulation (PVS), semen quality, sperm count, sperm motility, and further utilization of the ejaculate in men with SCI.</p>	<ol style="list-style-type: none"> 1. Ejaculation was achieved in 11 (55 %) patients [9 (82%) of patients with cervical SCI & 2 (18%) patients with thoracic SCI] 2. Success rate of PVS in patients less than 3.5 years since injury was 77 % in comparison with 14 % in patients over 3.5 years since injury. 3. Autonomic dysreflexia during PVS occurred in 7 patients, in 6 with cervical SCI and 1 patient with thoracic SCI. Symptoms of autonomic dysreflexia resolved within three minutes.
Kathiresan et al. 2012 USA	<p>Population: 444 men with SCI with no known causes of infertility other than SCI; level of injury: 176 cervical,</p>	<ol style="list-style-type: none"> 1. Sperm retrieval method in non-SCI control group: masturbation (n=43), PVS (n=243), EEJ (n=158).

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Case control Level 3 N SCI=444 N controls=61	193 T1-T10, 70 T11-caudal; 115 complete, 126 incomplete. Controls: 61 non-SCI men, healthy with no history of infertility. Treatment: Retrospective chart review of Male Fertility Research Program participants from 1991 to 2011. Sperm retrieval methods included masturbation, penile vibratory stimulation (PVS), and electroejaculation (EEJ). Outcome measures: sperm retrieval method (masturbation, PVS, EEJ), semen volume, sperm concentration, sperm motility, total sperm count.	Sperm retrieval method in non-SCI control group: masturbation (n=61). 2. 8.1% (43 of 528 SCI participants) retained the ability to ejaculate by masturbation. 3. Sperm motility was significantly higher in the SCI-masturbation group (36.9%) than the PVS group (25.9%) or EEJ group (15.0%), but lower compared with a control group of 61 non-SCI healthy men who collected their semen by masturbation (58.0%). 4. The SCI-masturbation group had similar antegrade sperm concentration as the PVS group, and control group, but significantly higher than the EEJ group.
Qiu et al. 2012 China Case-control Level 3 N SCI=26 N controls=16	Population: 26 infertile men with SCI (primary infertility present in 9), mean(SD) age 33.8(2.9) yrs, mean(SD) DOI 8.6(3.0) yrs (range 1-11 yrs), level of injury: C5-C6 (n=4), T2-T12 (n=22), mean(SD) yrs of infertility 6.8(4.2) yrs; Controls: 16 non-SCI fertile donors (all had previously fathered at least one child), mean(SD) age 32.9(2.1) yrs. Treatment: Collection of semen samples in SCI men using penile vibratory stimulation (PVS) (n=14), percutaneous vasal sperm aspiration (PVSA) (n=12); collection of semen samples in non-SCI donors all by masturbation (n=16). Outcome measures: sperm vitality and DNA integrity, sperm chromosomal aneuploidy.	1. The rate of sperm DNA fragmentation was higher in the PVS group than in the percutaneous vasal sperm aspiration (PVSA) group. 2. Aneuploidy rates for SCI patients were 1.5 to 1.6-fold higher for chromosomes 13, 18, and 21, and were 2.3- to 2.4-fold higher for chromosomes X and Y than for the control group.
Brackett et al. 2010 USA Case series Level 4 N=500	Population: 500 men with SCI (3,152 semen retrieval procedures); mean(SD) age 34.1(0.4) yrs (range 17-63); mean (SD) DOI: 10.0(0.3) yrs; Level of injury: 203 cervical, 123 T1-T6, 150 T7-T12, 20 ≤ L1,4 unknown.	1. Of the 500 men 9% could ejaculate by masturbation. 2. Penile vibratory stimulation (PVS) was successful in 86% of patients with a T10 or rostral injury level.

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	<p>Treatment: review of research data from Jan 1991 to Apr 2009 from SCI participants in a male fertility research program. Semen retrieval methods were performed according to ability: masturbation, if not then penile vibratory stimulation (PVS), if not then electroejaculation (EEJ).</p> <p>Outcome measures: semen retrieval methods: masturbation, PVS, EEJ; semen analysis: total sperm count, motility.</p>	<ol style="list-style-type: none"> 3. Electroejaculation (EEJ) was successful in most cases of failed PVS (91.9% responded to EEJ). 4. Sperm obtained without surgical sperm retrieval, in 97% of patients completing the treatment algorithm. 5. Total motile sperm counts exceeded 5 million in 63% of cases.
<p>Hibi et al. 2008 Japan Post-test Level 4 N=8</p>	<p>Population: 8 participants with cervical SCI and neurogenic anejaculation (age 26-46 yrs, mean 35.6).</p> <p>Treatment: Retrograde vasal sperm aspiration (ReVSA).</p> <p>Outcome Measures: Presence of motile sperm.</p>	<ol style="list-style-type: none"> 1. Motile sperm was recovered in all participants who underwent ReVSA (11 procedures total). 2. The retrieved sperm concentration was 109.4(64.7) × 10⁶ /mL (range 31.2-156.3 × 10⁶ /mL). 3. The retrieved motility of sperm was 69.8% (16.8) (range 50-91%). 4. Clinical pregnancies were achieved in 8 cases (7 couples).
<p>Arafa et al. 2007 Eqypt Post-test Level 4 N=69</p>	<p>Population: Men with SCI; Age: mean 36.6 yrs, SD=18.34; Injury level: at or below T10 (n=34), above T10 (n=35); Time since injury: mean 11.03 yrs, SD=7.80; anejaculatory.</p> <p>Treatment: Prostatic massage thru the rectum to push the sperm out through the ejaculatory ductal system.</p> <p>Outcome Measures: Semen retrieval.</p>	<ol style="list-style-type: none"> 1. Semen retrieval by prostatic massage was successful in 22 men (31.9%). 2. Semen retrieval by prostatic massage was higher for men with a SCI above T10 than below T10 (81.8% vs 18.2%).
<p>Brackett et al. 2007b USA Pre-post Level 4 N=297</p>	<p>Population: Men with SCI; Age: range 17-60 yrs; Injury level: cervical (n=109), T1-T10 (n=131), T11 or below (n=45), unknown (n=12); Time since injury: range 0.2-44.6 yrs.</p> <p>Treatment: Penile vibratory stimulation using 1 vibrator, or if this failed, 2 vibrators applied to glans penis using sandwich method.</p> <p>Outcome Measures: Semen retrieval.</p>	<ol style="list-style-type: none"> 1. 49% of all men ejaculate with 1 vibrator; 57% of men whose injury level was at or above T10 responded to 1 penile vibratory stimulation vs. only 15% with a level of injury at or below T11. 2. Of failures with 1 vibrator, 22 % responded to penile stimulation with 2 vibrators.

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Engin-Üstün et al. 2006 Turkey Case series Level 4 N=44	<p>Population: Men with SCI and partner; median age 26.0-29.5 yrs, range 20-31; 4 cervical, 38 thoracic, 2 lumbar.</p> <p>Treatment: Retrieval by electro-ejaculation (EE), testicular sperm extraction (TESE) or prostatic massage (PM). Fertilization was achieved through embryo transfers.</p> <p>Outcome Measures: Fertilization rate, pregnancy rate, live birth rate, sperm counts, sperm motility.</p>	<ol style="list-style-type: none"> 1. Fertilization, pregnancy, and live birth rates were the same between 3 methods of sperm retrieval. 2. Sperm count and sperm motility were the same between EE and PM methods.
Kolettis et al. 2002 USA Post-test Level 4 N=27	<p>Population: Men with SCI (n=27), 9 couples; Injury level: cervical (n=10), thoracic (n=16), lumbar (n=1).</p> <p>Treatment: Electrical stimulation (12-18V, 400-600mA for 30 second bursts) followed by intrauterine insemination or IVF.</p> <p>Outcome Measures: Seminal parameters, ejaculation rates, cycle function, pregnancy rates.</p>	<ol style="list-style-type: none"> 1. Ejaculation rates: 43/112 were antegrade ejaculations (38%), 24/112 were retrograde ejaculations, 45/112 were both antegrade and retrograde ejaculations (40%) and 2/112 were not able to ejaculate (2%). 2. Pregnancy rate: 3/9 couples achieved pregnancy, 2 of which resulted in live births and both were twins.
Le Chapelain et al. 1998 France Case series Level 4 N=44	<p>Population: Men with SCI; Age: mean 28.5 yrs, range: 19-49 yrs; Injury level: C4-L2, tetraplegia (n=17), paraplegia (n=22); Impairment: 8 complete, 9 incomplete.</p> <p>Treatment: Retrospective analysis of vibratory stimulation, electroejaculation or subcutaneous physostigmine (a reversible acetylcholine esterase antagonist) (at least 2 sessions).</p> <p>Outcome Measures: Ejaculation, conception, sperm count, motility.</p>	<ol style="list-style-type: none"> 1. 30/39 patients produced an ejaculation. 2. Greater success rate among participants with tetraplegia (96%), then T1-T10 (73%), then T11-L2 (42%). 3. Vibratory stimulation produced significantly higher volumes of sperm than electroejaculation, and better sperm quality. 4. Among 10 couples who wanted children, 3 pregnancies resulted and 2 births of healthy children.
Löchner-Ernst et al. 1997 Germany Post-test Level 4 N=219	<p>Population: 219 men; 51 participants with tetraplegia, 161 with paraplegia; Mean time since injury: 11.9 yrs.</p> <p>Treatment: Supranuclear patients were treated by vibrostimulation. When this failed, further treatment was applied: physostigmine medication and vibrostimulation, electroejaculation, physostigmine</p>	<ol style="list-style-type: none"> 1. Vibrostimulation in supranuclear lesions was successful in 133 patients. 2. EE was successful in all 7 infranuclear lesions and in 4 supranuclear patients failing with vibrostimulation. 3. Surgical retrieval was applied in 27 patients.

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	<p>with electroejaculation (EE), surgical approaches. Infranuclear patients were treated by EE.</p> <p>Outcome Measures: Semen retrieval and pregnancy success.</p>	<p>4. In 109 patients who wanted children, 73 pregnancies in 46 couples, leading to 54 births and 16 abortions.</p>
<p>Sønksen et al. 1994 Denmark Post-test Level 4 N=66</p>	<p>Population: Men with SCI and erectile dysfunction; Age: range 18-44 yrs; Time since injury: 0.6-39 yrs, Level of injury: C2-L1.</p> <p>Treatment: Vibrator (multicept ApS) and Relax (Nordic Light) vibrators. Different amplitudes were tested.</p> <p>Outcome Measures: Ejaculation responses.</p>	<ol style="list-style-type: none"> 1. Similar ejaculation responses when using frequencies of 80-100Hz and amplitude of 1mm. 2. At 100Hz and 2.5mm amplitude there were significantly higher ejaculation rates than amplitude of 1mm. 3. Ejaculation occurred in 58/66 men (88%).
<p>Leduc et al. 1992 Canada Post-test Level 4 N=37</p>	<p>Population: 37 men with SCI; Age: mean 29.5 yrs, range 19-61; 15 cervical (9 complete, 6 incomplete), 22 thoracic (20 complete, 2 incomplete), Time since injury: range 3 months-23 yrs.</p> <p>Treatment: 10mg nifedipine for autonomic dysreflexia, 40mg butylbromure hyoscine subcutaneously to limit some of the parasympathetic side effects of physostigmine, and then 2-4mg physostigmine subcutaneously 30 mins later and followed by masturbation by female partner.</p> <p>Outcome Measures: Ejaculation responses, pregnancies.</p>	<ol style="list-style-type: none"> 1. 54% of cases resulted in antegrade ejaculation. 2. 46 samples showed a mean normal count but low motility rate (28%). 3. Fresh unwashed sperm artificial insemination performed in 6 couples with 3 successful pregnancies.
<p>Beretta et al. 1989 Italy Post-test Level 4 N=102</p>	<p>Population: 102 men; Age: mean 25.6 yrs; Injury level: cervical-sacral lesions, above T11 (n=58), thoracolumbar lesions (n=36), sacral (n=8); Mean time since injury 6.1yrs.</p> <p>Treatment: Simple vibrator applied to the penis for ejaculatory response. 15 patients who wanted to conceive a child, received instruction in home use of vibrator.</p> <p>Outcome Measures: Ejaculation frequency, sperm quality.</p>	<ol style="list-style-type: none"> 1. Penile vibrators triggered ejaculation in 72 patients (70.5%). 2. 11 other patients showed 'weak' ejaculation with poor contractions of perineal muscles. 3. Stimulation ranged from 30 sec-20 min. Of 15 'home-use' patients, increase in sperm concentration and steep decrease in abnormal spermatozoa over 3 months. 4. 6 couples had homologous artificial insemination, 3 pregnancies resulted.

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<p>Ohl et al. 1989 USA Post-test Level 4 N=48</p>	<p>Population: 48 men with SCI; mean age 31yrs, range 20-53 yrs; 15 cervical, 29 thoracic, 4 lumbar; YPI 4 months-34 yrs; 56% complete, 44% incomplete. Treatment: Rectal probe electroejaculation (EE). Outcome Measures: Semen retrieval and sperm quality.</p>	<ol style="list-style-type: none"> 1. 10 million sperm obtained in 71% of participants (n=34). 2. Age and interval since injury had no effect on outcome. 3. Higher success among participants with paraplegia (90% ejaculated successfully) and in those using intermittent catheterization for bladder management compared to cervical or lumbar patients (successful ejaculation in 60% and 50%, respectively). 4. Indwelling urethral catheters and high-pressure reflex voiding had a negative impact on EE results.