

AN ANALYSIS OF 653 TRIALS OF PENILE VIBRATORY STIMULATION IN MEN WITH SPINAL CORD INJURY

[Clinical Urology: Original Articles]

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Abstract [↑](#)

Purpose: We evaluated ejaculatory response and semen quality in 653 trials of penile vibratory stimulation in 211 men with spinal cord injury, and compared results with low versus high amplitude vibratory stimulation.

Materials and Methods: Low and/or high amplitude penile vibratory stimulation was performed 1 to 27 times in each patient, and antegrade and retrograde specimens of those who ejaculated were analyzed.

Results: Significantly more patients ejaculated using high (54.5%) versus low (39.9%) amplitude stimulation. Using either amplitude the ejaculatory success rate was highest in men with injuries at C3 to C7, followed by T1 to T5, T6 to T10 and T11 to L3. While high amplitude stimulation increased the ejaculatory success rate in each group, the highest rate occurred in men with injuries at C3 to C7 (65.6%). Ejaculation was reliable, since most men who ejaculated did so during 100% of the trials and within 2 minutes of stimulation onset. Symptoms of

autonomic dysreflexia were safely managed with nifedipine. All patients who ejaculated produced antegrade specimens. With the exception of ejaculate volume, which was significantly higher with high versus low amplitude stimulation, semen parameters were similar using both vibrator amplitudes.

Conclusions: Ejaculatory success is better while semen quality is similar using high versus low amplitude penile vibratory stimulation in men with spinal cord injury. This method may be considered first line treatment for anejaculation in men with spinal cord injury. This method may be relative effectiveness, and relatively low investment of time and money.

Key Words: spinal cord injuries, ejaculation, spermatozoa, penis

Approximately 90% of the men with spinal cord injury are unable to ejaculate during sexual intercourse. [1] Those who wish to become biological fathers need assistance to produce a semen specimen via rectal probe electroejaculation or a vibrator applied to the penis. There have been various reports of the effectiveness of penile vibratory stimulation. [2-4] Our large-scale study evaluated 653 trials of penile vibratory stimulation in 211 patients for 6 years at a single center. We compared the ejaculatory response and semen quality obtained with low versus high amplitude penile vibratory stimulation.

MATERIALS AND METHODS

From 1991 to 1997, 211 men 19 to 47 years old (mean age plus or minus standard error of the mean 30.8 +/- 0.7) with a 1 to 29-year history (mean 8.3 +/- 0.6) of anejaculation due to spinal cord injury participated in our study. All were volunteers in good general health in the male fertility research program of the Miami Project to Cure Paralysis and they had not received any drugs known to affect semen quality within 6 months of study participation. As assessed by the University of Miami neurospinal index, [5,6] the levels of injury were C3 to C7 in 39.8% of the cases, T1 to T5 in 21.8%, T6 to T10 in 19.4% and T11 to L3 in 19.0%. Overall 79.5 and 20.5% of the participants had incomplete and complete lesions, respectively.

In this study we used 2 low and 2 high amplitude vibrators, defined as producing amplitudes of 1.6 and 2.5 mm., respectively, when applied to the penis (Figure 1). Amplitude refers to the peak-to-peak distance of the moving part of the vibrator, that is how far the vibrating part moves up and down. The low amplitude vibrators were the Oster model 129-01A [double dagger] and Sunbeam model 1850 to 1, [double dagger] and the high amplitude vibrators were the Ferti Care Clinic [section] and Ferti Care Personal. [section]



Figure 1. Low amplitude Oster model 129-01A and Sunbeam model 1850 to 1 vibrators (left), and high amplitude Ferti Care Clinic and Ferti Care Personal vibrators (right).

[double dagger] Oster/Sunbeam, Schaumburg, Illinois.

[section] Multicept, Copenhagen, Denmark.

Patients were placed supine or reclining at a 45-degree angle on an adjustable examination table. The vibrator was placed on the dorsum or frenulum of the glans penis. Placement of the patient and/or vibrator was sometimes based on patient comfort and sometimes on our efforts to seek optimal placement to induce ejaculation. The moving part of the high amplitude vibrators was removable for cleaning and sterilizing. Because the moving part of the low amplitude vibrators was not removable, for hygiene purposes it was covered with a sterile, nonspermicidal condom before each use.

Vital signs were monitored each minute throughout the procedure. Men with a history of autonomic dysreflexia were given 10 to 40 mg. nifedipine sublingually 15 minutes before stimulation onset. Initially 10 to 20 mg. nifedipine were given. If blood pressure increased to unacceptable levels or the patient became symptomatic, 0.4 mg. nitroglycerine was given sublingually or the procedure was aborted. At subsequent trials the nifedipine dose was increased until satisfactory control was observed.

Before most trials the bladder was emptied by catheterization, and 25 to 40 ml. of sperm washing medium (modified human tubal fluid medium) were added to the bladder to provide a buffered medium in the event of retrograde ejaculation. The vibrator was applied to the penis for up to 5 minutes. When no ejaculation occurred, stimulation was stopped for 1 minute and then resumed for up to 5 minutes. If ejaculation had still not occurred, this latter step was repeated. Stimulation was stopped if there were unstable vital signs, penile skin edema or no ejaculation within a total of 15 minutes of stimulation. Antegrade specimens were collected in specimen cups, while retrograde specimens were retrieved by collecting all bladder contents by catheterization and lavage with 24 to 40 ml. of sperm washing medium.

A low amplitude vibrator was initially used in the majority of cases due to historical rather than scientific reasons. Until 1995 only low amplitude vibrators were available at our laboratory. When a patient ejaculated during the first trial of vibratory stimulation, he underwent additional trials of vibratory stimulation (1 to 27) using a low or a high amplitude vibrator in a random sequence. When

he failed to ejaculate at the first trial, he underwent additional trials with a low or high amplitude vibrator. If no ejaculation occurred at 3 consecutive trials, the case was considered an ejaculatory failure in this study and referred for electroejaculation. Trials were performed 1 to 8 weeks apart except in some men who failed to ejaculate during the initial trial with a low amplitude vibrator. Those with stable vital signs underwent a trial with a high amplitude vibrator 10 minutes later.

Semen was analyzed in the raw antegrade specimens after 15 to 20 minutes of liquefaction. In the retrograde specimens sperm pellets formed after removing urine by centrifugation at 300 x gravity for 5 minutes were suspended in 1 to 2 cc of sperm washing medium. Semen was analyzed using Cell-Vu* disposable semen analysis chambers and sperm motility was graded by the 4-category World Health Organization method. [7] Viability staining of the sperm cells was performed based on the ability of 5% eosin Y to penetrate only damaged cell membranes. [7] Frequencies, such as the success rate of ejaculation by vibrator amplitude or injury level, were compared by chi-square analysis and semen quality parameters were compared by analysis of variance.

*Fertility Technologies, Natick, Massachusetts.

RESULTS

Ejaculation success rates.

Low or high amplitude vibratory stimulation was attempted a total of 653 times in 211 men, 105 of whom ejaculated (overall 49.8% success). Of the 211 patients 198 and 123 underwent 1 or more trials with a low and high amplitude vibrator, respectively. The success rate of ejaculation was significantly higher with a high than low amplitude vibrator. For example, when all 198 patients were evaluated (injuries from C3 to L3, Figure 2A), 79 (39.9%) ejaculated with a low amplitude vibrator during a total of 424 trials (mean 2.13 +/- 0.22 trials per patient, range 1 to 27), while 67 of the 123 (54.5%) ejaculated with a high amplitude vibrator during a total of 229 trials (mean 1.60 +/- 0.15 trials per patient, range 1 to 9).

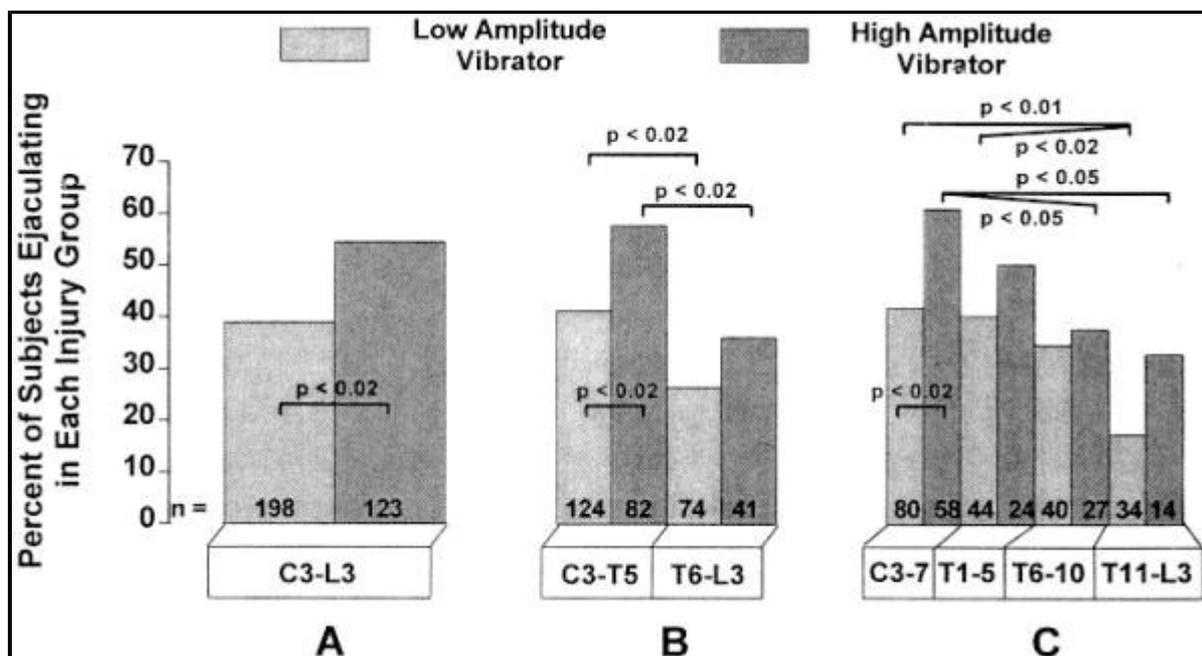


Figure 2. Ejaculatory success rates. A, by vibrator amplitude in all subjects. B, by level of injury T5 and above versus T6 and below. C, by 4 levels of injury.

To determine whether this improvement in the ejaculatory success rate was limited to a particular subset, patients were subdivided by level of injury (Figure 2, B and C). In each group high rather than low amplitude stimulation resulted in higher ejaculatory success rates. This difference reached statistical significance in the groups with injuries at C3 to C7 (Figure 2C) and C3 to T5 (Figure 2B).

With low amplitude stimulation the ejaculation success rate was significantly higher in the patients with injuries at C3 to C7 or T1 to T5 than in those with injuries at T11 to L3. With high amplitude stimulation the ejaculation success rate was significantly higher in the men with injuries at C3 to C7 than in those with injuries at T6 to T10 or T11 to L3 (Figure 2C).

Whether a low or high amplitude vibrator was used, there was a difference in the ejaculation success rate by level of injury. Using either vibrator success was greatest in men with injuries at the highest levels and it decreased in a stepwise manner with the highest success rates in the C3 to C7 group, followed by T1 to T5, T6 to T10, and T11 to L3. The success rate was significantly higher in men with injuries at C3 to T6 than in those with injuries at T7 to L3 (Figure 2B).

Completeness of injury was not predictive of ejaculatory success. For example, the percentage of patients with complete injuries who did versus those who did not ejaculate was not significantly different using a low (16.9 versus 22.5%) of high (15.3 versus 22.0%) amplitude vibrator. Similarly, in men with incomplete injuries there was no difference in the percentage of those who did versus those who did not ejaculate.

Recovery of failures. [↑](#)

We evaluated 93 men who completed trials with low and high amplitude vibrators, including 1 to 27 trials per patient (mean 2.19 +/- 0.35, 204 overall) with a low amplitude vibrator and 1 to 9 per patient (mean 1.97 +/- 0.16, 183 overall) with a high amplitude vibrator. Of these men 28 (30.1%) ejaculated with low and 47 (50.5%) ejaculated with high amplitude stimulation. Of the 65 patients who did not ejaculate with a low amplitude vibrator semen was recovered in 19 (29.2%) with a high amplitude vibrator, which was statistically significant ($p < 0.05$). In the men in whom low amplitude stimulation failed and from whom semen was recovered injury was cervical in 50.0%, at T1 to T5 in 22.2%, at T6 to T10 in 16.7%, and at T11 and below in 11.1%. All but 2 men who ejaculated with a low amplitude vibrator also ejaculated with a high amplitude vibrator.

Reliability of success rate. [↑](#)

We also examined the reliability of obtaining ejaculate from the same patient from 1 trial to another. We evaluated those who had ejaculated during at least 1 trial and who underwent 2 or more trials with the same amplitude vibrator, and calculated the percentage of trials for each individual that resulted in ejaculation. A total of 43 men underwent 2 or more trials (2 to 27 per patient, mean 5.47 +/- 0.84) with a low amplitude vibrator and 35 underwent 2 or more (2 to 9 per patient, mean 2.77 +/- 0.36) with a high amplitude vibrator. Overall ejaculation was achieved at 25 to 100% of the trials (mean 87.5 +/- 2.5%). The reliability rate was similar using stimulation of either amplitude (84.9 and 90.7% for low and high amplitude, respectively). The majority of patients ejaculated at 100% of the trials. For example, ejaculation was achieved at all trials using low amplitude stimulation in 26 of 43 men (60.5%) and high amplitude stimulation in 28 of 35 (80%). Of the remaining patients, who ejaculated inconsistently, reliability was 25 to 96.3% (mean 61.8 +/- 5.9%) in 17 and 33.3 to 83.3% (mean 53.3 +/- 6.3%) in 7 for low and high amplitude stimulation, respectively.

Response time. [↑](#)

At all trials during which ejaculation occurred mean time from onset of stimulation to ejaculation (response time) was 1.72 +/- 0.15 minutes. More detailed analysis revealed that response time was more rapid using high (7 seconds to 6 minutes, mean 0.95 +/- 0.11 minutes) than low (5 seconds to 15 minutes, mean 2.11 +/- 0.22 minutes) amplitude stimulation. The majority of patients ejaculated within 2 minutes (74 and 89% with low and high amplitude stimulation, respectively).

Symptoms during ejaculation. [↑](#)

At 100% of the trials that resulted in ejaculation 1 or more somatic responses were observed just

before and during ejaculation. The most common response was contraction of the abdominal muscles, followed in frequency of occurrence by spasticity below the level of injury, knee flexion, hip flexion and abduction of the thighs. However, these responses were not predictive of ejaculation. In approximately half of the trials there was somatic response but no ejaculation. Of the 211 men 87 (41.2%) required nifedipine for autonomic dysreflexia, and in all but 3 the level of injury was T8 or higher. Of those who received nifedipine 17.2% also required nitroglycerine during at least 1 trial.

Semen quality. [↑](#)

We performed interindividual and intraindividual comparisons of the quality of semen resulting from low versus high amplitude vibratory stimulation (see Table 1). In either case semen quality was similar in specimens obtained by low versus high amplitude stimulation, except that volume in antegrade specimens was significantly higher ($p < 0.04$) when obtained by high than by low amplitude stimulation. In addition, semen quality was better in antegrade versus retrograde specimens (see Table 1).

	Antegrade Specimens		Retrograde Specimens	
	Low	High	Low	High
	<i>Interindividual comparison</i>			
No. pts.	79	19	56	11
Mean \pm SEM vol. (cc) (range)	1.93 \pm 0.16 (0.1–5.4)	2.87 \pm 0.62 (0.4–7.2)*	0.91 \pm 0.08 (0.2–3.0)	1.46 \pm 0.58 (0.3–6.3)
Mean \pm SEM sperm/cc $\times 10^6$ (range)	104 \pm 11.5 (0–374)	131 \pm 18.4 (36–270)	35.5 \pm 7.68 (0–373)	40.7 \pm 7.70 (6–81)
Mean \pm SEM total sperm $\times 10^6$ (range)	199 \pm 27.2 (0–857)	310 \pm 71.0 (22–1068)	25.5 \pm 4.50 (0–119)	33.1 \pm 4.54 (55–364)
Mean \pm SEM % motility (range)	24.5 \pm 2.10 (1–69)	29.8 \pm 4.71 (6–63)	4.09 \pm 0.85 (0–22)	7.44 \pm 4.37 (0–52)
Mean \pm SEM % rapid linear sperm (range)	18.1 \pm 2.00 (0–67)	24.9 \pm 4.02 (4–56)	1.84 \pm 0.53 (0–15)	6.58 \pm 4.48 (0–49)
Mean \pm SEM % dead sperm (range)	56.9 \pm 2.82 (13–94)	55.1 \pm 5.30 (24–87)	84.7 \pm 2.61 (32–100)	83.2 \pm 4.90 (46–97)
	<i>Intra-individual comparison</i>			
No. pts.	26	26	16	16
Mean \pm SEM vol. (cc) (range)	2.15 \pm 0.31 (0.3–5.0)	2.56 \pm 0.29 (0.5–5.0)	0.90 \pm 0.14 (0.4–2.0)	0.92 \pm 0.12 (0.4–2.0)
Mean \pm SEM sperm/cc $\times 10^6$ (range)	128 \pm 24.1 (0–374)	92.3 \pm 17.1 (0–294)	36.0 \pm 9.50 (0–126)	49.5 \pm 12.3 (0–146)
Mean \pm SEM total sperm $\times 10^6$ (range)	256 \pm 56.4 (0–722)	143 \pm 26.2 (3–453)	36.6 \pm 10.0 (0–101)	35.9 \pm 12.1 (2–135)
Mean \pm SEM % motility (range)	30.3 \pm 4.32 (4–69)	26.0 \pm 4.73 (1–70)	6.22 \pm 2.31 (0–22)	5.87 \pm 1.71 (0–18)
Mean \pm SEM % rapid linear sperm (range)	24.4 \pm 4.31 (3–67)	20.8 \pm 4.52 (0–63)	3.21 \pm 1.77 (0–19)	3.68 \pm 1.14 (0–11)
Mean \pm SEM % dead sperm (range)	53.3 \pm 4.89 (16–94)	57.6 \pm 6.24 (12–93)	82.4 \pm 5.62 (32–100)	83.6 \pm 3.70 (59–100)

* Significantly greater ($p < 0.04$) than volume obtained with low amplitude.

Table 1. Comparison of semen quality between specimens obtained by low versus high amplitude vibratory stimulation

We analyzed antegrade and retrograde specimens from each patient who ejaculated with low or high amplitude vibratory stimulation. When a patient produced more than 1 specimen, semen parameters were averaged. For interindividual comparison specimens from the 79 patients who ejaculated with low amplitude stimulation were compared to those from the 19 who failed to ejaculate with low but ejaculated with high amplitude stimulation. For intra-individual comparison we analyzed specimens from low and high amplitude stimulation in the same 26 patients. All study participants produced an antegrade specimen. Many also produced a retrograde specimen but none produced only a retrograde specimen. Interindividual and intra-individual comparisons of antegrade and retrograde specimens obtained by low and high amplitude stimulation revealed that all retrograde values were significantly lower than antegrade values ($p < 0.05$). Retrograde volume and sperm count per cc were not compared to antegrade volume and sperm count per cc due to different collection methods.

DISCUSSION [↑](#)

We evaluated ejaculatory response and semen quality at 653 trials of penile vibratory stimulation in 211 men with spinal cord injury, and compared the results of low and high amplitude stimulation. To our knowledge our study is the largest of its kind to date. It presents new data and considers old questions on vibratory stimulation. Thus, this study is particularly useful for making current recommendations to urologists, and other health care professionals and patients on the use of vibratory stimulation in men with spinal cord injury.

We recommend vibratory stimulation as first line treatment for obtaining semen from anejaculatory men with spinal cord injury. In this study using a low cost, over-the-counter vibrator resulted in ejaculation in 39.9% of all patients with injury at C3 to L3, and in 44.5% with injury at T5 and

above, comprising 61.6% of our patient population. If purchased in the United States, over-the-counter vibrators are usually of low amplitude. We used 2 low amplitude vibrators. The Oster model was purchased at a local department store for \$9.99 in 1991 and it functioned for approximately 400 procedures. We wanted to buy another in 1994 but they were no longer manufactured. The vibrator manufactured by Sunbeam, which is similar to the Oster model, was obtained by mail for \$29.99. Thus, the effectiveness, low cost and ease of obtaining a low amplitude vibrator warrant its use, even if it is the only amplitude vibrator available.

However, we also recommend using a high amplitude vibrator, which significantly improved the success rate and speed of ejaculation, and did not cause additional problems in management. Recovery of the failure of low amplitude stimulation by high amplitude stimulation in 29.9% of cases eliminated the need for rectal probe electroejaculation, which is the alternative method of obtaining semen in anejaculatory men with spinal cord injury. Although electroejaculation is a successful method of assisted ejaculation, [8,9] it is invasive and preferred less by patients than vibratory stimulation, [10] and it results in poorer semen quality than vibratory stimulation. [10,11] In men who retain sensation below the level of injury electroejaculation may be painful and, thus, it must be performed in the operating room using general anesthesia. In our study 2 patients in this category ejaculated with high but not low amplitude vibratory stimulation. In these 2 men using a high amplitude vibrator saved the expense and risk of electroejaculation using general anesthesia. When treating patients, some physicians have anecdotally reported a preference for electroejaculation because of a belief that vibratory stimulation is too time-consuming and, should it fail, more time is then spent to perform electroejaculation. We found that the majority of patients ejaculated within 2 minutes of vibratory stimulation regardless of amplitude, and most who ejaculated with vibratory stimulation did so reliably from trial to trial. Thus, in most patients the time needed to assess the effectiveness of vibratory stimulation is minimal.

All of the patients who ejaculated in this study produced an antegrade specimen. Some also produced a retrograde specimen but none produced only a retrograde specimen, as sometimes occurs with electroejaculation. [12] For insemination purposes an antegrade specimen is preferred, because semen quality is typically better than in a retrograde specimen, as noted in previous studies [11,13] as well as in our series (see Table 1). Although there was a difference in semen quality between antegrade and retrograde specimens, there was no difference in semen quality by vibrator amplitude.

CONCLUSIONS [↑](#)

Ejaculatory success is better and semen quality is similar using high versus low amplitude penile vibratory stimulation in men with spinal cord injury. Depending on the vibrator used 40 to 55% of all men with spinal cord injury may be expected to respond. The higher the level of injury, the more likely the patient is to respond. Penile vibratory stimulation may be considered as first line treatment for anejaculation in men with spinal cord injury due to its safety, relative effectiveness, and relatively low investment of time and money.

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