

A Guide and Resource Directory to Male Fertility Following Spinal Cord Injury/Dysfunction

By

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We dedicate this booklet to the memory of Douglas Forbes, February 11, 1960 - January 9, 2000, who along with other men with SCI/D, inspired us to take on this project.

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This booklet is for informational purposes and should not replace the advice of a physician. Only a doctor familiar with SCI/D and its effects on fertility can evaluate and recommend specific treatments.

INTRODUCTION

This booklet provides information about sexual function and fertility in men with SCI/D. It outlines how men with SCI/D can become biological fathers.

In the United States, there are 8,000 to 10,000 spinal cord injuries that occur each year. The majority of these injuries happen to men between the ages of 16 and 45 – typically the reproductive years. Many men with spinal cord injury/dysfunction (SCI/D) experience fertility problems related to their injury and want to know if they can become biological fathers.

There are two main problems men with SCI/D face when considering biological fatherhood. First, there is the medical condition called anejaculation which occurs in ninety percent of men with SCI/D. *Anejaculation* is the inability to ejaculate during sexual intercourse. A pregnancy is unlikely to happen during sexual intercourse if ejaculation does not occur.

The other problem that men with SCI/D face when considering biological fatherhood is poor semen quality. Scientists have learned that men with SCI/D make normal numbers of sperm, however, most of the sperm in the ejaculate are not moving. The average percent of motile (moving) sperm in semen samples from men with SCI/D is 20% compared to 70% in able-bodied men. Pregnancy is less likely with a low number of motile sperm in the ejaculate. This may explain why few men with SCI/D have fathered children through sexual intercourse.

While anejaculation and poor semen quality are obstacles to men with SCI/D who wish to achieve biological fatherhood, there are methods available to help accomplish this goal. This guide provides information about changes in sexual function and fertility that may accompany SCI/D, and outlines the options available to deal with such changes. In addition, this booklet includes a directory of clinics and centers that treat couples with infertility secondary to a male partner with SCI/D.

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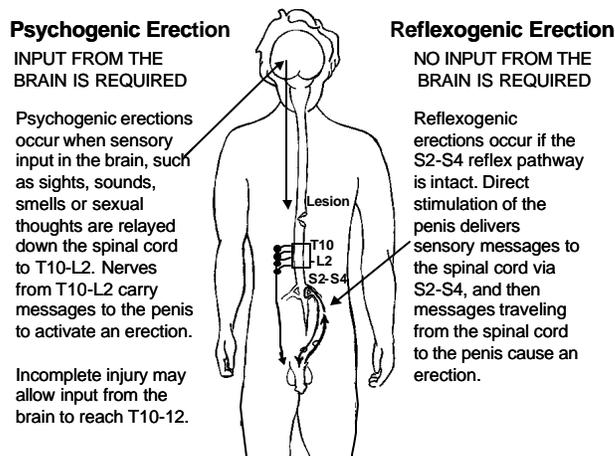
ERECTILE FUNCTION

Many men with SCI/D experience problems with erectile function, often having difficulty getting an erection and/or maintaining it. During an erection, the penis fills with blood and becomes firm so that it can be positioned in the woman's vagina for sexual intercourse. Difficulties with erections may result in *anejaculation* (the inability to ejaculate during sexual intercourse) which affects the ability to father children naturally. For many men, however, erectile function is also very important for sexual satisfaction for themselves and their partners. This section discusses how erectile function is affected by SCI/D and outlines treatments to enhance it. These treatments may improve erectile function and sexual satisfaction following SCI/D, however, they usually do not affect fertility. As discussed in the remainder of this booklet, the potential to become a biological father depends on the ability to ejaculate and on the man's semen quality.

Erections usually occur following SCI/D, although the quality may be insufficient for sexual intercourse.

Two types of erections usually work together to produce a firm and lasting erection. These are reflexogenic and psychogenic. *Reflexogenic* erections are coordinated by a reflex pathway in the spinal cord and do not require input from the brain. Direct stimulation of the penis activates sensory nerves that enter the spinal cord at S2-S4, and then return to the penis via nerve pathways that activate an erection. Reflexogenic erections can occur from direct stimulation of the penis or from internal stimulation such as a full bladder. *Psychogenic* erections happen when sensory input such as smells, sounds, and sights produce erotic emotions. The brain then sends messages down the spinal cord to the T10-L2 spinal nerves to stimulate an erection.

Following SCI/D, the nerve pathways to and from the brain that control erection are completely or partially disrupted. The injury may prevent messages in the brain from reaching the T10-L2 nerves that control erection and many men lose their ability to have psychogenic erections. On the other hand, men with SCI/D may still experience reflexogenic erections if their injury does not damage S2-4. Every person's injury is different and the ability to have erections and the quality of the erection will vary and depends on the severity and level of injury.



Treatments For Erectile Function

There are several treatment options when SCI/D decreases a man's ability to get and/or keep erections suitable for sexual intercourse.

Medications taken by mouth

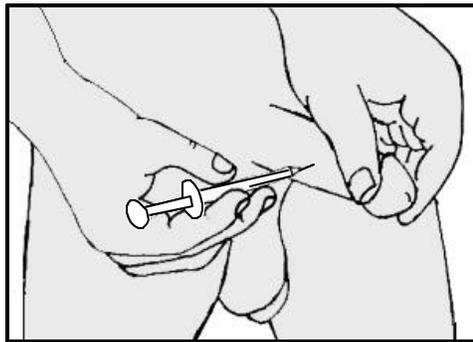
Viagra® (sildenafil citrate), approved in 1998 to treat erectile dysfunction, is a pill taken by mouth 20 to 60 minutes before sex. In studies with men with SCI/D, Viagra® improved the quality of erections and the man's satisfaction with his sex life. It improved erections in 65 -75% of men with SCI/D.^{1,2} While Viagra is well tolerated by most men, it is not effective in all cases. It also lowers blood pressure, which may present a risk to men whose blood pressure is low because of SCI/D. It may have serious side effects when taken with certain cardiac medicines. As with all of the treatments described in this section, men who wish to try Viagra® should see their urologist or other physician for a physical evaluation. Other drugs taken by mouth are currently being studied and, if shown to be effective and safe, may provide better alternatives to assist men with erections.



Injectable medications

Some medications, when injected into the penis, help blood vessels to open and the penis to fill with blood. The commonly prescribed medication is Caverject® (alprostadil). The amount of medication is carefully prescribed by a doctor, usually a urologist. The amount of medication is adjusted so that the erection lasts no longer than four hours.

Treatment options for erectile dysfunction include medications, penile implants and vacuum devices.



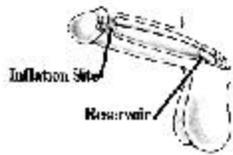
One risk of using injectable medications is a condition called priapism. *Priapism* is a medical emergency where the blood does not drain from the penis, which causes an erection that lasts for an extended period of time. If the condition is not treated, permanent damage to the penis can occur. It is important to carefully follow the doctor's instructions for using injectable medications so that erection does not last too long. Other risks of using injectable medications are

bruising, infection, or scarring of the penis. To reduce the risk of scarring, injections are usually used only once per week, which may be considered a disadvantage for those men who desire more frequent erections.

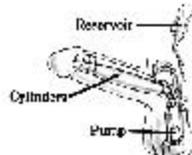
ERECTILE FUNCTION

Penile implants

Penile implants are devices that are surgically inserted into the penis to provide an erection. There are several types of implants. Inflatable implants are either self-contained or have a reservoir in the abdomen and a pump/valve in the scrotum. When an erection is desired, activating the pump moves water from the reservoir to a chamber in the penis. A malleable implant is a bendable rod placed in the penis. The rod is bent upward when an erection is desired. The risks of penile implants include infection; pressure sores or scar tissue forming inside the penis; erosion of the device through the skin of the penis or urethra; and the possibility of the device leaking or having mechanical failure.



Self-contained inflatable



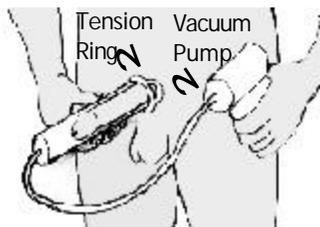
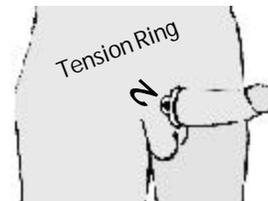
Inflatable with reservoir in abdomen



Malleable

Tension rings (venous flow constriction) and vacuum devices

Tension rings are designed for men who are able to get an erection but have trouble keeping it for sexual intercourse. Tension rings are usually made of rubber or silicone and are placed around the base of an erect penis. The tension ring at the base of the penis traps the blood in the penis to help maintain the erection.



A vacuum device can be used when the man is unable to get an erection on his own. These devices consist of a cylinder placed over the penis. A vacuum pump creates a negative pressure in the cylinder, drawing blood into the penis for an erection. A tension ring is placed at the base of the penis to keep the erection and then the cylinder is removed.

The risks associated with tensions rings and vacuum devices are bruising of the penis, and damage to the penis if the tension ring is left on too long. If the tension ring is left on for longer than 30 minutes, it can cause irreversible damage to the penile skin and tissue. Because most men with SCI/D lack sensation in the penis, they must be especially careful when using a tension ring. If there is a chance of falling asleep following sexual activity, setting an alarm clock or timer for 30 minutes can help prevent this serious complication.

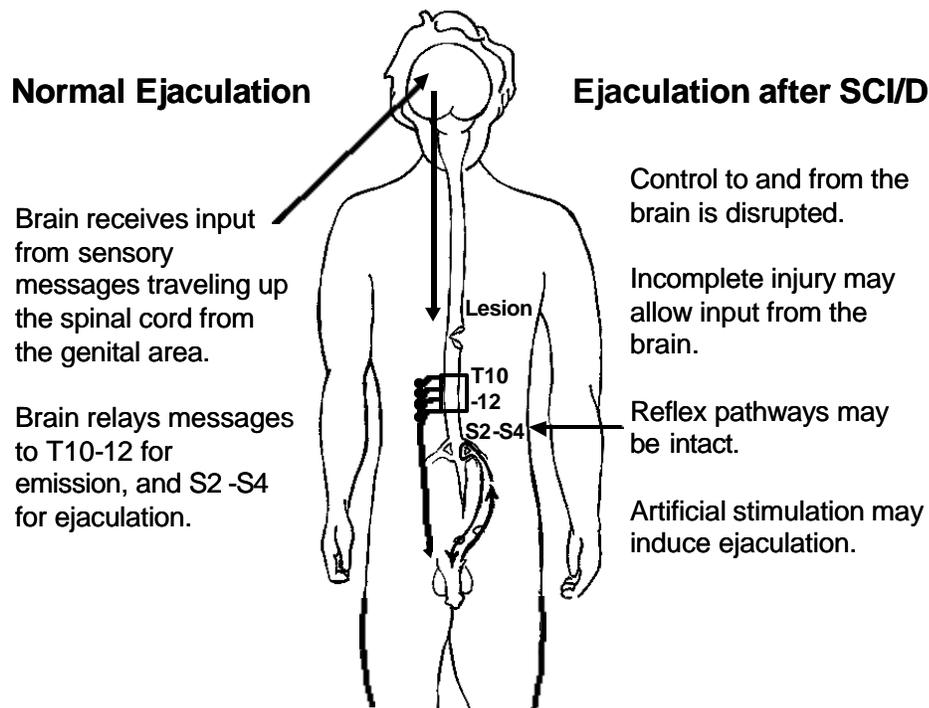
There are various tension rings and vacuum devices to choose from. Manual pump vacuum devices may require more hand function than battery operated pumps. Both tension rings and vacuum devices are available from medical supply companies or by mail order. Some vacuum devices require a doctor's prescription and may be covered by insurance.

EJACULATORY FUNCTION

Ejaculation, or the expulsion of semen from the urethra, is a complex reflex process. In the non-injured man, two spinal cord pathways are involved in the ejaculatory process. The T10-12 nerve pathways are responsible for *emission* (release) of the semen into the urethra. The S2-4 nerve pathways are responsible for the *ejaculation* (propulsion of the semen out the urethra). This process is coordinated by a nerve center in the brain that receives input from sight, sound, and smell. The brain also receives messages that travel up the spinal cord when the penis and/or body are touched in a sensual way. The coordination center in the brain relays messages to the spinal cord to stimulate erection and then ejaculation.

Most men with SCI/D cannot ejaculate during sexual intercourse; medical procedures are required to obtain their semen.

Following spinal cord injury/dysfunction (SCI/D), input to and from the brain may be disrupted, and is likely the reason why most men with SCI/D are unable to ejaculate during sex. The injury interferes with their ability to respond to normal sexual stimulation and to ejaculate in a normal manner. Since the reflex pathways (pathways not involving control from the brain) may still be intact after injury, artificial methods of stimulation may be used to induce ejaculation and retrieve semen.



Semen Retrieval

A Major Risk: Autonomic Dysreflexia (AD)

The major risk of any semen retrieval procedure is autonomic dysreflexia. AD is a potentially life threatening medical complication that can occur in injuries at or above T6. It is an overreaction of the nervous system to an irritating stimulus below the level of injury. In someone with SCI/D, the body's autonomic nervous system cannot properly manage its reaction to the irritating stimulus. Instead, the reaction becomes exaggerated, leading to symptoms such as sweating, chills, and headache. In some cases, AD can lead to dangerously high blood pressure levels, and this complication can lead to stroke, seizure, or even death.

Sexual activity, masturbation, and semen retrieval procedures can be irritating to the nervous system. To keep the blood pressure at a safe level during any of these procedures, medications, which require a prescription, can be taken before the procedure.

Autonomic dysreflexia is a significant risk during semen retrieval procedures in men with SCI/D.

Following SCI/D, when ejaculation does not occur with sexual intercourse, men may consider several options to assist with ejaculation. **The following semen retrieval methods may stimulate autonomic dysreflexia. As described above, there are potentially life threatening consequences if AD occurs and care must be taken to properly manage this condition. Before attempting any semen retrieval procedure, it is recommended that men with level of injury at T6 or above get an evaluation and recommendations from a doctor familiar with SCI/D and AD.**

Masturbation is stimulation of the penis by some means other than sexual intercourse, such as with the hand or an artificial device. Masturbation may deliver a more intense stimulus to the penis than sexual intercourse, and thus may lead to ejaculation in some men with SCI/D.

Penile vibratory stimulation (PVS) is a method in which a vibrator is applied to the head of the penis to stimulate an ejaculation. There are a wide variety of vibrators available. For purposes of ejaculation in men with SCI/D, it is often important to know if the vibrator is "high" or "low" amplitude. Vibrator amplitude is the distance (in millimeters) that the moving part of the vibrator travels up and down. High amplitude vibrators (2.5 mm) have been shown to be more effective in inducing ejaculation in men with

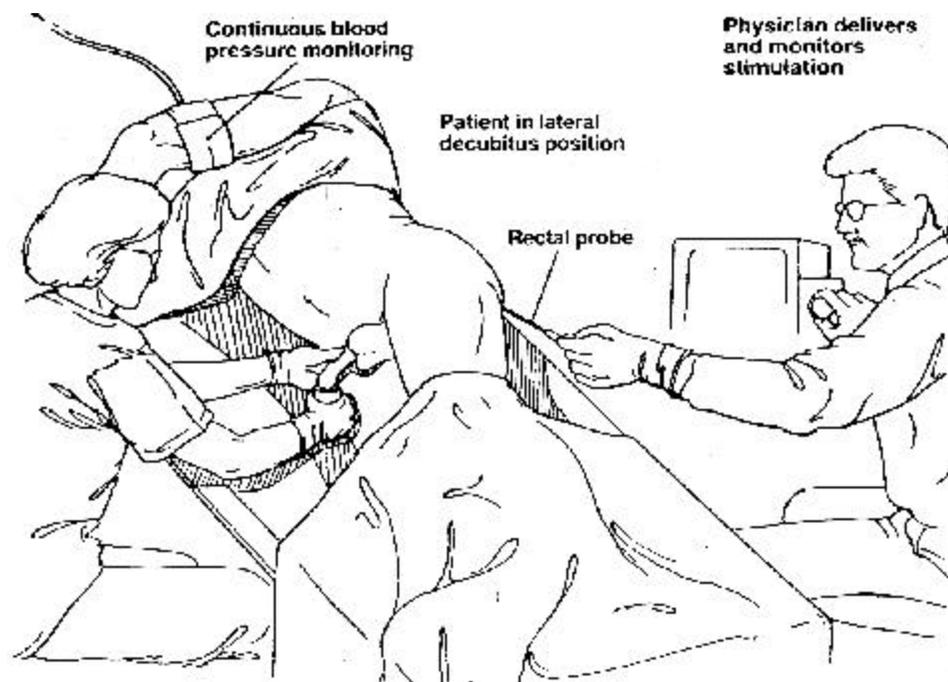


SCI/D. A high amplitude vibrator that is available by prescription is called the Ferticare® Personal. Other types of high amplitude vibrators are used in clinics and are not available commercially. In contrast, low amplitude vibrators (<2.5 mm) are readily available in various models. Generally called "massagers," they are sold in retail stores for the relief of muscle strain, and may be used for the purpose of inducing ejaculation in men with SCI/D. Studies have shown that 30%-40% of men with SCI/D can ejaculate with a low amplitude vibrator versus 55%-85% of men with a high amplitude vibrator.³

Penile vibratory stimulation (PVS) and rectal probe electroejaculation (RPE) are two methods of retrieving semen from men with SCI/D who cannot ejaculate during intercourse.

When sexual intercourse or masturbation does not produce an ejaculation, PVS is a relatively effective method. Compared to the alternative method of electroejaculation, most men prefer PVS because it is less invasive, less expensive, and may be tried at home.

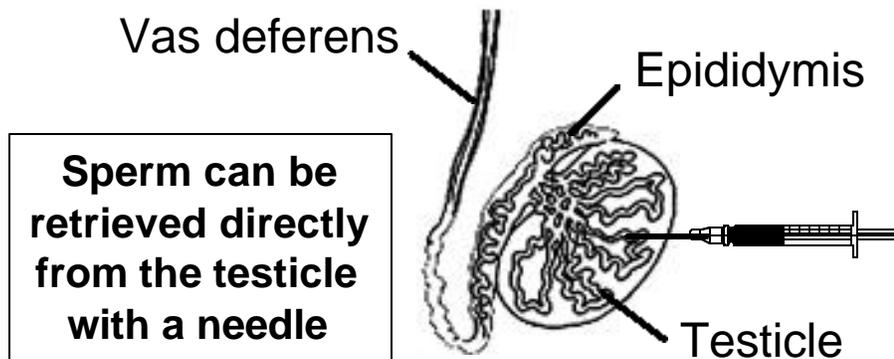
Rectal probe electroejaculation (RPE) is a procedure that is often used when PVS fails. During RPE, the man with SCI/D is positioned on his side and a doctor inserts an electrical stimulation probe into the rectum. The doctor controls the amount of electrical stimulation delivered so that an ejaculation occurs. The length of time that the probe is in the rectum is approximately 10 minutes. The procedure is generally well tolerated and only 5% of men with SCI/D require sedation or anesthesia to reduce discomfort.



EJACULATORY FUNCTION

Alternative Methods of Sperm Retrieval

Alternative methods of sperm retrieval are recommended when PVS and RPE are unsuccessful or unavailable. Sperm are made in the testicle and travel through the epididymis and vas deferens before reaching the outside of the body. Sperm can be obtained directly from the man's reproductive tract using minor surgery. The most common method is obtaining sperm from the testicle. This may be done in an "open" procedure in which a small incision is made in the scrotum to expose and gain access to the testicle. A small piece of testicle is then removed. Alternatively, a "closed" procedure may be done in which no incision is made and a needle is passed through the scrotal skin directly into the testicle. In addition to the testicle, sperm may be removed from the epididymis or from the vas deferens. The choice of sperm retrieval site (i.e., testicle, epididymis or vas deferens) largely depends on the preference and expertise of the center performing the surgery. The number of sperm obtained from any of these reproductive structures is relatively small compared to that obtained in an ejaculate, and thus if pregnancy is desired, an advanced procedure such as ICSI is often recommended. For further information on advanced procedures, see pages 19-21.



Problems With Semen Retrieval

Retrograde ejaculations

During normal ejaculation, the bladder neck closes and semen is forcefully expelled out through the tip of the penis. This process is called *antegrade ejaculation*. In some men

Retrograde ejaculation is a common occurrence in men with SCI/D.

with SCI/D, semen does not exit the penis but, instead, part or all of it enters the bladder during ejaculation. Called *retrograde ejaculation*, this process occurs when a dysfunction of the nervous system causes the bladder neck to remain open during ejaculation. Retrograde ejaculation is more common with RPE than with PVS or masturbation. It is possible to collect this sperm by using a catheter to drain the contents of the bladder following a retrograde ejaculation. The sperm may then be used for laboratory analysis or for insemination procedures. Sperm retrieved from the bladder usually has been exposed to urine. Since urine harms sperm, the sperm quality from a retrograde ejaculation is typically worse than from an antegrade ejaculation. Nevertheless, with proper handling by experienced lab personnel, sperm from a retrograde ejaculation is suitable for most assisted reproductive procedures (see pages 19-21 about assisted reproductive procedures).

Other risks or problems

There are risks associated with the use of PVS or RPE. A major risk for men with injuries at T6 or above is autonomic dysreflexia (AD). As discussed on page 10, care must be taken to properly manage AD. See a doctor familiar with SCI/D and AD for specific recommendations. Both PVS and RPE can cause uncomfortable feelings or pain during the procedure. The amount of discomfort relates to the ability to feel sensations below the injury, like a full bladder or bowel. Also, the stimulation usually creates contractions of the muscles of the abdomen and legs that may be uncomfortable. An additional risk that may occur with PVS is irritation, swelling, or bleeding of the penile skin. This risk can be reduced by limiting the amount of time the moving part of the vibrator is in contact with the penile skin.

To avoid risk during PVS or RPE, consult a physician familiar with retrieving semen from men with SCI/D.

SELF PENILE VIBRATORY STIMULATION

If you have been advised by your physician that you may safely practice penile vibratory stimulation (PVS) at home, the following procedure is recommended. Depending on your abilities and preferences, PVS can be done alone or with the help of a partner.

CAUTION: Men with injuries at or above T6 are prone to Autonomic Dysreflexia (AD) and should first perform PVS in a clinic under the supervision of medical personnel.

1. Preparation

If you are prone to autonomic dysreflexia (AD), take the blood pressure medication prescribed by your doctor at the recommended time prior to starting PVS. Empty the bladder prior to PVS.

See section on Autonomic Dysreflexia, page 10. Emptying your bladder before stimulation may also help to prevent AD.

2. Get into a comfortable position.

PVS can be done lying or reclining on a bed or suitable chair.

3. Hold the vibrator in one hand and the penis in the other.

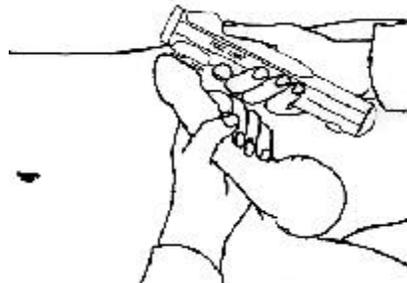
The penis should be held firmly but loosely. Holding it tightly may block the flow of semen from the urethra. Cupping the hand around the shaft of the penis will help to steady the penis during the stimulation. This is helpful if the penis has not become erect. If an erection occurs, holding the penis becomes easier and may not require as much hand control.

4. Turn on the vibrator and place the vibrating part on the head of the penis.

The vibrator can be placed on the top or bottom of the head of the penis. Some men have sensation and like to have the vibrator placed on the area with the most sensation. The penis does not have to be erect to begin stimulation.

5. Hold the vibrator against the penis with a firm pressure for up to 5 minutes.

The amount of pressure placed on the penis should be enough to begin to see some reaction in the body, for example, gooseflesh or a tightening of the abdominal muscles. When ejaculation is coming, spasms in the abdomen and/or legs will often occur. In many men, ejaculation occurs within 2 minutes of PVS. During stimulation, watch for signs of AD, such as a pounding headache, flushing of the skin above the level of the injury, a stuffy nose or an uneasy feeling. If there are signs of AD, or if the stimulation becomes uncomfortable, stop stimulation.



6. *When ejaculation occurs, catch the semen in a cup.*

If the semen is to be used for a laboratory analysis or for a pregnancy attempt, catch the ejaculate in a clean specimen cup. In cases where the semen is to be collected at home and delivered to a lab, the lab personnel will usually provide a sterile specimen cup.

7. *If ejaculation does not occur, take a break for a couple of minutes and inspect the penile skin for signs of damage, such as irritation, swelling or bleeding.*

If these signs occur, stop PVS immediately. If there is no damage to the penile skin, PVS may be continued.

8. *Continue stimulating in 5 minutes intervals with one minute breaks in between.*

Inspect the penile skin after every 5 minutes of stimulation. If there is evidence of penile skin damage, stop PVS immediately.

9. *If ejaculation does not occur within 20 to 30 minutes, stop and try again another day.*

If you use a Ferticare® Personal, the vibrator will hold its charge for 20 to 30 minutes and will then need to be recharged.

Facts about PVS

Several studies provide information about the use of PVS to stimulate ejaculation in men with SCI/D.³⁻⁵ The following summarizes these studies.

- PVS offers the potential for independent use, i.e., PVS may not require a physician's assistance.
- Non-invasive
- Relatively effective: 60-80% of men with lesions above T10 are able to ejaculate with PVS.
- High amplitude vibrators have better success rates of ejaculation compared to low amplitude vibrators.
- The higher the level of injury, the greater the chance of ejaculation with a vibrator.
- Compared to electroejaculation, PVS:
 - is preferred by patients;
 - results in better semen quality;
 - produces more antegrade and less retrograde ejaculation.

SELF PENILE VIBRATORY STIMULATION

Frequency of PVS

PVS can be used as often as the man or couple desires, providing the penile skin is not damaged and AD is not a risk. The likelihood of ejaculating with each attempt, however, varies from person to person. Some men are able to ejaculate every day; others need a longer period of time between ejaculations, perhaps a week or more. The reason for inconsistent ejaculation with PVS is not known. It may take more time for the nervous system to renew itself following ejaculation in a man with SCI/D. Semen quality does not improve significantly with frequent ejaculation in men with SCI/D (see page 28), and may, in fact, get worse with very frequent ejaculation (every 1-3 days). This is important to consider when a couple is attempting to achieve pregnancy. The man may need to determine what period of time between ejaculations is best when sperm is needed for insemination procedures.

Cost/Availability of Vibrators

Vibrator	Cost	Insurance Coverage
Low amplitude vibrators/massagers	\$50 - \$250	These vibrators are purchased over-the-counter in department and drugstores and are not usually covered by insurance
Ferticare personal (high amplitude vibrator)	\$695 - \$850	Prescription required <i>*Some private insurance companies pay; check with provider. (approved by VA, Workmans Comp. Insurance & some PPOs)</i> <i>*Medicare does not cover</i>

The Ferticare® is currently the only vibrator manufactured specifically for ejaculation in men with SCI/D. It requires a doctor's prescription and may be purchased from the following vendors.

United States distributor

**Orion Medical Group, Inc. /
Fertility Healthcare Supplies, Inc.**
29072 Silverado Canyon Rd.
P.O Box 717
Silverado, California 92676

Bus: 888-646-7466 (toll-free)
714-649-9284
Fax: 714-649-9866
Email: info@medicalvibrator.com
Web: www.medicalvibrator.com

Outside of the United States

Multicept A/S
Lyngsø Allé 3
2970 Hørsholm
Denmark

Bus: +45-4576-0515
Fax: +45-4576-0516
Email: info@multicept.com
Web: www.multicept.com

METHODS FOR ACHIEVING PREGNANCY

To achieve pregnancy, the man's sperm has to reach the woman's egg and fertilize it. The fertilized egg must then implant into the woman's uterus. Normally, pregnancy occurs from an ejaculation into the vagina occurring during sexual intercourse. Sperm ejaculated from the penis travels through the woman's cervix, uterus, and fallopian tubes where the sperm finds and fertilizes an egg recently released from the woman's ovary (The release of an egg from the ovary is called *ovulation*). **Some men with spinal cord injury/dysfunction (SCI/D) can ejaculate during sexual intercourse, and therefore, can possibly impregnate a woman during sexual intercourse. If pregnancy is not wanted, birth control should be used. Information about birth control can be obtained from a physician or from an appropriate health agency such as Planned Parenthood.**

Most men with SCI/D cannot impregnate a woman by sexual intercourse. By definition, the couple is diagnosed with "male factor infertility secondary to SCI/D." The male factor may be erectile

Most men with SCI/D are diagnosed with "male factor infertility" because they cannot impregnate a woman through sexual intercourse.

dysfunction, ejaculatory dysfunction, impaired semen quality, or a combination of these conditions. Thus, to achieve pregnancy, methods other than sexual intercourse are necessary. This section outlines methods to achieve pregnancy in couples with male factor infertility secondary to SCI/D.

When a man with SCI/D is unable to ejaculate during sexual intercourse, he may need masturbation, penile vibratory stimulation (PVS), or rectal probe ejaculation (RPE) in order to get his semen sample. PVS and RPE are described on pages 10-11. Once the method of assisted ejaculation and the quality of the sperm have been determined, the couple can attempt to achieve pregnancy with fertility procedures. The types of fertility procedures are intra-vaginal insemination, intra-uterine insemination (IUI), in-vitro fertilization (IVF), gamete intrafallopian transfer (GIFT), or intracytoplasmic sperm injection (ICSI).

Medical assistance is required for all of these fertility procedures, except for intra-vaginal insemination. An intra-vaginal insemination, sometimes called *in-home insemination*, can be done at home by the couple.

There are many methods available to help men with SCI/D become biological fathers. A proper evaluation of the man and woman is very important.

In-Home Insemination

When pregnancy is not possible, or has not occurred with sexual intercourse, semen may be

Candidates for home insemination are women in good reproductive health and men with good semen quality who can safely use PVS at home.

collected by another method of ejaculation and then introduced into the vagina. These other methods of ejaculation include masturbation, oral sex, or PVS. Any of these methods, particularly PVS, may stimulate autonomic dysreflexia (AD) (see page 10). It is recommended that men be evaluated for AD by their physician prior to trying alternative methods of ejaculation. It is especially important to consult a physician familiar with PVS of men with SCI/D before attempting PVS at home.

Procedure

Intra-vaginal inseminations should be done as close to the time of the woman's ovulation as possible. The steps are:

1. Collect the semen in a clean cup using masturbation, oral sex, or PVS.
2. Using a syringe without a needle, draw the semen into the syringe.
3. Insert the syringe deep into the vagina like a tampon.
4. Squirt the semen into the vagina to deposit it in the vagina near the cervix (the opening to the uterus.)

Timing of in-home inseminations

In-home inseminations should be done on the day of the woman's ovulation (release of the egg from the ovary). In most women, ovulation occurs between Day 13 and 15 of the menstrual cycle. To estimate the day of ovulation, count from Day 1 of the cycle, which is the day when blood flow begins. Additionally, the woman can look for signs of ovulation. One sign is a thin, clear, watery discharge from the vagina. Another sign may be pain in the abdomen near the time of ovulation. Counting the days after the start of the menstrual blood flow and looking for these signs can be helpful in deciding when to try an in-home insemination. In addition to using these signs, there are other at-home methods that help predict when ovulation will occur. These include basal body temperature and ovulation detection kits. For more information on predicting ovulation, see page 22.

Chances for success

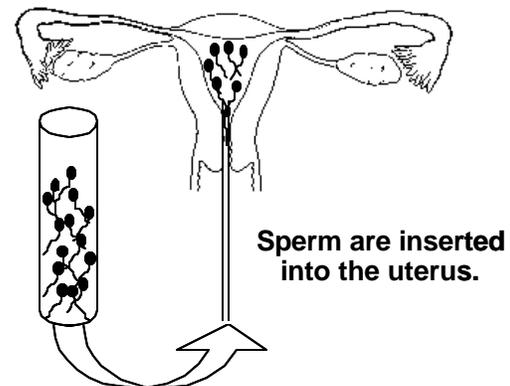
Researchers do not yet have good data on the chance of pregnancy with in-home insemination of couples whose male partner has SCI/D. Success will depend on the woman's age and reproductive health, proper timing of the insemination, and on the quality of the man's sperm. Research indicates that the higher the number of motile sperm, the greater the chance of pregnancy. (For further information, see the section on semen quality, page 26.)

Medically Assisted Procedures

Medically assisted fertility procedures, often called assisted reproductive technology (ART), are available to couples when in-home inseminations have not been successful or the chance of achieving pregnancy at home is low because of poor semen quality or because of female factors. Medically assisted fertility procedures may also be used when the man needs the help of a doctor to obtain his semen sample, such as with electroejaculation.

Intrauterine Insemination (IUI) involves collecting semen from the man and processing it in a laboratory to separate the sperm from the semen (the fluid portion of the ejaculate.) The semen collection is usually performed in a designated room at the clinic, rather than at home, since the semen specimen must be processed soon after collection. So that the insemination may be performed at the proper time, the woman's ovulation is typically monitored by ultrasound or urine testing 24-36 hours prior to ovulation (see section on ovulation detection, page 22). A doctor or specially trained nurse uses a small catheter to place the sperm inside the uterus of the woman. IUI can be done during unstimulated cycles where no fertility drugs are prescribed to the woman or during stimulated cycles where the doctor prescribes drugs to stimulate production of the eggs and/or to stimulate ovulation.

Intrauterine Insemination (IUI)



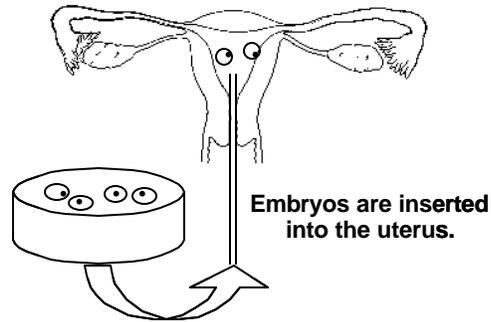
During intrauterine insemination (IUI), sperm from the man is placed into the uterus of the woman. IUI is often recommended when the man has 20 million or more motile sperm per ejaculate and the woman is in good reproductive health.

More advanced assisted reproductive technology is used when additional assistance is needed to help the sperm fertilize an egg. These procedures usually require that the woman take potent fertility drugs in order to produce several eggs during one cycle. The eggs are then removed from the ovary for fertilization outside the body. Careful monitoring with blood tests and ultrasound is used to determine the best time to remove the eggs from her body. (See section on ovulation detection, page 22.) The egg retrieval procedure uses a long needle guided by ultrasound to remove the eggs from the ovary. Once the eggs are retrieved, they are placed in a lab dish for use in one of the following ART procedures.

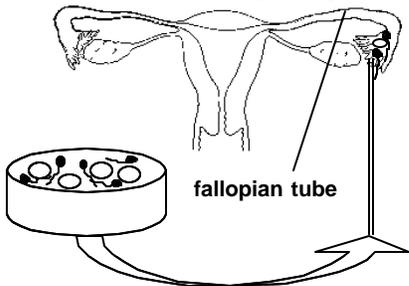
METHODS FOR ACHIEVING PREGNANCY

In vitro fertilization (IVF) is a procedure where sperm from the man are mixed with eggs retrieved from the woman. The mixture is left in a lab dish (approximately 2 days) where fertilization takes place. The fertilized eggs (embryos) are then placed into the uterus through a small tube that is introduced through the vagina. Pregnancy occurs if the embryo(s) implant into the lining of the uterus.

In vitro Fertilization (IVF)



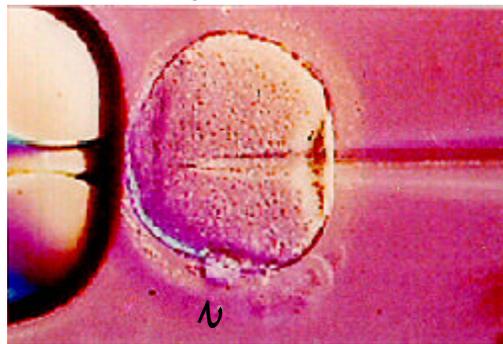
Gamete Intrafallopian Transfer (GIFT)



Retrieved sperm and eggs are surgically placed into a fallopian tube.

Gamete intrafallopian transfer (GIFT) involves minor surgery for the woman. On the same day that eggs are retrieved from the woman, they are mixed with sperm and placed in the fallopian tubes during an operation performed under mild anesthesia. Pregnancy occurs if the egg(s) fertilize and implant into the lining of the uterus.

Intracytoplasmic Sperm Injection (ICSI)



A single sperm is injected into an egg.

Intracytoplasmic sperm injection (ICSI) is a procedure where lab specialists (embryologists) take a single sperm and inject it into an egg taken from the woman. Several eggs are usually injected. The injected eggs are then incubated in a laboratory dish until it is known whether they became fertilized. Fertilized eggs (embryos) are then placed in the uterus of the woman using a small tube through the vagina.

Blastocyst transfer is a relatively recent modification of the IVF or ICSI procedure, in which fertilized eggs are incubated in a lab dish until they reach the blastocyst stage. The blastocyst stage requires 4-5 days of incubation rather than 2 days of incubation usually used in IVF and ICSI procedures. Research shows that pregnancy rates increase when blastocysts are transferred to the uterus rather than 2-day old embryos. Since not all embryos make it to the blastocyst stage, the success of this procedure is probably due to the selection of the most viable embryos for transfer.

IVF, GiFT and ICSI are often recommended when the man has a low number of motile sperm. The use of ICSI is increasing as more labs are becoming proficient in this method.

Further information about fertility drugs and insemination procedures is available from:

*American Society for Reproductive Medicine (ASRM)
1209 Montgomery Highway
Birmingham, Alabama 35216-2809
Phone: (205) 978-5000
Fax: (205) 978-5005
E-mail: asrm@asrm.org
Website: www.asrm.org/*

Risks of ART

A common question from couples is, "Are the babies healthy?" The risk of birth defects in babies from couples whose male partner has SCI/D is not any higher than that in the general population.

The chance of multiple pregnancy, i.e., twins, triplets, quadruplets, *is* increased with ART, especially when more than one egg or embryo is transferred. The problems associated with multiple births are miscarriage, premature delivery and the need for prolonged bedrest during the pregnancy. The risk of multiple pregnancy can occur with any woman undergoing ART, not just those whose male partner has SCI/D.

Another such risk is *hyperstimulation syndrome* which can result when drugs used to stimulate ovulation cause fluid to collect in the abdomen and the ovary, which becomes swollen and painful. This condition usually goes away by itself. Additionally, egg retrieval and other surgical procedures used in ART carry a risk of bleeding, infection, or damage to internal organs.

METHODS FOR ACHIEVING PREGNANCY

Chances for success

According to ASRM, technological advances in fertility treatments now make pregnancy possible for more than half of couples seeking treatment in the general infertile population. Individual centers have reported their pregnancy success rates using various forms of ART in couples whose male partner has SCI/D.⁶⁻¹¹ The success rates are similar to those obtained in the general population, and it appears that for any given number of motile sperm, those obtained from men with SCI/D offer the same potential for fertilization and pregnancy as those of non-injured men.

With any group of patients, the more advanced technologies have higher success rates. As the treatments for infertility improve, we may see an increase in the number of couples that are successful in achieving pregnancy. ASRM collects information from fertility specialists and reports the success rates for each type of fertility procedure. For more information, see the ASRM website www.asrm.org, or call (205) 978-5000.

Ovulation Detection

Determining when ovulation is likely to occur is necessary when couples are trying in-home inseminations or when doctors are scheduling ART with the couple. Ovulation detection methods include the basal body temperature charting, ovulation prediction kits, blood tests, and ultrasound.

Basal body temperature

The woman can take her basal body temperature daily and chart it to learn the normal body temperature fluctuations that occur throughout her monthly cycle. Since the body temperature rises slightly just after ovulation, the woman can use the information gathered from several months to predict the day of ovulation. Basal body thermometers with full instructions on how to use them are available without a prescription in most drugstores.

Ovulation detection is a critical step in attempting pregnancy.

Ovulation prediction kits

These kits allow the woman to test her urine for a rise in the level of Luteinizing Hormone (LH), which stimulates ovulation. This rise is called the LH surge. After the LH level in the urine rises, ovulation usually takes place within 12 to 44 hours. Urine test kits are useful in detecting the LH surge and predicting when ovulation will occur. Several brands of kits are available from drugstores and the manufacturer's instructions should be followed closely. Generally, the woman should begin testing her urine on Day 11 of the cycle. She should continue to test daily until the test turns positive. Each brand of ovulation prediction kit has package information that tells when to expect ovulation. Once the test is positive, follow the recommendations of the package information to determine the best time after the LH surge to do an insemination.

Blood tests

In addition to testing the urine for LH, doctors may choose to test the women's blood for the rising levels of LH. Other blood tests may be used to determine if ovulation actually occurred or to diagnose ovulation problems.

Ultrasound

Ultrasound monitoring is used by the doctor to examine the woman's ovaries (where eggs are produced). Eggs develop within a follicle, and follicle growth can be measured with ultrasound. Ovulation usually occurs when the size of the follicle is about two centimeters. As the doctors watch the growth of the follicle, they use this information to predict when ovulation might happen. If the eggs are going to be retrieved, the ultrasound is used to determine when the egg retrieval procedure should be done.

Common Questions

1. Which ART will my partner and I need?

A number of factors are considered when determining the type of insemination procedure needed for achieving pregnancy. One of the most important factors is the man's semen quality. Men with SCI/D often have lower numbers of motile (swimming) sperm. (For more information about semen quality in men with SCI/D, see pages 26-31.) In cases in which the SCI/D man has sufficient numbers of motile sperm, semen collection at home with intravaginal insemination may be successful. In general, researchers believe that the higher the number of *total motile sperm* in an ejaculated sample, the better the chance for pregnancy with intravaginal or intrauterine inseminations.

There are many factors for a couple to consider in choosing an assisted reproductive technology (ART): the man's semen quality, the woman's age and health, financial factors and emotional factors.

Other factors, including the age and reproductive health of the female partner, are important. When couples are considering procedures to achieve pregnancy, it usually is worthwhile for the woman to get an evaluation from a fertility specialist. While the cause of infertility in most cases is related to the man's SCI/D and his semen quality, some factors related to the woman contribute to the problem and may need to be treated by a fertility specialist.

The type of insemination or ART that the couple chooses may also be determined by the method of semen retrieval needed. If the man cannot ejaculate with sexual intercourse, masturbation, or safely at home with vibratory stimulation, he will need to visit a physician to have his semen retrieved by doctor-assisted vibratory stimulation, by electroejaculation, or by removing sperm surgically from the testes. The semen obtained in doctor-assisted ejaculation procedures are then used for ART. When the man's semen quality is not sufficient to attempt IVI or IUI, the couple often needs more advanced ART.

METHODS FOR ACHIEVING PREGNANCY

2. How long will it take to get pregnant?

This is a difficult question to answer because every couple is different and there are many factors that influence if and when pregnancy will happen. These factors include semen quality, the age and reproductive health of the woman, and the type of ART used. After evaluating the couple, fertility specialists will be able to provide a possible timeline for achieving pregnancy. In general, if no pregnancy has occurred after one year of trying at home, or four cycles of IUI, the couple should proceed to more advanced ART.

3. How much will it cost?

To estimate the total financial cost of achieving pregnancy, one must consider the cost of initial evaluations, the cost of the fertility procedures required by both the man and the woman, and the number of attempts. The cost of a fertility evaluation will vary from clinic to clinic, but an estimate is \$500 - \$1200 per person. When the evaluation is completed, the doctors present the options available to the couple. Table A provides an estimate of the cost per attempt for each of the various procedures. If the man needs PVS or RPE for semen retrieval, the cost of these procedures must be added, generally \$500 - \$1200 per procedure, depending on the complexity of the retrieval.

TABLE A

Insemination Type	Cost
In-home Insemination	\$50 (if ovulation detection kit is used)
Intrauterine Insemination	\$500 - \$1,000
In vitro fertilization	\$8,000 - \$10,000
Gamete intrafallopian transfer	\$10,000 - \$12,000
Intracytoplasmic sperm injection	\$12,000 - \$14,000

Most clinics provide clear information about their costs and payment policies and will work with the couple to determine what procedures are covered by their insurance plan. When considering the options, the couple should consider the cost-effectiveness of each option. While one procedure is more expensive, it may provide a better chance for pregnancy. For example, one ICSI may cost less in time and money than 4 failed IUIs that would then be followed up with IVF or ICSI.

4. How much will insurance cover?

Coverage for fertility care depends on where you live and the type of insurance coverage you have. A limited number of states have laws that require insurance companies to cover some fertility treatments. Each state and insurance provider is different, therefore, couples need to determine the exact coverage their plan provides. Often insurance companies will cover medical evaluations and procedures to diagnose the cause of infertility but will not cover the cost of treating the problem. A patient advocacy group called RESOLVE provides resource information regarding insurance coverage questions. A resource booklet entitled, "Infertility Insurance Advisor" is available for a small fee.

To receive information, contact:

RESOLVE
1310 Broadway
Somerville, MA 02144
Phone: (617) 623-0744
E-mail: resolveinc@aol.com
Website: www.resolve.org

5. Where can we find further information and support?

American Society for Reproductive Medicine (ASRM)
1209 Montgomery Highway
Birmingham, Alabama 35216-2809
Phone: (205) 978-5000
Fax: (205) 978-5005
E-mail: asrm@asrm.org
Website: www.asrm.org
ASRM provides a list of books concerning fertility and maintains patient information resources on their website.

RESOLVE, the National Infertility Association since 1974
1310 Broadway
Somerville, MA 02144
Phone: (617) 623-0744
E-mail: resolveinc@aol.com
Website: www.resolve.org
RESOLVE is a national infertility support group with a wealth of resource information about infertility. Their mission is to provide timely support and information to people experiencing infertility.

The InterNational Council on Infertility Information Dissemination, Inc.
P.O. Box 6836
Arlington, Virginia 22206
Phone: (703) 379-9178
Fax: (703) 379-1593
E-mail: INCIIDinfo@inciid.org
Website: www.inciid.org
INCIID provides infertility information and is dedicated to helping infertile couples explore their family building options.

SEMEN QUALITY FOLLOWING SCI/D

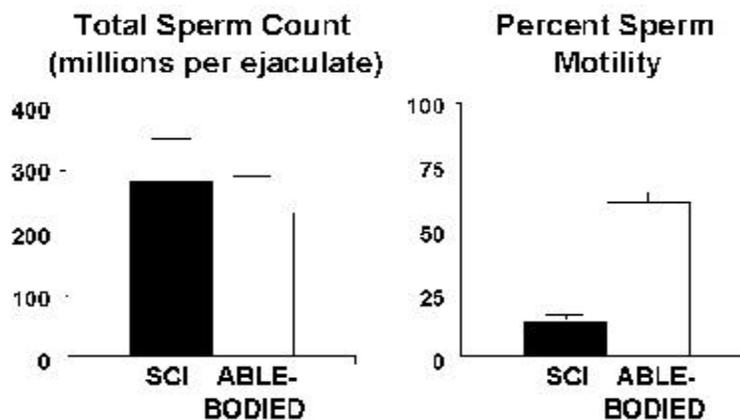
Characteristics of Semen

While men with spinal cord injury/dysfunction (SCI/D) have options to assist in getting their semen samples, they still face challenges in achieving pregnancy with their partners because of the effects that SCI/D has on the quality of the sperm. Typically, men with SCI/D make normal numbers of sperm, but the percent of motile sperm is lower than normal. The average percent of motile sperm in semen samples from men with SCI/D is 20% compared to 70% in able-bodied men. A major reason for infertility is this abnormally low sperm motility. Scientists have also found the following to be true:

It is common for semen of men with SCI/D to have normal sperm numbers, but abnormally low sperm motility.

- Most of the immotile sperm are dead.¹²
- The sperm are fragile and rapidly lose their ability to swim.¹³
- Low sperm motility does not correlate to level of injury, age, time post injury, or frequency of ejaculation.¹⁴⁻¹⁶
- Semen quality (numbers and motility) does not decline progressively with years post injury.¹⁵
- The type of semen impairments seen in men with SCI/D are not commonly seen in other infertile men.¹⁴

SEMEN OF MEN WITH SCI/D CONTAINS A NORMAL NUMBER OF SPERM, BUT ABNORMALLY LOW SPERM MOTILITY



Possible Causes of Impaired Semen Quality

Researchers have been conducting studies to learn what factors in SCI/D cause the decreased sperm motility. If the cause can be determined, new treatments may be developed to improve semen quality.

The following are some factors that have been studied to determine how they influence semen quality: seminal plasma factors, scrotal temperature, methods of bladder management, infrequency of ejaculation, and altered hormone levels. Except for seminal plasma factors, which are currently under investigation, none of the other factors explain the cause of decreased semen quality in men with SCI/D. A summary of these studies is given below. It is hoped that further research will uncover the real cause of infertility in men with SCI/D.

Seminal plasma factors

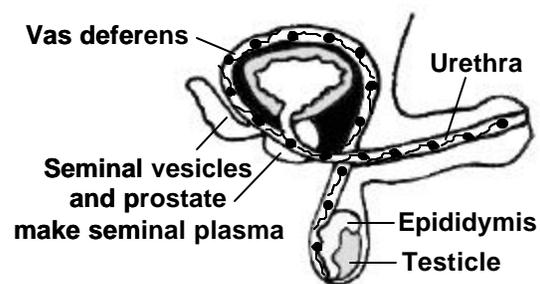
Researchers have turned their attention to factors within the seminal plasma (the fluid portion of the ejaculation) because poor semen quality is seen in all levels of SCI/D

The cause of low sperm motility in men with SCI/D may be linked to factors in the seminal plasma.

(paraplegics and tetraplegics alike), and the lifestyle and physical changes mentioned above are not the cause of decreased motility.

Sperm are made in the testicles and travel to the outside of the body through a series of tubes: the epididymis, the vas deferens, and the urethra. When ejaculation occurs, the sperm mix with seminal plasma to carry the sperm to the outside of the body. One study has shown that sperm of men with SCI/D taken from the vas deferens have almost normal motility.¹⁷ When the sperm mix with the seminal plasma during ejaculation, however, the motility of the sperm decreases.

Researchers are learning that the semen of men with SCI/D may be toxic to normal sperm and may contribute to poor sperm motility.¹⁸ They have confirmed that biochemical changes occur in the seminal plasma after SCI/D¹⁹⁻²¹ and are now conducting studies to determine whether these changes are the reason for poor sperm motility. Another study suggests that poor semen quality may be due to abnormal storage of sperm in the seminal vesicles of men with SCI/D.²² As research continues, there is hope that new treatments for the infertility can be developed.



SEMEN QUALITY FOLLOWING SCI/D

Physical and lifestyle changes

SCI/D causes physical changes and also changes in lifestyle. Researchers wondered whether factors related to these changes, such as scrotal temperature, methods of bladder management, infrequency of ejaculation, and altered hormones might be causes for impaired sperm motility following SCI/D. The following is a review of what has been learned.

Scrotal temperature

For the sperm to be made properly in the testicle, the temperature of the scrotum needs to be lower than body

Impaired semen quality in men with SCI/D is not due to elevated scrotal temperature from sitting in a wheelchair.

temperature. Men with SCI/D spend a significant amount of time sitting in their wheelchair on some type of cushion. It was once thought that this lifestyle change, or perhaps a change in the scrotum's ability to regulate temperature, caused an increase in the scrotal temperature and might be a reason for poor sperm quality. Most researchers now agree that men with SCI/D do not have a significantly elevated scrotal temperature and have found that scrotal temperature in men with SCI/D does not relate to their semen quality. Further proof that impaired semen quality does not seem to be related to scrotal temperature is that men with SCI/D who walk and do not use a wheelchair also have impaired semen quality.²³

Method of bladder management and UTIs

SCI/D usually results in changes in the bladder that require the use of either intermittent catheterization (IC), suprapubic tube, indwelling urethral catheter, or sphincterotomy to manage voiding. Researchers know that bladder management methods are not the cause of poor sperm, but men who use IC tend to have better sperm motility than men who use different methods of bladder management. Therefore, IC may be a better choice when men with SCI/D are interested in optimizing their semen quality. It should be noted, though, that using IC does not improve the semen quality to a normal level.²⁴

Researchers have also found that frequent urinary tract infections (UTI) often seen in SCI/D are not the cause of low sperm motility. When men were treated with antibiotics for UTIs, they did not have significant improvements in their semen quality.²⁴

Infrequency of ejaculation

Infrequent ejaculations have been thought to be the cause of poor semen quality because,

Frequent ejaculation does not improve semen quality in men with SCI/D.

without medical assistance, about 90% of men with SCI/D are not able to ejaculate on their own. Since most men with SCI/D were unable to ejaculate regularly, researchers wondered "if you don't use it, do you lose it?" Now that methods to stimulate ejaculations are readily available, studies have shown that sperm motility does not improve with more frequent or repeated ejaculations.¹⁶

Altered hormonal environment

Normal sperm production depends on normal levels of hormones that control fertility and reproductive function. The hormones related to male function are testosterone, prolactin, luteinizing hormone and follicle-stimulating hormone. Researchers questioned if the hormone levels of men with SCI/D were different than able-bodied men. Some studies have indicated abnormal levels of some of the hormones in men with SCI/D, but these abnormalities do not seem to be the cause of the poor semen quality.²⁵

Common Questions Related to Semen Quality Issues

1. *Should I freeze my sperm for future use?*

This question about cryopreservation (freezing) often comes from the belief that semen quality declines progressively after the injury. Research suggests that semen quality does not decline with the years past injury.¹⁵ Therefore, men with SCI/D should know that their decision to attempt to father children should not be influenced by the number of years since the injury. This question may also come from the idea that the semen quality may still be normal soon after the injury and should be saved for future use.

Unfortunately, researchers know little about the quality of semen shortly after injury. Men who have been injured for less than one year do not seem to respond to the assisted ejaculation

Routine sperm freezing is not necessary for most men with SCI/D.

procedures as easily as men injured for longer periods of time. Researchers have found semen quality to be very inconsistent in the first year or so after the injury. The reason for this is unknown and requires further research.

The freezing process itself causes a decrease in motile sperm by about half.²⁶ In other words, if the motility of the fresh semen sample is 20%, the thawed sample motility is expected to be 10%. For most insemination procedures, it is likely that a fresh semen sample will provide a better chance for success than a frozen and thawed sample. Therefore, freezing semen samples is usually not recommended. In planning for future inseminations, if a fresh sample can be obtained, there does not seem to be any advantage in freezing the sperm. Occasionally, men with SCI/D freeze their sperm for personal reasons or for logistical reasons, such as shipping the specimen between the ejaculation and insemination centers or when it is difficult to coordinate the timing of a fresh semen retrieval with the performance of assisted reproduction technologies.

SEMEN QUALITY FOLLOWING SCI/D

2. *Is there anything that can be done to make the semen quality better?*

Until the cause of impaired sperm motility following SCI/D is determined, there is little that can be done to restore semen quality to normal levels. The following are observations and conclusions made by researchers that are important to consider and may help optimize the quality of the sperm.

Semen obtained by PVS has better quality than semen obtained by electroejaculation

Since the development of high amplitude vibrators, 55% of all men with SCI/D can expect to respond to the vibrator

Semen quality is better when obtained by a vibrator versus electroejaculation.

and 80% will respond if the injury is above T10. Since research indicates that the semen obtained by PVS is of better quality than that obtained by electroejaculation, and because of the low investment of time and money, it is recommended that PVS be tried first before using electroejaculation.²⁷

Use of intermittent catheterization (IC) may improve quality

When researchers compared the semen quality of men using IC to those using other forms of bladder management, those using IC had better sperm motility.²⁴ It is unknown whether switching to IC will improve quality and, if it does, how long it would take to see a change.

Brown-colored semen

Occasionally, men with SCI/D will ejaculate brown-colored semen. In a study examining this phenomenon,²⁸ it was found that brown semen contains the same number of sperm and the same motility as the semen of normal color. Researchers have observed that 27% of men with SCI/D have ejaculated brown semen on at least one occasion and repeated ejaculations do not necessarily eliminate the brown color. They also found that men with brown semen were of all ages, all levels of injury, and all times past injury.

Brown-colored semen is a common occurrence in men with SCI/D. The cause of the brown color is unknown and does not harm the sperm.

One might think that the brown color is related to blood, but when investigators checked this they found that one half of the specimens contained no red blood cells. Researchers do not yet know the cause of brown-colored semen.

Sperm from men with SCI/D lose motility more quickly than the sperm from able-bodied men

Laboratory processing of sperm to be used for ART is a common practice used by fertility clinics. Knowing that the sperm from men with SCI/D lose their motility more quickly is important for clinics to know. Some of the sperm processing techniques take several hours to complete and may be damaging to the semen quality. Based on research results, it is recommended that semen of men with SCI/D be processed as quickly as possible.¹⁴

For assisted reproductive technologies, sperm from men with SCI/D should be processed at room temperature, as soon as possible after semen collection.

Semen samples kept at body temperature lose motility quicker than at room temperature

Another common practice used by laboratories that process sperm for insemination is to store the semen at body temperature. A research study looked at the effect of storing samples at body temperature versus room temperature.¹⁴ The results show that the sperm of men with SCI/D lose their motility faster when stored at body temperature. Therefore, it is recommended that semen from men with SCI/D be processed at room temperature.

Summary of Semen Quality Issues

Regardless of the level and extent of the spinal cord injury, most men have a normal sperm count but low sperm motility. Factors such as scrotal temperatures, method of bladder management, infrequency of ejaculation, altered hormonal environment, and years post-injury have been studied and do not provide an adequate explanation for poor semen quality. Recent studies indicate that the semen may contribute to poor sperm motility following SCI/D. Questions such as, "What changes in the semen cause poor sperm motility?" and, "Are the changes due to the disruption of the nervous system after SCI/D?" require further study. Answers to these questions will lead to a better understanding of the impairments in semen quality following SCI/D and eventually to new treatments for male infertility following SCI/D.

Future research will determine the ultimate cause of impaired semen quality in men with SCI/D.

While researchers do not yet know the cause of decreased semen quality in men with SCI/D, the information gained in studies in recent years along with the advances in assisted reproductive

technologies allow men with SCI/D to consider biological fatherhood. It is our hope that sharing the latest knowledge of fertility following SCI/D will assist couples in reaching their goal of parenthood.

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