

Neurobiology of Sexual Assault and Osteopathic Considerations for Trauma-Informed Care and Practice

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Sexual assault is a traumatic event with potentially devastating lifelong effects on physical and emotional health. Sexual assault is associated with gastrointestinal, neurologic, and reproductive symptoms, as well as obesity, diabetes, and chronic pain. With 1 in 3 women and 1 in 6 men experiencing some form of unwanted sexual violence in their lifetime, sexual assault is a significant public health problem that necessitates attention in the medical community. This review discusses relevant literature on the neurobiologic changes that occur as a consequence of sexual assault, such as how the brain responds during a traumatic experience and the impact of trauma on memory. Osteopathic considerations for trauma-informed care and practice and how all physicians can better serve patients with a history of sexual assault are also discussed.

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Sexual assault—including rape, unwanted sexual contact, intimate partner violence, stalking, and sexual harassment—is a major public health problem with long-term physical and mental health consequences for victims. Victims or survivors, as some prefer to be called, are people of all ages, sexes, races, ethnicities, and socioeconomic backgrounds. According to the 2017 National Intimate Partner and Sexual Violence Survey, 1 in 3 women and 1 in 6 men have experienced some form of unwanted sexual violence, defined in this survey as “rape, being made to penetrate, sexual coercion, and/or unwanted sexual contact.”¹ Nearly 23 million women and 1.7 million men have been victims of completed or attempted rape during their lifetime.¹ Furthermore, more than 27% of women and 11% of men have experienced contact sexual violence, physical violence, or stalking by an intimate partner, and 1 in 6 women and 1 in 19 men have experienced stalking.¹

Commonly reported negative effects of sexual assault include feelings of fear (62% women, 18% men), concerns for safety (57% women, 17% men), and symptoms of post-traumatic stress disorder (PTSD; 52% women, 17% men).¹ Numerous studies examining victimization and its psychological impact found that victims of sexual assault are at increased risk for developing PTSD, with abuse severity predicting higher levels of PTSD symptoms.²⁻⁶ Research examining the physical effects of sexual assault among men and women identified asthma, irritable bowel syndrome, frequent headaches, chronic pain,

difficulty sleeping, and limitations in daily activities.^{1,7} A review by Jina and Thomas⁸ also documented multiple physical consequences resulting from sexual violence against women, such as gastrointestinal symptoms (eg, nausea, vomiting, abdominal pain, diarrhea), cardiopulmonary and neurologic symptoms (eg, shortness of breath, arrhythmias, chest pain, asthma, hyperventilation, numbness, weakness, insomnia, fatigue), genital and reproductive symptoms (eg, vaginal bleeding or infection, genital irritation, pelvic pain, urinary tract infections, painful intercourse, and lack of sexual pleasure), PTSD, and depression.⁸ Physical effects observed among child and adolescent victims of sexual trauma include genital pain, dysuria, and genital bleeding.⁹

Sexual trauma and its lasting psychological and physical effects are critical issues to address in osteopathic medicine. Osteopathic medicine emphasizes an individualized, whole-person approach to treatment focusing largely on health promotion and disease prevention. However, victims of sexual assault are often reluctant to seek preventive care¹⁰⁻¹³ and disclose a history of sexual trauma.¹⁴ Additionally, touch is an important component of the osteopathic approach to medical care, which could make survivors of sexual trauma uncomfortable. Thus, obtaining a detailed history is important so that osteopathic physicians can be mindful of a patient's disclosed history of sexual trauma.

The aim of this review is (1) to discuss the literature on the neurobiologic changes and implications that occur as a consequence of sexual assault, including how structures of the brain respond during sexual assault; and (2) to discuss osteopathic considerations, trauma-informed care and practice (TICP), and how all physicians can better serve patients with a history of sexual trauma.

The Brain's Defense States During a Sexual Assault

When a danger or trauma to the body is detected, different defense states emerge in order of increasing threat: hypervigilance (freeze-alert),¹⁵ flight or fight,¹⁶ tonic

immobility (freeze-fright),^{17,18} and collapse.¹⁵ Memory is also affected, with both short-term effects and delayed long-term effects.

Hypervigilance (Freeze-Alert)

When a predator (*perpetrator* in the case of a sexual assault) is detected, hypervigilance is a common initial response. This defense state was adapted to allow prey to assess a potential threat while minimizing the risk of detection by freezing. The sympathetic nervous system, a division of the autonomic nervous system responsible for preparing the body for a "fight or flight" response during threatening situations,¹⁹ begins to dominate by increasing the heart rate and respiration rate to prepare the body to attack or transition into a state of immobility.¹⁵ The amygdala serves as the brain's early warning system. It is involved in the regulation of basic drives and emotions; it analyzes stimuli, alerts the rest of the brain to pay attention to the stimulus of concern, and generates bodily reactions, such as increasing heart rate and muscle tension.²⁰ The amygdala and insula together react to fearful stimuli,²¹ and the prefrontal cortex, which is responsible for rational thought and the deliberate, planned response to experiences,^{19,20} inhibits the amygdala's reactivity to fear.²²

When not functioning properly, these 3 structures form a network responsible for the impaired regulation of fear responses and hypervigilance to threat-related stimuli.²³ Neuroimaging studies focusing on how the brain perceives and responds to fear have found abnormal reactivity from the amygdala and those structures that communicate with it in survivors of sexual assault. For example, insufficient regulation from the prefrontal cortex leads to hyperarousal as well as the inability to suppress exaggerated fear responses to trauma-related stimuli.²⁴ Similarly, owing to the amygdala's structural plasticity, fluctuating levels of cortisol disrupt the balance between amygdala excitation and inhibition, leading to extensive dendritic growth, which increases the firing rate of the amygdala and manifests as chronic hypervigilance.²⁵ Physicians and caregivers should be aware of chronic hypervigilant states when caring for patients who are survivors of

sexual assault. It is important to foster an environment free of potentially fearful stimuli that might trigger a defensive response.

Fight or Flight

During a traumatic event, the amygdala is triggered and, in turn, activates the hypothalamus via their connection through the limbic system.¹⁶ The hypothalamus regulates physical and behavioral activities by influencing homeostatic functions and the activity of the autonomic nervous system, controlling the release of certain hormones, and regulating emotional states.^{19,20} The limbic system consists of the amygdala and hippocampus, a structure involved in keeping track of spatial location and encoding memories. The limbic system is intimately connected to the hypothalamus and pituitary gland and is important for the control of emotional experiences and expression.^{19,20} When stimulated by the amygdala, the hypothalamic-pituitary-adrenal axis is activated, wherein the hypothalamus sends a signal to the pituitary gland, which activates the adrenal glands (located above the kidneys).¹⁶ The adrenal glands release hormones, including glucocorticoids and catecholamines, that help the body respond to trauma.¹⁶

Under stressful conditions, glucocorticoids (eg, cortisol) provide the body with energy, and catecholamines (eg, norepinephrine and epinephrine) prepare the body for the fight or flight response.¹⁶ If the body's inherent response is to flee, the sympathetic nervous system facilitates blood flow to the lower extremities.¹⁵ Conversely, if the body's inherent response is to fight, the sympathetic nervous system facilitates blood flow to the upper extremities.¹⁵ The release of cortisol and norepinephrine is imperative for a flight or fight response, but high levels of these hormones also impair cognitive functioning in the prefrontal cortex by inhibiting working memory, which is important for facilitating reasoning, decision making, and behavior.^{15,25} As a result, rational thought, planning, and organization are limited.¹⁵

During this state, victims of sexual assault may not be able to strategize or logically plan appropriate steps to take to defend themselves or remove themselves

from the traumatic situation. Too often, survivors are asked why they did not perform action A or action B, which could have freed them from the perpetrator's control. It is important for physicians to keep in mind that the level of hormones released during this traumatic event impairs that type of rational thought and planning. More importantly, avoiding this line of questioning can help prevent victim-blaming and retraumatization.

Tonic Immobility (Freeze-Fright)

In addition to the fight or flight response, a fearful or traumatic stimulus can elicit a freeze-fright response, known as tonic immobility. Tonic immobility in non-human animals is well documented and understood.^{17,18} During a predator attack, prey will enter a state of tonic immobility after attempts to fight or escape are unsuccessful. In experimental situations, tonic immobility is induced by suddenly inverting and restraining the animal until it stops struggling.^{17,18} Other studies have shown that application of pressure while restraining is not necessary to induce tonic immobility.²⁶ In general, tonic immobility is a physiologic, involuntary, unlearned response elicited by extreme fear, physical contact, and the perception of entrapment with the inability to escape. It is characterized by motor immobility, muscular rigidity, suppressed vocal behavior, tremors, periods of eye closure, analgesia, and changes in heart rate and body temperature.^{17,18,27} Memory and learning remain intact.^{28,29} The circumstances known to induce tonic immobility in animals (eg, fear, physical contact, and restraint/perceived entrapment) are also present during instances of sexual assault.²⁷

Sexual assault survivors often report experiencing an inability to move or call out for help, previously referred to as "rape-induced paralysis." Survivors reported feeling faint and cold³⁰ and that their body went "absolutely stiff."³¹ Two studies using the Tonic Immobility Scale, a self-report measure used to assess the presence and severity of tonic immobility in victims of sexual abuse, showed that more than 50% of participants experienced tonic immobility during an

episode of childhood sexual abuse.^{32,33} These studies showed similarities between how human and non-human animals respond to situations of extreme fear, physical contact, and restraint. For example, reports of feeling stiff or paralyzed resemble the physical immobility seen in laboratory animals. Trembling and shaking reported by victims mirror the tremors seen in animals.³⁰ The inability of victims to scream or call out resembles an animal's suppressed vocal behavior, and survivors' reports of feeling faint or cold mimic a laboratory animal's change in heart rate and body temperature.³¹ Physicians and caregivers should consider that the patient could have entered a state of tonic immobility during the sexual assault and should help the patient understand that during fearful situations, the body's physiologic response may be to enter into a state of tonic immobility, preventing a victim from calling out for help, running away, or fighting back.

Collapse

If the defensive states described above are not viable, the body transitions into a collapsed state. In this state, the parasympathetic nervous system, which is responsible for preparing the body for "rest and digest" by conserving energy and promoting homeostasis, dominates, resulting in decreased heart rate, decreased respiration rate, and immobility.¹⁵ This collapsed state prepares a person for injury or death by releasing endogenous opioids to decrease impending pain.^{34,35} The endogenous opioids block both physical and emotional pain; research has documented a decrease in emotional pain with a state of mental defeat or surrender.³⁶ After a sexual assault, the survivor may appear to have flat affect or may seem detached.¹⁵ This lack of emotion is often confused with apathy or indifference; however, physicians must consider the effects of endogenous opioids when caring for survivor immediately after a sexual assault.

Memories

Research has established that high levels of glucocorticoids and catecholamines are released during traumatic, stressful, and fearful situations.³⁷⁻³⁹ Glucocorticoid and

catecholamine activity in the amygdala also has an effect on memory encoding, consolidation, and retrieval.⁴⁰ Catecholamines and nongenomic glucocorticoids exert rapid, short-lasting effects, whereas genomic glucocorticoids exert delayed, long-term effects.⁴¹ During an emotionally arousing event, the release of catecholamines and nongenomic glucocorticoids enhances encoding processes by strengthening synapses in the hippocampus.⁴² Studies show that glucocorticoid administration shortly after a stressful experience facilitates memory consolidation by suppressing learning and processing of competing information unrelated to the stressful event.⁴³ Further, this finding was supported by other research conducted by Oitzl and de Kloet,⁴⁴ Roozendaal et al,⁴⁵ and Roozendaal and McGaugh,⁴⁶ which demonstrated impaired memory consolidation after glucocorticoid removal and synthesis inhibition and enhanced memory consolidation after administration of a glucocorticoid receptor agonist in the amygdala in rat models. This shift in brain activity, which favors memory encoding and consolidation, has opposite effects on memory retrieval.

Buchanan et al⁴⁷ studied the effects of stress-induced cortisol response on memory retrieval and found that during times of increased stress, when high levels of glucocorticoids like cortisol are released, memory retrieval is impaired. Although Buchanan et al⁴⁴ observed impairments with memory retrieval during times of high stress, it is important to note that persons who experience memories in conditions of high emotional intensity have enhanced encoding, which allows them to develop more salient memories of their trauma.⁴⁸ Yuille and Cutshall⁴⁹ characterize highly emotional memories as "detailed, accurate, and persistent." Highly emotional reactions to traumatic events can even predict better recall,⁵⁰ with the central details of the experience well-retained over time.⁵¹

This information is vital when caring for victims of sexual assault. Often, whether in the emergency department or at the police station, victims are asked to explain the details of their assault shortly after it has

taken place. At this time, glucocorticoid and catecholamine levels are still extremely high, so a victim's recollection of events may be fragmented. Unfortunately, fragmented memories can be misinterpreted as inaccurate. As physicians and caregivers, it is important to be patient and give victims the proper time and space to heal and allow their memories to solidify.

Trauma-Informed Care and Practice

Survivors of trauma may be reluctant to seek preventive medical care, including cervical cancer screenings, mammograms, and dental screenings.¹⁰⁻¹³ Many of these services require clinicians to be close to and to touch the patient.⁷⁻¹⁰ For osteopathic physicians who practice osteopathic manipulative medicine, touch is a primary diagnostic tool during the physical and structural examination and as a method of treatment for somatic dysfunction. Palpation of a patient's skin, muscles, bones, joints, and viscera informs osteopathic physicians about the state of a patient's health, allows for the development of tactile memories of structural dysfunction and disease, and can be used to assess progress.⁵² These diagnostic and treatment methods, however, can be retraumatizing to the victim and survivor.¹⁰⁻¹³ Reluctance to seek preventive care is problematic, given that childhood and adult trauma are linked to heart, lung, and liver disease, as well as to obesity, diabetes, and neuroendocrine dysfunction.^{53,54} Thus, trauma is both a physical and psychosocial health problem. For these reasons, assessing trauma reflects the first tenet of osteopathic philosophy, that the body is a unit of body, mind, and spirit.⁵⁵ Therefore, the treatment of patients with a history of trauma necessitates an understanding of the bidirectional relationship between a patients' physical symptoms and their psychosocial well-being. Trauma-informed care and practice is a treatment framework that recognizes the widespread effect of trauma and addresses the effects of all types of trauma.^{53,56,57}

In TICP, every aspect of care is assessed and potentially modified to incorporate a basic understanding of how trauma affects a person's life.^{53,56,57} Specifically

1. Have you ever been sexually abused or raped? Yes / No
2. Have you ever felt afraid of your partner? Yes / No
3. Has anyone ever hit, injured, threatened or tried to control you? Yes / No
4. Do you wish to discuss issues related to rape, incest, sexual abuse, or coercion? Yes / No

Figure 1.

Sample clinical intake questions regarding sexual assault.

in the medical setting, TICP uses universal trauma precautions for all patients and trauma-specific strategies for patients with a known history of trauma. Universal trauma precautions focus on patient-centered communication and care and require an understanding of the effects of trauma on health.^{53,56,57} Trauma-specific services implore physicians to collaborate with colleagues across all specialties that are trauma informed and to maintain a referral list for patients who disclose a history of trauma.⁵³ Further, it requires physicians to have an understanding of their own history and manage their reactions to patients' stories to prevent burnout.⁵³ Importantly, physicians need to know when and how they will screen for trauma. **Figure 1** presents sample clinical intake questions. Trauma-informed primary care focuses on providing a calm, safe, and empowering environment for patients, providers, and staff; screening patients for current and past trauma as well as PTSD, depression, and substance abuse; and offering onsite and community programs that promote healing.⁵³

Similarly, osteopathic palpatory techniques promote the principles of TICP when physicians include an explanation of the nature and purpose of applying a technique to the patient's body while also addressing what the patient might experience during the examination.⁵² Importantly, the patient should decide if and when he or she is ready for osteopathic manipulation and which areas of the body are acceptable to touch. Some patients may never feel comfortable receiving osteopathic manipulation, and some patients may request having a family member or friend in the room during treatment. A patient may have certain preferences for his or her own treatment and, therefore,

Table.
Trauma-Informed Care and Practice (TICP) Approach to Care for Patients With a History of Sexual Assault

Steps	Without TICP Approach	With TICP Approach ^a	Example of TICP Approach ^a
Patient Presentation	20-yr-old woman presents with low back pain	20-yr-old woman presents with low back pain	
History Taking	You take a history of the back pain, including history of injuries.	You take a history of the back pain, including history of injuries. You also ask about any history of negative events.	"Tell me about any negative experiences in your life that you think have made an impact on you. For example, bullying, unhealthy relationships, things that were hard for you, things that you think other people don't usually experience." This question opens the discussion to various events but may not be covered by typical trauma screening questions. It also encourages patients to explain their experiences in their own words.
Examination and Treatment	You perform your examination, give her a brief explanation about OMT, obtain consent, and start performing OMT. The patient has a hard time relaxing, and she seems distant at the end of the visit.	You learn that the patient has a history of sexual trauma, and you explain how OMT involves touch and provide the patient with the opportunity to let you know if the touch required for examination and OMT would be acceptable. Talk through the areas of the body that would be treated and how you would use your hands to treat her.	"I think I may be able to help your pain with something called osteopathic manipulation. I use my hands to diagnose and treat different parts of your body that may be out of alignment. This involves touch, sometimes in areas where some people feel uncomfortable. The areas I would be touching today (and I point to those areas of my body as I say them) might include your feet, your hips, your sitting bones, your bottom, your upper ribs, your armpit, your neck, your head, and maybe inside of your mouth. I want you to know that if there is any part of your body you do not want me to treat with touch, that is absolutely acceptable. Please let me know, and you are allowed to change your mind. Also, before I touch sensitive areas, I will say 'I am going to touch your hip bones now' or 'I'm going to touch your sitting bones now.'" You then treat your patient. Your treatments need to be adjusted as you go, secondary to the patient's inability to relax and not being okay with touch on different areas of her body.
Follow-up	The patient does not return for follow-up.	The patient returns 3 wk later with some improvement in pain and has questions about the areas she did not want you to treat last time.	You discuss today's planned approach and she is able to relax and tolerate more treatments. She returns in 1 mo with further improvement.

^a The TICP approach to care with osteopathic manipulative treatment (OMT) adds approximately 2-3 minutes to the entire visit. However, it can result in increased patient satisfaction, comfort, trust, and adherence.

treatment should be tailored to individual patient preference. If a patient becomes uncomfortable during treatment, the physician should stop and ask the patient if he or she is okay or if he or she would prefer to have a staff member present. The overarching goal is to validate patients' experiences, advocate for their needs, and

support patient autonomy. When combining TICP with osteopathic manipulative treatment, osteopathic physicians have the tools to foster a safe, comfortable environment that promotes a trusting relationship with patients. The [Table](#) presents an example of an approach without TICP and an approach with TICP.

Reassure your patient that the sexual assault is not his or her fault.
Tell your patient that you are very sorry that this traumatic experience happened.
If your patient is struggling to remember every detail about the assault, provide reassurance that lapses in memory are common immediately after trauma.
Avoid interrogating your patient about the assault. It is not your job to investigate the sexual assault. Asking forceful questions may have the unintended consequence of making your patient feel like you are blaming him or her for the assault.
If your patient does not feel comfortable talking to you about his or her assault or reporting the assault to law enforcement, let the patient know of the option to talk to a confidential counselor.
Provide your patient with phone numbers for counseling and mental health services in the community. Offer to have your office staff reach out on the patient's behalf to set up an appointment because it may be too difficult for your patient to set up the first appointment with a counselor or mental health professional.

Figure 2.

Suggestions for physicians regarding how to communicate with patients who have been sexually assaulted.

Mandatory Reporting

Many states require mandatory reporting by physicians and other medical personnel after the treatment of a child, older adult, or vulnerable adult who has reported sexual assault or when sexual assault is suspected.⁵⁸ However, most states do not require physicians and other medical personnel to report cases of sexual assault in which the victim is a competent adult.⁵⁹ California is the only state that requires physicians and other medical personnel to report the assault of a competent victim.⁶⁰ Physicians and other medical personnel should familiarize themselves with the different categories of sexual assault, as well as the reporting statutes for the states in which they are licensed to practice medicine. A complete list of all state statutes is available on the National Center on Domestic and Sexual Violence website.⁵⁹

Psychological Treatment Referrals

Signs or behaviors that may be indicative of a patient needing psychological treatment include feelings of anger, fear, or sadness; sleep disturbances; self-harm; disruptive thoughts about the trauma; avoiding things and situations that are reminders of the trauma; problems at school or work; relationship difficulties; and sexual difficulties.⁶¹ Physicians should be prepared to offer psychological support and provide referrals for psychological

treatment to patients with a history of sexual assault. **Figure 2** provides suggestions for how to communicate with patients. Physicians also should be aware of services in their communities that provide forensic medical examinations, support groups, counseling, psychiatric, and legal assistance for patients who have been sexually assaulted. Regardless of what options are chosen, the patient should be in control of his or her treatment decisions and take an active role in his or her recovery.

When judgment and victim-blaming are removed from the patient-physician interaction, patients may be more likely to disclose details about their trauma history and communicate psychological and physical complaints. Physicians must strive to create a safe and trusting environment for victims of sexual assault.

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All authors provided substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; all authors drafted the article or revised it critically for important intellectual content; all authors gave final approval of the version of the article to be published; and all authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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