Editorial. Literature Review. Opinion.

C-SECTION IMPACT ON MATERNAL AND FETAL HEALTH. POSITIVE OUTCOMES WITH MICRO POINT STIMULATION OF C-SECTION SCARS

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Abstract: This review clearly demonstrates the dramatic impact of a C-section on the morbidity for both mother (physical and emotional) and child (especially related to adverse microbiome development in the growing infant). Also, millions of women who suffer symptoms both locally around the surgical site and more importantly distant effects related to sympathetic up-regulation, mainly through fascial/ fibrotic nerve stimulation. Our experience of the application of Micro Point Stimulation Scar Release therapy to C- section scars resulted in markedly improved pain in these patients who had long-standing symptoms The preliminary but impressive ultrasound findings showing the dramatic reduction in the fibrous/fascial mass after just one session of Micro Point Stimulation Scar therapy of 35 secs adds credence to the efficacy of this procedure in relieving pain symptoms from a simple inexpensive method of treatment. Micro Point Stimulation scar release therapy impacts on distant locations of pain; this challenges the traditionally held concepts of diseases and its pathophysiology. Abdominal and C-section scars may now be viewed as significant systemic contributors to pain and dysfunction throughout the entire body. The overuse of C-sections cannot be justified, and it is imperative, that the entire practice is reviewed to stem the rising use of this procedure. Wherever possible a delivery should happen in a home friendly environment, which is conducive to good health for mother and child.

Keywords: C-section, microbiome development in the growing infant. micro point stimulation, the morbidity for mother and child, overuse of C-sections, scar therapy, sympathetic up-regulation

A. C-section Maternal and Fetal Outcomes Childbirth is a miraculous and profound event in a woman's life that will change her forever. It is a powerful achievement that will have a lasting impact on a woman's life, health, and emotional state. Childbirth can be an event that is forever empowering and fulfilling. However, for some women, this epic event can hold emotions of fear, loss, and sadness [1] especially if the childbirth involves a cesarean section (C-section).

A C-section is a life-saving surgical procedure when certain complications arise during pregnancy and labor. The World Health Organization (WHO) recommends that C-section delivery rates should not exceed 10- 15 per 100 live births to optimize maternal and neonatal outcomes. However, a recent analysis from data around the world shows a C-section rate of approximately 19 percent seems to be ideal for the health of both women and newborns [2]. In the US, however, the situation is strikingly different; C-section is the commonest surgical procedure performed with 1.3 million such operations done annually, accounting for 32% of all births [3]. There has been a steady increase in the use of this procedure over the last 10-15 years - in the United States, the rate of C-section has risen 48% since 1996, reaching a level of 31.8% in 2007 [4]. This trend is reflected in many parts of the world, with the most populous country in the world, China, approaching 50% and some private clinics in Brazil approaching 80% [5.6].

The reasons for the increase are multi-faceted. Delayed childbearing, increasing maternal body mass, more multi-fetal gestations, and low utilization of vaginal birth after a previous cesarean (VBAC) are commonly cited causes [7,8].

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C-section delivery on maternal request [9] is not insignificant and a 2010 study by the National Institutes of Health found that truly elective C-sections accounted for about 10 percent of all of the scheduled procedures in the US [10,11] may also be contributing to the escalating rate of C-sections.

One needs to question whether this increase in the use of C-section has led to better maternal and fetal outcomes; the evidence shows that this is not so [12]. C-section is a major surgical procedure and is associated with immediate maternal and perinatal risks and may have implications for future pregnancies as well as long-term effects [13-17]. The planned C-section procedure may incur several risks for the mother. A C-section comes with surgical risks and complications from anesthesia (these may include severe headache, nausea, and vomiting), have longer hospital stays and a longer postpartum recovery period than women with vaginal deliveries, more blood loss than a vaginal delivery, decreased bowel function, breastfeeding is more difficult after a C-section, women are uncomfortable after surgery and numbness or pain in the area around the scar [18-22], they do not have immediate skin-to-skin contact with their baby. Skin-to-skin care is the practice of placing the infant directly on the mother to maximize surface-to-surface contact. This practice has numerous health benefits for both the mother and newborn, including helping initiate breastfeeding, stabilizing glucose levels, and maintaining infant body temperature [23-24].

Also, C-sections may be a hidden cause for millions of women suffering from chronic pain, as they have been reported to be linked to Chronic Post-Surgical Pain (CPSP) [25-29] and neuropathic pain [30]. Problems with C-section are not only physical but emotional [31,32]. A sense of loss, anger, violation, depression, post-traumatic stress disorder (PTSD), humiliation and helplessness has been reported associated with C-sections [33-43].

For the fetus, the well-known risks are neonatal depression due to general anesthesia, fetal injury during hysterotomy and/or delivery, increased likelihood of respiratory distress even at term and breastfeeding complications. C-section delivered birth, as opposed to a vaginal one, is unnatural and associated with unnatural physiology - a cesarean born baby is physiologically different from a baby born by the vaginal route. More after-birth complications can be seen after c-section birth in comparison to vaginal birth. The lungs and heart do not work in the same way; they have lower Apgar-score, indicating physiological problems; the glucose levels tend to be lower (especially in nonlabor c-sections); the body temperature is lower in the first 90 minutes after birth. C-section babies show more respiratory problems and breathing difficulties: respiratory distress syndrome which is a major cause of neonatal death; serum protein and serum calcium are lower; due to less stimulation of the nervous system and the respiratory system, breathing and reflexes are slower. Cesarean babies need more aspirations. They have more difficulties in adapting to the changing environment due to a lack of skin stimulation and hormonal exchange. There is more iatrogenic prematurity because the c-section was performed too early, before the end of the pregnancy. More c-section babies are referred to NICU and show more and longer stays in incubators. Delivery of C-section babies occur in a busy and noisy foreign surgical operating room environment, being handled by 'foreign' sterile hands, different flora that the fetus is first exposed to [44-46] – all can have a lasting impact on the long-term outcome.

Concurrent with the trend of increasing C-section, there has been an epidemic of both autoimmune diseases such as type 1 diabetes, Crohn's disease, and multiple sclerosis and allergic diseases, such as asthma, allergic rhinitis, hay fever, and atopic dermatitis [47,48]. The occurrence of these diseases is higher in more affluent, Western, industrialized countries. The interplay between the emerging microbial ecology of the gastrointestinal tract and the developing mucosal immune system serves as a backdrop for a relationship between C-section and the emergence of some of these diseases. With the highly immunoreactive intestine serving as the largest surface area of the body that is exposed to the environment, especially a vast array of luminal microbes and antigens, it is intriguing to speculate that the intestinal environmental interaction during early development of the immune system may relate to these diseases. Microorganisms in your gastrointestinal tract form a highly intricate, living "fabric" that plays an integral part in your health, affecting everything from bodyweight and nutrition to chronic diseases of all kinds; the groundwork for your gut microbiome is laid at the time of birth. Importantly, a baby basically "inherits" the microbiome from its mother, which is why it's so important to address one's gut health before, during and after pregnancy.

A vaginal birth allows the fetus to acquire the mother's vaginal bacterial microbiome as it transverses the vagina – now recognized as a crucial element of immune balance later in life [49]. The flora that a fetus acquires after a C-section is different from the mother's vaginal one and reflects those of the mother's skin and that of an obstetrician, nurse, and the incubator [50]. One intriguing

component of this relates to the early development of the intestinal microbiota, the developing immune system, and the early influence of C-section versus vaginal delivery on these phenomena. The immune system undergoes major development during infancy and is highly related to the microbes that colonize the intestinal tract [51-53]. It has been suggested that different initial exposures depend on the mode of delivery. The microbes that "seed" the intestine during either C-section or vaginal delivery may lead to changes in long term colonization and subsequent altering of immune development. The infant microbiome educates the immune system and primes organ function. Infant microbiome development is perturbed by C-section, perinatal antibiotics, and formula feeding and can predispose to childhood obesity [54]. Perturbed infant microbiomes have been linked to increased risk of metabolic and immune diseases. The infant microbiome plays an essential role in human health and its assembly is determined by maternal–offspring exchanges of the microbiota. A growing body of literature has reported differences in the structure of microbial communities between children delivered by C-section and those born vaginally [55-59]. Dominguez-Bello *et al* [60] demonstrated that the microbiota (across several body habitats, including the skin, oral, nasopharynx, and feces) of vaginally delivered neonates resembled the vaginal microflora of their mother, whereas the microbiota of neonates born by C-section resembled that of the mother's skin or surgical staff. Studies have found that stools of C-section delivered children have lower counts of *Bifidobacteria* and higher counts of *Clostridium difficile* than vaginally delivered children [61-63]. A longitudinal study found that babies delivered by C-section had lower overall bacterial diversity up to the age of 2 years, and delayed colonization of the gut by *Bacteriodetes*, compared with their vaginal delivered counterparts [64]. The three most important for child neonatal/child development are vaginal delivery, skin-to-skin contact, and breastfeeding.

B. Scars – Pathophysiology, Outcomes, and their Management Now let us look at the issue of C-section induced scars - their morbidity and pathophysiology. C-sections usually through a transverse incision, cut through skin, subcutaneous tissue, fascia, muscle, uterus to deliver the fetus. This leaves a scar all along this pathway. This procedure leaves the mother with symptoms of pain locally and distant, health dysfunction, and some report never feeling the same again. The pathophysiology of scar formation and related symptomology is now becoming more apparent and better understood. When the integrity of the skin is altered or the healing process is disturbed after an incision, it can be a source of symptoms not only locally but at distant sites. The skin is an organ and has a multitude of functions and has a multitude of connections with the central and peripheral nervous systems, through nerve endings and the innervations to the subcutaneous structures especially the fascia. Recently Benias *et al* [65] report on the structure and distribution of an unrecognized interstitium in human tissues.

We believe that this is not a new organ but represents the body-wide network of loose connective tissue that already has a name – the fascia. The space described by the authors [65] always existed and is recognized to be a dynamic space, where many actors in the course of disease and health stage their performance; some leave no footprints, while some are evidenced as scars.

What is a scar or scar tissue? After an incision to the skin, there are four main stages in skin healing: hemostasis (immediate), inflammation (within 24hours), proliferation (8-14 days with the migration of fibroblasts, laying down fibrin and collagen), and remodeling (can last for years) [66-68]. What happens, however, if these processes have been altered? The scar can shift the healing process toward a nonphysiological state, giving origin to a hypertrophic scar (HS), a keloid scar (KS), or an atrophic scar (AS), each one with a different etiology. When the dermis and the fascia are affected by scars, these structures are altered, and their function and capacity of interaction with the external and internal environment are lacking. Research has confirmed an increase of nerves in the region of scarring, particularly HSs, and accumulation of neuropeptides [69]. This means a scar can present daily stimuli, leading to the varied symptoms. It is well-known that KSs and HSs frequently arise in specific sites; especially the lower abdomen [70]. Deep surgical procedures and the resulting scars can also affect the fascia and the viscera, which then go through an identical healing process. The fascia is rich in corpuscles with proprioceptive properties and significant peripheral information, as well as with probable nociceptive function [71]. Furthermore, the fascial tissue is made of contractile fibers, which may produce spasms and consequential dysfunction and pain. An adhesion is a cicatricial event [72].

One of the most important connections between the skin and the body is that with the sympathetic nervous system. The skin can stimulate the sympathetic nervous system, which is connected to the entire nervous system, both efferently and afferently [73]. The fascia has a high density of nerve endings belonging to the sympathetic system [74]. When there is fascial injury, there is always fascial

dysfunction [74,75]. A physiological alteration in any part of the body will affect everything that is covered by the connective sheet: the symptom will arise in the area concerned with the alteration or, in contrast, in a distal area, when this is not capable of adapting to the new stressor [71]. Communication between the viscera and the brain is continuous. The brain receives (and responds to) continuous dynamic feedback of afferent visceral signals through neural and humoral pathways [76]. This applies to every part of the body; the fasciae envelop the viscera and are capable of conducting electrical activity under mechanical stimuli, giving rise to additional symptoms [77].

Based on this pathophysiology, C-sections leave the mother with symptoms of pain locally and distant, health dysfunction, and some report never feeling the same again. C-sections scars are also linked to internal adhesion formation; the incidence of detection of adhesions after visceral surgery is almost universal (97%-100%) [78-80]. Abdominal adhesions and can lead to irregular bowel movements [81], chronic abdominal pain [82-84], digestive disorders [85], endometriosis [86,87], intestinal obstruction, [88] block circulation [89-90], stagnate energy flows [91-92], lowered fertility [93,94], decreased libido [95-100], and impacts future infant mortality [101]. Abdominal scars influence the sympathetic nervous system and to the corresponding visceral and somatic domains (T11–L2) [102]. Visceral adhesions are also reported to negatively affect the sympathetic nervous system [103-110], and enteric nervous system [111-114]. C-section scars cause the systemic centralization of pain [115-117], as they are geographically located in the core of the body which influences sympathetic and enteric nervous systems, and the fear reflex [118,119]. Scars produce fascial injuries to negatively influence proper positioning of spinal and skeletal alignments [120-122].

Inflammation inside the pelvic area, tears in muscle fibers and tissue, and surgical sites are the host to what we call scar tissue. The body miraculously has the ability to heal itself and repair the injured site laying down new collagen.

This new tissue is altered biochemically and electrically and is not the same as the tissue around it. These chemical and electrical alterations cause the cell to send out miscommunication to the nervous system. This cellular turbulence is theorized to sympathetically upregulate the autonomic nervous system. This upregulation can lead to a fight, flight, or freeze reaction produced by the survival mode. This sympathetic activation stresses the body and proliferates the increase of disease and chronic pain.

Scars and trauma have long been recognized in neural therapy as a source of chronic pain as a result of sympathetic nervous system upregulation [123-125]. It is theorized that damaged local cells lose their normal membrane potential, transmitting abnormal electric signals throughout the rest of the body via the autonomic nervous system, acting as agonists to sympathetic upregulation resulting in stress and pain [126,127].

In addition, other side effects are less well understood but recognized as due to the C-section scar. A surgical scar also cuts through the integrity of the human energy field, cutting 'open' the field and creating a 'leakage' of energy [128,129], This can be readily seen on gas discharge visualization (GVD) images [130]. The horizontal scar of a C-section cut across the meridian lines of energy flow (as In Traditional Chinese Medicine) thus blocking energy integrity [128,129].

C. Impact of Microcurrent Therapies on the C-section Symptomology Microcurrent therapies involve applying weak direct currents (80 µA - <1 mA), and are now being increasingly recognized as an adjunct for pain relief and autonomic nervous system regulation; our experience and publications are extensive in this field [131-136]. It is theorized that electro-acupuncture and microcurrent electro-currents have different modulating effects on the autonomic nervous system and pain outcomes [137]. Microcurrent therapies below 500 mca (>=0.5ma) activate ATP, protein synthesis, and increased metabolism, while higher currents inhibited these vital processes that are necessary for normalizing the milieu [138]. This suggests that low amplitude microcurrent (Direct Current -DC) is more beneficial to cellular regeneration than high amplitude Alternate Current (AC) stimulation. We and others have shown that DC is more beneficial in these situations compared to AC [139]. There is no consensus in the literature identifying the best practice measures for microcurrent applied to scars for the treatment of chronic pain. Although sufficient evidence supports the application of micro-current point stimulation (MPS) to acupuncture points for chronic pain and stress [131, 134, 136, 140-142], there is no consensus of the best approach.

We have shown markedly positive results in a cohort study [154]. In this study, analysis of treatment outcomes pre, post and 48-hour follow-up after Micro-current Point Stimulation (MPS) was applied to C-section scars on 47 patients with a history of non-specific pains. MPS was applied bi-laterally along the length of C-section scars. Evaluations entailed a baseline Visual Analogue Score (VAS) pain scale assessment, which was repeated after an

electrotherapy treatment and 48 hours later. All 47 patients received one MPS Scar Release session. The VAS response of the 47-patient sample with chronic pain reflected a statistically significant reduction in mean post pain levels of 67.5% [p=0.0001] when compared to initial pain levels. When VAS was measured at the 48-hour follow-up, there was a further statistically significant reduction of 45.2% treatment [p=0.0001], for a total pain reduction of 82.2% [p=0.0001], when compared to initial pain levels. The positive results in this study could have major implications for patients who have C-section scars and are suffering from chronic post-surgical pain syndromes. Furthermore, we have recently shown that MPS therapy has a beneficial impact on neuromodulation such that there is a positive Influence on Heart Rate Variability, Stress and Vagal Activity [155]. Heart rate variability (HRV), stress and parasympathetic recovery are closely related to health, longevity and vitality in humans. The autonomic nervous system response with MPA showed a measurable reduction in sympathetic stress with subsequent improvement in vagal tone, HRV and exercise tolerance. This positive sympathetic nervous system deactivation shown in this study could have a major impact on other pathologies. This shows the pathway for the actions of MPS modulation and impact on symptomatology.

This study suggests that internal functional changes may have occurred that persisted despite further therapy. The preliminary but impressive ultrasound findings (Figures 1 and 2 - discussed below) showing the dramatic reduction in the fibrous/fascial mass after just one session of MPS therapy of 35 secs adds credence to the efficacy of this procedure in relieving pain symptoms from a simple inexpensive method of treatment. Whether this persists for a longer period remains to be determined and will dictate how frequently the MPS procedure is needed to maintain the improved state.

Chronic pain often equates to stress (and can be its cause), both of which can make our daily lives miserable, and can lead to significantly impaired health and high societal costs [143-145]. For many health care professionals, the underlying cause of chronic pain has been difficult to diagnose and therefore to impart proper treatment. Annually, millions of C-section scars are produced in North America,146 and when combined with the day-to-day accumulated patient traumas, they represent a large and formidable pool of patients with stress and pain within the female population [147]. This may help to explain the causation of symptoms for millions of chronic pain sufferers.

A C-section scar has the potential to negatively impact the body leading to sexual dysfunction, women's health issues, and chronic pain even years after the surgery. The scar affects the fascia, structural and muscular components of the body and interrupts the electrical, neurological, and energetic flow within the body. A scar alone can produce cellular imbalance at the local tissue site that can upregulate the nervous system causing or feeding the chronic pain cycle [148-149]. Scars relate to abdominal fascia connections with the sternum and the pubis and lead to postural problems, back pain, and dysfunctions in walking [150-152]. It is suggested in the literature that DC microcurrent mimics human bio-cellular communications, enhancing autonomic nervous system regulation and the production of beta-endorphins, resulting in body-wide therapeutic benefits [139,140,142,153]. These biochemical processes may provide a plausible explanation for the improved pain modulation overtime after concentrated DC microcurrent is applied and is an area where future research is required. We have previously reported, in several published studies, reduction in pain and salivary cortisol with improvements in autonomic nervous system functionality in patients using MPS [139, 140, 142]. The consistency of chronic pain improvements with MPS to C-section scars suggests there may be a strong relationship between chronic pain symptomology and C- section scars throughout the body. The apparent systemic influence of C-section scars on chronic pain within this data collection is even more impressive as approximately only 10% of the pain reported by patients was localized to the abdomen and area of the scar, suggesting C-sections may play a significant catalyst role in the current chronic pain crisis throughout the USA.

We have further impressive evidence from an MPS related ultrasound analysis (unpublished data). Figures 1 and 2 below show, in two patients, the dramatic reduction in fibrous tissue and web-like fascia with scar adhesions. The first was a patient with a single treatment of a scar using a 15 Mhz convex MSK diagnostic ultrasound on a three-year-old scar (Figure 1). The patient had multiple symptoms of arthritis pain of three years duration. The MPS treatment was applied on one occasion bi-laterally along the length of the abdominal scar. Evaluations entailed a baseline Visual Analogue Score (VAS) pain scale assessment, which was repeated after an electro-therapy treatment. There was a marked reduction in pain score and the US findings undertaken pre- and post-treatment. There was also a marked improvement in long standing symptoms of joint and back pain (distant from the c-section scar) in a woman with a C-section scar similarly treated (Figure 2).

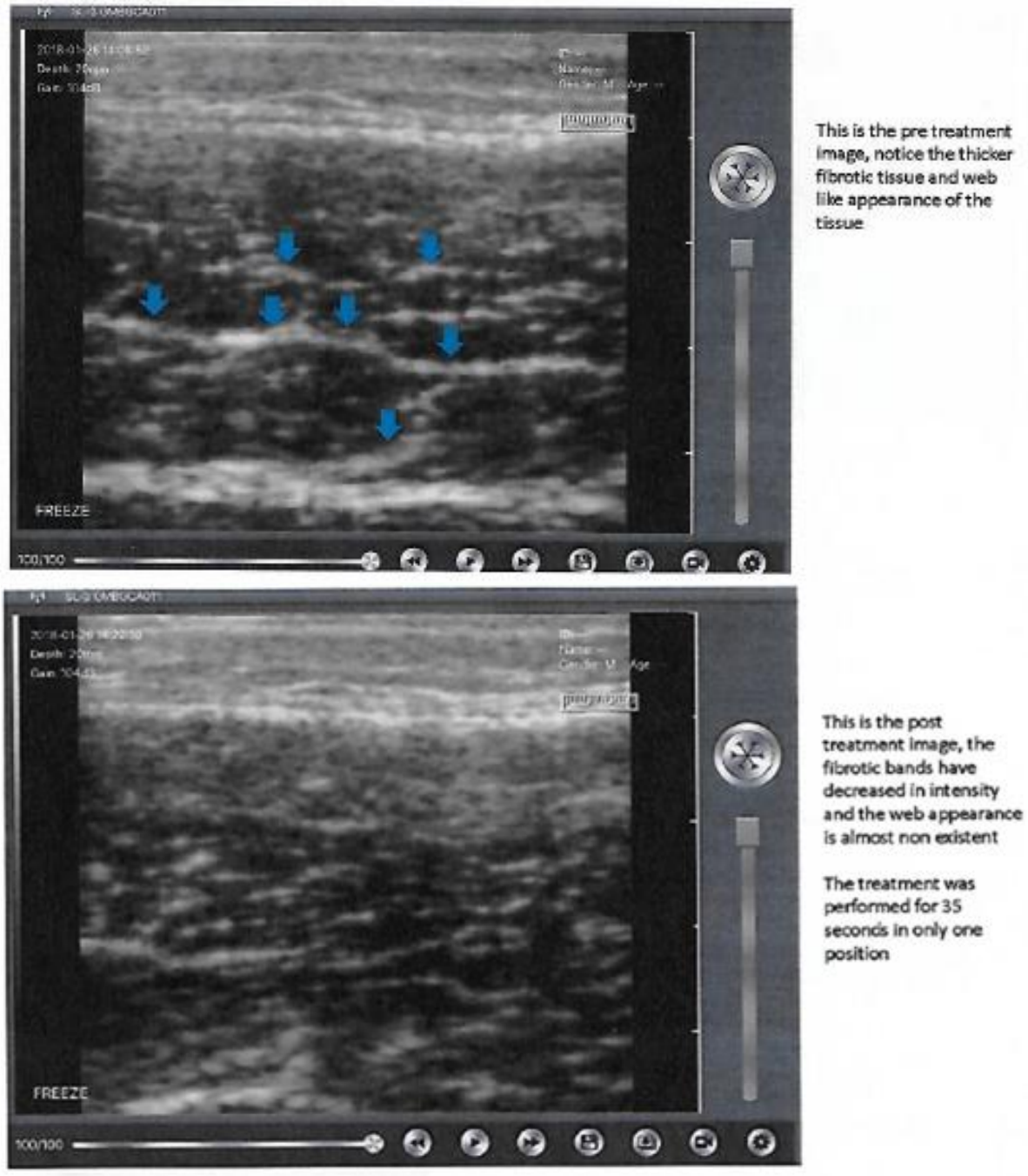

Figure 1. MPS scar release protocol entailed simultaneous application of two Dolphin Neurostim devices, one each side (lateral) of the scars [154]. This is an FDA-approved device which apply low frequency, concentrated, microcurrent stimulation for the relief of chronic pain and stress. MPS application time was 30-35 seconds per point at approximate one-quarter (1/4) inch intervals along the length of C-section scars.

Polarity of application is important, as on one side of the scar, the device is set to negative pole (-) and on the other side of scar, the second device is set to a positive-negative pole (+/-). The intent of this methodology is to push a negatively charged current back and forth through a positively charged (oriented) scar tissue.

These observations on pain relief from MPS treatment ushers in a new era of medicine that goes beyond isolative, mechanistic approach; it is imperative to include the whole body in terms of both diagnosis and treatment and have a more functional approach to patient care – something that proponents of holistic or vitalistic medicine have been saying for a long time.

symptoms both locally around the surgical site and, more importantly, distant effects related to sympathetic overdrive, mainly through fascial/ fibrotic nerve stimulation. As for the fetus, the evidence of potential problems related to adverse microbiome development as a result of a C-section is compelling and needs greater recognition – medical practitioners need to be cognizant of this

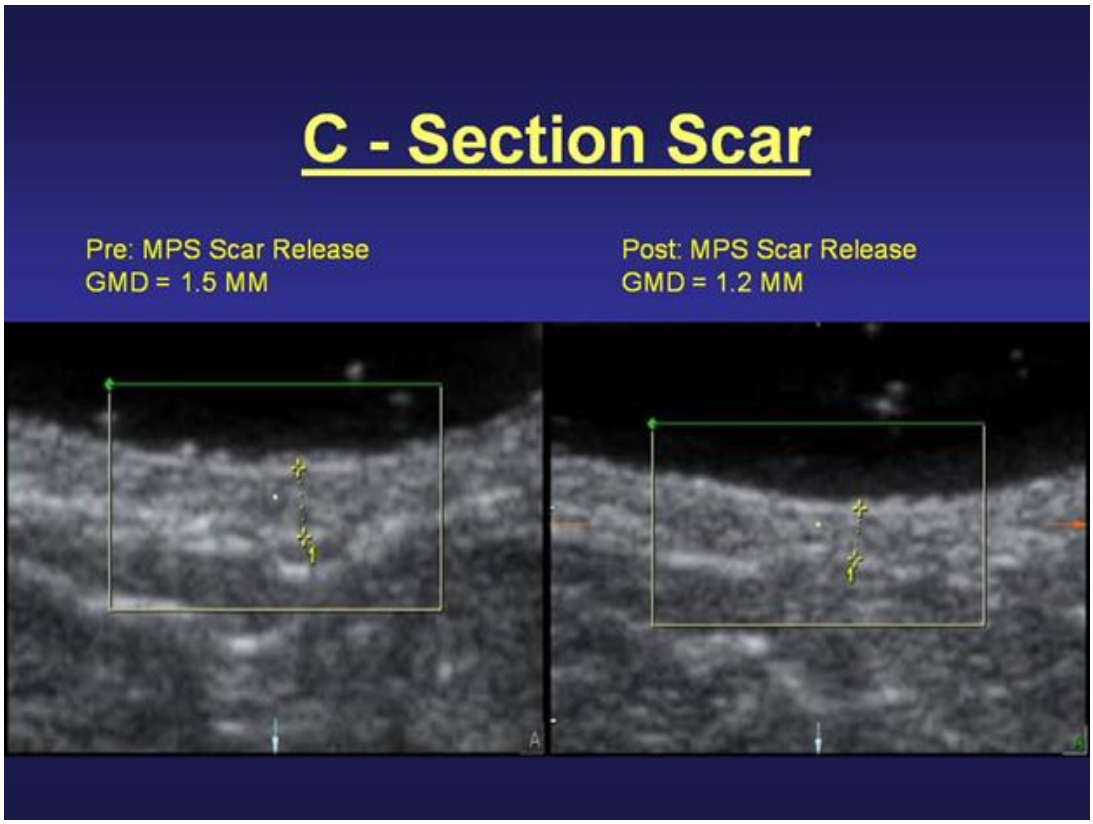

Figure 2. Pre and post ultrasound pictures of a C-section scar after a single treatment. Details of application are as per Figure 1.

D. Overall Conclusions This review clearly demonstrates the dramatic impact of a C-section on the morbidity for both mother and child. For the mother, it results in local and distant symptoms and we discuss the pathophysiological basis for the outcomes. The overuse of C-sections cannot be justified, and the entire practice must be reviewed to stem the rising use of this procedure. Where-ever possible a delivery should happen in a home friendly environment, which is conducive to good health for mother and child. This becomes a political and a general health issue and requires the population to be re-educated on the merits of vaginal deliveries and the poorer outcomes for mother and child related to unnecessary C-sections. Hospital-based vaginal deliveries and the use of C-sections have not improved the outcomes and the data shows millions of women who suffer

development and use it to inform themselves and the mother in choosing C-section delivery for non-medical reasons.

Our study data [154] adds further scientific evidence of how ill-health from one system can impact other supposedly unrelated and distant areas of 'symptoms and disease'. MPS scar release therapy impacts on distant locations of pain; this challenges the traditionally held concepts of diseases and its pathophysiology and leads to the treatment of symptoms only. Applying this new philosophy, abdominal C-section scars may now be viewed as significant systemic contributors to pain dysfunction throughout the entire body.

Disclosure Conflict of Interest All the authors whose names are listed in this study have an educational association with the sponsoring company Dolphin Neurostim; RG is an advisory consultant and KA receives honorariums and costs for teaching services.

This review did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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