Thesis

Biopsychosocial Effects of Radon Thermal Therapy in a Fibromyalgia Patient: A Case Report

Submitted by

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Graz, 02.07.25

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Graz, 02.07.25 Viktoria Wernig m.p.

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Zusammenfassung in Deutsch

Zielsetzung

Diese Fallstudie analysiert die kurz- und langfristigen biopsychosozialen Effekte der Radonthermaltherapie auf Schmerzen bei einer 49-jährigen Patientin mit Fibromyalgie, die acht Sitzungen im Gasteiner Heilstollen durchlief.

Methoden

Basierend auf den CARE-Richtlinien wurden eine Anamnese, validierte Fragebögen, wie der Fibromyalgia Impact Questionnaire (FIQ) und der Widespread Pain Index (WPI), sowie ein strukturiertes Interview durchgeführt, um Symptomveränderungen und relevante Faktoren, beispielsweise die Wirkung auf Muskelschmerzen, Parästhesien, morgendliche Steifheit und emotionale Entlastung durch die psychosoziale Unterstützung, zu erfassen. Die Literaturrecherche stützte sich auf „PubMed“, „Google Scholar“ und die Universitätsbibliothek der Medizinischen Universität Graz. Das Interview mit Fokus auf die biopsychosozialen Aspekte der Niedrigdosis-Radonthermaltherapie, wurde über WebEx durchgeführt und alle Daten in einer Sitzung erhoben.

Ergebnisse

Signifikante Verbesserungen der physischen und psychischen Symptome wurden dokumentiert. Die Patientin berichtete über eine Reduktion der Muskelschmerzen, Gelenkschwellungen und Parästhesien, insbesondere im linken Arm. Erste Verbesserungen wurden bereits nach der ersten Sitzung festgestellt, während die morgendliche Steifheit und Verspannungen im Verlauf der Therapie weiter nachließen. Die Patientin führte dies auf die regulierende Wirkung der Therapie auf das autonome Nervensystem zurück. Darüber hinaus trugen das unterstützende therapeutische Umfeld und der Austausch mit anderen Patient:innen zur emotionalen Entlastung bei.

Schlussfolgerung

Die Radonthermaltherapie zeigt Potenzial als integrativer Behandlungsansatz, indem sie physische und psychosoziale Vorteile kombiniert, und könnte eine wertvolle Ergänzung im Management von Fibromyalgie darstellen. Zukünftige Studien sollten die zugrunde

liegenden Mechanismen weiter erforschen und die Langzeiteffekte dieser Therapie evaluieren, um ihre Rolle in der Schmerztherapie zu optimieren.

Abstract in English

Objectives

This case report investigates the short- and long-term biopsychosocial effects of radon thermal therapy on pain-perception in a 49-year-old patient with fibromyalgia, who underwent eight sessions in the Gastein Healing Gallery.

Methods

Based on CARE guidelines, this case report included a medical history, validated questionnaires such as the Fibromyalgia Impact Questionnaire (FIQ) and the Widespread Pain Index (WPI), and a structured interview to assess symptom changes and relevant factors, such as the effects on muscle pain, paraesthesia, morning stiffness, and emotional relief through psychosocial support. A literature review was conducted using "PubMed," "Google Scholar," and the library of the Medical University of Graz. The interview was conducted via WebEx, with all data collected in a single session, focusing on the biopsychosocial aspects of low-dose radon therapy.

Results

Significant improvements in physical and psychological symptoms were documented. The patient reported reductions in muscle pain, joint swelling, and paraesthesia, particularly in her left arm. Initial improvements were noted after the first session, with continued reductions in morning stiffness and muscle tension throughout the therapy. The patient attributed these changes to the therapy’s regulating effects on the autonomic nervous system. Additionally, the supportive therapeutic environment and interaction with other patients contributed to emotional relief and reduced feelings of isolation.

Conclusion

Radon thermal therapy shows potential as an integrative treatment approach by combining physical and psychosocial benefits, making it a valuable addition to the management of fibromyalgia. Future studies should explore the underlying mechanisms and evaluate the long-term effects of this therapy to optimize its role in chronic pain management.

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Abbreviations

ACTH	Adrenocorticotropin
ACR	American College of Rheumatology
AT	Aquatic therapy
CARE	Case Report
CBT	Cognitive behavioural therapy
CFS	Chronic fatigue syndrome
CNS	Central nervous system
COMT	Catechol-O-Methyl-Transferase
CRP	C-reactive protein
DHEAS	Dehydroepiandrosterone Sulfate
EIA	Enzyme Immunoassay
EMDR	Eye Movement Desensitization and Reprocessing
E2	Estradiol
FIQ	Fibromyalgia Impact Questionnaire
FMS	Fibromyalgia Syndrome
FSH	Follicle-Stimulating Hormone
fT3	Free T3
fT4	Free T4
HPA	hypothalamic-pituitary-adrenal
IgA	Immunoglobulin A
IgG	Immunoglobulin G
IL-1	Interleukin-1
IL-6	Interleukin-6
IgM	Immunoglobulin M
LDR	Low-dose radon therapy
LH	Luteinizing Hormone
LNT	linear no-threshold
LTB4	Leukotriene B4

MCS	Multiple Chemical Sensitivity
ME	myalgic encephalomyelitis
miRNA	Micro ribonucleic acid
MPS	Myofascial Pain Syndrome
MRI	magnetic resonance imaging
MS	multiple sclerosis
NSAID	Non-steroidal anti-inflammatory drug
PGE2	Prostaglandin E2
PMR	Progressive Muscle Relaxation
PTSD	post-traumatic stress disorder
Q10	CoQ10
REM	Rapid eye movement
RMDs	Rheumatic musculoskeletal diseases
ROS	reactive oxygen species
SE	Somatic Experiencing
SFN	Small Fiber Neuropathy
SHBG	Sex Hormone-Binding Globulin
SS	Symptom Severity
TNF-α	Tumor Necrosis Factor-alpha
TSH	Thyroid-Stimulating Hormone
U/ml	Units per milliliter
WPI	Widespread Pain Index

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1. Introduction

1.1 Characteristics of Fibromyalgia Syndrome

Fibromyalgia, along with osteoarthritis, rheumatoid arthritis, ankylosing spondylitis and psoriatic arthritis, belongs to the group of rheumatic musculoskeletal diseases (RMDs). RMDs are a broad category encompassing various conditions that impact the musculoskeletal system, including joints, tendons, muscles, ligaments, and bones (1). Fibromyalgia syndrome (FMS) is a rheumatic condition characterized by heightened sensitivity to pain, especially in specific areas called tender points, disrupted sleep patterns, fatigue, joint stiffness, and tenderness in muscles and tendons. Individuals with this disease typically exhibit widespread musculoskeletal discomfort and experience additional issues such as sleep disturbances, stiffness, fatigue, and psychological distress (2). Those diagnosed with this condition are also at greater risk of suffering from depression and depressive symptoms; this may be linked to the physical symptoms that interfere with everyday functioning (3). There are also several functional symptoms like headache, migraine, changing or variable bowel habits, diffuse abdominal pain and a higher probability of urinary tract infections (4). The condition's cause involves multiple complex factors and isn't entirely understood (5).

1.2 Global Prevalence

FMS is affecting approximately 2.64% of the population in Europe, 2.41% in America, and 1.62% in parts of Asia (6). In Italy, around 2% of the total population is affected, with over 90% of those suffering from this condition being women (4). In Germany, Sauer et al., (2011) found the prevalence of fibromyalgia measured in the general population to be around 0.45%, with a percentage distribution of 0.4% for women and 0.05% for men. As Wolfe F et al. (8), described, the prevalence of fibromyalgia in Germany is around 2.1%. Prevalence percentages vary across countries due to different determination methods, age group inclusions, and sociocultural differences (5,6). This condition seems to occur more frequently in rural areas than in urban ones (5).

1.3 Pathophysiology of FMS

FMS is a multifaceted condition that results from the interaction of genetic predispositions, environmental influences, and physiological dysregulation. The following chapters outline what is known about the pathophysiology of FMS.

1.3.1 Genetic and Epigenetic Factors

Genetic predisposition plays a significant role, with heritability estimated at 50%. Variants in genes related to neurotransmitter regulation, pain sensitivity, and immune function, such as SLC64A4, TRPV2, and Catechol-O-Methyl-Transferase (COMT), are implicated. Epigenetic modifications, including DNA hypomethylation in genes associated with stress response and neuronal function, suggest that environmental factors like trauma or infections can influence gene expression, further contributing to FMS onset (9,10).

1.3.2 Environmental and Emotional Triggers

Environmental factors, such as trauma, chronic stress, and infections, act as catalysts in genetically predisposed individuals (11,12). Early-life adversity, including childhood abuse or neglect, has been linked to long-term changes in nociceptive pathways and increased susceptibility to FMS. A key feature is central sensitization, wherein the central nervous system (CNS) exhibits amplified pain responses due to heightened activity in ascending pain pathways and impaired descending inhibitory controls. This dysfunction leads to hyperalgesia (heightened pain from painful stimuli) and allodynia (pain from non-painful stimuli) (9,11,13). Dysfunction of the hypothalamic-pituitary-adrenal (HPA) axis, resulting in impaired cortisol secretion, further heightens pain sensitivity and stress reactivity (11,14,15).

Furthermore, a dysfunctional vagal tone reduces the parasympathetic control, leading to an overactive sympathetic nervous system, which elevates inflammation and pain sensitivity in FMS (15).

1.3.3 Immune System Dysfunction

Immune dysregulation in FMS is evident with increased levels of inflammatory cytokines such as TNF-α (Tumor Necrosis Factor-alpha) and IL-6 (Interleukin-6). Altered immune cell function, including reduced B-cell counts and aberrant monocyte activity, amplifies inflammation and pain sensitivity (10). Neuroinflammatory processes involving mast cells, T-lymphocytes, and other mediators also contribute to peripheral symptoms like swelling and skin discoloration, linking immune responses to the overall pain experience (16). Chronic stress and the resulting changes in cortisol levels can also sensitize peripheral nociceptors and promote the release of inflammatory cytokine (15).

While acute stress typically increases cortisol, chronic stress can lead to decreased cortisol levels by dysregulating the HPA axis, as seen in patients with stress-related disorders such as FMS, chronic fatigue syndrome (CFS), and post-traumatic stress disorder (PTSD). Research suggests that chronic activation of the HPA axis eventually leads to an adaptive reduction in cortisol production, contributing to widespread pain and fatigue in FMS patients (17).

1.3.4 Oxidative Stress and Mitochondrial Dysfunction

Oxidative stress is another key factor in FMS. Elevated reactive oxygen species (ROS) and reduced antioxidant defences disrupt mitochondrial function and energy metabolism, exacerbating pain and fatigue. Antioxidant therapies, such as co-enzyme Q10 (CoQ10) supplementation, have shown some potential, although further research is needed to confirm their efficacy. These findings underscore the role of oxidative stress in peripheral and central mechanisms of FMS (10,11,16).

1.3.5 Neurotransmitter Dysregulation

Alterations in neurotransmitter systems, including serotonin, norepinephrine, and dopamine, significantly impact pain perception and mood regulation in FMS. These imbalances contribute to heightened sensitivity to pain and associated symptoms like

fatigue and depression. Elevated levels of substance P and glutamate in cerebrospinal fluid exacerbate central sensitization and chronic pain mechanisms (10,11).

1.4 Correlations with Other Conditions and Comorbidities

Due to the complexity of symptoms, overlapping clinical presentations with other conditions, and the current lack of specific biomarkers or diagnostic tests for FMS (18), achieving an accurate diagnosis remains critical and challenging.

1.4.1 Neurological and Musculoskeletal Disorders

Conditions like peripheral neuropathy and small fiber neuropathy (SFN) have overlapping symptoms with FMS, such as widespread pain, fatigue, and autonomic dysfunction (18,19).

Peripheral neuropathy encompasses a wide range of nerve damage conditions caused by factors such as diabetes, alcohol abuse, vitamin deficiencies (B12, B1, B6), and specific medications. Its symptoms are burning pain, paraesthesia, weakness, and autonomic dysfunction and overlap significantly with those of FMS. Electrodiagnostic tests, such as nerve conduction studies or electromyography, are often required to confirm a diagnosis (19).

SFN, affecting up to 50% of FMS patients, often requires specialized diagnostic tools like skin biopsies, which are not widely available (18,19). Similarly, regional chronic myofascial pain syndromes (MPS) share many clinical features with FMS but is distinguished by localized trigger points, whereas FMS involves more generalized symptoms. Differentiating between these conditions is essential for appropriate treatment (20).

FMS also correlates with CFS and multiple chemical sensitivity (MCS). Since they share common symptoms concerning more than one organ system, people are often diagnosed with these conditions simultaneously (21).

Those diagnosed with FMS are also more likely to have a lower mental and physical health-related quality of life since the comorbidities of this disease centre around

depression, different forms of amnesia and concentration problems (4). This could be influenced by various factors like their beliefs about health, such as trust in doctors and the healthcare system, as well as their compliance and following their treatment plans (22).

1.4.2 Rheumatic and Endocrine Disorders

Early stages of rheumatic diseases, such as rheumatoid arthritis or polymyalgia rheumatica, may initially resemble FMS due to diffuse pain and fatigue before definitive symptoms like joint swelling emerge. Non-inflammatory conditions like hypermobility syndrome also overlap with FMS (19,23). Additionally, endocrine disorders like hypothyroidism or vitamin deficiencies (e.g. B12, D, magnesium) can mimic FMS, with symptoms such as fatigue and musculoskeletal pain improving significantly with adequate treatment (18,19,24).

1.4.3 Psychiatric and Overlapping Conditions

Psychiatric conditions, including depression and PTSD, can present similarly to FMS or coexist with it. The diagnostic approach often depends on the specialist consulted. Psychiatrists may diagnose somatic symptom disorders, while rheumatologists focus on musculoskeletal aspects (13). Furthermore, FMS, CFS and myalgic encephalomyelitis (ME) share overlapping symptoms, complicating differentiation. Recent research on Micro ribonucleic acid (miRNA) biomarkers shows promise for distinguishing these conditions and addressing their unique treatment needs (24). This also shows the importance of interdisciplinary collaboration in diagnosing FMS.

1.4.4 Infectious Triggers

Recent evidence suggests that infections may also act as potential triggers for the development or exacerbation of fibromyalgia syndrome (FMS). Various bacterial and viral pathogens have been associated with the onset of FMS symptoms, possibly through immune system dysregulation and persistent inflammation.

Lyme disease should be considered as a differential diagnosis for FMS, as some patients with ***Borrelia burgdorferi*** infection may present with diffuse musculoskeletal pain without objective joint swelling, closely resembling FMS. Additionally, Post-Treatment Lyme Disease Syndrome can manifest with persistent musculoskeletal pain, fatigue, and cognitive difficulties, mimicking FMS. To exclude Lyme disease as an underlying cause, serological testing for Borrelia-specific antibodies is essential, as a negative result can help rule out an active or post-infectious Borrelia-related pathology (25)

Furthermore, ***Yersinia*** infections can lead to reactive arthritis, a post-infectious inflammatory joint condition, which shares symptoms such as musculoskeletal pain and stiffness with fibromyalgia, making it an important differential diagnosis (26).
Other infectious conditions, which need to be tested in case of pain syndromes to rule out infectious arthritis are: *Chlamydia trachomatis*, *Mycoplasma pneumoniae*, *Coxsackievirus*, and *Parvovirus B19*. Serological testing is commonly used to confirm these infections, as outlined in diagnostic recommendations of our hygiene department at Medical University of Graz (27).
Chlamydia trachomatis is the most common bacterial cause of reactive arthritis in Western countries. However, only about 1–3% of people with a urogenital *C. trachomatis* infection develop the condition. The bacteria can spread through the bloodstream and persist in joint cells, leading to ongoing chronic inflammation (28).

Mycoplasma pneumoniae can cause complications beyond the respiratory system in approximately 25% of cases. Joint-related symptoms occur in around 14% of infected individuals (29).

Parvovirus B19 can cause joint pain, swelling, and skin rash, sometimes resembling autoimmune diseases. The condition often leads to symmetric joint inflammation, mainly affecting the hands, wrists, knees, and ankles. Although symptoms usually resolve on their own, they may last for several weeks (30).

1.4.5 Challenges in Over- and Under-Diagnosis

FMS is frequently underdiagnosed due to misconceptions about its existence or the reluctance of healthcare providers to use the FMS label, often opting for diagnoses like somatoform pain disorder or masked depression instead (13). Conversely, over-diagnosis may occur when FMS is diagnosed in patients with undetected conditions like SFN, vitamin deficiencies, or early-stage rheumatic diseases (18,19,24). This highlights the need for thorough differential diagnosis to avoid unnecessary or inappropriate treatment.

1.5 Social and Economic Consequences

FMS significantly impacts individuals' quality of life, often leading to disability, isolation, stigma and concern about long-term prognosis (6). Individuals affected by this condition typically require more frequent medical visits and have an increased likelihood of qualifying for disability pensions (4).

1.6 Gender Disparity in Diagnosis

FMS syndrome is predominantly observed in women, with estimates ranging from 80% to 96%. It can be said that men are often underdiagnosed, and therefore, research has primarily focused on women. Differences between the sexes can be found in the way they perceive pain. For example, women feel pain more intensely and are at a higher risk of chronification of the pain compared to men (6).

In the context of FMS, sleep disturbances also show sex-specific differences. Sleep breathing issues were more common in male FMS patients than in females. Pain for men, fatigue for women, and functional problems were linked to reduced sleep quality. In women, total sleep time and REM sleep were also related to their emotional state (31). Imbalances in prevalence and diagnosis between genders are also attributed to different social stigmas and cultural factors in Western societies, in which men are less likely to seek specialised care for chronic pain symptoms and are less likely to speak up about vague symptoms, thus hindering accurate diagnosis (6).

1.7 Treatment Approaches

Due to the complexity and many facets, it is hard to standardise the treatment. Instead, a thorough, holistic, and multidisciplinary management should be followed. The current treatment emphasises relieving the main symptoms and preventing a new flare-up. In most cases, the symptoms of FMS can be effectively managed through lifestyle adjustments and primary healthcare interventions (2).
The multidisciplinary approach is especially important since pain intensity is not the primary factor influencing the quality of life in fibromyalgia patients. Instead, psychological aspects, such as coping mechanisms and emotional well-being, play a more significant role (32).

First introduced by George Engel in his landmark 1977 paper, the biopsychosocial model integrates biological, psychological, and social factors into understanding and managing illnesses. Engel's framework highlights that diseases result from the dynamic interplay of these dimensions and cannot be fully understood or effectively treated by addressing only one aspect (33). Viewing the patient as a whole is essential rather than focusing solely on biological factors. For this reason, the biopsychosocial model should replace the reductionist biomedical approach, which considers only biological aspects of disease.

This model is especially relevant for chronic illnesses such as FMS. By considering the interconnected nature of biological, psychological, and social factors, the biopsychosocial approach empowers patients to manage their conditions actively. It also enhances outcomes through multidisciplinary care and stronger patient-doctor relationships (33).

1.7.1 Pharmaceutical Treatments

A pharmaceutical treatment plan mainly consists of non-steroidal anti-inflammatory drugs (NSAIDs) and paracetamol (1), but it also includes antidepressants, anticonvulsants, and muscle relaxants (2). It is important to remember that these medications can cause various side effects, such as gastrointestinal, kidney, heart, and lung problems, which can range in severity and even be life-threatening. These side effects may not only worsen the patient's

symptoms but also take a toll on the healthcare system, resulting in more hospital admissions than necessary (1).

1.7.2 Non-Pharmaceutical Treatments

In terms of non-medication treatment, exercise is crucial for managing FMS (2,34). People who have been diagnosed with FMS often show an increased intolerance to physical activity, which can lead to an inactive lifestyle. This makes the existing symptoms worse and increases the likelihood of additional diseases (34).
Alternative or complementary non-pharmacological treatments that complement traditional approaches can reduce reliance on pharmaceuticals and lower the risk of possible side effects (1). Previous studies have found a positive link between physical fitness psychological well-being in individuals with fibromyalgia. Specifically, higher levels of physical fitness have been associated with lower levels of depression and anxiety, as well as greater life satisfaction in women with FMS (35).

Psychological therapies and Mind-body therapies are also highly effective in managing FMS. These therapies aim to change the pain perception, reduce emotional distress, and highlight the importance of overall quality of life by reshaping negative thoughts, and behaviours related to pain. (36)
Another non-pharmacological treatment could be balneotherapy. It is well-tolerated and an effective complementary treatment for various conditions, especially those associated with chronic inflammation (37). In the following, non pharmacological interventions will be described in more detail.

1.7.2.1 Exercise

1.7.2.1.1 Aquatic exercise

Aquatic therapy (AT) is a form of physiotherapy involving exercises in water to enhance mobility, reduce pain, and improve overall function. A study comparing AT and land-based therapy in women with FMS found that both treatments were beneficial, but AT provided greater long-term improvements (38).

Specifically, after six weeks of follow-up, patients in the AT group reported greater pain reduction and improved sleep quality than those undergoing land-based therapy. These findings suggest that aquatic exercise should be included as part of physical therapy for individuals with FMS, particularly for those who struggle with weight-bearing exercises on land (39).

1.7.2.1.2 Tai chi

Tai Chi, a traditional Chinese mind-body exercise, combines slow, controlled movements with deep breathing and relaxation techniques, promoting both physical and mental well-being (40).
Research has shown that participants practicing Tai Chi experienced significant improvements in FMS symptoms, including pain reduction, improved sleep quality, reduced depression, and enhanced quality of life (41).

Notably, the benefits of Tai Chi persisted, exceeding the effects commonly reported for standard exercise and pharmacological treatments (40). Given these positive outcomes, Tai Ji Quan (a form of Tai Chi) led by a trained physiotherapist should be considered a beneficial rehabilitation method for FMS patients (42).

1.7.2.1.3 Yoga

Yoga has been extensively researched as a non-medication approach for FMS, as it integrates physical movements, breathing techniques, meditation, and coping mechanisms. Studies have shown that yoga programs effectively alleviate FMS symptoms and enhance overall function (2,41).
One study found that participants practicing yoga for 120 minutes per week under supervision and independently five to seven times per week for eight weeks reported notable improvements in pain management and physical function. Another study focusing on yoga breathing techniques combined with range-of-motion training revealed that after four weeks of regular practice, participants experienced enhanced quality of life, reduced global pain, and decreased dyspnoea, compared to a non-exercising control group (41).

1.7.2.1.4 Strength training

Strength and resistance training have been extensively studied for their effectiveness in managing FMS symptoms. Research has shown that muscle stretching and resistance training provide significant benefits, although their effects vary. Muscle stretching exercises are particularly effective in improving overall quality of life, especially by enhancing physical function and reducing pain. In contrast, resistance training has been most beneficial for reducing depression symptoms, while also contributing to improvements in energy levels, social interactions, and mental well-being (43). Furthermore, a review of multiple studies supports the positive effects of moderate- to high-intensity resistance training, demonstrating that it enhances physical function, reduces pain and tenderness, and improves muscle strength in women with fibromyalgia (44).

1.7.2.2 Psychotherapy

Psychological therapies, including cognitive behavioural therapy (CBT), relaxation techniques and patient education, are highly effective in managing FMS. These therapies aim to change pain perception, reduce emotional distress, and highlight the importance of overall quality of life by reshaping negative thoughts and behaviours related to pain.

CBT is the most researched form of psychotherapy for FM as part of a multidisciplinary approach. Patients in this kind of psychotherapy have been shown to improve coping strategies and pain behaviour, which helps reduce overall pain intensity and alleviate symptoms of depression and anxiety (36,45). Studies have demonstrated that CBT significantly reduces sleep disturbances in FMS patients, regardless of gender (46).

Additionally, Eye Movement Desensitization and Reprocessing (EMDR) therapy has been researched as a treatment for FMS, particularly in patients with a history of trauma. Studies suggest that EMDR alleviates emotional distress, reshapes negative pain-related beliefs, and lowers physiological arousal, contributing to symptom relief in FMS patients (47).

1.7.2.2.1 Body psychotherapy

Mind-body therapies, such as yoga or tai chi have shown great potential in managing FMS, particularly symptoms like pain and fatigue. Studies comparing these mind-body therapies to control groups consistently demonstrated significant pain reductions post-intervention (48).

Among the various mind-body approaches, one particularly relevant form of body-based psychotherapy is Somatic Experiencing (SE). SE is a therapeutic approach that addresses trauma by focusing on bodily sensations, including interoceptive, proprioceptive and kinesthetic experiences. SE aims to restore balance in the body's stress response system, including physical and emotional reactions. SE serves as an adjunct to cognitive and exposure therapies and has similarities to other somatic practices, such as meditation, to support healing (49).

The goal is to help individuals gradually tolerate and integrate trauma-related sensations, reducing arousal and facilitating emotional and physical resolution. SE does not require re-living the traumatic event but encourages creating new positive physical experiences to counter trauma. Initially designed for trauma, SE has also been effective in treating conditions such as anxiety, depression, and chronic pain by improving the body's self-regulation and reducing stress (50).

Considering the significant impact of psychological factors like anxiety, depression, and coping on the health-related quality of life of FM patients, it is essential to incorporate therapeutic approaches that address these aspects (51).

1.7.3 Balneotherapy

1.7.3.1 Historical Background and Modern Applications

Balneotherapy, derived from the Latin word "*balneum*" (bath), refers to the therapeutic use of natural mineral waters, mud, and thermal springs for health and wellness purposes. This practice has ancient origins, dating back to the Greeks and Romans, who recognized the healing properties of water and established elaborate bathhouses. Over time, balneotherapy has evolved, integrating scientific approaches while maintaining its traditional foundations. It encompasses various treatments, including hydrotherapy, peloid therapy (mud therapy), and inhalation therapy, often applied in specialized health resorts or spa facilities. The

minerals present in thermal and mineral waters, such as sulfur, magnesium, and calcium, are believed to have beneficial effects on musculoskeletal disorders, dermatological conditions, and respiratory ailments. Today, balneotherapy is widely practiced across Europe, particularly in countries like Germany, Hungary, and France, where it is often integrated into medical and rehabilitation programs (52).

1.7.3.2 Balneotherapy in Chronic Pain and Fibromyalgia

In modern healthcare, balneotherapy continues to gain recognition for its potential in managing chronic pain, arthritis, and stress-related conditions. Clinical studies have demonstrated its efficacy in improving circulation, reducing inflammation, and enhancing overall well-being. The warm temperatures and mineral-rich composition of therapeutic waters contribute to muscle relaxation and joint mobility, making it a valuable complementary treatment. Moreover, the psychological benefits of a spa environment, including relaxation and stress reduction, play a crucial role in holistic healing (52). Systematic reviews and meta-analyses have demonstrated that balneotherapy significantly improves the quality of life and reduces pain intensity in FMS patients, with effects lasting up to six months (53,54).

Balneotherapy has also proven effective in alleviating FMS by reducing inflammation-related pain and lowering levels of inflammatory mediators such as IL-1 (interleukin-1), PGE2 (prostaglandin E2), and LTB4 (leukotriene B4), which are linked to heightened pain sensitivity and chronic pain mechanisms often experienced in FMS (55,56). Furthermore, it has been shown to relieve symptoms of osteoarthritis by modifying plasma levels of adipocytokines like leptin and adiponectin, which regulate cartilage metabolism and inflammation, potentially improving pain and mobility in affected joints (57). Reductions in C-reactive protein (CRP) and improved antioxidant status during balneotherapy further contribute to managing chronic pain and inflammation commonly observed in FMS (58).

In addition to its anti-inflammatory properties, balneotherapy has been shown to increase circulating opioid peptides, providing pain relief and decreasing overall muscle tone. Its

ability to promote diuresis and sodium excretion may also reduce joint swelling and alleviate pain (59).
A meta-analysis by Langhorst et al. found balneotherapy for FMS to be safe, with rare side effects, especially compared to the significant adverse effects often associated with pharmacological treatments (60). This further demonstrates the value of spa therapy as a complementary treatment option.

1.7.3.3 Radon Therapy

For decades, low-dose radon therapy (LDR), which involves applying small amounts of the noble gas 222Rn, has been proven helpful in treating various inflammatory and non-inflammatory musculoskeletal diseases (61). Radon is absorbed into the body through breathing or the skin, especially when combined with heat. Most of the radon is then released through exhaling, while the small amount that stays in the body affects organs and tissues through its radioactive decay and emission of alpha particles (62). This treatment is particularly popular in various medical spas across Germany, Austria, Poland, the Czech Republic, and many more (61).

1.7.3.1 Bad Gastein Healing Gallery

Principles of using radiation and heat are also applied in the Bad Gastein Healing Gallery, a former gold mine situated 1270 m above sea level. The therapy facility comprises five levels, each with varying temperature and humidity conditions, ranging from 37°C with 75% humidity at Station I to 41.5°C with 100% humidity at Station IV. Patients are transported approximately two kilometres into the mountain via a special train and typically spend about 60 minutes in the therapy area, followed by a 30-minute rest period in designated relaxation rooms (63).
The radon particles cause an alpha radiation of 44 kBq/m3 in the therapy area, which leads to air ionisation (64). For comparison, this radiation exposure is significantly lower than that experienced during a transatlantic flight (65). Ten sessions in the gallery result in an exposure of approximately 2 mSv, which is equivalent to the radiation dose of a two-dimensional X-ray of the lumbar spine (Dr. M. Offenbächer, personal communication, [March, 2025]). The concentration of radon exposure stays the same in all four levels of

the treatment facility, while the humidity (70–100%) and mild hyperthermia (37–41.5 C) change depending on the level (66).
The healing chambers, situated deep within the mountain at the Gasteiner Heilstollen, are shown in Figure 1, offering a glimpse into the therapeutic environment.

The LDR, along with the mild hyperthermia, has an anti-inflammatory effect (64). The results of LDR in relation to pain reduction and better functioning in day-to-day activity have shown clinical relevance in patients with RMD (1,62,67). In the study of van der Zee-Neuen, FMS patients exhibited the most significant reductions in pain severity compared to the original measurements at the 9-month follow-up mark (1). Research on balneotherapy for rheumatoid arthritis found that pain levels were similar three months after treatment, whether radon was included or not. However, at six months, the use of radon demonstrated a noticeable reduction in pain frequency (52).

Figure 1: Visual representation of the healing chambers at the Gasteiner Heilstollen. © Gasteiner Heilstollen (printed with friendly permission)

1.7.3.2 Hyperthermia: Thermal stress and biological responses

Repeated mild thermal stress, ranging from 38° to 42° C, can impact functions like differentiation, wound healing, and angiogenesis. These effects lead to substantial biological responses, resulting in an overall enhancement of the organism's health and

functionality (37). In the case of fever, hyperthermia significantly influences the immune system, strengthens the body's defence mechanisms and promotes the growth of peripheral blood mononuclear cells (68).
Mild heat exposure triggers a heat shock response, which promotes the production of specific heat shock proteins. These proteins protect cells from further damage and enhance cellular stress tolerance by improving cellular function (37).

1.7.3.3 Neuroendocrine and Immune Effects

Heat-induced stress also triggers a range of neuroendocrine responses, including the release of hormones such as ACTH, cortisol, prolactin, and growth hormone. These hormones play a role in anti-inflammatory and anti-edema effects, particularly relevant in rheumatic conditions. Spa therapies have been shown to increase beta-endorphins, which provide pain relief and reduce muscle spasms. This increase in beta-endorphins is thought to be a key factor in how individuals tolerate thermal treatments.
Additionally, thermal stimuli may encourage the skin to produce opioid peptides, potentially influencing pain thresholds and emotional states. Heat therapy also enhances immune function by improving the mobility and activity of granulocytes, while increasing the flexibility of collagen-rich tissues like tendons and joints, which can enhance range of motion. These combined effects help alleviate the pain-muscle contraction-joint dysfunction cycle typical of chronic joint disorders, leading to long-term benefits (57).

1.8 Research Gap

Despite numerous studies on the symptoms, pathophysiology, and treatment options for FMS, a significant research gap remains regarding the subjective perception and specific mechanisms of complementary therapies such as radon thermal therapy.
While the biological benefits of balneotherapy and mild hyperthermia have been described in the literature, case reports covering the specific intervention in the Gasteiner Heilstollen remain scarce and it remains uncertain whether patients attribute their symptom relief specifically to radon therapy or to other factors, such as the meditative atmosphere experienced during the treatment sessions or psychosocial peer- support during the therapy in the Gasteiner healing chambers.

This case report aims to address this research gap by investigating the effectiveness of radon thermal therapy for a patient with FMS, analysing the subjective perceptions of the treatment, and exploring potential mechanisms through a comprehensive case report and evaluation of therapy outcomes. The goal is to enhance understanding of the roles that both physiological and psychological factors play in the efficacy of this therapy.

2. Materials and Methods

2.1 Literature Search Strategy

A comprehensive search of online literature was undertaken, mainly in PubMed and Google Scholar and at the University Library of the Medical University of Graz, from 1990 to March 2025, including articles in German and English language. The following search string was used:

(("Fibromyalgia"[MeSH Terms] OR "Fibromyalgia"[Title/Abstract] OR "Fibromyalgie"[Title/Abstract]) AND ("Treatment"[Title/Abstract] OR "Therapy"[Title/Abstract] OR "Management"[Title/Abstract] OR "Balneotherapy"[Title/Abstract])) OR (("Fibromyalgie"[Title/Abstract] OR "Fibromyalgia"[Title/Abstract]) AND ("Gastein"[Title/Abstract] OR "Radon Therapy"[Title/Abstract] OR "Radon Treatment"[Title/Abstract] OR "Balneotherapy"[Title/Abstract])) OR (("Gastein"[Title/Abstract]) AND ("Treatment"[Title/Abstract] OR "Therapy"[Title/Abstract] OR "Radon"[Title/Abstract] OR "Balneotherapy"[Title/Abstract])) AND ("1990/01/01"[Date - Publication] : "2025/01/31"[Date - Publication]) AND ("humans"[MeSH Terms]) AND (lang_english[Filter] OR lang_german[Filter])

2.2 Ethical Considerations

This case report was approved by the ethics committee of the Medical University of Graz (36-307 ex 23/24). All data was collected following the ethical guidelines of the Declaration of Helsinki and national and international regulations (69).
The participant was thoroughly informed about the objectives, methods, potential benefits, and risks of creating a case report. The participant's personal information was treated confidentially and used only in anonymised form for data analysis.

2.3 CARE Guidelines

The participant was interviewed according to CARE Guidelines, focusing on comprehensive biopsychosocial history, existing medical records, and self-perceived symptom changes.

The CARE Guidelines (Case Report) are internationally recognised standards designed to improve the quality and transparency of medical case reports. They provide a structured 13-item checklist covering all relevant aspects of a case, patient information, diagnostic assessments, therapeutic interventions, and informed consent.

These guidelines were created to improve the quality of case reports and facilitate personalized patient care, allow comparisons across different healthcare systems, and provide a solid foundation for research and medical advancements (70).

2.4 Interview

The interview was conducted via WebEx (Cisco Systems, Inc., San Jose, California, USA; Version 42.6, July 2024). Before the interview, the participant was asked to sign the consent form following CARE guidelines. Subsequently, the interview followed a structured guide with documented start and end times. All data, including the interview and questionnaires, were collected during a single session. No follow-up was planned. All mentioned documents and laboratory assessments can be found in the appendix as supplementary files (see Supplementary Files 1-3).

2.5 Questionnaires

The Interview started with the "Widespread Pain Index" and "Fibromyalgia Impact Questionnaire" forms. For further details, see Appendix (Supplementary File 1 and 2).

2.5.1 Widespread Pain Index

The WPI assesses the extent of pain across 19 specific body regions (see figure 2) over the past week. Each area where pain has been experienced scores one point, with a maximum possible score of 19. This index helps quantify the variable and widespread pain

characteristics of fibromyalgia. A higher WPI score indicates more widespread pain, which, when combined with other symptom assessments, such as the SS score, helps clinicians diagnose fibromyalgia (71).

The Widespread Pain Index (WPI) was created based on the concepts first published in "*The American College of Rheumatology Preliminary Diagnostic Criteria for Fibromyalgia and Measurement of Symptom Severity*" in 2010. Along with the Symptom Severity (SS) Scale, the WPI aimed to improve the diagnosis of FMS by addressing the limitations of earlier criteria (71). These new tools were introduced to provide a more comprehensive assessment of pain and symptom severity, recognising FMS as a multifaceted condition. Previously, diagnosis relied on identifying tender points requiring widespread pain, defined as axial, left- and right-sided, and upper and lower segment pain, or at least three months and pain in 11 out of 18 specific points. This method ignored other important symptoms like fatigue and cognitive issues, significantly limiting its effectiveness (13).

2.5.2 Symptom Severity Score

The SS score rates how bad three main symptoms have been recently: fatigue, unrefreshing sleep, and cognitive difficulties**.** Each symptom is rated from zero to three, and the total score ranges from zero to 12. A higher score shows more serious and long-lasting symptoms. Doctors use this score and the WPI to correctly understand how much someone is affected and diagnose fibromyalgia (71).

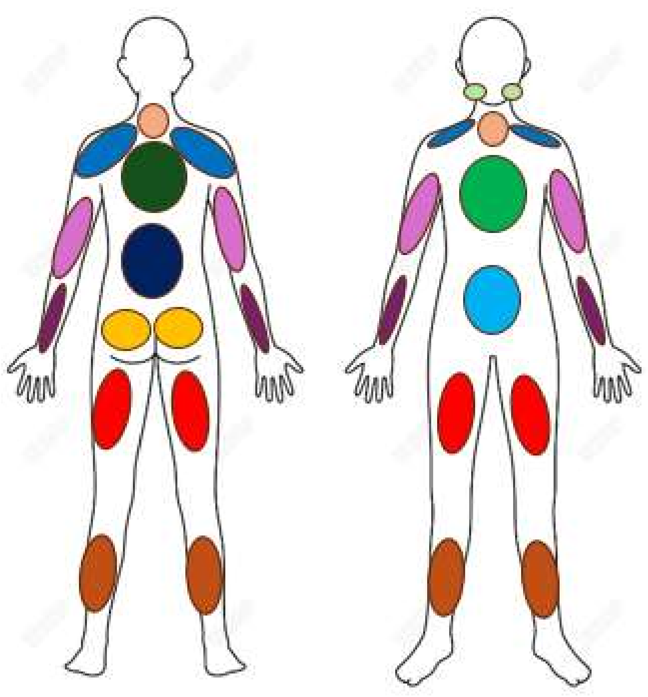

Figure 2: Painful body areas included in the Widespread Pain Index (WPI) scale from the 2010 American College of Rheumatology diagnostic criteria (71). Illustration adapted and redrawn based on Galvez-Sánchez and Reyes del Paso (13).

2.5.3 Fibromyalgia Impact Score

The Fibromyalgia Impact Questionnaire (FIQ) is a tool used to assess how FMS affects a person's daily life and functioning. It includes questions about the intensity of symptoms such as pain, fatigue, and stiffness, as well as the impact on activities like work, chores, and social activities. Scores on the FIQ range from 0 to 100, with higher scores indicating more severe impact. It helps doctors and researchers understand the overall burden of fibromyalgia on individuals and track changes over time in response to treatment. The FIQ is valuable for both diagnosis and monitoring the effectiveness of management strategies for fibromyalgia.

The FIQ is a tool used to assess how fibromyalgia affects a person's daily life and functioning. Developed in 1991 by Burckhardt, Clark and Bennett the FIQ consists of 10 items covering the intensity of symptoms such as pain, fatigue, and stiffness, as well as the impact on activities like work, chores, and social activities. The Scores range from 0 to 100, with higher scores indicating more severe impact.

The FIQ is valuable for diagnosis and monitoring of the progression of the condition, as well as the effectiveness of treatment strategies. Due to its comprehensive nature, healthcare providers can accurately assess not only the severity of symptoms but also the functional and emotional consequences of the disease (73).
The interview will use a German version of the FIQ validated by Offenbächer et al, 2000 (74).

3. Results

3.1 Patient Information

The patient described in this case report is a middle-aged woman (49 years) with a long-standing history of chronic pain and neurological symptoms. She has undergone extensive multidisciplinary assessments over several decades. Despite numerous consultations with specialists, her condition remained diagnostically elusive until recently.
She reports fluctuating sensory disturbances, including tingling, numbness, and stabbing sensations, predominantly in the extremities, which began a year before the diagnosis of FMS. These symptoms became unbearable, prompting her to seek further medical testing and actively pursue help. As a result, most specialist consultations occurred from 2022 onward, despite her experiencing chronic pain long before this time.

3.2 Clinical Findings and Diagnostic Assessments

This section outlines the diagnostic findings from the patient's history.

3.2.1 Neurological Evaluations (2024)

- Symptoms: Fluctuating sensory disturbances, primarily in the hands and feet, expanding to the arms and legs. Minimal concern for severe neurological disease.
- Findings:
  - Motor nerve conduction studies of the left median nerve showed a distal motor latency of 3.6 ms, a nerve conduction velocity of 57 m/s in the forearm, and an amplitude of 8 mV. In comparison, the left ulnar nerve exhibited a distal motor latency of 2.9 ms, suggesting a slight conduction delay in the median nerve relative to the ulnar nerve.
  - In the lower extremities, motor conduction studies of the right peroneal nerve demonstrated a distal latency of 3.6 ms, an NCV of 46 m/s in the lower leg, and 58 m/s at the fibular head, with amplitudes ranging between 5 and 4 mV. Similarly, the right tibial nerve exhibited a distal latency of 3.7 ms, an NCV of 50 m/s, and an amplitude of 14 mV.

  - Sensory conduction studies showed a maximum NCV of 53 m/s between the index finger and wrist in the left median nerve, with an amplitude of 49 μV. The right sural nerve demonstrated a conduction velocity of 42 m/s with an amplitude of 17 μV.
- Conclusion:
  - Overall, no pathological spontaneous activity was detected in electromyographic recordings, and no significant neurogenic lesions were identified. However, the slight delay in distal motor latency in the left median nerve, compared to the ulnar nerve, was suggestive of a mild left-sided carpal tunnel syndrome. There were no findings indicative of focal neurological deficits, polyneuropathy, or major nerve damage. A psychosomatic component in symptom perception was discussed due to the absence of significant neurophysiological abnormalities.

3.2.2 Internal Medicine Consultation (2024):

Findings: No significant pathological abnormalities in echocardiography, abdominal ultrasonography, or thyroid assessment. Routine bloodwork was unremarkable.

3.2.3 Radiological Imaging (2022):

Cervical Spine MRI (magnetic resonance imaging):

  - Mild deforming spondylosis and uncovertebral joint arthrosis (C3/C4 and C5/C6) without significant facet joint degeneration, disc protrusions, or myelopathy.

Lumbar Spine X-ray:

  - Minimal ventrolisthesis (L4) and chondrosis (L4/L5) with restricted motion, bilateral sacroiliac joint arthrosis, and subtle fibroostosis of the right trochanter major.

Shoulder MRI:

  - Tendinopathy of the supraspinatus tendon with mild humeral head elevation; no significant abnormalities.

3.2.4 Laboratory Assessments:

For further details, please refer to Supplementary File 3, which contains the complete laboratory values.

3.2.4.1 Immunological parameters (ANA, ANCA, ENA, dsDNA):

Autoantibodies

- ANA-Titer: 1:80
- **ANA Pattern: Speckled nucleolar (AC-9)**
- Cytoplasmic Antibodies: Negative
- ENA-Screen: 0.2 U/ml (Reference range: ≤1.0 U/ml)
- Since the ENA-Screen is negative, RNP70, U1RNP, Sm, Ro, La, Scl70, CENP, and Jo-1 antibodies are also negative.

Specific Autoantibodies

- dsDNA Antibodies: 3.3 U/ml (Reference range: ≤15.0 U/ml)
- MPO-ANCA: 1.2 U/ml (Reference range: 0.0 - 5.0 U/ml)
- PR3-ANCA: 1.4 U/ml (Reference range: 0.0 - 10.0 U/ml)
- P-ANCA (MPO-specific): Negative
- C-ANCA (PR3-specific): Negative

Medical Interpretation

- Findings: No significant ANA titer detected.
- Conclusion: No specific autoimmune findings indicative of a rheumatologic disorder.

3.2.4.2 Comprehensive bacteriological and antibody screening

Table 1 presents serological test results for various bacterial and viral pathogens, including *Borrelia burgdorferi, Yersinia, Chlamydia trachomatis, Mycoplasma pneumoniae, Coxsackievirus*, and *Parvovirus B19*. The table provides antibody types (IgG, IgA, and IgM), measured values, and corresponding reference ranges. Notably, elevated IgG levels for *Yersinia* and *Mycoplasma pneumoniae* were observed, while *Borrelia burgdorferi* IgM remained negative. These results help assess potential past or ongoing infections and immune responses.

Pathogen	**Antibody Type**	**Result [U/ml]**	**Reference Range [U/ml]**
Borrelia burgdorferi VlsE	EIA - IgG	1	3-5
Borrelia burgdorferi	EIA - IgM	Negative	-
Yersinia	**EIA - IgG**	**25**	**10-15**
Yersinia	EIA - IgA	6	10-15
Chlamydia trachomatis	EIA - IgG	7	10-15
Chlamydia trachomatis	EIA - IgA	<5	9-16
Mycoplasma pneumoniae	EIA - IgG	28	20-30
Mycoplasma pneumoniae	EIA - IgM	Negative	-
Coxsackievirus	**EIA - IgG**	**34**	**11-15**
Coxsackievirus	EIA - IgA	<4	10-15
Parvovirus B19	**EIA - IgG**	**Positive**	-
Parvovirus B19	EIA - IgM	Negative	-

Table 1: Own representation based on serological test results for various bacterial and viral pathogens values. Abbreviations used: E2 = Estradiol, EIA = Enzyme Immunoassay, IgA = Immunoglobulin A, IgG = Immunoglobulin G, IgM = Immunoglobulin M, U/ml = Units per milliliter (measurement unit used for antibody levels), VlsE = Variable major protein-like sequence, expressed (Borrelia burgdorferi antigen)

3.2.4.3 Hormone levels

23.05.24 (Blood Test - Serum)

- Cortisol: 12.7 µg/dl (Reference: Morning: 3.7 - 19.4 µg/dl, Afternoon: 2.9 - 17.3 µg/dl)
- Estradiol (E2): 22 pg/ml (Reference: Follicular: 21 - 251 pg/ml, Ovulatory: 36 - 649 pg/ml, Luteal: 21 - 312 pg/ml, Postmenopausal: 0 - 28 pg/ml, Patients with hormone therapy: 0 - 144 pg/ml)
- Follicle-Stimulating Hormone (FSH): 68.9 mIU/ml (Reference: Follicular: 3.0 - 8.1 mIU/ml, Ovulatory: 2.6 - 16.7 mIU/ml, Luteal: 1.4 - 5.5 mIU/ml, Postmenopausal: 26.7 - 133 mIU/ml)

- Luteinizing Hormone (LH): 26.2 mIU/ml (Reference: Follicular: 1.8 - 11.8 mIU/ml, Ovulatory: 7.6 - 89 mIU/ml, Luteal: 0.6 - 14 mIU/ml, Postmenopausal: 5.2 - 62 mIU/ml)
- Prolactin: 14.9 ng/ml (Reference: 5.2 - 26.5 ng/ml)
- Thyroid-Stimulating Hormone (TSH): 1.30 mIU/l (Reference: 0.2 - 3.8 mIU/l)

26.09.24 (Blood Test – Serum, in a perimenopausal, Follicular phase)

- Vitamin D3: 36 ng/ml (Reference: 30 - 100 ng/ml)
- Sex Hormone-Binding Globulin (SHBG): 115 nmol/l (Reference: Premenopausal: 15 - 123 nmol/l, Postmenopausal: 17 - 124 nmol/l)
- **Free Androgen Index: 0.6%** (Reference: Premenopausal: 0.7 - 8.7%, Postmenopausal: 0.5 - 4.7%)
- Dehydroepiandrosterone Sulfate (DHEAS): 136 µg/dl (Reference: 56 - 283 µg/dl)
- **Estradiol (E2):** 115 pg/ml (Reference: Follicular: 21 - 251 pg/ml, Ovulatory: 38 - 649 pg/ml, Luteal: 21 - 312 pg/ml, Postmenopause: 0 - 28 pg/ml, Postmenopause with hormone therapy: 0 - 144 pg/ml)
- FSH: 40.9 mIU/ml (Reference: Follicular: 3.0 - 8.1 mIU/ml, Ovulatory: 2.6 - 16.7 mIU/ml, Luteal: 1.4 - 5.5 mIU/ml, Postmenopausal: 26.7 - 133 mIU/ml)
- LH: 21.3 mIU/ml (Reference: Follicular: 1.8 - 11.8 mIU/ml, Ovulatory: 7.6 - 89 mIU/ml, Luteal: 0.6 - 14 mIU/ml, Postmenopausal: 5.2 - 62 mIU/ml)
- **Progesterone**: 0.1 ng/ml (Reference: Follicular: 0 - 0.3 ng/ml, Luteal: 1.2 - 16 ng/ml, Postmenopausal: 0 - 0.2 ng/ml)
- Prolactin: 9.1 ng/ml (Reference: 5.2 - 26.5 ng/ml)
- Testosterone: 0.20 ng/ml (Reference: Premenopausal: 0.15 - 0.50 ng/ml, Postmenopausal: 0.13 - 0.34 ng/ml)

23.05.24 (Blood Test - Serum - Aldosterone and ACTH)

- Aldosterone (Basal, Sitting): 4.5 ng/dl (Reference: 3.7 - 43.2 ng/dl)
- Renin (Basal, Sitting): 20.9 µU/ml (Reference: 5.3 - 99.1 µU/ml)
- Aldosterone/Renin Ratio: 0.2 (Reference: ≤2.4)
- Adrenocorticotropic Hormone (ACTH, Basal): 15.8 pg/ml (Reference: 10.0 - 46.0 pg/ml)

29.04.24 (Blood Test - Serum)

- TSH: 1.47 mIU/l (Reference: 0.2 - 3.8 mIU/l)
- Free T3 (fT3): 5.0 pmol/l (Reference: 3.3 - 6.5 pmol/l)
- Free T4 (fT4): 12.0 pmol/l (Reference: 10.0 - 25.0 pmol/l)
- Folic Acid: 6.3 ng/ml (Reference: 3.1 - 20.5 ng/ml)
- Vitamin B12: 282 pg/ml (Reference: 187 - 883 pg/ml)
- Vitamin D3 : 31 ng/ml (Reference: 30 - 100 ng/ml)

19.03.21 (Saliva Test - Hormone Profile)

- **Cortisol: 0.80 ng/ml (Reference: 3 - 9 ng/ml)**
- Progesterone: 50.67 pg/ml (Reference: Follicular: 30.3 - 51.3 pg/ml, Luteal: 87.3 - 544.3 pg/ml, Postmenopausal: 21.0 - 60.0 pg/ml)
- Estradiol : 1.90 pg/ml (Reference: Follicular: 0.80 - 7.70 pg/ml, Ovulatory: 3.40 - 13.90 pg/ml, Luteal: 1.76 - 4.99 pg/ml, Postmenopausal: 1.10 - 3.80 pg/ml)
- Progesterone/Estradiol Ratio: 26.67 (Reference: 30 - 50)
- Testosterone: 9.26 pg/ml (Reference: 7.7 - 39 pg/ml)
- DHEA: 117.56 pg/ml (Reference: 130 - 490 pg/ml)

A representation of the CRP value throughout the different laboratory assessments can be found in Table 2.

Date	CRP (mg/l)	Reference Range (mg/l)
22.08.22	0.8	0.0 - 5.0
29.04.24	<4.0	0.0 - 5.0
23.05.24	<4.0	0.0 - 5.0

Table 2: Own representation based on collected CRP laboratory values

3.3 Results of Questionnaires

Based on the diagnostic evaluation for FMS, the patient’s results met the three required criteria. First, the Widespread Pain Index (WPI) score of 14 exceeds the minimum threshold (≥7), and the combined severity score of Parts 2a (5 points) and 2b (3 points) totals 8, meeting the required threshold for severity (≥5 for WPI ≥7). Second, the

symptoms have persisted at this level for over three months. Third, no other medical condition accounts for the patient's pain. These findings confirm a diagnosis of fibromyalgia syndrome.

The patient has an official FMS diagnosis confirmed by a physician, and the current assessment further validates this diagnosis. The WPI score reveals the extensive nature of her pain, covering numerous painful areas. This result not only reaffirms her diagnosis but also highlights the significant burden of fibromyalgia, as individuals affected by this syndrome endure widespread, often debilitating discomfort. Such high WPI scores underscore the widespread impact on patient's quality of life and exemplify the persistent challenges faced by those with FMS.
Figure 3 shows a visual representation of all the painful areas.

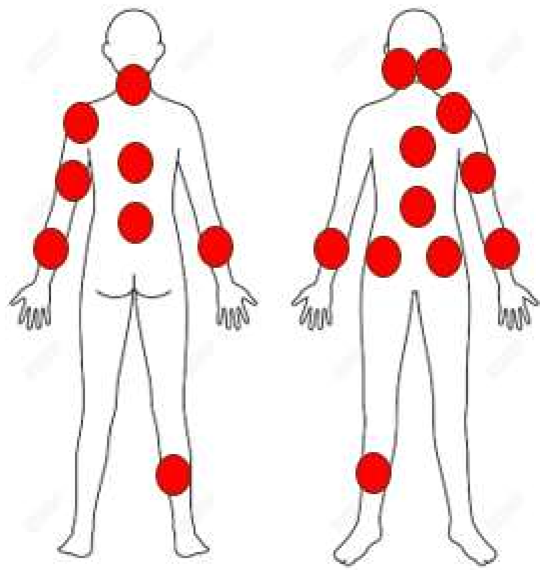

Figure 3: Painful areas of the patient associated with the Widespread pain Index.

3.4 Therapeutic Interventions

3.4.1 Bad Gastein Radon Thermal Therapy (July 2024)

The patient underwent LDR therapy in the Gastein Healing Gallery, specifically on Station 1A, which is characterized by a consistent radon concentration of approximately 44 kBq/m^3, a high-humidity environment (80–100%), and mild hyperthermia with temperatures between 37–38°C (63).

Following treatment, she reported a significant reduction in pain intensity and improvement in paresthesia of the left forearm, attributed to a possible functional thoracic outlet syndrome. A condition caused by the compression of structures in the thoracic outlet region, including the brachial plexus, subclavian artery, and subclavian vein (75). The most frequent symptoms paraesthesia and general pain in the upper extremities, head and neck area (76). She described the treatment as highly effective and expressed intent to pursue annual therapy. The full therapeutic effect is anticipated to peak six weeks post-treatment and last approximately nine months.

3.4.2 Neurological Recommendations

A pragmatic trial of 'Neuromultivit' film-coated tablets was planned for four weeks, containing 100 mg of thiamine hydrochloride (Vitamin B1), 200 mg of pyridoxine hydrochloride (Vitamin B6), and 0.2 mg of cyanocobalamin (Vitamin B12). However, the patient ultimately decided not to take the supplement, as she considered the dosage too high. Meanwhile, ferritin levels (target: 50–75 µg/L) were to be optimized to address potential involvement of iron metabolism. This was intended to be achieved through the addition of iron-rich foods.

3.5 Summary of the Interview / Patient Perspective

The patient, a 48-year-old woman diagnosed with FMS, provided an in-depth account of her experiences with the condition, emphasising its profound biopsychosocial impact. Her narrative highlighted not only the chronic pain and physical symptoms but also the emotional and social challenges associated with living with FMS.

3.5.1 Patient Information and Primary Concerns

The patient described her primary symptoms as widespread chronic pain, severe paraesthesia, and brain fog, which often left her feeling drained. She noted, *"It feels like my mind just doesn't function properly anymore. Even simple tasks sometimes feel impossible."* Sleep disturbances and emotional struggles, including feelings of frustration and isolation, further exacerbated her condition, creating a cycle that was difficult to break.

3.5.2 Relevant Past Interventions and Outcomes

Her symptoms began in her late teens when she experienced increasing psychological distress, including episodes of depression and anxiety. During this time, she became suicidal and sought treatment from a psychiatrist in private practice. She was prescribed the antidepressant Amitryptilin, but she does not recall the dosage. The medication caused significant side effects, such as hair loss, which led her to discontinue its use. Furthermore, she prefers not to provide additional details regarding her psychiatric treatment, and no medical records from that period are available. Around the same period, she also started experiencing persistent headaches and generalized muscle pain, which gradually progressed into severe and widespread pain.

The patient shared her history of trying various treatments, including physiotherapy medication (such as painkillers and antidepressants) and psychological support.
She highlighted her struggles with medications, explaining that she now avoids them completely due to severe side effects, such as gastrointestinal issues and dizziness, which occurred even at low doses. Instead, she manages her symptoms through lifestyle adjustments, moderate caffeine intake, and the use of dietary supplements, which she finds more tolerable. She limits her caffeine consumption to two cups of coffee daily, primarily to alleviate headaches.

The patient cannot recall the specific supplements she has taken, as she enjoys experimenting with different formulations and frequently changes them. She began this practice several years ago but does not remember exactly when. Rather than following a structured regimen, she finds enjoyment in trying various products from the same brand, which is described in the next paragraph. Consequently, she is unable to quantify the number of different supplements she has used over time but emphasizes that she has tried a wide range. She continues to take supplements from the same brand and frequently alters her selection.

As described, the patient prefers to take supplements exclusively from the 'Wolle' product range. Wolle is a manufacturer specializing in herbal supplements, with a focus on phytotherapy and natural ingredients. The brand's formulations commonly include herbs

traditionally associated with various physiological effects. Valerian root is used for its potential calming properties in anxiety and sleep disorders, while peppermint is associated with digestive support and relief from gastrointestinal discomfort. Juniper berries are thought to have detoxifying and diuretic effects that may support kidney function. Chamomile and sage are commonly used for their anti-inflammatory properties, with sage also being linked to oral and respiratory health. Dandelion is frequently used in the context of liver and kidney detoxification, while lavender is often incorporated for relaxation and stress relief. Additionally, ginger and cinnamon are traditionally used to support circulation and digestive function (77).

While these approaches provided some relief, they often addressed only parts of her symptoms or had temporary effects. However, she spoke positively about her experiences with relaxation therapies, especially "Somatic Experiencing”. This approach, she explained, helped her change how she viewed her body. She stated, *“I no longer see my body as something broken, but rather as something adapted to survive. Understanding why my body reacts the way it does has helped me accept it and start to reprogram myself.”* She began SE in the fall of 2023, she noted significant improvement after about three to four months, around early 2024. She continues to benefit from the therapy and plans to pursue it further, describing it as a valuable resource. She also mentioned developing a greater ability to live in the present without succumbing to fear, which she described as a significant emotional breakthrough.

3.5.3 Biopsychosocial Impact

The patient’s account underscored the profound biopsychosocial effects of FMS. She described the physical pain as deeply intertwined with her emotional well-being and social life, often feeling misunderstood by others. *“People don’t see what’s wrong with you, so they assume you’re fine. That’s one of the hardest parts—feeling like you’re constantly explaining yourself.”* The condition also strained her relationships and forced her to reduce her professional activities, further impacting her sense of self-worth.
However, her experiences with therapies like radon thermal treatment and somatic approaches demonstrated the importance of addressing all dimensions of the disease. She

emphasized the need for a more holistic view of FMS within the medical community, one that recognizes the interplay between physical, emotional, and social factors. *“Fibromyalgia isn’t just about the pain. It’s about how the pain changes your whole life—your mind, your relationships, everything. Treatments need to take that into account.”*

3.5.3.1 Psychiatric Assessment

The patient is a 48-year-old woman with a higher academic background, married, and a mother of two children. She is currently undergoing Somatic Experiencing Therapy and has previously engaged in Logotherapy, Existential Analysis, Hypnotherapy, EMDR, Family Constellations, and Behavioral Therapy. During her university years, she suffered from severe depression and required treatment from a psychiatrist for medication adjustments. She was prescribed antidepressants, but her suicidal thoughts were most severe between the ages of 23 and 25. However, she states that these thoughts are no longer present today and describes a newfound appreciation for life following her therapy.

Affectivity and Mood: The patient describes herself as generally emotionally stable and resilient, with an innate positivity and a strong sense of humour, which she uses as a coping mechanism. However, she acknowledges experiencing episodic mood fluctuations and a heightened emotional sensitivity. While she denies a direct link between her pain and current emotional well-being, she recognizes a deeper psychosomatic connection to her past. She emphasizes that feeling connected to others and being accepted as she is, significantly improves her ability to cope with pain.

Cognitive Functioning and Sleep: The patient reports chronic sleep disturbances, including difficulty falling asleep and frequent awakenings throughout the night. She describes her sleep as light and unrefreshing, often waking up feeling fatigued despite seemingly adequate sleep duration. Additionally, she experiences morning stiffness and worsened neurological symptoms upon waking, which tend to improve as the day progresses.

She finds it difficult to relax and notes that periods of physical inactivity, such as resting due to illness, worsen her discomfort. While she does not recall experiencing significant hormonal influences on her sleep, she has observed that her headaches tend to worsen around her menstrual cycle.
The patient has experienced persistent tinnitus for over 20 years, which sometimes interferes with her ability to fall asleep. She denies symptoms suggestive of sleep apnea or restless legs syndrome but frequently experiences muscle tension at night, including jaw-related discomfort.
The patient reports concentration and memory difficulties, which she finds frustrating. There are no indications of formal thought disorders, but she does describe intrusive thoughts and occasional compulsive thought patterns.

Psychosomatic and Vegetative Symptoms: She presents with chronic pain associated with fibromyalgia, including paraesthesia and musculoskeletal discomfort. Additionally, she experiences autonomic dysregulation, with symptoms such as heart palpitations, dizziness, and hypersensitivity to pain. She strongly believes that emotional stressors from her past have played a role in the development of these symptoms.

Perception and Self-Experience: The patient describes occasional depersonalization experiences, as well as moments where her surroundings feel unreal or distant. However, she does not report any hallucinations or delusions, and there is no indication of psychotic symptoms or ego disturbances.

Psychodynamic Perspective: The patient displays a high level of responsibility and self-discipline, emphasizing the need to "function" despite her physical limitations. She demonstrates a strong frustration tolerance, but admits that her humour is primarily a tool for emotional regulation. Her personal history reveals childhood stressors and family conflicts, which she suspects may have contributed to the development of her chronic pain and psychosomatic symptoms.

3.5.4 Therapeutic Interventions: Radon Thermal Therapy and Relaxation Techniques

The patient highlighted her participation in the LDR therapy at the Gastein Healing Gallery as a pivotal moment in her treatment journey. After eight sessions, she reported noticeable improvements in muscle pain and sensory disturbances, particularly in her left arm. She shared, *"By the second week, I could feel the difference in my muscle pain and even in the numbness in my arm. It's remarkable how much better it has gotten since."* Other benefits included reduced joint swelling, improved morning stiffness, and a sense of overall relaxation, which she attributed to the therapy's effects on her autonomic nervous system. She stated, *"I feel looser, calmer, and my body recovers from tension faster now."*
Beyond the physical improvements, the patient emphasized the psychological benefits of the therapy. She described the Healing Gallery as a unique and supportive environment where participants shared similar struggles. *"It was comforting to be around others who understood what I was going through. The sense of community really helped with the feelings of isolation."* Additionally, she incorporated relaxation techniques into her routine, enhancing her ability to manage stress and pain.

4. Discussion

Despite extensive research on the symptoms, pathophysiology, and treatment options for FMS, a significant gap remains in understanding the subjective perception and specific mechanisms behind complementary therapies such as radon thermal therapy. While the biological benefits of balneotherapy and mild hyperthermia have been documented in the literature, there is a lack of case reports specifically addressing the intervention in the Gasteiner Heilstollen. It remains unclear whether patients attribute their symptom relief primarily to radon therapy or to other factors, such as the meditative atmosphere experienced during treatment sessions or the psychosocial peer support within the healing chambers.

This case report aimed to address this research gap by examining the effectiveness of radon thermal therapy for a patient with FMS, analyzing the subjective treatment experience, and exploring potential mechanisms underlying symptom improvement. The study was guided by key questions: To what extent can symptom improvement be achieved by a patient with FMS following a biopsychosocial approach and treatments in the Gastein Healing Gallery? How does the patient receive the treatment? How much of the effect does the patient attribute to radon therapy, as opposed to the meditative state experienced during the one-hour tunnel session?

The results demonstrated significant symptom improvement following the LDR therapy in the Gastein Healing Gallery, particularly in pain reduction, functional mobility, and overall well-being. These findings align with previous research on the analgesic effects of balneotherapy in FMS patients (55,57,58).

Additionally, the patient's positive perception of the therapy highlights its acceptance and underscores the broader role of psychosocial factors in chronic pain management. By integrating both physiological and psychological perspectives, this case report contributes to a more comprehensive understanding of the therapeutic potential of radon therapy for FMS.

4.1 Summary of Findings

Despite an extensive workup, several laboratory findings suggest underlying contributing factors to the patient's chronic symptoms. Notably, she demonstrated serological evidence

of previous infections with *Yersinia*, *Mycoplasma pneumoniae*, *Coxsackievirus*, and *Parvovirus B19*, all of which have been implicated in chronic fatigue, post-infectious arthritis, and persistent inflammatory responses (26,29,30,78). Additionally, hormonal imbalances, including elevated FSH and LH levels, suggest a perimenopausal transition, which could contribute to systemic symptoms. The patient also reported that her headaches are linked to her menstrual cycle: *"My headaches are dependent on my period."* A reduction in circulating oestrogen has been associated with a lower pain threshold, which may explain why some individuals experience heightened pain, including headaches, at certain points in their cycle (79).

Furthermore, her vitamin B and D levels were at the lower end of the normal range, which may affect pain perception and muscle function (80,81).
Although a neurovitamin supplement was prescribed to address this, the patient ultimately chose not to take it, as she considered the dosage too high.
The patient also exhibited pronounced hypocortisolism, raising the question of adrenal insufficiency or chronic stress-related dysregulation of the HPA axis, which could contribute to widespread pain and fatigue in FMS patients (11,14,15,17). It remains unclear whether corticosteroid therapy, such as Prednisolone, was ever considered in her treatment history. Addressing adrenal function and stress management strategies could be beneficial.

The patient underwent low-dose radon therapy in the Gastein Healing Gallery, completing eight sessions, and she highlighted the therapy's immediate and lasting effects on her symptoms.

Additionally, the patient reported significant benefits from incorporating SE and relaxation techniques into her therapeutic regimen. SE helped shift her perspective on her body, enabling her to view it with gratitude rather than frustration. She described how understanding the survival mechanisms her body adopted helped her cope better and "reprogram" herself emotionally. This newfound ability to remain present and avoid falling into cycles of fear contributed to her overall well-being, although it did not directly alleviate her pain.

4.2 Symptoms and their Improvement

One of the aims of this case report was to describe the extent to which the radon-treatment in the Gastein Spa could improve the widespread symptoms of a patient with FMS. The patient experienced a significant improvement in fine motor skills and a reduction in paraesthesia immediately after the first session, alleviating the impairments that had previously hindered her ability to perform daily activities. Since the paraesthesia in her hands was her most pressing concern, she perceived the therapy as a success even after the first session. Throughout the treatment, she observed improvements in morning stiffness and joint swelling.

These findings align with research on radon's long-term analgesic effects. The immediate improvement can be attributed to a study showing that a 15-minute radon bath can enhance tissue blood flow by up to 400%, with these increased circulatory effects lasting for over an hour after treatment (82). Significant pain relief was reported as early as four weeks into radon therapy, with its effects surpassing those of warm water baths (83). Similarly, Verhagen et al. highlighted the potential of balneotherapy, including radon exposure, in alleviating rheumatic symptoms (52). Furthermore, Offenbächer et al. investigated the unique therapeutic environment of the Gastein Healing Gallery, emphasizing the combined effects of heat, humidity, and radon exposure. Their findings suggest that these factors work well toghether to enhance physiological responses and improve overall well-being (64).
A study by Falkenbach et al. reviewed multiple clinical trials on radon therapy for rheumatic conditions and found that, while immediate effects were minimal, patients reported substantial pain relief at follow-ups three to six months after treatment (62). This suggests that radon therapy may provide long-term benefits in chronic pain management.

4.3 Acceptance of LDR

The patient in this case-report accepted the treatments in the Gastein Healing Gallery especially well.
Notably, the acceptability of LDR is high, as it is framed as a spa treatment that most individuals would voluntarily undertake. Additionally, LDR is non-invasive and painless,

which further enhances its acceptance. Social attitudes towards spa treatments are generally positive, particularly in Austria, where sauna and spa culture are deeply ingrained and widely embraced (84). This cultural familiarity likely contributes to the openness and willingness of Austrian patients to engage with LDR as a therapeutic option.

The therapy's location in a picturesque village with stunning scenery adds to its appeal, allowing patients to perceive the experience as a vacation rather than medical treatment. A study from 2023 emphasizes that high-quality physical environments and supportive settings, which promote safety, respect, and restoration, can enhance psychological well-being and therapeutic outcomes (85). In the context of LDR in Bad Gastein, the scenery and communal hotel arrangements likely create such a supportive environment, fostering emotional resilience and improving the overall treatment experience.

Also, the therapeutic effect of spa treatments ("*Kureffekt*") is well known and describe long-term physiological and psychological improvements of wellbeing. These treatments regulate bodily functions through normalization and homogenization, meaning that individual physiological functions become more stable and consistent over time, aligning with a healthy baseline. Another key aspect is rhythmization, particularly the synchronization of circadian rhythms, which helps regulate biological processes, improve internal stability, and support overall health (86).

In this patient's case, she highlighted the importance of structure and consistency in her treatment experience, emphasizing how the predictable routine of radon therapy, combined with the soothing environment, contributed to her sense of stability and relaxation. She reported that the high humidity and warmth helped her body recover from tension more effectively, while the structured schedule provided a sense of security. This underscores the role of environmental and habitual factors in managing chronic symptoms.

The other important effect is the so-called "*Hafteffekt*" This effect refers to the long-lasting benefits of spa treatments that persist for months after the therapy has ended, such as pain relief, improved mood, reduced morning stiffness, enhanced relaxation, and better overall health satisfaction (86).

However, as the treatment takes place inside a former mining tunnel, it requires patients to enter via a special train that transports them deep into the mountain. While this environment contributes to the therapeutic effect through warmth and high humidity, it may be unsuitable for individuals with claustrophobia or severe anxiety disorders.
In the patient's case, she described the environment of the Healing Gallery as deeply relaxing, emphasizing the warmth and humidity as key elements in her symptom relief. Additionally, certain contraindications exist, including unstable cardiovascular conditions, uncontrolled high blood pressure, severe kidney disease, acute infections, and active malignancies (87). These factors should be carefully considered before undergoing treatment.

4.3.1 The Social Aspect of LDR

Beyond the physiological effects, the patient frequently emphasized the supportive atmosphere created by the group dynamic during her stay in Bad Gastein. Sharing accommodations with other patients undergoing similar treatments helped foster a sense of connection and mutual understanding. Discussing shared experiences with others who comprehended the challenges of chronic illness helped alleviate feelings of isolation and frustration. These observations suggest that the social component of group-based therapy environments may play a significant role in patient outcomes. Studies have already proven that shared accommodations lessen the effects of loneliness (88).

A well-designed shared healthcare facility can also help reduce stress and support coping mechanisms by encouraging social interactions and facilitating open communication between patients and staff. This is particularly relevant for individuals with chronic illnesses, who often experience psychological distress upon hospital admission (85). Social support is strongly associated with better mental health, including improved social and emotional functioning and reduced pain. Social support directly improves the quality of life in FMS patients, further highlighting the need for accommodating social treatments (51). Such findings underscore the importance of a biopsychosocial approach to chronic

pain management, integrating both the physiological and psychological aspects of treatment.

The patient's positive response to LDR also underscores its potential acceptability among individuals with FMS, particularly those who are sceptical of pharmaceutical treatments. The patient's reliance on non-pharmaceutical approaches, such as caffeine, dietary supplements, and relaxation techniques, reflects a broader trend among FMS patients to seek holistic and minimally invasive therapies due to the significant side effects often associated with conventional medications (2).

4.3.2 Risk Considerations and the Debate on Radiation Exposure

While radon therapy has demonstrated potential therapeutic benefits, concerns persist regarding its well-documented health risks. Radon, a radioactive gas, is recognized as the second leading cause of lung cancer after smoking. Extensive epidemiological research has established a strong association between prolonged, high-dose radon exposure and an elevated risk of lung cancer (82).

In clinical spa settings, the intensity and duration of radon exposure are significantly lower compared to occupational or environmental exposures. However, the potential cumulative impact of repeated low-dose treatments remains a topic of ongoing debate. Currently, there is a notable gap in long-term epidemiological studies specifically evaluating the cancer risk associated with periodic, low-level radon therapy in therapeutic environments (89).

"Radiation hormesis" suggests that low doses of ionizing radiation stimulate protective biological mechanisms, enhancing cellular repair and immune function. In contrast, the linear no-threshold (LNT) model assumes that all radiation exposure poses a risk. These differing perspectives impact public health policies and medical applications. Proponents of hormesis argue that the LNT model leads to unnecessary fear and excessive restrictions, while critics emphasize the need for caution due to potential long-term risks that remain uncertain. Ongoing research aims to clarify the true effects of low-dose radiation on human health (90).

4.4 Contribution of the Meditative State During Treatment

An intriguing aspect of LDR is the meditative and deeply relaxing state induced during the hour-long sessions in the Healing Gallery. The patient highlighted the calming effects of the high-humidity, high-temperature environment, which appeared to facilitate stress reduction and ANS regulation. This aligns with previous findings that suggest thermal and radon thermal therapies can induce beta-endorphin release, enhance blood circulation, and reduce muscle spasms (37,58).

The patient also reported experiencing pain relief through psychotherapy and relaxation techniques, such as SE earlier in her life. She expressed a strong belief that her fibromyalgia is connected to her childhood experiences and emotional trauma, stating: *"I am certain that my illness is linked to my childhood and one or more emotional triggers."* She also acknowledged a particular fondness for sweets, saying: *"My great indulgence is sweets."* A study suggests that high sugar intake may intensify inflammation, which could contribute to the progression of conditions such as rheumatoid arthritis and other inflammatory disorders (91).

Research suggests that stress-related disorders can result from allostatic load—the strain on the body to maintain balance—and an imbalance in the autonomic nervous system, characterized by excessive activity of the sympathetic nervous system and insufficient activity of the parasympathetic nervous system. Mind-Body exercises like SE, Progressive muscle relaxation, yoga or meditation can ease this imbalance and actively help relieve stress (92).

To manage chronic musculoskeletal pain, research by Shao et al. highlights the potential of vagus nerve stimulation through deep breathing to reduce pain sensitivity and increase pain thresholds, likely due to its anti-inflammatory effects (93). Similarly, somatic relaxation techniques practiced by the patient and the meditative state induced during LDR may activate the vagus nerve, promoting relaxation, reducing inflammation and enhancing pain tolerance. Additionally, the patient considers her faith to be an essential protective factor in her life, which may contribute to her overall well-being and mental health (94).

The anti-inflammatory reflex works by detecting inflammatory signals and sending them to the brainstem, which then triggers a response via the vagus nerve to reduce inflammation. Specifically, the vagus nerve influences immune cells by promoting the release of acetylcholine, which interacts with receptors on macrophages to suppress the production of pro-inflammatory cytokines like TNF-α and IL-6 (95). These mechanisms could explain the patient's improvements in pain and overall well-being.

However, it is essential to acknowledge that not all individuals benefit equally from such therapeutic approaches. Some patients may experience more pronounced improvements due to factors such as psychological resilience, which has been associated with better mental health outcomes and a greater ability to cope with and manage chronic pain. Additionally, individuals with prior exposure to complementary therapies or those actively engaged in a supportive therapeutic community may respond more effectively to treatment, as these factors can enhance pain coping mechanisms and overall well-being (96).
This variability could partially explain why the patient responded so positively to the radon thermal therapy in the Gastein Healing Gallery, as her previous success with psychosomatic techniques may have enhanced her receptiveness to this form of treatment.

4.5 Methodological Considerations and Limitations

This case report utilized a structured interview and validated questionnaires, including the WPI and FIQ. While this approach allowed for an in-depth exploration of the patient's experiences, it also presented several limitations.

Single-case studies provide valuable insights, particularly in exploring the intricate interplay of physical, psychological, and social factors in complex conditions like FMS. By offering an in-depth analysis of individual experiences, they capture nuanced psychosocial effects and patient-specific responses that larger cohort studies may overlook. Although these studies lack a control group and involve small sample sizes, these characteristics are intrinsic to their design rather than methodological flaws. While randomized controlled trials remain the gold standard, single-case studies are crucial for identifying long-term

response patterns and delayed treatment effects, which are particularly relevant given the multifactorial nature and symptom variability of FMS (97).
On the other hand, case reports inherently lack generalizability and are prone to selection and recall biases. Additionally, the reliance on self-reported data introduces the possibility of response-shift bias, where perceived improvements may reflect changes in the patient's interpretation of their symptoms rather than objective changes.

Despite these limitations, using the CARE guidelines ensured methodological consistency and transparency, making the findings valuable as a foundation for future research.
The literature search for this case report only included articles written in English and German. This language restriction may have led to the exclusion of relevant research published in other languages.

4.6 Suggestions for Future Research

Further research is needed to elucidate the specific biological mechanisms of radon exposure and how these processes interact with other factors influencing patient outcomes. Understanding these mechanisms could help clarify the full therapeutic potential of radon thermal therapy and support its integration into clinical practice for chronic pain management.
Future studies should explore the relative contributions of radon exposure and psychosocial dynamics, including communal aspects such as shared living arrangements and group interactions, to determine their influence on therapeutic outcomes. This could provide valuable insights into designing more holistic treatment strategies for FMS and other chronic pain syndromes.

The potential for LDR to reduce medication use and hospital visits represents a promising area for cost-effectiveness analysis. Future research could quantify these economic benefits, providing evidence for broader implementation in healthcare systems.

4.7 Possible Further Investigations for the Patient to Clarify Diagnosis and Adapt Treatment

Diagnostic evaluation of infectious agents and hormonal dysregulation is critical to clarifying the underlying factors contributing to the patient's persistent symptoms. Given the serological evidence of previous infections, a targeted approach with additional testing and tailored treatment strategies may be beneficial.
Interestingly the patient mentioned that, *"The muscle pain sometimes feels like sore muscles after exercise or body aches during the flu."*
In the case of *Yersinia*-associated post-infectious arthritis, the presence of positive IgG but negative IgA suggests a past infection rather than an active mucosal infection. If confirmed, antibiotic treatment may be considered (26).
Similarly, *Mycoplasma pneumoniae* has been implicated in chronic inflammatory processes, particularly in joint involvement (29). While the patient's serology suggests a past infection, reactivation cannot be entirely ruled out.
For *Coxsackievirus*, the markedly elevated IgG levels suggest a prior infection, which has been associated with chronic fatigue and neuromuscular symptoms. Although no direct antiviral treatment exists, immune modulation strategies, such as lifestyle interventions and supportive therapies, may be beneficial in managing residual symptoms (78).
Likewise, *Parvovirus B19* is known to cause persistent fatigue and joint pain in some individuals. Further immunological assessments may help determine whether this virus is contributing to the patient's symptomatology (30).

In addition to the infectious disease perspective, the patient's hormonal profile warrants further investigation. The elevated levels of FSH and LH, in conjunction with low progesterone and testosterone, suggest a perimenopausal transition. Such hormonal fluctuations are known to contribute to fatigue, musculoskeletal pain, and mood disturbances (79). Low free testosterone can also contribute to fatigue, loss of libido and to muscle weakness (98). Further assessment of adrenal function is also necessary, given the presence of hypocortisolism. This could involve morning cortisol measurements, ACTH testing, and possible stimulation tests to evaluate adrenal insufficiency (99).

Furthermore, the patient's low-normal levels of vitamin B and D may influence pain perception and muscle function (80,81). Considering these findings, targeted supplementation could be explored as a therapeutic option.

A notable diagnostic limitation in this case is the absence of cranial imaging to rule out multiple sclerosis (MS) and other inflammatory brain conditions, given the patient's neurological symptoms, including paraesthesia and fine motor impairment. MS remains an important differential diagnosis in such presentations, as it shares overlapping features with fibromyalgia. While the patient underwent cervical and shoulder MRI, as well as an MRI for the temporomandibular joint and trigeminal nerve according to her own account (though no documentation is available), these do not constitute a full cranial MRI. The lack of comprehensive cranial imaging represents a significant gap in the diagnostic workup, and such imaging should be strongly considered to exclude demyelinating disease (100).

4.8 General Clinical implications

The findings of this case report suggest several practical applications for the clinical management of FMS. First, LDR appears to offer a viable non-pharmaceutical option for symptom management, particularly for patients who experience significant side effects from conventional medications.

Second, the integration of LDR into holistic treatment plans could enhance patient outcomes by addressing both the physiological and psychosocial dimensions of the disease. Such advancements could also lead to significant economic benefits, including reduced reliance on medications and fewer hospital visits, as the therapy may help mitigate symptom exacerbations in chronic conditions like FMS.

Furthermore, existing research supports the active implementation of holistic approaches to managing chronic pain. Techniques such as PMR, SE and vagus nerve stimulation through deep breathing or meditation have demonstrated efficacy in alleviating symptoms by targeting the biopsychosocial factors that significantly influence and sustain chronic pain.

Combining these non-pharmaceutical interventions with pharmaceutical treatments would provide a more comprehensive strategy, ensuring that both biological and psychosocial contributors to chronic pain are addressed.

Finally, the supportive environment of the Healing Gallery highlights the importance of considering social factors in treatment planning. Group-based interventions that foster a sense of community and mutual understanding may amplify the benefits of physical therapies and improve patients' overall quality of life.

5. Conclusion

This case report underscores the multifaceted nature of FMS and highlights the potential of LDR as part of a comprehensive, biopsychosocial approach to its management. By addressing physical, psychological, and social factors, LDR could have significant potential for improving the quality of life for individuals with FMS.

Furthermore, this case report emphasizes the importance of holistic therapies that integrate non-pharmaceutical methods, such as relaxation techniques and group-based interventions, alongside conventional treatments.
However, further research is essential to validate these findings, explore the underlying biological and psychosocial mechanisms, and refine treatment protocols to enhance efficacy.

By integrating these insights, LDR could become a valuable addition to the broader landscape of chronic pain management, offering a safe, effective, and patient-centered alternative for individuals who face challenges with traditional pharmaceutical treatments. Additionally, LDR could complement pharmaceutical approaches by enhancing their effectiveness and potentially reducing the required dosage, thereby minimizing side effects and improving overall patient outcomes. Moreover, the potential economic benefits and improved patient outcomes make it an attractive option for inclusion in future healthcare strategies.

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Appendices

Supplementary file 1

Questionnaires

Fibromyalgie-Syndrom | FiRe-Net Patientenschulung | Arbeitsblätter

Fragebogen zur Erfassung des Fibromyalgie-Syndroms

Um die folgenden Fragen zu beantworten, berücksichtigen Sie als Betroffene(r) folgendes: Wie habe ich mich in der **vergangenen Woche** gefühlt?

- unter der laufenden Therapie und Behandlung
- ohne Schmerzen oder Beschwerden von anderen bekannten Erkrankungen zu berücksichtigen

Teil 1 Widespread-Pain-Index (WPI)

Kontrollieren Sie jede Zone des Körpers, die in der **letzten Woche** Schmerzen verursacht hat.

- ☒ Schultergürtel links
- ☐ Schultergürtel rechts
- ☒ Oberarm links
- ☐ Oberarm rechts
- ☒ Unterarm links
- ☒ Unterarm rechts
- ☒ Hüfte links
- ☒ Hüfte rechts
- ☐ Oberschenkel links
- ☐ Oberschenkel rechts
- ☐ Unterschenkel links
- ☒ Unterschenkel rechts
- ☒ Kiefer links
- ☒ Kiefer rechts
- ☒ Brustkorb
- ☒ Bauch
- ☒ Nacken
- ☒ Oberer Rücken
- ☒ Unterer Rücken
- ☐ Keine Zone

Zählen Sie die Anzahl der Zonen zusammen und geben Sie Ihren „Großflächigen Schmerzindex" (Widespread Pain Index WPI) hier ein (zwischen 0 und 19):

..14....... **Punktzahl**

Fibromyalgie-Syndrom FiRe-Net Patientenschulung
Arbeitsblätter

Teil 2a Symptom-Schweregrad (Symptom Severity Score SS score)

Geben Sie den Grad der Schwere Ihrer Beschwerden während der letzten Woche in der folgenden Tabelle ein:

Müdigkeit

0 = kein Problem
1 = leichte oder milde Probleme, im Allgemeinen mild oder zeitweise auftretend
2 = mäßig bis deutliche Probleme; häufig und/oder auf einem mittelmäßigem Niveau
3 = heftig, durchdringend, dauerhaft, stört das Leben

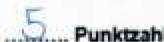
Nicht erholsamer Schlaf

0 = kein Problem
1 = leichte oder milde Probleme, im Allgemeinen mild oder zeitweise auftretend
2 = mäßig bis deutliche Probleme; häufig und/oder auf einem mittelmäßigem Niveau
3 = heftig, durchdringend, dauerhaft, stört das Leben

Merk- und Konzentrationsstörungen

0 = kein Problem
1 = leichte oder milde Probleme, im Allgemeinen mild oder zeitweise auftretend
2 = mäßig bis deutliche Probleme; häufig und/oder auf einem mittelmäßigem Niveau
3 = heftig, durchdringend, dauerhaft, stört das Leben

Zählen Sie die entsprechenden Punktzahlen zusammen und geben Sie diese hier ein


.... **Punktzahl**

Geben Sie jedes der folgenden anderen Symptome an, das Sie in der **letzten Woche** gehabt haben:

- ☒ Muskelschmerz
- ☒ Reizdarmbeschwerden
- ☐ Müdigkeit, Ermüdung
- ☒ Denk- oder Erinnerungsprobleme
- ☒ Muskelschwäche
- ☒ Kopfschmerzen
- ☒ Bauchschmerzen, Krämpfe
- ☒ Benommenheit, Kribbeln
- ☒ Schwindel
- ☒ Schlaflosigkeit
- ☒ Depressionen
- ☐ Verstopfung
- ☒ Unterbauchschmerzen
- ☒ Übelkeit
- ☒ Nervosität
- ☒ Brustschmerzen
- ☒ Verschwommenes Sehen
- ☐ Fieber
- ☒ Durchfall
- ☐ Mundtrockenheit
- ☐ Juckreiz
- ☒ Kurzatmigkeit
- ☒ Kalte Hände, kalte Füße
- ☐ Nesselsucht
- ☒ Ohrgeräusche
- ☐ Brechreiz
- ☒ Sodbrennen
- ☒ Geschwüre i. d. Mundschleimhaut
- ☒ Geschmacksminderung, -verlust
- ☐ Krampfanfälle
- ☒ Trockene Augen
- ☐ Luftnot
- ☐ Appetitverlust
- ☐ Hautausschlag
- ☐ Sonnenlichtempfindlichkeit
- ☒ Hörstörungen
- ☐ Empfindliche Haut
- ☐ Haarausfall
- ☒ Häufiges Wasserlassen
- ☒ Schmerzhaftes Wasserlassen
- ☐ Blasenkrämpfe

Auswertung Teil 2b

☐	0 Symptome	= Null Punkte
☐	1-10 Symptome	= 1 Punkt
☐	11-24 Symptome	= 2 Punkte
☒	25 oder mehr	= 3 Punkte

...8..... **Gesamtpunktzahl Teil 2a und 2b**

Zählen Sie Teil 2a und 2b zusammen.
Dies ist Ihr Grad der Symptomschwere von 0 bis 12.
Was bedeutet Ihr Schweregrad?

Eine Patientin, ein Patient erfüllt die Kriterien eines Fibromyalgie-Syndroms, wenn folgende drei Bedingungen zutreffen:

1. Teil 1 ist größer oder gleich 7 und der Schweregrad aus Teil 2a+b ist größer oder gleich 5
   oder
   Teil 1 ist zwischen 3 und 6 und
   Teil 2a+b gleich oder größer als 9

2. Die Beschwerden bestehen in dieser Ausprägung länger als die letzten drei Monate.

3. Sie haben keine andere Erkrankung, die Ihre Schmerzen erklären könnte.

Meine Behandlungen und Therapien

Denken Sie bitte an Ihren bisherigen Krankheitsverlauf und Ihre Beschwerden.
Was haben Sie bisher unternommen, um Ihre Erkrankung und Ihre Beschwerden zu behandeln?

Behandlung, Therapie	+ tut mir gut - tut mir weniger gut	Notizen (z.B. hat kurzfristig geholfen, etc.)

Physiotherapie (-)
Psychotherapie (+/-) "Hat auf der Körperebene garnix gebracht! Seelisch teilweise."
Osteopathie (+/-) "Wenig Wirkung."
Somatic Experiencing (++)
Kräutermischungen (+)
Massagen (+) "Hilft nur kurzfristig."
Akupunktur (-) "Vor Jahren einmal probiert, hat wieder neue Symptome ausgelöst."
TCM (-) "Hat wieder neue Symptome ausgelöst."
Ayurveda (+/-) "Eine ambulante Kur hat für ca. ein Jahr geholfen, später brachte es nichtsmehr."
Cranio Sacrale Therapie (+/-) "Hilft unterschiedlich, teilweise entspannend, teilweise keine Wirkung."
Gasteiner Heilstollen (++!) "Hat mir extrem gut getan!"
Feldenkrais (+) "Hatte nicht die Ruhe für regelmäßigen Kurs. Teilweise gut getan, teilweise nicht."
Yoga (+/-)

Meine Medikamente in der Übersicht

Medikamente, die Sie zurzeit einnehmen:

Name des Medikaments	Grund der Einnahme (z. B. Schmerzen, Schlaflosigkeit)	Einnahme (z. B. 2 x 1 Tablette)
Wirkung, Verträglichkeit	Notizen (z. B. Nebenwirkungen, Wechselwirkungen mit anderen Medikamenten)	

Name des Medikaments	Grund der Einnahme (z. B. Schmerzen, Schlaflosigkeit)	Einnahme (z. B. 2 x 1 Tablette)
Wirkung, Verträglichkeit	Notizen (z. B. Nebenwirkungen, Wechselwirkungen mit anderen Medikamenten)	

Medikamente, die Sie nach Bedarf einnehmen:

Name des Medikaments	Grund der Einnahme (z. B. Schmerzen, Schlaflosigkeit)	Einnahme (z. B. 2 x 1 Tablette)
Wirkung, Verträglichkeit	Notizen (z. B. Nebenwirkungen, Wechselwirkungen mit anderen Medikamenten)	

Name des Medikaments	Grund der Einnahme (z. B. Schmerzen, Schlaflosigkeit)	Einnahme (z. B. 2 x 1 Tablette)
Wirkung, Verträglichkeit	Notizen (z. B. Nebenwirkungen, Wechselwirkungen mit anderen Medikamenten)	

Fibromyalgia Impact Questionnaire (FIQ)

Quelle: Offenbaecher M, Waltz M, Schoeps P. Validation of a German version of the Fibromyalgia Impact Questionnaire (FIQ-G). J Rheumatol 2000; 27 (8): 1984-8.

1. Vorgehensweise: Für die Fragen 1-10 bitte jeweils die Nummer mit einem Kreis markieren, die am besten Ihren Zustand in der letzten Woche beschreibt. Falls Sie irgendeine der aufgeführten Tätigkeiten normalerweise nicht ausführen, so bitte streichen Sie die Frage.

Waren Sie in der Lage:	**immer**	**meistens**	**gelegentlich**	**nie**
a. Einkaufen zu gehen	☒	☐	☐	☐
b. Wäsche mit Waschmaschine und Trockner zu erledigen	☒	☐	☐	☐
c. Essen vorzubereiten	☒	☐	☐	☐
d. Geschirr mit der Hand zu waschen	☒	☐	☐	☐
e. Teppichvorleger staubzusaugen	☒	☐	☐	☐
f. Betten zu machen	☒	☐	☐	☐
g. um einige Häuserblocks zu gehen	☒	☐	☐	☐
h. Freunde oder Verwandte zu besuchen	☒	☐	☐	☐
i. Hof- oder Gartenarbeit zu erledigen	☒	☐	☐	☐
j. Auto zu fahren	☒	☐	☐	☐

2. Von den 7 Tagen der letzten Woche: an wievielen Tagen haben Sie sich wohl gefühlt?

0 1 2 3 4 5 6 7

3. An wievielen Tagen der letzten Woche konnten Sie aufgrund Ihrer Fibromyalgie nicht Ihrer Arbeit nachgehen? Falls Sie nicht außerhalb des Hauses arbeiten, bitte diese Frage unbeantwortet lassen.

0 1 2 3 4 5

Fibromyalgia Impact Questionnaire (FIQ) 2/2

Bitte lesen Sie die Anleitung auf Seite 1 zum Ausfüllen des nachfolgenden Fragetypus bei Bedarf nochmal durch.

Vorgehensweise: Für die verbleibenden Punkte, bitte die Stelle auf der Linie markieren, die am besten Ihren Zustand in der vergangenen Woche beschreibt.

4. Als Sie während der vergangenen Woche arbeiteten, wie stark haben Schmerzen oder andere Symptome Ihrer Fibromyalgie Ihre Arbeitsfähigkeit eingeschränkt

keine Probleme bei der Arbeit — grosse Schwierigkeiten bei der Arbeit

5. Wie ausgeprägt waren Ihre Schmerzen?

kein Schmerz — sehr starke Schmerzen

6. Wie **müde** sind Sie gewesen?

nicht müde — sehr müde

7. Wie müde haben Sie sich am Morgen nach dem Aufstehen gefühlt?

gut ausgeruht aufgewacht — sehr müde aufgewacht

8. Wie schlimm war Ihre Steifigkeit?

keine Steifigkeit — ausgeprägte Steifigkeit

9. Wie nervös oder aufgeregt haben Sie sich gefühlt?

nicht aufgeregt — sehr aufgeregt

10. Wie depressiv haben Sie sich gefühlt?

nicht depressiv — sehr depressiv

Supplementary file 2

Transcribed Interview (Anonymized)

Demografische Informationen

Alter, Beruf, Kinder, Partnerschaft, Bildungsgrad (Ausbildungsjahre)

„ 48, höhere Akademische Ausbildung mit Lektoratsstelle , 2 Kinder (m/f), verheiratet in glücklicher Ehe mit gesundem Mann“

Hauptbeschwerden

- "Aus welchem Grund begaben Sie sich ursprünglich in Behandlung beim Gasteiner Heilstollen?"
- Kurze Zusammenfassung in den eigenen Worten der Patient*innen
- Kurze Zusammenfassung, welche Symptome das Syndrom im Allgemeinen bei dem oder der Proband*in hervorruft

„Es war eigentlich Zufall, wir haben Urlaub auf einer Alm gesucht und haben eine Alm im Gasteiner Tal gebucht. Mir ist dann eingefallen, dass die Mutter einer Freundin Polyarthritis hat und so geschwärmt hat von dem Gasteiner Heilstollen. Zufälligerweise war die Alm nur 40 Minuten entfernt und ich habe dann spontan entschlossen die Heilanstalt zu Googlen und eventuell dort hinzufahren. Da ist mir auch zum ersten Mal der Gedanke gekommen, dass ich Fibromyalgie haben könnte, da die Symptome, die auf der Website besprochen worden sind, genau meine Symptome waren. Also Holla-die-Waldfee, diese Morgensteifigkeit und die Schmerzen beim Aufstehen ist genau das, was ich habe. Nach kurzer Recherche habe ich dort angerufen und mir die Termine ausgemacht für 8 Einfahrten. Das Hauptsymptom, dass mich am meisten verzweifeln lässt, sind die Gefühlsstörungen in den Armen. Schmerzen bin ich schon gewöhnt, aber diese Gefühlsstörunken, die teilweise auch die komplette linke Gesichtshälfte inkludieren sind im Alltag wirklich beeinträchtigend. Wenn ich dann meine Lippe nicht mehr fühle und sie sich beim Sprechen nicht perfekt mitbewegt oder wenn ich Parästhesien in den Armen und Finger spüre, lassen sich Alltagshandlungen einfach nicht mehr gut durchführen. Nach meinem Gespräch mit Dr. Offenbacher für meine erste Behandlung im Heilstollen wurde mein Verdacht an Fibromyalgie erkrankt zu sein auch bestätigt. Er hatte auch gute Erklärungen für die Gefühlsstörungen, die seiner Meinung von verspannten Muskeln

ausgehen sollen. Und ich muss wirklich sagen, die Gefühlsstörungen sind während der ersten Einfahrt schon besser geworden. Es ist so viel besser und das ist für mich ein richtiger Segen."

Schmerzgeschichte

- **Wo ist der Schmerz lokalisiert? (Tender Points)**
- **Strahlt er aus? Wenn ja, wohin?**

„Schmerzen habe ich eigentlich überall. Am Knie seit Monaten, das rechte Iliosakralgelenk ist irgendwie blockiert, die Schultern tun auch sehr weh. Die Halswirbelsäule bereitet mir am längsten schon Schmerzen. Abgeklärt wurde eigentlich jedes Gelenk außer das Knie, weil es erst seit ein paar Monaten dabei ist. Dabei wurden nur leichte Abnützungen des Gelenkes entdeckt aber sonst nichts. Kopfschmerzen habe ich auch, wobei diese präklimakterisch aufgetreten sind. Zusammenfassend ist schmerztechnisch vor allem der Bewegungsapparat betroffen. Ich denke es geht eher von Muskeln und Sehnen aus. Meine Fingergelenke und Handgelenke tun auch immer mal wieder weh. Wobei sie dabei aber nicht anschwellen. Der Neurologe meinte es sei ein Karpaltunnelsyndrom, wobei mir nicht nur die Hand, sondern ja der ganze Arm einschläft, was wiederum nicht für ein Karpaltunnelsyndrom spricht. Es sind sehr viel lästige Sachen von Kopf bis Fuß."

„Zusammenfassend wo ich Schmerzen habe: Knie rechts, Iliosakralgelenk rechts, Hüfte linke, Schultergürtel links und rechts, Arm links, Halswirbelsäule, Kiefergelenk beidseits."

- **Ändert sich der Schmerz im Laufe der Zeit?**

„Ich glaube es hat mit Stress zu tun, wobei ich auch wirklich Phasen habe, wo es mir auch wirklich gut geht. Also wo es mir seelisch gut geht, wenig Stress in der Arbeit und es geht mir auch privat gut, und trotzdem geht es mir körperlich so schlecht. Wobei ich es jetzt auch schon besser verstehe, da natürlich in dem Moment, wo Kapazität frei ist, der Körper seine Probleme mehr zeigt. Aber es ist eigentlich jeder Tag eine Herausforderung für sich auch wenn es von außen so aussieht als würde man den Alltag eh funktionieren. Innerhalb

eines Tages wäre mir jetzt kein Muster bewusst, wobei die Kopfschmerzen schon hormonell bedingt sein könnten."

- **Wann hat es begonnen / wie lange besteht es schon?**

„Die Muskelschmerzen haben sehr klassisch ab dem 40. Lebensjahr begonnen und die Gefühlsstörungen haben erst vor einem Jahr ca. begonnen. Die Morgensteifheit und die Nervenprobleme sind in der Früh am schlimmsten und werden im Laufe des Tages besser."

Intermittierend oder konstant?

„ich würde es schon als konstant bezeichnen. Komplett schmerzfreie Tage gibt es eigentlich nicht. Beziehungsweise noch nicht. Ich bin sehr optimistisch auch durch die neue Therapie im Heilstollen."

- **Wenn intermittierend, wie lange dauert es an und wie oft tritt es auf?**
- **Qualität (Dumpf, scharf/messerartig, Druck, Enge, Kribbeln usw.)**

„Es kommen immer mal neue Sachen hinzu. Schmerz habe ich aber meistens immer irgendwo. Er fährt durch wie ein Stromschlag, es kribbelt, es sticht, es brennt teilweise und manchmal ist es einfach eingeschlafen und ich spüre die Region nicht mehr. Bewegung hilft mir aber sehr. Also egal ob walken oder Gymnastik zuhause, die Bewegung hilft mir mit den Schmerzen. Aber selbst bei der harmlosesten Bewegung schlafen Körperregionen ein und fangen an zu kribbeln. Die Muskelschmerzen fühlen sich auch teilweise an wie Muskelkater oder Gliederschmerzen bei einer Grippe."

- **Schweregrad oder Intensität (NRS von 0 bis 10)- an einem guten Tag und an einem schlechten Tag**

„Ein guter Tag wäre bei 3-4. Ein schlechter Tag ist bei 8-9. Wobei ich alle drei Wochen Migräne bekomme, dann würde ich es als 10 bezeichnen. Die dauert dann 4-5 Tage."

- **Welche Trigger Faktoren sind Ihnen bekannt?**
- **Können Sie sich an den Moment erinnern wo die Schmerzen zum ersten Mal aufgetreten sind? Was haben Sie in diesem Moment gemacht?**

„Nein, es gab keinen fixen Moment in dem der Schmerz ausgelöst worden ist. Ich habe das Gefühl, dass es sich einfach mit dem Alter mitentwickelt hat. Ganz extrem ist es erst seit 3

Jahren, das passt auch zu meiner prämenopausalen Zeit. Also vielleicht ist es einfach, dass sich der Körper im Alter weiter verändert."

- **Lindernde / verschlimmernde Faktoren**

„Bewegungen aller Art. Damit meine ich aber eher seichteren Sport, wie Walken und Gymnastik. Ich tue mir wirklich schwer zu entspannen, also das Schlimmste ist, wenn ich durch eine Infekt mehrere Tage Ruhe geben muss. Es hilft auch, wenn ich meinen Alltag trotz all dieser Dinge meistern kann."

- **Haben Sie andere Begleitsymptome**?

„Mein Kiefer und mein Trigeminus machen mir immer mal wieder Beschwerden. Es wurden auch schon mehrere MRT gemacht, da auch Lymphknoten und Leukoplakien gefunden wurden. Die Untersuchungen waren aber immer unauffällig. Ich bekomme immer wieder mal Blasen und Aphten im Mundraum. Tinnitus habe ich seit 20 Jahren. Magenschmerzen und Reizdarmsymptomatiken spielen auch immer wieder eine Rolle. Herzrasen und Herzstolpern fallen mir auch öfters mal auf. Kurzatmigkeit und niedriger Blutdruck. Asthma als Kind, wobei ich auf die Medikamente schlecht reagiert habe. Grundsätzlich reagiere ich auf eigentlich alle Medikamente schlecht, was die Therapie dieser Symptome auch nicht einfacher macht. Außerdem Schwindel und Übelkeit. Es wechselt halt immer mal durch."

- **Verändert sich der Schmerz in Zusammenhang mit dem Menstruationszyklus?**

„Immer um die Regel herum verschlimmert sich alles. Kopfweh wird schlimmer und irgendwie habe ich das Gefühl mein komplettes Gestell verschiebt sich. Da hilft dann auch nichts mehr. Wenn ich so mal Kopfweh bekomme, hilft Koffein und Massage von Trigger Points schon, aber wenn ich dieses spezielle Kopfweh bekomme, rund um die Periode herum, hilft einfach Garnichts. Die Nervenstörungen sind nicht hormonell abhängig."

- **Gab es seit Beginn Ihrer Menopause Veränderungen der Symptome?**

„Ich bin noch in der Prämenopausalen Zeit"

- **Spezifisch für die Therapie**

- **Wie hat die Therapie Ihre Symptome verändert?**

„Die Somatic Experiencing hat mir geholfen die Sichtweise auf meinen eigenen Köper zu ändern. Dass man nicht angeschaut wird, wie ein Auto das Defekt ist, sondern dem Köper dankbar entgegenkommt und auch versteht, dass die Überlebensreaktionen, die der Körper aus verschiedensten Gründen annehmen musste, jetzt nicht mehr passen. Das Verständnis über die eventuellen Gründe, warum diese Reaktion überhaupt da ist hilft mir damit besser umzugehen und mich quasi neu zu programmieren. Die Fähigkeit im Hier und jetzt zu sein, ohne in die Angst reinzufallen hat mir schon sehr geholfen. Die Schmerzen wurden jedoch erst durch den Gasteiner Heilstollen verbessert.“

„Im Gasteiner Heilstollen habe ich 8 Einfahrten gemacht. Nach der ersten Einfahrt war ich positiv überrascht, wie gut ich es vertragen habe. Weil ich es oft kenne, dass mein Körper auf die harmlosesten Sachen schlecht reagiert und die Situation anstrengender oder sogar qualvoller macht. Es war überraschend, am therapiefreien Tag nach den ersten 2 Einfahrten, wie sehr es den Körper doch beansprucht hat. Wir wollten eine kleine Wanderung machen, aber ich musste bei der ersten steileren Stelle wieder umdrehen. Herzrasen und Kurzatmigkeit, obwohl ich sonst sehr trainiert bin. Grundsätzlich bin so glücklich diese Therapien entdeckt zu haben. es ist so fein und angenehm. Schon in der zweiten Woche habe ich einen merkbaren unterschied der Muskelschmerzen und vor allem auch in den Gefühlsstörungen im linken Arm gemerkt. Davon abgesehen, dass es so entspannend und angenehm ist. Ab der Fünften oder Sechsten Einfahrt in der 1A Station war habe ich gemerkt, dass die Knieschmerzen besser werden. Gegen Ende der Zweiten Woche habe ich gemerkt, dass die Gefühlsstörungen deutlich besser geworden sind. Die sind auch weiterhin seit der Behandlung besser geworden und das sehe ich als Hauptgewinn der Therapie. Das ist wirklich ein Wahnsinn. Ich freue mich schon auf die weitere Therapie. Die Trigeminus Probleme sind kurzeitig besser geworden nach der Therapie aber sind seitdem wieder schlechter geworden. Gleich wie das Iliosakralgelenk. Ich habe auch das Gefühl das es sehr positiv auf mein autonomes Nervensystem gewirkt hat. Verspannungen in der Früh haben sich schneller wieder gelöst. Gelenkschwellungen wie ich sie teilweise bei den Fingern und dem Handgelenk habe, haben sich schneller wieder erholt. Ich fühle mich entspannter und gelockerter. Das habe ich mir selbst nicht

gedacht, dass es so merkbar auch auf mein autonomes Nervensystem geht. Ich bin ja eigentlich mit wenig Erwartungen hingegangen. Es war auch schön in einem Umfeld zu sein, wo man weiß, dass jeder an verschiedensten Sachen leidet und man nicht alleine ist. Ich hatte den Eindruck, dass jeder dem anderen Wünscht das es besser wird. Der Austausch mit Menschen mit derselben Diagnose oder einem ähnlichen Leiden war sehr gut-tuend."

Vorgeschichte (und Anlegen einer Timeline)

- **Erkrankungen im Kindheitsalter**
- **Erkrankungen im Erwachsenenalter (alle bekannte Erkrankungen und seit wann)**
- **Haben genannte Erkrankungen einen Einfluss auf die chronische Schmerzsymptomatik?**
- **Operationen, Krankenhausaufenthalte, Verletzungen, Traumata**
- **Relevante frühere Interventionen mit Ergebnissen**

„Ich hatte schon vom Säuglingsalter weg sehr häufige schmerzhafte Infekte. Eigentlich von 6 Monaten weg bis in die Pubertät. Danach nur noch vereinzelt, aber trotzdem noch häufiger als ein Durchschnittsmensch, würde ich behaupten. Danach hat der Tinnitus angefangen. Da kann ich mich auch auf einen klaren Auslöser erinnern. Es war ein emotionaler Konflikt mit einem Familienmitglied, dass mir sehr nahegestanden ist. Das war dann wie ein Presslufthammer der neben meinem Ohr ist mit 3 verschiedenen Tönen. Da gab es einen Zeitpunkt, wo ich es wirklich nicht mehr aushalten konnte. Ich habe alles ausprobiert, was die Schulmedizin empfiehlt, zum Beispiel Kortison und ähnliche Mittel. Und mir war bewusst, dass man nach sechs Monaten mit dauerhaftem Tinnitus statistisch gesehen damit rechnen muss, ihn nicht mehr loszuwerden. Das macht die Panik auch nur größer. Ich habe dann mit Akkupunktur und Osteopathie angefangen, das hat aber alles einfach nicht geholfen. Nach 6 Monaten war ich psychisch so am Ende das ich zu einer Spezialambulanz für Tinnitus gefahren bin. Der Arzt dort hat mir zum ersten Mal das Gefühl gegeben, dass man mir aktiv zuhört und mich ernst nimmt. Er hat mir diese Rauschgeneratoren empfohlen, mit dem ich dann auch wieder schlafen konnte. Heute habe

ich zwar immer noch hin und wieder den Tinnitus, der besteht aber meistens nur aus einem Ton und sind aushaltbar für mich. Die Rauschgeneratoren benutzte ich nur noch selten. Außerdem hatte ich schon immer Kopfweh. Im Turnunterricht konnte ich meinen Kopf nie runter hängen lassen und auch beim Schlafen muss ich immer mit erhöhtem Kopf schlafen, da ich sonst so viel Druck in meinem Schädel aufbaue. Während dem Studium hat es mit dem Bauchweh und der Gastritis angefangen, dies ist dann übergegangen in Reizdarmsymtomatik. Die Beziehung mit meiner Mutter war sehr geplagt und emotional belastend."

„Operiert wurden nur meine Mandeln und ein gebrochenes Sprunggelenk im Erwachsenenalter. Mit sechs bin ich mit dem Kopf voraus von der Reg Stange gefallen, das hat meine Halswirbelsäule bestimmt auch ein wenig verletzt."

„Durch die vielen Antibiotika, die ich genommen habe bei den zahlreichen Infekten, wurde ich allergisch gegen viele."

- **Wie würden Sie Ihren aktuellen Gesundheitszustand einschätzen?**

1 (sehr schlecht ?	2	3	4		5	6	7	8	9	10 (sehr gut)
							x			

Alle Diagnosen

- **Diagnostische Tests (Screening-Tests oder Untersuchungen- was wurde wann und wo durchgeführt?)**
- "ich schicke Ihnen alle Befunde die ich habe."

Welche weiteren Untersuchungen sind bei Ihnen zukünftig geplant?

„keine eigentlich. Die Therapie durch den Gasteiner Heilstollen und Dr. Offenbächer geht weiter."

Intervention

- **Arten von therapeutischen Interventionen (pharmakologisch, chirurgisch, präventiv, Selbstpflege)**

„ich vertrage keine Schmerzmittel. Koffein hilft bei Kopfweh aber das ist eigentlich die einzige Substanz die ich zu mir nehme. Operative Interventionen wurden nicht durchgeführt.“

- **Verabreichung der therapeutischen Intervention (Dosierung, Stärke, Dauer)**
- **Unvorhergesehene und unerwünschte Ereignisse**

„Wenn ich NSAR oder Tramal nehme bekomme ich Bauchweh und fühle mich psychisch nicht wie ich selbst und die Schmerzen wurden auch nicht besser.“

- **Mit welchen Erwartungen haben Sie diese Therapie begonnen und wurden sie erfüllt?**
- **Allergien/Unverträglichkeiten**
- **Allergien? Saisonal, Umwelt, Kontakt- und Nahrungsmittelallergie,Medikamentenallergie**

„Allergie habe ich nur auf Baktrien, das Antibiotikum und Unverträglichkeiten habe ich auf fast alle Schmerzmittel inklusive Valium. Und sonst eine allgemeine Überempfindlichkeit auf eigentlich alle Medikamente. Wenn ich eine Narkose bekomme wird die halbe Dosis genommen.“

Impfstatus

„geimpft bin ich aus der Liste gegen Covid, Mumps-Masern-Röteln, Diphterie, Tetanus, Polio und Pocken“

Familienanamnese

- **Gab/gibt es in der Familie irgendwelche Erkrankungen: Herz-Kreislauf Erkrankungen, Schlaganfälle,Krebserkrankungen,Asthma,Diabetes,rheumatische Erkrankungen, psychische Erkrankungen, Autoimmunerkrankungen, Immundefekte**
- **Alter / aktueller Gesundheitszustand von Eltern, Geschwistern und Großeltern (falls zutreffend)**

„Ich habe seit einigen Jahren keinen Kontakt mehr zu meiner Familie und bin deshalb nicht auf dem neuesten Stand. Bewegungsapparat war bei beiden Eltern ein Thema. Meine Mutter hatte viele Rückenprobleme, auch mit frühem Bandscheibenvorfall."

Sozialanamnese

- **Lebenssituation**
- **Familienstatus**
- **Finanzielle Situation**
- **Religionszugehörigkeit**
- **Beruf**
- **Tabak / Alkohol, illegale Drogen, Koffeinkonsum (falls zutreffend)**
- **Private Interesse (Freizeitverhalten,Nebentätigkeiten)**

„Ich wohne in einem Haus mit mehreren Stockwerken und Keller. Es tut mir zwar alles weh, aber ich kann alles. Manchmal wird halt der Fokus mehr darauf gesetzt einfach den Alltag zu meistern, anstatt das Haus durchzuputzen. Aber es ist nicht so, dass ich es gar nicht schaffe. Ich bin in einer glücklichen Ehe und meine Familie ist mein ganz großes Geschenk. Für meine Kinder bin ich sehr dankbar und mein Mann unterstütz mich sehr. Ich fühle mich in meinem Leben aus sozialer Sicht sehr wohl und habe auch gute Freundschaften. Finanziell bestehen keine Probleme. Wir haben keine Religionszugehörigkeit, aber der Glaube ist ein wichtiger Faktor in meinem Leben. Tabak oder Alkohol vertrage ich nicht, davon wird mir schwindlig. Koffein trinke ich bei Kopfweh. Ich lese gerne oder gehe gerne in die Therme. Walken, spazieren oder Wandern sind auch immer gut."

Erhebung des psychopathologischen Befunds (Status Psychicus)

- **Befindet Sie sich derzeit in einer Psychotherapie? (ja/nein)**
- **Haben Sie schon jemals eine Psychotherapie in Anspruch genommen? Wenn ja, welche Form? Wann? Wie lange? Bei wem?(Verhaltenstherapie, Psychoanalyse, systemische Therapie?)**

„Zur Zeit befinde ich mich in der Somatic Experiencing Therapie. Früher war ich Logotherapie, Existenzanalyse, Hypnotherapie, EMDR, Familienaufstellungen und Verhaltenstherapie. Das ist aber alles schon länger her“

- **Waren Sie schon einmal in einer psychiatrisch-fachärtzlicher Behandlung? Wenn ja,wann und weswegen)**

„Ja, als ich im Studium an einer Depression gelitten habe. Ich war beim Psychiater zur Medikamenteneinstellung. Von dem Medikament sind mir aber leider die Haare ausgefallen. Nach dem Einstellen mit den Medikamenten und der Psychotherapie wurde mir zum ersten Mal bewusst, wie es ist, wenn man gerne lebt. Ich hatte schon seit der Pubertät Suizid Gedanken. Zwischen 23 und 25 waren die suizidalen Gedanken am schlimmsten. Heute ist das gar kein Thema mehr.“

- **Haben Sie das Gefühl, dass der Schmerz mit ihrem seelischen Wohlbefinden zusammenhängt**?

„Nein, im aktuellen nicht. Es besteht wahrscheinlich eine Verbindung mit dem Auslöser all dieser Dinge aber zur jetzigen Zeit sind meine Schmerzen nicht abhängig von meinem Wohlbefinden.“

Welche subjektive Krankheitstheorie haben Sie? Woher glauben Sie, dass die Symptome kommen?

„Ich bin mir sicher, dass es mit meiner Kindheit und einem oder mehreren emotionalen Auslösern zusammenhängt.“

Primärer Krankheitsgewinn:

- **Inwieweit beeinflusst der Schmerz Ihre täglichen Aktivitäten?**
- **Gibt es Situationen, in denen der Schmerz weniger intensiv ist oder Sie ihn weniger wahrnehmen? Gibt es gewisse Kontexte,**
- **Gefühle oder emotionale Situationen wo sie den Schmerz anders wahrnehmen? Wenn ja, welche?**

„Meine täglichen Aktivitäten werden nicht so beeinflusst. Es ist von außen auch nicht so bemerkbar, weil mir das auch wichtig ist zu funktionieren. Wo man es merkt ist eher, wenn

ich nicht mehr so unternehmungsfreudig bin. Wenn ich mich verbunden fühle zu Personen, also wenn ich mich sicher fühle, dass ich so wie ich bin in Ordnung bin, sind die schmerzen besser aushaltbar."

Sekundärer Krankheitsgewinn

- **Hat sich Ihre Rolle in der Familie oder in Ihrem sozialen Umfeld seit Beginn der Schmerzen verändert?**
- **Gibt es Vorteile oder positive Aspekte, die Sie durch Ihre Schmerzerfahrung erlebt haben, z.B. mehr Zeit für sich selbst oder Befreiung von bestimmten Verpflichtungen? Haben Sie durch Ihre Schmerzen Zugang zu Ressourcen oder Unterstützung erhalten, die Ihnen sonst nicht zur Verfügung gestanden hätten?**

„Nein nachdem es nie anders war hat sich nichts verändert. Die kennen mich alle so wie ich bin. Ich würde keine positiven Aspekte sehen. Ich glaube, dass mein Körper viel abgefangen hat, was die Seele aushalten musste. Vielleicht hat mich das auch vor anderen Krankheiten bewahrt."

Welche dieser Beschwerden kommen bei Ihnen vor und wie häufig?

	(fast)nie	Ab und zu	Häufig	(fast) immer
Tagesmüdigkeit		x		
Rasche Erschöpfbarkeit		X		
Konzentrationsstörungen		X		
Gedächtnisstörung		X		
Einschlafstörung	X			
Durchschlafstörung				X
Schnarchen	X			
Nächtliche Atemauffälligkeiten/Pausen	X			

Morgendliches Früherwachen (mind. 2 Stunden vor normaler Aufstehzeit)	X			
Traurige Stimmung			X	
Keine Motivation/Antrieb/Schwierigkeiten in die Gänge zu kommen	X			
Freudlosigkeit		X		
Interesselosigkeit				
Schwierigkeiten emotional zu reagieren oder Gefühle zu empfinden	X			
Stimmung deutlich schlechter am Morgen		X		
Stimmung deutlich schlechter am Abend		X		
Innere Unruhe				X
Gefühle außerhalb des eigenen Körpers zu sei oder stark neben sich zu stehen			X	
Gefühle, dass die Umgebung unwirklich oder fremd ist			X	
Ängste				X
Panikattacken			X	
Fähigkeiten oder Wahrnehmungen, die andere Menschen nicht haben (z.B. hören von Stimmen oder Gedanken eingegeben zu bekommen)			X	
Ständig wiederholende Gedanken			X	
Ständig wiederholende Handlungen, die ich eigentl. Nicht ausführen will (z.B. sehr häufiges Händewaschen, Zählen, Ordnen)	X			
Vermindertes sexuelles Interesse		X		

Heißhungerattacken		X		
Appetitlosigkeit	X			
Phasen, in denen meine Verwandten oder Bekannten mir sagen, dass meine Stimmung „zu gut“				X
Phasen, in den meine Verwandten oder Bekannten mir sagen, dass ich „extrem gereizt“ sei	X			
Gedanken nicht mehr Leben zu wollen			X	
Selbstverletzungen (z.B. Ritzen, Brennen)	X			
Husten		X		
Auswurf	X			
Schleimgefühl im Hals oder Rachen		X		
Verstopfte Nase/Nasenlaufen/Niesen				X
Luftnot bei Anstrengung		X		
Luftnot in körperlicher Ruhe			X	
Engegefühl/ Beklemmung der Brust			X	
Nächtliches Wasserlassen				X
Nächtliches Zähneknirschen				X
Morgendliche Unausgeglichenheit	X			
Schwindel			X	
Mundgeruch	X			
Rückenschmerzen, Halswirbelsäule				X
Rückenschmerzen Lendenwirbelsäule				X
Hüftprobleme/Schmerzen				X
Knieprobleme/Schmerzen				X

Andere Schmerzen				X
Sonstige Gelenksbeschwerden			X	
Muskel oder Wadenkrämpfe			X	
Muskelschwäche	X			
Vermehrtes Schwitzen Tagsüber	X			
Vermehrtes Schwitzen nächtlich			X	
Kopfschmerzen			X	
Haarausfall	X			
Hautprobleme (Jucken, Rötung, Akne)	X			
Trockene Haut, Raue Haut	X			
Gehäuftes Wasserlassen			X	
Starkes Durstgefühl			X	
Augentrockenheit, Augenbrennen, gerötete Augen		X		
Gelbliche Augen	X			
Sehstörungen, Verschwommensehen, Blitze sehen			X	
Mundtrockenheit	X			
Wassereinlagerungen (Hände? Füße?)	X			
Kalte Hände oder Füße			X	
Mir ist ständig zu warm	X			
Kälteempfindlichkeit				X
Hitzeempfindlichkeit	X			
Herzklopfen				X
Ich brauche lange Erholungsphasen	X			

Ernährungsanamnese

- **Ernährungsform (omnivor, vegetarisch, vegan), wie viele Mahlzeiten werden am Tag gegessen? Zwischenmahlzeiten? Wann ist die letzte Mahlzeit des Tages? Snacks? Lieblingsessen? Lebensmittel, die nicht vertragen werden?**

Heißhungerattacken auf Süßes? Trinkmenge? Wie viele Kaffee am Tag? Wie viele Softdrinks/Energydrinks pro Tag? Wie oft Fertigprodukte? Convenience Food/Take away Food? Wie viele Portionen Obst und Gemüse werden tgl gegessen? (Eine Portion ist eine Handfläche)? Beschwerden nach dem Essen? (Müdigkeit? Übelkeit?Völlegefühl?)

„Ausgewogene Omnivore Ernährung. Mein großes Laster sind aber Süßigkeiten. 3 Hauptmahlzeiten mit manchmal Zwischenmahlzeiten. Gern Gemüse und gern süß. Inzwischen vertrage ich alles. Als Kind habe ich von Kuhmilch Ohrenschmerzen bekommen. Scharfes Essen vertrage ich aufgrund der Magenschmerzen nicht so gut. Ich trinke 2 Tassen Kaffee pro Tag aber keine Softdrinks. Beschwerden nach dem Essen sind Müdigkeit, manchmal Müdigkeit und Sodbrennen."

- **Appetit, Gewichts-Verlust oder Zunahme, (in welchem Zeitraum? Wie viel? Gewollt oder nicht gewollt? Diäten?)**

„Hat sich eigentlich nicht verändert"

- **Schwankungen der Stimmung bzgl Tageszeit, Körperlicher Verfassung (Schmerz)**

„Schon immer wieder ein paar Schwankungen aber ohne Muster. Es ist immer unterschiedlich. Manchmal ist es in der Früh schlimmer, manchmal am Abend."

- **Verdauung: Stuhlfrequenz, Stuhlkonsistenz, Blähungen, Bauchschmerzen, Blut-Schleimauflagerungen?**

„Reizdarm von Diarrhoe Typ bei Stress, sonst alles normal. Blähungen und Bauchschmerzen manchmal."

Für Frauen:

- **Zyklusdauer, Symptome**
- **Ist die Regelblutung schmerzhaft**
- **Ist die Regelblutung unregelmässig?**
- **Haben sie Zwischenblutung**
- **Perimenopause**
- **Menopause**
- **Besteht derzeit eine Schwangerschaft**

„24 Tage Zyklus mit starker Blutung, Ab und zu wird eine Periode ausgelassen, aber ich würde schon sagen das ich noch immer regelmäßig meine Periode bekomme. Meine Kopfschmerzen sind von der Periode abhängig. Selten Zwischenblutungen. Ja, ich glaube schon das ich in der Perimenopause bin."

Sexual Anamnese

- **Wirkt sich Symptomatik aus das Sexualleben aus?**

„Die Schmerzen beeinträchtigen schon auch das Sexualleben, vor allem seit dem letzten Jahr. Wobei es mir immer geholfen hat gegen die depressive Stimmung, aber der Schmerz ist halt doch beeinträchtigend."

Selbstbeschreibung

- **"Was für ein Mensch sind Sie?"**

„Am ehesten würde ich mich beschreiben als Mensch der immer das Beste aus der Situation macht. Ich habe mich immer bemüht zumindest für andere etwas Gutes daraus zu machen. Mir ist es auch wichtig, dass die Menschen in meinem Leben nicht mitbekommen oder beeinflusst werden durch mein Leid. Die können auch nichts dafür. Ich habe viel Galgenhumor. Humor ist die Waffe der Wehrlosen. Wenn nichts mehr hilft, kann man immer noch einen blöden Witz darüber reißen. Ich glaub ich habe auch von Natur eine gewisse Grundpositivität. Ich würde mich auch als sehr empathisch beschreiben. Ich bin sehr führsorglich, und lerne gerade dies auch mir selber zukommen zu lassen."

Supplementary file 3

26.09.24

Untersuchung	Befund	Einheit	Grafik	Referenzbereich	
Hämatologie					
Leuko	5.5	G/l		3.8 -	10.3
Ery	* **4.0**	T/l		4.1 -	5.4
Hämoglobin	128	g/l		120 -	160
HKT	0.36	l/l		0.36 -	0.48
MCV	91	fl		80 -	96
MCH	32	pg		28 -	33
MCHC	35	g/dl		32 -	36
Diff-BB Prozent					
Seg	65	%		40 -	75
Eo	3	%		0 -	7
Baso	0	%		0 -	2
Lympho	27	%		17 -	47
Mono	5	%		4 -	12
Diff-BB Absolut					
Seg	3.6	G/l		2.1 -	7.7
Eo	0.17	G/l		0 -	0.47
Baso	0.00	G/l		0 -	0.11
Lymph	1.5	G/l		1.1 -	4.5
Mono	0.3	G/l		0.2 -	0.7
Thrombozyten					
Thrombozyten	184	G/l		140 -	400
MPV	8.8	fl		7 -	12
Bluteiweißkörper					
EBK	343	µg/dl		225 -	478
Transferrin	274	mg/dl		180 -	382
Transferrinsättigung	32	%		16 -	45
Ferritin	31	µg/l		10 -	204
Serumelektrolyte					
Magnesium	0.92	mmol/l		0.66 -	1.07
Eisen	125	µg/dl		50 -	170
Vitamine/Serum					
Vitamin B12	235	pg/ml		187 -	883
Folsäure	7.7	ng/ml		3.1 -	20.5

Untersuchung	Befund	Einheit	Grafik	Referenzbereich
Vitamin D3	36	ng/ml		30 - 100
Hormone				
SHBG	115	nmol/l		
Prämenopausal: 15 - 123 nmol/l				
Postmenopausal: 17 - 124 nmol/l				
Freier Androgen Index	0.6	%		
Referenzbereich:				
Präm.: 0.7 - 8.7 %				
Postm.: 0.5 - 4.7 %				
DHEAS	136	µg/dl		56 - 283
Östradiol	115	pg/ml		
Referenzbereich:				
Foll.: 21 - 251 pg/ml				
Ovul.: 38 - 649 pg/ml				
Lut.: 21 - 312 pg/ml				
Postm.: 0 - 28 pg/ml				
Pm. mit Hor.th..: 0 - 144 pg/ml				
FSH	40.9	mIU/ml		
Referenzbereich:				
Foll.: 3.0 - 8.1 mIU/ml				
Ovul.: 2.6 - 16.7 mIU/ml				
Lut.: 1.4 - 5.5 mIU/ml				
Postm.: 26.7 - 133 mIU/ml				
LH	21.3	mIU/ml		
Referenzbereich:				
Foll.: 1.8 - 11.8 mIU/ml				
Ovul.:7.6 - 89 mIU/ml				
Lut.: 0.6 - 14 mIU/ml				
Postm.: 5.2 - 62 mIU/ml				
Progesteron	0.1	ng/ml		
Referenzbereich:				
Foll.: 0 - 0.3 ng/ml				
Luteal.: 1.2 - 16 ng/ml				
Postm.: 0 - 0.2 ng/ml				
Prolaktin	9.1	ng/ml		5.2 - 26.5
Testosteron	0.20	ng/ml		
Prämenopausal: 0.15 - 0.50 ng/ml				
Postmenopausal: 0.13 - 0.34 ng/ml				

12.08.24

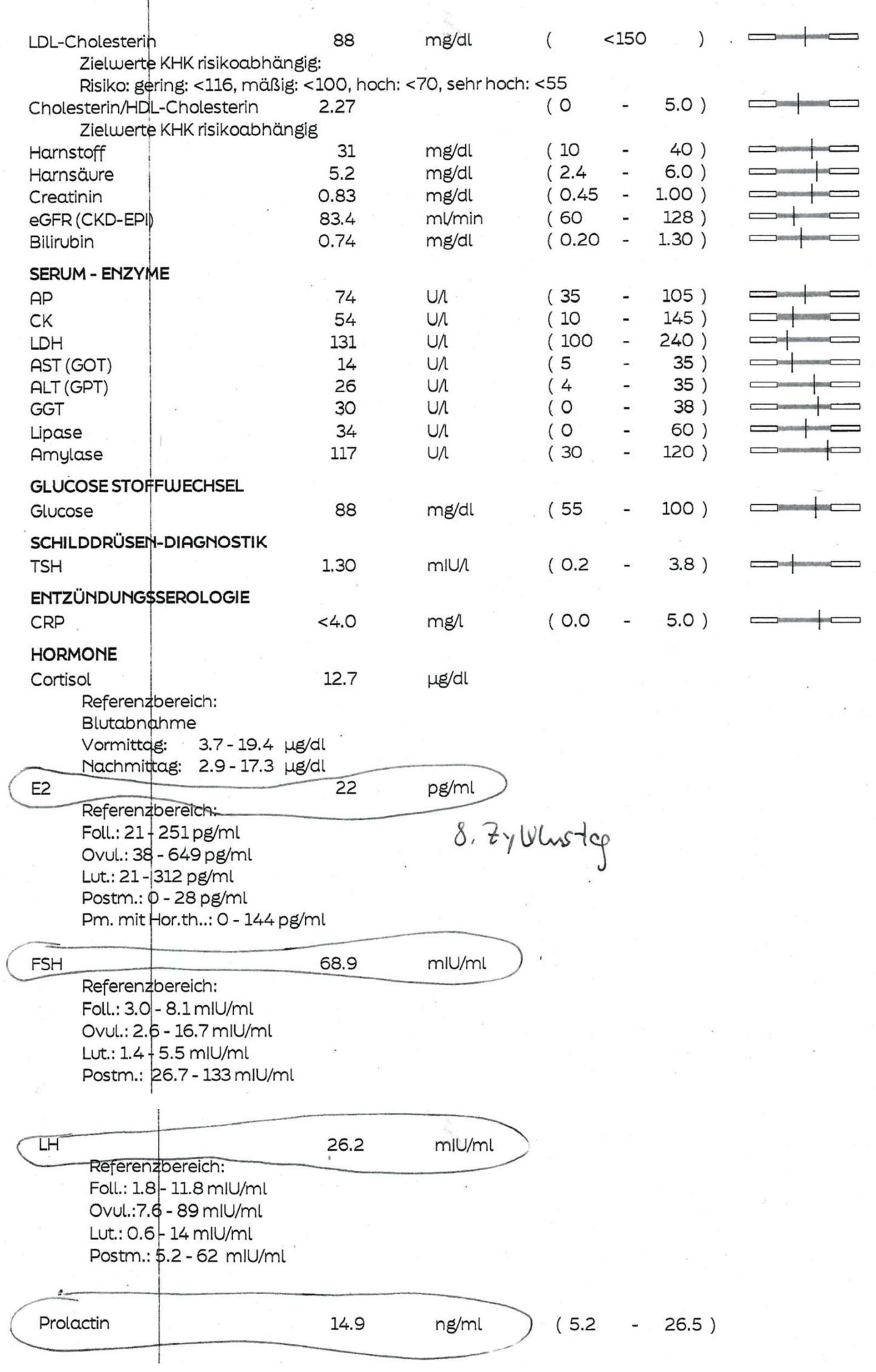
Laborbefund

Auswertung vom 12.08.2024

Harn		
Glukose	Negativ	(---)
Bilirubin	Negativ	(---)
Keton	Negativ	(---)
Spezifisches Gewicht	>=1.030	(---)
Blut	0	(---)
pH	5.5	(6-8)
Protein	Negativ	(---)
Urobilinogen	0.2	(---)
Nitrit	Negativ	(---)
Leukozyten	0	(---)

23.05.24

HÄMATOLOGIE					
Leukozyten	4.51		G/l	(4.1	- 11.3)
Erythrozyten	**4.08**	-	T/l	(4.1	- 5.1)
Hämoglobin	13.5		g/dl	(12.3	- 15.3)
Hämatokrit	38.0		%	(36	- 45)
MCV	93.0		fl	(80.0	- 97.0)
MCH	33.0		pg	(28.0	- 33.0)
MCHC	35.5		g/dl	(32.0	- 37.0)
Thrombozyten	195		G/l	(135	- 440)
Differentialzählung (%)					
Neutr. Gran.	60		%	(48	- 75)
Lymphozyten	33		%	(20	- 40)
Monozyten	5		%	(2	- 12)
Eos. Gran.	2		%	(0	- 5)
Baso. Gran.	0		%	(0	- 2)
Differentialzählung (abs.)					
Neutr. Gran. absolut	2.69		G/l	(1.80	- 7.70)
Lymph. absolut	1.47		G/l	(1.00	- 4.80)
Monozyten absolut	0.20		G/l	(0.20	- 1.00)
Eos. Gran. absolut	0.08		G/l	(0.04	- 0.45)
Baso. Gran. absolut	0.01		G/l	(0.00	- 0.20)
SERUM - EISENSTOFFWECHSEL					
Eisen	76		µg/dl	(40	- 170)
Ferritin	17		ng/ml	(15	- 500)
SERUM - MINERALSTOFFE					
Natrium	143		mmol/l	(136	- 145)
Kalium	4.3		mmol/l	(3.4	- 5.2)
Calcium	2.36		mmol/l	(2.00	- 2.65)
Magnesium	0.90		mmol/l	(0.70	- 1.10)
SERUM - CHEMIE					
Cholesterin	170		mg/dl	(	<200)
Triglyceride	34		mg/dl	(	<150)
HDL-Cholesterin	75		mg/dl	(	> 40)



Parameter	Wert	Einheit	Referenzbereich
LDL-Cholesterin	88	mg/dl	(<150)
Zielwerte KHK risikoabhängig: Risiko: gering: <116, mäßig: <100, hoch: <70, sehr hoch: <55			
Cholesterin/HDL-Cholesterin	2.27		(0 - 5.0)
Zielwerte KHK risikoabhängig			
Harnstoff	31	mg/dl	(10 - 40)
Harnsäure	5.2	mg/dl	(2.4 - 6.0)
Creatinin	0.83	mg/dl	(0.45 - 1.00)
eGFR (CKD-EPI)	83.4	ml/min	(60 - 128)
Bilirubin	0.74	mg/dl	(0.20 - 1.30)
SERUM - ENZYME			
AP	74	U/l	(35 - 105)
CK	54	U/l	(10 - 145)
LDH	131	U/l	(100 - 240)
AST (GOT)	14	U/l	(5 - 35)
ALT (GPT)	26	U/l	(4 - 35)
GGT	30	U/l	(0 - 38)
Lipase	34	U/l	(0 - 60)
Amylase	117	U/l	(30 - 120)
GLUCOSE STOFFWECHSEL			
Glucose	88	mg/dl	(55 - 100)
SCHILDDRÜSEN-DIAGNOSTIK			
TSH	1.30	mIU/l	(0.2 - 3.8)
ENTZÜNDUNGSSEROLOGIE			
CRP	<4.0	mg/l	(0.0 - 5.0)
HORMONE			
Cortisol	12.7	µg/dl	Referenzbereich: Blutabnahme Vormittag: 3.7 - 19.4 µg/dl; Nachmittag: 2.9 - 17.3 µg/dl
E2	22	pg/ml	Referenzbereich: Foll.: 21 - 251 pg/ml; Ovul.: 38 - 649 pg/ml; Lut.: 21 - 312 pg/ml; Postm.: 0 - 28 pg/ml; Pm. mit Hor.th..: 0 - 144 pg/ml
FSH	68.9	mIU/ml	Referenzbereich: Foll.: 3.0 - 8.1 mIU/ml; Ovul.: 2.6 - 16.7 mIU/ml; Lut.: 1.4 - 5.5 mIU/ml; Postm.: 26.7 - 133 mIU/ml
LH	26.2	mIU/ml	Referenzbereich: Foll.: 1.8 - 11.8 mIU/ml; Ovul.:7.6 - 89 mIU/ml; Lut.: 0.6 - 14 mIU/ml; Postm.: 5.2 - 62 mIU/ml
Prolactin	14.9	ng/ml	(5.2 - 26.5)

8. Zyklustag

Gastro, Niere, Nebenniere - ENM					
Aldosteron,basal,sitzend	4.5			ng/dL	(3.7- 43.2)
Renin, basal, sitzend	20.9			µU/mL	(5.3- 99.1)
Aldosteron/Renin-Ratio	0.2				(- 2.4)

Die Aldosteron-Renin-Ratio (ARR) wurde aufgrund der aktuellen Labormethoden an der Endokrinologie-Laborplattform berechnet.
Literatur: Pilz S. et al. Journal für Hypertonie 2019, 23 (1)

Neuroendokrinologie - ENM					
ACTH basal	15.8			pg/mL	(10.0- 46.0)

29.04.24

HÄMATOLOGIE				
Leukozyten	5.47		G/l	(4.1 - 11.3)
Erythrozyten	**4.08**	-	T/l	(4.1 - 5.1)
Hämoglobin	13.4		g/dl	(12.3 - 15.3)
Hämatokrit	38.0		%	(36 - 45)
MCV	93.1		fl	(80.0 - 97.0)
MCH	32.8		pg	(28.0 - 33.0)
MCHC	35.2		g/dl	(32.0 - 37.0)
Thrombozyten	184		G/l	(135 - 440)
Differentialzählung (%)				
Neutr. Gran.	69		%	(48 - 75)
Lymphozyten	22		%	(20 - 40)
Monozyten	6		%	(2 - 12)
Eos. Gran.	2		%	(0 - 5)
Baso. Gran.	0		%	(0 - 2)
Differentialzählung (abs.)				
Neutr. Gran. absolut	3.79		G/l	(1.80 - 7.70)
Lymph. absolut	1.20		G/l	(1.00 - 4.80)
Monozyten absolut	0.32		G/l	(0.20 - 1.00)
Eos. Gran. absolut	0.09		G/l	(0.04 - 0.45)
Baso. Gran. absolut	0.02		G/l	(0.00 - 0.20)
SERUM - EISENSTOFFWECHSEL				
Eisen	82		µg/dl	(40 - 170)
Ferritin	20		ng/ml	(15 - 500)
SERUM - MINERALSTOFFE				
Natrium	141		mmol/l	(136 - 145)
Kalium	4.2		mmol/l	(3.4 - 5.2)
Calcium	2.34		mmol/l	(2.00 - 2.65)
Magnesium	0.88		mmol/l	(0.70 - 1.10)
SERUM - CHEMIE				
Cholesterin	175		mg/dl	(<200)
Triglyceride	44		mg/dl	(<150)
HDL-Cholesterin	82		mg/dl	(> 40)

LDL-Cholesterin	84		mg/dl	(<150)
Zielwerte KHK risikoabhängig:				
Risiko: gering: <116, mäßig: <100, hoch: <70, sehr hoch: <55				
Cholesterin/HDL-Cholesterin	2.13			(0 - 5.0)
Zielwerte KHK risikoabhängig				
Harnstoff	36		mg/dl	(10 - 40)
Harnsäure	5.7		mg/dl	(2.4 - 6.0)
Creatinin	0.86		mg/dl	(0.45 - 1.00)
eGFR (CKD-EPI)	79.9		ml/min	(60 - 128)
Bilirubin	1.00		mg/dl	(0.20 - 1.30)
SERUM - ENZYME				
AP	71		U/l	(35 - 105)
LDH	114		U/l	(100 - 240)
AST (GOT)	13		U/l	(5 - 35)
ALT (GPT)	27		U/l	(4 - 35)
GGT	28		U/l	(0 - 38)
Lipase	26		U/l	(0 - 60)
Amylase	116		U/l	(30 - 120)
GLUCOSE STOFFWECHSEL				
kontrolliert.				
Glucose	85		mg/dl	(55 - 100)
HbA1c	**4.26**	-	%	(4.30 - 6.49)
HbA1c IFCC	23.1		mmol/mol	(22.9 - 47.5)
SCHILDDRÜSEN-DIAGNOSTIK				
TSH	1.47		mIU/l	(0.2 - 3.8)
fT3	5.0		pmol/l	(3.3 - 6.5)
fT4	12.0		pmol/l	(10.0 - 25.0)
ENTZÜNDUNGSSEROLOGIE				
CRP	<4.0		mg/l	(0.0 - 5.0)
VITAMINE				
Folsäure	6.3		ng/ml	(3.1 - 20.5)
Vitamin B 12	282		pg/ml	(187 - 883)
Vitamin D 3 (25-OH)	31		ng/ml	(30 - 100)
SPURENELEMENTE				
Selen	**6.9**	-	µg/dl	(7.4 - 13.9)

26.08.22

Erreger	Methode	Ergebnis	Grenzwertbereich
Antikörper gegen Bakterien			
B. burgdorferi VlsE	EIA - IgG	**1** U/ml	3-5
Borrelia burgdorferi	EIA - IgM	**negativ**	
Yersinia	EIA - IgG	**25** U/ml	10-15
Yersinia	EIA - IgA	**6** U/ml	10-15
Antikörper - Sonstige Erreger			
Chlamydia trachomatis	EIA - IgG	**7** U/ml	10-15
Chlamydia trachomatis	EIA - IgA	**<5** U/ml	9-16
Mycoplasma pneumoniae	EIA - IgG	**28** U/ml	20-30
Mycoplasma pneumoniae	EIA - IgM	**negativ** U/ml	
Antikörper gegen Viren			
Coxsackievirus	EIA - IgG	**34** U/ml	11-15
Coxsackievirus	EIA - IgA	**<4** U/ml	10-15
Parvovirus B19	EIA - IgG	**positiv**	
Parvovirus B19	EIA - IgM	**negativ**	

23.08.22

```
Anforderungstext
ggr. AC Gelenksarth.
 Autoantikörper
   ANA-Titer    1:80
   ANA          schollig nukleolär (AC-9)
   Cytopl.AK    negativ
   ENA-Screen         0.2     U/mL       (        -     1.0)
      Bei negativem ENA-Screen sind RNP70-, U1RNP-, Sm-, Ro-, La-, Scl70s-,
      CENP- und Jo-1-AK negativ.
   dsDNA-AK           3.3     U/mL       (        -    15.0)
   MPO-ANCA           1.2     U/mL       (     0.0 -    5.0)
   Pr3-ANCA           1.8     U/mL       (     0.0 -   10.0)
   p-ANCA MPO     negativ                (-negativ )
   c-ANCA PR3     negativ                (-negativ )

Med. Beurteilung
   Befund         <Text>
      Nicht signifikanter ANA-Titer. Kein spezifischer Befund.
```

22.08.22

Untersuchung	Befund	Einheit	Grafik	Referenzbereich
Blutabnahme				
am	22.08.2022			
Blutsenkung				
Blutsenkung	2	mm/h		0 - 20
Rheumaserologie				
CRP	0.8	mg/l		0 - 5
RF	<20	IU/ml		bis 30
Hämatologie				
Leuko	4.6	G/l		3.8 - 10.3
Ery	4.1	T/l		4.1 - 5.4
Hämoglobin	130	g/l		120 - 160
HKT	0.38	l/l		0.36 - 0.48
MCV	93	fl		80 - 96
MCH	32	pg		28 - 33
MCHC	34	g/dl		32 - 36
Diff-BB Prozent				
Seg	62	%		40 - 75
Eo	3	%		0 - 7
Baso	0	%		0 - 2
Lympho	30	%		17 - 47
Mono	5	%		4 - 12
Diff-BB Absolut				
Seg	2.9	G/l		2.1 - 7.7
Eo	0.14	G/l		0 - 0.47
Baso	0.00	G/l		0 - 0.11
Lymph	1.4	G/l		1.1 - 4.5
Mono	0.2	G/l		0.2 - 0.7
Gerinnung				
Thrombozyten	203	G/l		140 - 400
MPV	8.8	fl		7 - 12

Untersuchung	Befund	Einheit	Grafik	Referenzbereich
Bluteiweißkörper				
Ferritin	16	µg/l		10 - 204
Elektrophorese				
Albumin	63.4	%		55.8 - 66.1
Alfa1	3.4	%		2.9 - 4.9
Alfa2	8.3	%		7.1 - 11.8
Beta 1	6.6	%		4.7 - 7.2
Beta 2	3.7	%		3.2 - 6.5
Gamma	14.6	%		11.1 - 18.8
Elphor-Graphik	gem.			
Organ.Blutbestandteile				
Harnsäure	5.1	mg/dl		2.5 - 6.2
Vitamine/Serum				
Vitamin D3	44	ng/ml		30 - 100
weitergeleitet an				
Hygiene-Institut	Chlamydien			
Immunologie/LKH	ANA, ANCA			
Infektionsserologie				
Borrelien IgG Negativ	<5.0	U/ml		0 - 10
Borrelien IgM Negativ	<0.10	INDEX		0 - 0.9
Beurteilung Borrelien:	/			

Kein Nachweis spezifischer Borrelien-Antikörper.
Bei weiter bestehendem klinischen Verdacht ggf. Kontrolle nach drei bis vier Wochen (verzögerte Antikörperbildung möglich).

SARS-CoV-2 S1/S2 IgG	1430.0	BAU/ml		über 33.8

Neutralisierende Antikörper gegen SARS-CoV-2 nachweisbar.

SARS-CoV-2 IgG Nukleokapsid	0.0	Index		über 1.4

19.03.21

Test	Ergebnis	Einheit	Normbereich	Vorwert
Speichelanalytik				
Hormon Profil (Speichel)				
Cortisol	0,80	ng/ml	3 - 9	
Progesteron	50,67	pg/ml	87,3 - 544,3	
			Follikelphase: 30,3 - 51,3 pg/ml Lutealphase: 87,3 - 544,3 pg/ml Postmenopause: 21,0 - 69,0 pg/ml Phasenbezogene Normwerte bei Probenentnahme außerhalb der Lutealphase.	
Östradiol	1,90	pg/ml	1,76 - 4,99	
			Follikelphase: 0,80 - 7,70 pg/ml Ovulationsphase: 3,40 - 14,30 pg/ml Lutealphase: 1,76 - 4,99 pg/ml Postmenopause 1,10 - 3,80 pg/ml Phasenbezogene Normwerte bei Probenentnahme außerhalb der Lutealphase.	
Progesteron/Östradiol/Quotient	26,67	Quotient	30 - 50	
Testosteron	9,26	pg/ml	7,7 - 39	
DHEA	117,56	pg/ml	130 - 490	