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Restytucja wielkości cech postawy w płaszczyźnie czołowej po obciążenia masą transportowanych przyborów szkolnych w trybie ciągu lewą i prawą ręką uczniów obojga płci w wieku 7 lat

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Ocena postawy ciała gimnazjalistów w kontekście ich aktywności fizycznej

Assessment of body posture of junior high school students in the context of their physical activity

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Multimodal programmes in the treatment of myofascial pain syndrome (MPS) – a two-step review

Programy multimodalne w leczeniu zespołu bólu mięśniowo-powięziowego (MPS) – przegląd dwuetapowy

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Abstract
Myofascial pain syndrome (MPS) is one of the most common ailments associated with the human musculoskeletal system, characterised by the presence of the so-called trigger points (TrP – trigger point; MTrPs – myofascial trigger points). The International Association for the Study of Pain indicates that MPS may affect approximately one-third of people with chronic musculoskeletal pain, and that there is a lack of appropriate classification which can be attributed to a misunderstanding and/or misinterpretation of the pathophysiology. Given the diverse causes of pain syndromes in myofascial structures, it is vital to properly select and integrate therapeutic methods. The scientific literature indicates that treatment programmes should include a variety of manual therapy methods and rehabilitation exercises. Trigger point therapies, such as dry needling or dry cupping, are also widely used. At the heart of the success of rehabilitation programmes, in the opinion of the authors of this publication, is their multimodality, i.e. selection of therapeutic methods based on the cause of the pain, providing for measurable, reproducible diagnostic methods in therapy.
Aim of the study. The aim of this study is to analyse and infer conclusions on multimodal myofascial pain therapy programmes.
Material and methods. Given the complex research problem set as the aim, the study was carried out through a literature review in terms of two criteria:
Criterion I (C I): analysis of the literature on the etiology and pathogenesis of myofascial pain (i.e. causes and triggers, symptoms, social and environmental factors determining the onset of MPS), diagnostic procedures (initial diagnosis and ongoing monitoring of treatment outcomes), and therapeutic methods used in the course of MPS.
Criterion II (C II): a literature study of research publications addressing multimodal programmes for myofascial pain therapy, with their qualitative evaluation using the modified PEDro scale, and empirical testing of hypotheses based on the literature study and the analysis made in Part I.
Data sources: PubMed, SCOPUS, Science Direct, MEDLINE, PEDro, Cochrane, Embase, Web of Science Core Collection, Google Scholar electronic databases were searched systematically, restricting the languages to English and German only.
Results. The analysis of the literature showed that the causes, symptoms and associations of myofascial pain have been described in detail. There are also numerous reports on a variety of therapeutic methods, together with a precisely described methodology for their implementation. It is not uncommon to recommend combining methods into multimodal programmes, which unfortunately does not mean that there are many such programmes or that studies on MPS are consistent. The literature study on multimodal treatment programmes for MPS revealed that there is no correlation between its pathogenesis and a purposeful selection of specific therapeutic methods. In a small number of cases, a complex etiopathogenesis led to the formation of multidisciplinary teams. This may be associated with the absence of strict recommendations on the diagnostic methods applicable to the assessment of MPS.
Conclusions. 1. Multimodal programmes for the treatment of musculoskeletal pain, notably MPS and MTrPs, should include a detailed and comprehensive diagnosis (structural, biochemical, psycho-emotional) which should serve as the basis for the formation of interdisciplinary rehabilitation teams. 2. Musculoskeletal diagnosis, in addition to radiological assessment, should include measurable techniques of postural and functional assessment (such as pedobarography, wearable sensors, assisted anthropometry, i.e. photogrammetry, videogrammetry, etc.), aimed primarily at the ongoing assessment of posture. 3. The choice of therapeutic methods and patient education should be based on the causes of the patient's pain, taking into account systemic diseases, postural defects, lifestyle and psycho-emotional state. 4. Scientific research in multimodal treatment programmes should be carried out in randomised groups, with due attention to the methodologies of diagnostic and therapeutic procedures and group selection.

Keywords
chronic pain, myofascial pain, manual therapy, exercise, multimodal programmes

Streszczenie
Zespół bólu mięśniowo-powięziowego (MPS) jest jedną z najczęstszych dolegliwości związanych z układem mięśniowo-szkieletowym człowieka, charakteryzującą się obecnością tzw. punktów spustowych (TrP – trigger point; MPs – myofascial trigger points). International Association for the Study of Pain wskazuje, że MPS może dotyczyć około jednej trzeciej osób z przewlekłym bólem mięśniowo-szkieletowym oraz że brak jest odpowiedniej klasyfikacji, co można przypisać niezrozumieniu i/lub błędnej interpretacji patofizjologii. Biorąc pod uwagę różnorodne przyczyny powstawania zespołów bólowych w strukturach mięśniowo-powięziowych, istotny jest właściwy dobór i integracja metod terapeutycznych. Literatura naukowa wskazuje, że programy leczenia powinny obejmować różnorodne metody terapii manualnej oraz ćwiczenia rehabilitacyjne. Powszechnie stosowane są również terapie punktów spustowych, takie jak suche igłowanie lub suche bańki. U podstaw sukcesu programów rehabilitacyjnych, zdaniem autorów niniejszej publikacji, leży ich multimodalność, czyli dobór metod terapeutycznych w oparciu o przyczynę bólu, zapewniający mierzalne, powtarzalne metody diagnostyczne w terapii. Celem tego badania jest analiza i wyciągnięcie wniosków na temat multimodalnych programów terapii bólu mięśniowo-powięziowego. Materiał i metody. Biorąc pod uwagę złożony problem badawczy, jaki postawiono za cel, badanie przeprowadzono poprzez przegląd literatury pod kątem dwóch kryteriów:
Kryterium I (C I): analiza piśmiennictwa dotyczącego etiologii i patogenezy bólu mięśniowo-powięziowego (tj. przyczyn i wyzwalaczy, objawów, czynników społecznych i środowiskowych determinujących wystąpienie MPS), postępowania diagnostycznego (wstępna diagnostyka i bieżąca obserwacja wyników leczenia), i metody terapeutyczne stosowane w przebiegu MPS.
Kryterium II (C II): studium literaturowe publikacji naukowych dotyczących multimodalnych programów terapii bólu mięśniowo-powięziowego wraz z ich oceną jakościową przy użyciu zmodyfikowanej skali PEDro oraz empiryczne testowanie hipotez w oparciu o studium literaturowe i analizę dokonaną w części I .
Źródła danych: PubMed, SCOPUS, Science Direct, MEDLINE, PEDro, Cochrane, Embase, Web of Science Core Collection, Google Scholar systematycznie przeszukiwano elektroniczne bazy danych, ograniczając języki tylko do angielskiego i niemieckiego.
Wyniki. Analiza piśmiennictwa wykazała, że szczegółowo opisano przyczyny, objawy i powiązania bólu mięśniowo-powięziowego. Istnieją również liczne doniesienia o różnych metodach terapeutycznych wraz z dokładnie opisaną metodologią ich realizacji. Nierzadko zaleca się łączenie metod w programy multimodalne, co niestety nie oznacza, że takich programów jest wiele i że badania nad MPS są spójne. Studium literaturowe dotyczące multimodalnych programów leczenia MPS wykazało, że nie ma związku między jego patogenezą a celowym doborem określonych metod terapeutycznych. W niewielkiej liczbie przypadków złożona etiopatogeneza doprowadziła do powstania zespołów wielodyscyplinarnych. Może to być związane z brakiem ścisłych zaleceń dotyczących metod diagnostycznych mających zastosowanie do oceny MPS.
Wnioski. 1. Multimodalne programy leczenia bólów narządu ruchu, zwłaszcza MPS i MPPS, powinny zawierać szczegółową i kompleksową diagnostykę (strukturalną, biochemiczną, psychoemocjonalną), która powinna stanowić podstawę do tworzenia interdyscyplinarnych zespołów rehabilitacyjnych. 2. Diagnostyka narządu ruchu, oprócz oceny radiologicznej, powinna obejmować mierzalne techniki oceny posturalnej i funkcjonalnej (takie jak pedobarografia, czujniki ubieralne, antropometria wspomagana, tj. postawy.
3. Wybór metod terapeutycznych i edukacja pacjenta powinny być oparte na przyczynach dolegliwości bólowych pacjenta, z uwzględnieniem chorób ogólnoustrojowych, wad postawy, stylu życia i stanu psychoemocjonalnego. 4. Badania naukowe nad multimodalnymi programami leczenia powinny być prowadzone w grupach losowych, z należytym uwzględnieniem metodologii postępowania diagnostyczno-terapeutycznego oraz doboru grup.

Słowa kluczowe
ból przewlekły, ból mięśniowo-powięziowy, terapia manualna, ćwiczenia, programy multimodalne

Introduction

Approximately 85% of the human population experience myofascial pain at least once in their lifetime [1]. Its prevalence varies, ranging from 21% of patients presenting with orthopedic problems up to even 93% of patients undergoing treatment at pain management centres [2]. Overall, musculoskeletal pain has been shown to affect about 26% of the adult population, 39% of the elderly population and about 86% of workers [3]. MPS often leads to disability, accounting for approx. 40–50% of the economic cost associated with disorders affecting the quality of work in the European Community. These disorders are not life-threatening, but have a definite impact on the quality of life, psychosocial status, etc. [4–6].

The onset of specific myofascial pain may be acute (although this is not a rule) with concomitant autonomic symptoms [7–8]. Chronic pain in myofascial structures is often a complex condition with no clear clinical definition, while the recurrence and persistence of symptoms complicates the process of planning and selecting therapeutic approaches [9–11].

MPS is often defined as a pain syndrome in a specific area of the body, which may coexist with one or more pain foci, or the so-called trigger points [12–13]. While the pain foci have been defined in different ways, it is becoming increasingly common to refer to them as myofascial trigger points (MTrPs) [13–16]. Recurrent MPS has been shown to be closely associated with the presence of MTrPs [9–10, 17–18]. Trigger points are a common reason for patients presenting to primary care and pain clinics [19–21].

Myofascial pain, triggered by MTrPs, manifests itself as areas/spots/bands of tense myofascial tissue [17, 22–25]. When pressed, they can elicit local and radiating pain. The pain may cause the patient to restrict their mobility, which in the long term can lead to motor dysfunction. Pain also significantly contributes to the development of symptoms associated with the autonomic system [13, 23, 26–32]. Autonomic symptoms include vasodilation or vasoconstriction, lacrimation (tearing), piloerection (hair standing) [33–36]. Active trigger points may cause spontaneous pain, while latent points are only painful upon compression [21, 23, 26–28, 37]. Pressure, needle insertion and other methods of trigger point stimulation can elicit a local twitch response, defined as an involuntary, rhythmic muscle contraction at or near the MTrP site [21, 38]. The location of the twitch response is easier to identify in the case of active trigger points [23, 39–40].

Upon physical examination, MTrP sites show an altered muscle tone, hypersensitivity to touch, often during stretching, leading to restriction of movement or eliciting jump sign. Sometimes there is a palpable or even visible tremor [7, 22]. For the most part, patients describe trigger points as a significantly unpleasant sensory and emotional experience. Depending on the actual and potential tissue damage, the patient's subjective perception may differ [41].

Myofascial pain can be classified in a number of ways, as acute or chronic, neurogenic, accompanying inflammation, visceral, somatic, nociceptive, etc. [42–43]. Depending on the location of the pain, MTrPs can trigger focal or referred pain (felt at a site distant from the site of the painful stimulus). [31, 44–46]. Sustained contractile activity of a trigger point in the muscle induces local ischemia, hypoxia and changes at nociceptors, leading to pain in deep myofascial structures and at distant locations [1]. The muscle fascia contains mechanoreceptors sensitive to changes in length, muscle tension and neurological stimuli. Some theories cite abnormalities in fascial structures as the main factor in MPS development [47–48]. MTrPs can develop in different muscle groups, but they are most common in the sternocleidomastoid, trapezius, levator scapulae, infraspinatus, and rhomboid muscles of the upper back and neck [49–52]. Chronic headache, including migraine, and chronic complaints in the upper quadrant (quarter pain), as well as craniofacial complaints are often attributed to MTrPs [20, 53–57]. Myofascial pain has also been shown to affect 95.5% of patients with low back pain, occurring in the paraspinal, piriformis, tensor fascia lata muscles [58] and also in patients with intervertebral disc diseases [59] and spinal cord compression. [60]. According to the research literature, myofascial pain and associated trigger points can occur in almost any musculoskeletal ailment, including tendonitis [61], craniomandibular dysfunctions [62–63], in the course of carpal tunnel syndrome [64], pelvic pain and urologic diseases, etc. [65–68]. The research literature also refers to the phenomenon of chronic MPS as a postoperative complication. It is defined as moderate to severe pain lasting at least three months after surgery [69]. For instance, chronic postsurgical pain (CPSP) of neuropathic origin persisting beyond the normal healing time is reported by 6–10% of patients undergoing total knee arthroplasty [70]. This phenomenon should be recognised as a serious health problem, seeing as prolonged postoperative use of opioids and adjuvant analgesics represents a risk of addiction in total knee arthroplasty (TKA) patients, leading to significant economic costs for this group [70–71].

It should be emphasised that symptoms have been challenged to varying degrees, which may be related to misidentified pathophysiology [72–74].

Aim of the study

The aim of this study is to identify the relationships between the multifaceted etiopathogenesis of myofascial pain and the development of multimodal programmes for managing MPS and, as a consequence of the above considerations, to conduct an analysis on the selection of appropriate diagnostic and therapeutic methods and the formation of an interdisciplinary team.

Materials and methodology of the study

The papers included in the literature analysis below were dedicated to a detailed investigation of the causes, symptoms and impact of systemic diseases and external factors on the formation of MPS. The results of this analysis helped guide further research, involving on a review of the literature on multimodal treatment programmes for MPS. Given that the research and analysis was carried out in two stages, the aim was pursued through a database search according to two sets of search criteria:

Criterion I (C I): analysis of the literature on the etiopathogenesis of myofascial pain (i.e. causes and triggers, symptoms, social and environmental factors determining the onset of MPS), therapeutic methods used in the course of MPS and diagnostic procedures (initial diagnosis and ongoing monitoring of treatment outcomes).

Source of data (C I): PubMed, MEDLINE, PEDro, Web of Science Core Collection, Cochrane, Embase, Google Scholar. Search keywords: myofascial pain syndrome, myofascial trigger point, and these keywords in combination with: manual therapy, muscle energy techniques, joint mobilization, neuromobilization, dry needling, dry cupping, kinesiotaping, therapeutic exercises, home exercises, patient education.

Inclusion criteria (C I): the papers included in the analysis had to be published in peer-reviewed journals, in English and one article in German, discussing scientific research studies relevant to the aim and main issue of this review. Only content confirmed in more than 3 peer-reviewed publications was analysed.

Exclusion criteria (C I): content at the stage of hypothesis, research projects, expert opinions, etc. was not accepted for analysis.

Criterion II (C II): a literature study of research publications addressing multimodal programmes for myofascial pain therapy, with their qualitative evaluation using the modified PEDro scale, and empirical testing of hypotheses based on the literature study and analysis made in Part I.

The literature was tested through the authors' research hypotheses (H), formed on the basis of the literature study in Part I, that is:
H1: Multimodal treatment programmes for MPS rely on the strict methodology of scientific research work
a. They account for age, sex, weight, with a multi-centre approach to patient selection,
b. Participant selection takes place by random sampling, with the use of blinding (therapist/patient, sample, etc.), follow-up, intention to treat, comparison of groups, final score estimation, statistical analysis,
H2: The selection of therapeutic methods to be included in a multimodal treatment programme for MPS is based on a detailed diagnosis (measurable, reproducible, objective) of the patient's condition, including comorbidities,
H3: In the case of comorbidities associated with MPS, a multidisciplinary team is set up,
H4: Therapeutic methods and patient education are selected depending on the diagnosis.

Source of data (C II): Database search was conducted in PubMed, MEDLINE, PEDro, Web of Science Core Collection, Cochrane, Embase, Google Scholar. Searched keywords were: myofascial pain syndrome and myofascial trigger point, and these keywords in combination with: myofascial pain and myofascial pain in combination with multimodal, multi-modal, approach, integrated methods, treatment, non-invasive treatment, interdisciplinary multimodal pain therapy.

Inclusion criteria (C II): the papers included in the analysis had to be published in peer-reviewed journals, in English, discussing scientific research studies relevant to the aims and main issue of this review, in which multimodal treatment programmes were implemented and evaluated. The analysed content addressed MPS treatment programmes with a description of integrated programmes and/or provided for a role of multidisciplinary teams. Thus, our analysis included articles that described 2 or more rehabilitation methods (e.g. manual therapy, exercise, dry needling, dry cupping) and/or physical therapy and/or diet therapy, psychotherapy, etc.

Exclusion criteria (C II): content at the stage of hypothesis, research projects, expert opinions, etc. was not accepted for analysis. Also excluded were manuscripts containing recommendations for multimodal treatment programmes based on a literature review (those were included in Part I of this study). Moreover, articles on pharmacological and surgical methods and articles indicative of research work focusing on only one rehabilitation method were excluded from the analysis.

Main issue – Criterion I
Etiopathogenesis of myofascial pain
The causes of myofascial pain and MTrPs, and the resulting impairment of musculoskeletal function, are not entirely clear. One concept is the release of neurovasoactive substances (i.e. bradykinin (BK), prostaglandin, interleukin-1β, substance P), which enhance nociceptor sensitivity and vascular permeability, leading to edema. Consequently, the pressure on the capillaries and restriction of blood supply causes local ischemia, increasing the release of substance P, which exacerbates tissue irritation. Another theory, of the so-called motor end plate, points to a neuromuscular connection by which painful contraction, triggered by the release of acetylcholine, leads to the release of calcium stored in the muscles and sarcomere shortening. There is also a theory whereby hypersensitive points arise as reflex disorders due to the improper functioning of spinal nerves and/or abnormalities in the spine [43, 75–85]. Lastly, patients with myofascial pain were found to present pathological changes in red fibres, known as "moth-eaten fibres" [86–90].
The musculoskeletal system is the largest organ in the human body, and its system of force and pressure distribution can be associated with different types of pain, often coexisting not only with problems specific to musculoskeletal structures, but also with systemic diseases, postural defects, psycho-emotional disorders, etc. [42, 50, 91]. The most commonly reported causes of MTrPs include trauma and structural overload [16, 36, 92–95], coexisting osteoarticular and neurological dysfunctions [14, 45, 96–100], psycho-emotional state and stress [101], and damage to muscle fibres [17, 102–104]. Other causes of myofascial pain include adaptive and eccentric muscle lengthening, postural defects, joint hypermobility, inappropriate physical and social conditions – these can activate MTrPs [17, 105]. Myofascial trigger points may be associated with other pain syndromes [106], i.e. postherpetic neuralgia [107–108], complex regional pain syndrome and phantom pain [109–110], muscle spasms [111], and rare diseases etc. [112–113].
As a result, each of these factors impairs the supply of oxygen and nutrients to tissues, resulting in compensatory shortening of the muscles and consequently increased metabolic demand on the tissues [23, 114]. Researchers have also implicated nutritional deficiencies (vitamin C, B, D, iron, zinc, folic acid) and fo-

od intolerances (e.g. lactose, casein, gluten) in activating MTrPs [93, 105, 115–118].

Diagnosis of myofascial structures and posture

Detailed history, gait and posture analysis, palpation and compression, functional assessment (ranges of motion), assessment of referred pain projection and local twitch response all contribute to an accurate diagnosis, but there are no clearly defined methods enabling an unambiguous diagnosis of trigger points [119–121]. Taut bands of muscle fibre can be identified by electromyography [122], sonoelastography [123], thermography (infrared imaging) [124], and magnetic resonance imaging [125]. Biochemical diagnostics have been performed, too [126].

Diagnostic procedures and monitoring are also recommended to track progress in therapy using all integrated therapeutic methods. The methods for assessing the effects of manual therapy, exercise, stretching, joint mobilization etc. should be measurable, objective and reproducible, which is where computer techniques can come in, measuring ranges of motion, muscle performance, and general movement patterns (such as pelvic kinematics, gait, balance etc.). These include sensor systems for postural and functional assessment [127–131], pedobarography [132–138], videogrammetry, photogrammetry etc. They are applicable both in the initial evaluation, ongoing monitoring and in planning further stages of therapy, postural reeducation and stabilization [139–146].

Progress monitoring in therapy, but also follow-ups at specific time points after therapy, are important due to the perpetuating factors promoting the persistence of myofascial pain. These include mechanical problems (e.g. head protraction, pelvic torsion, biomechanical disorders), psycho-emotional (e.g. stress), nutritional and metabolic factors [21, 31, 147]. The management of perpetuating factors requires the inclusion of a multidisciplinary team [105].

Non-pharmacological and non-surgical therapies for myofascial structures used in myofascial pain

<u>Manual therapy</u>

The efficacy of various manual therapy techniques can be attributed mainly to the effects of oxygen and nutrient uptake, both during the treatment and during the release and relaxation of structures in the course of manual therapy [20]. The techniques used in the treatment of myofascial pain, in addition to classic massage, include ischemic compression for the treatment of MTrPs, muscle energy technique (MET), strain-counterstrain, spray and stretch, static stretching, transverse friction massage, joint mobilization or manipulation, and other soft tissue mobilization techniques [148–157]. Muscle energy techniques aim to cause the muscle to lengthen, strengthen, to reduce swelling and relieve passive congestion. They produce a rapid therapeutic effect in the course of acute pain in myofascial structures [158–160]. METs are also widely used for joints with restricted mobility [161–162], as are some other methods, e.g. AKA-H (arthrokinematic approach-Hakata) or HVLA (high velocity low amplitude), intended to improve joint glide, which also produces an indirect effect on the functionality of myofascial structures [163–166]. At this point, it is worth emphasising that, in terms of the range of motion, depending on the pathophysiology of the pain, for any therapeutic intervention to be effective, manual therapy must address both myofascial and joint structures. This knowledge inspired the development of therapeutic approaches combining these two aspects, such as e.g. the Mulligan concept, the SNAG (sustained natural apophyseal glide) technique, which involves the application of accessory passive glide along the joint plane while the patient simultaneously performs an active movement, under loading conditions [167]. This consequently improves the functionality of the structures and increases the range of motion [167–170]. In pain therapy, it is important to restore nerve mobility relative to adjacent structures, which can be achieved by manual therapy using neural mobilization techniques. If the intervention is applied as early as possible, it may be possible to avoid morphological changes in neural structures [171–172].

In manual therapy procedures, apart from the local approaches, an important role is played by the tensegrity concept, i.e. a holistic approach based on structural integration. It has been shown time and again to be one of the most effective rehabilitation methods in balancing musculoskeletal strains and relieving chronic myofascial pain, including trigger point therapy [173–175]. This is important mainly because excessive tension in tissues represents a damaging stimulus which is distributed in the human body in a linear manner [176–178]. Pain originating in myofascial structures can therefore be felt at a different location (sometimes even quite distant) than the initial pain stimulus, or TrP [179–183]. The inclusion of tensegrity models in diagnosis and therapy helps restore structural balance in the patient's body. It is an important aspect of MPS therapy, with implications for increasing structural functionality, proper force/load distribution, and activation of stabilising muscles [182]. As a result of this intervention, muscles regain the important functions of cushioning, anti-gravity and stabilization of osteoarticular structures [173–174, 182, 184]. This is particularly relevant in chronic and recurrent pain, e.g. low back pain [176–178]. Integrated manual therapy methods include myofascial release (MFR) [185–161] and osteopathic techniques (osteopathic manipulative treatment – OMT). OMTs are used to treat myofascial structures, as well as joint manipulation and mobilization (including MET), and visceral manipulation (of the internal organs) [158–159, 191].

<u>Therapeutic methods dedicated to the elimination of MTrPs</u>

Equally effective and popular interventions are aimed at eliminating trigger points, and involve the local application of needles (dry needling) or cups (dry cupping) [20]. Dry needling can be used in the treatment of pain of myofascial origin in all regions of the body, e.g. head, back [22, 150, 192], lower and upper limbs [150, 193–194], etc. The main effects of dry needling include pain relief, through stimulating the spinal cord and sympathetic response, activation of biochemical changes in tissues through improving local microcirculation, reduction of chemical mediators and induction of an immune response [192]. Research studies have also shown that dry needling corrects the levels nociceptive chemicals, such as bradykinin, calcitonin-gene-related peptide, and substance P [22]. Stimulation of alpha-delta nerve fibres leads to the release of endorphins and enkephalins [150,192,195]. It has been suggested that this process results in opioid-mediated pain suppression [197]. All these processes help reduce muscle tension and increase range of motion in myofascial structures, thereby reducing pain [198]. The insertion of a needle at the trigger point as well as palpation can elicit a twitch response [23, 26–28]. Some studies indicate that the analgesic and relaxing effect is achieved as a result of the twitching induced by dry needling [23, 39, 199].

Trigger points can also be managed by dry cupping, which are used in the treatment of painful trigger points, increased tension and other complaints related to myofascial structures mainly to increase subcutaneous blood flow and dilate blood vessels, which improves microcirculation, relieving muscle tension and promoting healing. These metabolic effects are similar to those of dry needling [200]. Dry needling treatments are usually followed by stretching exercises [32].

Improved local blood flow, regeneration of pain points and normalization of tension in the fascial system with reduced pressure on pain receptors can also be achieved with elastic therapeutic tape (Kinesio Taping – KT). It augments lymph circulation, reduces swelling and enables local decompression. It is also used to relax and mobilize long structures and in therapies based on the anatomy trains concept [201–205].

Physical therapy in the treatment of myofascial pain

Physical therapy treatments are widely used in the management of pain in myofascial structures:

• shockwave therapy – is designed to normalise tension in myofascial structures and eliminate MTrPs, both active and latent [206–207],

• magnet therapy, which through the use of a constant and slowly changing magnetic field increases the secretion of opiates from the β-endorphin group, thereby increasing pain response latency and the pain threshold [185,208–212],

• electrotherapy and electrical stimulation, which promotes the release of adenosine triphosphate (ATP), seeing as low ATP levels may be responsible for the activation of MTrPs [211–213],

• ultrasound therapy, which works on both active and latent trigger points [196, 214–215].

Pain in the pelvic area, of urologic or gynecologic origin, can be situated inside the body. This is an important aspect, mainly due to the need for adapting therapeutic methods and sometimes employing additional therapeutic tools [216–217]. Despite the fact that laser therapy, as a matter of principle, improves microcirculation and eliminates metabolic by-products from tissues, it has been demonstrated that placebo treatment produced better effects than low-level laser therapy (LLLT) [160].

Rehabilitation exercises as part of therapy and home exercise

Next to manual therapy, exercise plays an important role in the rehabilitation of myofascial pain. However, in this case, too, the type of exercise depends on the therapeutic goal, ranging from decompression and relaxation exercises for pain relief (e.g. the McKenzie method) [160, 218–220] to core stability exercise with strength training, such as Yoga [221–223]. Eccentric exercises have been shown to have a positive effect in the therapy of both active and latent trigger points [224–226]. Stretching exercises and Yoga also improve respiratory function and the psycho-emotional state of pain patients, which is an important aspect in the therapy of pain, both acute and chronic [227–228]. Core stability training has the important role of reducing structural instability, which is important in the prevention of recurrent pain syndromes in affected tissues, particularly in spinal pain [229–231]. Core stability training is more effective if performed using rehabilitative ultrasound imaging of isolated muscle groups, aiming to ensure proper contraction while maintaining joint mobility [232–235].

Patient education

Patient education, particularly in the case of chronic myofascial pain, is aimed at providing knowledge on pain management, regulation of rest and physical activity. A cognitive-behavioural intervention is also required, involving pain neuroscience education, belief revision, and helping accept and adapt to flare-ups and (temporary or permanent) disability [236–238]. Learning to manage flare-ups includes both stress management and the implementation of various elements of self-therapy, e.g. relaxation, decompression techniques etc. [239–241].

Manual therapy (MT) and exercise, performed during therapy sessions as well as at the patient's home, are effective, but recommendations and the research literature are not always clear on how often they should be applied for the optimal effect [22]. The combination of MT and exercise with dry needling produces therapeutic effects in both chronic pain and postoperative conditions [242–243]. These are relatively low-cost and minimally invasive techniques, producing similar short-term analgesic effects [244].

Our literature study according to Criterion I enabled us to identify the problem of multifaceted etiopathogenesis of MPS, which points to the need for multimodal programmes in the treatment of myofascial pain, targeting the specific cause.

Based on the literature study, the different causes (pathogenesis) of MTrPs and myofascial pain have been matched to their dedicated therapeutic approaches, as summarised in Table 1.

Table 1. An overview of the causes of MTrPs with the therapeutic approaches aimed at eliminating the cause/pathogenic factors

Cause	Therapeutic method targeting the cause
Active and/or latent trigger points in general, local pain syndromes and phantom pains (also with concomitant swelling, local fever)	Methods to eliminate pain: • manual therapy – ischemic compression, • local methods: dry needling and dry cupping, kinesiotaping, • manual therapy: MET, • strain-counterstrain, • spray and stretch technique.

Cause	Therapeutic method targeting the cause
Trigger points caused by nerve compression or entrapment (without signs of swelling or local fever, with radiating pain)	Manual therapy based on neural mobilization
Trigger points and myofascial pain caused by long-term joint immobilization.	• Bone and joint mobilisation: MET, HVLA, AKA-H, • myofascial therapy using structural integration procedures (tensegrity) e.g. according to the anatomy trains concept – MFR, OMT, • exercise: the McKenzie method, Yoga.
Trigger points coexisting with remote pain; Postural defects	• Myofascial therapy using structural integration procedures (tensegrity) e.g. according to the anatomy trains concept – MFR, OMT, • stretching exercises: the McKenzie method, Yoga, • corrective exercises for strength and stability training.
Pain of psycho-emotional origin	Therapeutic methods targeting the cause of myofascial pain and psychotherapy (a multidisciplinary team including a psychotherapist).
Pain caused by nutritional deficiencies	Therapeutic methods targeting the cause of myofascial pain and clinical nutritional therapy (a multidisciplinary team including a nutritionist, biochemistry specialist).
Systemic diseases	A multidisciplinary team including a specialist in the field dedicated to the treatment of the patient's specific disease entity

The above literature study has raised important questions about the procedures undertaken in the treatment of myofascial pain. These questions then became the foundation for the literature analysis in Part Two.

Main issue – Criterion II

The literature review in Part I revealed the high complexity and multifaceted nature of the pathogenesis of MPS. It also identified a number of therapeutic approaches to the treatment of MPS, targeting the specific cause and symptoms of myofascial pain. Most research studies mention the need for the integration of therapeutic approaches and a multidisciplinary approach to MPS. Our quantitative analysis showed, however, that there are few randomised trials investigating multimodal treatment programmes for MPS that would simultaneously address the following three important aspects: method selection based on etiopathogenesis, integration of therapeutic approaches and interdisciplinarity of the treatment team. For the most part, such comprehensive studies were based on literature reviews. There are many studies on the efficacy of a specific therapeutic method based on case studies, whose findings should be treated with caution as they do not represent the entire population. The literature analysis also revealed a great deal of inconsistencies and a lack of clear recommendations regarding diagnostic methods for MPS.

For our detailed analysis, we selected seven articles on multimodal programmes which reported on research with groups of patients. The findings, together with the auxiliary questions to test the hypotheses, are shown in Tables 2–6.

Table 2. Testing H1: Background information on sample size, sex, age, weight and location of patients (i.e. single-centre or multicentre study)

Test questions	Articles included in the analysis						
	1[245]	2[10]	3[246]	4[247]	5[248]	6[249]	7[217]
Sample size [number of people]	150	72	9	14	120	120	393
Age (minimum) [0–no data, or age given]	0	18	20–40	0	0	18	18
Age (maximum) [0–no data, or age given]	0	65	65	0	0	18 years plus	80

Test questions	Articles included in the analysis						
	1[245]	2[10]	3[246]	4[247]	5[248]	6[249]	7[217]
Number of male patients [0–no data, or number of male patients given]	0	0	0	0	0	0	314
Number of female patients [0–no data, or number of female patients given]	0	0	0	0	0	0	79
BMI [0–no data, or result given]	0	0	21 ± 3.29	0	0	0	0
Number of centres participating in the study [number]	1	1	1	1	1	1	1

Table 3. Methodology testing using the modified PEDro scale [250]

Test questions	Articles included in the analysis						
	1[245]	2[10]	3[246]	4[247]	5[248]	6[249]	7[217]
Was there a research protocol with inclusion and exclusion criteria?	1	1	1	1	1	1	0
With randomisation (random allocation of patients into groups)?	0	1	0	0	1	1	0
Was group allocation blinded?	0	1	0	0	1	1	0
Were study groups analysed statistically for homogeneity of patient characteristics and baseline measurements (in the research tools used in the study)?	0	1	0	0	1	1	0
Was a single-blind design used (with the patients unaware of their allocation to the treatment or control group)?	0	0	0	0	0	0	0
Was a double-blind design used (with the researchers responsible for therapy unaware of the patients' group allocation to the treatment or control group)?	0	0	0	0	0	0	0
Was a double-blind design used (with the researchers responsible for diagnostics unaware of the patients' group allocation to the treatment or control group)?	0	0	0	0	1	1	0
Were the patients subjected to follow-up after completion of the study?	1	1	1	0	1	1	1
Was the study conducted with the intention to treat?	1	1	1	1	1	1	1
Were the results analysed statistically by intergroup comparisons?	1	1	0	0	1	1	0
Did the analysis include variability measurements and final point estimation?	1	1	0	0	1	0	0
Were treatment outcomes analysed statistically?	1	1	1	1	1	1	1

Key – Table 3: 0 – no data relating to the test question asked, 1 – YES, i.e. an affirmative answer to the test question asked

Table 4. Testing H2: Diagnostic procedures used in the implementation of a multimodal myofascial pain programme

Test questions	Articles included in the analysis						
	1[245]	2[10]	3[246]	4[247]	5[248]	6[249]	7[217]
Were diagnostic methods for the initial assessment of the patients' condition identified?	1	1	1	1	1	1	1
Was there an assessment of pain and tension at trigger points?	1	1	1	1	1	1	0
Were pain scales used? (if so, which ones?)	VAS	VAS-P / GPE	0	VAS	Electronic pain measurement	VAS	0
Was there an assessment of posture?	0	0	0	0	1	1	0
Was there an assessment of function/fitness? (if so, what kind)	0	DASH	CF-PDI/NDI	WOMAC	MANUAL	MANUAL	0
Was there an assessment of gait determinants?	0	0	0	1	0	0	0
Were diagnostic methods for assessing ongoing	1	1	1	0	1	0	0

Key – Table 4: 0– no data relating to the test question asked, 1 – YES, i.e. an affirmative answer to the test question asked; descriptive responses are the names of the pain scales and the diagnostic methods used in the case of affirmative answers.

Table 5. Testing H3: Participation of a multidisciplinary team in the multimodal approach to myofascial pain therapy

Test questions	Articles included in the analysis						
	1[245]	2[10]	3[246]	4[247]	5[248]	6[249]	7[217]
Was a multidisciplinary team involved in myofascial pain therapy?	0	0	1	0	0	0	1
Were pain complaints differentiated depending on their origin: myofascial, neurological, psycho-emotional, biochemical, nutritional deficiencies?	1	1	1	0	0	0	1
Was a diet therapy specialist included in the treatment team?	0	0	0	0	0	0	0
Was nutritional supplementation provided?	0	0	0	0	0	0	0
Was an assessment of psycho-emotional state included?	0	0	1	0	0	0	0
Was a psychotherapist included in the treatment team?	0	0	1	0	0	0	0
What diagnostic procedures were used?	0	0	1	0	0	0	0
What behavioural interventions?	0	0	1	0	0	0	0
Were systemic diseases included in the diagnostic process?	0	1	0	0	0	0	1
Were specialists of the relevant systemic diseases involved in the therapeutic process?	0	0	0	0	0	0	1
Were the results analysed statistically?	1	1	1	1	1	0	1

Key – Table 5: 0 – no data relating to the test question asked, 1 – YES, i.e. an affirmative answer to the test question asked.

Table 6. Testing H4: Procedures for selecting therapeutic modalities to be used in the multimodal / interdisciplinary programme for myofascial pain therapy

Test questions	Articles included in the analysis						
	1[245]	2[10]	3[246]	4[247]	5[248]	6[249]	7[217]
Was the number of therapy sessions determined? [0– no information, or number given]	5	12	6	10	30	10	4 sessions per week, for 6 months
Was the number of procedures to be applied during each session specified? [0–no information, 1–YES]	1	0	0	0	1	1	1
Duration of therapy [weeks]	4	12	0	4	10	5	"6 days at the facility 6 months at home"
Is there information on which therapies were applied during a particular session? [0 – no information, 1 – YES]	1	0	0	0	1	1	1
What therapeutic methods were used?							
Ischemic compression of trigger points	0	1	0	0	1	0	1
Manual therapy of myofascial structures (joint mobilization, neural mobilization, dynamic soft tissue mobilization)	0	0	1	0	1	1	0
Strain counterstrain (SCS)	0	0	0	0	1	0	0
Dry needling of trigger points	1	0	0	1	0	1	0
Spray and stretch	1	1	0	0	0	0	0
Kinesio taping	1	0	0	0	0	0	0
Therapeutic exercise	1	0	1	1	0	1	1
Other (which?)	0	0	0	0	Deneroll	0	Internal Myofascial Trigger Point Wand and Paradoxical Relaxation Therapy (PRT)
Has the treatment methodology been described in detail?	1	0	1	1	1	1	1
Was Patient Education provided?	1	0	1	0	1	1	1
In therapy, was it specified on which areas of the body the therapy was carried out? *	0	1	1	1	1	1	1
How many people were treated in a given area of the body? [number]							
Cervical spine, shoulders, arms	102	0	9	0	120	120	0
Craniofacial (temporomandibular joint area)	1	0	9	0	0	0	0
Shoulder	0	72	0	0	0	0	0
Upper limb (elbow)	14	0	0	0	0	0	0
Lumbosacral	30	0	0	0	0	0	0
Pelvis (pain of urologic/gynecologic origin)	0	0	0	0	0	0	393
Lower limb (hip, knee)	0	0	0	14	0	0	0
Foot and ankle joint	10	0	0	0	0	0	0
TOTAL	***157***	***72***	***9***	***14***	***120***	***120***	***393***

Key – Table 6: 0 – no data relating to the test question asked, 1 – YES, i.e. an affirmative answer to the test question asked. The table sections below the question: In therapy, was it specified on which areas of the body the therapy was carried out? present the number of people who had therapy in the specific area of the body.

Discussion

As shown in Part I of our study, research dedicated to myofascial pain therapy programmes needs to take into account two essential aspects, i.e.:

1. this type of pain affects around 90% of the human population,
2. it has a complex etiology, involving not only short-term complaints (e.g. due to trauma, periodic dysfunctions), but mainly chronic conditions related to posture, systemic diseases, work, social status and psychophysical state.

Non-traumatic myofascial pain in most cases can be elicited by trigger points [251–252]. Many studies confirm the efficacy of MFTrP therapies, e.g. dry needling in randomised groups, in different areas of the body [253–258]. However, empirically, it can be concluded that in the case of comorbidities (i.e. systemic diseases, postural defects, sensory-motor deficits, psycho-emotional problems, etc.) the pain may return in the same and/or different location or form. Hence, it is crucial to combine therapeutic methods in multimodal programmes, involving an interdisciplinary team. Moreover, multimodal programmes should provide for a careful selection of therapeutic modalities, based on an objective and reliable diagnosis of MPS etiopathogenesis. Despite the recommendations for measurable diagnostic methods in myofascial pain, such as EMG, sonoelastography, thermography (infrared imaging) and MRI [122–125, 259], the majority of the research studies dedicated to multimodal programmes used palpation and inspection methods in the evaluation of both function and pain [260–261].

In the majority of the articles included in our analysis, pain was assessed using the Visual Analogue Scale (VAS). Moustafa et al. (2018) used an algometric measurement of the pressure pain threshold (PPT) at the most tender point of the upper trapezius muscle before and after treatment [262]. The average value of 3 repetitive measurements with an interval of 30 to 60 s (expressed as kilograms per square centimetre) was used to analyse the PPT data [263]. It should be noted, however, that the analysis did not include an assessment of latent and referred trigger points, which was characteristic of the majority of the articles reviewed in Part II of the study. Bron et al. (2011) assessed secondary outcome measures using the VAS-P and GPE scales (which is used to differentiate changes in pain and function) [10]. They also used the DASH questionnaire, which is recognised as one of the best questionnaires for patients with shoulder symptoms [264–265].

From the clinical perspective of myofascial pain, given that trigger points in the latent phase can alter activation patterns and/or cause weakness in pain-free muscles [266–268], through structural, functional, compensatory, etc. relationships, muscle tension and range-of-motion testing should be included in the diagnosis. In three of the seven articles analysed, a manual goniometer was used to measure ranges of motion (Bron et. al. 2011, Marcos-Martín et al. 2018, Moustafa et al. 2018) [10,246-248]. Núñez-Cortés et al. used the WOMAC scale and a digital inclinometer for both disability diagnosis and functional assessment [247]. WOMAC is used extensively in clinical trials, mainly in surgery and traumatology, notably for its sensitivity and validity [269]. Unfortunately, the use of both a manual goniometer and an inclinometer is fraught with scale discrepancies. In this case, the Constant-Murley scale was used, with subscales including subjective pain and mobility [270–272]. In the assessment of disability, in turn, Marcos-Martín et al. (2011) employed the CF-PDI method for craniofacial assessment, and NDI for cervical spine assessment [247]. The Neck Disability Index (NDI) is a questionnaire with 10 items referring to the activities of daily living, in which patients rate their subjective experience [272–274]. The reliability, construct validity and responsiveness of NDI have been studied. In addition, cervical and shoulder alignment and head translation posture were assessed using photogrammetry, which provides reliable data for postural anthropometry [275–277].

In rehabilitation diagnosis, it is important to assess baseline functional parameters and then evaluate treatment progress on an ongoing basis. This is because the outcome may be affected by both compensatory movement and the original constraint. Hence the strict recommendation to use measurable, reproducible diagnostic methods in the assessment of posture and function [278–279]. Indeed, the development of MPS is heavily influenced by global postural defects, abnormal locomotor patterns, physical conditions (including weight) etc. [17, 49, 105]. The literature analysis has shown that in multimodal therapy programmes, global patterns (gait, running, ranges of motion) are assessed locally (i.e. in a particular area of the body).

Núñez-Cortés et al. (2017) proposed a walk test, pre- and post-intervention, as an objective and valid measure of exercise tolerance and exercise capacity [280]. The timed up-and-go test (TUG) was used to evaluate dynamic equilibrium, predicting the risk of falling [281]. Lower-body muscle power was assessed using a 30-second chair-stand test. This test can be influenced by range of motion in joints [282] and balance [283] and it was used to measure lower-body muscle power based on Smith et al. [284]. The use of measurable tests deserves recognition (as emphasised repeatedly in this publication) as an indication of best practices in rehabilitation diagnosis and therapy. Nowadays, there are numerous devices and sensors for postural and functional assessment [127–131] of balance, gait, force and pressure distribution [132–139], in combination with videogrammetry and photogrammetry. In most research studies, functional diagnosis is performed out locally, rarely globally. The diagnostic methods used, despite the significant advances in measurable (computer-controlled) technologies, mainly boil down to visual assessment, palpation, analogue measurements or questionnaires. The analysis of multimodal programmes is largely based on a local assessment of the pain problem [17, 20, 44–46, 49, 51, 53, 55, 62–63, 66, 188].

The literature study revealed a significant deficit in methods for a global assessment of posture, postural patterns, gait determinants, etc. This may undermine the efficacy of the therapeutic approaches, also in the assessment of referred and latent pain.

The local approach to the problem is reflected in the research literature where diagnostic methods are tested in specific ailments and isolated body areas (as seen in both Part I and Part II of this publication). The combination of manual therapy and dry needling with pain neuroscience education is probably the preferred multimodal approach [285–288]. The multimodal programmes included in our analysis appear to confirm the above assertion, although manual therapy and dry needling were used in 3 of the 7 articles, which seems puzzling, mainly due to the fact that the existence of MTrPs was reported in all of them, while ischemic compression, dry needling, dry cupping are local methods dedicated to the elimination of active (painful) trigger points. Pérez-Palomares et al. in their findings went as far as stating that dry needling did not have a meaningful effect in MPS therapy, compared to groups that received a multimodal therapy programme. This finding can nevertheless be challenged (as the authors admitted objectively), due to the fact that patients received a personalised therapy programme. The principle of reproducibility was therefore not complied with [248].

The patient's individual complaints should also guide the choice of rehabilitation exercises (both in the process of patient education and therapist-monitored therapy), i.e. stretching, isometric exercises, proprioceptive and postural re-education, including during activities of daily living [287, 289–293].

None of the analysed programmes explicitly described the rules for method selection, making it impossible to ascertain whether the choice of method depended on the cause of pain. The literature review has led us to conclude empirically that scientific research is focused on proving the effectiveness of specific therapeutic methods rather than entire programmes. Even if the title suggests the opposite. Each of the seven articles included in the analysis presents a well-defined methodology for administering the respective therapeutic methods, patient education, etc. This has probably had a positive impact on the findings from the studies, i.e. pain relief, functional improvement. Such an approach to the evaluation of efficacy does not yield itself to a comparative analysis of treatment outcomes.

In the majority of the articles included in the analysis, the results were analysed statistically and observations were conducted according to the "follow-up" and "intention to treat" principles. In rehabilitation procedures, it is hardly possible to fulfil the condition that the specialist should not know the patient's group allocation. Hence, double blinding in rehabilitation studies is not common. However, studies investigating the efficacy of multimodal programmes for MPS treatment need to be randomised. Given the diverse etiology, these programmes should be developed with strict grouping of patients according to the cause of pain.

Randomisation of patient groups is also relevant to the issue of pain projection and latent lesions in myofascial structures, where it is important to diagnose and treat the surrounding and distant tissues and even posture as a whole. It is also necessary to select the treatment method to address the location of the pain in structural terms, i.e. muscle stretching and strengthening, fascial stretching, joint mobilization, neural mobilization, etc. (see also the summary in Table 1, Part I of this article).

As a result, detailed diagnosis, differentiation of causes and evaluation of the general condition all have implications for the composition of multidisciplinary teams in the development of multimodal myofascial pain treatment programmes. Given that pain is often associated with high levels of stress, depression, anxiety, there is an important role on the team to be played by a psychotherapist. Marcos-Martín et al. (2018) highlighted the important role of the psychotherapist in the assessment of kinesiophobia and catastrophising [294]. Thus, their multimodal therapy programme for chronic cervico-craniofacial pain employed distraction and stress management techniques, and relaxation exercises (i.e. Yoga). The team assembled for the study by Anderson et al. (2016) included a urologist, primarily because the pain they studied involved the pelvic floor [217. In the other articles included in the analysis, the involvement of a multidisciplinary team was not reported. Indeed, in the studies by Marcos-Martín et al. (2018), Núñez-Cortés et al. (2017), Moustafa et al. (2018), concomitant systemic diseases were listed as an exclusion criterion [246]. Having regard to the anatomical relationships of the musculoskeletal and visceral structures, as well as biochemical and lifestyle factors, it is important that further research should include treatment efficacy analysis with the participation of an interdisciplinary team.

Results of hypothesis testing

1. (+) Multimodal treatment programmes for MPS rely on the strict methodology of scientific research work, with respect to treatment methodology, including statistical analysis of the results; (-) on the other hand, research methodology (randomisation, blinding, final estimation) is not strictly adhered to.
2. In the analysed articles, the selection of therapeutic methods to be included in a multimodal treatment programme for MPS was not based on a detailed diagnosis (measurable, reproducible, objective) of the patient's condition, including comorbidities.
3. In most of the reviewed articles a multidisciplinary team was not set up in the case of comorbidities associated with MPS.
4. The selection of therapeutic methods in the analysed multimodal programmes does not indicate explicitly the correlations between the method and the cause of pain, comorbidities, psycho-emotional state, etc.

Conclusions

1. Multimodal programmes for the treatment of musculoskeletal pain, notably MPS and MTrPs, should include a detailed and comprehensive diagnosis (structural, biochemical, psycho-emotional) which should serve as the basis for the formation of interdisciplinary rehabilitation teams.
2. Musculoskeletal diagnosis in MPS therapy, in addition to radiological assessment, should include measurable techniques of postural and functional assessment (such as pedobarography, wearable sensors, assisted anthropometry, i.e. photogrammetry, videogrammetry, etc.), aimed primarily at the ongoing assessment of posture.
3. The choice of therapeutic methods and patient education should be based on the causes of the patient's pain, taking into account systemic diseases, postural defects, lifestyle and psycho-emotional state.
4. Scientific research in multimodal treatment programmes should be carried out in randomised groups, with due attention to the methodologies of diagnostic and therapeutic procedures and group selection.

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