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Review

Pediatric oncological pain: the influence on the posture of the head and the spine. A narrative review

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Abstract

Pediatric oncological pain (OP) is a common condition in children with cancer, resulting in postural changes in the head and spine, which significantly impact their quality of life. Osteosarcoma is the most prevalent type of pediatric tumor affecting head and spine districts. Its exact cause is still unknown, although it may be attributed to DNA mutations in bone cells, either inherited or acquired after birth; it often leads to bone and muscle pain and discomfort. This can initiate a harmful cycle, including mood disorders like anxiety and depression and maladaptive thoughts.

Conducting a thorough functional assessment of children with OP is crucial, involving clinical and psychological evaluations and multidisciplinary rehabilitative approaches. A physical evaluation of the head and spine primarily focuses on assessing motor abilities through inspection of joint mobility, muscle strength, palpation, reflexes, and sensitivity.

This narrative review considered randomized clinical trials, observational and cohort studies, and case reports; studies that did not meet inclusion criteria were excluded; 41 studies were selected for this review.

A team of healthcare professionals, including orthodontists, physiatrists, pediatricians, oncologists, and psychologists, collaboratively manage children with OP, aiming to minimize the physical and mental disability caused by OP. It is based on education, exercise therapy, and psychological approaches.

Education should include proper ergonomic postural guidance for sitting and standing, pain education (neuroscience education), and management of mood disorders and maladaptive thoughts (cognitive-behavioral education).

Exercise therapy should focus on active postural correction, including exercises to counteract forward head posture, hyperkyphosis, and sway-back; strengthening exercises for spinal deep muscles; segmental stretching involving limbs and back muscles; and functional exercises.

Psychological therapy, particularly cognitive-behavioral therapy, involves cognitive restructuring, time-based activity pacing, relaxation techniques, and adaptive coping strategies.

This review provides a comprehensive overview of the clinical postural assessment of the head and spine, which is essential for planning effective multidisciplinary rehabilitative treatments.

Keywords

Behavioral medicine, mandibular osteonecrosis, multidisciplinary rehabilitation, oncological pain, pediatric oncology, vertebral metastases.

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Introduction

Pediatric oncological pain (OP) is a frequent condition in cancer patients, leading to postural alterations in the head and spine, negatively affecting the quality of life of children with tumors [1, 2]. OP in this population is often caused by central sensitization of tissues involved, such as bones, ligaments, tendons, and muscles, as well as bone fragility, spinal instability, and neurological damage [3, 4]. Osteosarcoma is the most common type of pediatric neoplasm affecting the head and spine, and its exact cause is still unknown, although it may be attributed to DNA mutations in bone cells, either inherited or acquired after birth [5]. Osteosarcoma can cause or be accompanied by bone and muscle aches, often leading to postural changes in the head and spine, such as hyperflexion of the head, kyphosis, or postural sway [6, 7]. OP can also contribute to a vicious circle in young cancer patients, leading to mood disorders like anxiety and depression, as well as maladaptive thoughts such as catastrophizing, fear of pain, and fear-avoidance [8, 9]. Therefore, conducting comprehensive functional assessments of children with OP is crucial, involving clinical and psychological evaluations by a multidisciplinary team of specialists, including physiatrists, orthodontists, psychologists, pediatricians, and oncologists, who can collaboratively plan effective rehabilitative approaches [10]. This review aims to provide a comprehensive overview of the clinical postural assessment of the head and spine in children with OP, highlighting the importance of these assessments in planning multidisciplinary rehabilitative procedures.

Materials and methods

Focused questions

What approach is taken in the postural assessment of the head and spine in children with OP due to osteosarcoma? Is multidisciplinary rehabilitation treatment beneficial for these young individuals?

Eligibility criteria

The analysis of studies included in this review adhered to specific inclusion criteria:

1. study design: randomized clinical trials, observational and cohort studies, and case reports;
2. participants: children with a history of OP due to osteosarcoma localized in the head and spine;
3. interventions: postural assessments related to children with OP due to osteosarcoma in the head and spine;
4. outcome: the role of postural assessments in children with OP due to osteosarcoma in the head and spine. Studies investigating the benefits of multidisciplinary rehabilitation for these individuals were also considered.

Only studies meeting all of these inclusion criteria were included in this review. Certain exclusion criteria were also applied, which included:

1. abstracts of articles published in non-English languages;
2. duplicate articles;
3. irrelevant studies that did not address the research question, investigated different supplementary treatments or had full-text content inconsistent with the abstract;
4. *ex-vivo* or experimental animal research;
5. analysis lacking Ethics Committee approval;
6. narrative reviews, systematic reviews, or systematic and meta-analysis reviews.

Search strategy

The review employed the PICO model (Population, Intervention, Comparison, Outcome) to conduct the literature search.

A comprehensive search was conducted on the PubMed (MEDLINE) and Scopus electronic databases to identify and analyze abstracts of studies assessing postural, physical and psychological evaluations in children with OP due to osteosarcoma. Additionally, abstracts of studies investigating the benefits of multidisciplinary rehabilitation for these individuals were also examined.

Research

The search utilized specific medical subject heading (MeSH) [11] terms as follows: cancer pain, head and neck neoplasms, osteosarcoma, patient care team, pediatrics, and spine.

The PubMed (MEDLINE) and Scopus databases were searched for articles published between 2010 and 2023, with a focus on individuals aged 11 to 19 years. The latest search was conducted on July 3, 2023. Two trained reviewers performed the search and resolved disagreements and discrepancies through consensus and consultation with two additional reviewers. Titles and abstracts of identified articles were thoroughly reviewed, and irrelevant studies were excluded. The remaining significant articles were further screened for similar studies meeting the inclusion criteria. Relevant results were extracted by reading the full texts of the included studies.

Results

The initial search identified 967 articles based on MeSH terms, published between 2010 and 2023. After applying inclusion and exclusion criteria, focusing on specific study designs and participant characteristics, a total of 41 articles were screened and evaluated for eligibility.

Discussion

Evaluation

Physical evaluation

A physical evaluation of the head and spine primarily focuses on assessing motor abilities [12]. The evaluation includes the following components, along with reliability and validity estimates of performance (**Tab. 1**).

1. Inspection: observation from the front and back to identify any abnormal anatomical features (e.g., lateral or oblique deviation of the head, rib humps), and from the side to detect atypical postures (e.g., hyperflexion of the head, hyperkyphosis, flatback, and swayback). Overall, evaluative tests show varying levels of reliability and validity [13, 14].
2. Examination of joint mobility: evaluation of the range of motion for rotation and translation of the temporomandibular joint (TMJ), as well as extension, lateral flexion, and forward bending of the neck and back. Reliability and validity are generally poor for TMJ evaluations but more satisfactory for neck and back assessments [15-17].
3. Evaluation of muscle strength: assessment of the main muscles in the head, neck, and back, using a scale ranging from 0 to 5 to evaluate their strength. Muscle strength was assessed by the Medical Research Council (MRC) Scale for Muscle Strength, which was first described by Kleyweg and colleagues in 1988 [12]. Tests show good reliability and validity for the head, neck, and back muscles [18, 19].
4. Palpation of muscles: examination of muscles by palpating with the fingertips, identifying taut bands and hypersensitive zones. Tests for TMJ evaluations are satisfactory, while limited evidence exists for manual neck and back assessments [20, 21].
5. Peripheral neurological examination: assessment of reflexes and sensitivity, including superficial and deep responses. Reliability and validity are generally poor for head, neck, and back assessments. However, a specific test called the Subjective Peripheral Neuropathy Screen, originally developed for adolescents with HIV, has

Table 1. List of physical tests.

Type	Head examples	Spinal examples
Inspection	Lateral or oblique deviation of the head	Rib humps Hyperkyphosis Swayback
Examination of joint mobility	Rotation and translation of the TMJ	Lateral flexion Forward bending Extension
Evaluation of muscles strength	Evaluation of masseter, temporalis, medial and lateral pterygoid muscles	Evaluation of the sternocleidomastoids, the longissimus, iliocostalis, and spinalis; the longus colli and capitis, and the abdominal internal and external obliques
Palpation of muscles	Evaluation of masseter, temporalis, medial and lateral pterygoid muscles	Evaluation of sternocleidomastoids; the abdominal internal and external obliques
Assessment of reflexes (superficial)	The stretch reflex, the Golgi tendon reflex	The stretch reflex, the Golgi tendon reflex
Assessment of reflexes (deep)	Jaw jerk	Biceps, quadriceps
Assessment of sensitivity (superficial)	Tactile, proprioceptive, thermal and pain sensation	Tactile, proprioceptive, thermal and pain sensation
Assessment of sensitivity (deep)	Batiestesia, chinestesia, barestesia, and pallestesia	Batiestesia, chinestesia, barestesia, and pallestesia
Assessment of sensitivity (combined)	Topognosia, grafestesia, and stereognosia	Topognosia, grafestesia, and stereognosia

TMJ: temporomandibular joint.

shown satisfactory psychometric properties and may be useful for the oncological population [22].

Other clinical investigations important for physical evaluation in children include the assessment of balance and walking ability [23]. Balance assessment helps understand a child's ability to maintain static and dynamic equilibrium; further examples embrace the sensation of feeling dizzy as if the room is spinning, unsteady, or lightheaded, and these unpleasant sensations may occur also if young individuals are lying down, standing, or sitting. Walking assessment evaluates their gait and detects any deviations from normal walking patterns. Quantitative tests, such as the Timed Balance test and the Modified 6-Minute Walk test (6MWT), are commonly used for these evaluations [24, 25].

Radiological examinations are generally not useful for postural assessment, and more advanced non-invasive evaluations are currently recommended [25].

Psychological evaluation

It is important to note that mood disorders, such as anxiety and depression, are common in young individuals with OP due to head and spinal tumors. These individuals may also experience maladaptive thoughts, including catastrophizing, fear of pain, and fear of movement.

Therefore, alongside postural assessments, evaluations that address psychological disturbances are recommended [26, 27].

Multidisciplinary care team

The postural assessment of young individuals with OP due to head and spinal cancers typically involves orthodontists and physiatrists. Orthodontists evaluate postural alterations related to teeth, jaw irregularities, and TMJ disorders, while physiatrists assess functional changes in the neck and back.

Clinical psychologists play a crucial role in providing mental evaluations and cognitive-behavioral therapy (CBT) to help young individuals learn coping strategies and improve their overall well-being.

Oncologists and pediatricians also form part of the multidisciplinary team, providing medical care throughout the treatment process.

Collaborating effectively as a multidisciplinary team (**Tab. 2**), these professionals can reduce the impact of OP on physical and mental disability in children [10].

Table 2. Interventions for young people with oncological pain (OP) due to head and spinal tumors.

Multidisciplinary team	Multidisciplinary rehabilitation
Physiatrist	Physical evaluation Treatment planning of the spine
Orthodontist	Physical evaluation Treatment planning of the head/TMJ
Psychologist	Mental evaluation CBT planning
Oncologist	Oncological care
Pediatrician	Medical care

CBT: cognitive-behavioral therapy; TMJ: temporomandibular joint.

Multidisciplinary approaches

Working as a team also involves implementing multidisciplinary approaches that encompass education, exercise therapy, and psychological therapies.

Education

Education should include proper ergonomic postural guidance for sitting and standing, pain education (neuroscience education), and management of mood disorders and maladaptive thoughts (cognitive-behavioral education) [28, 29].

Exercise therapy

Exercise therapy should focus on active postural correction, including exercises to counteract forward head posture, hyperkyphosis, and sway-back. Strengthening exercises for spinal deep muscles, segmental stretching involving limbs and back muscles, and functional exercises aimed at improving neuromotor control and coordination should be advised. Quantitative tests and exercises targeting balance and walking ability can also aid in rehabilitation [30, 31].

Psychological therapy

Psychological therapy, particularly CBT, is recommended for young individuals with OP due to head and spinal cancers. CBT involves cognitive restructuring, time-based activity pacing, relaxation techniques, and adaptive coping strategies. These approaches help individuals schedule activities based on time, manage pain perception, and address mood disorders and maladaptive thoughts through healthier activities [32].

Limitations

This review has certain limitations. Direct comparisons between studies were not possible, and the matching of variables may vary depending on the affected individual.

Additionally, the search method used may have been too specific for the scoping question. Further research is necessary to delve deeper into the evaluation of postural assets in young individuals with OP resulting from a history of osteosarcoma.

Conclusions

This review provides an overview of postural evaluation's clinical features and importance in children with OP due to head and spinal tumors. Adequate assessments based on comprehensive clinical evaluations are recommended. A multidisciplinary team is crucial in managing children with OP and minimizing its impact on physical and mental well-being.

Research agenda

- Improve reliability and validity as concerns tests during the postural assessment of children with OP.
- Improve evidence, possibly through randomized controlled trials (RCTs), of multidisciplinary rehabilitation that includes education, exercise, and CBT as for young people with OP from osteosarcoma of the head and the spine. Adequate follow-ups are expected.
- Add evidence, possibly through RCTs, to the role of multidisciplinary teams as major clinical contributors to the care of young people with OP from osteosarcoma of the head and the spine.

Data availability statement

Upon request to the corresponding author, the data are available for use.

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Declaration of interest

The Authors declare no conflict of interest. Funding: this research received no external funding.

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