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Influence of physical activity on individuals with fibrous dysplasia - implications for sports participation, trauma risk and rehabilitation – a narrative review

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Abstract

Background. Fibrous dysplasia (FD) is a rare disease caused by postzygotic mutations in the GNAS gene, which lead to replacement of normal bone with pathological fibro-osseous tissue. These lesions can cause pain, deformities, impairment of physical function and higher susceptibility to bone fractures. This raises the question of how the disease influences physical activity and the ability of affected people to participate in sports.

Aim. The aim of this review was to summarize available data regarding the influence of the physical activity in people with fibrous dysplasia, especially focusing on participation in sport and risk of trauma.

Material and methods. A narrative review of 20 journal articles and one book chapter identified in PubMed.

Results. Available data indicate that higher skeletal disease burden is associated with physical limitations and decreased quality of life. Bone fractures pose a significant complication of the disease, especially in people with higher Skeletal Burden Score and extensive skeletal involvement. At the same time physical activity can support maintaining fitness, strength and hip mobility. Such activities as aquatic exercises and stationary cycling are suggested as appropriate forms of rehabilitation. However, there is a lack of studies directly comparing specific sports and risks connected with participation in them.

Conclusions. Physical activity in people with fibrous dysplasia should be chosen individually, taking into consideration the location and extent of skeletal lesions, deformities, history of fractures and coexisting endocrinopathies. Based on the available data it is currently impossible to create universal recommendations for all patients. Further studies are needed to establish more specific recommendations for sports participation in this population.

Key words: fibrous dysplasia, physical activity, sports participation, exercise, fracture risk, rehabilitation

1. Introduction

Fibrous dysplasia (FD) is a genetic disease, whose etiology is caused by postzygotic activated variants in the GNAS gene, encoding the α subunit of the stimulatory G protein (Gαs). (Palmisano et al., 2025) Gαs causes impaired GTPase activity, that results in excess cAMP production through its extended interaction with adenylyl cyclase. These changes result in abnormal bone formation and remodeling, which identifies FD. Skeleton stem cells (SSCs) with the mutation of Gαs produce an osteogenic stroma, which is accumulated in the bone marrow. SSCs may also induce the expansion of local non-mutated cells. Histological features of the FD show a benign, medullary, fibro-osseous neoplasm that can be multifocal and is characterized by distorted, poorly organized, and inadequately mineralized bone and intervening fibrous tissue. These histological features indicate some alterations in multiple cellular and molecular pathways, which participate in bone and bone marrow homeostasis after birth. The fibrous tissue originates from the proliferation of marrow fibroblasts and osteogenic precursor cells, which produce structurally abnormal bone and fail to differentiate into adipocytes or sustain hematopoiesis. This disorder is quite rare and its frequency of occurrence ranges from 1/4000 to 1/10000. It is said that it represents 5-7% of benign bone tumors. (Tuompo et al., 2025) There are two types of this disease: monostotic FD (affects only one bone) and polyostotic FD (affects multiple bones). Monostotic type accounts for 70-80% of FD cases. (Tuompo et al., 2025) When this disease is also connected with hyperpigmentation and hyperfunctioning endocrinopathies, it is called McCune-Albright syndrome. (Szymczuk et al., 2023) Craniofacial bones are the ones, that are most commonly affected (with femur and ribs). Lesions in the craniofacial region occur in 10-25% of monostotic type and in up to 50% of polyostotic type. The zygomaticomaxillary region is the most common. The craniofacial region can be really problematic due to its complexity and the proximity of different organs. FD can cause bone expansion, which can lead to deformation of the face and functional impairment, however, some of the lesions can remain asymptomatic. This disease can be associated with facial and sinonasal involvement (36-92%), ophthalmologic features, loss of hearing (up to 30%), oral and dental complications and skull base deformities. If the femur is affected, then its proximal part is prone to deformity called coxa vara ("shepard's crook deformity"). Lesions in this region can lead to bone fractures due to its fragility. (de Castro et al., 2023) If the spine is affected, then scoliosis is also a common complication. However, the typical manifestation of the disease is

asymptomatic – the painless bone swelling or "bump", which is found accidentally on radiographs or CT scans. Additionally, it can also be manifested by gentle asymmetry, that expands during childhood. (Boyce & Collins, 2019) The most typical radiological finding is a "ground glass" appearance on the CT scan, but lesions can show sclerotic, cystic, pagetoid, mixed or "orange peel" features as well. The management of the disease can vary significantly depending on the individual case. The way of treating asymptomatic or pediatric patients with gentle symptoms focuses on observation. Obviously, it is connected with regular check-ups and radiological control. Another method of treatment is intravenous bisphosphonates (BP). Different studies show mixed results about lesions and pain reduction in patients using BP. This therapy is also connected with side effects such as osteonecrosis of the jaw. Consecutive antiresorptive medication, which has been studied lately, is denosumab. It is a monoclonal antibody, which is an inhibitor of RANKL. The downside of this therapy is, that the therapeutic result is transient, and the discontinuance of it can be associated with a rebound in bone turnover and severe hypercalcemia. (de Castro et al., 2023) The last method of FD management is surgical intervention. The extent of the procedure really depends on the location of the lesions and the implications they cause. In sinonasal involvement, endoscopic surgery is the first line of the treatment, but the zygomaxillomandibular region is suitable for radical resection. The advanced hearing impairment can require temporal region surgery. Generally, surgery is not only used to remove the diseased tissues, but also to reduce pain, decrease asymmetry, or restore function.

Given the structural abnormalities, fracture susceptibility and functional limitations associated with FD, participation in physical activity may present unique challenges. At the same time, appropriately selected exercise is recommended to maintain cardiovascular fitness, muscle strength and mobility. This narrative review aims to summarize the available evidence regarding physical activity in individuals with FD, with particular emphasis on sports participation, fracture and trauma risk and exercise selection.

Research objective: To summarize the available evidence on physical activity and sports participation in individuals with fibrous dysplasia, with particular emphasis on rehabilitation, fracture risk, and factors relevant to individualized recommendations.

2. Research material and methods

This narrative review included 20 journal articles and one book chapter of GeneReviews publication regarding fibrous dysplasia (FD) and McCune-Albright syndrome (MAS). The

search was conducted in PubMed during September and October of 2026. Sources were chosen basing on their relevance to disease characteristics, rehabilitation, fracture risk, physical function, quality of life and sports participation. Publications concerning pathogenesis and medical or surgical management were also included to provide clinical background. The literature included original research articles, reviews, case reports, a consensus statement and a book chapter. The findings were summarized narratively. No formal assessment of the methodological quality or risk of bias of the included studies was performed.

3. Role of physical activity in rehabilitation in fibrous dysplasia

The most common way of managing fibrous dysplasia are regular check-ups and radiological control. If this approach is chosen to control fibrous dysplasia (FD), it is also connected with altering and optimizing lifestyle factors, which contribute to optimal bone health. The management of the disease then is based on achieving appropriate levels of 25-OH vitamin D (especially in patients treated with anti-resorptive medication), avoiding smoking at all, limitation of alcohol intake and sufficient physical exercise, what is the most important thing for us. So physical activity is recommended, because it optimizes fitness. Of course choice of the exercises should be appropriate and should concentrate on optimizing cardiovascular fitness and enhance educational and occupational performance. Rehabilitation is also connected with physical activity and should focus on improving and maintaining strength, function and loss of mobility, which can occur. (Javaid et al., 2019) Even if the surgical treatment is needed, the period of avoiding any weighting of the body should be minimized. (Gun, Arif, et al., 2023)

Some research shows that one of the biggest problems in patients with polyostotic fibrous dysplasia (PFD) is decline in range of motion in hip and loss of hip strength, which influences patients' ambulation ability. The way of treating those patients should be connected with strategies to improve or maintain hip strength and range of motion. Authors indicate that aquatic therapy is the safest way to do that. Other appropriate options are indoor stationary cycling and bi- or tricycling. Correcting leg length discrepancies and hip malalignment is also important. (Paul et al., 2014) Studies also indicate that physical activity may be beneficial in the management of chronic pain conditions, such as fibromyalgia, low back pain, and migraine, which may occur in patients with fibrous dysplasia. Depression and psychological stress are also commonly reported in patients experiencing chronic pain and other complications of the disease. Regular physical activity may contribute to reducing these symptoms and improving patients' overall well-being. (Wentworth et al., 2025)

4. Risk of bone fracture in fibrous dysplasia

Fibrous dysplasia (FD) is connected with normal bone tissue being replaced with pathological expansile fibro-osseous tissue. It results in lesions in the skeleton which are built of poorly mineralized and weakened bone. (Gun, Osamor, et al., 2023) This raises the question of whether affected bones are more susceptible to fractures following trauma. Research shows that patients with fibrous dysplasia (FD), especially ones with McCune-Albright Syndrome (MAS) and endocrinopathies such as precocious puberty, hyperthyroidism, growth hormone excess, neonatal Cushing' syndrome and hypophosphatemia are prone to long bones fractures and the first fracture to occur at younger age. (Geels et al., 2021) The most common bone to be fractured is femur and it occurred in 51% of patients. The femur was followed by humerus (22%), tibia (16%), forearm (12%) and fibula (2%). (Geels et al., 2021) Studies also show that the most endangered were children between ages 6-10. (Leet et al., 2004) The median age at first fracture was 8.0 years. (Geels et al., 2021) A higher lifelong risk of fractures was stated in patients with skeleton burden score (this score shows the percentage of body affected by the disease and can range from 0 to 75 (Geels et al., 2021)) above 25 and age at first fracture at or before 7 years old. Studies also show that particularly lesions in a spine can lead to pathologic vertebral fractures. (Kafchinski et al., 2025) Hypophosphatemia is also really important factor which leads to fractures. Abnormal osteoprogenitor cells produce excess fibroblast growth factor 23 (FGF23), which reduces renal phosphate reabsorption and may lead to hypophosphatemia. This occurs especially in patients with high skeletal FD burden. Research confirmed that patients with frank hypophosphatemia and low-normophosphatemia have increased long bone fractures risk and lifetime fracture rate. (Gun, Osamor, et al., 2023)

5. Individual assessment before sports participation

Multiple factors associated with fibrous dysplasia may influence patients' ability to participate in specific physical activities and may increase their susceptibility to injury. Therefore, recommendations regarding sports participation should not be generalized to all patients with fibrous dysplasia but rather individualized according to disease severity, skeletal involvement, fracture risk, and functional status. A decision should be made especially by the physician and their patient. (Kafchinski et al., 2025) An attending physician has much more information about patient's condition such as full medical history, physical examination, laboratory results, radiological and nuclear imaging. (Javaid et al., 2019) These are very important factors, that

enable to make right decision about sports participation. History of fractures, deformities and also endocrinopathies should be also taken into consideration. However, the guidelines from 1993 induce that patients with extensive skeletal involvement should avoid all contact sports. (Kafchinski et al., 2025)(Szymczuk et al., 2024). In patients with PFD and MAS exercises with patient's own body weight are probably safe, however usage of free weights or machines should be approached with caution. (Paul et al., 2014)

Activity	Current evidence
Aquatic exercises	Recommended, especially as a form of rehabilitation (Paul et al., 2014)
Stationary cycling	Appropriate (Paul et al., 2014)
Bi- or tricycling	Can be deemed as safe in some patients (Paul et al., 2014)
Body-weight resistance exercises	Probably safe (Paul et al., 2014)
Free weights exercises	Can be approached with caution and supervision (Paul et al., 2014)
Contact sports	Avoid if the skeletal involvement is significant (Szymczuk et al., 2024)
High-risk activities	Avoid if the skeletal involvement is significant (Szymczuk et al., 2024)

The availability of studies concerning specific sports activities in patients with fibrous dysplasia is limited. Although recommendations of some sports that can be beneficial for them can be found, there remains a need for further prospective studies, which will provide more information about the risk of trauma during specific disciplines and information about intensity and types of training recommended for patients with fibrous dysplasia.

6. Discussion

The aim of our article was to assess what is the best for people who suffer from fibrous dysplasia concerning physical activity. It seems to be really hard for now to establish one the most beneficial protocol, which would cover every patient. Generally, quality of life of people with fibrous dysplasia in studies was significantly lower than general population. (Majoor et al.,

2017) The factor, which mostly affects lives of people with fibrous dysplasia is skeletal burden score, the higher it was in studies the quality of life was lower. (Majoor et al., 2017) People with MAS were the ones, whose lives were affected the most. The quality of life in study was assessed based on various factors, among which there was physical function. Fibrous dysplasia can be regarded as a physically disabling condition. The physical function correlates with the skeletal disease burden and the higher the score, the more physical function is limited.(Kelly et al., 2005) It seems that, the loss of the normal femoral-neck shaft angle and disease burden especially in the lower extremities have the greatest effect on functional activity.(Leet et al., 2006)

Summarizing different studies, we can conclude that in this disease we really need subjective opinion adjusted to every patient to make the right decision about the physical activity and it limitations. The quality of life of people with monostotic fibrous dysplasia is less affected than patients with polyostotic dysplasia. (Jousse et al., 2025) Taking that into account we may suspect that physical activity of monostotic patient is barely disturbed. If patient have sole lesion in for example a craniofacial region, probably their ability to participate in different sports is comparable to general population. (Hagelstein-Rotman et al., 2020) However, preserved physical function does not necessarily indicate that participation in all sports is equally safe. The localization of skeletal lesions appears to be an important factor. If we concern fractures, we can see that femur and humerus are among most commonly fractured bones, so if those are involved it should be taken into consideration during individual assessment. (Geels et al., 2021) It can be reasonable to condsider participation of patients with those bones affected in sports associated with higher risk of truma. However, the evidence is insufficient now to recommends restrictions on specific sports. There is a case described, where a 15 years-old patient with MAS was presented with proximal femoral fracture, which occurred during a low-energy trauma, what can indicate that severely affected patients can suffer a fracture even after minor trauma. (Aslan et al., 2022) There is also a case of 19 years old patient, who was suffering from pain in her hip during basketball training. After examination it turned out she had a 10 cm fibrous dysplasia lesion in her left femoral neck. After 6 months of unsuccessful analgetic treatment, the surgical intervention was applied. Patient was able to return to basketball training after 12 weeks. Follow up showed that she was able to return to competitive basketball and remain pain free with no complications.(Yung et al., 2018) Although this finding cannot be generalized, it illustrates that return to demanding physical activity may be possible in selected patients following appropriate treatment and individualized assessment.

There is a lack of satisfying evidence for which sports are safe for people with fibrous dysplasia. Therefore, it is needed to conduct more prospective studies concerning specific sports and what risk they can cause.

Nevertheless, there are certain things we can feel secure about. It is confirmed that physical activity as a form of rehabilitation is really important factor in managing fibrous dysplasia. Patients hip strength and mobility can be affected by the disease, what influences patients' ambulation ability. In such cases aquatic exercises and cycling are really beneficial because they can help improving hip strength and mobility or at least preserving it. (Paul et al., 2014) Physical activities should also focus on improving general fitness and cardiovascular conditions in fibrous dysplasia patients.

7. Conclusions

Fibrous dysplasia (FD), despite affecting multiple aspects of patients' lives, should not automatically exclude them from sports participation. Each patient should be assessed individually, and decisions regarding sports participation should be made jointly by the patient and the treating physician, taking into account the patient's medical history and disease severity. (Kafchinski et al., 2025) Particular caution is warranted in patients with a high Skeletal Burden Score, skeletal deformities, a history of fractures, and associated endocrinopathies (especially hypophosphatemia). (Gun, Osamor, et al., 2023)

Physical activity should not be considered only as a recreational activity in patients with FD, as it may also play an important role in rehabilitation and in maintaining mobility, muscle strength and general physical fitness. Based on the currently available evidence, low-impact activities appear to be appropriate for many patients with FD; however, participation in other types of sports should not be categorically excluded and should be considered on an individual basis. (Paul et al., 2014) Importantly, evidence regarding the safety and risks associated with specific sports in patients with FD remains limited. Further studies are needed to establish more specific recommendations for sports participation in this population.

Disclosure

Author Contributions

Conceptualization: [AK], [MD], [AS], [MP], [AB], [JM], [MW], [RD], [NK], [JP]

Methodology: [AK], [MD], [AS], [MP], [AB], [JM], [MW], [RD], [NK], [JP]

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AI:

AI was used to assist in refining the academic English of the manuscript, ensuring clarity, consistency, grammatical accuracy, and adherence to scientific writing standards. All AI tools were used as assistive instruments under human supervision. The final interpretation of findings and conclusions remained the responsibility of the authors.

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