

The Diffuse Idiopathic Skeletal Hyperostosis (DISH): A Literature Review on the Rehabilitation Treatment

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DOI:

10.32098/mltj.04.2023.19

LEVEL OF EVIDENCE: 4

SUMMARY

Introduction. The diffuse idiopathic skeletal hyperostosis (DISH), also known as Forestier-Rotès-Querol disease, is a systemic pathology characterized by the diffuse ossification of the ligaments of the spinal column. It can be linked to several metabolic disorders, such as obesity and type II diabetes, and its prevalence among the elderly population is high. DISH may be asymptomatic and only acknowledged in the imaging, or it can be associated to serious clinical conditions like stiffness, pain and reduced spine mobility. At the moment, specific guidelines for the treatment of the DISH do not exist. This article aims to analyze the available literature concerning the rehabilitation treatment in patients affected by DISH.

Materials and methods. Until July 2023, PubMed, PEDro, Scopus and Google Scholar were accessed, with no time constraints.

Results. The literature available is poor, but the authors of the selected studies suggest programs based on therapeutic exercise, manual therapy, postural education, instrumental physical therapy. The discrepancy between the results obtained in case report and in RCT and cohort study, may express the need of a personalized treatment, since the characteristic of the pathology are variable depending on the localization of the hyperostosis. The rehabilitation strategies just proposed may be investigated in order to create a therapeutic path for DISH patients.

Conclusions. Patients affected by DISH may cope with conditions of severe disability, caused by stiffness, pain, respiratory and dysphagic symptoms. The physiotherapy program should be based on stretching and mobility exercises to avoid pain and stiffness. This can be seen as the starting point, so that in the future this pathology might be more researched and easily diagnosed, in order to create useful guidelines and to better manage this less-known clinical condition.

KEY WORDS

DISH; Forestier disease; guideline; rehabilitation treatment; physiotherapy.

INTRODUCTION

The diffuse idiopathic skeletal hyperostosis (DISH) is a less-known pathology associated with old age and risk factors such as obesity, hypertension, atherosclerosis and diabetes (1). It is a non-inflammatory disease that, with a prior metabolic deficit and through unknown mechanism, appears with an increased bone apposition and ligament calcification on the spine, and the thoracic vertebrae are involved in 100% of the cases (2, 3). The ossification originates from an alteration of the osteoblast activity and differentiation among entheses (**figure 1**). Also, this issue may be caused not only by non-genetic factors, but by a specific genetic background not yet defined (4, 5).

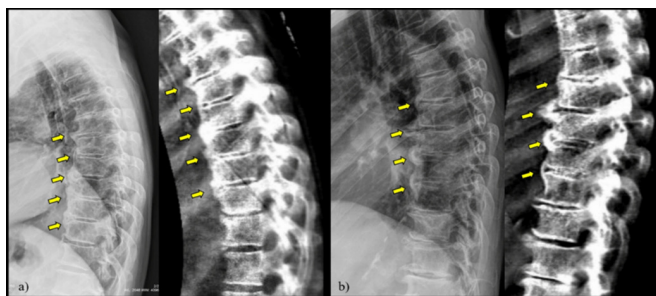


Figure 1. Two DISH cases on (a) DXA (bone densimetry); (b) VFA (Vertebral Fracture Assessment) in two women with type II diabetes.

Fassio A, Adami G, Idolazzi L, *et al.* Diffuse Idiopathic Skeletal Hyperostosis (DISH) in Type 2 Diabetes: A New Imaging Possibility and a New Biomarker. *Calcif Tissue Int.* 2021;108(2):231-9. doi: 10.1007/s00223-020-00768-2.

Clinical characteristics and symptoms

DISH should be suspected in patients with back stiffness and with limited thoracic mobility. The diagnosis is mainly radiological, and the RX of the spine is the gold standard (6). However, the TC is able to detect DISH with a rate of 27.1% compared to the 17.6% of the standard RX, so it may be used in addition (7). Resnick classification criteria for DISH are the most commonly used to make diagnosis:

- Flowing ossification along the anterolateral aspect of at least four contiguous vertebral bodies.
- Relative preservation of intervertebral disc height in the involved segment.
- Absence of apophyseal joint bony ankylosis and sacroiliac joint erosion (8).

Lately Mata *et al.* described another score system for the ossification extension (9):

1. No ossification presents.
2. Ossification present without bridging.
3. Ossification present with incomplete bridging of the disc space.
4. Complete bridging of the disc space by ossification.

Criteria of disc height conservation and the absence of inflammatory or degenerative disease in apophyseal and sacroiliac joint allow to exclude spondylodiscitis, disc degeneration and ankylosing spondylitis (AS) among the causes of bridging (10).

Most symptoms occur due to altered skeletal biomechanics, that lead to pain, stiffness (especially during the morning and late evening, worsen by cold and inactivity) and limited ROM, in particular during the lateral flexion (11-13). The bridging of the anterior longitudinal ligament (ALL) may influence the physiological curves, causing often the thoracic hyperkyphosis (Cobb angle > 40°). Moreover, because of the bone compression of contiguous structures, respiratory, gastrointestinal and neurological symptoms may develop. The impairment is assessed using the Health Assessment Questionnaire (11).

The symptoms which appear on the shoulder, elbow and knee caused by the enthesopathy, are less common, and only reported in 15-25% of the patients.

Differential diagnosis

The differential diagnosis should be done with AS (12), spondylosis (spine generalized osteoarthritis) (14, 15) and the ossification of the posterior longitudinal ligament (OPLL) (16-19) (**figure 2**). The following **table I** sums up the differences between these diseases.

Table I. Differences between DISH, AS, spondylosis and OPLL.

| DISH | AS | Spondylosis | OPLL |
|--|---|---|--|
| Over 50 yrs old | Early adulthood | Over 60 | |
| Idiopathic | Inflammatory spondyloarthropathy (rheumatoid factor usually negative) | Subsequent to traumas, overuse job or rheumatic pathologies | Unknown pathophysiology |
| Metabolic syndrome | High reactive-C protein CRP | Osteoarthritis | |
| Thickening and calcification of ligaments and entheses + bone hypertrophy in different sites | Bilateral symmetrical sacroiliitis, with a bamboo spine aspect | Loss of disc height caused by cartilaginous degeneration | Myelopathy and/or radiculopathy with severe neurological disease |

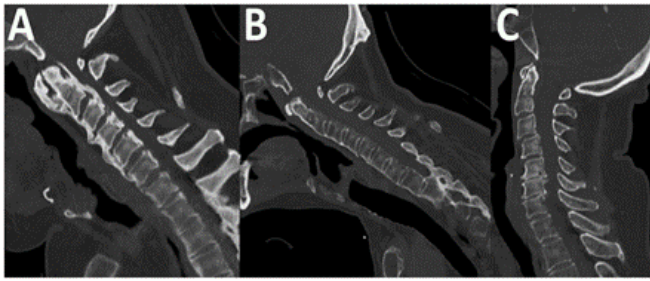


Figure 2. Sagittal TC shows the radiological differences between DISH (A), AS (B) and spondylosis (C). DISH (A) is characterized by the bridging of the longitudinal ligament.

Le HV, Wick JB, Van BW, Klineberg EO. Diffuse Idiopathic Skeletal Hyperostosis of the Spine: Pathophysiology, Diagnosis, and Management. *J Am Acad Orthop Surg.* 2021;29(24):1044-51. doi: 10.5435/JAAOS-D-20-01344.

MATERIALS AND METHODS

Literature research was executed in PubMed, Google Scholar and PEDro databases until June 2023, without any restriction on language and publication year.

The following keywords were used in combination: diffuse idiopathic skeleton hyperostosis, DISH, Forestier’s disease, exercise, exercise therapy, physiotherapy, physiotherapeutic treatment, spinal hyperostosis, ankylosing spinal hyperostosis, rehabilitation, rehabilitation proto-

cols, management of DISH. If title and abstract matched the topic, the full text was accessed.

RESULTS

The rehabilitation treatment of DISH

At the present moment specific guidelines for the physiotherapeutic management of DISH patients do not exist, since the available literature is poor. Our literature research found few articles, of which only one is a RCT. The authors of the studies set up different rehabilitation program based on therapeutic exercise, manual therapy, postural education, instrumental physical therapy.

Al-Herz *et al.*’s program focused on pain, stiffness, ROM and disability, and suggest daily exercises for 2 weeks. Although the advantages are poor, this may be an expression of the delayed diagnosis compared to the clinical presentation of symptoms, and/or that, in that precise phase of the pathology, the treatment can only slow down the progression of the impairment (20) (table II).

Wendy B. Katzman *et al.* published a randomized controlled trial (RCT) on ≥ 60 years old patients with Cobb angle $\geq 40^\circ$. The rehabilitation program consisted of strengthening exercises of paravertebral muscles, mobility and postural training. Every

Table II. Physiotherapeutic treatment by Al-Herz, *et al.*

| | Position | Type of exercises |
|--------------------------------|------------------------------------|---|
| Strengthening exercises | Supine | Bridge + alternated extension of the knees Crunch Quadriceps isometric |
| | Lateral decubitus | Hip abduction with knee flexed (before) and extended (after) |
| | Prone | Hip extension |
| | Supine | Knees to chest: alternated and then together |
| | Supine | Pelvis rotation with knee flexed Pelvis rotation with crossed leg (foot on the contralateral knee: extra rotated hip with knee flexed) |
| Mobility exercises | Supine | Active mobilization of the cervical spine |
| | Seated, supported by the seatback | Trunk rotation |
| | Quadrupedal | “Cat back”: mobilization of the thoracic and lumbar spine. Useful for hyperkyphosis |
| | Prone | Head and arms extension, trying to hold the eyesight horizontality: useful for hyperkyphosis |
| | Standing | Lateral trunk flexion with contralateral shoulder abduction |
| Elongation exercises | Supine (with TheraBand), or seated | Hamstrings stretching |
| | Supine, hip and knee flexed | Lumbar mm. stretching |

Al-Herz A, Snip JP, Clark B, Esdaile JM. Exercise therapy for patients with diffuse idiopathic skeletal hyperostosis. *Clin Rheumatol.* 2008;27(2):207-10. doi: 10.1007/s10067-007-0693-z

session lasted 1 hour, 2 times a week for three months. The intensity of the exercise gradually increased 4-5 unit, measured with the Borg scale (70-80% of the perceived effort) (figure 3) (21).

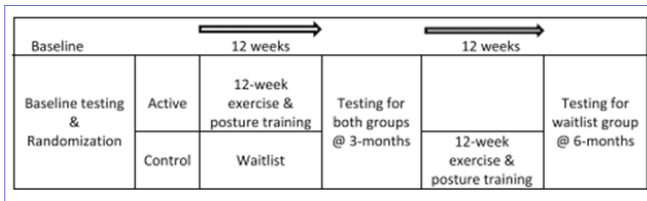


Figure 3. Steps of the study by Katzman *et al.*

Katzman WB, Parimi N, Gladin A, *et al.* Sex differences in response to targeted kyphosis specific exercise and posture training in community-dwelling older adults: a randomized controlled trial. *BMC Musculoskeletal Disord.* 2017;18(1):509. doi: 10.1186/s12891-017-1862-0.

This determined a relevant improvement assessed with the Debrunner kyphometer, after three months: this type of protocol may stop the progression of the dismorphism and even reduce it. It is important to specify that this RCT was not designed expressly for DISH patients, but for patients with dorsal hyperkyphosis, of which $\frac{1}{4}$ was affected by

DISH. However, it could be helpful to add appropriate exercises for breathing, in order to improve ventilation (22). Three cases report on patients affected by hyperkyphosis explain the importance of consider the scapular-humeral complex during the physiotherapeutic assessment, since they are biomechanically and functionally connected. In presence of a muscular impairment, in these patients, the strengthening of the scapular stabilizer, in addition to the elongation of the pectoral muscles, may be relevant to correct the posture and to recover an adequate scapular-thoracic rhythm (23).

Patel HM and Patel DV reported a case of a 65 years old patient with hyperkyphosis and serious low back pain, with bridging and OPLL. The rehabilitation program had positive results and it was made up of education of the patients, therapeutic exercises, electrotherapy for paravertebral muscles, stretching of all the inferior limb muscles and manual therapy, 45/60 mins for 6 weeks. Furthermore, there was an unsupervised home program (HEP) based on the FITT principle: frequency, intensity, time, type of exercise, and it was adjusted on outcomes (24) (table III).

Last, Nagai *et al.* centered their study on manual therapy in the treatment of dysphagia and dysphonia in an 81 years old patient

Table III. The rehabilitation program in a 65 y.o. patient with hyperkyphosis, severe LBP and OPLL.

| Intervention | Intensity | Frequency | Duration |
|--|--|------------------------------|-------------|
| Supervised exercise program | | | |
| Moist heat in lower back | 10 min | Given in all PT session | 30 sessions |
| Flexibility exercises for back and lower limb muscles | 30 s hold 3 repetitions of each muscle | Given in all PT session | 30 sessions |
| Muscle energy technique of back extensor, flexors and rotators muscles | 5 repetitions 10 s hold 3 sets | Given in all PT session | 30 sessions |
| Activation of core muscles of spine multifidus and transversus abdominis | 10 repetitions 10 S hold | Given in all PT session | 30 sessions |
| Progressive strength training for lumbar stabilizer muscles | 10 repetitions 10 s hold 2 sets | Starts at the end of 2 weeks | 20 sessions |
| Isotonic exercises of lower limb muscles with sand bags | 3 sets of 10 repetitions each muscle | Starts at the end of 2 weeks | 20 sessions |
| IFT | 15 min, program number 8, base frequency 100 Hz and spectrum 50 Hz | Given in all PT session | 30 sessions |
| Unsupervised HEP | | | |
| Moist heat in lower back | 10 min | Daily | 43 sessions |
| Self-stretching of hamstring, piriformis and back muscles | 30 s stretch 3 repetitions | Daily | 43 sessions |
| Back muscles isometric and active range of motion exercises of back and lower limb | 10 repetition 5 s hold 2 sets | Daily | 43 sessions |
| Walking | At least 20-30 min | Daily | 43 sessions |

Patel H, Patel D. Effectiveness of physiotherapy treatment in a case of diffuse idiopathic skeletal hyperostosis (DISH) in 65 year old male. *Physiotherapy - The Journal of Indian Association of Physiotherapists.* 2020;14(1):50. doi: 10.4103/PJIAP.PJIAP_30_19.

with OALL and a C3-C6 bridging, causing the compression of the posterior pharyngeal face by osteophytes. The treatment consists of mobilization of the cervical spine according to Maitland method (grade 1 and 2) and of postural rehabilitation (25). Manual therapy executed on the thoracic and cervical spine was able to improve the ROM, thoracic flexibility and postural stability, increasing the voice volume too (25) (table IV).

Another topic of discussion is the difference on the choice of the rehabilitation treatment recommended in literature between DISH and AS. A 2022 systematic review and meta-analysis of Gravaldi shows the importance of Pilates and Baduanjin Oigong in the treatment of AS, to restore the functional abilities and ADLs (26).

Starting from these studies, it may be possible to investigate and then propose some intervention strategies, in order to build a therapeutic path for patients affected by DISH, since the ankylosis is the core of the clinic and the most disabling element of both pathologies.

DISCUSSION

The rehabilitation treatment of DISH mainly provides a conservative approach, centered on the management of the symptoms. If it is ineffective, such as when there is an impingement of nervous roots or in the presence of swallowing symptoms, the surgical management is chosen, with the removal of bone spur (27).

Only few rehabilitation protocols were described, even if many authors suppose that most treatment for osteoarthritis

(OA) may be useful for DISH (28): a literature review and the latest scientific evidences suggest that DISH is a distinct clinical disease with different characteristics (29). The goals of the conservative management are:

- Reduction of pain and stiffness.
- To prevent, delay or stop the progression of the pathology.
- To treat the dysmetabolism: to educate the patient towards an active healthy lifestyle.
- To prevent complications, such as falls (29).

Diverse therapeutic modalities may be used to reduce pain, including pharmacological therapy and physiotherapy (1). These few studies recommend therapeutic exercises, stretching and mobility exercises, but also thermotherapy and ultrasound therapy (20, 28).

General measures, like the reduction of the weight, acceptable physical activity, low-saturated fat and carbohydrates diet are essential to reduce or stop the progression of the DISH (26). The physiotherapist should conduct a counselling activity, in order to educate the patient towards a healthier lifestyle: aerobic activity promotes the reduction of the symptoms, particularly pain and stiffness (1).

In patients with obstructive sleep apnea (OSAS) associated to DISH, the obstructive element is managed conservatively, resorting to surgery only when the ventilatory therapy with CPAP (Continuous Positive Airway pressure) fails. According to the international guidelines, the CPAP is the gold standard in these cases (30).

The physiotherapeutic management is necessary after the surgery, to the recovery of the ADLs (31). In the end, it is

Table IV. Summary of the rehabilitation treatment of the articles.

| Article | Type of study | Goal | Population | Exercises | Main results |
|------------------------------|--------------------------|--|---|--|---|
| Al-Herz <i>et al.</i> , 2007 | Prospective cohort study | Increase ROM, reduce pain and disability | 15 ppl with an age range of 51-86 | Therapeutic exercise: strengthening, mobility and stretching | Increased score on Schober test |
| Katzman <i>et al.</i> , 2017 | RCT | To reduce dorsal hyperkyphosis | 101 patients, 48 of which controls, with average age 70.0 and Cobb \geq 40° | Postural raining + paravertebral muscles strengthening | Reduction of the hyperkyphosis, assessed by the Debrunner kyphometer |
| Patel HM and Patel DV, 2020 | Case Report | To reduce pain and consequent disability | 65 years old male | Counselling, postural training, therapeutic exercises, manual and instrumental therapy | Reduction of VAS score from 8 to 2, and of the Quebec Disability Index from 84 to 41. |
| Nagai <i>et al.</i> , 2019 | Case Report | To treat dysphagia and dysphonia | 81 years old male | Manual therapy: mobilization according to Maitland method (1 and 2 grade) and postural exercises | Increased cervical and thoracic mobility, improved voice volume and duration, reduction of coughing |

indispensable a personalized treatment, since the characteristic of the pathology are variable and differs from person to person, depending on the localization and extension of the hyperostosis.

CONCLUSIONS

It is important to set up a multidisciplinary team when undertaking the patient, considering the systemic character of pathology and its complications. The rehabilitation treatment should be based on therapeutic exercises focused on the strengthening of the posterior muscular chain, on mobility and stretching, on manual therapy such as the Maitland method, and in addition instrumental physical therapy can be added, as thermotherapy. Postural exercises are proposed to prevent and slow down the evolution of postural disturbs, like the thoracic hyperkyphosis.

Thus far, literature has little studies on the rehabilitation treatment of the patient with DISH. Hopefully this disease will be more researched in the future, considering its high prevalence among the elder population, so that

appropriate guidelines can be made to help the physiotherapist and the whole team.

FUNDINGS

None.

DATA AVAILABILITY

Data are provided along with the review.

CONTRIBUTIONS

FO: writing – original draft, writing – review & editing, synthesis methods, final approval. MNA: writing – original draft, writing – review & editing, data collection, data extraction. FS: writing – original draft, study selection, data collection, data extraction. NM: writing – review & editing, final approval.

CONFLICT OF INTERESTS

The authors declare that they have no conflict of interests.

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