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Osteoarthritis: physical medicine and rehabilitation—nonpharmacological management

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Arthrose: Physikalische Medizin und Rehabilitation – nichtmedikamentöses Management

Zusammenfassung Arthrose ist eine degenerative Gelenkserkrankung, welche Menschen mittleren und höheren Alters betreffen kann. Eine Arthrose der Knie- und Hüftgelenke bedeutet meist nicht nur Schmerz und Bewegungseinschränkung, sondern eventuell auch den Verlust der Selbständigkeit. Daher ergeben sich die Therapieziele 1) Reduktion der Schmerzen, 2) Erhalt der Selbständigkeit und 3) Verbesserung der Lebensqualität. Eventuell vorhandene Begleiterkrankungen oder -umstände müssen in der Therapieplanung berücksichtigt werden. Alle Richtlinien zur nichtmedikamentösen Behandlung der Hüft- und Kniearthrose empfehlen durchwegs Bewegungstherapie zur Verbesserung von Schmerz und eventuell auch Funktion. Zusätzlich haben sich therapeutischer Ultraschall, neuromuskuläre Elektrostimulation, transkutane elektrische Nervenstimulation, Magnetfeldtherapie, Lasertherapie, Wärmebehandlungen und Akupunktur als effektiv erwiesen. Einlagenversorgung und die Verordnung von Hilfsmitteln wie Schienen oder Gehhilfen ergänzen das therapeutische Spektrum. Solch ein multimodales Management beeinflusst Schmerz, Funktion, Mobilität und Lebensqualität von PatientInnen mit Arthrose der unteren Extremitäten im positiven Sinne.

Schlüsselwörter: Arthrose, Rehabilitation, Übungs-, Trainingstherapie, Physikalisch medizinische Maßnahmen

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Summary Osteoarthritis (OA) is the most common joint disease, mainly affecting middle-aged and elderly persons. People with OA of the knee or hip experience pain and deconditioning that may lead to disability. Treatment goals include pain control, maximizing functional independence, and improving quality of life within the constraints imposed by both OA and comorbidities. Exercise is a core recommendation in all nonpharmacological guidelines for the management of patients with knee or hip OA; it is supposed to ameliorate pain and maybe function as well. Therapeutic ultrasound, neuromuscular as well as transcutaneous electrostimulation, pulsed magnetic field therapy, low-level laser therapy, thermal agents, acupuncture, and assistive devices such as insoles, canes, and braces can be used additionally in a multimodal therapeutic program. They may positively influence pain and function, mobility, and quality of life in patients suffering from OA of the lower limbs.

Keywords: Osteoarthritis, Rehabilitation, Exercise, Physical modalities

Introduction

Osteoarthritis (OA), the most common joint disease, mainly affects the middle-aged and older population. It is characterized by progressive loss of articular cartilage, appositional new bone formation in the subchondral trabeculae, and formation of new bone at the joint margins (osteophytes). Low-grade synovitis is often seen. OA is a ubiquitous disease; however, joints of the lower extremities are most commonly affected.

The aim of this article is to give an overview on conservative nonpharmalogical management of patients suffering of OA concentrating on the most frequently affected joints—knees and hips—based on the evidence of the efficacy of exercise and different physical modalities on

OA. Pharmacological and surgical therapies are covered in other manuscripts of this issue.

Diagnosis and functional assessment

An osteoarthritic knee typically represents with localized tenderness pain on active and passive motion, and crepitus. Muscle atrophy is seen secondary to disuse. Pain in the area of the groin and along the inner aspect of the thigh as well as loss of range of motion (ROM)—mainly internal rotation—characterize an osteoarthritic hip. Radiologic examination verifies the diagnosis of OA; laboratory evaluations are helpful in excluding other joint diseases. The American College of Rheumatology (ACR) classification criteria for OA of the knee [1] and hip [2] are shown in Table 1.

Table 1. ACR classification criteria for osteoarthritis of the knee and the hip [1, 2]

Clinical	Clinical and radiographic	Clinical and laboratory
Knee		
Knee pain plus at least 3 of the following 6:	Knee pain plus at least 1 of the following 3:	Knee pain + at least 5 of the following 9:
– Age > 50 years	– Age > 50 years	– Age > 50 years
– Stiffness < 30 min	– Stiffness < 30 min	– Stiffness < 30 min
– Crepitus	– Crepitus	– Crepitus
– Bony tenderness	Plus	– Bony tenderness
– Bony enlargement	– Osteophytes	– Bony enlargement
– No palpable warmth		– No palpable warmth
		– ESR ≤ 40 mm/h
		– RF < 1:40
		– SF OA
Sensitivity: 95 %	Sensitivity: 91 %	Sensitivity: 92 %
Specificity: 69 %	Specificity: 86 %	Specificity: 75 %
Hip		
Hip pain plus: – Hip internal rotation < 15° – ESR ≤ 45 mm/h (if ESR not available, substitute hip flexion ≤ 115°) Or Hip pain plus: – Hip internal rotation ≥ 15° – Pain on hip internal rotation – Morning stiffness of the hip ≤ 60 min – Age > 50 years	Hip pain plus at least 2 of the following 3: – ESR of less than 20 mm/h – Femoral or acetabular osteophytes on radiographs – Joint space narrowing on radiographs	–
Sensitivity: 86 %	Sensitivity: 89 %	
Specificity: 75 %	Specificity: 91 %	

ESR erythrocyte sedimentation rate, *RF* rheumatoid factor, *OA* osteoarthritis, *SF* synovial fluid: clear, viscous, or white blood cell count < 20000/mm^3

OA of a single joint is a local problem in the articular structure and function. However, it causes limitations in activity and participation (Fig. 1). Pain leads to a higher tonus of the surrounding muscles and to some fear-avoidance strategies: to changed movement patterns and restrictions in everyday activities. If these changes are long lasting, then the consequences are: loss of ROM of the affected joint, muscular and cardiovascular deconditioning as well as changes of the somatosensory system with an increased risk of falling. Further restrictions in the activities of daily living (ADLs), social isolation, depressive mood, and sleep disturbances are frequent after-effects. If the affected person is an elderly person with comorbidities hardly able to manage everyday life, these changes may even lead to his/her loss of self-dependence. Thus, a local joint problem affects many different aspects of a person's daily activities and quality of life. The International Classification of Functioning (ICF) core sets for OA include 55 categories—13 categories from the component body functions, 6 from body structures, 19 from activities and participation, and 17 from environmental factors [3].

Besides history, clinical and possibly radiological as well as biochemical examination, further evaluation of patients with self-report measures is used. The Western Ontario and McMaster Universities OA Index (WOMAC) [4], the Hip and Knee Osteoarthritis Outcome Score (HOOS [5], and KOOS [6]), and the Lower Extremity Function Scale (LEFS) [7] may be helpful in determining capability, potential, and prognosis of rehabilitation.

The aim of rehabilitation of an OA patient is a complex management of the patient with a holistic approach taking into account local problems, the patient's limitations in activities and participation as well as comorbidities and context factors.

Assignment

Patients should be given information about the disease that there is no known cure for OA, and what the aim of the treatment is. The Osteoarthritis Research Society International (OARSI) recommendations [8] advise that the treatment of OA of the knee and hip should be directed toward reducing joint pain and stiffness, maintaining and improving joint mobility, reducing physical disability and handicap, improving health-related quality of life, limiting the progression of joint damage, and educating patients about OA as well as its management.

The therapeutic program must be individualized keeping in mind the patient's demands, but the therapeutic options are diverse.

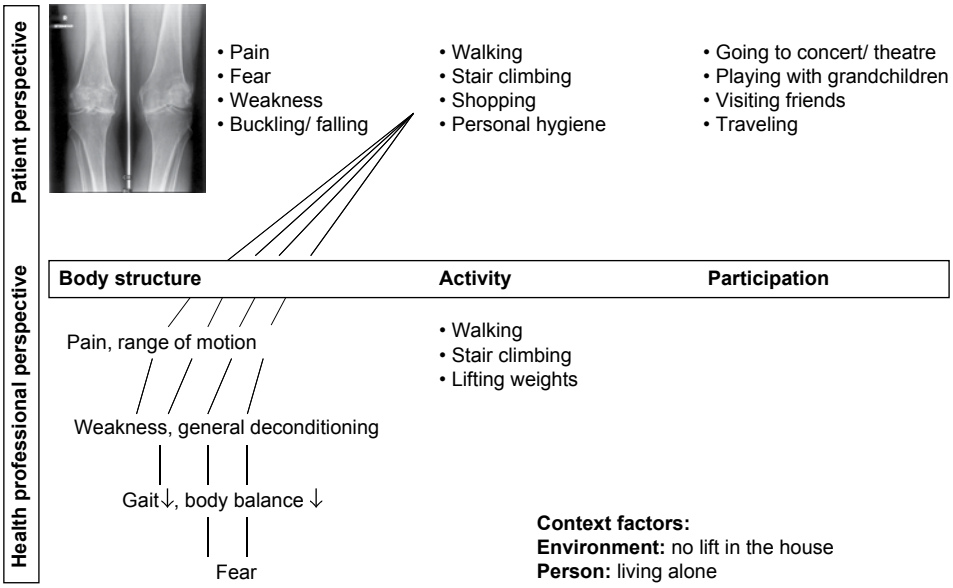

Fig. 1 Limitations of a person suffering of knee osteoarthritis according to the International Classification of Functioning (ICF, 2001). The *upper* part of the figure represents the patient perspective and the *lower* part the health professional perspective

Therapeutic options, rehabilitative interventions

Exercise

All international guidelines [8–11] advocate exercise as a first-line management for people with OA. According to a Cochrane Review [12], there is platinum-level evidence that land-based therapeutic exercise has at least short-term benefit in terms of reduced knee pain (SMD 0.40) and improved physical function for people with knee OA (SMD 0.37). These effect sizes are similar to the effects, which can be achieved from simple analgesia and non-steroidal antiinflammatory drugs [10], but the risk of side effects is lower. Concerning the efficacy of exercise for OA of the hip, there is a limited number of randomized controlled trials (RCTs); however, a small treatment effect on pain, but not on physical function, was detected [13]. An update reports a silver-level evidence of the benefit of land-based exercise for people with symptomatic hip OA [14]. This is in line with another metaanalysis showing the efficacy of therapeutic exercise (especially, with an element of strengthening) on pain reduction [15]. *Aquatic exercise* minimizes joint load and, therefore, seems particularly useful in the initial phase of exercising. Beneficial short-term, but no long-term effects, have been documented for patients with hip and knee OA [16].

In general, exercise should be recommended to patients suffering from OA. Exercise, however, includes different aspects of training. Participation in a *resistance training* (RT) program can attenuate the progressive loss of muscle strength commonly seen in older knee OA patients [17]. This is important, because weakness of the quadriceps muscle has been shown to correlate significantly with pain and functional ability in knee OA [18, 19]. Concerning a potential reduction of disease progression data are diverse: Mikesky et al. [17] showed a decreased rate of joint space narrowing in OA knees after strength training compared with ROM exercises. Other authors could not find an improvement in knee adduction moment after RT [20, 21]. In general, isokinetic training is more suitable than isometric training and the combination of eccentric and concentric training seems to induce better results than concentric training only [22]. Comparing high and low RT, both regimens seem to reduce pain, increase function, muscle strength, and ameliorate walking time [23].

Since most patients are deconditioned, *aerobic exercise* is often recommended to improve their aerobic capacity. A metaanalysis, which included RCT comparing the efficacy of aerobic walking with home-based quadriceps strengthening exercises in patients with knee OA, revealed effect sizes of 0.52 and 0.39 for aerobic walking and quadriceps strengthening, respectively for pain; for self-reported disability, pooled effect sizes were 0.46 for aerobic walking and 0.32 for quadriceps strengthening [24]. Similar effect sizes were published in the OARSI recommendations for the management of hip and knee OA Part III [10]. Engaging in physical activities performed to achieve a training effect is related to subsequent good performance outcomes such as walking and a chair-raise test [25].

Flexibility (ROM) exercises generally increase the length and elasticity of muscles and periarticular tissues. In OA patients, the aim of such exercises is to decrease stiffness, to increase joint mobility, and to prevent contractures. Usually, they are performed in conjunction with strength or aerobic exercises. Data exclusively evaluating flexibility exercises in OA patients do not exist, but flexibility exercises as part of a complex exercise therapy proved to be effective in patients with knee OA [26]. In this study, it is also shown that agility and perturbation training does not have an additive effect to a standard exercise therapy in community dwelling OA patients who are able to walk without an assistive device and who are not frequent fallers [26]. Tai Chi is a popular exercise

intervention, but data on its effect for OA patients are sparse [27]; no definite conclusion can be drawn.

Exercise may be performed in supervised group classes, as individual treatment with a physiotherapist, and unsupervised at home. All three forms of treatment delivery achieve significant treatment benefits; however, the number of directly supervised exercise sessions influences treatment effect sizes [12].

Of course, safety of an intervention is an important point. In general, exercise is safe and well tolerated by most patients with lower limb OA. However, the patient has to be informed that disease activity can vary from day-to-day, and that signs of excessive exercise stress include joint pain during activity, pain lasting more than 1–2 h after exercise, swelling, fatigue, and weakness. It is been shown that fear of physical activity is associated with negative treatment response [28].

Exercise is a core recommendation in all guidelines for the management of patients with hip or knee OA. There is strong evidence that therapeutic exercise has at least short-term benefits in reducing pain and improving physical function for people with knee OA. For people with hip OA, exercise ameliorates pain, but has no significant effect on physical function. According to the American Geriatrics Society Panel on Exercise and Osteoarthritis [29], a physical activity program for OA patients should include exercises to improve flexibility, strength, and endurance.

Weight reduction

For overweight knee OA patients, weight loss is especially recommended. An effect size of 0.20 and 0.23 was calculated for improvement in pain and physical function, respectively [30]. In these patients, the combination of exercise with weight loss appears to be more effective than either intervention alone [31]. A possible explanation for these effects may be that weight loss is associated with improvements in the quality and quantity of medial articular cartilage in knee OA patients [32]. Therefore, encouragement to lose weight in overweight patients with lower limb OA is strongly suggested in the guidelines for the management of OA.

Physical modalities

Heat and cooling

Heat can be applied superficially or by means of microwave. The application of microwave seems to enhance heat shock protein 70 (Hsp 70), which has a protective effect on the cartilage and inhibits the apoptosis of chondrocytes. Furthermore, it enhances the matrix metabolism of the cartilage [33]. Superficial heat or cold can reduce pain, patients have to experiment which intervention offers the greatest relief [34, 35].

Neuromuscular electrical stimulation

Neuromuscular electrical stimulation (NMES) for women with mild and moderate OA of the knee was insufficient to induce gains in quadriceps muscle strength or activation [36]. Considering that the increase of muscle strength requires NMES on a daily basis, the protocol of this study (3 times 30 min each week) seems to be insufficient. The results of a Cochrane Review showed better activation of the quadriceps muscle after NMES, but no increase in isometric torque [37].

Pulsed electromagnetic field therapy

A metaanalysis of RCTs dealing with the effects of pulsed electromagnetic field therapy (PEMF) in the management of OA of the knee showed significant effects on ADLs, but no effects on pain and stiffness. The treatment is recommended as an adjuvant therapy for people with OA of the knee [38]. A study published in the same year investigating the effects on pain alone also showed no pain relief by this treatment modality [39]. Comparing PEMF to physiotherapy (stretching, ROM exercises, and strengthening exercises), both treatments decreased the severity of pain and improved ADLs showing no significant difference between the PEMF versus physiotherapy group. Costs for physiotherapy are much lower than for PEMF [40]. A review published recently confirms the positive effect on function, but also no significant decrease of pain [41].

Ultrasound

The discussion about the use and benefit of therapeutic ultrasound for knee and hip OA is controversial. A Cochrane Database Review from 2010 asserts that therapeutic ultrasound may be beneficial for patients with OA of the knee, but due to the low quality of the evidence there is some uncertainty about the magnitude of the effect on knee pain and function [42]. A multimodal program of physical therapies for patients with OA of the knee showed no difference in the outcomes for pain, function, and ADLs whether using therapeutic or sham ultrasound [43]. Another study comparing therapeutic to sham ultrasound found significant improvements for pain, function, ROM, inflammation, and swelling of the knee joint [44–46]. Concerning hip OA treatment with therapeutic ultrasound is encouraged by a study [47]. Therapeutic ultrasound is a safe, supportive therapeutic option with low costs and is favored by many patients and therapists.

Transcutaneous electrical nerve stimulation

Transcutaneous electrical nerve stimulation (TENS) is known to reduce pain for many medical conditions. A Cochrane Database Review from 2009 could not confirm that TENS is effective for pain relieve hampered by the inclusion of only small trials of questionable quality [48]. Comparing a single therapeutic session of high-

Table 2. Recommendations for knee-OA: nonpharmacological therapies

Land-based exercise	1A	2A
Aquatic exercise	1A	2A
Lose weight	1A	2A
Self-management program	1B	2B
Manual therapy and physiotherapy	1B	X
Psychosocial intervention	1B	X
Taping	1B	X
Insoles	1B	X
Thermal agents	1B	X
Walking aides	1B	X
Tai Chi	1B	X
Acupuncture	1B	2C
TENS	1B	X
Manual therapy alone	1C	X
Knee braces	1C	2C
Lateral directed patellar taping	1C	2B
Balance exercises	1C	X
Lateral heel wedges	X	2B
Flexibility training	X	2C
Electrotherapy	X	X
Manual LD	X	X
Therapeutic ultrasound	X	X
Mudpacks	X	X
Manual massage	X	X

TENS transcutaneous electrical nerve stimulation, *1* Hochberg et al. [9], *2* AAOS Clinical Practice Guideline [68], *A* strong, *B* moderate, *C* unable to recommend, *X* not mentioned

Table 3. Recommendations for hip-OA: nonpharmacological therapies

Land-based exercise	1A	2A
Aquatic exercise	1A	2A
Lose weight	1A	2A
Self-management program	1B	X
Manual therapy and physiotherapy	1B	X
Psychosocial intervention	1B	X
Thermal agents	1B	2B
Walking aids	1B	2B
Balance exercises	1C	X
Tai Chi	1C	X
Manual therapy alone	1C	X
Electrotherapy	X	2B
Therapeutic ultrasound	X	2B
Pulsed magnetic field therapy	X	2B
Acupuncture	X	2B
Ergotherapy	X	2B
Manual massage	X	X
Mudpacks	X	X
Manual LD	X	X

1 Hochberg et al. [9], *2* AWMF Leitlinie [69], *A* strong, *B* moderate, *C* unable to recommend, *X* not mentioned

frequency with low-frequency TENS and placebo TENS, pain was reduced by all of them [49]. The conjunction of TENS with therapeutic exercises leads to the best level of activation of the quadriceps muscle, thereby providing better function and less pain [50].

Low-level laser therapy

Low-level laser therapy (LLL) associated with exercise is effective in reducing pain, improving function and activity for people with OA of the knee [51]. It also improves the microcirculation in the irradiated area [52] and could be recommended as adjunctive therapeutic option treating OA of the knee.

Massage

Sixty minutes of massage per week improved the subscales for pain and functionality of the WOMAC scores after 8 weeks of treatments. After 24 weeks, there were no differences compared with usual care [53]. Stimulating massage of the quadriceps femoris, gracilis, sartorious, and the hamstrings did not help in the repositioning of the effected knee joint [54].

Acupuncture

The authors of a Cochrane Database Review concluded statistically significant benefits for peripheral joint OA by acupuncture, but suggested that some of the effects might be due to expectation or placebo effects [55]. This observation can be partially related to the behavior of the acupuncturist [56]. Gait patterns improved after acupuncture probably because of the accomplished pain relief [57].

Assistive devices

Canes

In the beginning, the use of a cane increases energy expenditure of patients with knee OA [58]. However, the daily use of a cane immediately decreases pain [59] and after 1 month of cane usage, energy expenditure does not occur any longer due to adaption to cane use, while still diminishing pain and improving function [60]. Cane use should be contralateral to the effected knee, thereby significantly reducing the medial knee load of the effected joint. For optimum benefit, lateral placement of the cane should be favored [61]. Using a cane with hip OA, there is a lack of improvement for pain and function and additionally the gait velocity decreases [62].

Braces, insoles

For the medial knee OA, the use of lateral wedges reduces the knee-ground reaction force lever arm, which seems to be the central mechanism of the load-reducing effects. To better understand why some patients do not respond to the treatment, further evaluation of patient characteristics are needed [63]. A recent study compared the biochemical and clinical effects of valgus knee braces and lateral wedged insoles. Lateral insoles were better accepted by patients. By reducing the knee loading in OA, both treatments could slow the speed of progression of OA [64]. Using valgus unloader braces, activity levels are positively influenced. Muscle strength improved for the hamstrings and did not result in any muscle impairment after a 6-month period [65]. For hip OA, the wearing of a brace of the WISH-type shows a positive effect on the turning phase of the Timed Up and Go Test. This result could be accomplished with or without the application of the brace at the assessment. This effect could be due to daily exercise [66]. The wearing of braces and insoles is recommended by the American College of Rheumatology 2012 [1, 2].

Conclusion

OA is a localized degenerative joint problem leading to impairment and in some cases also to psychological disability and reduced quality of life. Since affected patients are mostly elderly persons, they often have comorbidities, which have to be taken into account when planning patient management. Problems and needs of the patient have to be defined to specify the aim of rehabilitation. There is general consensus that rehabilitation of OA patients requires a combination of nonpharmacological and pharmacological modalities. Exercise and weight reduction are key elements in conservative nonpharmacological therapy. Thermal agents, electrostimulation of muscles, TENS, ultrasound, and acupuncture are supposed to have positive effects on pain and function in patients suffering from OA of the lower limbs (Tables 2 and 3). In addition, assistive devices such as insoles, braces, and canes seem to improve the patients' mobility and quality of life. Concerning the cost-effectiveness of conservative treatments for the management of knee and/or hip OA, there is limited evidence; however, all studies evaluating exercise interventions found the programs to be cost saving [67].

Conflict of interest
The authors declare that there is no conflict of interest.

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