Medical Background

Contents

1. Introduction

Musculoskeletal disorders are among the most prevalent long-term illnesses, and they account for more pain and sickness absence from work than any other medical condition. The most common condition of musculoskeletal complaints is Low Back Pain (LBP). Pain in the neck and shoulder area is almost as common. The prevalence of disorders of the upper extremities has received only limited attention in population-based epidemiological research. Pain and restricted movement of the shoulder joint are common symptoms, but both medical definitions and diagnostic criteria still vary.

The most common manifestations of musculoskeletal disorders are pain, restrictions of physical function, degeneration of tissue structures, absence from work and early retirement. These symptoms are partly interrelated, but to some extent they have differing causes. It is important to understand which causes can and should be addressed. In terms of public health and national economy, the great significance of musculoskeletal disorders is not primarily due to pain, physical impairment, functional deficits or tissue degeneration, but rather to losses of working time. The treatment costs of these conditions pale in comparison to those related to sickness absence and premature retirement.

Manifestations of musculoskeletal disorders
- *Pain*
- *Functional deficits*
- *Structural tissue damage and degeneration*
- *Absence from work and permanent disability*

Classification

The classification of musculoskeletal disorders is difficult, as is evident from the widespread use of such imprecise terms as ”back pain” and ”the neck and shoulder area”. It is often assumed that most patients with back or neck problems suffer from mechanical pain. That is, their pain varies with mechanical (physical) stresses to which the spine and the upper extremities are subjected and where no general or non-musculoskeletal illnesses (such as cancer or infection) are involved. In some severe conditions of the back, as well as the neck and shoulder area, the pathogenesis is relatively well known. These diagnoses include spinal nerve-root compression and specific problems of the shoulder joint and upper extremities (such as shoulder dislocation). In these cases, the aetiology, pathophysiology, prognosis and cause-specific treatment are known. However, many of the “diagnoses” of

back, neck and shoulder conditions do not readily yield similarly useful information.

It is important to understand that one can rarely pinpoint the tissue or segment from which pain in the back or neck originates. Frequently, one fails to even find the aetiology of the problem. It is similar in many cases involving pain in the upper extremities, where the precise cause remains unknown and the diagnoses only describe the symptoms. In shoulder disorders, for instance, one can often discern several overlapping symptoms from different specific problems (instability, impingement syndrome, rotator cuff tear). This is fundamental problem in the prevention and treatment of many chronic conditions of the back as well as neck and shoulder area. However, this should not prevent from successfully treating the symptoms.

Etiological models

In many musculoskeletal disorders, such as those of the low-back and neck, it is seldom possible to determine the tissue from which pain emanates. Moreover, as medical research is oriented towards ever more minuscule scales - genes and molecules, it is unlikely that pathogenesis of musculoskeletal pain will be fully explained in the near future. In many musculoskeletal disorders there is only a weak association between tissue damage and subjective impairment or work disability. An explanation of this discrepancy requires a wider perspective than a straightforward focus on tissue-level problems.

Within musculoskeletal disorders, a biopsychosocial explanation model was first applied for back disorders to replace a model that made the simple inference "structural problem causes disorder". The biopsychosocial model is also applicable to many disorders of the neck and upper extremities. It differentiates pain, subjective impairment, disability in work and disability in everyday life into separate spheres, each involving partially distinct contributing factors.
The biopsychosocial model facilitates treatment without necessitating a full explanation for the origin of pain. In itself the model only provides a description of the patient's situation; but as the focus is on the subjective experience of the patient, the goal of the treatment can be set at restoring physical function, amelioration of pain and the adoption of new patterns of behaviour.

The ideal of science is to discern "final, primary causes" and "laws of nature" in their most minute details. This

Specific back disorders	*Non-specific back disorders*
- *low-back trauma: vertebral fracture, contusion etc.* - *lumbar intervertebral disc herniation* - *lumbar spinal cord stenosis*	- *chronic back pain without a specific reason* - *degenerative back disorder*
Specific neck disorders	*Non-specific neck disorders*
- *cervical trauma: vertebral fracture, disc dislocation, ligament lesion etc.* - *cervical disc herniation* - *cervical spinal cord stenosis*	- *tension neck* - *torticollis* - *whiplash trauma* - *late whiplash-associated disorder, WAD*
Specific disorders of upper extremities	*Non-specific disorders of upper extremities*
- *shoulder joint dislocation* - *instability of shoulder joint* - *shoulder joint impingement syndrome* - *rotator cuff tear* - *various types of tendinitis, e.g. those of extensor tendons of finger or wrist* - *rheumatoid arthritis* - *osteoarthritis*	- *load-related pain* - *mixed shoulder disorders* - *adhesive capsulitis*

Table 1. Specific and non-specific disorders of back, neck and upper extremities.

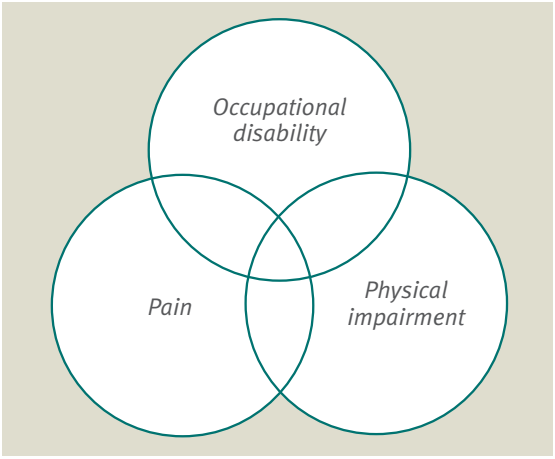

Figure 1. Biopsychosocial model of musculoskeletal disorders.

approach, however, does not work in many disorders of low-back, neck, shoulder and upper extremities. In these conditions, subjectively experienced symptoms and health-relevant behaviours are modified individually and in varying weights by biological, psychological and social factors. A doctor or health care professional may unintentionally induce typical illness-enhancing behaviour by "discovering" that cervical disc degeneration seen on a radiological imaging or a "creaky" tendon is "a reasonable biological explanation" for a transient pain episode that would pass by itself. If a healthy person with a transient pain episode is labelled sick, and if the treatment prescribed prohibits exercise and exertion, a recipe for disaster is created. Careless comments such as "arthrosis of the joint is terrible, in such a young person"; "don't expect to do any work with this hand" or "after a whiplash like this you will need years of physiotherapy to keep symptoms at bay", may induce the patient to think that he or she is afflicted by a difficult disorder and severe impairment. In a worst case scenario this belief will last on its own even after the original "trauma" has healed.

The basic principles of Evidence-Based Medicine (EBM)

"Evidence-based medicine is the conscientious, explicit and judicious use of current best evidence in making decisions about the care of the individual patient. It means integrating individual clinical expertise with the best available external clinical evidence from systematic research."

David Sackett

In this context "explicit" refers to the systematic use of scientific and clinical knowledge with every patient to whom it is applicable. "Judicious" denotes evaluation of the advantages and disadvantages of diagnostic tests and alternative treatments on the basis of clinical expertise. Finally "conscientious" refers to taking into account each patient's baseline condition, clinical status and preferences. The use of the best available evidence presupposes that the clinician is capable of distinguishing between trustworthy and unreliable information (critical evaluation) and obtaining reliable, up-to-date information as required.Therefore, evidence-based medicine signifies a rational combination of clinical experience with the best (up-to-date) scientific evidence, whilst taking into account the patient's own values and preferences. Knowledge discovered in high-quality research is an essential constituent of evidence-based treatments. It has a bearing on the treatment selection, selection of diagnostic tests (validity of tests) and gives indications on the prognostic value of factors affecting the course of illness (risk factors; factors predicting and influencing treatment outcome). Evidence-based medicine is not based solely on randomized clinical trials, although the evidence they produce is especially valuable. Evidence revealed by systematic reviews of randomized clinical trials is only one of criteria that need to be considered when selecting between treatment interventions.

Of the listed criteria "efficacy in research setting" should especially be based on randomized clinical trials whenever possible. As a rule, patients have been chosen for such trials on the basis of predefined inclusion and exclusion criteria and typically have only one medical condition. The trials provide reliable evidence on the efficacy of the intervention at its best. However, follow-up studies with extensive population cohorts may produce more reliable evidence on the safety and effectiveness of treatments in normal circumstances (in which patients' backgrounds and motivation levels vary more widely than in research settings). Also, the skill level of caregivers and their resources may differ from those that are available at specialized research centres. It is especially difficult to carry out studies on the efficacy of treatments when rare or multiple illnesses are involved. This is why evidence based on randomized trials is mostly lacking for such disorders. In these cases, the most reliable information about treatment efficacy and applicability can be obtained with careful research in large population cohorts. Similarly, cohort-based follow-up studies are required in identifying prognostic factors, as the methodology of

randomized trials offers no comparative advantages. Discerning the efficacy of active treatments by observation and randomized studies is also problematic. In observation studies, patients' activity is influenced to some extent by hereditary factors that also have a bearing on many beneficial health-related habits. In randomized trials it is not possible to carry out blinded selections between patients who have participated in active treatments and those who have not done so.

Investigation of the economic factors in health care is not easy or unambiguous, and many decisions have to be made on the basis of human values rather than economy. Nevertheless, economic considerations should not be dismissed altogether. One criterion of economy is cost-effectiveness, which is defined as a comparison of a treatment's effectiveness (health benefits) in normal circumstances with the costs that the intervention involves. One of the ways health benefits and benefits that can be measured in terms of money, e.g. comparing the costs of intervention to produce a saving in terms of sickness absence. may be measured is with health-related quality of life. If it is possible to define a generally acceptable monetary value to health benefits, then that value can be used in an economic analysis to signify effectiveness. Cost-benefit analysis compares outlays. and benefits that can be measured in terms of money, e.g. comparing the costs of intervention to produce a saving in terms of sickness absence.

Criteria	*Description*
Efficacy (health benefit) in research setting	*Is there evidence on the efficacy of treatment in the research setting?*
Safety	*What kinds of side effects and risks does the treatment involve?*
Effectiveness (health benefit) in normal circumstances	*Does the treatment work in "normal circumstances"?*
Cost-effectiveness	*Are the results commensurate with costs?*
Availability	*Do the costs make the treatment unaccesible from the patient's point of view?*

Table 2. Therapies can be assessed according to different criteria.

2. Disorders of the back

Definition

Definitions of the "disorders of the back" vary. The most commonly used concepts "low back pain", "low back trouble" and "low back disorder" are used as synonyms although they often refer to different aspects of the issue. None of the terms clarifies the structure that has been damaged, or indeed if any structural abnormality is involved at all.

With the exception of a herniated disc, trauma, spinal stenosis and certain rheumatic diseases, it is rarely possible to identify the definite causes of low back pain and trouble. Most patients exhibit degenerative changes on radiological imaging, but it is not possible to draw definite conclusions to the origin of pain. That is why the most commonly used classification divides low back disorders into three groups: those related to herniated disc, specific and rare conditions, and non-specific conditions. The latter are the most prevalent. On the basis of pain duration, low back disorders are classified into acute (‹ 6 weeks), prolonged (subacute) and chronic (› 3 months). Recent research has raised questions about the duration-based grouping, as novel low back pain and significant pain persisting

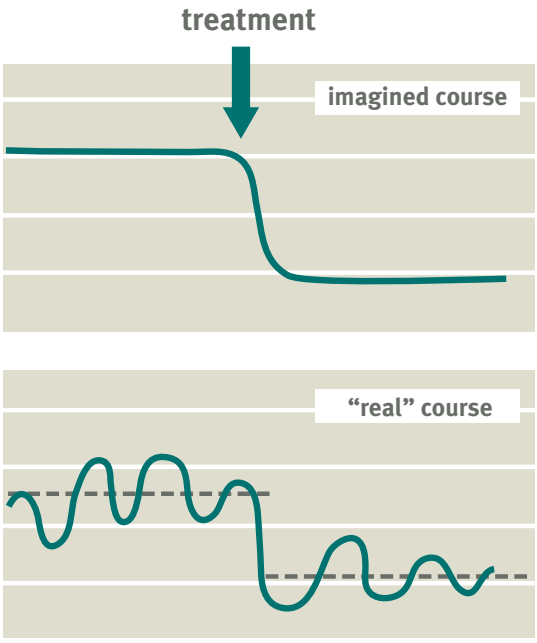

Figure 2. Recurrent nature of spinal pain.

from day to day on a stable level are both relatively rare in adults. The idea of constant, stable back pain was associated with the belief that it would be possible to achieve a permanent reduction in the level of pain with

suitable treatment. The current opinion is that low back pain has a strong tendency to recur and that the clinical picture of chronic back pain also follows a recurrent course: i.e. there are periods of relative ease between episodes of perhaps severe pain. Successful treatment reduces the average intensity of pain, but it is likely that there will be continued "ups" and "downs" in the severity of pain. The prevalence of low back pain is noticeably more common in individuals that have had pain episodes in the past than in individuals that have not experienced them before.

Most episodes of low back pain are transient phenomena, and from the point of view of public health or national economy, they do not cause significant problems by themselves. The situation becomes more problematic if the pain is prolonged and becomes chronic: somatic phenomena become intertwined with various psychological processes and the resulting syndrome causes suffering, impairment and disability.

Prevalence, risk factors and determinants

According to the results of various surveys, three out of four adults aged over 30 have experienced at least one episode of low back pain during their lifetime. Back pain is relatively common, even during adolescence. One half of the adult population has had more than five episodes of low back pain. Over the last few decades, the prevalence of experienced low back pain has remained

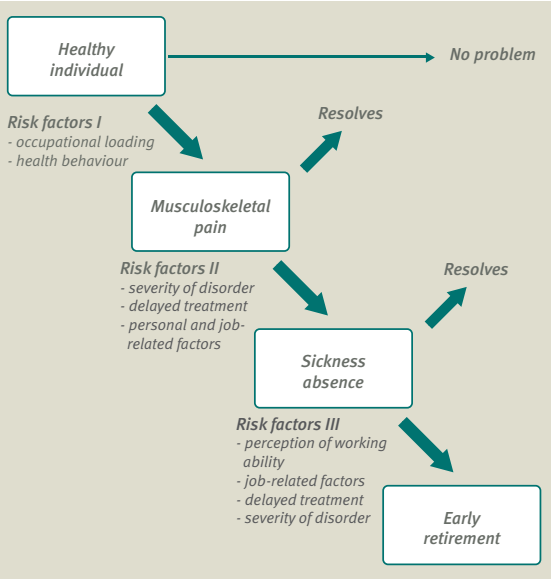

Figure 3. The course of musculoskeletal disorders may be seen as a chain of events where different outcomes have different risk factors.

steady or slightly decreased in most countries, but it should be noted that in different countries the trends go in different directions. "Chronic back syndrome", as diagnosed by a doctor with a clinical examination, has markedly declined. "Health 2000" was a Finnish nationwide, cohort-based survey that relied on clinical examinations. It was found that the prevalence of the condition was 10% among males and 11% among females, while 20 years earlier the corresponding figures had been 18% and 16%.

There are significant differences between risk factors related to the first episode of low back pain and those that are involved with chronicity. Several concurring and even interrelated risk factors may be involved in inducing pain. Physical work, repeated lifting or carrying of heavy loads, difficult postures at work, whole-body vibration, weakness of trunk muscles, trauma, obesity, smoking and stress are factors that have been shown to have a bearing on the onset and prevalence of low back disorders. Genetic predisposition may be a significant risk factor for lumbar disc herniation in young people and recurrent back pain associated with disc degeneration.

Personal and behavioural traits are factors, which cause differences in how people react to psychological stress, for instance. They affect not only how pain is experienced, but also the activation of back muscles. However, too few studies have been carried out so far and those that have been carried out have weaknesses.

Risk factors and acute back pain are both very common. This makes it difficult to devise guidelines for the primary prevention of low back pain, except the promotion of a healthy lifestyle in general. One could even question the need to take preventive action against low back pain as it is such an insignificant, transient condition and almost everyone experiences it at one time or another.

However, the need to prevent frequent recurrence of (debilitating) pain and chronicity, together with their sequelae cannot be disputed. Yet the risk factors mentioned earlier seem to be of limited value in predicting the chronicity of back pain. Factors that are extrinsic (i.e., related to disorder but external to the individual) have recently been shown to be more significant in predicting chronicity than those that are intrinsic to the individual. Localized symptoms usually have better prognosis and recur more rarely than radiating

pain symptoms. The number of back pain episodes experienced, severity of pain, severity of impairment and wide referral of radiating pain increase the probability of recurrence and chronicity. In addition, the risk of chronicity is also affected by external psychological and psychosocial factors: back pain is more common among lower social classes, those less educated and those in employee position. Depression, fatigue and distress also increase the danger of chronicity. It can be assumed that early, efficacious treatment and secondary prevention reduce the probability of chronicity.

Pathophysiology, prognosis and implications

Experimental studies have attempted to locate the origin of back pain by irritating the different spinal tissues during local-anaesthesia surgery. Often these studies have revealed soreness in the outer rim of anulus fibrosus, in the vertebral end-plate located between the disc and bony vertebra, in the anterior spinal dura and ligamentum longitudinale posterior. Pain is rare in ligamenta supraspinale and interspinalia, zygapophyseal capsules and muscle-bone interfaces. If not compressed or chemically irritated, the nerve root is painless. A compressed nerve root or nerve root exposed to nucleus pulposus tissue is painful. The epidural space is well innervated and nucleus pulposus tissue may cause an inflammatory reaction there. This causes either local, radiating pain or a combination of these depending on the irritated tissue structure: anterior dura in local pain and nerve root or its surrounding tissues in radiating pain.

Acute back pain quickly triggers spasm reactions and reflex inhibition of the paravertebral muscles. This function of the paraspinal muscles is not always automatically restored after pain recedes. If acute pain caused by tissue damage becomes prolonged, widespread deficits in motor control may develop. They may cause excess activity of the paraspinal muscles during rest, delay in the reaction reflexes of trunk muscles, deficits in their co-ordination, in addition to deficits in balance control. A “vicious circle of increasing disability” may develop, in which (load-provoked) pain and functional deficits in the paraspinal muscles lead to underutilization of the back that in turn causes “disability” that maintains pain: in due course this vicious circle results in chronic low back disorder. When the situation persists, the motion of the back becomes restricted and muscle strength and endurance are weakened. In laboratory and imaging studies it has been discovered that patients with chronic low back pain exhibit a reduction in collagen synthesis and atrophy of paraspinal muscles.

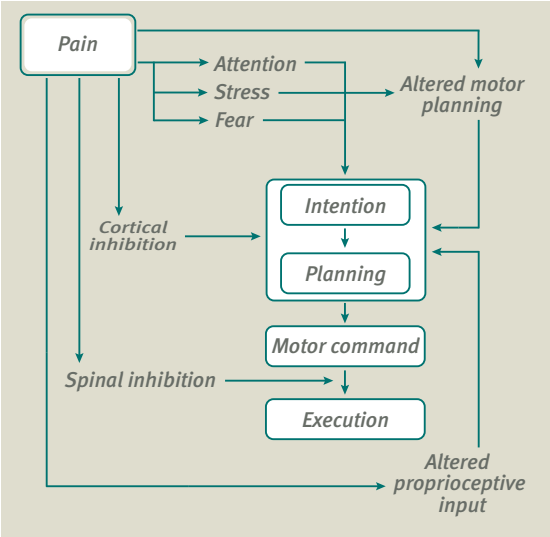

Figure 4. The effect of pain, stress and fear on motor control. Modified from Hodges et al.

Prolonged low back disorder is regarded as a psychophysiological and psychosocial problem that is related, not only to the physical factors mentioned earlier, but also to psychological and social factors. Anxiety, depression, stress reactions, fatigue, mistaken beliefs and fear of pain are among the factors that have been found to be more prevalent with chronic back pain patients than in the general population. However, the order in which these phenomena occur is not clear. Cross-sectional studies do not reveal directions of causal connections, and the few longitudinal studies carried out so far have produced somewhat contradictory results. Depression and distress seem to predict the onset of pain, but on the other hand prolonged pain seems to contribute to depression and stress. Nevertheless, a prolonged period of low back disorder does not always aggravate psychological and psychosocial problems. Psychological symptoms are not directly associated with the duration of symptoms. Rather, they are associated with the level of impairment experienced by the patient.

Typical symptoms of low back disorders include local pain or pain radiating to lower extremities, back stiffness or fatigue. In chronic disorders that cause work disability, the role of psychological and psychosocial factors is especially prominent. Symptoms of the back

rarely result in severe deficits in daily activities or loss of independent coping, but the symptoms are a significant cause of permanent occupational disability, especially in physically demanding jobs. Back disorders also contribute significantly to short spells of sickness absence from work, subjectively experienced impairment, and use of pain medication and physiotherapy services.

Diagnostics and the main treatment approaches

A doctor's clinical examination, which is based on a knowledge of functional anatomy and is repeated when necessary, plays a central role in clarifying the need for further tests and defining the course of treatment. The first tasks are to exclude the possibility of serious illness (malignant tumours, infections, etc.), identify symptoms of possible severe nerve compression, which may require surgical treatment, and refer such patients for further examinations and treatment. In an overwhelming number (80%) of patients with back pain the cause is functional (non-specific) and does not automatically require laboratory tests or diagnostic imaging examinations. Diagnostic imaging is necessitated if there is a reason to suspect the presence of a serious disorder, or if symptoms persist for more than six weeks. Usually there are only weak causal links between back pain and signs of degeneration or other abnormalities seen in imaging examinations. As the exact cause of back pain is usually not revealed, the main reason to perform imaging examinations is to exclude serious illnesses or to support the planning of surgical treatment. In prolonged back disorders, it is also important to uncover psychological and social factors.

Serious conditions (malignancy, infections) induc-

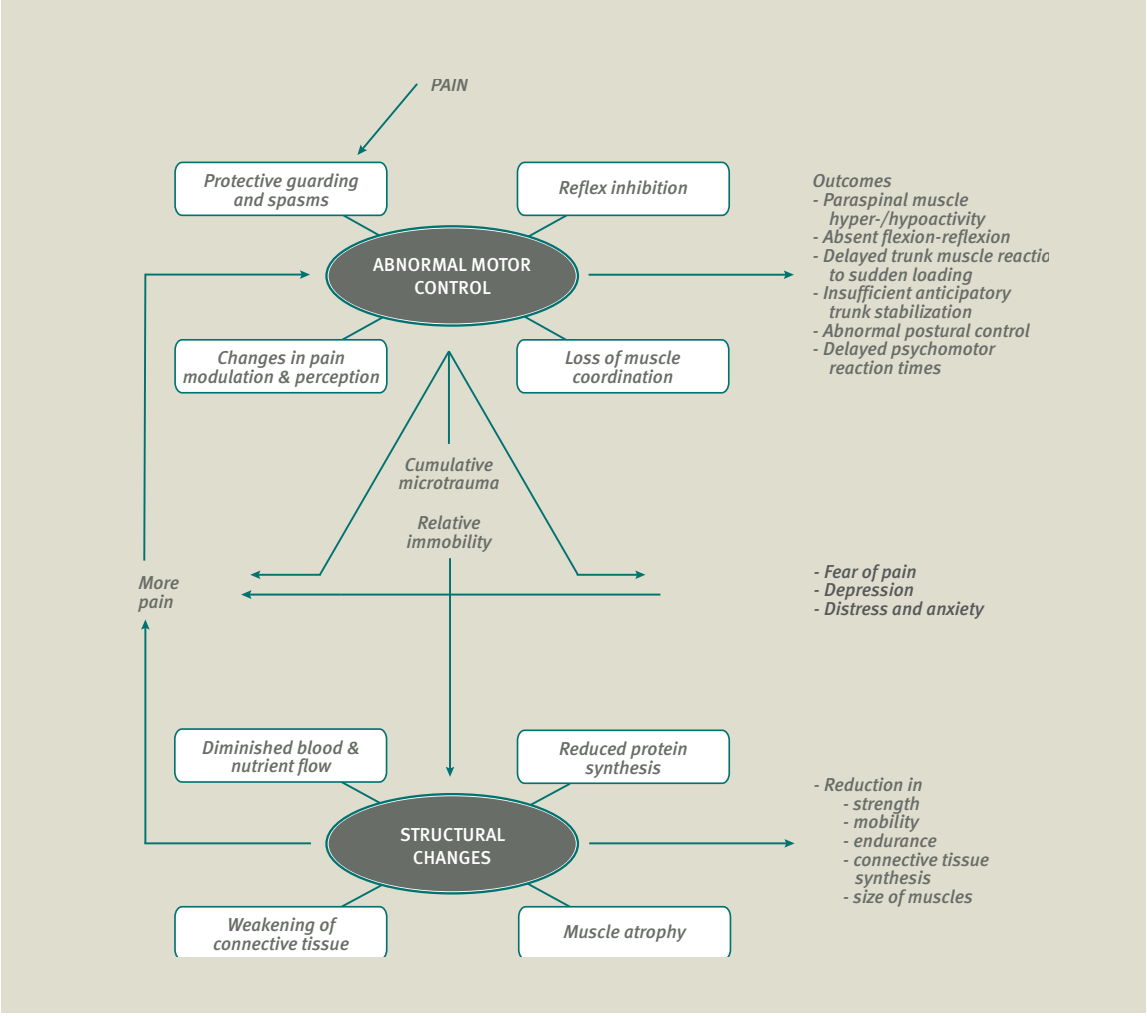

Figure 5. Potential mechanisms involved in the chronicity of low back pain.

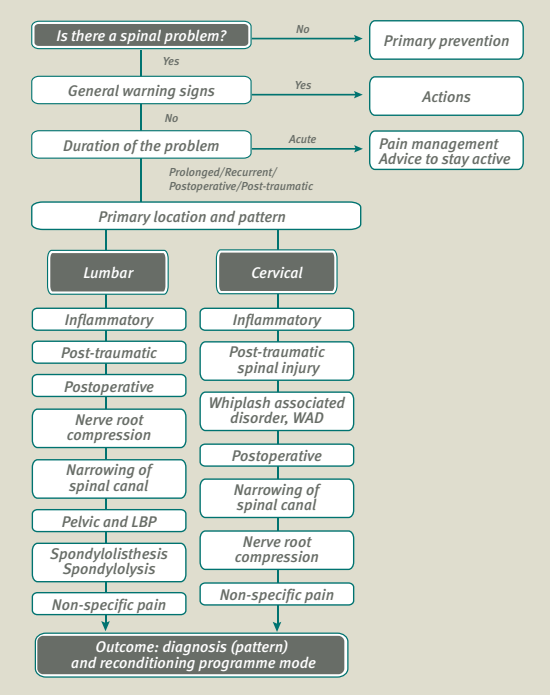

Figure 6. Treatment approaches in spine disorders.

ing low back pain and nerve-root compression, which cause neurological deficits, should be diagnosed early. These patients require further tests and cause-specific treatment. In acute back pain, bed rest should be avoided, and patients should be encouraged to continue daily activities within the limits permitted by pain. Physical exercise has not been shown to provide benefits, nor has it been shown to do any harm. Early, efficacious treatment of pain using anti-inflammatory pain medication, for example, limiting pain-provoking physical loading, but remaining active in daily living reduces the risk of chronicity. Correct information about the benign prognosis of the condition reduces anxiety and increases satisfaction with treatment. If the disorder becomes prolonged, the patient should be encouraged to move the back, carry out physical activities and perform exercises. Efficient rehabilitation treatment should be started without delay. It is recommended that comprehensive charting of the patient's overall situation, active treatment and rehabilitation should be launched after low back disorder involving significant impairment has lasted for six weeks. In the treatment of prolonged low back pain, physical exercises that are sufficiently intensive, promote general fitness and improve body co-ordination compliment other interventions that develop work capacity and function to speed up recovery. However, it has to be kept in mind that opportunities to improve coping at work diminish rapidly as absence from work continues.

Evidence for efficacy of active treatments in back disorders

Medical exercise therapy carried out independently of other treatments is efficacious in the management of chronic back disorders, but not in acute back pain. However, the extent to which independent benefits can be achieved by fitness/exercise therapy have to be critically considered. In a systematic Cochrane-review and meta-analysis, 61 randomized clinical trials that included 6390 adult participants in total, were analyzed. The review revealed strong evidence for the efficacy of exercise in the treatment of chronic back disorder, but on the basis of the meta-analysis pain-related benefits were small when considering all of the trials (Table 3.). However, the impact on pain varied according to the channel through which participants had been selected into the studies. Patients that were selected via normal healthcare displayed pain-related benefit that was about 6 units better than the average for all patients (some of whom were recruited by newspaper advertisements and other such means).

A lack of evidence was observed on the efficacy of exercise on pain and impairment in subacute low back pain, although in two studies it was reported that progressive exercise reduced absence from work.

Efficacies of different forms of exercise were studied in another meta-analysis. The aim was to identify particular exercise intervention characteristics that decrease pain and improve function in adults with non-specific chronic low back pain. 43 trials of 72 exercise treatment and 31 comparison groups were included. Stretching and strengthening demonstrated the largest improvement over comparisons. The authors concluded that exercise therapy consisting of individually designed programs, including stretching or strengthening, and delivered with supervision may improve pain and function in chronic non-specific low back pain. They also concluded that strategies should be used to encourage adherence.

Functional restoration / work conditioning is a course of action in which progressive exercise (guided by physiotherapists, for example) is combined with the cognitive-behavioural approach. Here patients' mistaken beliefs and conceptions are rectified and patients are supported in modifying their behaviours to directions that are beneficial for health. A systematic Cochrane review and meta-analysis included 18 rand-

omized trials that followed this approach. It revealed that the average reduction in sickness absence from work obtained by the functional restoration approach was 45 days per 12 months. In addition, the review concluded that exercise therapy without the cognitive-behavioural elements had no impact on sickness absence or return to work.

Multidisciplinary rehabilitation of low back disorders usually includes various forms of exercise therapy as a part of an extensive programme of rehabilitation offered in an institutional setting. A Cochrane review based on ten randomized trials evaluated the efficacy of multidisciplinary biopsychosocial rehabilitation in chronic low back pain. The review concluded that there is strong evidence for the efficacy of multidisciplinary rehabilitation when the treatment includes exercises for functional restoration. However, the results on sickness absence and return to work were contradictory, and there is lack of evidence on these topics.

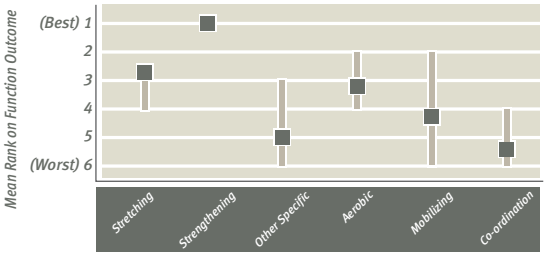

Figure 7. Mean rank on function outcome in non-specific LBP. Hayden et al.

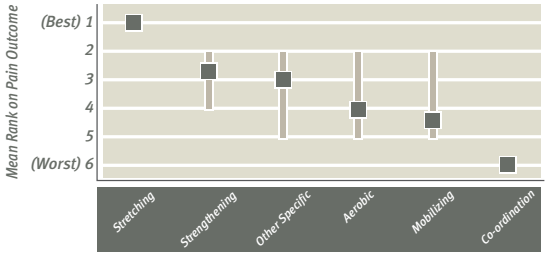

Figure 8. Mean rank on pain outcome in non-specific LBP. Hayden et al.

	Magnitude of the effect	*95% confidence interval*
*Chronic low back disorder **		
• *pain*	*7,3*	*3,7 - 10,9*
• *disability*	*2,5*	*1,0 - 3,9*
Subacute low back disorder		
• *pain*	*1,9*	*-1,1 - 4,9*
• *disability*	*1,1*	*-3,2 - 5,3*
Acute low back pain		
• *pain*	*0,03*	*-1,3 - 1,4*
• *disability*	*1,4*	*-2,8 - 5,6*

** In all participating clinical patients the impact on pain was about six units larger.*

Table 3. Meta-analysis of randomized trials on the treatment of chronic back disorder. Hayden et al.

3. Disorders of the neck

Prevalence, risk factors and determinants

Disorders of the neck and shoulder area are almost as common as those of the lower back. Typical symptoms include neck pain, stiffness and fatigue. Headache and nausea are more prevalent among patients with neck pain than in general population. When interviewed, more than 60% of all adults recall having had experienced pain in the neck and shoulder region at some time. In the Finnish survey "Health 2000", it was found that 26% of males over 30 and 40% of females had experienced neck pain during the last month. The corresponding figures for the shoulder were 23% in males and 40% in females. In the survey, long-term neck or shoulder syndrome (lasting more than 12 weeks) was diagnosed in 5% of males and 7% of females. In a similar survey carried out 20 years earlier, the syndrome had been diagnosed in 10% of men and 14% of women; the prevalence of the long-term syndrome has thus declined by a half in a period of 20 years. However, there has been no corresponding change in short-term symptoms of the neck and shoulder area.

In 1994 a comprehensive research project (Study on Musculoskeletal disorders, Absenteeism, Stress and Health, SMASH) on musculoskeletal disorders was launched in Holland. The project was a prospective three-year follow-up study of 1789 subjects lasting three years. The participants were required to have been in employment for more than one year, have worked for at least 20 hours a week, and have had no symptoms of neck pain for a period of one year preceding the study. 1334 subjects fulfilled the criteria. Once a year (from 1994 to 1997), an extensive interview and video recording of working tasks was carried out to quantify work-related and psychosocial risk factors. The findings of the study were reported in terms of prevalence of neck pain and sickness absence caused by neck pain (Table 4.).

The most significant rate ratios (RR) were as follows:

Neck pain and physical variables
- sedentary work: RR 2.34, (95% CI 1.05-5.21)
- neck flexion and poor endurance of neck muscles: RR 2.5, (95% CI 1.11-5.61)

Neck pain and psychological variables
- high quantitative job demands: RR 2.14, (95% CI 1.28-3.58)
- low co-worker support: RR 2.43, (95% CI 1.11-5.29)

Sickness absence and physical variables
- neck flexion: RR 4.19, (95% CI 1.50-11.69)
- similar figures for neck flexion exceeding 45 degrees and neck rotation exceeding 45 degrees

Sickness absence and psychological variables
- low decision authority at one's job RR 3.66, (95% CI 1.44-9.26)
- discrepancy between skills and job demands RR 2.56, (95% CI 1.08-6.04)

On the basis of these results work-related physical and psychological circumstances are independent risk factors of neck pain and of comparable significance. This was the first time it was shown that neck pain and sickness absence due to neck disorders were not explained by the same factors (similar differences have earlier been shown in back trouble). That is why preventive programmes should take into account both physical and psychosocial work-related factors. On the basis of the study, one should avoid uninterrupted sedentary work, avoid non-ergonomic neck positions and exercise the neck muscles regularly. Work organization management and society should pay attention to the pace of work. In addition, workers should be provided with a sufficient occupational support network and opportunities for training to maintain their skills.

The improvement of the physical condition of the joints and muscles (as a result of exercise) is related to coping with the burden of static or monotonic work. If the conditioning level is good, tissues can cope with heavier loading. From the point of view of job performance it is essential to select suitable workers for each task, take advantage of services that help to maintain workers' work capacities and monitor and develop working conditions.

Symptoms of the neck and shoulder area rarely lead to severe functional deficits or permanent disability. However, they are of great significance as causes of short-term absence, subjectively experienced impairment, consumption of pain medication and physiotherapy services. Usually neck and shoulder pain is a recurrent condition. Local symptoms have, in general, a more benign prognosis and recur less often than radiating pain symptoms.

Work-related physical and psychosocial variables	*Occurence of neck pain* [a]	*Sickness absence due to neck pain* [b]
Neck flexion › 20 ° (over 40% of work time)	+	++
Neck flexion › 45 ° (over 5% of work time)	-	++
Neck rotation › 20 ° (over 25% of work time)	-	++
Sitting (over 95% of work time)	++	-
Quantitative job demands	++	+
Conflicting job demands	-	-
Decision authority	+	++
Co-worker support	++	-
Supervisor support	-	-
Job security	-	+

[a] *recurrent or chronic neck pain during last 12 months.*
[b] *more than 3 days absence from work due to neck pain*
- no relationship; + increased relative risk, however not statistically significant;
++ statistically significant increased relative risk

Table 4. Summary results of the prospective cohort study examining the relationship between work-related physical and psychosocial variables and the occurence of neck pain and sickness absence due to neck pain. Modified from Ariëns.

Pathophysiology, prognosis and sequelae

A major proportion of neck disorders is thought to originate from muscles or other soft tissues, facet joints or discs. However, the exact pathophysiological mechanisms of symptoms are not well known. For most patients with neck or shoulder pain it is not possible to give an exact pathological or anatomical diagnosis; the situation is similar to low back disorders. It is assumed that local tissue lesions, metabolic problems, muscle fatigue, non-ergonomic working positions, general posture and deficits in motor co-ordination contribute to neck disorders.

Localized neck pain can, in principle, originate from all structures that have nociceptors. Compression of the nerve root or inflammation of the nerve root opening may also cause radicular nerve root lesions and pain radiating to the upper extremities.

Whiplash

Whiplash trauma refers to an injury in which the neck is strained in a rapid, whip-like movement first into hyperextension and then hyperflexion. Following a whiplash trauma, the signs and symptoms of the neck and upper extremities may vary from no symptoms to unbearable pain, forced neck position and comprehensive neurological symptoms and signs. In these cases, one is unlikely to identify a single specific cause of pain. Late Whiplash-Associated Disorder (WAD) is a syndrome in which the original whiplash problem does not resolve within six months, but becomes a chronic problem that is difficult to treat. In prolonged WAD, symptoms may be polymorphous. Headaches, dizziness, nausea (especially under exertion), depression and anxiety are common. It has been shown in numerous studies that WAD is also associated with an extensive decline in psychomotoric and cognitive performance. This is indicated by deficits in short-term memory, concentration and eye-hand co-ordination.

Tension neck

By definition, tension neck is a syndrome in which pain is associated with tension in the neck muscles. It is assumed that the condition is related to excessive biomechanical or psychological load, which affects the musculature and the other tissues of neck and shoulder area. Typically people with tension neck work on computers or have to maintain their arms in static, elevated positions. In addition, the need to perform repetitive, monotonic movements in their jobs is typical of tension neck patients. The complaint is more common in females than males. It is thought that tension neck may lead to metabolic dysfunction, microtrauma and gradual muscular changes that do not reverse with rest. The symptoms are manifested in a variety of ways, including aching or stiffness throughout the neck and shoulder area. As the trouble progresses, dizziness and nausea may be involved.

Tenderness, pain, and tension in muscles do not necessarily arise from the muscles themselves. Instead, they can be a sign of segmental irritation in cervical tissues or may reflect a more generalized dysfunction of muscle balance. Pain research has produced clear evidence that lesions in other tissues can increase muscle tonus within the same myotome. Muscles themselves have quite a large number of nociceptors that are particularly sensitive to the lack of oxygen. Recently, it has been discovered that chronic neck pain involves deficits in activation and co-ordination of the muscles in the neck and shoulder area. Deep cervical muscles that maintain posture react with delay to increased loads, and secondary muscles have to compensate for this by excessive activation. This dysfunction in co-ordination may contribute to a continuation of functional neck disorder and pain, regardless of the original cause of pain.

Diagnostics and the main treatment approaches

As the exact aetiology and pathophysiology of neck disorders is not well known, their classification also varies. Clinical diagnosis is made mainly on the basis of the patient's history and clinical tests. The prognosis of neck disorders is in most cases benign, and that is why symptoms can (should) be treated without the need for a specific diagnosis. Serious and systemic illnesses have to be excluded.

Neck disorders can be classified on the basis of history, symptoms and clinical findings as follows:

1. Local (non-specific) neck pain.
2. Radiating neck pain.
3. Whiplash trauma.
4. Myelopathy (compression of spinal cord)
5. Other neck disorders: pain related to systemic illnesses and tumours; sequelae of cervical fractures.

On the basis of the duration of symptoms the first three groups can be divided into acute (less than 12 weeks) and chronic (more than 12 weeks) conditions.

The main approaches in the treatment of neck disorders

As has been explained, it is seldom possible to identify an exact cause for pain in the neck and shoulder area with clinical examination. If trauma, tumour and myelopathy are excluded, ordinary cervical X-ray images or MRI scans cannot be expected to yield significant additional information about the causes of neck pain. Therefore it makes sense to aim primarily at excluding serious illnesses (i.e. tumours, infections and fractures). The approach is similar to that followed in low back disorders. Treatment can be planned on the basis of a working hypothesis that can be made more specific on the basis of patient's response to treatment and clinical follow-up. If necessary, the approach can be modified.

The prognosis of local acute neck pain is usually good, and in some patients the symptoms disappear or resolve spontaneously. Pain can be treated by anti-inflammatory pain medication. Action can be taken to eliminate load factors that provoke pain, but the patient should be encouraged to continue daily activities within the limits permitted by pain. Specific exercise therapy is usually not necessary in acute neck pain. Exercises that can be carried out by the patient at home can be useful, especially in the prevention of chronicity after whiplash trauma.

In the treatment of chronic neck pain, patients are encouraged to stay active. Continuation of day-to-day activities within the limits permitted by pain is important. Active functional restoration treatment programmes that enhance strength, endurance and co-ordination of the muscles provide benefits for a large proportion of patients with chronic neck pain. Assessment of working conditions and leisure time exposure should be carried out, at the latest, when the neck disorder is becoming chronic. Predisposing factors should be eliminated, respectively. Anti-inflammatory pain medication must not be used for prolonged periods. If pain involving significant disability has lasted six weeks, the patient should be referred for an assessment of treatment needs. When required, treatment and rehabilitation must be started.

Precautions and contraindications to exercise

Neck disorders may involve rare diseases that demand special caution when selecting form of exercise. In patients with neck trauma, the possibility of cervical fracture has to be excluded. In elderly patients, especially when osteoporosis or rheumatic diseases are involved, even a minor cervical trauma can cause a fracture (diagnosed in 3% of all patients with neck trauma). An important clinical problem is a fracture of the dens. Its diagnosis is often delayed and it causes cervical instability and severe disability. Fracture in this segment cannot be always identified even when MRI is used, and cervical CT imaging needs to be applied as a basis of diagnosis.

Pain that is continued, progressive, occurs at night, at rest or is untypical may indicate some serious disease of the cervical area. Often these patients exhibit systemic symptoms such as weight loss, deterioration of their overall physical condition and disability. Typically, patients are 50 years of age or older. Recovery from cancer may be found in the patient's history (in females it is often breast cancer and in males prostate cancer).

Cervical myelopathy is a rare condition and its diagnosis requires vigilance in clinical examination. Pain is rarely the dominating symptom. Sensory symptoms, numbness in upper and/or lower limbs, dizziness, disturbances of balance, increased clumsiness, difficulties in walking and ataxia are typical in myelopathy. Thorough clinical examination may reveal a positive Babinski reflex, hyperactive tendon reflexes and provocation of symptoms during cervical extension and/or retraction. Timely surgical treatment may save the patient from disability, so the possibility of myelopathy has to be kept in mind when examining patients. MRI is an important tool in diagnosis and it should be performed without delay if myelopathy is suspected.

Rheumatic diseases often involve lesions in the upper cervical spine. Even considerable dislocations of vertebrae may cause just minor symptoms or no symptoms at all. Often pain is involved and sometimes there may be complications including neurological deficits, or even quadriplegia and sudden death. Diagnosis is made on the basis of flexion imaging. Usually treatment is conservative, but surgery may also be needed. Before planning mobility or exercise treatment the sta-

bility of the cervical spine has to be ascertained.

Severe neck disorders often involve headaches, visual disturbances and nausea, especially if WAD is involved. In these cases, starting mobility exercises and exercise treatment may be especially challenging as even small neck movements may provoke pain and associated symptoms.

Evidence for the efficacy of active treatments in neck disorders

No known randomized studies have been carried out on the significance of active interventions in the treatment of acute non-specific neck disorder, and therefore the efficacy of exercise is unclear in this condition. Continuation of normal daily activities within the limits permitted by pain is recommended.

In acute whiplash trauma, randomized studies have shown that self-administered exercise is more efficacious in treating pain than resting, medication or using a supporting collar. Similar results have been reported for disability, range of motion and chronicity. Mobility exercise carried out during recuperation seems to prevent chronicity in whiplash trauma.

Efficacy of exercise therapy in the treatment and rehabilitation of chronic neck disorder has been studied in 15 (or more) randomized controlled trials. Eight of these studies had no control groups. The comparisons were made between various types of exercise therapy, or exercise therapy was compared with other forms of physiotherapy (mobilization, manipulation, etc.). In these studies efficacy differences between active treatments were marginal. Seven trials included control groups, and in most of these studies exercise therapy was efficacious in treating pain and disability (at least in the short term). However, the results of these randomized trials were contradictory. In some studies, exercise provided no benefits. In others, the benefits were of short duration. Only a few studies showed that exercise provided long-term benefits. Interpretation of the results is made difficult by heterogeneity of methods and the small sizes of participating patient groups. What can be said, however, is that if the exercises did not target neck specifically, no efficacy on neck pain related to the neck disorder was observed. Exercise has to be also of sufficient intensity and duration: light exercises and stretching aimed at improving general well-being had little effect on neck disorders in the reviewed studies. On the other hand, the benefits of even intensive exercise disappear in due course after exercising is discontinued. In two randomized studies, reductions in pain and disability were achieved with proprioceptive training. Light loading was used, but the exercise was targeted specifically at the neck and repeated frequently. As a conclusion of the available evidence, the potential benefits of exercise treatment in neck disorders seems to depend on specific targeting of the neck and the patient's compliance with the treatment.

4. Shoulder disorders

Prevalence, risk factors and determinants

Pain and restriction in the shoulder joint are common, but the terminology used to describe shoulder disorders is quite diverse. In addition, the diagnostic criteria have been only partly established. About 5% of patients visiting a general practitioner have shoulder complaints. About 5% of Finns aged 30 years or over have long-term shoulder disorders. 20-50% of all people experience troubling shoulder pain each year. In many countries shoulder complaints are next to back and neck conditions as the most prevalent musculoskeletal disorders. The prevalence of shoulder disorders is somewhat higher in females than males; the prevalence grows slowly with age. The complaints often emerge in the context of work. Shoulder trauma comprises 3-20% of all trauma related to physical exercise. In comparison with ailments of other joints, those of shoulder are accentuated by their slower recovery and relatively high prevalence in the working age population.

Shoulder disorders can be classified as follows:

- Dislocation
- Instability
- Impingement syndrome and rotator cuff tear
- Acromioclavicular (AC) joint injury
- Osteoarthritis
- Adhesive capsulitis

Among the working age population the most common form of shoulder pain is a consequence of compressed rotator cuff. This “impingement syndrome” may be related to various background factors. Friction may cause inflammation, scar tissue formation and ruptures of various sizes. Typical symptoms include pain at night and with exertion, especially when upper extremities are raised to shoulder level. Impingement is rare among young people, but may occur especially if inherited or acquired joint laxity is present and if the muscles surrounding the shoulder joint are weak.

Terms such as “impingement”, “rotator cuff tendinitis”, “rotator cuff syndrome”, “supraspinatus tendinitis”, “periarthritis”, “rotator cuff tear (RCT)”, etc. describe a variation on a continuum of disorders that originates from tendinitis in one or more tendons and progresses to tissue ruptures.

Friction-induced inflammation, swelling and finally rupture are thought to develop most frequently in the

presence of certain predisposing factors. Among them are tightness in the posterior capsule, weak rotator cuff and a narrowed subacromial space. If the joint capsule is tight, it pushes the humeral bone towards the acromion; a weak rotator cuff allows worsening of the impingement, and the subacromial space may be narrow because the acromion has a hooked morphology. The latter may be an inherited condition or develop as a result of osteoarthritis. Several other theories have been presented, but without clear supporting research evidence. The significance of these anatomical and functional factors has not been ascertained in prospective follow-up studies.

Research on work-related risk factors of shoulder pain has increased over recent years. A research group (at The National Institute of Occupational Health and Safety, NIOSH) in the United States published a review article of 20 epidemiological studies. It was revealed that work which involved frequent repetitive movements of upper extremities (especially in flexion or abduction of more than 60 degrees), increased the risk of developing rotator cuff syndrome. The risk is increased if the positions mentioned involve the use of heavy tools. Exposure to vibration seems to be of minor importance. Only three of the reviewed studies gave a precise definition of shoulder pain. Therefore, it was concluded that the evidence remains poor and specific recommendations for prevention are not easily justifiable.

Rotator cuff disorders are not a problem that is related solely to ageing, although the prevalence of degenerative rotator cuff changes identified on radiological imaging grows with age. Only a proportion of people develop rotator cuff lesions related to ageing. A significant number of these so-called degenerative lesions are scars resulting from friction. Rotator cuff disorders are not caused automatically by repetitive movements, as they can also afflict the non-dominant hand and people performing light sedentary work.

Trauma may also cause rotator cuff tears in healthy tissue. However, trauma-related rotator cuff tears comprise less than 10% of all cases. Major ruptures usually result only from massive traumas. In young people, lesser traumas may cause partial ruptures that often heal spontaneously. The same is true, for example, of microtraumas with throwing athletes.

Follow-up studies are underway, but their results have not yet been published. That is why recommendations on preventive measures have to be based mainly on knowledge gained through clinical experience. Maintaining mobility, the muscle balance of the joint and taking ergonomic factors into account at work is supposed to reduce the risk of developing shoulder complaints.

Traumatic dislocation of the shoulder is a common injury, but it affects mainly young people. Among the elderly, dislocation often causes injuries in bony structures and therefore these cases have to be treated along separate lines. Laxity of the shoulder joint is a significant cause of pain and above all a factor that impairs performance. Laxity of the shoulder is also a predisposing factor for other shoulder disorders. It has been discovered that onset of the classical impingement syndrome is often preceded by various degrees of laxity in the shoulder joint especially in young people.

With the individuals under the age of 21, the annual incidence rates of shoulder dislocation are 20 in females and 5 in males per 10000 individuals, respectively. An earlier dislocation raises the risk of recurrence by 2 or 3 fold. Follow-up studies show that shoulder dislocations seldom heal and become asymptomatic without treatment.

Risk factors for the first occurrence of shoulder dislocation are not precisely known. Falls on the outstretched arm and violent collisions, either at work or in leisure time pursuits, may displace the head of the humerus from its socket. Sports in which falls and collisions are frequent increase the risk of shoulder injury, especially if the rules of the game are not adhered to or if protective gear is not used. Contributing factors include a pre-existing labral tear and ligaments strained in an earlier dislocation. Muscle function can compensate reasonably well for injuries in passive structures. However, in extreme positions the head of the humerus slips easily out of the capsule, if its stability is not supported by the labrum and the ligaments. The significance of these injuries is heightened by the fact that recovery is slow and incomplete.

Tissue injuries caused by shoulder dislocations tend to vary from one age group to another. In individuals who are less than 60 years of age, the most common soft tissue injuries are lesions of the cartilaginous labrum. In people aged 60 or over, rotator cuff tears are the most significant injuries. In all age groups there are about as many Bankart lesions (detachment of anterior glenoid labrum) as Hill-Sachs depressions on the head

of the humerus.

The importance of preventing shoulder dislocation is highlighted by a recent observation, which revealed that the risk of shoulder osteoarthritis is increased by a previous incidence of dislocation. According to the study, patients who had experienced dislocation saw a 10-20 fold increase in the risk of shoulder osteoarthritis compared to the normal level. Shoulder osteoarthritis is an increasing problem, although it remains more occasional than osteoarthritis of the knee or hip.

Physiology and pathophysiology

The shoulder joint and shoulder girdle form a system consisting of three major joints: the shoulder joint (articulatio humeri or glenohumeral joint), acromioclavicular joint (articulatio acromioclavicularis) and scapulothoracic joint (articulatio scapulothoracalis). The main bones are the upper arm bone (humerus), shoulder blade (scapula) and collar bone (clavicula). The shoulder joint is a ball-and-socket joint, in which the joint cavity is significantly smaller than the head of the humerus. The joint cavity is also flatter than the more strongly rounded head of the humerus. That is why the shoulder joint has a wider range of motion and is less stable than other joints. The shoulder joint is surrounded by the joint capsule and is also strengthened by ligaments. The capsule is attached to the periphery of the joint cavity on the shoulder blade and the neck of the humerus. The capsule is relatively loose and facilitates the wide range of shoulder movements. The capsule maintains a "vacuum" effect that contributes to the stability of the shoulder joint. The vacuum is lost if the capsule ruptures or if it is opened during surgery. Another function of the joint capsule-ligament complex is to act as a proprioceptive sensory organ that feeds back important sensory information needed for the timely activation of muscles surrounding the shoulder joint.

A rim of fibrous cartilage (labrum glenoidale) encircles the joint cavity. The labrum increases the contact surface of the joint by 50-70%. It also enhances the stability of the joint by acting as a host for the ligament endings. Together with the joint capsule the labrum glenoidale also maintains the vacuum effect within the joint. The vacuum is lost in lesions of the labrum. Typical lesions include anterior dislocations of the shoulder joint, in which the upper extremity is in external rotation and abduction, causing detachment of anterior labrum. This is what is called a Bankart lesion. A rupture of the tendon of the long head of the biceps muscle is in turn called a Superior Labrum Anterior Posterior (SLAP) lesion.

The four muscles of the rotator cuff (supraspinatus, infraspinatus, subscapularis and teres minor) are primarily responsible for the dynamic stability of the shoulder joint. The rotator cuff is also known as humeroscapular muscle group. The tendons of these muscles are tightly connected to the capsule of the shoulder joint and form a capsule of tendons around the anatomical neck of the humerus. Functionally the tendon of the long head of the biceps muscle is regarded as a part of the rotator cuff.

The term "rotator cuff" does not clearly indicate its most important function, which is to control and adjust the position of the head of the humerus in the joint cavity during arm movements. The muscles of the rotator cuff keep the contact in the shoulder joint stable in all positions. The muscles controlling the shoulder joint act in agonist-antagonist pairs (such as the deltoid and infraspinatus in abduction). The rotator cuff includes movement-sensing nerves that participate in the control of the shoulder's multidimensional arcs of movement.

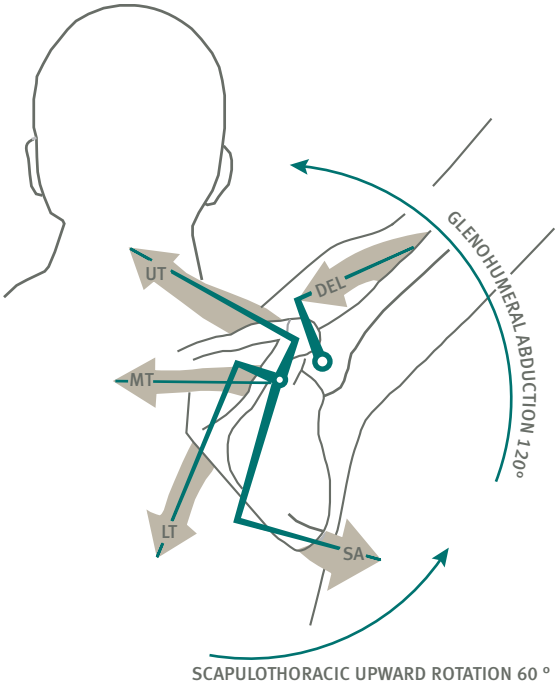

Figure 9. Humeroscapular rhythm. SA=serratus anterior, DEL= deltoideus, UT=upper trapezius, MT=middle trapezius and LT=lower trapezius. Rotator cuff fine tunes the alignment of the head of humerus in relation to scapular fossa.

The co-coordinated movements of the humerus and shoulder blade is called the humeroscapular rhythm. When the upper extremity is elevated along the plane of the shoulder blade, the joint cavity moves medially, turns upwards and slides up as the shoulder blade rotates. In over 90° of elevation, external rotation of the humerus is needed. Otherwise tuberculum major would collide with acromion. The humeroscapular rhythm is co-coordinated by tonic muscles, rotator cuff and rotators of the shoulder blade.

For optimal performance of the shoulder joint, the function of scapulothoracic muscles should be as perfect as possible. Often the ability of serratus anterior and parts of trapezius to turn the shoulder blade upwards has been weakened, resulting in the overloading of the glenohumeral joint when arm is raised. Strengthened and often shortened pectoralis major and latissimus dorsi also have a negative impact on the function of shoulder joint. The increased activation of these thoracohumeral muscles tends to twist the shoulder blade medially and in addition they push the humerus anteriorly. The muscles of the rotator cuff offset the variation in these forces. They keep the head of the humerus in the joint cavity in as optimal a position as possible.

Dysfunction of the shoulder blade may be primary or secondary. Winging of the shoulder blade, its incomplete retraction or protraction and disturbances in the movement rhythm are common. Pain in the neck-shoulder girdle may inhibit the tonic muscles of the shoulder blade. Trapezius, serratus anterior, rhomboids, and levator scapulae are all exposed to overloading and damage. Loss of the protracted movement of the shoulder blade may lead to the rotator cuff impingement syndrome. Its permanent protracted position may restrict the subacromial space and result in impingement symptoms. The correct humeroscapular rhythm is an important prerequisite for the healthy functioning of the shoulder joint; however, this can easily be disturbed by pain in the neck and shoulder area. Typically, chronic shoulder disorders involve (secondary) functional disorders

Diagnostics and the main treatment approache

Dislocation of the shoulder joint

The shoulder joint may dislocate anteriorly (›90% of the cases) or posteriorly (‹ 10% of the cases). The typical injury mechanism in shoulder dislocation is collision or twisting when the upper arm is in abduction with external rotation.
More than 90% of all surgically treated shoulder dislocations involve, not only a strained or ruptured capsule complex, but also a Bankart lesion, i.e., the detachment of anterior glenoid labrum. In elderly patients, the dislocation may be complicated by a fracture as well. About 80% of dislocations involve compression of the head of the humerus (Hill-Sachs lesion), but it seldom affects the course of treatment or long-term prognosis. Neural damages arise in about 5% of shoulder joint dislocations. Most shoulder dislocations in people over 40 also involve rotator cuff tears.

A first shoulder dislocation can take place at any age, but dislocations mainly occur before the age of 20, or between 50 and 60 years of age. At a young age, labral lesions usually complicate dislocations; among the elderly the most common complication is a rotator cuff tear.

Painful, post-traumatic deformity of the shoulder joint is an indication of dislocation; in differentiating diagnostics fracture is to be considered if the injury mechanism is unknown. Repositioning of the joint should be performed as soon as possible in order to limit damage to soft tissues and nerves. Usually pain resolves forthwith after repositioning. Immediate surgical treatment is rarely needed. Clinical examination and diagnostic imaging ascertain the diagnosis. After repositioning the dislocated joint, the arm is placed in a sling to create the best possible condition for the healing of soft tissues. Estimates of immobilization times required vary in the literature, from a few days to six weeks.

When treated with prompt repositioning, immobilization and gradually progressive rehabilitation, the shoulder can be expected to recover and even allow a return to sports in 10-16 weeks. Active treatment aiming at strengthening the stability of the shoulder joint significantly reduces the risk of recurrent dislocation.

Shoulder joint instability

Shoulder joint instability is a condition in which the stability of the shoulder joint is defective and the head of the humerus moves excessively relative to the joint cavity. It results in recurrent dislocations or subluxations, with which the head of the humerus moves to the edge of the joint cavity. Instability accelerates joint

degeneration and may lead to premature arthrosis.

Instability may develop as a result of trauma, general laxity of the ligaments, congenital factors or other medical conditions, if the structures that are responsible for the stability of the joint have been damaged or are abnormal. If the first traumatic dislocation in an under 20-year-old is left untreated, instability will follow with a probability of 90%.

The diagnosis is based on the patient's history and clinical examination. For exclusion purposes diagnostic imaging can be carried out as well. Chronic shoulder instability typically occurs in young people who are actively involved in sports.

Shoulder impingement and rotator cuff tear

The rotator cuff should slide below the acromion smoothly and without interference. Shoulder impingement is a condition in which the rotator cuff is compressed or rubs against the acromion and/or the coracoacromial ligament. The condition can be complicated by subacromial bursitis and various tendinitises. The result is pain, tenderness and restricted movement.

Tendinitises are common stress injuries of the shoulder joint. Tendinitis of the supraspinatus insertion is common, but repetitive strain may also involve tendinitis of the long head of biceps as well as luxation of the biceps tendon.

Subacromial bursitis may involve strong symptoms. Calcified bursitis may elevate the blood sedimentation rate and create a strong clinical picture of inflammation.

Impingement syndrome may lead to a rotator cuff tear. The rotator cuff tear may also result from trauma or excessive loading. A rotator cuff tear usually presents in middle-aged or elderly patients; it is rare in individuals who are less than 40-years of age. The prevalence is similar between males and females.
Shoulder impingement syndromes and rotator cuff tears are classified as follows:

I degree	*Swelling and pain*
II degree	*Inflammation and scarring*
III degree	*Partial tear of the rotator cuff*
IV degree	*Complete tear of the rotator cuff*

The typical age of patients with impingement syndrome or a torn rotator cuff is over 50 years.

Patient history and clinical examination may give indications of an impingement or tear. However, the symptoms and clinical findings are often similar to those in patients with frozen shoulder syndrome, arthrosis or neural lesions.

The clinical examination should include measurement of range of motion and specific diagnostic tests (Neer's; Hawkin's); differences between active and passive ranges of motion and positive findings in provocation tests indicate the diagnosis. It has to be confirmed by imaging findings. Plain x-ray imaging can be used to exclude fractures and serious illnesses and verify the shape of the acromion. Ultrasound may reveal swelling or lesions in the rotator cuff. Magnetic resonance imaging depicts the status of soft tissues more accurately than ultrasound.

Treatment is started with rest, activities that provoke symptoms are limited and anti-inflammatory medication (NSAIDs, cold therapy, corticoid injections) are used to ease the pain. Progressive active rehabilitation programmes are efficacious in the treatment of the impingement syndromes as well as of small or partial tears of the rotator cuff.

Surgical treatment is only rarely required. This is especially true in elderly and other patients with increased risk of complications in this instance; the benefits and risks of surgery should be weighted carefully. Surgical treatment is recommended for active young and middle-aged patients with the IV degree trauma (complete tear). The operation aims at restoring the integrity of the rotator cuff; a complete tear will not heal by itself. In young patients suspected of having the shoulder impingement syndrome, instability as a primary cause for the shoulder disorder should be excluded first. The repair of an extensive tear does not always succeed; in some of the patients debridement of the shoulder joint should be considered. One option in the treatment of the impingement syndrome is acromioplasty, in which the subacromial space is extended by bone resection and/or excision of coracoacromial ligament.

Arthrosis of the shoulder

Arthrosis may occur in the shoulder joint and the acromioclavicular (AC) joint. Progressive pain related to loading is a typical symptom. Arthrotic pain is usually

felt behind the shoulder or deep within it. Arthrosis pain in the AC joint localizes in the frontal shoulder area and in the area of the AC joint. Restricted movement is another typical sign; crepitus may also be heard during shoulder movements. As the disorder progresses, pain at night may become a significant problem.

Typical clinical examination findings include muscle atrophy, palpation tenderness, restricted movement, crepitus and provocation of pain when loading the joint. Narrowing of the joint space and osteophytes may be observed in native radiography. If an injection of local anaesthetic removes the pain, the diagnosis can be considered certain.

Treatment is usually conservative: rest, medication and cold therapy. Progressive physiotherapy may be useful in maintaining functions. If the pain cannot be brought under control, surgical treatment may be considered. Prosthetic surgery is rapidly becoming more common in the treatment of shoulder arthrosis; the most usual procedure in the treatment of the arthrosis of the AC joint is resection of the collar bone.

Adhesive capsulitis (frozen shoulder)

Frozen shoulder is a condition in which the shoulder movements are restricted. The exact aetiology of the disorder is not known, but it is thought that inflammation plays a central role in its development. The shoulder joint capsule becomes thicker and diminishes in size, restricting shoulder mobility. Usually only one shoulder is afflicted, but every third patient has the restriction in both shoulders.
In an idiopathic presentation of this disorder, the histology of the joint capsule is abnormal. The aetiology of the change has not been fully explained. Diabetes is known to be a predisposing factor. Frozen shoulder may also develop as a result of trauma or prolonged immobilization.

	Age	*Aetiology*	*Inspection*	*Active range of motion*	*Passive range of motion*
Shoulder dislocation	*Young*	*Trauma*	*Deformation in the shoulder joint area*	*No movement*	*Restricted*
Instability	*Young*	*Instability provoked by movement*	*Normal*	*Normal or excessive*	*Normal or excessive*
Impingement syndrome/ Rotator cuff tear	*Middle-aged/ elderly*	*Pain after loading and weakness*	*Shoulder blade protraction*	*Restricted in abduction and rotation*	*Painful*
AC-trauma	*Young*	*Direct hit on the shoulder (trauma)*	*AC-joint deformity*	*Restricted by pain*	*Restricted by pain*
Arthrosis	*Elderly*	*Post-traumatic or rheumatic*	*Muscle atrophy possible*	*Restricted*	*Restricted*
Adhesive capsulitis	*Middle-aged/ Elderly*	*Idiopathic or post-traumatic*	*Muscle atrophy possible*	*Clearly restricted*	*Clearly restricted*

Table 5. Findings related to the most common shoulder disorders.

The main symptom is restricted movement. The syndrome develops gradually, and three phases may be discerned in its progression:

- Pain phase. Pain associated with movement and restriction progresses gradually; first abduction and external rotation are restricted. Pain at night may occur. The phase lasts between two and nine months.
- Stiffness phase. Pain starts to lessen and shoulder movements become less painful, although movement becomes increasingly constrained. The range of motion may be less than half of that in a healthy shoulder. The phase lasts about 4 – 12 months.
- Healing phase. The disorder begins to heal. In most patients, the range of motion improves over the next few years.

In the beginning, pain can be treated with anti-inflammatory pain medication, cold therapy and injections. At a later stage, progressive mobility therapy is planned for the treatment of the movement restriction.

Differential diagnostics

Table 5. shows probable diagnoses on the basis of different anamneses and clinical findings; the table should be regarded as an approximate guide for diagnosis.

5. DBC treatment concept

How does DBC apply evidence-based medicine?

As a fundamental, DBC functional rehabilitation includes systematic quantification of both the physical function and psychological factors, which "drive" the therapeutic process. The baseline assessment yields a bio-psychosocial profile of the patient and establishes initial parameter levels, which are monitored later as progress and outcome indicators. The profile is used in the design of an individualized treatment program and in assessing prognostic factors. The tests that measure range of motion, endurance/strength and questionnaires on pain, function and psychological well-being of the patient are periodically repeated during the rehabilitation treatment. This allows the scheduling of a correct therapeutic approach on an individual basis, and gives the patient feedback on the improvement of his/her physical capacity and well-being.

DBC functional rehabilitation programs aim to:

- Restore the range of motion.
- Restore muscle co-ordination and movement control.
- Improve muscle endurance.
- Improve general condition.
- Re-educate patients in the difference between normal physical loading and pain.
- Reduce fears and avoidance behaviour.
- Tackle the psychological/social/occupational obstacles to return-to-work.

The individualized treatment program combines specific exercises together with cognitive-behavioural support. The exercises progress gradually and are carried out under close supervision of trained staff. Cognitive-behavioural support includes individual education and "learning by doing". Towards the end of the program, a home exercise program is introduced to maintain the results.

The DBC treatment sessions' average duration is 60 minutes and treatment is carried out twice per week. During the treatment program there are assessment sessions of 90 minutes evaluating the patient's baseline condition, progress and/or outcome. The monitoring of outcomes provide information on the progress and outcome of treatment and allows for long-term follow up.

The clinic-specific DBC quality assurance system includes ongoing clinical support, training workshops and patient data analysis. The quality assurance reports are produced twice a year on the basis of patient data from each clinic. These reports help to demonstrate the effectiveness of the treatments at local level. All this results in a treatment program, which is strongly based on the principles of EBM:

1. The DBC treatment concept is based on knowledge obtained from scientific research. The validity of measurements and efficacy of treatments have been evaluated in several studies. The test and treatment results gathered on tens of thousands of treated patients in DBC databanks have been used in the development of the treatment programmes. The treatment results are good when the treatment method is applied correctly.
2. Diligence in the reproducibility of the treatment method at different locations is achieved as a result of personnel training and careful documentation of treatments given to patients.
3. Individualized treatment programmes are planned on the basis of initial measurements and take into account the patients' individual preferences and needs.
4. The QA process enables the monitoring of clinical treatment results, which are obtained at the local level.

DBC treatment concept – general principles

The DBC treatment concept is formed by a combination of DBC assessments, treatments and outcome monitoring protocols. The protocols cover all of the main phases of the treatment process. They comprise of uniform procedures for initial patient assessment, methods that enable the design of individualized treatment programs, techniques for monitoring treatment progress and outcome, and tailored guidelines that help patients to maintain the results achieved during the rehabilitation phase.

Baseline assessment

Standardized clinical examination
Clinical examination forms the basis of planning individualized treatment programs and constitutes an important screening phase for the detection of possible contraindications for active treatment. The standardized DBC clinical examination comprises of items proven to be of primary importance for back, neck and shoulder patients.

Questionnaires
The evaluation includes questionnaires charting the patient's complete history and present status of the back, neck or shoulder. The questionnaires also provide a comprehensive description of the patient's functional and psychosocial status, general health and working conditions.

Medical background
This module of the questionnaire collects information on the number and duration of pain episodes, the onset of the pain, as well as the length of absence from work. Information on the medical background is used in predicting the duration of the treatment program.

Pain intensity, pain duration and pain drawing
Pain intensity is measured using a 100 mm Visual Analogue Scale tool. Pain drawing and pain frequency information indicate the severity of the condition. These modules of the questionnaire influence the predicted duration of the treatment, initial loading level of the DBC exercise devices and load progression.

Psychological questionnaires
The Fear Avoidance Behaviour Questionnaire assesses the patient's beliefs about the relationship between physical activity (including work) and pain. Rimon´s Brief Depression Scale is used to screen for depressive symptoms and the Recovery Locus of Control probes the patient's attitudes towards treatment. Usually, the results of the psychological modules are favourable, and the therapist can concentrate on giving cognitive and behavioural support. An additional psychological module can be added to the individual treatment program, if a patient needs it.

Physical impairment index
The physical impairment indexes are used for assessing the level of self-experienced physical impairment and disability. The shoulder impairment index is based on the subjective shoulder scale of the American Shoulder and Elbow Surgeons (ASES).

Job description, working status
The level of physical workload, and psychological factors at the workplace are screened. Work-related factors can be taken into account in the planning of the

individual treatment program as well as in selecting the means by which the patient is supported to continue his or her work.

Physical activity
Physical activity is measured by obtaining a Metabolic Equivalents of Task (MET) score.

Stress VAS
Subjective stress is measured with a 100 mm Visual Analogue Scale tool.

Personal goals
The patient's personal goals and expectations of getting better with the DBC treatment are also mapped. It is important to know to what extent the patient's expectations are realistic. If the expectations are unrealistic, the danger is that the patient will not be satisfied even if the results achieved will be good in relation to the patient's initial state.

Pattern of the disorder
On the basis of the patient's medical history and clinical examination, a physician or therapist carries out the identification of the individual disorder pattern. Imaging and laboratory findings sometimes provide useful additional information. The best available treatments can be selected for each type of disorder by taking advantage of evidence accumulated within the DBC network.

Range of motion
Range of Motion (ROM) can be measured in each DBC rehabilitation device. ROM measurements indicate the severity of the patient's condition and are important in the planning of the treatment.

Fatigue and EMG activity in low back muscles
The DBC Muscle Monitor can be used to measure "muscle fatigue" during exercise with the DBC Lumbar Extension device. Absent flexion-relaxation (a condition often present in low back pain patients) can also be detected. The DBC Muscle Monitor provides reliable information on progress achieved during and after the treatment and gives valuable feedback for the planning of individualized treatment programs.

Isometric strength
Isometric strength testing system is applicable with back and shoulder treatments.

Individualized treatment program

Duration of treatment
The duration of the treatment is predicted on the basis of the patient's pain severity and the level of deconditioning.

Exercises
The special features of the DBC devices are a major factor in the success of DBC treatment programs. The DBC devices guide patients' movements through planned, targeted, controlled and physiologically correct patterns. The movement patterns have been designed on the basis of thorough biomechanical research with the aim of restoring the natural arcs of movements in the lumbar, cervical and shoulder regions. The reconstruction of physiological movements takes place on the basis of repeated, isolated exercises with variable resistance levels using three-dimensional arcs of movement as required. The exercise patterns are individualized for every patient.

Safety (ROM limiters)
Targeting of loading
Iso-inertial (variable resistance)
Low friction (end-feel)
Adjustability
Throughput

Table 6. Why do we use devices?

Cognitive and behavioural support

Cognitive and behavioural support is essential for achieving good results. Support is given by the DBC therapist during treatment sessions in the form of discussions, where the "benign nature and good prognosis" of the patient's condition is emphasized.

Supporting elements

Relaxation between exercises and adequate resting periods are included in the DBC treatment protocols to relieve muscle tension. Protocols also integrate functional exercises that improve the patients' physical capabilities in day-to-day activities. Individualized functional exercises form the basis of the home exercise programs for each patient. Throughout the DBC treatment, patients are encouraged to keep active following the conclusion of the programs.

On the basis of the initial patient assessment, psychological and workplace interventions can be added to the protocol as supplementary modules.

Monitoring outcome

The progress in physical function and pain reduction is monitored during the treatment. An evaluation of function, pain and impairment levels and overall treatment satisfaction is carried out at the conclusion of the program. Periodical follow-up evaluations can be performed. This is not only to monitor the condition of the patient, but also to verify the results obtained with the home programs.

If the patient continues to lead an active lifestyle and exercises regularly, the results obtained with the DBC treatment can be maintained for years to come. The continuing benefits are evident in terms of avoiding absence from work in addition to living free from chronic pain.

DBC in back disorders

The DBC treatment method for back disorders is rehabilitation aimed at restoring function. The physical elements of the method consist of exercises and stretching/relaxation intervals specifically targeting the back. These are combined with the cognitive-behavioural components that redress the patients' mistaken conceptions and support changing their behaviour towards a healthier outlook. This is why a specific focus on the back differentiates the DBC treatments from more general exercise training programmes. The fact that the DBC approach takes into account the psychological perspective differentiates it from other therapeutic exercise forms. This is crucial in cases with chronicity and work absenteeism. It is important to realize that the DBC treatment method includes all the elements that have been shown to have the highest efficacy in the treatment of chronic back pain (see above, page 13, for the evidence).

The contents and duration of the physical rehabilitation program are defined on the basis of the severity of pain, the severity of deconditioning, psychological profile and social needs. These are assessed with validated questionnaires and measurements. The questionnaires and assessments are essential not only in defining the needs, but they are also used in monitoring the progress and documenting the outcomes.

The physical reconditioning program includes progressive co-ordination, mobility and muscle endurance exercises in combination with stretching and relaxation. Specially trained therapists guide the physical reconditioning program. The treatment is primarily based on exercises in iso-inertial rehabilitation devices; correct loading and range limiters ensure that exercises are performed in a painless range of motion and ensure that they find their right target in the lumbar spine. Treatment includes controlled movements in lumbar/thoracic flexion, extension, rotation and lateral flexion. Treatment is planned on the basis of initial endurance test, mobility measurements, clinical examination and interviews. Records are kept about the level of progress. The treatment begins with low loads for the first weeks. Here the object is to improve mobility and to teach proper co-ordination and control of the lumbar spine. The load is gradually increased with subjectively strenuous loading applied within the pain tolerance of the individual patient only later in the program. The load is further increased in a gradual and controlled manner until, at the end of the program, the patients are instructed to continue an individual secondary-prevention program. This is carried out with or without guidance depending on the patient's individual needs. The inclusions of exercises, rate of progression of loading and ranges of motion are individualized based on the type (diagnosis) and severity of the back problem.

One issue to be considered in assessing the possible efficacy of exercises for the treatment of low back trouble is whether the training effects are back specific. This is achieved with pelvic stabilization techniques using devices employing a "hip lock mechanism". Lumbar posture and the involvement of pelvic sagittal

rotation produce a large variation in strength production. Pelvic stabilization excluding strong gluteus and hamstring muscles is required to specifically test and train the lumbar extensor function.

Trunk extension involves strong gluteal and hamstring muscles and in an erect position, the back extensors are only slightly involved, and even then in a static way. In isolated spinal extension, the aim is to exclude the function of the gluteus and hamstring muscles with a specific "hip lock". The lock system aims at preventing pelvic sagittal rotation and subsequently, the dynamic movement of the muscles involved. Specific devices are required for this function. Electromyographic findings confirm, for example, that static loading of upper body extension primarily targets the gluteal and hamstring muscles, rather than spine erector muscles.

The key difference between back-specific and non-specific exercises is that the loading and, subsequently, the effect can be targeted in an isolated and safe way to the lumbar spine.

The therapist's role

The skills of the therapists to target the loading accurately and in the right place(s), especially at the early phase of the active treatment, play a crucial role in the success of the treatment program. The aim is to achieve segmental motion of the lumbar spine in a controlled manner. Very few individuals are able to produce the desired motion without the hip lock system and external guidance from the therapist. Later on, after the correct movements have been learned, the role of the therapist in active treatment is primarily in guiding the progress of loading and movement ranges, and teaching a functional (home) exercise program. The patient is advised to follow this program in order to maintain the results.

An elementary part of the treatment program is cognitive and behavioural support and motivation given by the therapists and the other members of the rehabilitation team. This is given using reinforcement of the "benign nature and good prognosis" of low back pain during treatment sessions. Written handouts that describe the back problem in an understandable language are distributed to the patient. In addition, the evaluation results concerning pain, disability, the objective measurements and their changes are used as a tool to convince the patient of progress. All this results in diminished fear of pain and increased self-efficacy beliefs.

DBC back treatment results

Research

The efficacy of the DBC protocol has been studied in a randomized setting. 57 middle-aged patients with a non-specific, chronic LBP were randomly assigned to either a 12 week DBC treatment program, or to a 4-week passive control treatment program, which was focusing on pain relief with the means of physical and thermal therapy. 19 men and 11 women completed the active program, and 16 men and 8 women completed the passive treatment program. After the intervention patients were followed-up and re-measured at six months and one year.

Several variables were recorded before and after the interventions, in addition to a follow-up at 6 months and one year: Pain and Disability Index (PDI), low back pain (100 mm VAS), and paraspinal muscle fatigability (spectral EMG) in the DBC 90 sec submaximal isoinertial back endurance test. The changes in back pain intensity (VAS scale), disability (PDI score) and lumbar fatigability (Mean Power Frequency Slope, MPFSLOPE) were significantly larger in the active DBC group than in the passive control treatment program. The changes were not significantly different between men and women. Pain intensity, disability and lumbar fatigability all decreased significantly during the active program. No significant changes were observed during the passive treatment program in any of these outcome variables. The change in fatigability (MPFSLOPE) did not correlate with changes in either pain intensity (VAS) or disability (PDI). The difference between groups in all outcome measures remained significant during the one year of follow up.

Thus, the DBC treatment was successful in reducing pain, self-experienced disability and lumbar fatigability compared to the passive treatment program, which was focused on pain relief. The study also revealed that the benefits regarding reduction in pain and physical impairment and the improvement in lumbar endurance still remained at the one-year follow-up.

Long-term outcomes

A follow-up study investigating the long-term results of DBC treatment was conducted in Luxembourg. 125 consecutive chronic or recurrent low back pain patients (76 women, 49 men) participated in a 12-week active low-back rehabilitation program at an outpatient DBC unit. They were followed up at an average of 14 months before their back symptoms and function were reas-

sessed. The outcomes of the study were defined as a recurrence of persistent pain and sickness absence from work. A survival/failure analysis was performed between those who had continued exercising and who had been physically inactive.

Twenty-five subjects out of the 125 followed (20%) had been physically inactive during the follow-up, 36 subjects (29%) had practiced individual home exercises, 21 (17%) had participated in fitness training, and 43 (34%) had participated in ongoing training once a week in the DBC unit with back specific devices. Kaplan-Meier survival function was used to assess the occurrence of outcome variables (pain relapse or absenteeism) during the follow up. Recurrences of persistent pain during the follow-up period were fewer among those who had maintained regular exercise habits after the treatment than among those who had been physically inactive. Similarly, absence from work was fewer among the physically active than among the physically inactive.

After two years of follow-up, over eighty percent of subjects who had remained active after the DBC treatment continued to work without sickness absence. In the physically inactive group, roughly 50 percent continued working without absence. In multiple regression analysis it became evident that patients with good pain reduction outcome from the LBP rehabilitation program were more likely to participate in physical exercise.

This study revealed that DBC treatment, when completed successfully, predicts low rates of sickness absence due to back pain after the treatment. An essential part of DBC treatment is to modify the patient's behaviour towards physical activity. When the treatment is successful in terms of reducing the pain level, patients are likely to remain physically active after the DBC treatment. Achieving a sufficient level of pain reduction during the active treatment program necessitates thorough assessment of the patient's symptoms and function, as well as individual planning of contents and length of the treatment program. Significantly low absence rates can be achieved after the individualized DBC functional restoration.

DBC quality assurance results

Based on the findings from 57 501 treated patients, the average reduction of pain and impairment was 31,9 mm and 30,3 mm on 100 mm VAS with the DBC lumbar treatment.

In different subgroups of patients, the rate of pain and impairment decline is rather similar, although there are some differences in the baseline levels of pain and especially impairment.

DBC back treatment action mechanisms

Several mechanisms are involved in mediating the proven benefits of the DBC treatments. As far as the physical outcomes are concerned, trunk control, muscle endurance, strength and range of motion improve. The DBC treatment devices have been designed specifically to place a target load on postural muscles that support the spine. If patients carry out (self-administered) exercises intensively enough, their overall physical condition improves. In patients with back pain, the potential for the treatment to improve their mood should not be overlooked either. One central mechanism is the reduction of fears and dispelling of misconceptions; these phenomena have wide ranging consequences on behaviour.

DBC's treatment results are backed up by several scientific studies that have shown that movement and physical exercise influence the level of experienced pain. To some extent, the mechanisms involved in pain reduction are still unclear. Suggested theories include: acti-

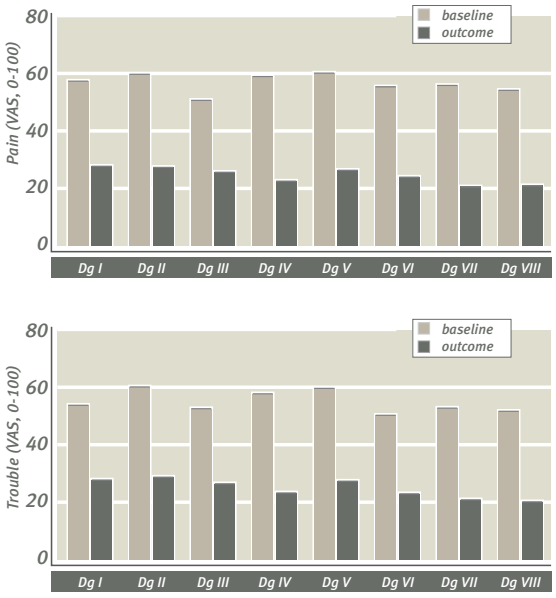

Figure 10. DBC lumbar treatment results in different diagnostic subgroups: pain (above) and impairment (below). I =Inflammatory, II=Post-traumatic, III=Postoperative, IV=Nerve root compression, V=Stenosis, VI=Pelvic and LBP, VII=Spondylolisthesis and -lysis, VIII=Non-specific pain.

vation of pain gate control, release of endorphins with intensive exercise and suppression of the brain's pain centres by the activation of the motor cortex. Whatever the mechanism is, the reduction is undeniable. Also "learning by doing" can be a strong factor in inducing a person to unlearn the role of being a patient. Here, general activation and mood improvement may lower the patient's pain experience, as the patient realizes that his or her wellbeing increases during the therapy or rehabilitation. A definite organic (periferic nociceptive) reason for pain cannot be identified for most of the patients with back disorders.

DBC in neck disorders

The DBC treatment method for neck disorders is rehabilitation aimed at restoring function. Its physical elements comprise of progressive exercises targeting the cervical spine, thoracic spine, and their adjacent tissues and includes stretching/relaxation intervals. These elements are combined with the cognitive-behavioural approach, in which patients' mistaken conceptions and beliefs are redressed. Patients are given support in changing their behaviour towards a healthier outlook.

The contents and duration of the physical rehabilitation program are defined on the basis of the severity of pain and impairment, psychological profile, and social needs. These are assessed with validated questionnaires and measurements. The questionnaires and assessments are essential, not only in defining the needs, but also used in the monitoring of progress and documenting outcomes.

The physical reconditioning program includes progressive co-ordination, mobility and muscle endurance exercises combined with stretching and relaxation. Specially trained therapists guide the physical reconditioning program. The treatment is primarily based on exercises in specific rehabilitation devices; correct loading and range limiters ensure that exercises are performed in a painless range of motion and that they target the right area. Treatment includes controlled movements in cervical/thoracic extension and rotation, and shoulder blade adduction. Treatment is planned on the basis of initial range-of-motion measurements, questionnaires and interviews, and records are kept of the progress. The treatment begins with low loads for the first weeks with the object of improving mobility and especially teaching proper co-ordination and posture of the cervical spine. The load is gradually increased so that only later subjectively strenuous loading is applied within the pain tolerance of the individual patient. The load is further increased in a gradual and controlled manner until, at the end of the program, the patients are instructed to continue an individual secondary-prevention program with or without guidance depending on their individual needs. The inclusions of exercises, rate of progression in loading and ranges of motion are individualized based on the type (diagnosis) and severity of the neck problem.

DBC neck treatment results

Research

A randomized comparative study with single-blind outcome assessments compared the efficacy of a multimodal treatment emphasizing proprioceptive training (DBC) with activated home exercises (HOME) and recommendation of exercise (CONTROL) in patients with non-specific chronic neck pain. The study group consisted of seventy-six patients (22 men, 54 women) with chronic, non-specific neck pain. Sixty-two subjects participated in the 1-year follow-up. Subjective pain and disability, cervical ranges of motion, and pressure pain threshold in the shoulder region were measured at baseline, at 3 months, and at 12 months. The DBC treatment consisted of 24 sessions of progressive exercises, relaxation and behavioural support. The HOME regimen included a neck lecture and two sessions of practical training for home exercises and instructions for maintaining a diary of progress. The CONTROL treatment included a lecture regarding care of the neck with a recommendation to exercise. According to the exercise diaries, the actual amount of exercise was largest in HOME group and smallest in CONTROL group.

The average self-experienced total benefit was highest in the DBC group, and the HOME group rated above the CONTROL group. Differences between the groups in favour of the DBC treatment were recorded in the reduction of neck symptoms and improvements in general health and self-experienced working ability. Changes in measures of mobility and pressure-pain threshold were minor. Since no major differences were noted in the objective measurements of cervical function between the groups, it can be assumed that neck pain and especially its chronicity comprises a condition where motivation and perception of the problem plays a significant role. These findings support the idea that multimodal treatment, which integrates both proprioceptive and endurance exercises as well as behav-

ioural support is more efficacious in treating chronic neck pain patients than solitary training.

DBC quality assurance results

Based on the findings of 9 244 treated patients, the average reductions of pain and impairment were 33,4 mm and 32,6 mm on 100 mm VAS with the DBC cervical treatment. In different subgroups of patients, the rate of pain and impairment decline was slightly different. There were also differences in the baseline levels of pain and impairment.

DBC neck treatment action mechanisms

There are potentially several mechanisms that mediate the benefits of exercise and mobility therapy in patients with pain in the neck and shoulder area. As exercise targets the neck, mobility and exercise therapy enhances muscle strength, co-ordination and mobility as well as reduces pain in the neck and shoulder area. DBC treatments differ from other mobility therapies in that the 3-dimensional arch of movement that they "force" upon the neck is physiologically correct. The DBC mobility exercises have been specifically designed to restore the correct coupled motions of the cervical spine. As a result of the cognitive-behavioural approach, mistaken beliefs are systematically redressed, fears are relieved and support/motivation is given to the patient. The purpose is to help the patient reduce the experienced impairment and inhibitions, which prevent the normal use and loading of the neck. Furthermore, the potential impact of physical exercise on the patient's mood should not be underestimated.

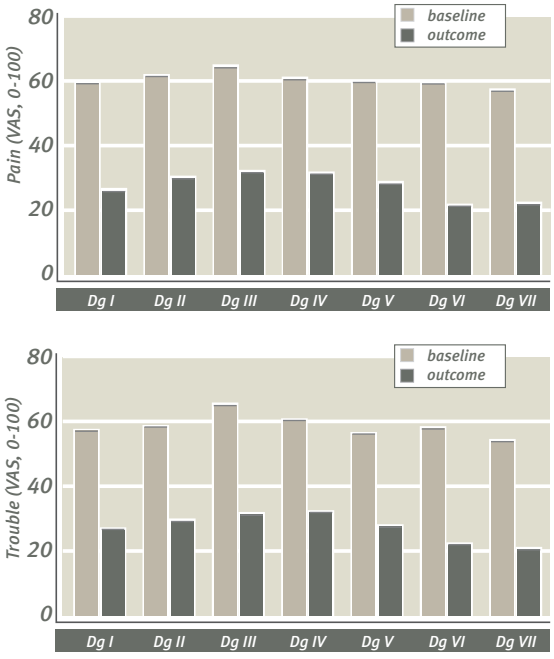

Figure 11. DBC neck treatment results in different diagnostic subgroups: pain (above) and impairment (below). I =Inflammatory, II=Post-traumatic, III=WAD, IV=Postoperative, V=Stenosis, VI=Nerve root compression, VII=Non-specific pain.

DBC in shoulder disorders

The primary aim of reconditioning is to restore the normal control of scapular movements and humeroscapular rhythm. Later, it aims to reverse the effects of physical deconditioning, especially in the rotator cuff. This is achieved by improving postural control and co-ordination, and by producing adaptive changes in the tissues in a progressive, controlled way. Strengthening of the muscles and other soft tissues is based on the progression (increase) in loading. This is gained either by increasing the weight, number of repetitions, range of motion used, or by applying increasingly demanding functional exercises. Improvements of neural control and co-ordination are based on repetition of the correct movement under guidance. The contents of the reconditioning program are chosen on the basis of the anatomic/ aetiopathologic diagnosis, i.e., the pain pattern defines the components (exercises) and the progression of restoration.

The DBC Shoulder treatment system is based on the notion of different exercise levels. The level of exercises is chosen based on the healing process. Each treatment can be divided into different phases, each containing exercises that are safe at that stage of the healing process. Treatment is typically carried out in 6-week modules. The recommended length of treatment for most problems is 12 weeks (24 sessions). The more severe the problem, the longer the program needs to be.

Treatment is carried out twice a week in order to give the structures enough time to recover in between sessions. In special cases and in the early phase of the treatment (low loading) 3-4 sessions per week can be carried out. If more than 2 sessions are done, one must be very careful not to overload the patient. One treatment session lasts an average of one hour. However, this might vary from country to country.
Progression of the program mainly happens by moving in to more demanding exercises. For range of motion, the main principle is that the preferred range of motion

is pain free. However, for some diagnoses (patterns), there are separate instructions about how to progress the range of motion. Those need to be followed carefully.

DBC shoulder treatment results

DBC quality assurance results

Based on the findings of 893 treated patients, the average reduction of pain and impairment was 35,2 mm and 39,5 mm on 100 mm VAS with the DBC shoulder treatment. The results in different subgroups are shown in Figure 12.

DBC shoulder treatment action mechanisms

Physical exercises and mobilization may have several beneficial action mechanisms in patients with shoulder disorders. Relearning the correct activation (proximal stability) of the shoulder blade and the humeroscapular rhythm reduces loading on, and therefore, repetitive strain of the glenohumeral joint. The strengthening of the rotator cuff, especially in external rotation, shortens the upward and forwards slide of the head of the humerus, easing impingement symptoms. DBC mobility exercises have been specifically designed to restore the humeroscapular control and strengthen the rotator cuff. Therefore, these exercises can be expected to have a significant impact on pain and impairment. Moreover, the cognitive-behavioural approach helps to reduce the patient's trouble-experience and inhibitions, which prevent the normal use and loading of the upper extremity.

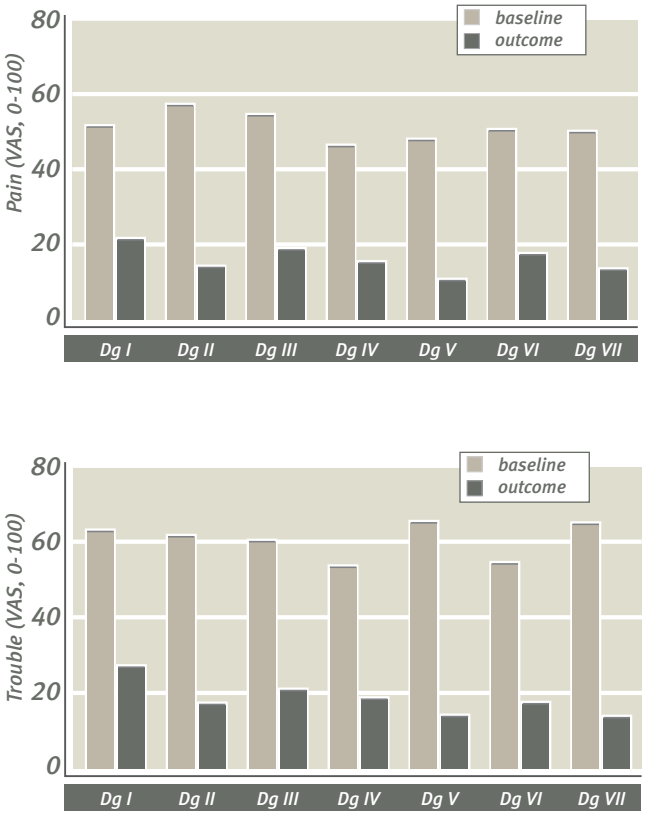

Figure 12. DBC shoulder treatment results in different diagnostic subgroups: pain (above) and impairment (below). I = AC separation, II = Frozen shoulder, III = Impingement, IV = Proximal fracture, V = Dislocation, VI = Instability, VII = SLAP lesion.

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