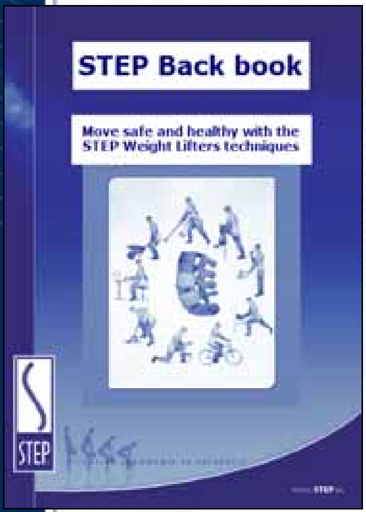

Back Pain, Type 1

Human Ergonomics
A Physical Behavioral Approach
Part One, Evidence Base

Prevention is Essential

Prevention of overloading activities

Active with save Back use

Prevention of painful activities

Passive with protection

Prevention of reccurrence and worsening

First Self-care, then therapy

Encouraging Self-care at work, and in home situations.

STEP | Perfect in Preventie
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Back pain, Humane Ergonomics, A Physical Behavioral Approach, part I

Bert Bruggeman en Henk Jan Kooke

A scientifically sound Self-care approach to back pain by flexion activities.

Human Ergonomics

With Human Ergonomics, we realize and learn save back use and give people handles so that they themselves can prevent overload in the workplace and at home. The current technical ergonomics focuses on user-friendly products and people-friendly processes, "fit the task to the person". More attention should be made for adjustment of man to perform the task, "changing the person to fit the task" as McGill says (2). McGill also advocates a combination of Human Ergonomics Applied to the problem, making it easier to tackle back pain. More attention to human ergonomics is urgently needed in the Netherlands, given the negative influence exerted by recent publications by lifting the "laissez-fair" view salute, and thus the Humane Ergonomics - which teaches safe backpack use - is seriously and irresponsibly undermined (8 t / m 12) and requires urgent correction in practice.

A Physical Behavioral Approach

The title probably makes some people instantly think of graded activity and / or graded exposure, (para) medical intervention directions where a more psychological approach is central. However, this is not the case. In this article we will discuss an more physical approach.
The Physical Behavioral Approach (PBA) to back pain certainly seems as necessary as the psychological behavioral approach, which today too much emphasis is on (1, 2). The PBA is also intended to complement a more body-oriented approach (in diagnosis en therapy) of the current (para)medical world.
The PBA diagnoses activities (which activities are provoked and which aren't) the most important. On the basis of these activity diagnosis, a PBA set policy is stated, which prevents provocative activities as much as possible.
The PBA approach is a primary and secondary preventive approach, focused on self-care in many musculoskeletal disorders. In this article we will only discuss the PBA policy for back pain type 1, which is non-specific back pain, caused and exacerbated by flexion activities (bending, lifting, sitting, getting up from sitting, sit-ups, dressing) and where extension activities (walking, standing, sitting with your legs straight) are reductive.

Non-specific back pain usually are specific for activities

In 1987 the Quebec Task Force published a diagnostic classification of activity related spinal disorders (3), without clearly indicating the importance of a detailed specification, of the provocative, and reducing activities and without the advice to focus policy on it. Making distinctions between provocative and reducing activities in non-specific back pain was something we had already described in 1993 (4). Also we explained how normal it is in degenerative back problems to specify in reducing and provocative activities, without being here, moreover a consistently conservative policy is set. For non-degenerative back complaints this is much less the case. Sikorsky is one of the first who, in 1985, pointed out, flexion and extension specification and a set policy on it (5). We have since brought this up with the PBA policy consistently in practice.
Nowadays there are more advocates of more provocative and reducing activities specification for back pain (6). The fact that there is an urgent need for differentiation in non-specific back pain, was recently wholeheartedly advocated by Prof Dr. Maarten van Kleef in a press release from the EUROPEAN WEEK AGAINST PAIN, he argues that the categorization of 95% of non-specific back pain is very unsatisfactory and unscientific (7).

2. Human Ergonomics, the evidence base

2.1. McGill, avoid maximum flexion load

We have, for twenty years, advocated The STEP PBA policy in non-specific back pain caused and exacerbated by flexion activities (Fig. 1 and 2) and have recently found support in publications from McGill (1, 2). McGill, who is not just a book and agency scientist, gives in his article "Linking latest knowledge of injury mechanisms and spine function to the prevention of low back disorders" the following guidelines for primary and secondary prevention of back pain:

1. Take an evidence-based strategy based on the neutral position of the lumbar spine. Bend the torso from the hip more than from the back;

2. Avoid repetitive maximal flexion;

3. Avoid prolonged flexion postures;

4. Avoid short-term flexion postures under heavy loads, especially in the morning;

5. Avoid asymmetrical flexion loads;

6. Ensure a proper biomechanical "Envelope of function", ensure safe and healthy loads, not too much, nor too little. No single drug or therapy can succeed without the daily overload to remove which stands recovery in the way;

7. Ergonomic tools are important, but often not at hand. Better employee training and techniques to influence behavior are needed. Personal safe backpack use, which can prevent overloading - is the only way for prevention and intervention.

We agree 100% with this, and believe that with this strategy a perfect primary and direct secondary prevention of back pain can be achieved, which can bring the pandemic of back pain to a halt.

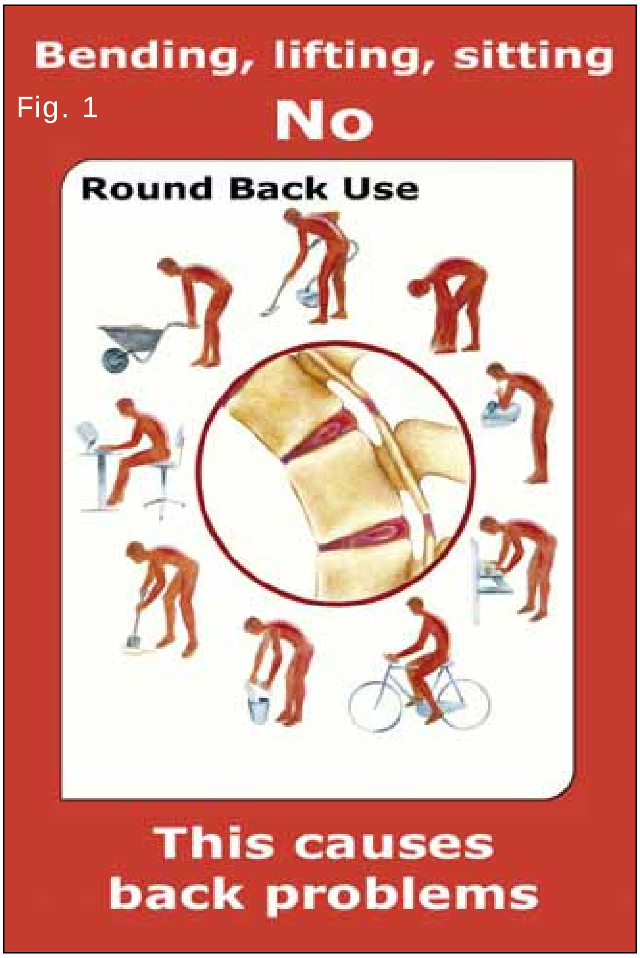


Fig. 1

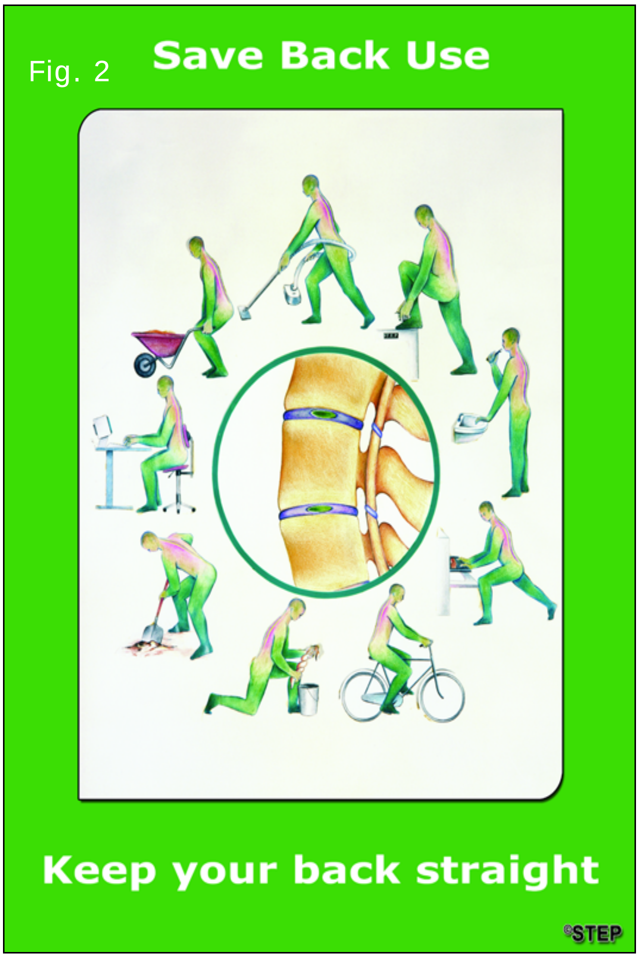


Fig. 2

2.2. More evidence for the prevention of maximum back flexion

In other scientific studies evidence can be found for the danger of maximum flexion with and without rotation (15 t / m 21). The importance of preventing flexion maximum load during the natural recovery of back pain by flexion load is emphasized by the following facts:

1. In the direction of the maximum lumbar flexion the bending load runs exponentially. Adams, McNally and Dolan indicate that over 75% of the maximum lumbar flexion high bending loads occur (22), and that the bending load by 75% increases as the back moves from 85% to 95% of the maximum flexion (23).

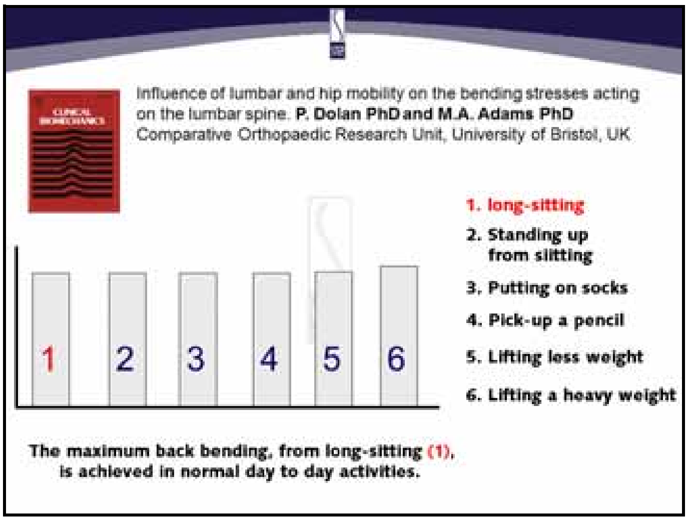
2. In common ADL activities maximal lumbar flexion is achieved (24) (Fig. 3 and 11).

3. After longer lasting flexion postures (bending-and sitting) creep (25), decreased reflex activity and fatigue of the back muscles occurs (26, 27). After the flexion posture creep still persist. This residual laxity may predispose to hyper flexion injury (25)

4. In bending with straight knees 45% of the time in the bent and standing up motion there is more than 90% lumbar spine flexion and maximum flexion relaxation (28), so the high bending load is borne only by the passive structures (Fig. 4).

5. During a crouch and standing up motion, 25% of the time there is maximum lumbar spine flexion with flexion relaxation. This means that for 25% of the time the maximum bending load is carried only by passive structures (Fig. 5).

In short, every reason to avoid stress in maximal flexion to realize primary prevention of back pain and secondary prevention in existing back problems during the natural healing process.



The maximum back bending, from long-sitting (1), is achieved in normal day to day activities.

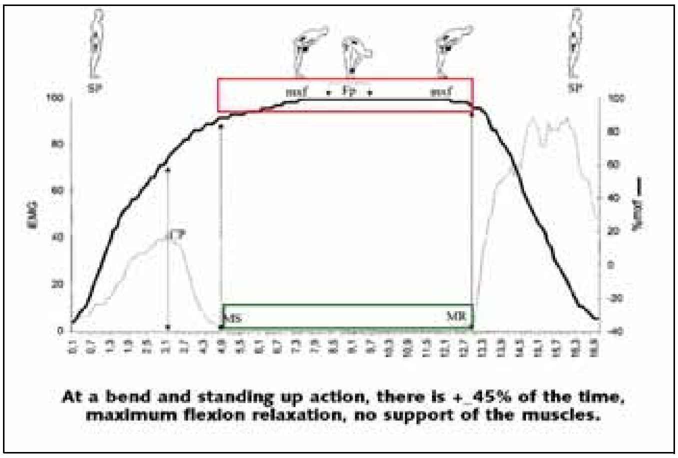


Fig. 4. At a bend and standing up action, there is +_45% of the time, maximum flexion relaxation. SP = Starting Position, CP = Critical Point, point of fall EMG, MS = Myoelectrical Silence, MR = Myoelectrical Resumption, mxf = maximum LWK flexion, Fp = flexed position, 1 sec.

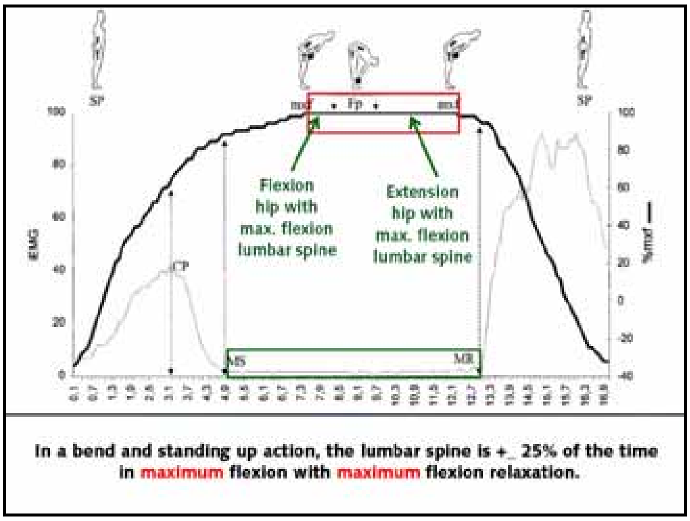


Fig. 5. in a bend and standing up action, LWK is +_ 25% of the time in maximum flexion with maximum flexion relaxation.

2.3. Evidence for the prevention of maximum flexion with Weight Lifters Techniques (WLT)

An important aspect of the PBA policy is to teach safe back use with the evidence based WLT.

Peak Compression and peak bending load when lifting the handles

Scientific research in 2008 at the Free University of Amsterdam by Faber and Kingma determined that the compression load at GHT I (WLT, Weight Lifter Technique) is significantly less than Stoop and squat when lifting a crate and a large box (Fig. 6). Kingma e.a. published on the large box Ergonomics (29).

Another interesting fact from the study of lifting the handles, is that the peak bending load with WLT is significantly less than Stoop and Squat when lifting a large box (Fig. 7, right). With a crate this is only the case with respect to Stoop (Fig. 7, left).

Peak Compression and peak bending load when lifting the bottom of the object

From the above study, also shows that lifting a wide object at the bottom the peak compression load is significantly less when WLT and Stoop are compared with squat (Fig. 8, right). Lifting a crate, however, shows no difference between the lifting techniques.

With respect to the peak bending load on lifting a crate at the bottom there is a significant difference between WLT and Squat compared to stoop (Fig. 9, left). When lifting a large box at the bottom there is a significant difference between WLT compared Stoop and Squat (Fig. 9, on the right).

GHT therefore have significant advantages over Stoop and Squat about peak compression and bending loads. The statement "no matter how you tilt", made by renowned Dutch scientists (9 t/m 12) does not seem very balanced with a view to the peak compression load and internal bending load. There isn't an open eye for the danger of kyphotic lumbar spine load

International scientist's

International scientists have, however, an open eye to the danger of kyphotic lumbar spine load (15 t / m 21, 30 t / m 36). A position of moderate flexion, which prevents maximum flexion, is indicated by Adams and Arjmand

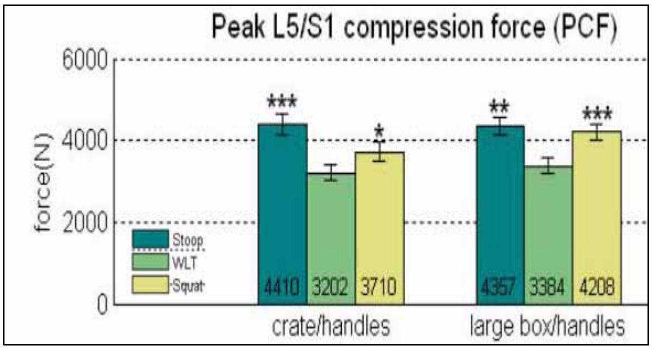


Fig. 6. Lifting at the handles: with WLT there is ± 25% and ±15% less peak compression force compared with respectively Stoop and Squat. With WLT and a large box there is ± 23% and ± 20% less peak compression

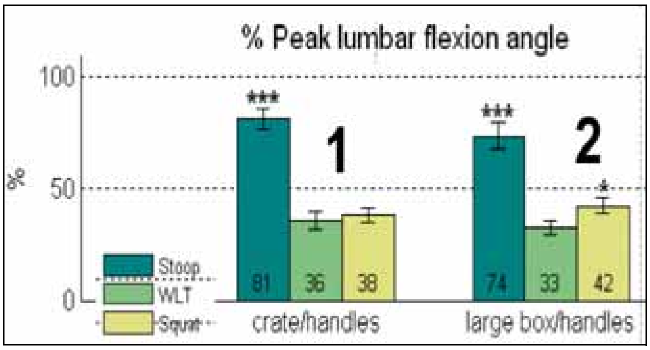


Fig. 7. Lifting at the handles: with WLT and a crate there is ±55% less peak bending load, relative to Stoop, relative to Squat, there is no difference. With WLT and a large box there is relative to Stoop and Squat respectively ±55% and ±20% lower peak bending load.

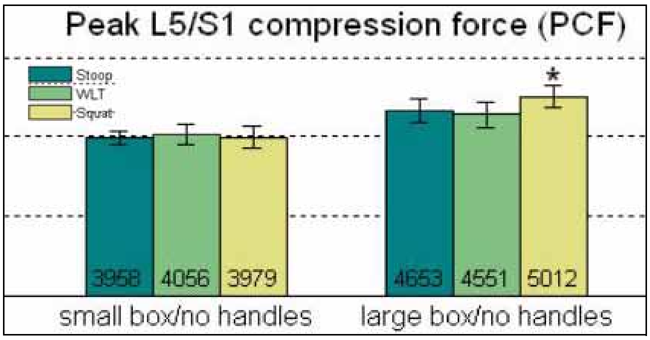


Fig. 8. Lifting at the bottom of the object: in the case of a small box there is no significant difference in peak compression force between the 3 lifting techniques. When there is a large box with GHT and Stoop this is ±10% less compared to Squat.

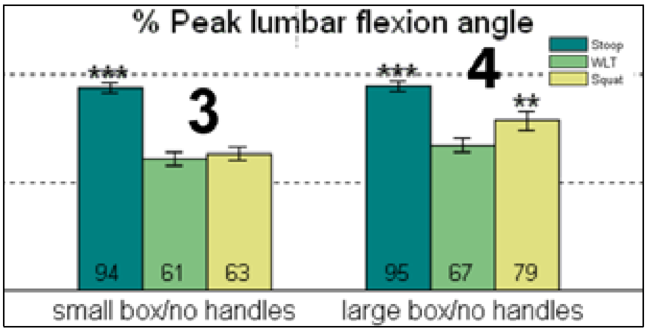


Fig. 9. Lifting a crate at the bottom: with WLT and squat there is 35% lower peak bending load compared to Stoop. A broad box at the bottom: with WLT there is ±30% and ±15% less peak bending load compared tot stoop and squat respectively.

(22, 37). WLT meet this requirement. WLT remains more than 30% of maximum flexion removed, even at low to the ground lift, 39% in lifting a crate at the bottom (Fig. 9, left) and 33% in lifting a large box at the bottom (Fig. 9, right). Advocates of WLT are also found in the literature (25, 38 t/m 41), to wide acceptance has not yet led, the massive indoctrination wit squat techniques was probably too large.

WLT II and III

WLT I and II techniques are used by us to avoid kyfotisch back use (Fig. 10).

McGill also describes GHT I, II and III techniques to prevent maximal flexion (2). By placing a leg to the rear in GHT II and III the maximum flexion of the lumbar spine is even better prevented as in GHT I. GHT II and III remain, as well as GHT I, at least 30% away from maximum lumbar flexion. With the BodyGuard this can well be measured (Fig. 12).The Body Guard is a wire sensor placed on the lumbar spine (Fig. 13) which produces an electrical signal by stretching. The degree of stretching and the time of the stretching is indicated in a graph. With the Body Guard the movement of the lumbar spine can be reliable measured for a longer time (42, 43), an alarm signal in unwanted back flexion positions is possible.

Fig. 10. The three WLT I, II and III

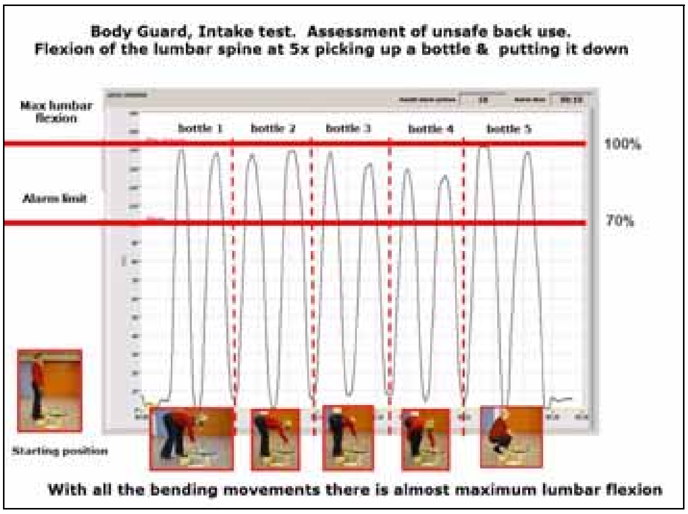


Fig. 11. With the BodyGuard the flexion of the lumber spine can be measured while bending and lifting. In a number of standard lifting actions the maximum LWK flexion is almost always reached.

Fig. 13. The BodyGuard, 1 the stretch sensor, 2. the measurement, alarm and storage unit.

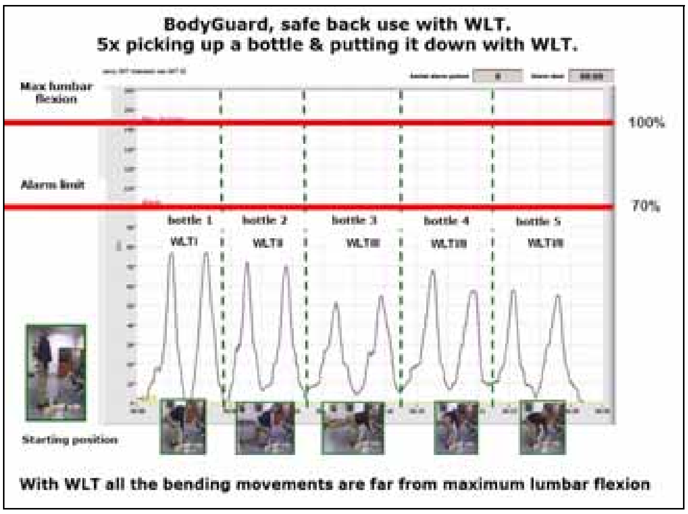


Fig. 12. With WLT I, II and III, the lumbar spine is always far away from the maximum lumbar flexion in the same standard lifting actions.

2.4. More evidence aspects in WLT

WLT are inextricably linked with the aspects Connect, Support, Tilting and Close (CSTC). In teaching WLT these aspects are always explicitly included in the learning process.

Connect (fig. 14)

Asymmetric load in flexion is the largest risk factor for low back pain (15, 19 t/m 21). Connecting from WLT I to II en III prevents that the lumbar spine is loaded asymmetrically (45).

Support (Fig. 15, 16 and 17)

The STEP / VU research (46) has found that lifting a crate with WLT and support (Fig. 15 left) the peak compression force is ± 35% and ± 20% less compared with Stoop and Squat respectively and the peak bending load was ±50% and ± 30% less compared with Stoop and Squat respectively.

Furthermore, it is found that when the lifting 25 kg. with WLT and support (Fig. 15, right) the peak compression load was ± 25% less compared with a free technique (47).

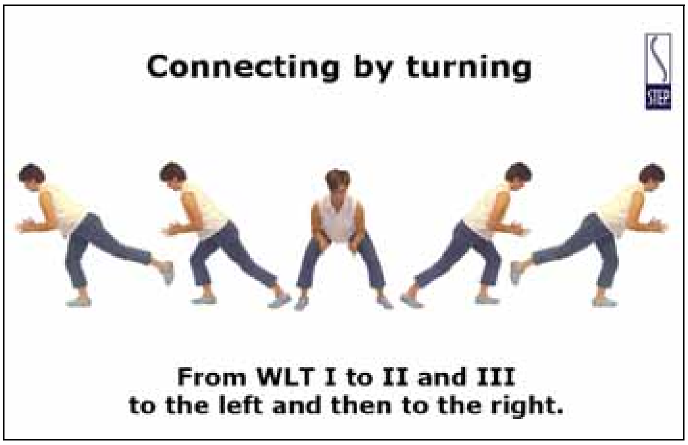


Fig. 14. Connecting by turning on the feet

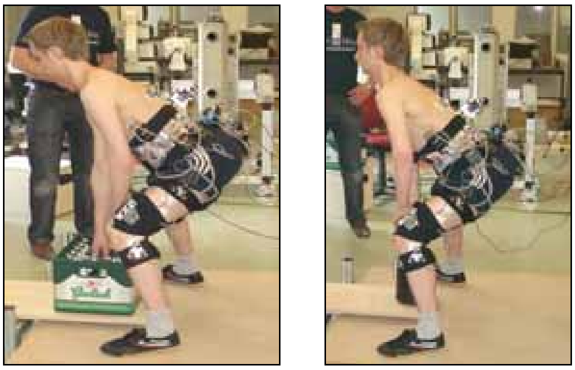


Fig. 15. Support and WLT I. Left with the crate, right with 25 kg.

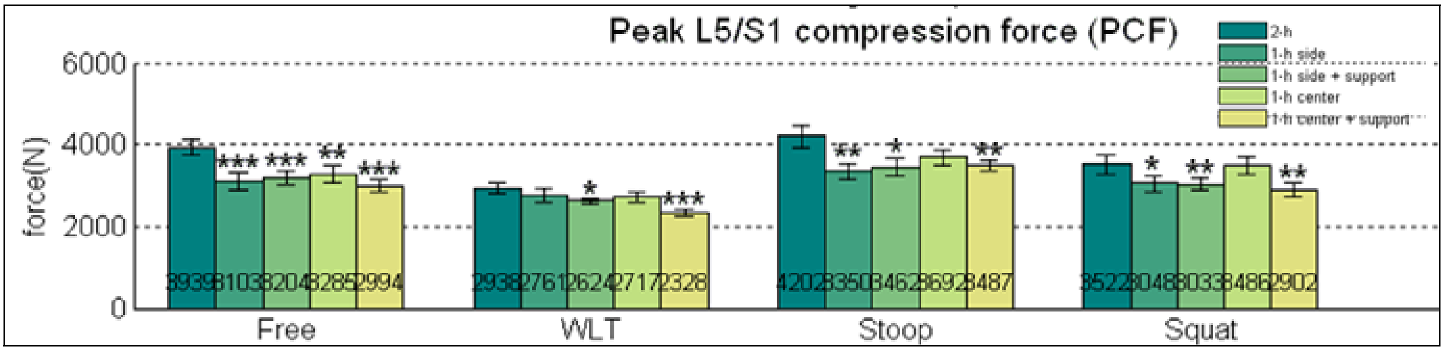


Fig. 16. To pick up a crate with two hands (2h), one hand on the side (1-h side), one hand on the side and support (1-h side), one hand in the centre and support (1-h centre and support). The peak compression force is with GHT is continuously the lowest and with GHT 1-h centre + support the very lowest, ±35% lower than with Stoop and ±20% lower than with Squat.

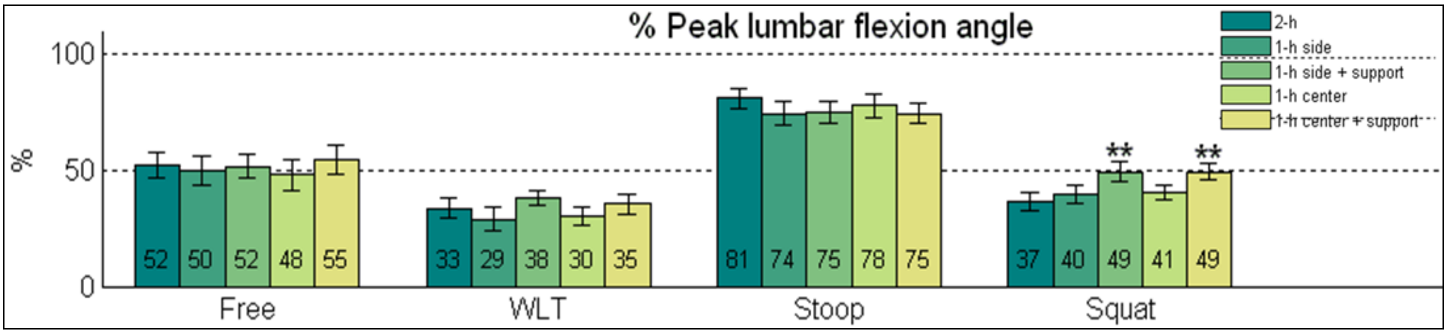


Fig. 17. To pick up a crate with two hands (2h), one hand on the side (1-h side), one hand on the side and support (1-h side + support), one hand in the centre and support (1-h centre and support). The peak bending load is with GHT is continuously the lowest and with GHT 1-h centre + support the very lowest, ±50% lower than with Stoop and ±30% lower than with Squat.

Tilting (Fig. 18, 19, 20, 21 and 22)

Small box:

Only tilting in WLT reduces peak compression force with ± 20% (Fig. 18 and 19). Tilting in WLT reduces the peak compression force ±20% compared with tilting in Free and Stoop and ±10% compared with tilting in Squat.

The peak bending load was reduced by tilting in all techniques with ±15%, except for Free. Tilting in WLT and Squat reduces the peak bending load with ± 40% compared with tilting Stoop and 25% compared with tilting in Free (Fig. 20).

Large box:

The peak compression force is ±20% less with tilting in WLT. With WLT and tilting, the peak compression force is ±20% smaller compared with tilting in Free, Stoop and Squat. (Fig. 21).

The peak bending load with WLT and tilting is ±25%, ±40% and ±15% lower compared with tilting in Free, Stoop and Squat respectively.

Close (fig. 23)

With WLT the horizontal distance is the smallest, ± 20% less compared with Free, Stoop and Squat (47).

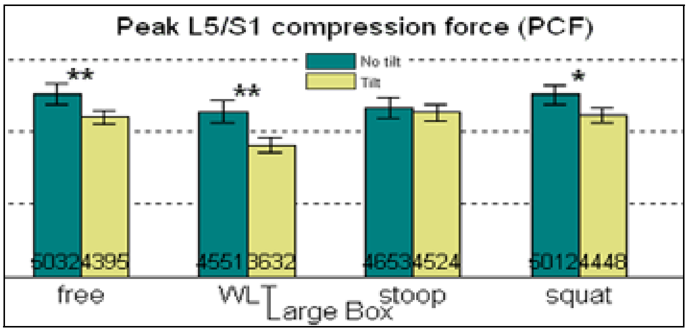


Fig. 21. Tilting with a large box: with WLT and tilting the peak compression force is ±20% less compared with WLT en no tilting. With WLT and tilting, the peak compression force is ±20% smaller compared with tilting in Free, Stoop and Squat.

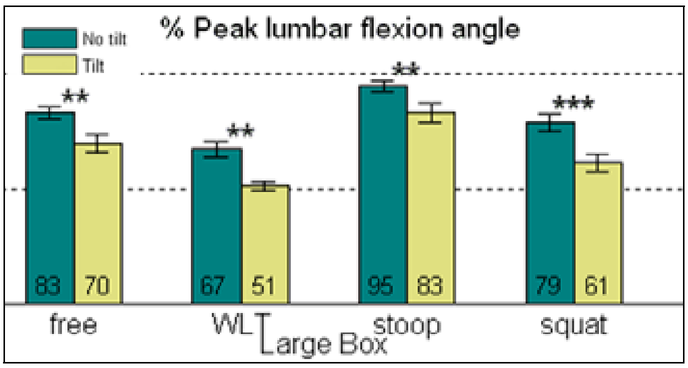


Fig. 22. Tilting with a large box: all the techniques reduce the peak bending load, ±15% for Free and Stoop and ±20% for WLT and Squat. With WLT and tilting the bending is ±25%, ±40% and ±15% lower compared with tilting in Free, Stoop and Squat respectively.

Fig. 18. Tilting with WLT I, left with the small box, right with the large box.

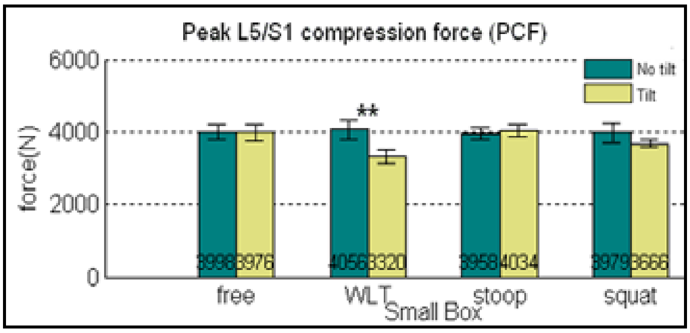


Fig. 19. Tilting with a small box: only WLT makes the peak compression force significant± 20% less. Tilting in WLT makes the peak compression force ± 20% less compared with tilting in Free and Stoop and ±10% compared with tilting in Squat.

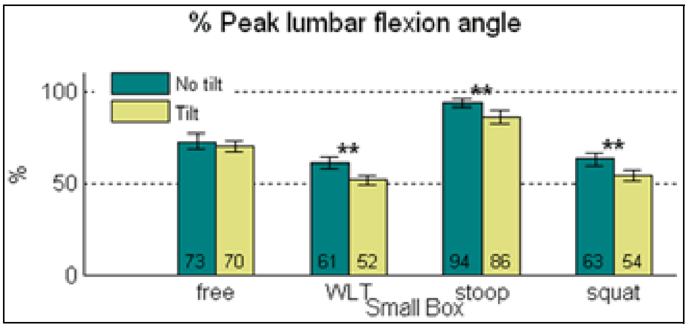


Fig. 20. Tilting with a small box: all techniques, except Free, have a lower peak bending load, ±10% with Stoop and ±15% with WLT and Squat. With WLT and Squat, the bending load is the lowest with and without tilting.

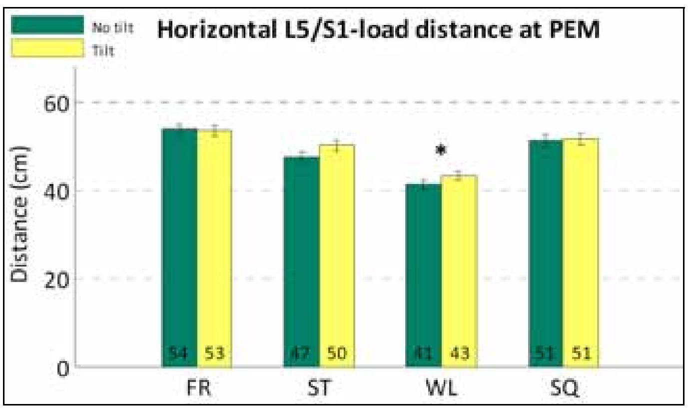


Fig. 23. With WLT the smallest horizontal distance.

2.5. Human Ergonomics and the evidence of orthopedic basic principle

The orthopedic basic principle of "prevention of overload during the natural healing process" and better "in the case of tissue overload, there is a fall in tissue strength and normal daily activities become dangerous. At that time, it is very important to prevent overload by normal daily activities". Preventing overload by normal daily activities is the basic principle of Human Ergonomics (Fig. 24 and 25).

In the book orthopedics (49), this is advocated in a dozen musculoskeletal disorders and also in back complaints by the orthopedic surgeon AJ Verbout.

This principle was also well described by overload injuries, by orthopedic surgeon Hermans (49). Recently it was quite clearly advocated by the American orthopedic surgeon Dye (50) for disorders of the musculoskeletal system in general, with the clear, explicit addition to prevent overload by normal daily activities and reduced tissue strength (Fig. 24 and 25). McGill also calls for preventing of overload, for a safe envelope of exposure, not too much, or too little load during the recovery process (1).

STEP uses the basic orthopedic principle consistently, not only in back pain but with all load-related musculoskeletal disorders. To realize this principle from day 1, STEP uses the PBA, an evidence based policy.

The STEP PBA policy for back pain and musculoskeletal disorders in general, is based on the guidelines of RL Swezey (51). Swezey emphasizes information, Self-care, home therapy and devices to prevent overload. STEP is extending from the seventies to specialize in Self-care. The PBA policy consists of 5 main components:

1. Objectification of health status and results;
2. Information on (un) safe back use, home therapy and home exercise;
3. Training in safe back use with WLT I/II/III;
4. The use of protective and behavioral devices to realize and learn immediately save back use en prevent overload at home
5. Maintain or improve functional capacity with Functional FATness (**F**unctional **A**DL **T**raining, **F**unctional **A**utomation **T**raining with WLT I, II and III.

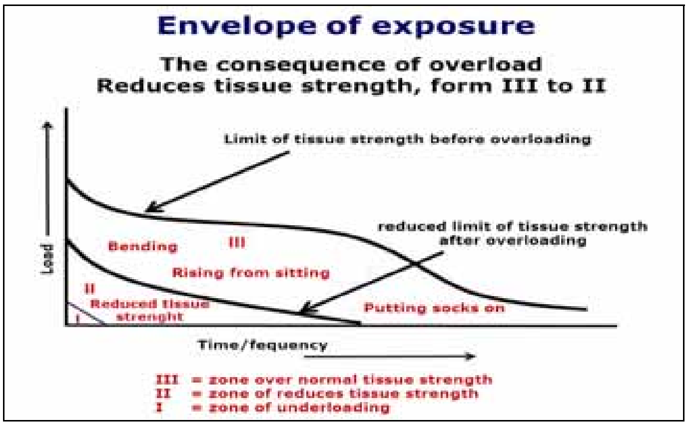


Fig. 24. After a back injury, the tissue strength is reduced, from III to II. Normal ADL loads (for example bending, getting up from sitting and putting socks on) now become dangerous. Preventing this painful loads with safe back use is necessary.

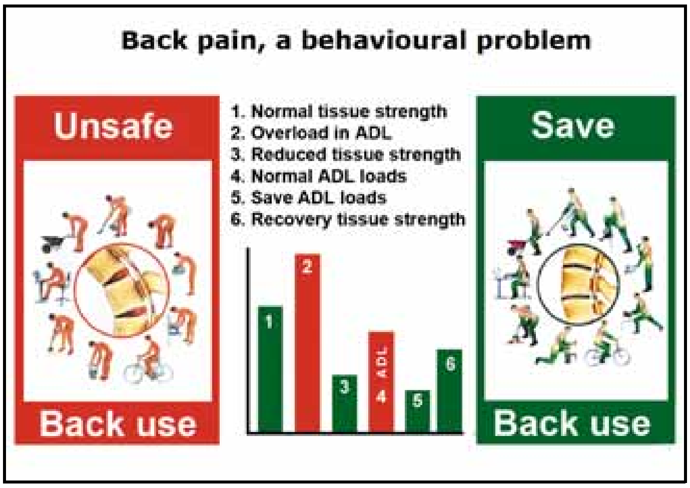


Fig. 25. At 3 the reduced tissue strength.
At 4 normal ADL loads are now dangerous
At 5. With the STEP PBA policy we ensure safe back use in daily live and prevent the normal ADL loads to disturb the natural recovery
At 6 recovery due to save loading strategy

The purpose of the PBA policy is a fast, undisturbed and functional recovery by the prevention of recurrences in the short and long term.

In Backaches, Human Ergonomics, A Physical Behavioral Approach, Part II we discuss the five components of the PBA policy in detail.

In Part III we discuss casuistic with PBA policy.

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