

Medical Exercise Therapy



Mentor, Leo Wouters Ms. Sc, P.T., OMT

Kim Song June Ph.D., M.S. PT.

- ❖ Oddvar Holten ; Medical Exercise Therapy
(M.E.T)
- ❖ Freddy Kaltenborn ; Medical Training Therapy
(M.T.T)
- ❖ Ola Grimsby ; Scientific Therapeutic
Exercise Progression
(S.T.E.P)

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Medical Exercise Therapy (M.E.T.)

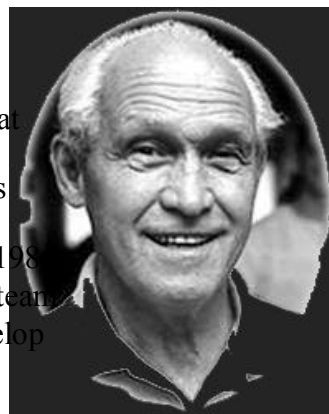
- ❖ **The main reason why medical exercise therapy was developed in the early 1960s, was Oddvar Holten's interest in applying graded exercises when treating and preventing dysfunction in the musculoskeletal system**
- ❖ **Medical exercise therapy also has its background in Oddvar Holten's skills in Norwegian manipulative therapy, in which graded exercises are used as treatment in addition to specific articulation and manipulation techniques**

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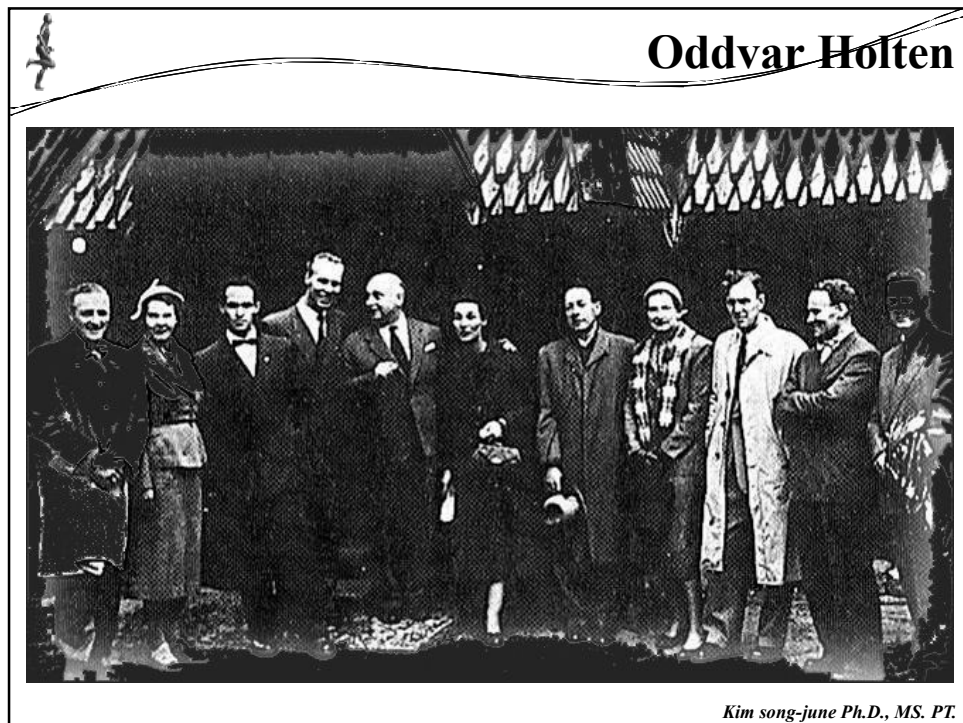


Medical Exercise Therapy (M.E.T.)

- ❖ **The founder of MET was Oddvar Holten (1921~1995)**
 - Athlete in speed skating
 - Teacher in physical education (Statens Gymnastikkskole), 1946-1947
 - Norwegian physical therapist
 - In 1951 he qualified as a physiotherapist at Oslo Ortopediske Institute (O. O. I.)
 - Manual therapy in Norway and passed his exam. in 1960
 - Teacher in manual therapy from 1964 to 1988
 - Trainer for the Norwegian speed skating team
 - During the early 1960s, he started to develop a system of exercise therapy, later called Medical Exercise Therapy
 - Worked with Hettinger and Muller



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Oddvar Holten (1921~1995)

- ❖ He felt that his patients could not reach optimal rehabilitation through manipulative therapy alone
- ❖ Active exercise improve the function and the workload ability of all structures and functions of the locomotor system – *normalizes function*

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Changes in the use of the locomotor system

- ❖ **Manual work —→ Sedentary work**
- ❖ **Large movement pattern —→ Static work**
- ❖ **Lots of aerobic work —→ Little aerobic work**

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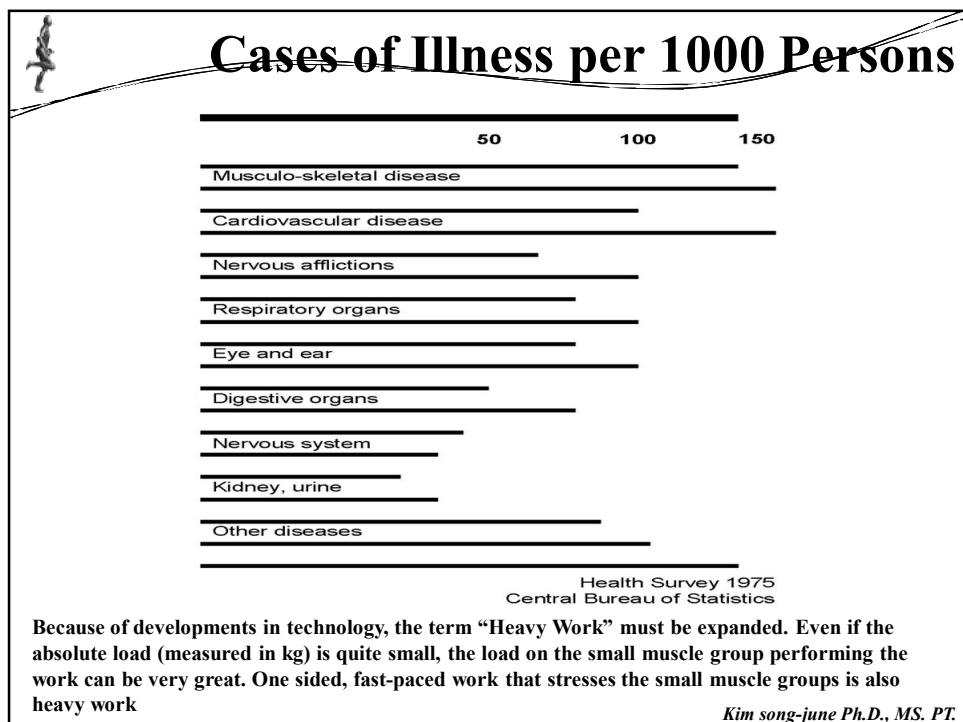
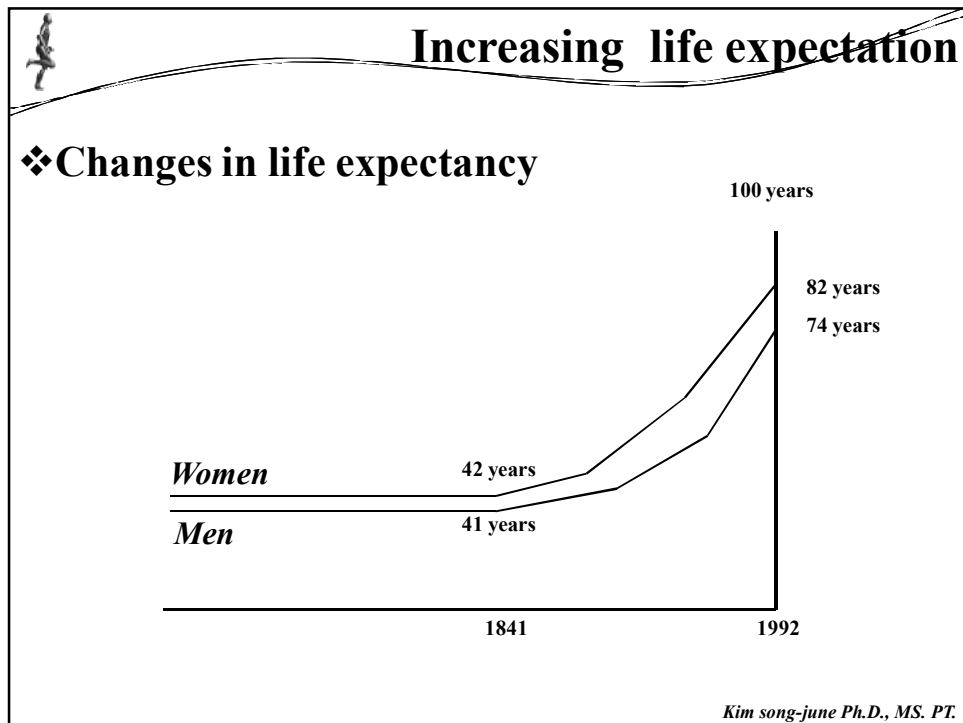


Changes in the use of the locomotor system

Conti.....

- ❖ **Consequences of the changes in using our locomotor system**
 - Homo sedates
 - Homo monotonous
 - Homo inactive

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The Basic Principles

Oddvar Holten and Tom A. Torstensen



The Basic Principles

- ❖ *Physical stress and psychosocial conditions related to work and leisure are important factors in the occurrence of disorders in the musculoskeletal system*
- ❖ *Who are on disability retirement because of overload stress and subsequent pain in the musculoskeletal system*

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Overload

❖ **"Stress, which over time or in intensity exceeds the limit of the tissue adaptability, and results in pain and discomfort."** *(Hermansen, 1981)*

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How one can prevent and treat the overload syndrome

- ❖ **By increasing tolerance through medical exercise therapy and regular exercise**
- ❖ **By optimizing the work load through ergonomic measure**
- ❖ **By improving conditions for work satisfaction**
(psychosocial and physical working environment)

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Criteria M.E.T

(approved by Norwegian law, proposed by Oddvar Holten)

- ❖ Exercise program is based on the clinical examination of the patient
- ❖ The therapist is continuously supervising the exercise room
- ❖ Apparatuses should be designed to create the possibility for optimal stimuli
- ❖ Treatment time of 1 hour – maximal 5 patients per hour

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Criterion A

- ❖ The aim of modern physiotherapy is to reconstitute, prevent relapses and to increase the patient's work capacity
- ❖ The tolerance for physical and psychological loading should be better after finishing the physiotherapy treatment compared to when the dysfunction/disease commenced

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Criterion B

Conti.....

- ❖ **Physiotherapy for the musculoskeletal system is the treatment of joint connections and muscles and their servants, being the neuromuscular system, the cardiovascular and the respiratory system as well as the organs for energy production**

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Criterion C

Conti.....

- ❖ **Modern methods for training/exercising are mostly associated with a high number of repetitions (500-1000) which the patient performs him/herself**
- ❖ **It is not rational in such cases that have one physiotherapist per patient**

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Medical Exercise Therapy
Criterion C
Conti.....

❖ **Phase of Functional Exercise**

➤ Fitts & Posner 3phase model ;

- ✓ 1 phase : Cognitive stage
- ✓ 2 phase : Associative stage
- ✓ 3 phase : Automatic stage

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Medical Exercise Therapy
Criterion C
Conti.....

❖ **Phase of Functional Exercise**

➤ Fitts & Posner 3phase model ; *Conti.....*

The diagram illustrates the flow of information through three stages of motor learning:

- Motor learning** leads to the **Short term sensory store (250ms~2sec)**.
- The **Short term sensory store** feeds into a **Filter: Selective attention**. This filter removes **Redundant sensory information**, allowing information to pass to **Short term memory (120sec)**.
- The **Short term memory** feeds into a second **Filter: meaning & repetition of information**. This filter removes **Redundant single & insignificant event**, allowing information to pass to **Long term memory**.

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Criterion D

Conti.....

- ❖ **Physiotherapists should if possible try to objectively measure the progression of the treatment, using objective measurements for dosing the treatment as well as for the outcome of the treatment**

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Criterion E

Conti.....

- ❖ **The patients degree of motivation will influence the result of the treatment**
- ❖ **Increased motivation is obtained when the patient at all times is orientated about the prognosis and the progression of the treatment**
- ❖ **This is made possible when the work capacity in the exercise room is dosed and graded in relation to the maximal work capacity of the patient using objective measurements**

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Criterion E

Conti.....

- ❖ In addition the exercise program is written down on a exercise card, hence the patient will objectively follow the scheme of treatment, the progressions of the exercise program, and improvements as decreased pain experience and improved function
- ❖ When planning my institute also had to consider other variables

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Criterion E

Conti.....

- ❖ Two of those were increasing patient motivation and their active coping strategy
- ❖ To obtain this goal the patients are working in a group setting, where each patient has an individually designed exercise program for their movement disorder
- ❖ The treatment gives the patient an increased insight in how an exercise program can improve a painful condition

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Criterion E

Conti.....

- ❖ **Another important factor is the cooperation with the Norwegian Manual Therapy Group and the implementation of an active exercise program in relation to pre and post manipulative procedures**
- ❖ **Medical exercise therapy is integrated in the manipulative procedures by maintaining or improving the function of joints and their related structures after manipulative procedures**

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- ❖ **The objective of M.E.T. (Prof. Alvik)**
 - **“The patient should be healthier after treatment than prior to the appearance of the illness”⁽¹⁹⁶⁷⁾**

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Conti.....

❖ Why integrate Medical Exercise Therapy in your treatment ;

- With M.E.T. you will improve the conditions of well-being for the musculoskeletal system and the supporting system of organs *(Difficult to grade the charge at a treatment table OH.)*
- M.E.T. can be a good supplementary treatment in connection with passive joint mobilization. Restoration of normal function in all peri-articular structures *(OH.)*

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Medical Exercise Therapy

Conti.....

❖ Why integrate Medical Exercise Therapy in your treatment ; *Conti.....*

- The concept offers a rational scheme of treatment. The selection of exercises and the mode of dosage increase the therapeutic capability of the physiotherapist *(OH.)*
- M.E.T. is an objective method. In the scheme of treatment as well as in the assessment of results of the treatment *(OH.)* (Setting up an M.E.T.- program and dosing of exercises is now computerized *(Leo Wouters, 1980. KOMMA Program)*)

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Medical Exercise Therapy

Conti.....

❖ **Why integrate Medical Exercise Therapy in your treatment ;** *Conti.....*

- M.E.T. motivate patients. They follows the scheme of treatment objectively *(OH.)*
- Responsibility is asked of the patient for his own health. He / She must execute and count the exercises properly and exercise on an regular basic
- M.E.T. offers the therapist variation in his/her work and a relief of the physical burden of it

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Conti.....

❖ **Individual exercise program ;**

- Clinical examination and/or re-assessment of the patient are the bases for dosage and selection of the exercises
- In average patients get 3 individual treatments before starting up an M.E.T. program
- M.E.T. is used in a one/one setting. However it is possible to treat up to 5 patients at the same time (EU), still working with individualized therapy
- In that case you should be organized well
 - ✓ Exercise room, maybe cooperate with a PTA, computerized,.... ... be experienced in M.E.T

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In medical exercise therapy

- ❖ **To specifically tests a joint for hyper-/ hypo-mobility → stabilizing or mobilizing**
 - Initial starting position for the exercise
 - Specific and selective exercises
 - Grading the load in accordance to the pathology

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In medical exercise therapy

Conti.....

- ❖ **Oddvar Holten developed a system of treating patients by applying specific graded exercises**
 - "The branch of exercise therapy where the patient performs exercises in specially designed apparatus, without manual assistance but constantly monitored by the physiotherapist
 - The apparatus must be designed to optimally stimulate the relevant functional quality, neuromuscular, arthrogenic, circulatory, and respiratory

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In medical exercise therapy....

Conti.....

❖ **Oddvar Holten developed a system of treating patients by applying specific graded exercises** - con....

- “To obtain this effect, the patient carries out the exercises from a defined starting position, in a specific range of movement, or part of this range, against a graded load
- “Medical exercise therapy is based on a minimum of one hour's effective treatment (excluding dressing and undressing, shower/bath etc.)

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❖ Assessment

- Muscle tests
- Specific joint tests
- Functional tests

Conti.....

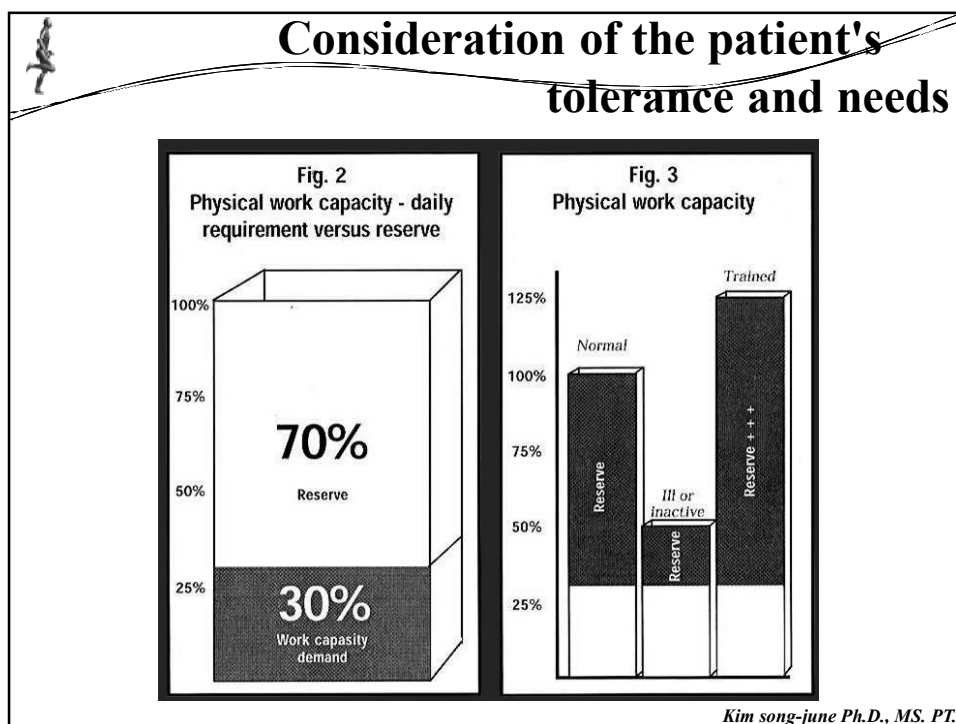
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In medical exercise therapy....

Conti.....

- ❖ *From the patient's history and the assessment a diagnosis is determined and an optimal treatment regime established*
- ❖ *The therapy also included reassessment and adjustment when required*

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Consideration of the patient's tolerance and needs

Conti.....

❖ **Optimal MET program**

- **Several exercises(7-9) with 2-3sets, each of 20-30 repetitions, a total of close to 1000 repetitions**
 - ✓ **Reason 1 : Hasten the regeneration-process**
 - ✓ **Reason 2 : Increase the tolerance**
 - ✓ **Reason 3 : Increase the coordination**

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Consideration of the patient's tolerance and needs

Conti.....

- ❖ **The tolerance level mirrors the patient's current level of physical activity and determines the grading of the load used for treatment**
- ❖ **The patient's needs are determined by the amount of stress the tissue structures are put under during work and leisure**

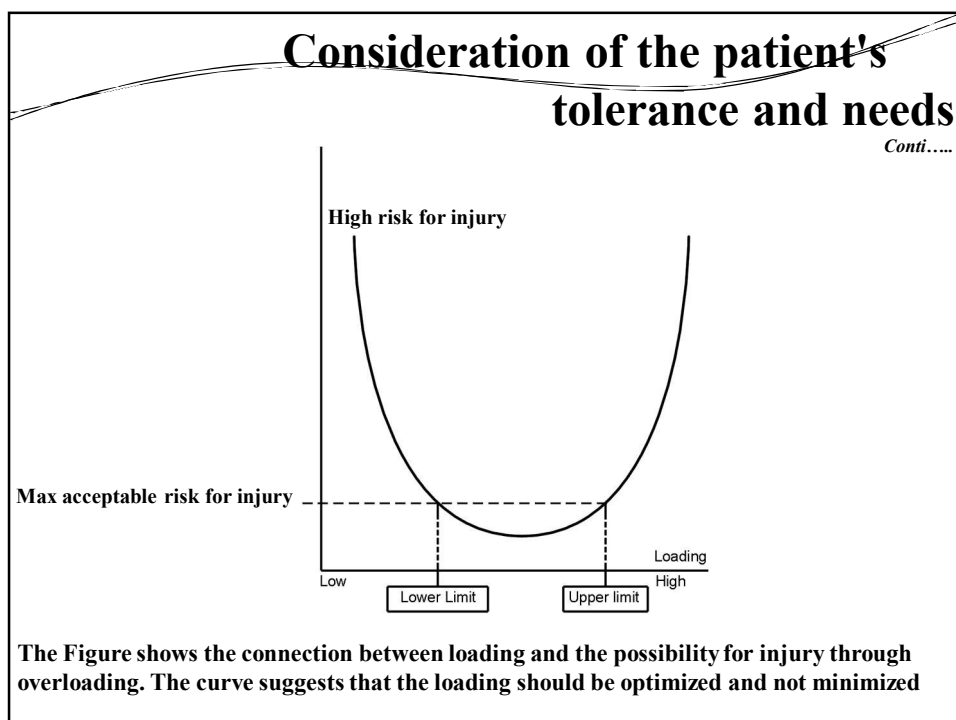
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Consideration of the patient's tolerance and needs

Conti.....

- ❖ **In cases of dysfunction in the musculoskeletal system it is important to know the different tissues optimal regeneration stimulus**
- ❖ **This principle is applied in medical exercise therapy by giving the pathological degenerated tissue structure its optimum regeneration stimulus**

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Optimum regeneration stimulus for the different tissue structures

❖ **The "well-being" and the speed of regeneration of these tissue structures is the differentiated by their vascularization**

- A muscle is a high metabolic tissue structure with rich vascular system
 - ✓ Its optimum stimulus is contraction (tension) and relaxation
 - ✓ The required tension (power development) determines the load grading

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Optimum regeneration stimulus for the different tissue structures

Conti.....

❖ **The "well-being" and the speed of regeneration of these tissue structures is the differentiated by their vascularization - continue**

- The optimum regeneration stimulus for the low metabolic tissue structures
 - ✓ Bone tissue, cartilage and connective tissue (tendons and ligaments), is an intermittent compression/release - stretch mechanism

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Optimum regeneration stimulus for the different tissue structures

Conti.....

❖ Through graded exercises it is possible to obtain optimum stimulation of these tissue's structures and their stress tolerance

➤ By grading the exercises specifically, one can obtain this effect at an early stage in the rehabilitation program

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Optimum regeneration stimulus for the different tissue structures

Conti.....

❖ The well-being and the speed of regeneration of tissue structures is differentiated by their vascularization

	High-Metabolic tissue structure	Low-Metabolic tissue structure
Vascular System	rich	rare
Tissue	muscle	bone, cartilage, tendon, ligament, disk
Optimal Regeneration Stimulus	Contraction -relaxation	Intermittent compression - release

❖ Through graded exercise it is possible to obtain optimum stimulation of these tissue structures and their stress tolerance



To accomplish this it is necessary to follow the requirements for objectivity laid down

by O. Holten

❖ Defined starting position ;

- In order to isolate the effect and to grade the resistance.

❖ Defined range of movement (ROM)

❖ Defined resistance ;

- Size of weight.

❖ Defined resistance ;

- Over time.

❖ Defined resistance ;

- Where in the range of movement.

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To accomplish this it is necessary to follow the requirements for objectivity laid down

by O. Holten

Conti.....

❖ Defined number of repetitions

❖ Defined speed

❖ Defined frequency

❖ Defined rest between each set ;

- Defined number of resting periods

❖ Defined rhythm of treatment ;

- How often the patient is treated each week

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❖ Objectives for the different exercises of a M.E.T-program ;

- To influence the muscle
- To influence the joint
- To influence the coordination

(Functional pattern)

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Medical Exercise Therapy

Conti.....

❖ How to reach the objectives for a M.E.T.-Program ;

- Proper SELECTION of exercises (+ specific modifications for execution)
- Proper DOSAGE for the exercises (resistance, number of repetitions, breaks)

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Medical Exercise Therapy

Conti.....

❖ Methodology of dosing exercises

- First we explain dosing to improve the muscle function.
- Secondly we will explain how to dose to improve the joint function by mobilizing or stabilizing
- Thirdly dosing to influence the coordination as required in stabilization, proprioception and motor skill

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Dosage of Exercise To influence the muscle

❖ Physiological qualities ;

- Endurance
- Strength
- Endurance/strength

❖ Histological qualities ;

- Arrangement of collagen
- Tension loading capacity of collagen

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Different muscle work

- ❖ Eccentric
- ❖ Concentric
- ❖ Static(=Isometric)

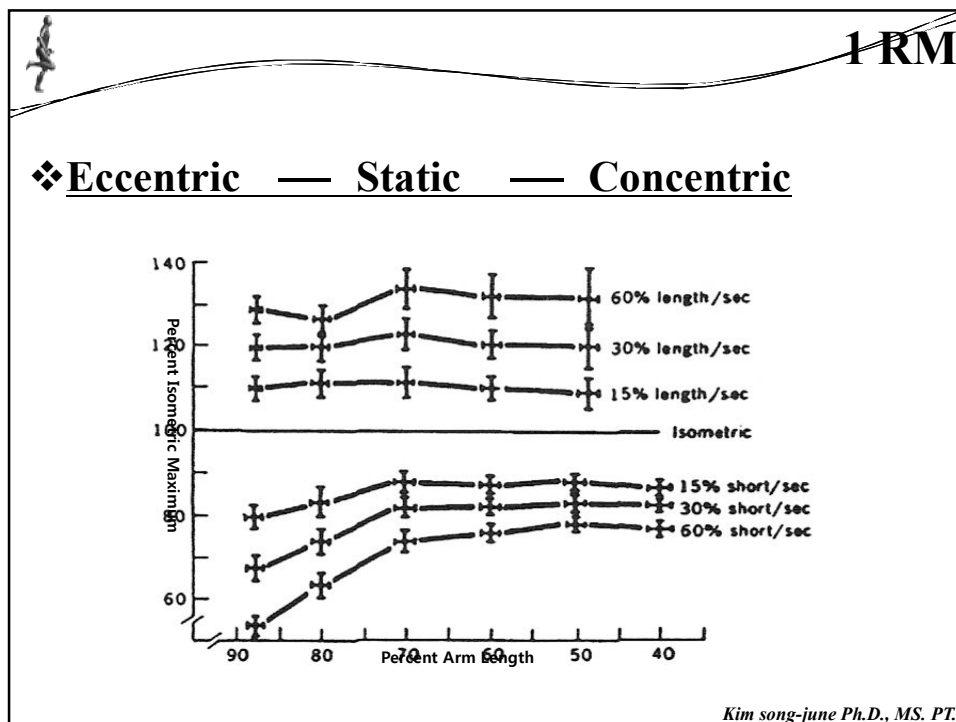
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Definition of 1RM

- ❖ **1RM(Resistance Maximum) for Isometric muscle work ;**
 - The maximum resistance you can overcome with static muscle work only once :
 - ✓ In a define position
 - ✓ During a define time

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Definition of 1RM
Conti.....

❖ **1RM(Repetition Maximum) for Concentric muscle work ;**

- The maximum resistance you can resistance you can overcome with concentric muscle work only one time :
 - ✓ In a defined concentric ROM
 - ✓ With a defined Speed

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Definition of 1RM

Conti.....

❖1RM(Repetition Maximum) for Eccentric muscle work ;

- The maximum resistance you can overcome with eccentric muscle work only one time :
 - ✓ In a defined eccentric ROM
 - ✓ With a defined speed

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Definition of 1RM

Conti.....

❖1RM(Repetition Maximum) for Dynamic muscle work ;

- The maximum resistance you can overcome with dynamic muscle work only one repetition :
 - ✓ In a defined dynamic ROM
 - ✓ With a defined speed

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The influence on the muscle of exercising with a certain % 1RM

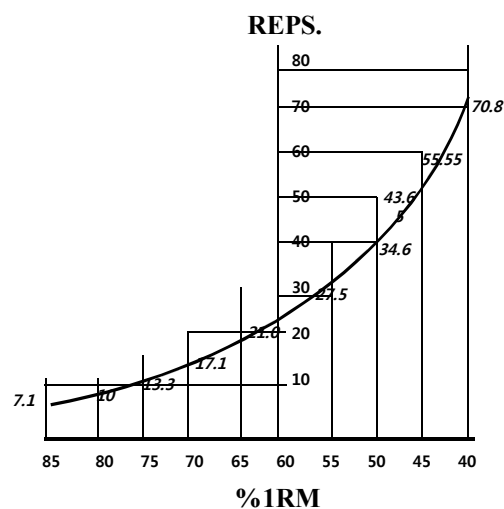
❖ M.E.T system.....,

➤ Two different phases.

- ✓ First phase ;
 - Try to regain the normal function(=normalising phase).
- ✓ Second phase ;
 - Try to increase the workload of the muscle(=optimalising phase).

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Maximum number reps./ %1RM



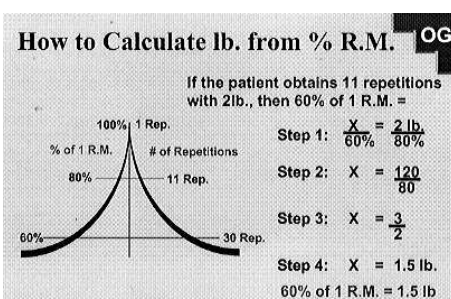
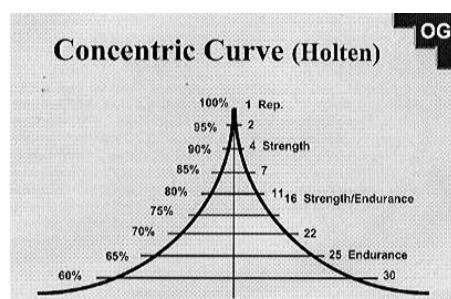
Dosing in Practice

- ❖ All exercise are tested one by one (*Vary muscle groups*)
- ❖ The resistance is chosen by the therapist
- ❖ The maximum number of repetitions that a patient is able to execute properly is the basis of dosage
- ❖ Compare the maximum number with the dosage curve to confirm if your goal will be reached ;
 - Either you calculate the dosage : number – sets – break
 - Either you calculate/deduct a new test – resistance

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Holten diagram

- ❖ Holten diagram graphically displays the relationship between the number of repetitions until fatigue and the percentage of the resistance maximal (RM) used in each repetition



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Calculating the resistance to re-test the exercise

- ❖ **Test ;**
 - Internal rotation shoulder with 2kg, 45 reps.
- ❖ **Aim ;**
 - Strength/endurance training with 70% of 1RM.
- ❖ **Training effect of the test ;**
 - 45reps. Means that the resistance, 2kg, is 50% of 1RM.
- ❖ **Calculation resistance ;**
 - $(2\text{kg} : 5) \times 7 = 2.8\text{kg}$ (via 10% 1RM to 70%)
- ❖ **Resistance to re-test with ;**
 - 3kg (the calculated resistance is corrected some because there is not linear relationship)

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Calculating the dosage

- ❖ **Muscular ; (3sets)**
 - Condition :
 - ✓ Maximum number of repetitions is reached through muscular fatigue
 - Not by pain, bad coordination,
 - Execution of the test :
 - ✓ Every movement should be identical
 - Allow some wrong movements which you deduct, but use them to show compensations
 - If the tested number of repetitions satisfy to the wanted effect (% of 1RM) :
 - ✓ Either decrease the number by 20%
 - ✓ Either decrease the resistance by 10%

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Zones of repetitions

❖ Muscular ;

- Test Zone 80% of 1RM : 8 ~ 12reps.
- 70% of 1RM : 15 ~ 20reps.
- 60% of 1RM : 25 ~ 30reps.
- 50% of 1RM : 40 ~ 47reps.
- 40% of 1RM : 68 ~ 76reps.
- 30% of 1RM : 108 ~ 118reps.

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Zones of repetitions

Conti.....

❖ Mobilizing and Coordination ;

- Test 20% above the number of 25 ~ 40reps.
- Depending the estimated motivation.

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Calculating the dosage

❖ **Mobilizing and Coordination ; (3sets)**

- Condition :
 - ✓ The quality of the execution should be the wanted one
 - Stabilizing consciously, good mobilization,
- Depending on the motivation of the patient apply sets between 25 and 40 repetitions
- Deduct the tested number of repetitions at least with 20%
- Keep always the resistance of the test

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Rest breaks

❖ **Muscular training ;**

- 40% of 1RM 30 seconds
- 50% of 1RM 45 seconds
- 60% of 1RM 60 seconds
- 70% of 1RM 120 seconds

❖ **To influence the joint ;**

- 30seconds(remark : depending the % of 1RM of secondary muscle work)

❖ **To influence the coordination ;**

- 30 seconds (same remark joint)

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General Remarks on Dosing Exercise & Breaks Between Series

	Zone of Dosage	Breaks Times
80% of 1RM	8~12 reps.	
70% of 1RM	15~20 reps.	120seconds
60% of 1RM	25~30 reps.	60seconds
50% of 1RM	40~47 reps.	45seconds
40% of 1RM	68~76 reps.	30seconds
30% of 1RM	108~118 reps.	



Why is this number of repetitions the maximum for the patient ?

- ❖ **Stopped because of muscle fatigue**
 - Which muscles ?
- ❖ **Stopped because of pain**
 - Where ?
- ❖ **Stopped because losing coordination**
 - Where located ?

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~~Why deduct the resistance with 10 % ?~~

- ❖ **The tested number is rather on the low side of the dosing zone**
- ❖ **The pulley make it easy to implement it, and the number of repetitions is situated in the middle of the dosing zone**

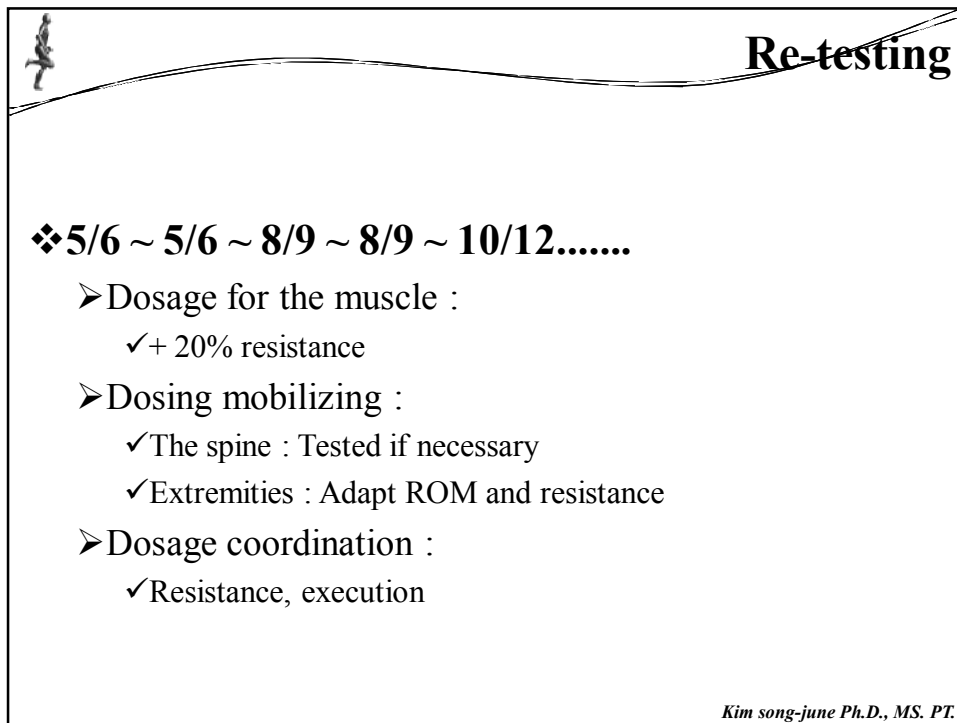
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~~Why deduct the number of repetitions with 20% ?~~

- ❖ **The number of repetitions is rather on the high side of the dosing zone**
- ❖ **The resistance of the apparatus can not be decrease any more**
- ❖ **The increments of the resistance of the apparatus are big to dose correct**

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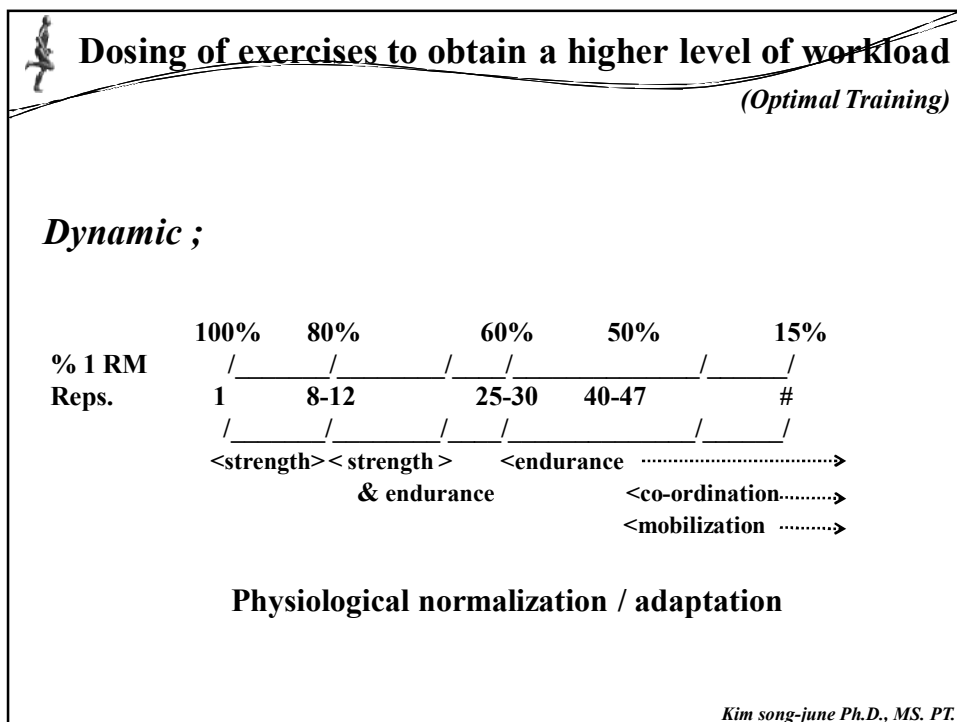


Re-testing

❖ 5/6 ~ 5/6 ~ 8/9 ~ 8/9 ~ 10/12.....

- Dosage for the muscle :
 - ✓ + 20% resistance
- Dosing mobilizing :
 - ✓ The spine : Tested if necessary
 - ✓ Extremities : Adapt ROM and resistance
- Dosage coordination :
 - ✓ Resistance, execution

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Dosing of exercises to obtain a higher level of workload (Optimal Training)

Dynamic ;

	100%	80%	60%	50%	15%
% 1 RM	/	/	/	/	/
Reps.	1	8-12	25-30	40-47	#
	/	/	/	/	/
	<strength> < strength >		<endurance	>	
	& endurance			<co-ordination.....>	
				<mobilization>	

Physiological normalization / adaptation

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Static ;

	100%	80%	60%	50%	15%
% 1 RM	/	/	/	/	/
Reps.(5/5 sec) ;	1	8-12	25-30	40-47	#
	/	/	/	/	/
	<strength>		<endurance		

Physiological normalization / adaptation

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Dosing of exercises to achieve “normal” strength and functioning “free of symptoms”
(Normalizing Training)

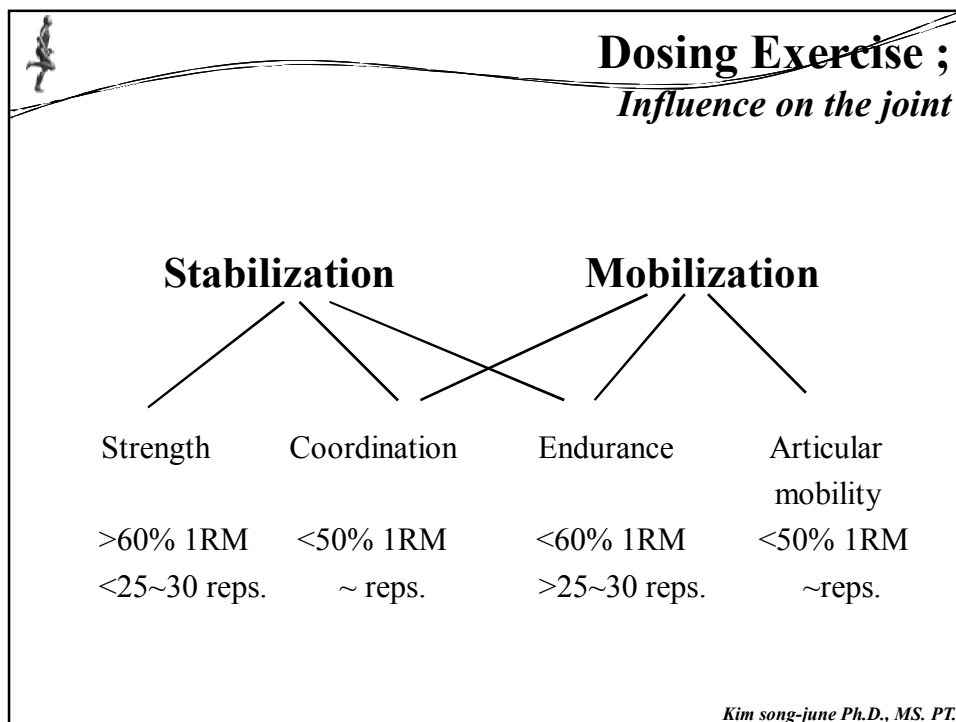
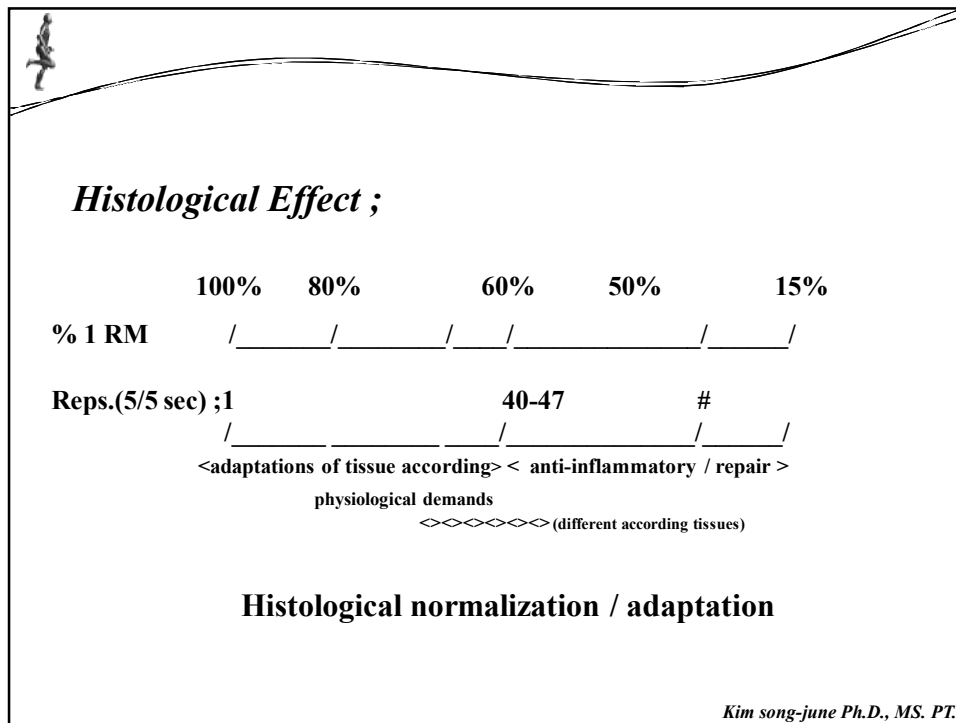
Dynamic ;

	100%	80%	60%	50%	15%
% 1 RM	/	/	/	/	/
Reps.	1	8-12	25-30	40-47	#
	/	/	/	/	/
	<strength>	<strength>	<endurance		
		-endurance	<co-ordination		
			<mobilization		

Physiological normalization / adaptation

PS : Exercise strength in case of hypotrophy : >30~40%1RM=normal strength

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Dosing Exercise ;

Influence on the coordination

- ❖ **Learning (move consciously – quality) ;**
 - <50% 1RM.
 - Total number reps. > 25~30.
 - Moderate tempo – progressive more % of 1 RM-short series
- ❖ **Automatization ;**
 - <50% 1RM.
 - ~reps.
(*progressive increasing of the speed*)

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Example 1 ;

Internal Rotation Shoulder Endurance 60% 1RM

- ❖ **Test ; 30reps. With 1kg(=2.20lbs), muscular fatigue**
- ❖ **Calculation ;**
 - -20% number repetitions; 3x24repetitions.
 - Resistance 1kg(2.20lbs) and 1minute break
- ❖ **Calculation ;**
 - -10% resistance ; 3x30 repetitions
 - Resistance 0.9kg(1.98lbs) and 1minute break

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Example 2 ;

De-loaded knee bending Endurance 50% 1RM

❖ **Test ; 40reps. With 1.5kg(=33lbs), muscular fatigue**

❖ **Calculation ;**

- -20% number repetitions; 3x32repetitions.
- Resistance 1.5kg(33lbs) and 45 seconds break

❖ **Calculation ;**

- -10% resistance ; 3x40 repetitions
- Resistance 20kg(44lbs) and 45seconds break
 - ✓ PS ; Body weight 65kg(143lbs)
 - ✓ Resistance test ; 65kg-15kg=50kg
 - ✓ Resistance exercise(-10%) ; 50-5=45kg → -20kg

Kim song-june Ph.D., MS. PT.



Example 3 ;

Shoulder abduction Mobilization the ROM

❖ **Test ; 45reps. With -1.5kg(= -3.30lbs), losing coordination**

❖ **Calculation ;**

- Minimal-20% number repetitions; Keep always the resistance(-1.5kg)
- 3x25 repetitions (can be maximal 3x36 reps. Motivation)
- Resistance -1.5kg(-3.30lbs) and 30seconds break

Kim song-june Ph.D., MS. PT.