WORK SIMULATION TOOLS

INSTALLATION/OPERATION MANUAL

830-269

BIODEX

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INTRODUCTION

This manual covers operation procedures for the following product:

830-269 Attachment, Work Simulation Tools

NOTE: *It is recommended that the rehabilitation professional become thoroughly familiar with this manual before using the Work Simulation Attachments. Only by doing so will the operator guarantee safe, efficient and successful use of the set.*

The Biodex Work Simulation Attachments provide a means of therapy for restoration of workplace skills and dexterity impaired by disease or injury of the upper extremities. Conventional exercise equipment does not adequately reproduce complex workplace motions encountered in everyday life. Shop equipment is too specialized, costly and bulky for the physical therapy office and falls short of preparing the patient for performing actual tasks that would be encountered on the job.

The Biodex Work Simulation Attachments provide numerous applications related to the simulation of job tasks and upper extremity movements. Use of the tools works range of motion, upper extremity strength and fatigue tolerance. The Biodex System allows the therapist to thoroughly monitor patient progress on the job task for a quick functional return. The Work Simulation Attachments aid in recreating the patient's occupational activities and measure his/her level of performance.

All of the work simulation motions can be accomplished in Isokinetic, Passive Reactive, Eccentric, Isometric or Isotonic modes at speeds up to 500 deg/sec and torques up to 300 ft-lbs in Eccentric mode. All of the speed, torque and safety features are identical to those of the Biodex Multi-Joint System.

Realistic simulation of certain motions can be achieved by taking advantage of unique Biodex features after trying various modes, speeds and torque limits. For example, in passive mode, with Dynamometer tilt of 30 degrees using an passive speed of 10 deg/sec and a torque limit of 10 ft-lbs with a ROM of 120 degrees, the steering wheel attachment feels very much as though it is attached to the steering post of a tractor trailer being driven down an interstate highway. You will undoubtedly define other modes, speeds and orientations suitable to your work hardening programs.

PARTS LIST

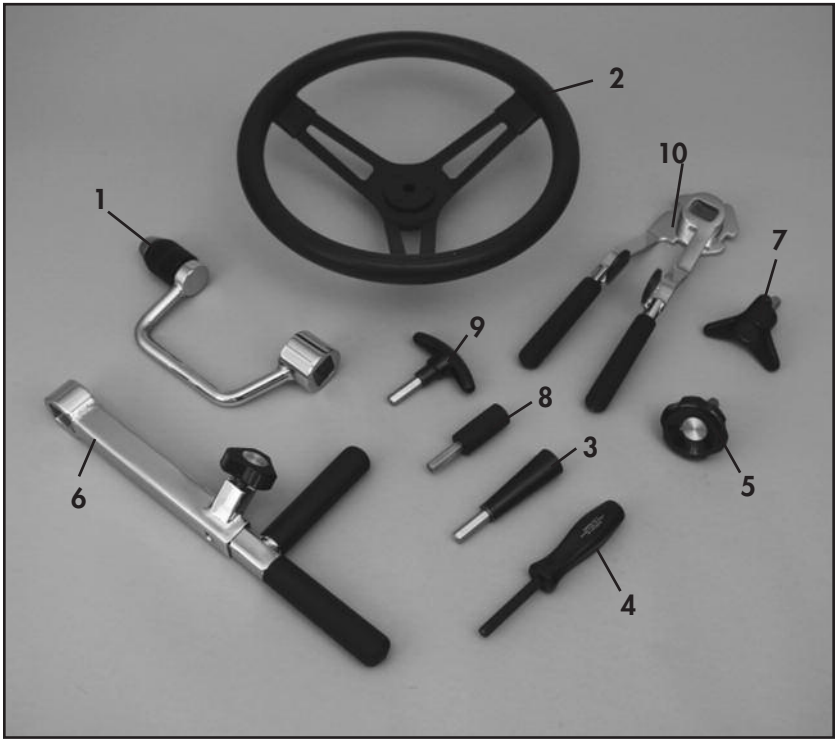

Figure 1: The Biodex Work Simulation Attachments

1. 830-271 Multiple Tool Adapter
2. 830-278 Upper Extremity Wheel
3. 830-280 Speed Wrench Simulator
4. 875-281 Screwdriver Simulator
5. 875-273 Spherical Grasp
6. 820-690 Upper Extremity Wrench Simulator
7. 875-277 3-Point Prehension with Rotation
8. 875-272 Precision Pinch with Rotation
9. 875-274 Lateral Pinch with Rotation
10. 830-282 Prehension with Parallel Grip

SET-UP

Setting up your Biodex Multi-Joint System for use with the Work Simulation Attachments is simple and quick.

Just follow the steps below and then make adjustments based on the specific tool attachment to be used.

1. Position the patient and Biodex dynamometer as per patient protocol.
2. Select Setup mode on the Biodex Multi-Joint System 3.
3. Set appropriate range of motion limits.
4. Select the desired mode for the exercise or acquisition to be performed.
5. Select Attachment Select and set sensitivity to 5.
6. Press Start to begin.
7. Increase or decrease ROM, speed, etc., as per patient comfort.

NOTE: Both the height and angle of the dynamometer are dependent upon the task to be performed and how the task is performed by the patient. Patients can stand or sit but in either case it is critical to achieve a realistic simulation of work performance, thus the reason for such variances. Correct positioning of the patient should minimize substitution of muscle groups not targeted by the exercise or acquisition.

Using the Multiple Tool Adapter

The Multiple Tool Adapter is used to attach each of the following attachments to the dynamometer.

- Precision Pinch
- Lateral Pinch with Rotation
- 3-Point Prehension
- Spherical Grasp
- Parallel Grip with Pronation/Supination
- Speed Wrench Simulator

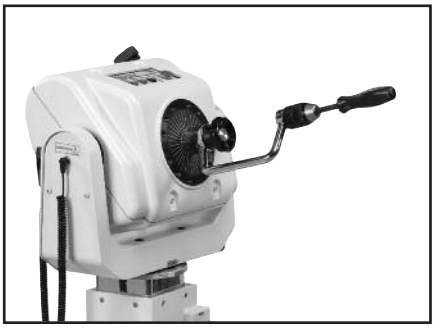

Figure 2: Multiple Tool Adapter

To attach the Multiple Tool Adapter:

1. Insert the adapter onto the dynamometer shaft.
2. Tighten the locking knob.
3. Insert the appropriate attachment into the Multiple Tool Adapter chuck and tighten the chuck to secure the attachment in place.

Upper Extremity Wheel

Figure 3: Upper Extremity Wheel

Composite upper extremity motion with hand grip. Compound wrist motion.

Tool or Task	Job Description
Steering Wheel	Driver
Equipment Controls	Mechanic
Steam Valves	Carpenter
Fork Lift	Plumber

Speed Wrench Simulator

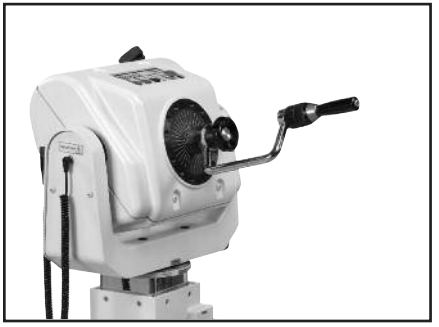

Figure 4: Speed Wrench Simulator

Tool or Task	Job Description
Hand Drill	Carpenter
Speed Wrench	Mechanic
Ratchet	Construction Worker
Trowel	Mason

Screwdriver Simulator

Figure 5: Screwdriver Simulator

Parallel grip with pronation/supination.

Tool or Task	Job Description
Screwdriver	Carpenter
Pole	Construction Worker
Pipe	Maintenance Mechanic
Throttle	Electrician

Spherical Grasp

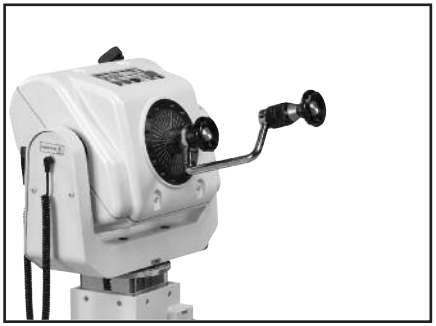

Figure 6: Spherical Grasp

Tool or Task	Job Description
Tuning	Plumber
Door Knob	Carpenter
Valve Control	Welder
Nut	Construction Worker

Upper Extremity Wrench Simulator

Figure 7

Figure 8

Figures 7 and 8: The Upper Extremity Wrench Simulator can be used to simulate several motions including: pushing/pulling (figure 7) and cranking/lifting (figure 8).

Elbow flexion/extension and shoulder motion with cylindrical grasp.

Tool or Task	**Job Description**
Crow Bar	Construction Worker
Drill Press	Plumber
Ratchet	Press Feeder
Wheelbarrow	Heavy Machine Operator

3-Point Prehension with Rotation

Figure 9: 3-Point Prehension with Rotation

Tool or Task	Job Description
Faucet	Plumber
Lugs	Assembler
Small Parts Assembly	Jeweler

Precision Pinch with Rotation

Figure 10: Precision Pinch with Rotation

Tool or Task	Job Description
Radio Knob	Electrician
Fine Tuner	Radio Technician
Manipulation of Equipment Controls	Electronics Tester Maintenance Mechanic

Lateral Pinch with Rotation

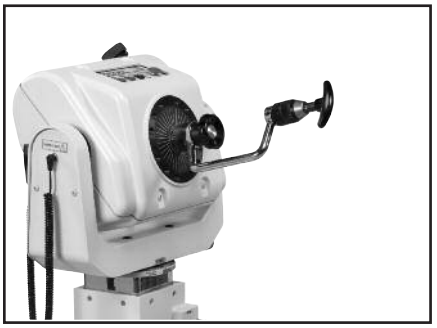

Figure 11: Lateral Pinch with Rotation

Tool or Task	Job Description
Wing Nut	Assembler

Prehension with Parallel Grip

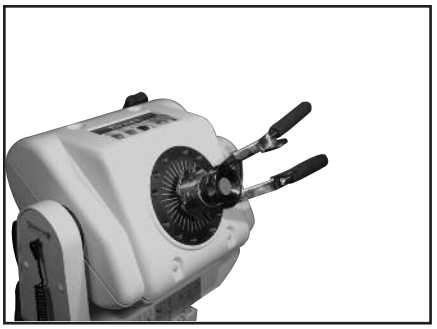

Figure 12: Prehension with Parallel Grip

Tool or Task	Job Description
Pliers	Electrician
Pruning Shears	Gardener
Scissors	Mechanic
Baseball	Baseball Player

WORK HARDENING

"Work Hardening is a highly structured, goal oriented, individualized treatment program designed to maximize the individual's ability to return to work. Work hardening programs, which are interdisciplinary in nature, use real or simulated work activities in conjunction with conditioning tasks that are graded to progressively improve the biomechanical, neuromuscular, cardiovascular/metabolic and psychosocial functions of the individual. Work hardening provides a transition between acute care and return to work while addressing the issues of productivity, safety, physical tolerances and work behaviors." (1)

Concepts

1. It has been recommended when treating an industrial population to stay away from passive modalities and initiate active work hardening programs.
2. In using the work tools for rehabilitation or work hardening, attempt to replicate the work or home situation as closely as possible. Rehabilitation may end by work, time or repetitions. Use the parameter that most closely simulates the patient's unique work situation.
3. If possible, the clinician should go into industry with an event counter, ROM measurement device and a spring scale to measure force and incorporate these parameters into the rehabilitation program. Videotaping the work site may be extremely helpful.
4. In general, the focus of a work hardening program should be on quantifying function rather than focusing on pain.
5. Although the main purpose of work hardening is job simulation, the clinician needs to perform a job analysis and identify awkward or dangerous work postures. The task may need to be modified and the person instructed to take frequent micro-breaks from the acitivity. The clinician should be aware of prolonged sitting or standing because of the effects on the disc, heart rate and swelling.
6. In general, it has been recommended that work be performed at elbow height. Precision work may be performed slightly higher, and work that requires increased strength slightly lower. (2)
7. Job situations that are repetitive in nature, require forceful exertions and involve vibration may be dangerous when performed over long periods of time.
8. Fatigue must be carefully monitored since there is a greater chance of injury at this time.

Clinical Considerations

1. Biodex testing is performed for three reasons — quantification, baseline data and goal setting. During the evaluation process, it is recommended to compare results from side to side and in two handed tasks, clockwise to counterclockwise. The dominant side must be considered during testing and rehabilitation.
2. The stabilizing muscles are important for injury prevention. Keep in mind the concept of total limb strengthening.
3. When performing work hardening with the work tools, keep in mind the pathomechanics of the injury. If a patient is diagnosed with carpal tunnel syndrome, full wrist flexion and extension are contraindicated. There are stresses on the median nerve in both positions. The patient should not be worked through the extremes of the motion during therapy and his/her task at the work site should be modified to eliminate the full range.
4. Keep in mind desensitization with carpal tunnel syndrome or autonomic dysreflexia. Soft, adaptable material may be secured to the handle of a tool and then removed as the patient becomes desensitized.
5. Some reported occupational factors of cumulative trauma disorders of the upper extremity are listed in the following chart on page 13 (Armstrong et al., 1982).

Disorder	Reported Occupational Risk Factors
Carpal Tunnel Syndrome	1. Accustomed and unaccustomed repetitive work with the hands. 2. Work that involves repeated wrist flexion or extreme extension, particularly in combination with forceful pinching. 3. Repeated forces on the base of the palm and wrist.
Tenosynovitis and Peritendonitis Crepitans of the Abductor and Extensor Pollicus Tendons of the Radial Styloid (DeQuervains's Disease)	1. More than 2,000 manipulations per hour. 2. Performance of unaccustomed work. 3. Single or repetitive local strain. 4. Direct local blunt trauma. 5. Simple repetitive movement that is forceful and fast. 6. Repeated radial deviation of the wrist, particularly in combination with forceful exertions of the thumb. 7. Repeated ulnar deviation of the wrist, particularly in combination with forceful exertions of the thumb.
Tenosynovitis of Finger Flexor Tendons	Exertions with a flexed wrist.
Tenosynovitis of Finger Extensor Tendons	Ulnar deviation of the wrist outward roation.
Epicondylitis	Radial deviation of the wrist with inward wrist rotation.
Ganglionic Cysts	1. Sudden or hard unaccustomed use of tendon or joint. 2. Repeated manipulations with extended wrist. 3. Repeated twisting of the wrist.
Neuritis in the Fingers	Contact with hand tools over a nerve in the palm or sides of the fingers (3).

FOOTNOTES

1. Matheson LN: Work Hardening Program Accreditation. Industrial Rehabilitation Quarterly 1(2): 1, 1988.
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2. Armstrong TJ, Radwin RG, Hansen DJ, Kennedy KW: Repetitive Trauma Disorders: Job Evaluation and Design. Human Factors 1(28): 325, 1986.
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12. May VR, Stuart, Soderberg: Rehabilitating the Injured Worker: A Physical Capacity Evaluation and Work Hardening Model. Physical Therapy 65(5): 738, 1985.
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