



# Recommended Weight Limits for Lifting and Holding Limbs in the Orthopaedic Practice Setting

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Nurses and other caregivers face high risk for developing work-related musculoskeletal disorders while lifting and holding limbs in the orthopaedic practice setting. A task force including representatives from the National Association of Orthopaedic Nurses, American Nurses Association, National Institute for Occupational Safety and Health, Patient Safety Center of Inquiry at the James A. Haley Veterans Administration Medical Center in Tampa, Diligent Services, and Guldmann, Inc., developed an orthopaedic clinical tool for determining maximum recommended weight limits for lifting and holding arms and legs for treatment of the orthopaedic patient. Scientific evidence, concepts of ergonomic safety, and safe patient-handling equipment were incorporated into this clinical tool.

**T**he National Association of Orthopaedic Nurses (NAON) has developed a guidance statement on the safe handling and movement of patients in the orthopaedic setting. The development process for the NAON guidance statement has been described in a previous article (Sedlak, Doheny, Nelson, & Waters, 2009). The NAON guidance statement was developed to identify patient-handling tasks in an orthopaedic setting that present caregivers with high risk for work-related musculoskeletal disorders (MSDs) and provide evidence-based solutions for reducing the risk of each task identified. This is the fifth in a series of articles presenting high-risk orthopaedic tasks and outlining ergonomic solutions. This article will focus on Orthopaedic Clinical Tool No. 1—Lifting and Holding Limbs in the Orthopaedic Setting. An alternate method for determining safe weights for lifting and holding limbs with casts is also provided.

## Background

A survey of orthopaedic nurses determined that lifting and holding limbs during treatment procedures was considered a high-risk task for development of work-related MSDs. Lifting and holding limbs of patients during treatment is frequently a necessary component of care in the orthopaedic setting. In addition, it is

performed many times during a typical work shift. High frequency of performing this task, patient obesity, and the added weight of orthopaedic appliances, such as casts and splints, increases the risk of work-related MSDs for workers performing this task. In addition, the orthopaedic caregiver frequently works in situations where environmental barriers place the caregiver in awkward positions that further increase risk to the caregiver.

Often when orthopaedic care is being provided, the caregiver must lift and/or hold a limb in place while some type of treatment is being provided, such as casting or cast preparation (see Figure 1). When a caregiver must lift a leg or arm, it is important to make sure that the weight of the limb being lifted does not exceed the strength capability of the caregiver.

The patient's condition may add complexity to the task and increase risk of MSDs. For example, complexity may include caring for a patient with contracted limbs, in which the contracted extremity involves a shortened tendon that does not allow for full range of

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**FIGURE 1.** Manual lifting and holding of a leg during an orthopaedic procedure.

motion, thus causing difficulty with using many types of holding devices. In addition, fractured extremities may be difficult to hold when a closed reduction is being performed. In such cases, manual pressure as well as traction need to be applied to approximate a fracture. Lastly, handling limbs from an obese patient increases the weight to be lifted or held by the caregiver.

In a recent article, Waters (2007) indicated that no caregiver should ever lift more than approximately 35 lb of a patient's weight under ideal conditions and that the maximum recommended weight for lifting would be even less for many patient-handling tasks in which the arms are extended during the lift. This is often the case when lifting and holding limbs during orthopaedic treatments, such as casting and splinting.

To assist caregivers, a table of weight limits was developed to assist in determining whether a specific lift and/or hold of a limb is acceptable and whether some type of lift or hold assist device is needed (see Table 1). For lifts of limbs with casts, an alternate method is provided for assessing whether the lift is recommended or not. This clinical tool for evaluating whether a specified limb lifting or holding task would

**TABLE 1. LIFTING AND HOLDING LEGS OR ARMS IN AN ORTHOPAEDIC SETTING**

Patient Weight, lb (kg)	Body Part	Body Part Weight, lb (kg)	Lift		Hold		
			1 hand	2 hands	2 hands <1 min	2 hands <2 min	2 hands <3 min
<40 (<18)	Leg	<6.3 (3)					
	Arm	<2.0 (1)					
40–90 (18–41)	Leg	<14.1 (6)					
	Arm	<4.6 (2)					
90–140 (41–64)	Leg	<22.0 (10)					
	Arm	<7.1 (3)					
140–190 (64–86)	Leg	<29.8 (14)					
	Arm	<9.7 (4)					
190–240 (86–109)	Leg	<37. (17)					
	Arm	<12.2 (6)					
240–290 (109–132)	Leg	<45.5 (21)					
	Arm	<14.8 (7)					
290–340 (132–155)	Leg	<53.4 (24)					
	Arm	<17.3 (8)					
340–390 (155–177)	Leg	<61.2 (28)					
	Arm	<19.9 (9)					
390–440 (177–200)	Leg	<69.1 (31)					
	Arm	<22.2 (10)					
>440 (>200)	Leg	>69.1 (31)					
	Arm	>22.2 (10)					

**Note.** These are guidelines for the average weight of the leg and arm and are based upon the patient's weight. The maximum weight for a 1-handed lift is 11.1 lb. and for a 2-handed lift, 22.2 lb. **No shading:** Okay to lift and hold; use clinical judgment and do not hold longer than noted. **Gray shading:** Do not lift alone; use assistive device or more than one caregiver.

**Examples from Table 1:** It is safe to manually lift the leg of a patient weighing 120 lb with two hands to place the leg in a sling, but it should not be manually held for more than a few seconds. Similarly, it is safe to manually lift the arm of a patient weighing 185 lb with two hands, but the arm should not be held in place longer than 1 min. In addition, it is safe to lift the arm of a patient weighing up to 440 lb with two hands, but the arm should not be held manually for more than a few seconds.

**TABLE 2. ALTERNATE METHOD FOR DETERMINING SAFE LIFTING AND HOLDING LIMBS WITH CASTS**

Limb	Limb Weight Factor <sup>a</sup>	1 hand	2 hands	2 hands < 1 min	2 hands < 2 min	2 hands < 3 min
Leg	0.157	11.1 lb	22.2 lb	11.6 lb	7.8 lb	6.4 lb
Arm	0.051	(5.1 kg)	(10.2 kg)	(5.3 kg)	(3.5 kg)	(2.9 kg)

<sup>a</sup>From *Occupational Biomechanics*, by D. B. Chaffin, G. B. J. Anderson, and B. J. Martin, 1999, New York: Wiley. Copyright 1999 by John Wiley & Sons.

be recommended considers both the caregiver and the patient, so that the task may be performed in a safe manner.

## Description of the Tool

The Orthopaedic Clinical Tool: Lifting and Holding Legs or Arms in an Orthopaedic Setting is shown in Table 1. The chart provides an estimate of the average weight for an adult patient's leg and arm as a function of his or her whole body mass, ranging from slim to morbidly obese body type. Weights are presented both in US pounds (lb) and metric (kg) units. Maximum lift and hold loads were calculated on the basis of 75th percentile shoulder flexion strength and endurance capability for US women as described by the Association for periOperative Registered Nurses (AORN, 2007), where the maximum weight for a one-handed lift is 11.1 lb and for a two-handed lift, 22.2 lb.

The shaded areas in Table 1 indicate whether it would be acceptable for one caregiver to lift the listed body parts with one or two hands or hold the respective body parts for 1, 2, or 3 min with two hands. Respecting these limits should reduce the risk of muscle fatigue and the potential for MSDs. Orthopaedic caregivers must use clinical judgment to assess the need for additional staff member assistance or assistive devices to lift and/or hold one of these body parts for a particular period of time.

It is important to note that Table 1 shows the recommended weight limits for limbs without a cast in place. If the caregiver is lifting a limb with a cast, the additional weight of the cast should be added to the weight of the limb to determine whether the lift is acceptable. An alternate method for assessing lifts of limbs with casts is provided in Table 2. Table 3 lists the typical weights of several types of casts.

As can be seen in Table 2, to use the alternate method for determining whether a manual lift would be recommended, you must multiply the patients' body weight with the limb factor (0.157 for leg and 0.051 for

arm) and add the weight of the cast (see Table 3). Compare the calculated weight to the value in the appropriate task box. If the total limb weight (including the weight of the cast) exceeds the weight in the appropriate box, then the caregiver should not manually lift the limb alone but should use an assistive device or more than one caregiver to perform the lift. Conversely, if the calculated weight is less than the value in the appropriate box, then it should be acceptable to manually lift and hold the limb, but the caregiver should use clinical judgment and not hold longer than noted.

For example, if the patient weighs 200 lb and has an arm cast weighing 5 lb, then the total arm weight would be  $200 \text{ lb} \times 0.051$  plus 5 lb, or 15.2 lb. In this case, the arm should not be lifted with one hand (i.e., 15.2 lb > 11.1 lb) but could be lifted with two hands (i.e., 15.2 lb < 22.2 lb). As noted in the table, the arm can be lifted, but it should not be held in that position more than a minute (15.2 lb > 11.6 lb). That is, the arm can be lifted into a sling, but some type of technology should be used to hold the limb during any procedures. Although this recommendation may seem extreme, nurses should consider their safety when lifting and holding limbs. Similarly, if the patient weighs 75 lb and has a 5-lb leg cast, then the total limb weight would be  $75 \text{ lb} \times 0.157$  plus 5 lb, or 16.8 lb. In this case, it would not be recommended to lift the limb with one hand (i.e., 16.8 lb > 11.1 lb), but it would be acceptable to lift it with two hands (i.e., 16.8 lb < 22.1 lb). Similarly, even with two hands, the limb should not be held more than a few seconds (16.8 lb > 11.6 lb).

## Rationale for the Clinical Tools for Lifting and Holding Limbs

Patient weight is divided into weight categories (see Table 1), ranging from very light to morbidly obese. Normalized weight for each leg and each arm is calculated as a percentage of body weight where each complete arm weighs 5.1% of total body mass and each leg

**TABLE 3. TYPICAL WEIGHTS OF CASTS**

Short Arm Cast (Adult)	Long Arm Cast (Adult)	Short Leg Walking Cast (150-lb Adult)	Long Leg Cast (150-lb Adult)	Infant Body Spica (20–30 lb)	Child Body Spica (3–5 yr old, 30–50 lb)
0.5 lb	1 lb	2 lb	3.0 lb	2 lb	4 lb
2 rolls 3"	1 roll 2"	4 rolls 4"	3 rolls 3"	2 rolls 2"	5 rolls 3"
	3 rolls 3"		3 rolls 4"	3 rolls 4"	5 rolls 4"
+ webril <sup>a</sup>	+ webril <sup>a</sup>	+ webril <sup>a</sup>	+ webril <sup>a</sup>	+ webril <sup>a</sup>	+ webril <sup>a</sup>

<sup>a</sup>Weight of webril is 0.25 lb per packet.



**FIGURE 2.** Use of assistive lifting device to lift and hold a leg during an orthopaedic procedure.

weighs 15.7% of total body mass (Chaffin, Anderson, & Martin, 1999). All weights are presented in both pounds and kilograms, rounded to the nearest whole unit.

To accommodate 75% of the US female working population, maximum load for a one-handed lift is calculated to be 11.1 lb (5.0 kg). This is determined by calculating the strength capabilities for a 25th percentile US woman maximum shoulder flexion moment (the mean equals 40 Nm, standard deviation equals 13 Nm; Chaffin et al., 1999) and 75th percentile US woman shoulder to grip length (the mean equals 610 mm, the standard deviation equals 30 mm; Pheasant, 1992). Maximum loads for one person for a two-handed lift (i.e., 22.2 lb/10.1 kg) are calculated as twice that of a one-handed lift. Muscle strength capabilities diminish as a function of time; therefore, maximum recommended loads for two-handed holding of limbs are presented for 1-, 2-, and 3- min durations. After 1, 2, and 3 min of continuous holding, muscle endurance has decreased by 48%, 65%, and 71% of initial lifting strength, respectively (Pheasant, 1992; Rohmert, 1973a, 1973b). If the limits in Table 1 are exceeded, additional staff members or assistive limb holders or positioners should be used. This rationale for the current clinical tool is identical to the rationale used by the AORN to determine recommended weight limits for lifting limbs for caregivers in the operating room setting (AORN, 2007).

## Solutions for Lifting and Holding Limbs

For those tasks deemed to be unacceptable to perform manually, the task force recommends the added personnel or use of an assistive device, such as a limb positioner or limb sling and a floor-based or ceiling lift or other type of vertical support structure. An example of assistive technology for lifting and holding limbs is shown in Figure 2. Special needs of the patient should be considered when deciding on what type of assistive equipment will be used, and the clinical judgment of the caregiver will be important in choosing the most appropriate solution for a specific task.

## Summary/Conclusions

The task force assembled by the NAON identified the task of lifting and holding limbs of patients in orthopaedic settings as high risk for workers developing work-related MSDs. These tasks, which often require high muscle force and endurance, are performed often in the orthopaedic practice setting. To address the problem, the NAON ergonomic task force developed an orthopaedic clinical tool designed to assist the caregiver in determining when patient-handling equipment should be used to assist the worker in lifting or holding a limb for tasks performed in the orthopaedic setting. The orthopaedic clinical tool for lifting and holding limbs provides guidance for decision making based on the body weight of the patient. For those tasks deemed unacceptable for manual handling, the task force recommends use of additional caregivers or use of assistive technology, such as limb positioners or slings and vertical lift devices, such as floor-based or ceiling-mounted equipment.

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## APPENDIX A. HELPFUL HINTS ON SLINGS

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Selection of the appropriate sling accessory for movement/lift/transfer, must include the following considerations:

- Decision to transfer patient in sitting vs. supine position—choose correct functionality of the sling
- Select appropriate size
- Maintain alignment of the affected body part(s) according to preoperative/postoperative guidelines
  - Consider the patient's body size, shape and features (e.g. very large abdominal girth can limit degree of hip flexion)
- Features of sling:
  - consider where material covers the patient
  - strap options for seated slings—the length of material for strap supports of the lower extremities can often be modified by selecting differing loop attachment points of the sling onto the hanger bar (e.g. providing more material length will allow lower extremity to be in less flexed position)
  - seated slings back height can vary from supporting whole trunk and head to covering pelvis/waist only. When upper extremities are involved, consider height of the sling—high back slings will wrap around and enclose an upper extremity, while a low back sling will allow upper extremity to be free
- If alignment/positioning guidelines cannot be met with available sling accessory, transfer patient supine with sheet style sling or antifriction methods, then sit upright.
- The "Patient Care Sling Selection and Usage Toolkit" is available for download at: <http://www.visn8.med.va.gov/patientsafetycenter/safePtHandling/toolkitSlings.asp>