Lateral Rotation Mattresses for Wound Healing

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– Carol Anderson, RN, PHN; Laurie Rappl, PT, CWS

Continuous lateral rotation therapy utilizes mattresses and beds that move the patient in a regular pattern around a longitudinal axis. Although these devices have been used for several decades for other medical purposes, literature is scant regarding their role in the treatment of skin breakdown in the bedridden, difficult-to-reposition patient. A descriptive study was undertaken to ascertain the rate of wound healing and number of weeks to achieve wound closure when continuous lateral rotation therapy was employed in patients with partial-thickness (n = 10) and full-thickness (n = 20) ulcers on the trunk or pelvis. Patients receiving the services of Advanced Therapy Surfaces in home or long-term care between March 15, 2002 and April 1, 2003 were enrolled. Partial-thickness wounds healed at an average rate of 16.68% per week, with an average time for continuous lateral rotation therapy of 9.25 weeks. Full-thickness wounds healed at an average rate of 14.38% per week (time to healing 11.25 weeks). No additional areas of skin breakdown were observed. These encouraging results suggest that additional research is warranted.

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Mattresses and beds that move the patient in a regular pattern around a longitudinal (ie, head to foot) axis are variably referred to as *lateral rotation, continuous lateral rotation therapy, oscillating therapy,* or *kinetic therapy.* Although these terms are often used synonymously, one defined technical difference has been noted. According to the Centers for Disease Control's Guideline for the Prevention of Nosocomial Pneumonia,[1] *kinetic therapy* refers to rotation of 40 degrees or more to each side (for an arc of 80 degrees), and *continuous lateral rotation therapy* rotates up to 40° to each side (up to an 80-degree arc). These specialized mattresses and beds have been used for more than 30 years, mainly in the prevention and treatment of cardio-respiratory conditions in ICU patients. Anecdotally, they have been used to treat skin breakdown in the bedridden, difficult-to-reposition patient. However, scant evidence in the literature addresses the incidence of skin breakdown or the treatment outcome of skin breakdown using these mattresses.

History of the Design

The original design for a rotating bed frame was incorporated in the RotoRest® (Kinetic Concepts Inc., San Antonio, Tex.). This bedframe-and-surface device secures patients in a supine position and rolls or rotates them from left side to right side in a 124-degree arc, or 62 degrees in each direction. Since that time, many devices that turn the patient around a longitudinal axis

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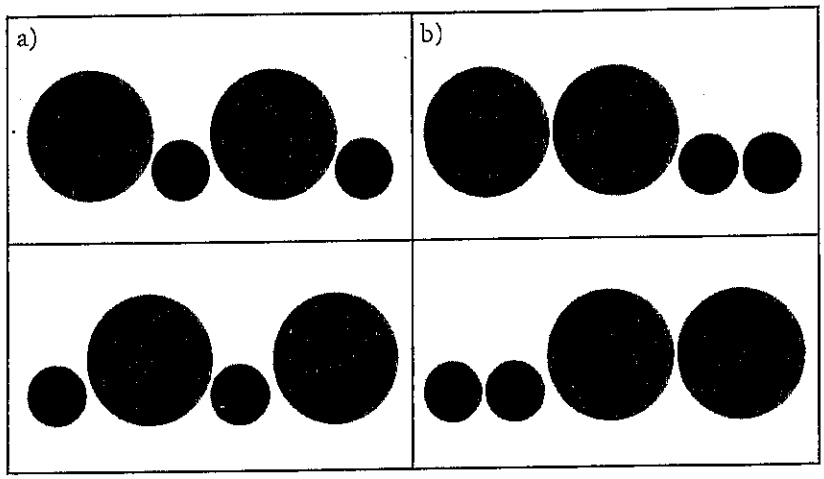
using various means have been developed. These include other full combination bedframe-and-surface devices and replacement mattresses that turn the patient using either air inflated tubes or pillows. Angles of achievement vary from 60-degree arc, or 30 degrees in each direction, up to the aforementioned 124-degree arc. As a group, these surfaces are commonly referred to as continuous lateral rotation (CLR) or continuous lateral rotation therapy (CLRT).



1. a) Alternating pressure usually refers to a pattern of inflation/deflation in an A-B-A-B style. b) CLRT turns the patient from side to side on a regular basis in an inflation/deflation pattern of AA-BB.

Other powered support surfaces that are widely used for wound care have been developed, such as low-air-loss and alternating pressure. They are commonly used during the treatment of pressure ulcers, specifically those on the trunk and pelvis, per Medicare guidelines for Group II surfaces.[2] The difference between alternating pressure and CLRT is in the pattern of inflation/deflation (see Figure 1).

Literature Review

Cardio-respiratory issues. Research published since 1980 on various CLRT surfaces has centered on cardio-respiratory issues such as decreasing the incidence of atelectasis, pneumonia, and pulmonary compromise in the immobilized patient.[3] Despite the number of studies published, drawing firm conclusions is difficult because of the variety of patient populations, bed or mattress features, degrees of patient movement, physiological markers used to identify changes, and results obtained (see Table 1 and Table 2).

Patient populations have included those with acute unilateral pulmonary injury,[4,5] closed head injury,[6,7] orthopedic injuries,[6] penetrating trauma,[8] mixed medical/surgical patients,[9-14] acute respiratory distress syndrome (ARDS),[15,16] or several groups in one study.[17] Patient care settings included ICUs of varying specialties[4-16] and centers for chronic ventilator-dependent patients.[18] Surface features have varied from those with 60 - to those with 124-degree arcs. Some studies do not specify the degree of turn, the frequency of turning, or the amount of time per 24 hours spent in rotation. In one review article, Sahn[19] concluded that CLRT must be instituted early to decrease the incidence of lower respiratory tract infections, including pneumonia. Basham et al[3] published an extensive and detailed literature review and introduced a tool to identify those patients who might benefit from CLRT.

Most studies compare outcomes on these surfaces to "standard care" or manual turning every 2 hours. However, Krishnagopalan et al[20] found that, although clinicians agreed that repositioning every 2 hours was optimal, q2hour repositioning was achieved in only 3% (two of the 74) of ICU patients observed in the study. They concluded that research comparing any type of rotational therapy to manual q2hr turning may be comparing turning to not turning rather than to degree or frequency of turning. Davis[15] noted that, although the protocol stipulated turning q2hr, in reality, turning was done every 3 hours. No studies comparing the results of using various degrees of rotation, frequencies

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KEY POINTS

- Traditionally used to prevent or manage cardio-respiratory problems in patients with limited mobility, continuous lateral rotation therapy also can be an option for the prevention or management of skin breakdown.
- Because information about the effects of continuous lateral rotation therapy on prevention and healing is limited, the authors recorded the wound outcomes of 30 patients with pressure ulcers who were placed on this type of mattress.
- The results are encouraging and suggest that more carefully designed studies are warranted.

TABLE 1
REVIEW OF STUDIES ON CONTINUOUS LATERAL ROTATION THERAPY MATTRESSES OR BED SYSTEMS

Author, year, study design	Bed, angle and frequency of rotation	Patient population (number of patients)	Outcome variable studied	Results
Schimmel[4], 1977, Experiential, case report	RotoRest®; non-rotating, patient positioned with affected lung superior to normal lung	Acute unilateral pulmonary injury (1)	Pulmonary blood flow	Improved ventilation, perfusion, oxygenation in damaged lung when patient laterally positioned with damaged lung superior to uninvolved lung
Bein[5], 1998, prospective investigation	RotoRest®; 124-degree arc every 7 min. Compares continuous axial rotation to supine positioning	Acute lung injury (10)	Compares ventilation/perfusion (Va/Q) relationships	No differences between CLRT and supine on minute ventilation, tidal volume, $PaCO_2$. Significant improvement in oxygenation (PaO_2/FIO_2) in patients with Murray score of 2.5 or less, i.e., less lung diseased patients. CLRT not effective in patients with late or progressive ARDS (Murray score > 2.5)
Gentilello[6], 1988, prospectively randomized	RotoRest®; 124-degree arc every 7 min	Critically ill, immobilized due to CHI or traction (65)	ICU LOS, incidence of pneumonia, and atelectasis	Decreased LOS in ICU, decreased incidence of pneumonia and atelectasis. Averaged 13.4 hr/day on rotation
Clemmer[7], 1990	RotoRest®; 124-degree arc every 7 min	CHI (49)	LOS, mortality, rate of improvement in pulmonary status	No significant benefits in mortality, morbidity, ICU LOS, hospital LOS, rate of pulmonary improvement of CRT
Fink[8], 1990, prospective randomized	RotoRest®; 80-degree arc every 7 min for 10-16 hr/day versus manual turning q2hr on conventional beds	Critically ill patients with chest trauma (106)	Incidence of LRTI	Decreased incidence of LRTI development, not significant decrease in nosocomial pneumonia in non-head trauma patients, but decreased LOS for pneumonia treated on CRT. In head trauma patients, CLR decreased incidence of pneumonia. CRT should be used early in patient illness as a preventative. Less effective as a treatment
Nelson[9], 1989, crossover, self-control	RotoRest®; supine, right side down, left side down, and rotating 124-degree arc every 3.5 min	SICU, receiving mechanical ventilatory support for radiographically symmetric acute lung disease (10)	Pulmonary gas exchange and hemodynamics in symmetric acute lung disease	No significant hemodynamic or ventilatory differences among 4 different positions, including CLR. No effect of CLR on cardiac index, arterial bp, pulmonary arterial occlusion pressure, vascular resistance and ventricular work, total ventilation ($PaCO_2$, VCO_2, alveolar ventilation, vent rate, total volume, Vd/Vt. Only major effect of CLR was on oxygenation, improved hypoxemia, restored PaO_2 toward the supine value when PaO_2 dropped in lateral steep positioning
deBoisblanc[10], 1993, prospective, randomized	Biodyne®; up to 90° arc every 7 min	Medical ICU patients divided into one of 5 DRGs. (106)	Morbidity, mortality, length of time on mechanical ventilator, ICU LOS, overall hospital LOS, nosocomial pneumonia	No differences in morbidity, mortality, length of time on mechanical ventilator, ICU LOS, overall hospital LOS. Decrease in nosocomial pneumonia on CLR

Author, year, study design	Bed, angle and frequency of rotation	Patient population (number of patients)	Outcome variable studied	Results
Traver[11], 1995, prospective randomized	Biodyne[t]; up to 80-degree (mean was 51degrees) arc at 5 min right, 10 min center, 5 min left; versus manual q2hr (undefined degree of turn)	Critically ill ICU patients in two teaching hospitals (103)	LOS, duration of ventilation, incidence of pneumonia, survival	No differences between the two groups for LOS in ICU, number of days duration of mechanical ventilation, incidence of pneumonia, survival, or total hospital stay. High APACHE II scores (≥ 20) showed improved survival of test group (77.8% versus 47.4%)
Whiteman[12], 1995; randomized controlled trial	Restcue[s]; 60-degree arc, 32 position changes per hour or 8 left to right turns or "full cycles" per hour; versus stationary bed	Post-liver transplant ICU (69)	Duration of mechanical ventilation, ICU LOS, incidence of atelectasis, incidence, and time to onset of LRTI and of pneumonia	No effect on duration of mechanical ventilation , LOS in ICU, incidence of atelectasis, incidence of pneumonia. Statistically significant decrease in incidence of LRTI and longer time to onset of LRTI. Tendency toward decreased nosocomial pneumonia
Raoof[13], 1999, prospective, randomized	Triadyne[s]; 90-degree arc in 15 min, 5-min pause in 45° left, center, 45° right with 20 min mechanical percussion every 4 hr versus manual turning with manual percussion q2hr	Medical ICU or ventilator ward patients, respiratory failure, evidence of atelectasis on chest radiographs (24)	Resolution of atelectasis	Significantly higher rate of partial or complete resolution of atelectasis may be achieved in critically ill patients who receive both CLR and mechanical percussion (82.3% versus 14.3%). Significant improvement in index of oxygenation and reduced need for bronchoscopy in test group versus control group
Russell[14], 2003	Unknown; 80-degree arc. Compares incidence rates before/after educating staff on need to reposition patients on lateral rotation bed	ICU (unspecified)	Incidence of skin breakdown	Incidence of **skin breakdown** on lateral rotation beds decreased by 54% after education in patient repositioning on lateral rotation beds
Davis[15], 2001, prospective, quasi-experimental, random assignment	Efica[n]; compared q2 hr manual turn versus q2 hr turn with 15 min manual percussion and postural drainage (PPD) versus CLR 60-degree arc q10 min versus CLR 60-degree arc q10 min with pneumatic vibration/ percussion	Critically ill, paralyzed, sedated patients with ARDS (19)	Physiological effects of manual turning and respiratory therapy versus CLR	No statistically significant differences in measured cardio-respiratory variables such as blood gases, $PaCO_2$, airway pressures, cardiac output with short term (6 hours) CLR. Secretion clearance is enhanced by CLR. PPD results in increase in sputum volume only in patients with excessive secretions. Manual PPD more effective than bed PPD. Arterial oxygenation significantly improved during CLRT versus supine. Mentions that "q2hr" manual turning was really "q3hr"
Staudinger[16] 2001, randomized prospective pilot	RotoRest'; 124-degree arc q4min from left to right; compare prone positioning and CRT	ICU, mechanically ventilated patients with ARDS from nontraumatic causes (26)	Oxygenation and hemodynamics in patients suffering from ARDS	CLRT seems to exert effects comparable to prone positioning on respiratory and hemodynamic variables, and could serve as an alternative when prone positioning seems inadvisable

continued

Table 1 continued

Author, Year, study design	Bed, angle and frequency of rotation	Patient Population (number of patients)	Outcome variable studied	Results
Summer[17], 1989, prospective randomized	RotoRest*, 124-degree arc every 7 min. versus conventional beds and manual turning q2hrs.	Critically ill medical patients, many diagnoses grouped into five categories or DRG's (86)	Development of nosocomial pneumonia	Effective against pneumonia and ARDS during first 7 days of use, after 7 days may be detrimental because no positive effect on pulmonary status. Results varied by diagnosis. decreased LOS in ICU, decreased period of mechanical ventilation in COPD and pneumonia patients, hypoxemia not improved on CLRT, did not prevent development of atelectasis or frequency of pneumonia
Kirschenbaum[18], 2002, prospective control	Efica[¶]; 60-degree arc + 10 min vibration/ percussion q2 hrs versus standard care	Patients requiring prolonged mechanical ventilation (37)	Examine the effect of CLRT on the prevalence of vent-associated pneumonia and mortality in pats requiring long-term mechanical ventilation	CLRT patients less likely to develop pneumonia (3/17 or 17.6% on CLRT versus 10/20 or 50% on manual turning. Period from study entry to the development of pneumonia was significantly greater in CLRT patients (29 days) versus control group (12 days). Lower morbidity with CLRT, but mortality not significantly different. Hypothesizes that major component of the benefit due to rotation, cannot determine if vibration/percussion enhanced the benefits of CLRT. **Specifies no increase in pressure ulcer incidence**
Krishnagopalan[20], 2002, prospective longitudinal observational	None. Examines how often patients are turned	Mixed med/surg ICU patients in three tertiary care hospitals (74)	Assess whether critically ill, immobilized patients are turned q 2 hrs.	97% did not receive turning every 2 hours. 23% missed required turns by only 1-2 hrs, 50% were supine 4-8 hrs., 23% not repositioned for > 8 hrs. Hypothesizes that studies claiming to show CLRT is better than "standard care" (manually turning q2) really show benefits of turning versus not. CLRT may simply be assuring that standard of care is being met
Izutsu[22], 1998, prospective randomized	Morten Co., (Japan) type RACB-1; 30-degree arc every 15 minutes versus manual q2hr turning	Bedridden, long-term-care patients with existing breakdown (31)	Improvement in existing skin breakdown	**Severity (depth) of ulcers improved significantly on rotation beds**

* *RotoRest, KCI, San Antonio, Tex.*
† *Biodyne, KCI, San Antonio, Tex.*
‡ *Restcue, Supprt Systems International, Charleston, SC*
§ *Triadyne, KCI, San Antoni, Tex.*
¶ *Efica, Hill Rom, Batesville, Ind.*

TABLE 2
REVIEW ARTICLES ON CONTINUOUS LATERAL ROTATION THERAPY

Author, year, study design	Bed, angle, frequency of rotation	Patient population	Outcome variable studied	Description/Main conclusion(s)
Sahn[19], 1991; article review	Various	Various	Consequences of immobilization on the respiratory system, effects of CLR in the prevention of lower respiratory tract infections (LRTI) , optimal utilization and potential complications of CLR	CLRT must be instituted early to decrease LRTI including pneumonia. Studies cited are unclear as to optimal degree of rotation, minimum time/day on CLRT (studies he cited were only 10-16 hr/day). **Skin breakdown not in list of complications cited in any of the articles reviewed**
Basham[3], 1997; article review, personal clinical experience, introduction of new assessment tool	Various	Various	Use of CLRT in ICUs. Development of pneumonia or atelectasis, duration of intubation, LOS in ICU	Extensive review of literature, addresses various technologies including beds, mattress-replacement systems. Cautions against generalizing results from different technologies and diagnoses. Introduces PIRT (Patient Identification for Rotational Therapy) tool
Choi[21], 1992, meta-analysis of six studies	Various	ICU		Decreased incidence of pneumonia, atelectasis, decreased duration of intubation, shorter LOS in ICU; **no effect on incidence of pressure ulcers**, ARDS, embolism, ICU costs, total LOS in hospital, or survival (mortality)

of rotation, or the use of mattress vibration/percussion features have been published.

Rotation therapy and skin. Anecdotally, CLRT has been used both to prevent and to heal skin breakdown, but research about the effects of these surfaces on skin is limited. Kirschenbaum[18] specified that no difference was found in pressure ulcer incidence between two groups of chronic ventilator patients using either 60-degree arc with vibration/percussion or manual turning q2hr. In a meta-analysis of six studies, Choi[21] found no positive or negative effect on the incidence of pressure ulcers with the RotoRest system. Russell[14] reported on the incidence of pressure ulcers in an ICU before and after educating the nurses on the need to reposition patients on mattresses that turn patients in a 90-degree arc. The incidence of pressure ulcers in the ICU of that 500-bed tertiary care hospital went from 11 to five in 6 months. Izutsu et al[22] used a "rolling air cushion bed" that turns the patient in a 30-degree arc every 15 minutes compared to a control group that was manually turned every 2 hours. The wounds in the study group showed a statistically significant decrease in depth, but not in area, of ulceration while the control group showed no improvement.

In summary, knowledge about the effects of CLRT for pressure-related skin damage is limited. The purpose of this study was to ascertain the effects of CLRT on healing partial- and full-thickness ulcers.

Methods

A descriptive study was conducted to record the rate of wound healing and total number of weeks to achieve wound closure in both partial- and full-thickness ulcers when CLRT is employed for skin and wound management. The authors also wanted to compare these rates of healing with other studies reporting wound healing rates to determine if the outcomes on CLRT are comparable. Specifically, the goal of this study was to determine: 1) the rate of wound closure of partial-thickness wounds by area, 2) the rate of wound closure of full-

TABLE 3
NUMBER OF WEEKS UNTIL WOUND CLOSURE

Weeks (range)	Partial-thickness wounds (N, %)	Full-thickness wounds (N, %)
2 - 4	4 (40%)	4 (20%)
4.5 - 8	2 (20%)	4 (20%)
8.5 - 12	0	3 (15%)
12.5 – 16	2 (20%)	5 (25%)
16.5 +	2 (20%)	4 (20%)
Average	9.5 weeks, (SD 6.5)	11.25 weeks, (SD 6.6)

thickness wounds by volume, 3) the number of weeks to closure of partial-thickness wounds, 4) the number of weeks to closure of full-thickness wounds, and 5) the incidence of new skin breakdown while using the CLRT mattress.

Patients. The study population consisted of all patients with a partial-thickness (Stage II) or full-thickness pressure ulcer (Stage III or IV) on the trunk or pelvis using the services of Advanced Therapy Surfaces (ATS), a company that specializes in the rental of support surfaces, between March 15, 2002 and April 1, 2003. In the home care setting, only patients insured under Medicare who met the criteria for a Group II mattress could participate. Medicare requires the home care supplier to have more wound information than private insurances do; thus, access to wound measurements for these patients was available. Long-term care patients who met their facility's criteria for a powered mattress and whose facility allowed ATS to have direct access to the patient or to wound size information also were included.

Because very small wounds can heal quickly, only partial-thickness ulcers with an area of more than .5 cm^2 and full-thickness ulcers with a volume (length x width x depth) of more than .5 cm^3 were included. Patients were excluded from the study if they died before their wounds closed, changed to another provider and lost services of ATS, or if their wounds were not closed by the end of the study (April 1, 2003). Patients were not excluded for any comorbid factors that are impediments to wound healing such as advanced age, congestive heart failure, diabetes, or smoking.

Materials. Patients received the use of a powered support surface that includes the CLRT modality (PressureGuard APM², Span-America, Greenville, SC). This mattress turns the patient in a 40-degree arc, 20 degrees to each side, on a 10-minute cycle, six full side-to-side turns per hour.

Caregivers were instructed to reposition patients per their facility protocol, or every 2 hours from side to side or in as many various positions as possible in relation to the mattress surface while not putting pressure on the ulcer site. Even though CLRT mattresses "rotate" the patient, joints, muscles, and organs require regular position changes for stimulation, stretch, and function. Unless manual turning is contraindicated by conditions such as extreme pain with handling, fixed contractures, or medical necessity, CLRT mattresses do not replace the need for manual re-positioning.

Data. Data collected included the date the mattress was placed, wound location and stage, wound measurements (l x w for partial-thickness ulcers and l x w x d for full-thickness ulcers) using the widest or deepest points available on the date of mattress placement, and the date of wound closure. Measurements were taken by the primary nurse involved with each patient. Patients, family, and facility staff were interviewed monthly to assess the incidence of new ulcer development during use of the mattress.

Data were separated into two groups: partial-thickness wounds and full-thickness wounds. Wound area in patients with partial-thickness ulcers was calculated as l x w. Wound volume in full-thickness wounds was calculated as l x w x d. Number of weeks to closure was calculated by subtracting the date of wound closure from the date of mattress placement and rounding to the closest half-week.

Results

Partial-thickness wounds. Initially, 12 patients with 17 wounds were assessed. After excluding patients with wounds smaller than .5 cm^2 in area, the group included 10 patients, three with more than one wound (13 wounds total); however, to reduce bias, only one wound per patient was included. The average wound area of the 10 wounds was 12.93 cm^2 (SD 16.82 cm^2) and the average rate of closure over the study period was 1.42 cm^2 (SD 1.31 cm^2 or 16.68 %, (SD 10.7%) per week. The average number of weeks to wound closure was 9.5 (SD 6.5) (see Table 3).

Full-thickness wounds. This group initially included 30 patients with 38 wounds. After excluding 10 patients with wounds smaller than .5 cm^3 in volume, 20 patients with 23 wounds remained. Again, only one wound per patient was included. The average wound volume was 22.81 cm^3 (SD 30.42 cm^3) and the average rate of closure was 3.33 cm^3 (SD 6.67 cm^3) per week or 14.38% (SD 12.50%). The average time to healing was 11.25 weeks (SD 6.61) (See Table 3).

Incidence of new skin breakdown. No new areas of skin breakdown occurred in any of the 30 patients included in this study.

Discussion

As with all descriptive studies, all patients placed on the mattress were included, regardless of conditions that may affect wound healing. Partial-thickness ulcer data were analyzed separately from full-thickness ulcer data for several reasons. Partial-thickness ulcers involve only the epidermis and part of the dermis and are too shallow to accurately measure depth. Area measurements — ie, simple length and width of the widest points — are, therefore, appropriate for partial-thickness ulcers, as the goal is re-epithelialization rather than filling in volume. Conversely, measuring only the length and width of full-thickness ulcers does not include the depth that must fill in during the healing process. Depth must be used to document healing of full-thickness wounds.

In this study, average rate of wound closure of the partial-thickness wounds was much lower than the rates of full-thickness wounds. This is counterintuitive. One would expect that partial-thickness ("less severe") wounds would close at a faster rate than full-thickness or deep wounds. This discrepancy may be explained, in part, by the fact that partial-thickness or Stage II wounds are often due to friction or maceration and they are easily re-opened by trauma. Therefore, although they may close rapidly, they can also re-open rapidly, and can re-open several times while the mattress is in place. The recorded date of closure may not be the first date of closure, as caregivers may delay return of the mattress until the ulcer(s) did not re-open. Therefore, the data on number of weeks to wound closure and the rate of wound closure of the partial-thickness wounds may be skewed.

The average rate of wound closure per week on the full-thickness wounds was 3.33 cm^3, a figure that also seems high. The limitation of the small sample size means that one patient can have an extraordinary effect on the average. In this case, dropping one patient who started with a large wound (106 cm^3) would have changed the average rate of wound closure to 1.91 cm^3, (SD 2.13 cm^3) per week.

The 14.38% average percentage of wound closure of full-thickness wounds per week was much higher than the recently reported 5% per week for wounds in patients placed on low-air-loss mattresses.[23] Even after removing the one high outlier patient (baseline wound 106 cm^3), the average percentage of wound closure per week remained higher (13.64%) than that reported on low-air-loss.

Sixty percent of the partial-thickness wounds and 55% of the full-thickness wounds closed in 12 weeks. Despite the small number of subjects in this study, these results are similar to, or slightly better than, those recently reported by Bolton et al.[24] In their study, when consistent validated protocols of care based on validated standardized wound and patient assessments were applied to 767 wounds in outpatient wound care and long-term care, 61% of the patients with superficial or partial-thickness ulcers and 36% of full-thickness ulcers healed in 12 weeks.

In contrast to Russell[14] and to anecdotal reports of CLRT causing skin breakdown, no new ulcers developed. This may be due to teaching caregivers to continue repositioning patients while on the study mattress or to the unique properties of this product that separate it from other products, or a combination of both.

Limitations

The lack of control inherent in descriptive studies, the small number of wounds in each group, and large standard deviations limit the ability to test for statistically significant differences. Because a mattress is only an adjunct to the total process of wound care and healing, ensuring best practices of good wound care is important to any mattress study. In the role of consultant and clinical support, ATS has no control over direct patient or wound care. The long-term care referral sources are known by the primary author, and standard wound care practices based on moist wound healing are followed in those

facilities. For the home care patients, Medicare requires "appropriate wound care" as one criterion for patients on Group 2 surfaces such as the CLRT mattress. However, the authors had no control over the entirety of the patients' wound care programs.

The inclusion criteria did not specify an age limit; however, the criteria for Medicare in homecare, or for residency in a long-term care facility, nearly guarantees the older ages of the participants and, indeed, all were over 60 years old.

Conclusion

Continuous lateral rotation therapy was used as an adjunct to good wound care practices in managing partial-thickness (superficial, or Stage II) and full-thickness wounds (Stage III or Stage IV). Continuous lateral rotation therapy delivered in a 40-degree arc to the selected undiluted population of homecare and long-term care patients appears to assist in the closing of pressure ulcers and demonstrated results comparable to low-air-loss mattresses and outcomes of larger studies. Future studies are needed to compare the use of CLRT to other accepted mattress technologies such as alternating pressure and low-air-loss for pressure-related wounds. In addition, optimal degree and frequency of rotation have not been determined. - OWM

References

1. Tablan O, Anderson L, Arden N, Breiman R, Butler J, McNeil M. Hospital Infection Control Practices Advisory Committee. *Guideline for Prevention of Nosocomial Pneumonia.* Centers for Disease Control.1994.
2. Durable Medical Equipment Regional Carrier (DMERC) Region C Supplier Manual.
3. Basham K, Vollman K, Miller A. To everything turn, turn, turn. . . an overview of continuous lateral rotational therapy. *Resp Care Clin North Am.* 1997;3(1):109–134.
4. Schimmel L, Civetta J, Kirby R. A new mechanical method to influence pulmonary perfusion in critically ill patients. *Care Med.* 1977;5(6):277–279.
5. Bein T, Reber A, Metz C, Jauch KW, Hedenstierna G. Acute effects of continuous rotational therapy on ventilation-perfusion inequality in lung injury. *Intensive Care Med.* 1998;24:132–137.
6. Gentilello L, Thompson DA, Tonnesen AS, et al. Effect of a rotating bed on the incidence of pulmonary complications in critically ill patients. *Crit Care Med.* 1988;16:783–786.
7. Clemmer TP, Green S, Ziegler B, et al. Effectiveness of the kinetic treatment table for preventing and treating pulmonary complications in severely head-injured patients. *Crit Care Med.* 1990;18:614–617.
8. Fink MP, Helsmoortel CM, Stein KL, et al. The efficacy of an oscillating bed in the prevention of lower respiratory tract infection in critically ill victims of blunt trauma: a prospective study. *Chest.* 1990;97:132–137.
9. Nelson L, Anderson H. Physiologic effects of steep positioning in the surgical intensive care unit. *Arch Surg.* 1989;124:352–355.
10. deBoisblanc BP, Castro M, Everett B, et al. Effect of air-supported, continuous postural oscillation on the risk of early ICU pneumonia in nontraumatic critical illness. *Chest.* 1993;103:1543–1547.
11. Traver G, Tyler M, Hudson L, Sherrill D, Quan S. Continuous oscillation: outcome in critically ill patients. *J Crit Care.* 1995;10(3):97–103.
12. Whiteman K, Nachtmann L, Kramer D, Sereika S, Bierman M. Effects of continuous lateral rotation therapy on pulmonary complications in liver transplant patients. *Am J Crit Care.* 1995;4(2):133–139.
13. Raoof S, Chowdhrey N, Raoof S, et al. Effect of combined kinetic therapy and percussion therapy on the resolution of atelectasis in critically ill patients. *Chest.* 1999;115:1658–1666.
14. Russell T, Logsdon A. Pressure ulcers and lateral rotation beds: a case study *J WOCN.* 2003;30(3):143–145.
15. Davis K, Johannigman JA, Campbell RS, et al.The acute effects of body position strategies and respiratory therapy in paralyzed patients with acute lung injury. *Crit Care.* 2001;5:81–87.
16. Staudinger T, Kofler J, Mullner M, et al. Comparison of prone positioning and continuous rotation of patients with adult respiratory distress syndrome: results of a pilot study. *Crit Care Med.* 2001;29(1):51–56.
17. Summer WR, Curry P, Haponik EF, Nelson S, Elston R. Continuous mechanical turning of intensive care unit patients shortens length of stay in some diagnostic-related groups. *J Crit Care.* 1989;4:45–53.
18. Kirschenbaum L, Azzi E, Sfeir T, Tietjen P, Astiz M. Effect of continuous lateral rotation therapy on the prevalence of ventilator-associated pneumonia in patients requiring long-term ventilatory care. *Crit Care Med.* 2002;30:1983–1986.
19. Sahn S. Continuous lateral rotational therapy and nosocomial pneumonia. *Chest.* 1991;99:1263–1267.
20. Krishnagopalan S, Johnson W, Low L, Kaufman L. Body positioning of intensive care patients: Clinical practice versus standards. *Crit Care Med.* 2002;30:2588–2592.
21. Choi SC, Nelson LD: Kinetic therapy in critically ill patients: combined results based on meta-analysis. *J Crit Care.* 1992;7:57–62.
22. Izutsu T, Matsui T, Satoh T, Tsuji T, and Sasaki H. Effect of rolling bed on decubitus in bedridden nursing home patients. *Tohoku J Exp Med.* 1998;184:153–157.
23. Branom R., Rappl L. "Constant force technology" versus low-air-loss therapy in the treatment of pressure ulcers. *Ostomy/Wound Management.* 2001;47(9):38–46.
24. Bolton L, McNees P. Wound healing outcomes using standardized care. Poster presented at WOCN 2003, Cincinnati, Ohio. June 14-18, 2003.