UTILITY OF MULTIPLE MEASUREMENTS OF CONTROL LIMB VOLUME TO ASSESS THERAPY OUTCOMES FOR UNILATERAL ARM AND LEG LYMPHEDEMA

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BACKGROUND/GOALS

Outcome assessments of treatments for limb edema depend on reporting progressive changes in affected limb volumes. A useful method for unilateral edema is to compare treated limbs with contralateral "normal" limbs for reference. In this way treatment progression can be expressed as changes in percentage edema (%edema) based on measurements made on both limbs prior to treatment and progressively until treatment ends. However, some clinics only measure normal limbs once (prior to treatment) and determine changes in edema with reference to this initial measurement. Our goal was to compare outcomes that would be reported using these two different approaches.

METHODS

Bilateral limb volumes were measured (tape measure) and tracked with limb volume software* in arms of 75 post-mastectomy women (unilateral lymphedema) and in 45 persons with unilateral leg edema. All women had received 10 complex decongestive physiotherapy (CDP) treatments. An example of the limb volume tracking procedure is illustrated in figures 1-3. The impact of using only one control limb volume (start value) to determine %edema at treatment end was determined by comparing its result with that of using control limb measures at treatment start and at treatment end (Figures 5-8 qnd table 1). To further investigate possible differences in predicted efficacy of therapy associated with the single measurement method, the %change in %edema was determined for both approaches and under- or overestimation of therapeutic outcomes determined (Table 1)

*Limb Volumes Professional®
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Example of Limb Volume Tracking*

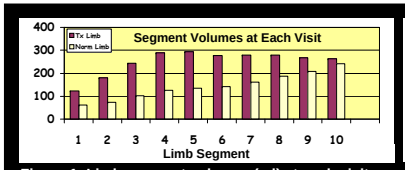

Figure 1: Limb segment volumes (ml) at each visit are determined at 4 cm intervals by circumference measurements and a frustum model algorithm

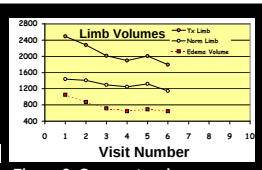

Figure 2: Segment volumes are used to auto-determine total limb volumes (ml) and edema volume

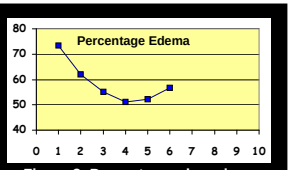

Figure 3: Percentage edema is auto-determined and tracked over the course of therapy.

MAIN RESEARCH FINDINGS

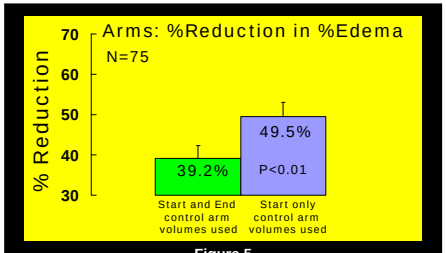

Figure 5

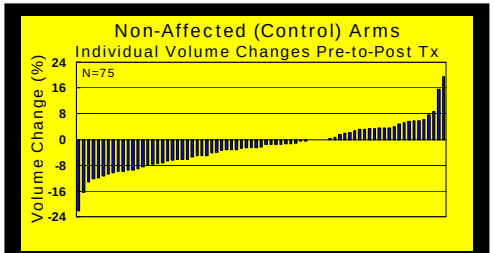

Figure 6

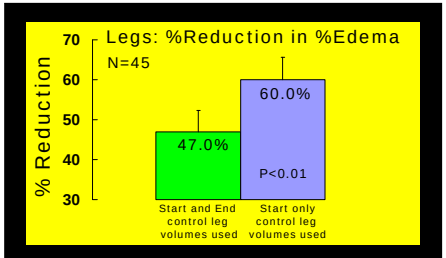

Figure 7

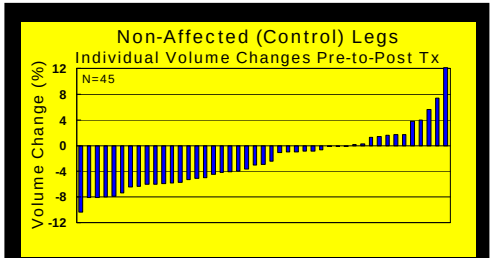

Figure 8

RESULTS

When only initial control limb volumes were used as reference, the reduction in arm %edema was overestimated at 49.5% as compared to 39.2% if control limbs were included for each %edema determination (Figure 5 and table 1).

Similar overestimation patterns were found for leg measurements, with corresponding reductions in %edema of 60.0% vs 47.0% (Figure 7 and table 1).

The distribution of the differences varies in a manner as shown in Figures 6 and 8 for the unilateral arm and leg lymphedema patients included in this analysis.

CONCLUSIONS

Results suggest that significant and unpredictable reporting errors arise if multiple control limb measurements are not included during the course of therapy.

The exclusion of such measurements has the effect of distorting the efficacy of therapy. Such distortions impact perceptions of patient, therapist and physician.

Since inclusion of control limb measures consumes little additional time in view of the automated calculation possibilities now available, it would seem prudent to follow this dual-limb measurement procedure as a matter of good standard practice.

Table 1. Summary of Edema Volumes and Reductions in Unilateral Limb Edema

	Pre-treatment Edema Volume		Post-treatment Edema Volume (ml)		Reduction in Edema Volume (%)	
	(ml)	(%)	E_{V2}	E'_{V2}	E_{V2}	E'_{V2}
Arms	939±567	42.7±30.2	571±380*	502±414	39.2±26.4*	49.5±30.7
Legs	2272±2302	30.6±29.5	1388±1811*	1206±1778	47.0±35.6*	60.0±37.3

Table 1. Pre-treatment edema volumes (ml and %) are those measured prior to start of therapy. E_{V2} denotes edema volume at end of treatment determined using both pre- and post-treatment control limb volumes. E'_{V2} denotes edema volume calculated using as reference only the control pre-treatment limb volume. Reductions in edema volume (ml and %) are calculated based on either E_{V2} or E'_{V2}. Values obtained using E_{V2} were all significantly less than corresponding E'_{V2} values * (p=0.002).