Monitoring with Bioimpedance Spectroscopy to Reduce the Rate of Progression to Chronic Breast Cancer Related Lymphedema: A Meta-Analysis

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○ Objectives

Chronic breast cancer-related lymphedema (BCRL) is a potentially serious complication following treatment. Monitoring progression towards BCRL with bioimpedance spectroscopy (BIS) may allow earlier detection/intervention.

The purpose of this meta-analysis is to evaluate BCRL incidence rates among patients monitored by BIS compared to circumference monitoring and background rates.

○ Methods

Eligible peer-reviewed studies from PubMed, CINHAL, or Google Scholar were published in English from 2013 onward and conducted in North America, Europe, or Oceania.

Incidence rates abstracted from studies were classified by BCRL monitoring method: background (no standardized BCRL circumference or BIS assessments), circumference, or BIS.

A random effects model was used to calculate a pooled annualized estimate of BCRL incidence while accounting for clinical and methodological heterogeneity.

Subgroup analyses examined differences in duration of follow-up and high-risk surgical procedures (mastectomy, ALND, SLNB).

○ Results

50 studies were included, representing over 67,000 women.

Annualized incidence of BCRL was 4.9% (95% CI: 4.3-5.5) for background studies (n=35), 1.5% (95% CI: 0.6-2.4) for BIS-monitored studies (n=7), and 7.7% (95% CI: 5.6-9.8) for circumference-monitored studies (n=11).

Differences between studies did not result in significant heterogeneity after square-root transformation.

Progression rates in BIS-monitored patients were reduced by 69% (*p*<0.001) compared to background and 81% (*p*<0.001) compared to circumference-monitored patients.

○ Conclusions

Evidence indicates monitoring with BIS significantly reduces risk of BCRL.

BIS aids in the assessment of subclinical BCRL and significantly reduces the rate of BCRL compared to circumference-monitoring, particularly in high-risk patients, by triggering earlier interventions to prevent BCRL.

○ Acknowledgement

Figure 1. CONSORT Diagram

Figure 2. BIS-Monitored Studies ALND

Note: Rather than traditional grayscale boxes, hollow circles were used to represent the weight effect of each individual study on the overall pooled estimate to increase visibility. Weights are from random effects analysis.
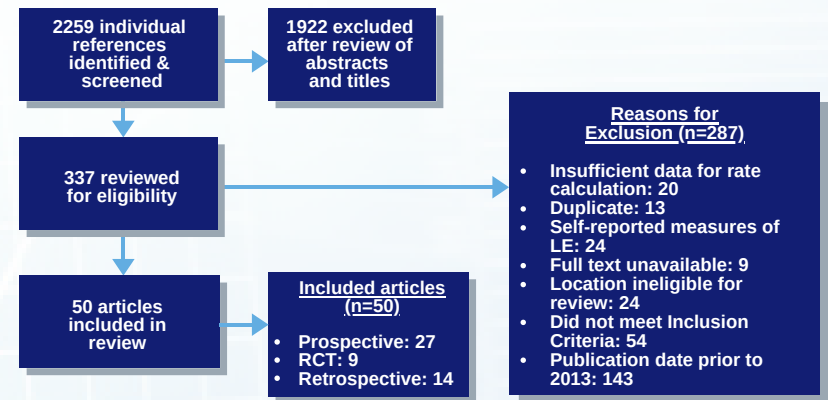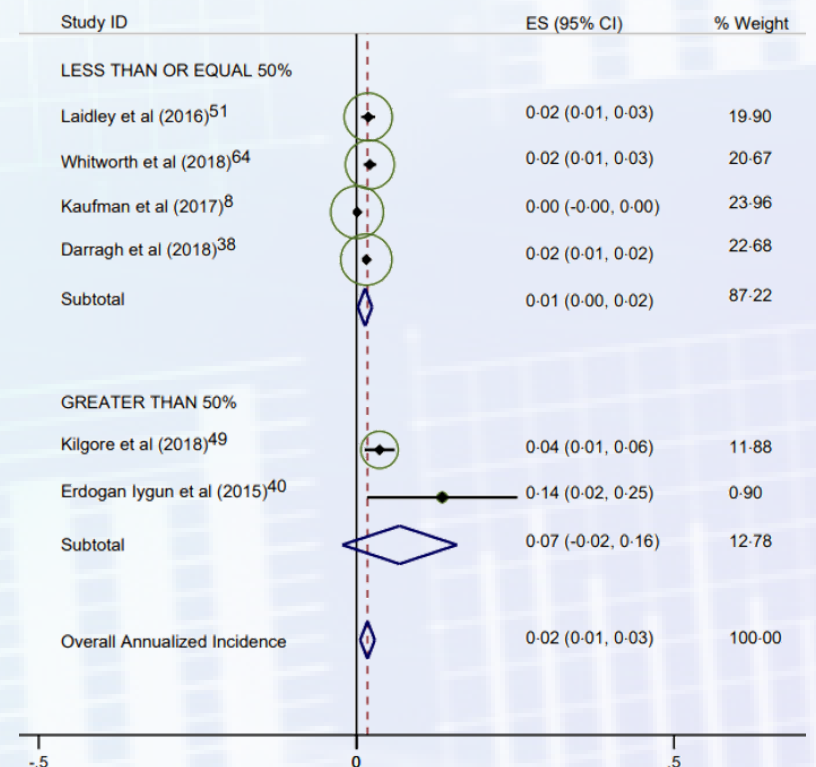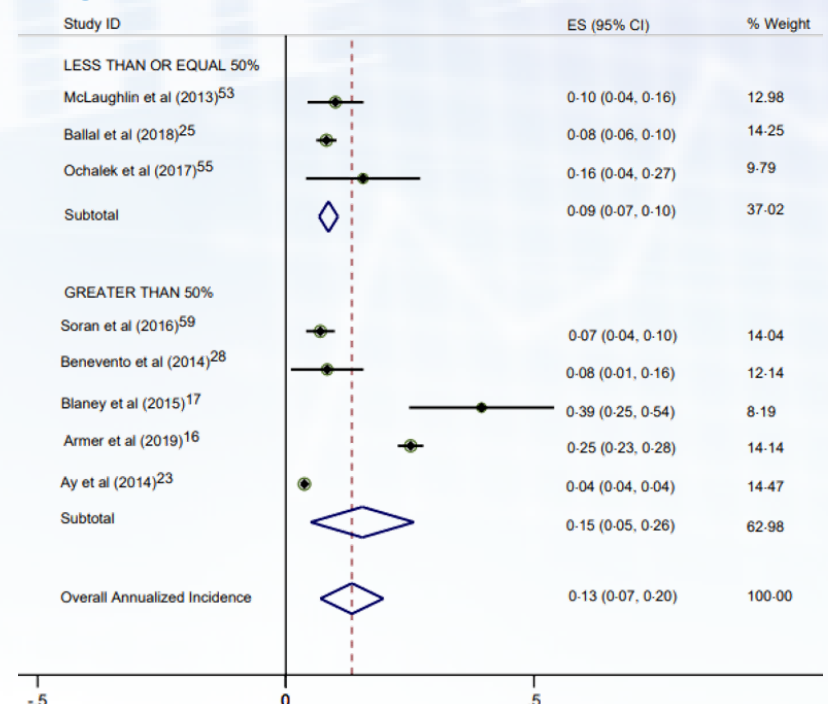
Figure 3. Circumference-Monitored Studies ALND

Note: Rather than traditional grayscale boxes, hollow circles were used to represent the weight effect of each individual study on the overall pooled estimate to increase visibility. Weights are from random effects analysis.

Table 1. Annualized Incidence of BCRL by Study Type

	No Intervention (Background Rate)		Monitoring with BIS				Monitoring with Circumference				Comparative Rate Ratio	
	Included studies (n)	Incidence (%; 95% CI)	Included studies (n)	Incidence (%; 95% CI)	Rate Ratio *	*p*-value	Included studies (n)	Incidence (%; 95% CI)	Rate Ratio †	*p*-value	BIS vs. Circum	*p*-value
By Study Type												
Prospective	19	7·9 (6·1-9·8)	4	2·1 (0·0 -4·1)	0·27	<0·001	6	11·0 (5·8-16·3)	1·39	<0·001	0·19	<0·001
RCTs	6	10·1 (6·1-14·0)	1	0·5 (-0·2-1·2)	0·05	<0·001	3	7·1 (0·4-13·8)	0·70	0·04	0·07	<0·001
Retrospective	10	3·5 (2·7-4·4)	2	1·6 (1·1-2·2)	0·46	<0·001	2	5·8 (1·5-10·2)	1·66	<0·001	0·28	<0·001
Axillary Lymph Node Dissection (ALND)												
≤50%	17	4·4 (3·6-5·2)	4	1·4 (0·2-2·5)	0·32	<0·001	3	8·6 (6·7-10·5)	1·95	<0·001	0·16	<0·001
>50%	16	6·8 (5·3-8·4)	2	6·8 (-2·2-15·8)	1·00	1·0	5	15·4 (5·0-25·8)	2·26	<0·001	0·44	<0·001
Sentinel Lymph Node Biopsy (SLNB)												
≤50%	10	6·0 (4·5-7·5)	1	13·5 (1·7-25·4)	2·25	0·06	2	14·4 (-6·6-35·4)	2·40	<0·001	0·94	0·88
>50%	15	5·0 (3·8-6·2)	4	1·4 (0·2-2·5)	0·28	<0·001	6	6·1 (3·1-9·1)	1·22	<0·001	0·23	<0·001
Mastectomy												
≤40%	17	4·1 (3·4-4·8)	1	13·5 (1·7-25·4)	3·29	0·004	4	14·5 (2·1-26·8)	3·54	<0·001	0·93¥	0·87
>40%	15	5·2 (3·9-6·6)	3	1·3 (-0·2-2·8)	0·25	<0·001	3	6·1 (2·7-9·5)	1·17	<0·001	0·21	<0·001

*BIS versus no intervention
†Circumference versus no intervention