Meta-analysis of the value of prophylactic drainage

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May 19, 2009

Contents

1 Introduction

The following is a meta-analysis of the value of prophylactic drainage. Table 1 shows 52 studies with a total of 6930 surgeries that were identified as suitable for this analysis. The studies included in this analysis compare a prophylactic drain group and a no-drain group with respect to various outcomes such as hematoma, healing, abscess, seroma and infection. There are a total of 3495 surgeries in the drain group and 3435 in the no-drain group.

The analysis is performed using the `meta` package in R (Schwarzer, 2009).

Section 2 describes the methodology used, section 3 presents the results of the cumulative meta-analyses including breast biopsies, section 4 presents the results of the cumulative meta-analyses excluding breast biopsies, and section 5 presents the results for the meta-analyses by procedure type.

2 Methodology

A separate meta-analysis is conducted for each outcome where the drain group is defined as the treatment group and the no-drain group is defined as the control group. Studies that do not mention a given outcome are excluded from that analysis. In each meta-analysis first a test of homogeneity is performed. Next, publication bias is tested for using funnel plots. Lastly, results of the fixed and random-effects analyses are presented along with forest plots displaying the 95% confidence intervals for the odds ratios.

2.1 Test of Homogeneity

Under a fixed-effects model, the k study specific summary statistics share a common mean θ. The hypotheses tested are as follows:

$$\begin{aligned} H_0 &: \theta_1, \theta_2, \cdots, \theta_k \\ H_A &: \text{ At least one } \theta_i \text{ different.} \end{aligned}$$

If H_0 cannot be rejected, the studies are homogenous, i.e. there is no significant between-study variation. This indicates that a fixed-effects approach should be adopted. On the other hand, if H_0 is rejected, the studies are heterogeneous, i.e. the study means arose from two or more distinct populations. This indicates that a random-effects approach should be adopted. Alternatively, covariates may be identified that stratify the studies into homogenous populations (Normand, 1999).

This test is performed using the `metabin` function which calculates fixed and random effects estimates for meta-analyses with binary outcome data.

It should be noted that heterogeneity is common in many meta-analyses as studies are never identical due to factors such as the study population, technique, etc. (Houwlingen et al., 2002). A small p-value indicates that the heterogeneity is present; however even if the p-value is large it does not necessarily mean that heterogeneity can be safely ignored (Greenland,

1987). Therefore in the following analysis results of both fixed and random-effects approaches are presented.

2.2 Continuity correction

A continuity correction of 0.5 is added to the cell frequency of studies with a zero count outcome. In the function `metabin` a correction of 0.5 is the default (`incr = 0.5`). This is added only to cell frequency of studies with a zero cell count (`allincr = FALSE`).

Studies that have zero events on both treatment arms, called zero total events, are excluded from the analysis since it has been shown that zero total event studies do not contribute to a fixed effects meta-analysis (Sweeting et al., 2004). In the function `metabin` this is the default setting (`allstudies = FALSE`).

An alternative continuity correction, generally called a "treatment arm" correction, that adds a factor of the reciprocal of the size of the opposite treatment arm to the cells was considered as well (Sweeting et al., 2004). The results of this analysis were similar to the results of the analysis with the 0.5 correction and therefore for ease of calculation the 0.5 correction approach was used.

2.3 Fixed-effects model

The Mantel-Haenszel method is used to calculate the fixed effect estimate and an odds ratio is used as the measure of treatment effect. In the function `metabin`, this is achieved by setting `method = "MH"` and `sm = "OR"`.

2.4 Random-effects model

The `metabin` function run with the `method = "MH"` and `sm = "OR"` parameters will also return a Random-effects model using the DerSimonian-Laird estimate DerSimonian & Laird (1986).

2.5 Forest plots

The forest plots display estimates of drain effects of each study on a log scale along with the 95% confidence intervals of the odds ratios. The size of square reflects the weight of each study and these weights are also displayed in the last two columns in the plot. The diamonds represent the overall estimate of the drain effect under fixed and random-effects models along with the 95% confidence intervals of these estimates.

2.6 Publication bias

Publication bias is tested for using funnel plots generated using the function `funnel` and a rank correlation test equivalent to testing

$$\begin{aligned} H_0 &: \text{ Symmetry in funnel plot} \\ H_A &: \text{ Asymmetry in funnel plot.} \end{aligned}$$

This test is performed using the `metabias` function.

Funnel plots are created using the `funnel` which creates scatter plots of sample size on the y-axis versus the estimated effect size on the x-axis when `yaxis = "size"` is set. In the case of no publication bias the plot should look like a funnel since larger studies tend to demonstrate less variability among effects and are less prevalent than smaller studies. A missing 'piece' from the plot indicates that there may publication bias (Normand, 1999). The dashed line on the plot is the fixed effect estimate and can be obtained by setting `comb.fixed = TRUE`.

	Group	NoDrain	Drain	HemND	HemD	HealND	HealD	AbscND	AbscD	SerND	SerD	InfND	InfD
1	1	Allaire, 2000	26	24	-	-	7	1	-	-	0	3	1
2	1	Magann, 2002	205	194	1	3	20	20	-	-	5	3	14
3	1	Al-Inany, 2002	40	78	1	0	5	9	0	0	-	-	5
4	1	Loong, 1988	69	66	-	-	2	2	-	-	-	-	7
5	1	Ramsey, 2005	144	124	3	3	22	27	1	4	12	13	-
6	1	Kumar, 2004	50	46	1	0	10	2	-	-	6	0	3
7	2	Gallup, 1996	88	109	4	3	10	7	2	1	-	-	3
8	2	Cardosi, 2006	67	77	1	2	9	10	2	4	5	5	4
9	2	Kozol, 1986	45	53	-	-	-	-	-	-	-	-	4
10	2	Shaffer, 1987	92	102	-	-	0	0	-	-	-	-	10
11	2	Higson, 1978	99	98	0	0	-	-	-	-	-	-	11
12	2	Andrades, 2005	10	15	0	1	3	4	-	-	5	5	1
13	2	Borile, 2008	33	30	1	0	-	-	-	-	2	1	-
14	2	Ein, 2006	84	96	-	-	-	-	-	-	-	-	13
15	3	Corion, 2008	52	50	4	6	3	7	-	-	-	-	3
16	3	Collis , 2004	150	150	4	4	13	15	1	3	1	1	5
17	3	Wrye, 2002	49	49	1	1	3	3	-	-	-	-	-
18	4	Jain, 2003	29	58	-	-	0	1	-	-	12	15	1
19	4	Purushotham, 2002	185	190	-	-	-	-	-	-	57	52	10
20	5	Wheeler, 1976	50	50	5	9	-	-	-	-	-	-	0
21	5	Warren, 1994	55	52	48	34	-	-	-	-	-	-	1
22	5	Law, 1990	58	40	22	9	10	11	-	-	-	-	1
23	6	Jones, 2007	50	50	2	1	1	1	-	-	-	-	0
24	7	Blank, 2003	18	12	-	-	2	5	-	-	-	-	-
25	7	Brown, 2004	41	42	0	0	-	-	-	-	-	-	0
26	7	Payne, 1996	97	103	0	0	-	-	0	0	0	0	1
27	8	Healy, 1989	50	50	0	0	-	-	-	-	0	0	3
28	8	Dunlop, 1990	62	65	0	0	-	-	6	5	-	-	60
29	8	Youssef, 2004	57	49	14	7	-	-	-	-	-	-	4
30	9	Youssef, 2004	36	34	8	10	-	-	-	-	-	-	0
31	10	Cameron, 1988	20	20	0	0	-	-	-	-	9	2	0
32	10	Talbot, 2002	30	60	-	-	-	-	2	5	29	48	3
33	10	Soon, 2004	51	36	0	1	0	1	1	1	49	34	7
34	10	Zavotsky, 1997	22	24	0	0	0	0	-	-	-	-	2
35	10	Somers, 1991	119	108	2	2	2	4	-	-	106	79	12

36	11	Peiper, 1997	50	50	-	-	-	-	0	2	8	7	-
37	12	Lang, 1998	149	138	15	7	3	0	-	-	-	-	1
38	13	Duranthon, 2000	43	43	0	0	-	-	-	-	-	-	0
39	13	Tjeenk, 2004	100	100	48	40	-	-	-	-	-	-	13
40	14	Walmsey, 2005	295	282	1	0	0	0	-	-	-	-	25
41	14	Ovadia, 1997	12	18	-	-	0	1	-	-	-	-	0
42	14	Niskanen, 2000	31	27	0	0	0	0	0	0	0	0	1
43	14	Murphy, 1993	20	20	-	-	1	1	-	-	-	-	0
44	14	Johansson, 2005	51	54	0	0	-	-	-	-	-	-	2
45	14	Mengal, 2000	76	76	0	0	0	0	-	-	-	-	0
46	15	Ovadia, 1997	26	32	-	-	0	0	-	-	-	-	0
47	15	Niskanen, 2000	19	20	0	0	0	0	0	0	0	0	1
48	15	Adalberth, 1998	30	30	-	-	-	-	-	-	-	-	-
49	15	Esler, 2003	50	50	0	1	-	-	-	-	-	-	1
50	15	Jenny, 2001	30	30	-	-	1	0	-	-	-	-	0
51	15	Holt, 1997	68	69	0	0	0	0	-	-	0	0	0
52	15	Mengal, 2000	52	52	0	0	0	4	-	-	-	-	0

Table 1: Data

3 Results of cumulative meta-analyses (including breast biopsies)

3.1 Meta-analysis for Hematoma

23 out of the 52 studies are included in this analysis. 15 studies are excluded since they did not mention hematoma as an outcome and 14 are excluded since they have zero total events.

There are 2654 surgeries in the drain group and 2689 surgeries in the no-drain group that are included in this analysis. In the drain group 144 (5%) of these surgeries resulted in hematoma while in the no-drain group 186 (7%) surgeries showed this outcome.

Table 2 presents the results of the meta-analysis. The test of heterogeneity has a $\chi^2(22) = 18.5$ with a p-value of 0.676, which indicates homogeneity of studies.

Table 2: Hematoma, odds ratios and test of heterogeneity

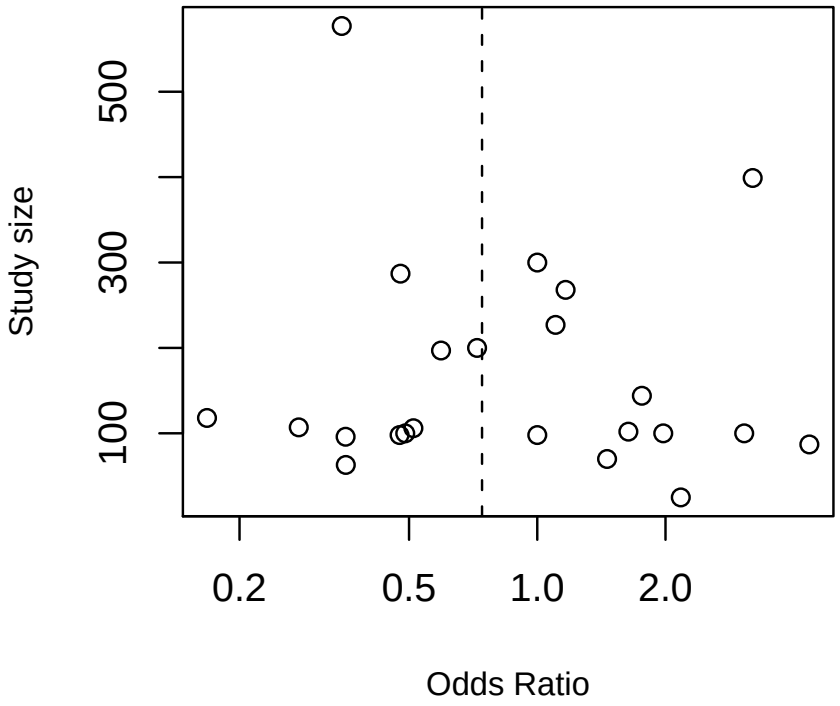
```
Number of trials combined: 23

                          OR            95%-CI       z  p.value
Fixed effect model   0.7418  [0.5658; 0.9727] -2.1602   0.0308
Random effects model 0.7406  [0.5591; 0.9811] -2.0932   0.0363

Quantifying heterogeneity:
tau^2 = 0.0000; H = 1 [1; 1.24]; I^2 = 0% [0%; 35%]

Test of heterogeneity:
    Q d.f. p.value
 18.5   22   0.676

Method: Mantel-Haenszel method
```

The funnel plot in Figure 1 appears to be somewhat symmetric and the rank correlation test of funnel plot asymmetry test with a p-value of 0.5792 does not indicate asymmetry in the funnel plot (results shown in Table 3).

Table 3: Rank correlation test of funnel plot asymmetry

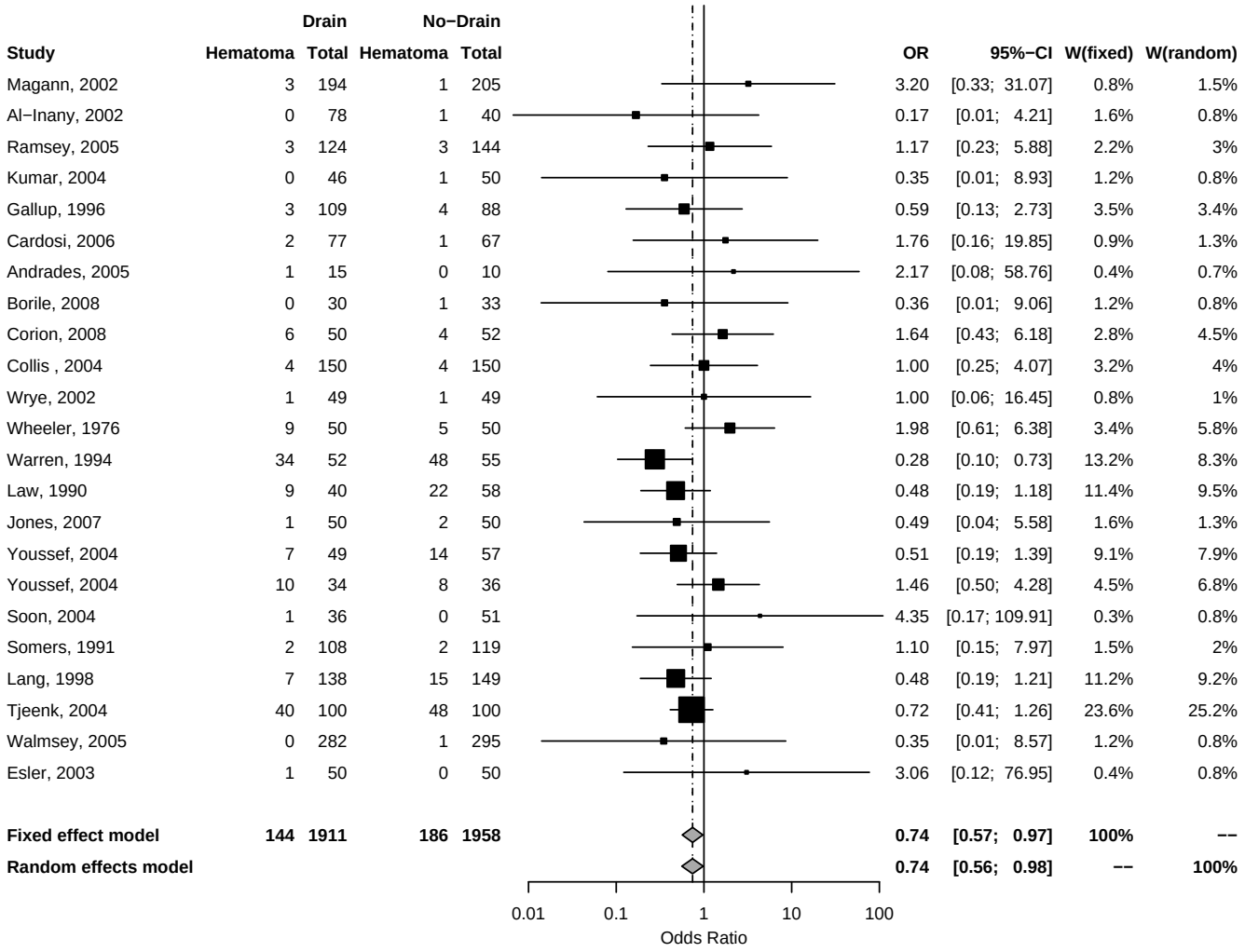
```
Rank correlation test of funnel plot asymmetry

data:  hema
z = 0.5546, p-value = 0.5792
alternative hypothesis: asymmetry in funnel plot
sample estimates:
      ks    se.ks
21.00000 37.86379
```

Figure 1: Funnel plot for Hematoma meta-analysis



The forest plot in Figure 2 displays the odds ratios of individual studies along with their 95% confidence intervals and weights. The analysis reveals an advantage for drained patients with respect to hematoma (Fixed: OR 0.74; CI 0.57-0.97, Random: OR 0.74; CI 0.56-0.98) and this advantage reaches statistical significance with p-values of 0.0308 and 0.0363 for fixed and random-effects models, respectively.

Figure 2: Hematoma forest plot



3.2 Meta-analysis for Healing

23 out of the 52 studies are included in this analysis. 21 studies are excluded since they did not mention healing as an outcome and 8 are excluded since they have zero total events.

There are 2176 surgeries in the drain group and 2167 surgeries in the no-drain group that are included in this analysis. In the drain group 136 (6%) of these surgeries resulted in healing while in the no-drain group 127 (6%) surgeries showed this outcome.

Table 4 presents the results of the meta-analysis. The test of heterogeneity has a $\chi^2(22) = 23.9$ with a p-value of 0.3525, which indicates homogeneity of studies.

Table 4: Healing, odds ratios and test of heterogeneity

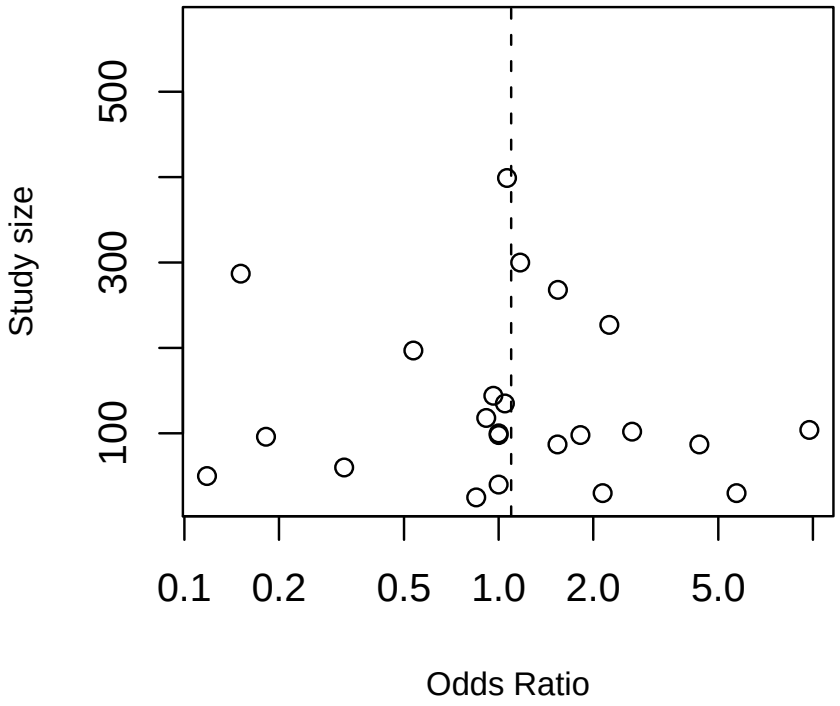
```
Number of trials combined: 23

                          OR           95%-CI      z  p.value
Fixed effect model   1.0962  [0.8492; 1.415] 0.7051   0.4807
Random effects model 1.1188  [0.8350; 1.499] 0.7518   0.4522

Quantifying heterogeneity:
tau^2 = 0.0394; H = 1.04 [1; 1.31]; I^2 = 7.9% [0%; 41.6%]

Test of heterogeneity:
    Q d.f.  p.value
 23.9   22   0.3525

Method: Mantel-Haenszel method
```

The funnel plot in Figure 3 appears to be symmetric and the rank correlation test of funnel plot asymmetry test with a p-value of 0.8533 does not indicate asymmetry in the funnel plot (results shown in Table 5).

Table 5: Rank correlation test of funnel plot asymmetry

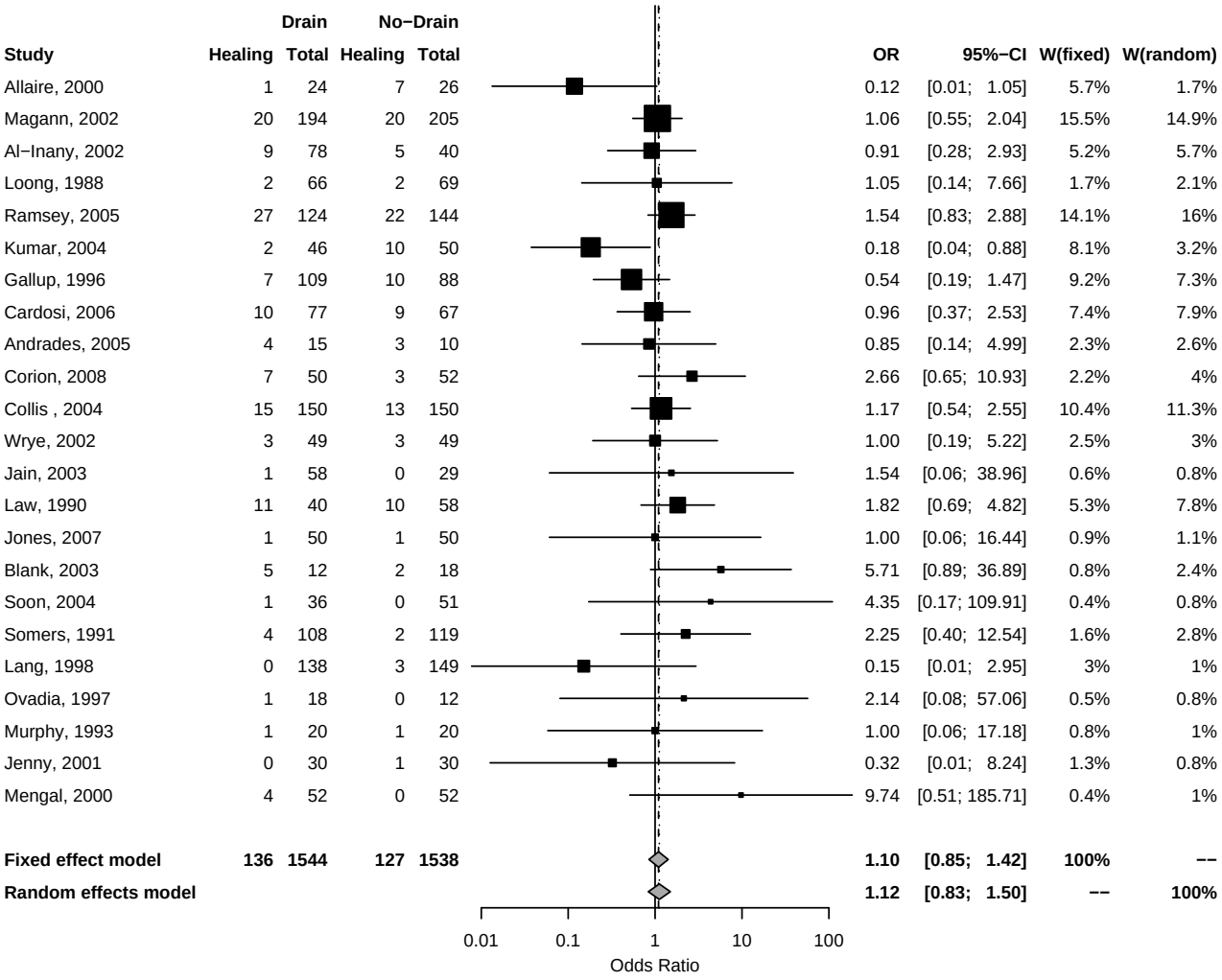
```
Rank correlation test of funnel plot asymmetry

data:  heal
z = 0.1849, p-value = 0.8533
alternative hypothesis: asymmetry in funnel plot
sample estimates:
      ks    se.ks
 7.00000 37.86379
```

Figure 3: Funnel plot for Healing meta-analysis



The forest plot in Figure 4 displays the odds ratios of individual studies along with their 95% confidence intervals and weights. The analysis indicates that drainage status has no significant effect on the outcome of healing (Fixed: OR 1.10; CI 0.85-1.42, Random: OR 1.12; CI 0.83-1.50) with p-values of 0.4807 and 0.4522 for fixed and random-effects models, respectively.

Figure 4: Healing forest plot



3.3 Meta-analysis for Abscess

8 out of the 52 studies are included in this analysis. 40 studies are excluded since they did not mention abscess as an outcome and 4 are excluded since they have zero total events.

There are 899 surgeries in the drain group and 829 surgeries in the no-drain group that are included in this analysis. In the drain group 25 (3%) of these surgeries resulted in abscess while in the no-drain group 15 (2%) surgeries showed this outcome.

Table 6 presents the results of the meta-analysis. The test of heterogeneity has a $\chi^2(7) = 4.35$ with a p-value of 0.7384, which indicates homogeneity of studies.

Table 6: Abscess, odds ratios and test of heterogeneity

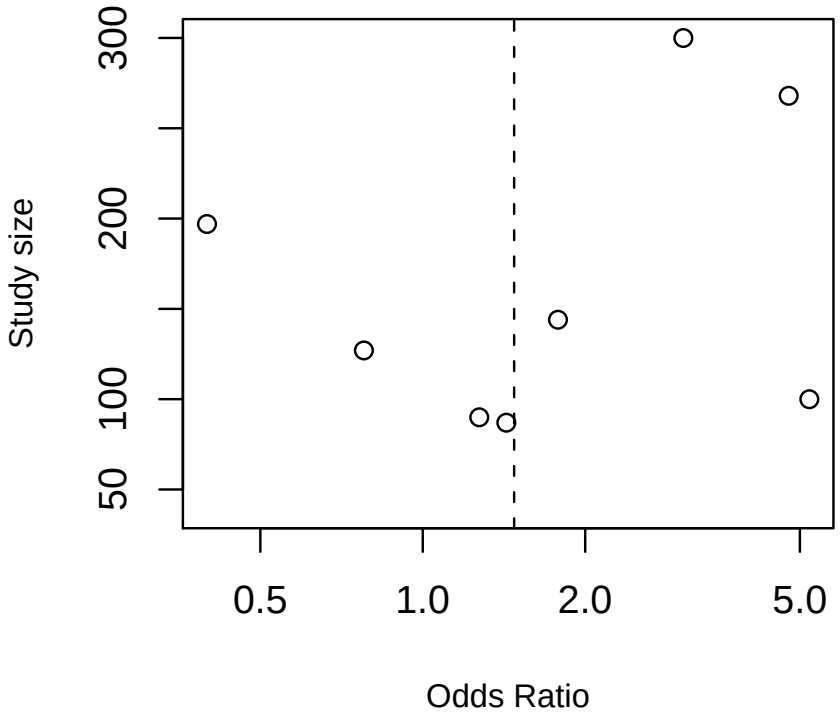
```
Number of trials combined: 8

                          OR            95%-CI      z  p.value
Fixed effect model   1.4770  [0.7730; 2.8222] 1.1805   0.2378
Random effects model 1.3971  [0.7044; 2.7710] 0.9569   0.3386

Quantifying heterogeneity:
tau^2 = 0.0000; H = 1 [1; 1.38]; I^2 = 0% [0%; 47.9%]

Test of heterogeneity:
    Q d.f.  p.value
 4.35    7   0.7384

Method: Mantel-Haenszel method
```

The funnel plot in Figure 5 does not appear to be symmetric however the rank correlation test of funnel plot asymmetry test with a p-value of 0.216 does not indicate asymmetry in the funnel plot (results shown in Table 7).

Table 7: Rank correlation test of funnel plot asymmetry

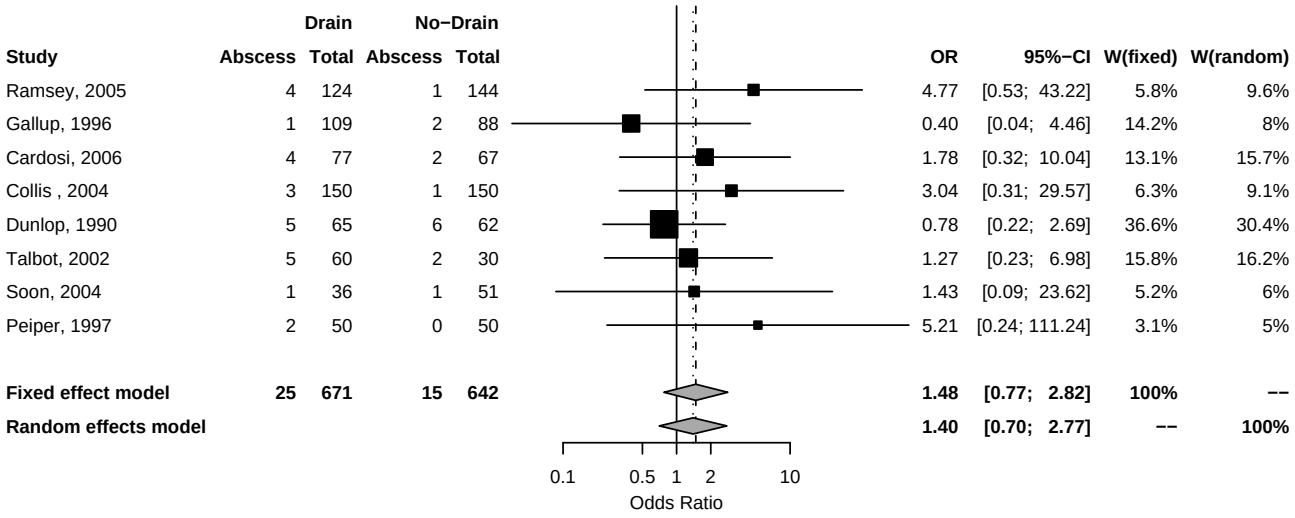
```
Rank correlation test of funnel plot asymmetry

data:  abscess
z = 1.2372, p-value = 0.216
alternative hypothesis: asymmetry in funnel plot
sample estimates:
       ks     se.ks
10.000000  8.082904
```

Figure 5: Funnel plot for Abscess meta-analysis



The forest plot in Figure 6 displays the odds ratios of individual studies along with their 95% confidence intervals and weights. The analysis does not indicate that drainage status has a statistically significant effect on the outcome of abscess (Fixed: OR 1.48; CI 0.77-2.82, Random: OR 1.40; CI 0.70-2.77) with p-values of 0.2378 and 0.3386 for fixed and random-effects models, respectively. However there is a slight trend towards favoring no-drain.

Figure 6: Abscess forest plot



3.4 Meta-analysis for Seroma

15 out of the 52 studies are included in this analysis. 32 studies are excluded since they did not mention seroma as an outcome and 5 are excluded since they have zero total events.

There are 1451 surgeries in the drain group and 1434 surgeries in the no-drain group that are included in this analysis. In the drain group 268 (18%) of these surgeries resulted in seroma while in the no-drain group 306 (21%) surgeries showed this outcome.

Table 8 presents the results of the meta-analysis. The test of heterogeneity has a $\chi^2(14) = 18.67$ with a p-value of 0.1781, which indicates homogeneity of studies.

Table 8: Seroma, odds ratios and test of heterogeneity

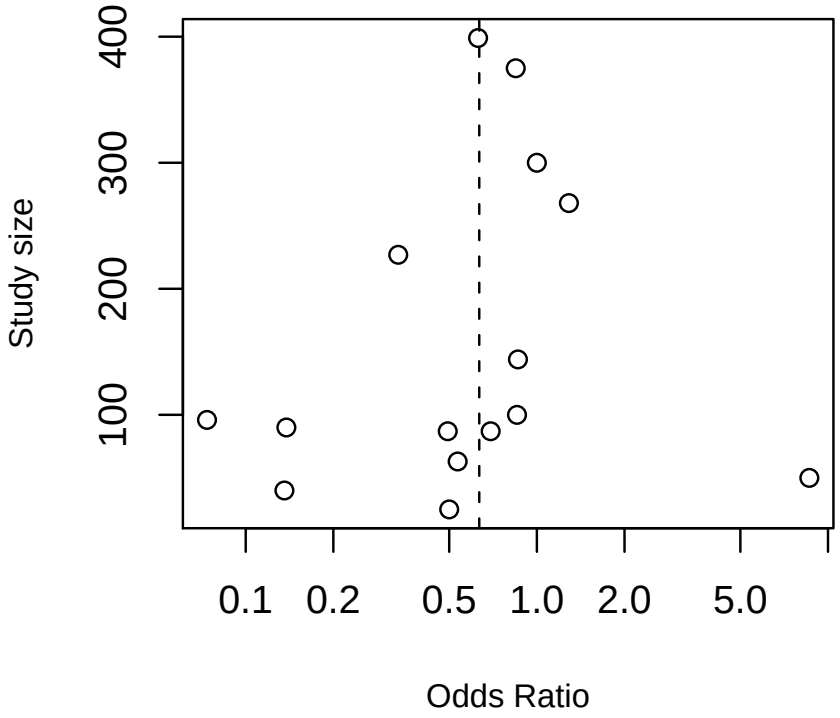
```
Number of trials combined: 15

                          OR            95%-CI       z  p.value
Fixed effect model   0.6340  [0.4866; 0.8262] -3.3740   0.0007
Random effects model 0.6153  [0.4252; 0.8903] -2.5765   0.01

Quantifying heterogeneity:
tau^2 = 0.1146; H = 1.15 [1; 1.57]; I^2 = 25% [0%; 59.5%]

Test of heterogeneity:
     Q d.f.  p.value
 18.67   14   0.1781

Method: Mantel-Haenszel method
```

The funnel plot in Figure 7 does not appear to be symmetric as there appears to be a 'piece' missing on the right; however the rank correlation test of funnel plot asymmetry test with a p-value of 0.5862 does not indicate asymmetry in the funnel plot (results shown in Table 9).

Table 9: Rank correlation test of funnel plot asymmetry

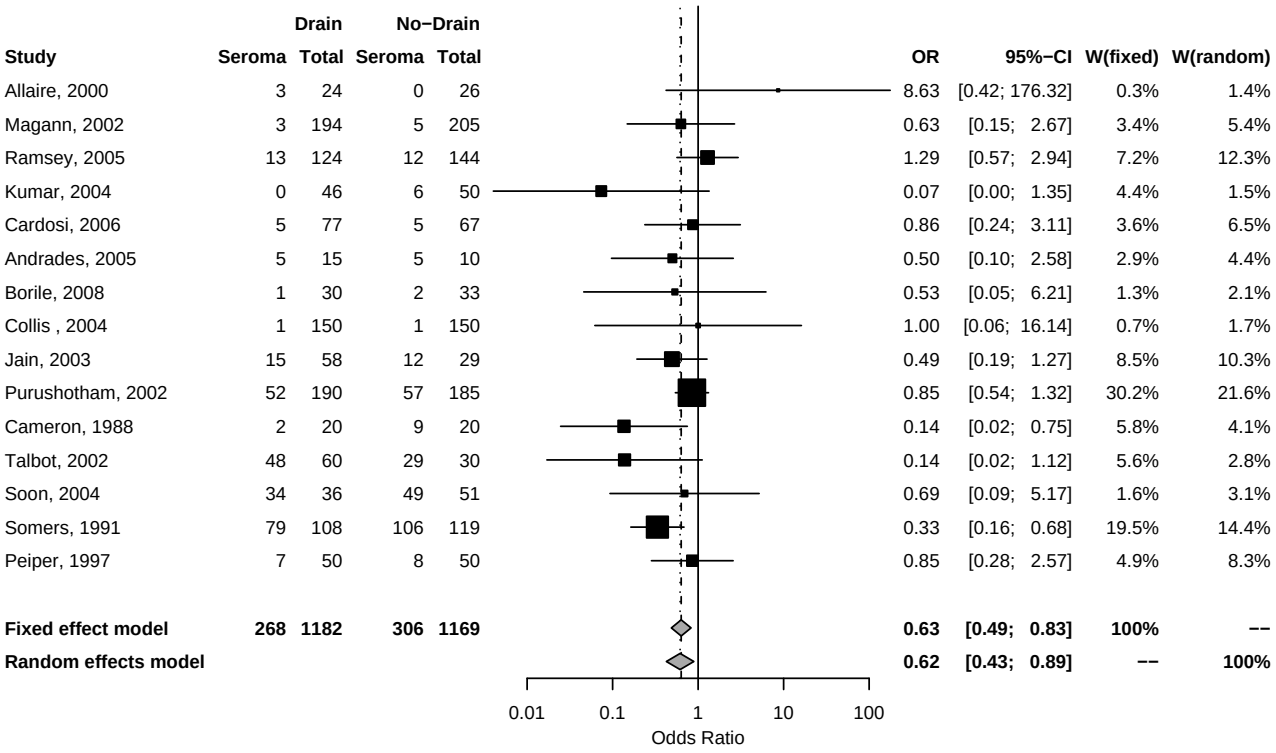
```
Rank correlation test of funnel plot asymmetry

data:  seroma
z = -0.5444, p-value = 0.5862
alternative hypothesis: asymmetry in funnel plot
sample estimates:
       ks     se.ks
-11.00000  20.20726
```

Figure 7: Funnel plot for Seroma meta-analysis



The forest plot in Figure 8 displays the odds ratios of individual studies along with their 95% confidence intervals and weights. The analysis reveals an advantage for the drained patients with respect to seroma (Fixed: OR 0.63; CI 0.49-0.83, Random: OR 0.62; CI 0.43-0.89) and this advantage reaches statistical significance with p-values of 7e-04 and 0.01 for fixed and random-effects models, respectively.

Figure 8: Seroma forest plot



3.5 Meta-analysis for Infection

39 out of the 52 studies are included in this analysis. 6 studies are excluded since they did not mention infection as an outcome and 7 are excluded since they have zero total events.

There are 3200 surgeries in the drain group and 3111 surgeries in the no-drain group that are included in this analysis. In the drain group 230 (7%) of these surgeries resulted in infection while in the no-drain group 233 (7%) surgeries showed this outcome.

Table 10 presents the results of the meta-analysis. The test of heterogeneity has a $\chi^2(38) = 27.49$ with a p-value of 0.8962, which indicates homogeneity of studies.

Table 10: Infection, odds ratios and test of heterogeneity

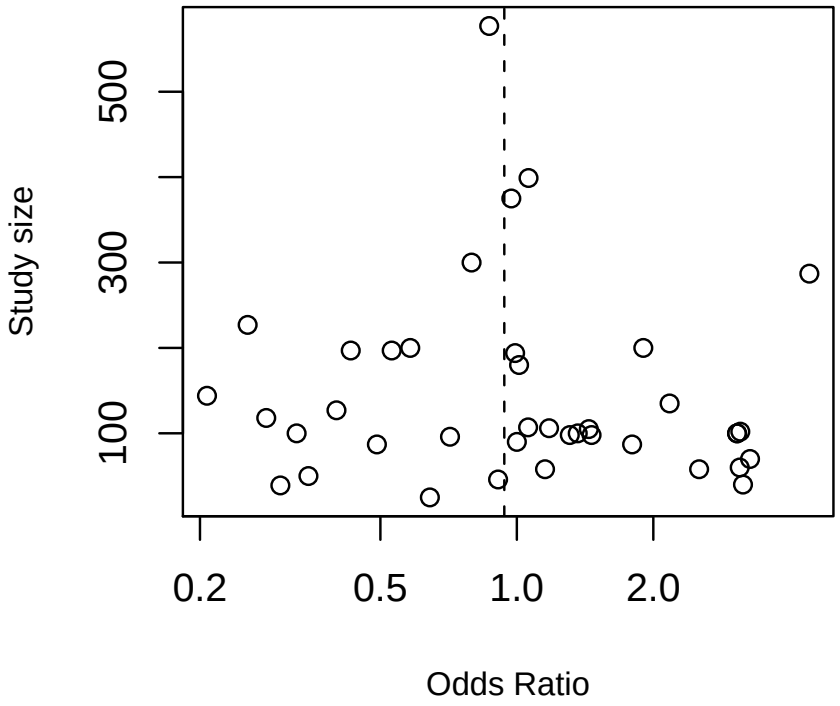
```
Number of trials combined: 39

                          OR            95%-CI       z  p.value
Fixed effect model   0.9382  [0.7559; 1.1646] -0.5780   0.5633
Random effects model 0.9435  [0.7538; 1.1810] -0.5076   0.6117

Quantifying heterogeneity:
tau^2 = 0.0000; H = 1 [1; 1.07]; I^2 = 0% [0%; 12.4%]

Test of heterogeneity:
     Q d.f.  p.value
 27.49   38   0.8962

Method: Mantel-Haenszel method
```

The funnel plot in Figure 9 appears to be symmetric and the rank correlation test of funnel plot asymmetry test with a p-value of 0.4245 does not indicate asymmetry in the funnel plot (results shown in Table 11).

Table 11: Rank correlation test of funnel plot asymmetry

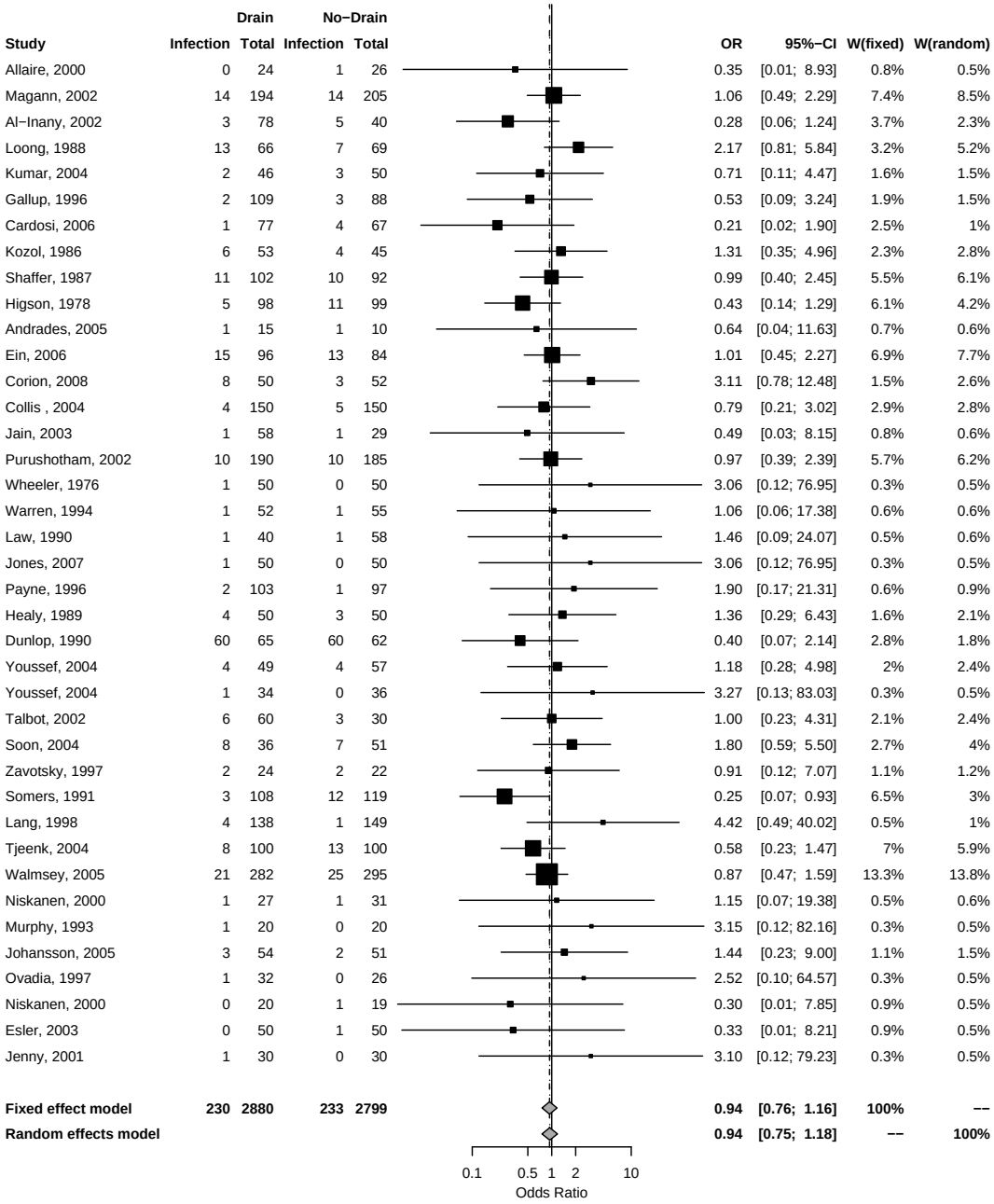
```
Rank correlation test of funnel plot asymmetry

data:  infection
z = 0.7987, p-value = 0.4245
alternative hypothesis: asymmetry in funnel plot
sample estimates:
      ks    se.ks
66.00000 82.63779
```

Figure 9: Funnel plot for Infection meta-analysis



The forest plot in Figure 10 displays the odds ratios of individual studies along with their 95% confidence intervals and weights. The analysis indicates that drainage status has no significant effect on the outcome of infection (Fixed: OR 0.94; CI 0.76-1.16, Random: OR 0.94; CI 0.75-1.18) with p-values of 0.5633 and 0.6117 for fixed and random-effects models, respectively.

Figure 10: Infection forest plot



4 Results of cumulative meta-analyses (excluding breast biopsies)

4.1 Meta-analysis for Hematoma

20 out of the 49 studies are included in this analysis. 15 studies are excluded since they did not mention hematoma as an outcome and 14 are excluded since they have zero total events.

There are 2512 surgeries in the drain group and 2526 surgeries in the no-drain group that are included in this analysis. In the drain group 92 (4%) of these surgeries resulted in hematoma while in the no-drain group 111 (4%) surgeries showed this outcome.

Table 12 presents the results of the meta-analysis. The test of heterogeneity has a $\chi^2(19) = 10.7$ with a p-value of 0.9343, which indicates homogeneity of studies.

Table 12: Hematoma, odds ratios and test of heterogeneity

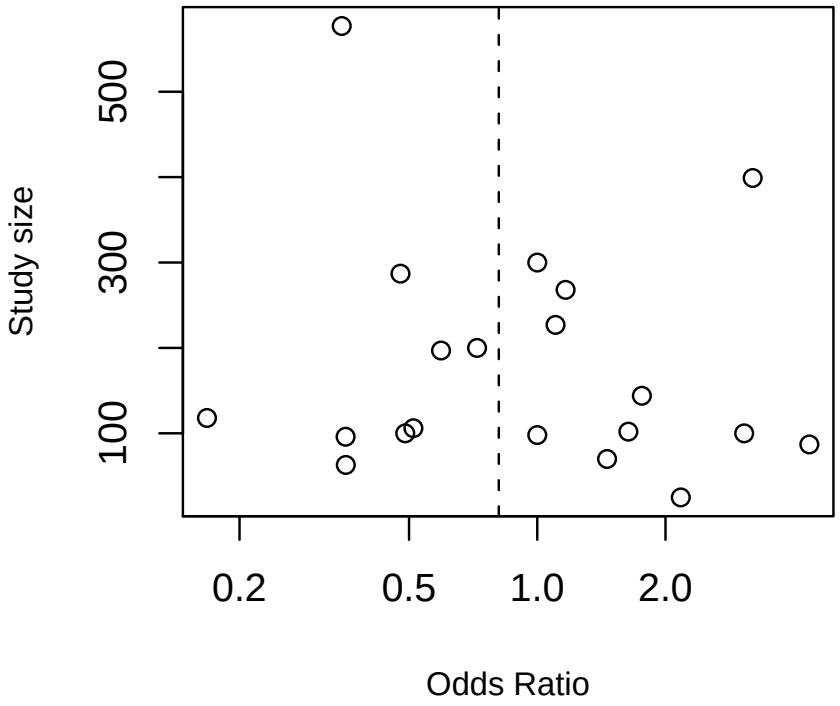
```
Number of trials combined: 20

                          OR            95%-CI       z  p.value
Fixed effect model   0.8122  [0.5946; 1.1094] -1.3075   0.191
Random effects model 0.8091  [0.5866; 1.1159] -1.2915   0.1965

Quantifying heterogeneity:
tau^2 = 0.0000; H = 1 [1; 1.04]; I^2 = 0% [0%; 7.3%]

Test of heterogeneity:
     Q d.f.  p.value
 10.67   19   0.9343

Method: Mantel-Haenszel method
```

The funnel plot in Figure 11 appears to be somewhat symmetric and the rank correlation test of funnel plot asymmetry test with a p-value of 0.8457 does not indicate asymmetry in the funnel plot (results shown in Table 13).

Table 13: Rank correlation test of funnel plot asymmetry

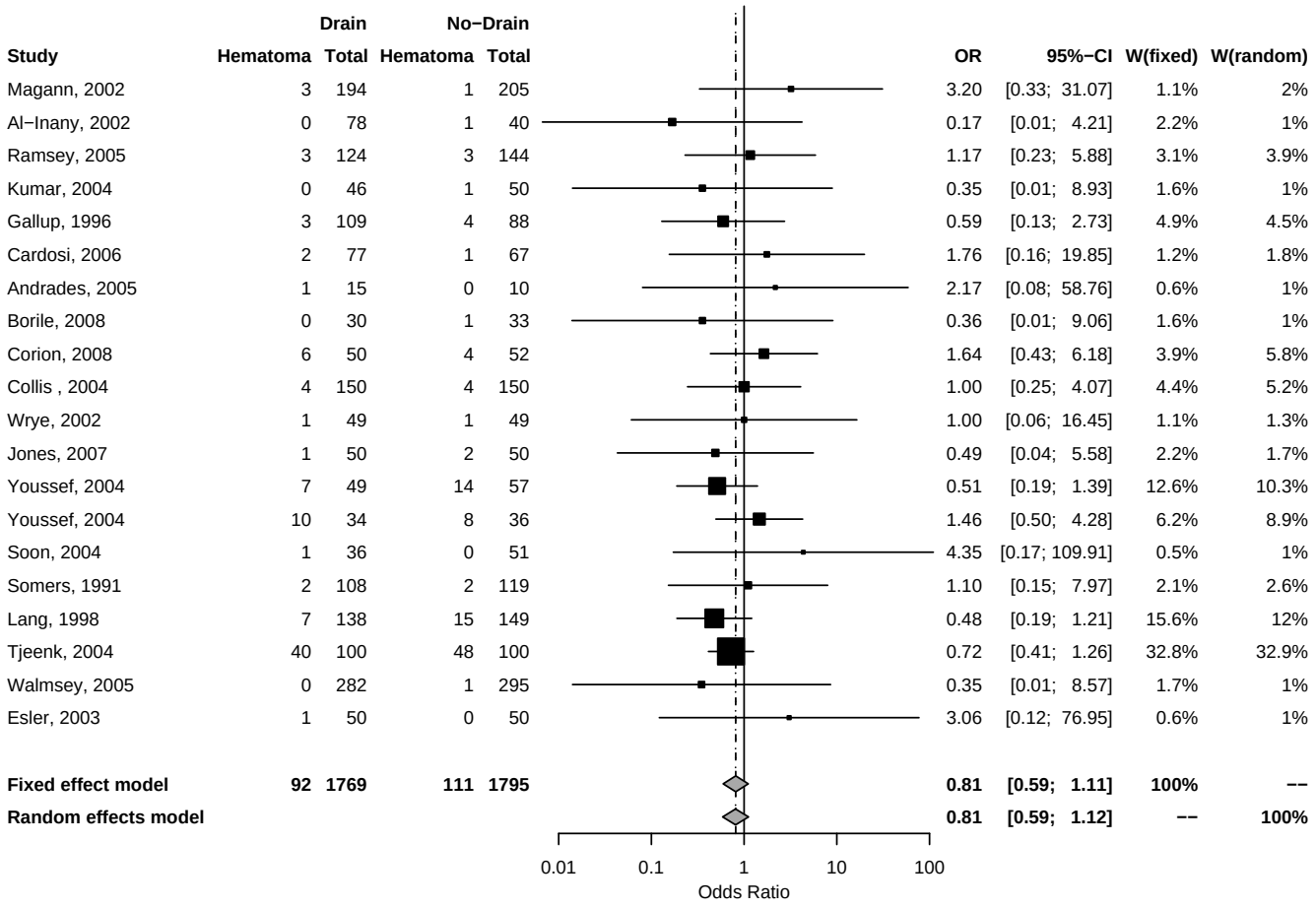
```
Rank correlation test of funnel plot asymmetry

data:  hema_nbb
z = 0.1947, p-value = 0.8457
alternative hypothesis: asymmetry in funnel plot
sample estimates:
      ks    se.ks
 6.00000 30.82207
```

Figure 11: Funnel plot for Hematoma meta-analysis



The forest plot in Figure 12 displays the odds ratios of individual studies along with their 95% confidence intervals and weights. The analysis indicates that drainage status has no significant effect on the outcome of healing (Fixed: OR 0.81; CI 0.59-1.11, Random: OR 0.81; CI 0.59-1.12) with p-values of 0.191 and 0.1965 for fixed and random-effects models, respectively.

Figure 12: Hematoma forest plot



4.2 Meta-analysis for Healing

22 out of the 49 studies are included in this analysis. 19 studies are excluded since they did not mention healing as an outcome and 8 are excluded since they have zero total events.

There are 2136 surgeries in the drain group and 2109 surgeries in the no-drain group that are included in this analysis. In the drain group 125 (6%) of these surgeries resulted in healing while in the no-drain group 117 (6%) surgeries showed this outcome.

Table 14 presents the results of the meta-analysis. The test of heterogeneity has a $\chi^2(21) = 22.9$ with a p-value of 0.3496, which indicates homogeneity of studies.

Table 14: Healing, odds ratios and test of heterogeneity

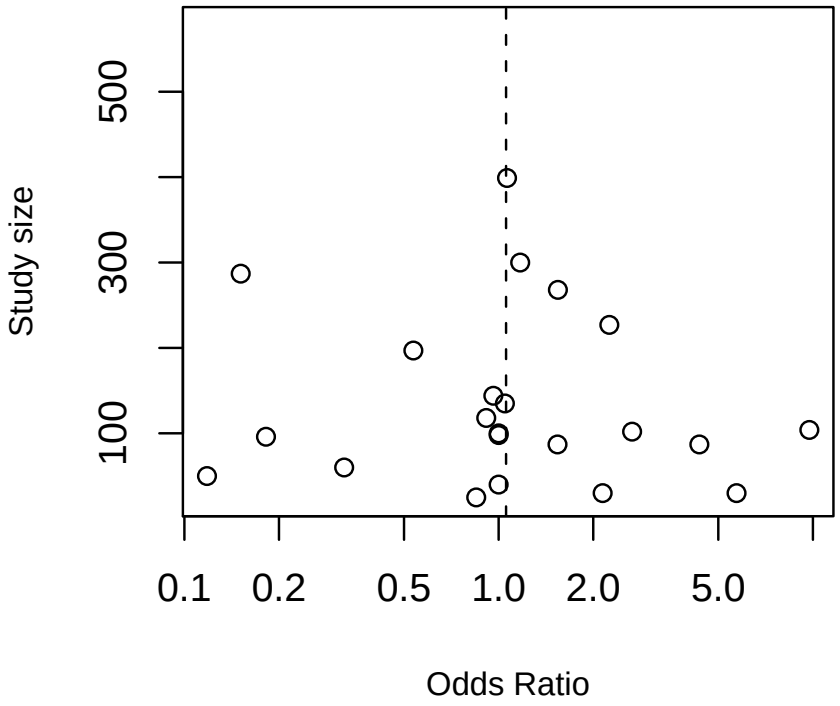
```
Number of trials combined: 22

                          OR            95%-CI      z  p.value
Fixed effect model   1.0560  [0.8104; 1.3761] 0.4035   0.6866
Random effects model 1.0724  [0.7889; 1.4577] 0.4460   0.6556

Quantifying heterogeneity:
tau^2 = 0.0431; H = 1.04 [1; 1.32]; I^2 = 8.3% [0%; 42.4%]

Test of heterogeneity:
     Q d.f.  p.value
 22.89   21   0.3496

Method: Mantel-Haenszel method
```

The funnel plot in Figure 13 appears to be symmetric and the rank correlation test of funnel plot asymmetry test with a p-value of 0.7139 does not indicate asymmetry in the funnel plot (results shown in Table 15).

Table 15: Rank correlation test of funnel plot asymmetry

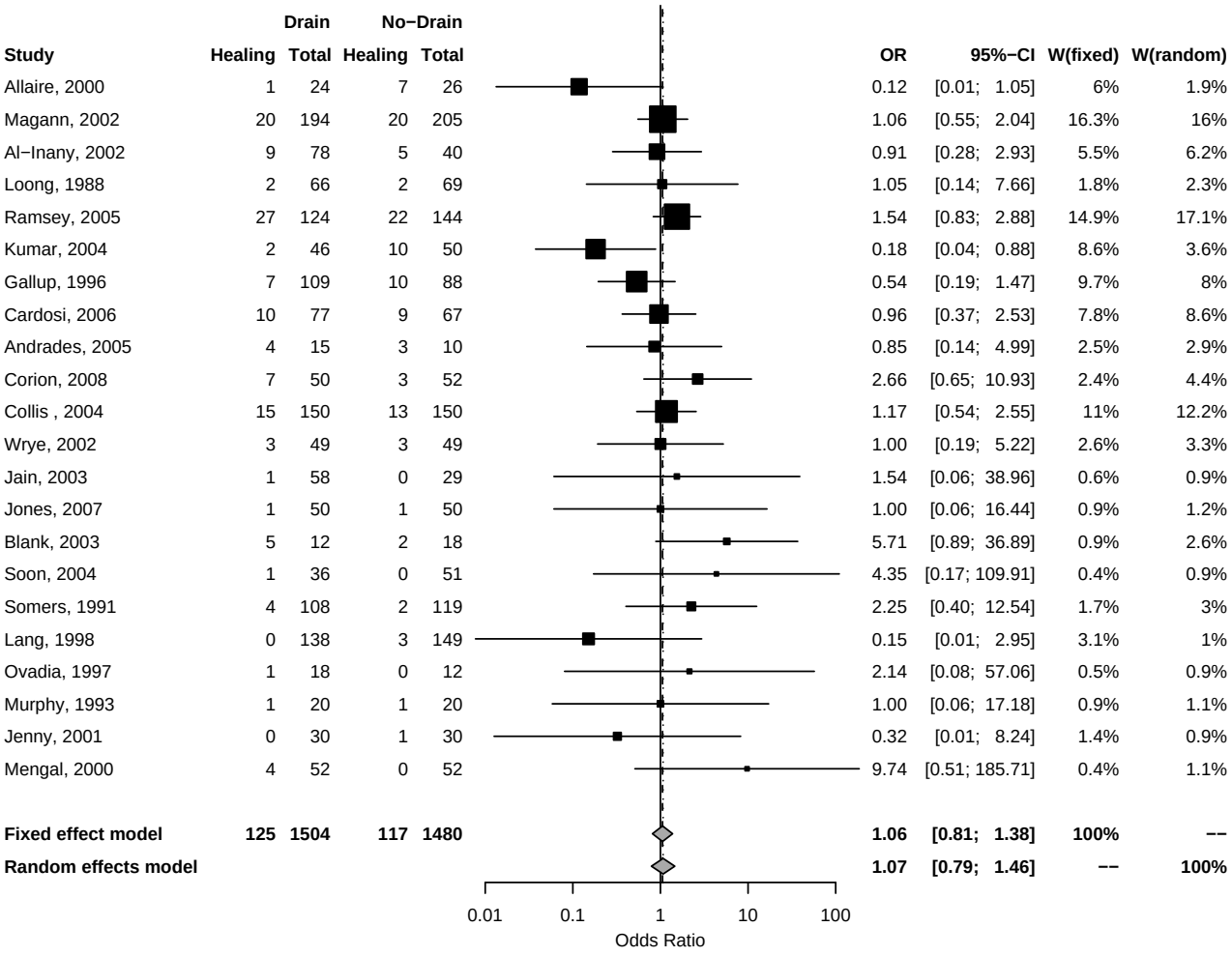
```
Rank correlation test of funnel plot asymmetry

data:  heal_nbb
z = 0.3666, p-value = 0.714
alternative hypothesis: asymmetry in funnel plot
sample estimates:
      ks    se.ks
13.00000 35.46360
```

Figure 13: Funnel plot for Healing meta-analysis



The forest plot in Figure 14 displays the odds ratios of individual studies along with their 95% confidence intervals and weights. The analysis indicates that drainage status has no significant effect on the outcome of healing (Fixed: OR 1.06; CI 0.81-1.38, Random: OR 1.07; CI 0.79-1.46) with p-values of 0.6866 and 0.6556 for fixed and random-effects models, respectively.

Figure 14: Healing forest plot



4.3 Meta-analysis for Abscess

8 out of the 49 studies are included in this analysis. 37 studies are excluded since they did not mention abscess as an outcome and 4 are excluded since they have zero total events.

There are 899 surgeries in the drain group and 829 surgeries in the no-drain group that are included in this analysis. In the drain group 25 (3%) of these surgeries resulted in abscess while in the no-drain group 15 (2%) surgeries showed this outcome.

Table 16 presents the results of the meta-analysis. The test of heterogeneity has a $\chi^2(7) = 4.35$ with a p-value of 0.7384, which indicates homogeneity of studies.

Table 16: Abscess, odds ratios and test of heterogeneity

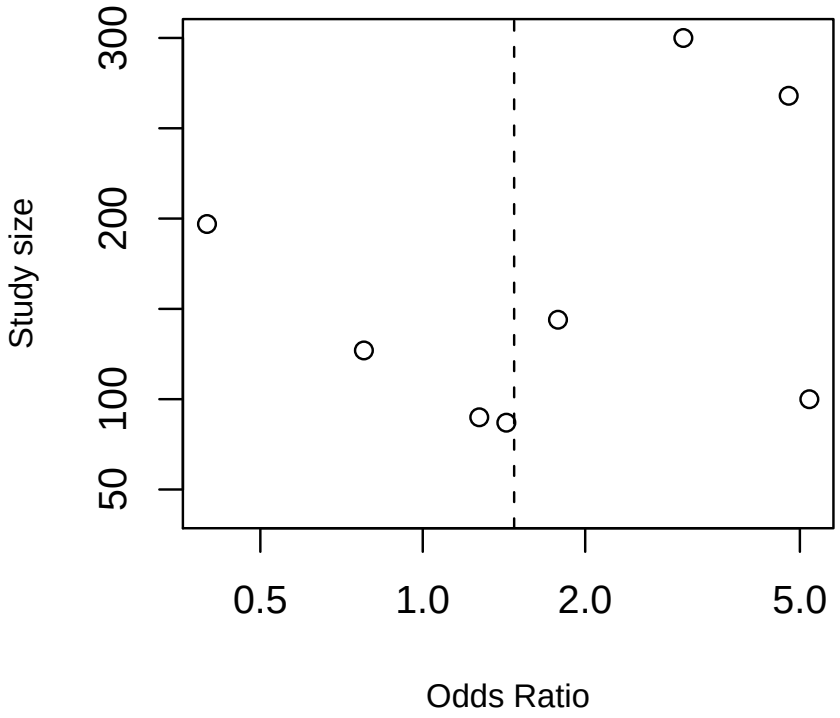
```
Number of trials combined: 8

                          OR            95%-CI      z  p.value
Fixed effect model   1.4770  [0.7730; 2.8222] 1.1805   0.2378
Random effects model 1.3971  [0.7044; 2.7710] 0.9569   0.3386

Quantifying heterogeneity:
tau^2 = 0.0000; H = 1 [1; 1.38]; I^2 = 0% [0%; 47.9%]

Test of heterogeneity:
    Q d.f.  p.value
 4.35    7   0.7384

Method: Mantel-Haenszel method
```

The funnel plot in Figure 15 does not appear to be symmetric however the rank correlation test of funnel plot asymmetry test with a p-value of 0.216 does not indicate asymmetry in the funnel plot (results shown in Table 17).

Table 17: Rank correlation test of funnel plot asymmetry

```
Rank correlation test of funnel plot asymmetry

data:  abscess_nbb
z = 1.2372, p-value = 0.216
alternative hypothesis: asymmetry in funnel plot
sample estimates:
       ks     se.ks
10.000000  8.082904
```

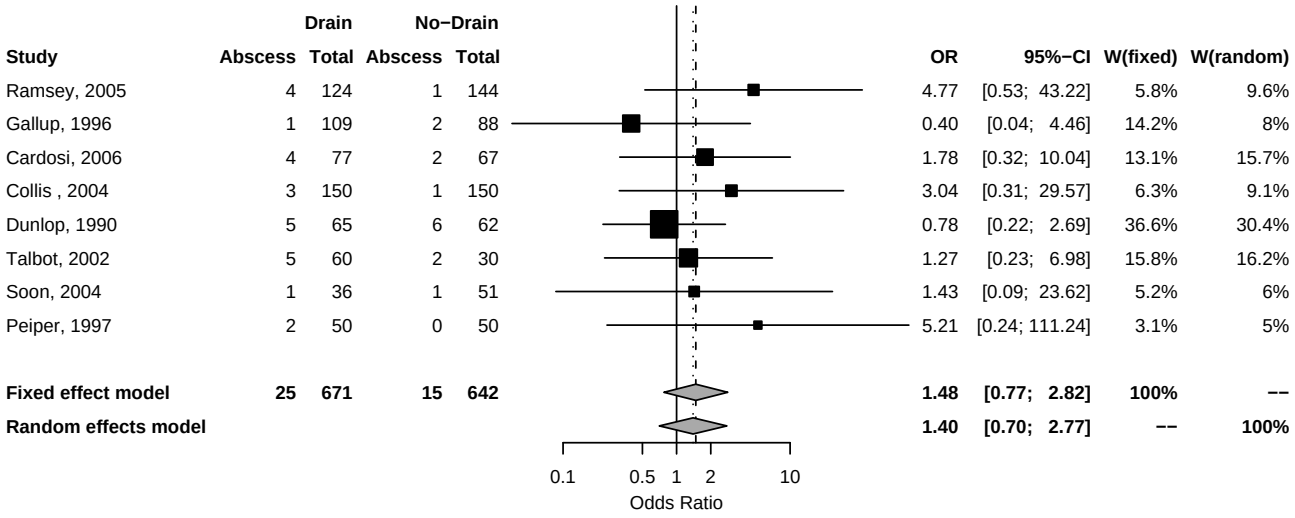
Figure 15: Funnel plot for Abscess meta-analysis



The forest plot in Figure 16 displays the odds ratios of individual studies along with their 95% confidence intervals and weights. The analysis does not indicate that drainage status has a statistically significant effect on the outcome of abscess (Fixed: OR 1.48; CI 0.77-2.82, Random: OR 1.40; CI 0.70-2.77) with p-values of 0.2378 and 0.3386 for fixed and random-effects models, respectively. However there is a slight trend towards favoring no-drain.

These results are same as the ones in section 3 since there were no breast biopsies with the abscess outcome.

Figure 16: Abscess forest plot



4.4 Meta-analysis for Seroma

15 out of the 49 studies are included in this analysis. 29 studies are excluded since they did not mention seroma as an outcome and 5 are excluded since they have zero total events.

There are 1451 surgeries in the drain group and 1434 surgeries in the no-drain group that are included in this analysis. In the drain group 268 (18%) of these surgeries resulted in seroma while in the no-drain group 306 (21%) surgeries showed this outcome.

Table 18 presents the results of the meta-analysis. The test of heterogeneity has a $\chi^2(14) = 18.67$ with a p-value of 0.1781, which indicates homogeneity of studies.

Table 18: Seroma, odds ratios and test of heterogeneity

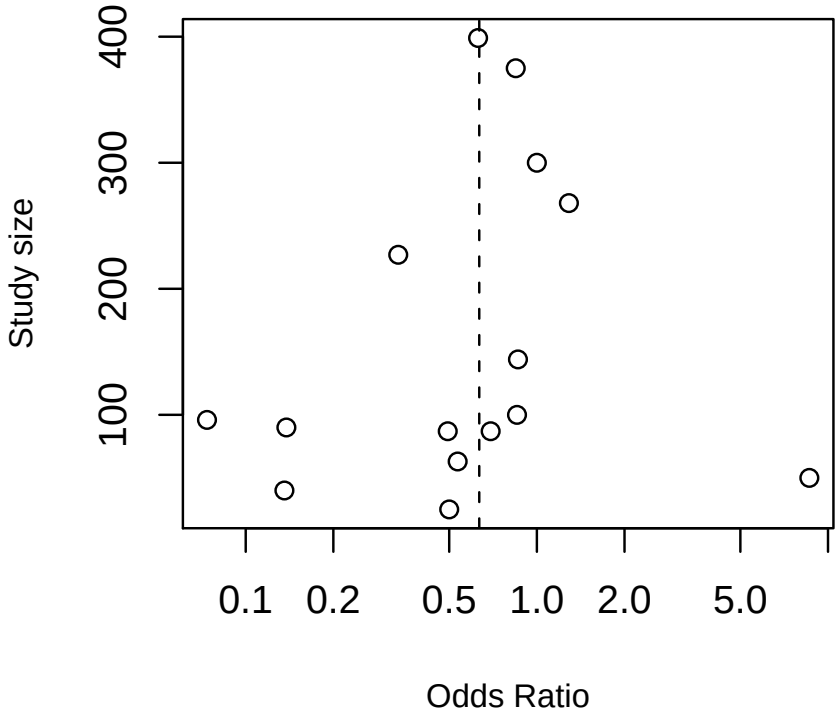
```
Number of trials combined: 15

                          OR            95%-CI       z  p.value
Fixed effect model   0.6340  [0.4866; 0.8262] -3.3740   0.0007
Random effects model 0.6153  [0.4252; 0.8903] -2.5765   0.01

Quantifying heterogeneity:
tau^2 = 0.1146; H = 1.15 [1; 1.57]; I^2 = 25% [0%; 59.5%]

Test of heterogeneity:
     Q d.f.  p.value
 18.67   14   0.1781

Method: Mantel-Haenszel method
```

The funnel plot in Figure 17 does not appear to be symmetric as there appears to be a 'piece' missing on the right; however the rank correlation test of funnel plot asymmetry test with a p-value of 0.5862 does not indicate asymmetry in the funnel plot (results shown in Table 19).

Table 19: Rank correlation test of funnel plot asymmetry

```
Rank correlation test of funnel plot asymmetry

data:  seroma_nbb
z = -0.5444, p-value = 0.5862
alternative hypothesis: asymmetry in funnel plot
sample estimates:
       ks     se.ks
-11.00000  20.20726
```

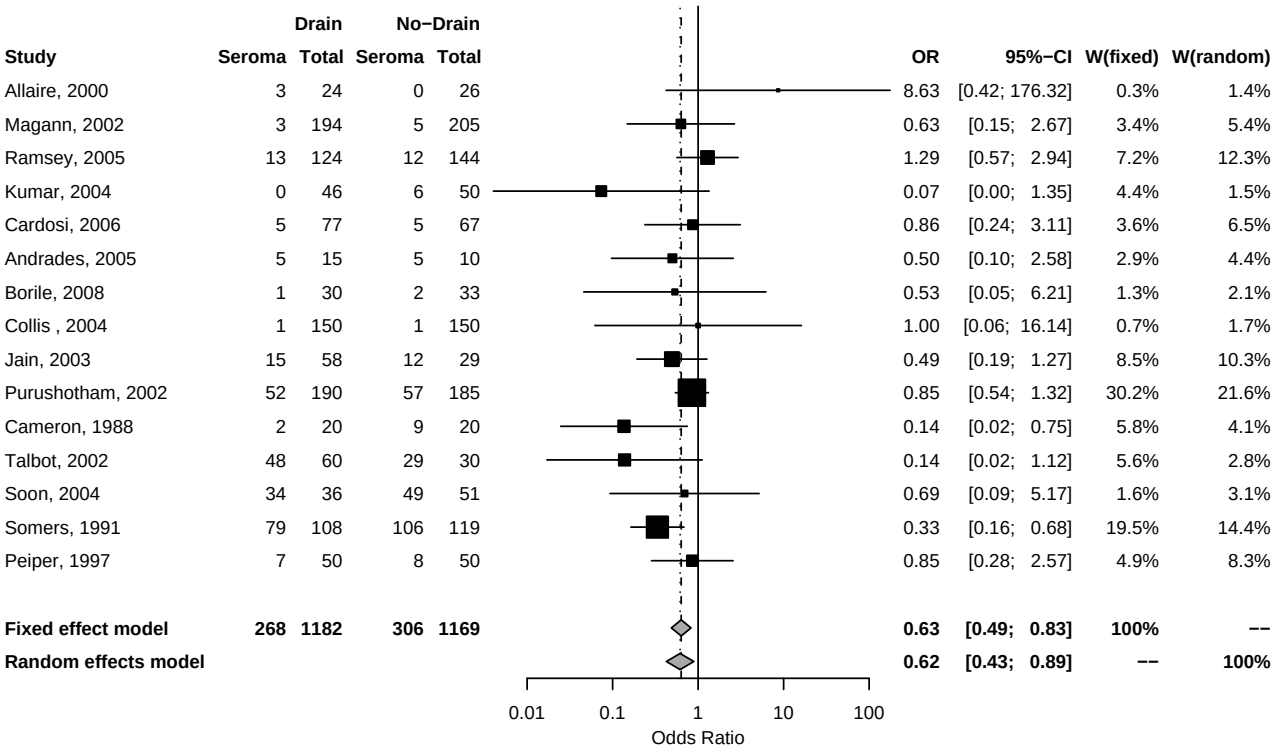
Figure 17: Funnel plot for Seroma meta-analysis



The forest plot in Figure 18 displays the odds ratios of individual studies along with their 95% confidence intervals and weights. The analysis reveals an advantage for the drained patients with respect to seroma (Fixed: OR 0.63; CI 0.49-0.83, Random: OR 0.62; CI 0.43-0.89) and this advantage reaches statistical significance with p-values of 7e-04 and 0.01 for fixed and random-effects models, respectively.

These results are same as the ones in section 3 since there were no breast biopsies with the seroma outcome.

Figure 18: Seroma forest plot



4.5 Meta-analysis for Infection

36 out of the 49 studies are included in this analysis. 6 studies are excluded since they did not mention infection as an outcome and 7 are excluded since they have zero total events.

There are 3058 surgeries in the drain group and 2948 surgeries in the no-drain group that are included in this analysis. In the drain group 227 (7%) of these surgeries resulted in infection while in the no-drain group 231 (8%) surgeries showed this outcome.

Table 20 presents the results of the meta-analysis. The test of heterogeneity has a $\chi^2(35) = 26.87$ with a p-value of 0.8358, which indicates homogeneity of studies.

Table 20: Infection, odds ratios and test of heterogeneity

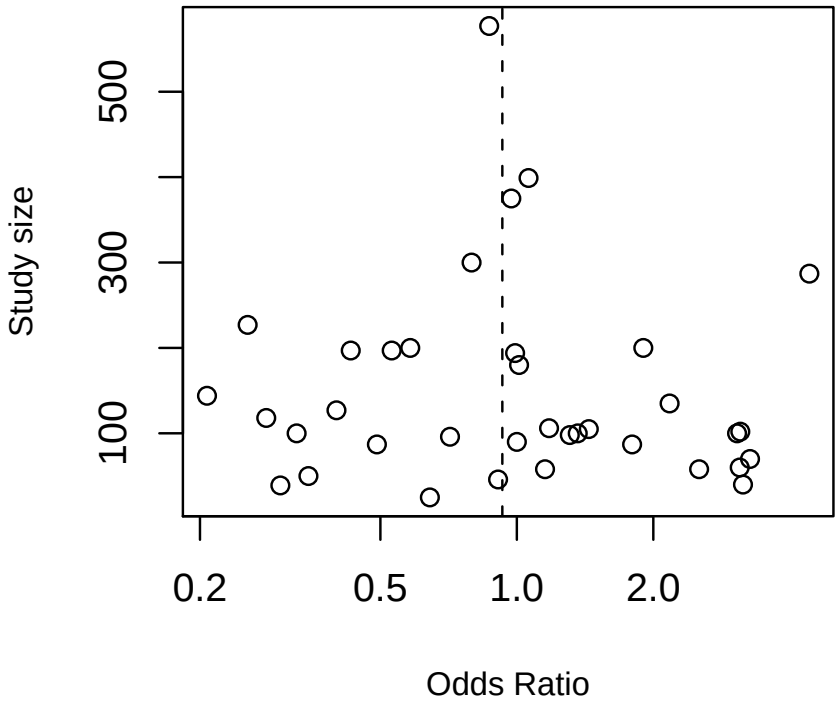
```
Number of trials combined: 36

                          OR            95%-CI       z  p.value
Fixed effect model   0.9289  [0.7469; 1.1554] -0.6624   0.5077
Random effects model 0.9347  [0.7452; 1.1723] -0.5846   0.5588

Quantifying heterogeneity:
tau^2 = 0.0000; H = 1 [1; 1.11]; I^2 = 0% [0%; 19%]

Test of heterogeneity:
     Q d.f.  p.value
 26.87   35   0.8358

Method: Mantel-Haenszel method
```

The funnel plot in Figure 19 appears to be symmetric and the rank correlation test of funnel plot asymmetry test with a p-value of 0.6335 does not indicate asymmetry in the funnel plot (results shown in Table 21).

Table 21: Rank correlation test of funnel plot asymmetry

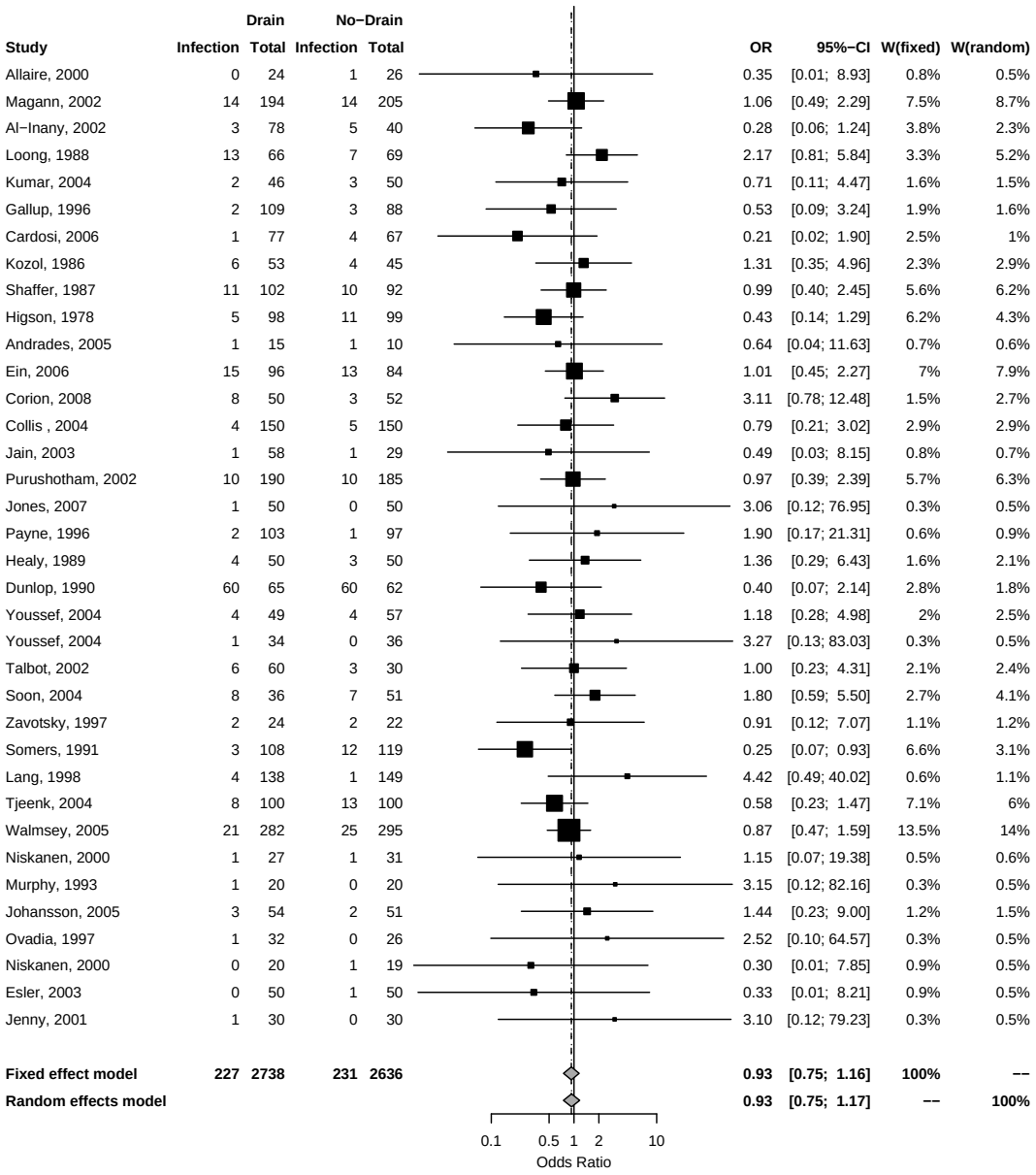
```
Rank correlation test of funnel plot asymmetry

data:  infection_nbb
z = 0.4768, p-value = 0.6335
alternative hypothesis: asymmetry in funnel plot
sample estimates:
      ks    se.ks
35.00000 73.40981
```

Figure 19: Funnel plot for Infection meta-analysis



The forest plot in Figure 20 displays the odds ratios of individual studies along with their 95% confidence intervals and weights. The analysis indicates that drainage status has no significant effect on the outcome of infection (Fixed: OR 0.93; CI 0.75-1.16, Random: OR 0.93; CI 0.75-1.17) with p-values of 0.5077 and 0.5588 for fixed and random-effects models, respectively.

Figure 20: Infection forest plot



5 Results of meta-analyses by procedure type

5.1 Cesarean section

6 cesarean section studies are included in the meta-analysis which indicates that drainage status has no significant effect on the outcome of hematoma (OR 1.00; CI 0.35-2.84), healing (OR 0.93; CI 0.64-1.36), seroma (OR 0.93; CI 0.50-1.72) or infection (OR 1.03; CI 0.62-1.73).

The forest plots are presented in Figure 21 and other meta-analysis output and plots for this procedure type can be found in the Appendix (Section 8.1).

This analysis excludes the abscess outcome as there are fewer than three studies reporting this outcome.

5.2 Abdominal wounds

8 abdominal wound studies are included in the meta-analysis which indicates that drainage status has no significant effect on the outcome of hematoma (OR 0.83; CI 0.28-2.43), healing (OR 0.74; CI 0.39-1.41), seroma (OR 0.67; CI 0.27-1.70) or infection (OR 0.77; CI 0.49-1.21).

The forest plots are presented in Figure 22 and other meta-analysis output and plots for this procedure type can be found in the Appendix (Section 8.2).

This analysis excludes the abscess outcome as there are fewer than three studies reporting this outcome.

5.3 Breast reduction

3 breast reduction studies are included in the meta-analysis which indicates that drainage status has no significant effect on the outcome of hematoma (OR 1.26; CI 0.51-3.13) or healing (OR 1.36; CI 0.73-2.54).

The forest plots are presented in Figure 23 and other meta-analysis output and plots for this procedure type can be found in the Appendix (Section 8.3).

This analysis excludes the abscess, seroma and infection outcomes as there are fewer than three studies reporting these outcomes.

5.4 Breast biopsy

3 breast biopsy studies are included in the meta-analysis which reveals an advantage for drained patients with respect to hematoma (OR 0.56; CI 0.32-0.97) and this advantage reaches statistical significance with a p-value of 0.0401.

On the other hand, the analysis indicates that drainage status has no significant effect on the outcome of infection (OR 1.64; CI 0.31-8.51).

The forest plots are presented in Figure 24 and other meta-analysis output and plots for this procedure type can be found in the Appendix (Section 8.4).

This analysis excludes the healing, abscess and seroma outcomes as there are fewer than three studies reporting these outcomes.

5.5 Femoral wounds

3 femoral wounds studies are included in the meta-analysis which indicates that drainage status has no significant effect on the outcome of infection (OR 0.89; CI 0.37-2.11).

The forest plots are presented in Figure 25 and other meta-analysis output and plots for this procedure type can be found in the Appendix (Section 8.5).

This analysis excludes the hematoma, healing, abscess and seroma as outcomes as there are fewer than three studies reporting these outcomes.

5.6 Axillary lymphnode resection

5 axillary lymphnode resection studies are included in the meta-analysis which an advantage for drained patients with respect to seroma (OR 0.28; CI 0.16-1.39) and this advantage reaches statistical significance with a p-value of 3e-05.

The analysis also indicates that drainage status has no significant effect on the outcome of infection (OR 0.77; CI 0.40-1.47).

The forest plots are presented in Figure 26 and other meta-analysis output and plots for his procedure type can be found in the Appendix (Section 8.6).

This analysis excludes the hematoma, healing and abscess outcomes as there are fewer than three studies reporting these outcomes.

5.7 Hip arthroplasty

6 femoral wounds studies are included in the meta-analysis which indicates that drainage status has no significant effect on the outcome of infection (OR 0.96; CI 0.56-1.67).

The forest plots are presented in Figure 27 and other meta-analysis output and plots for this procedure type can be found in the Appendix (Section 8.7).

This analysis excludes the hematoma, healing, abscess and seroma as outcomes as there are fewer than three studies reporting these outcomes.

5.8 Knee arthroplasty

7 femoral wounds studies are included in the meta-analysis which indicates that drainage status has no significant effect on the outcome of infection (OR 0.94; CI 0.23-3.84).

The forest plots are presented in Figure 28 and other meta-analysis output and plots for this procedure type can be found in the Appendix (Section 8.8).

This analysis excludes the hematoma, healing, abscess and seroma as outcomes as there are fewer than three studies reporting these outcomes.

5.9 Clean-contaminated wounds

Clean contaminated wounds may occur in intra-abdominal procedures, such as an appendectomy or a cholecystecomy, and where a drain is placed in the subcutaneous tissue. During the surgery an organ such as the gallbladder or the appendix is retrieved through the wounds, therefore these wounds are not considered just clean, but clean-contaminated. Most, but not all abdominal wounds studies considered in section 5.2 fall in this category.

5 clean-contaminated wounds studies are included in the meta-analysis which indicates that drainage status has no significant effect on the outcome of infection (OR 0.69; CI 0.40-1.19).

The forest plots are presented in Figure 29 and other meta-analysis output and plots for this procedure type can be found in the Appendix (Section 8.9).

This analysis excludes the hematoma, healing, abscess and seroma as outcomes as there are fewer than three studies reporting these outcomes.

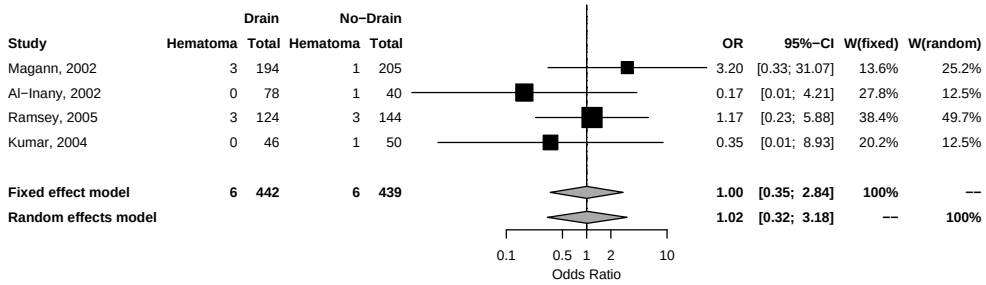
5.10 Obese patients

7 obese patient studies are included in the meta-analysis which indicates that drainage status has no significant effect on the outcomes of hematoma (OR 0.79; CI 0.31-1.99), healing (OR 0.94; CI 0.63-1.42), abscess (OR 1.71; CI 0.57-5.10), seroma (OR 1.35; CI 0.70-2.60) or infection (OR 0.67; CI 0.38-1.20).

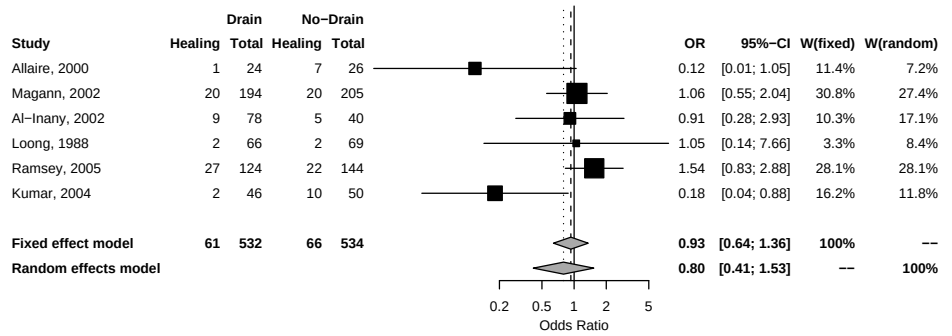
The forest plots are presented in Figure 30 and other meta-analysis output and plots for his procedure type can be found in the Appendix (Section 8.10).

Figure 21: Cesarean section forest plots

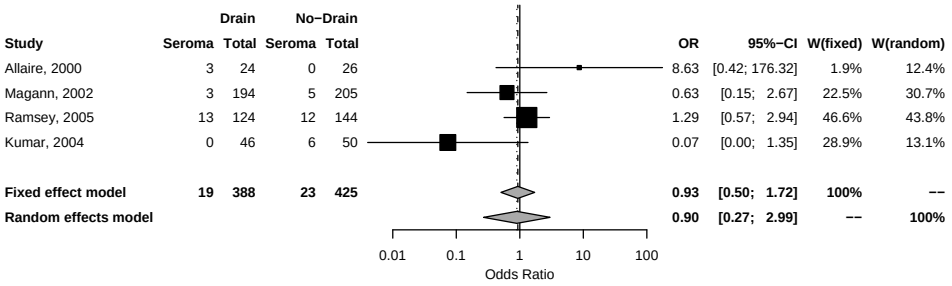
A. Hematoma



B. Healing



C. Seroma



D.Infection

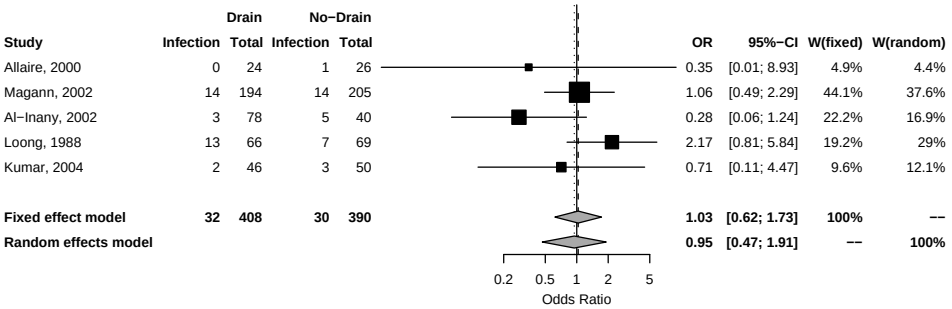
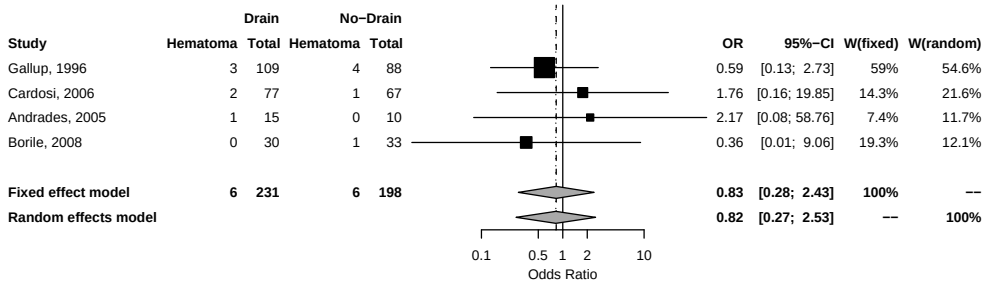
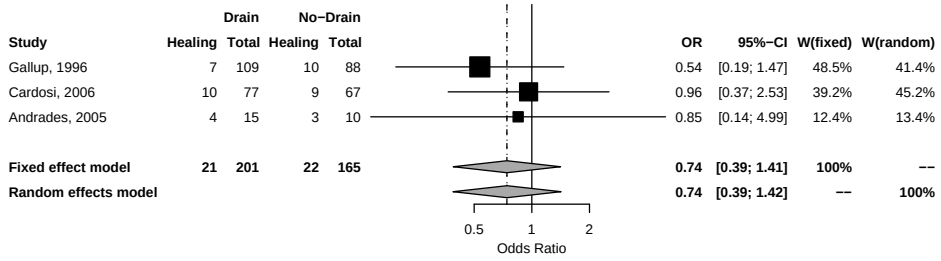


Figure 22: Abdominal wound forest plots

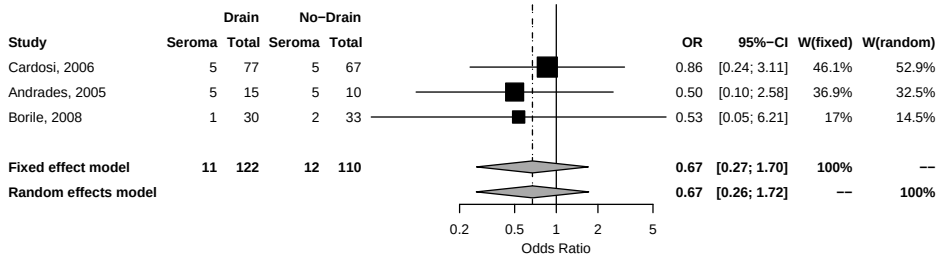
A. Hematoma



B. Healing



C. Seroma



D.Infection

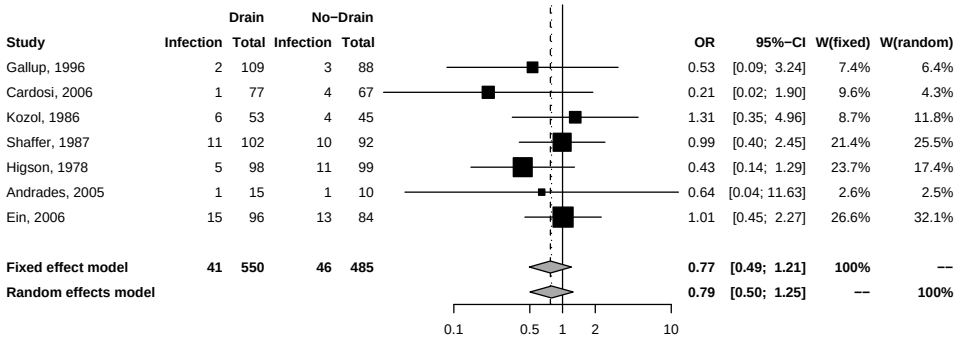
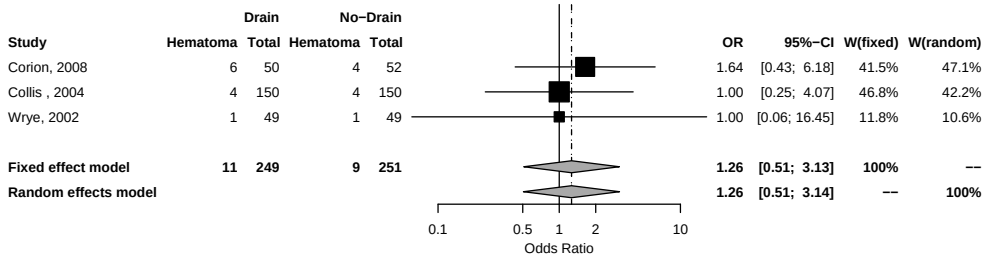


Figure 23: Breast reduction forest plots

A. Hematoma



B. Healing

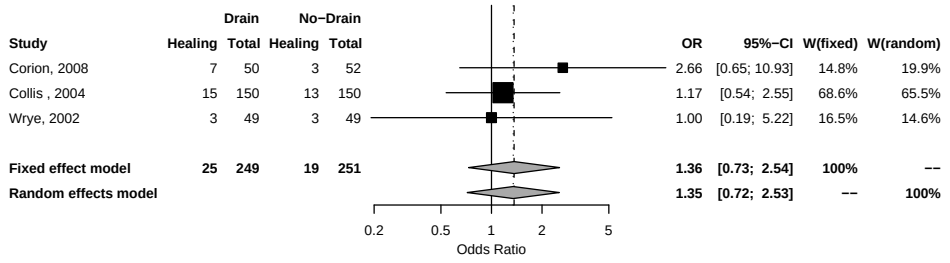
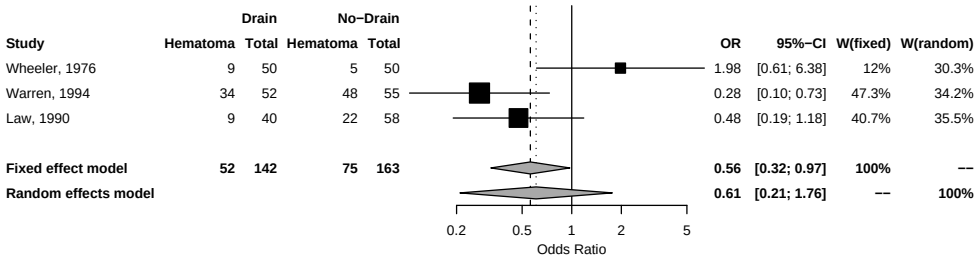


Figure 24: Breast biopsy forest plots

A. Hematoma



B. Infection

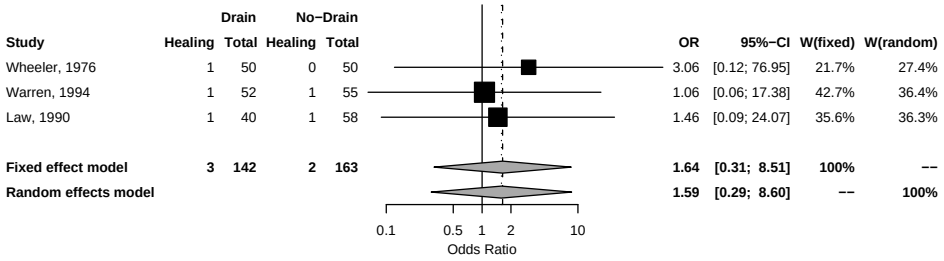


Figure 25: Femoral wounds forest plots

Infection

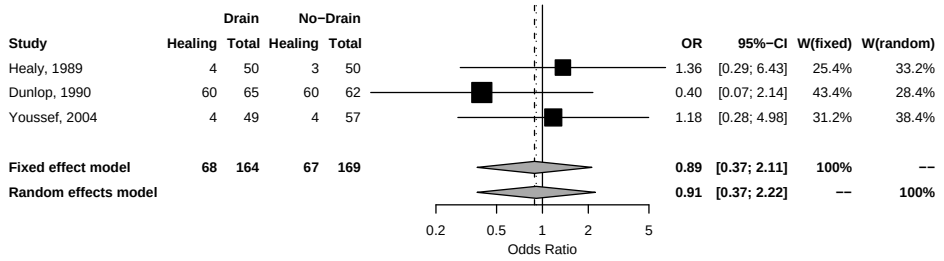
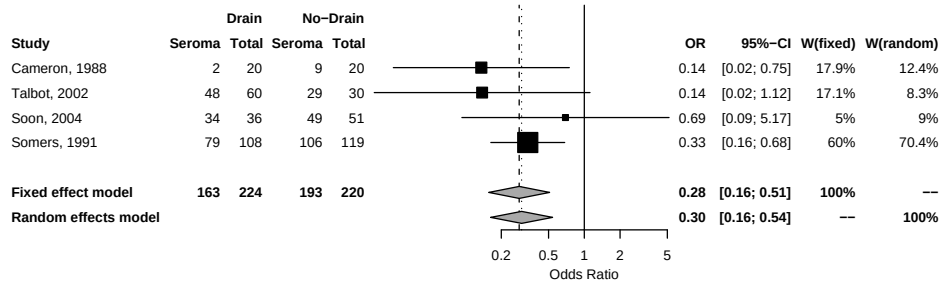


Figure 26: Axillary lymphnode resection forest plots

A. Seroma



B. Infection

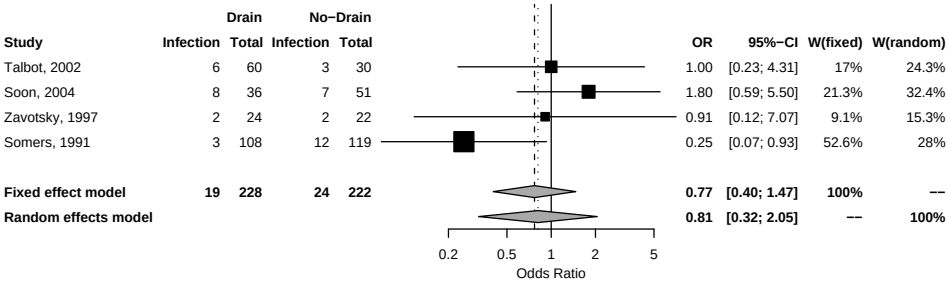


Figure 27: Hip arthroplasty forest plot

Infection

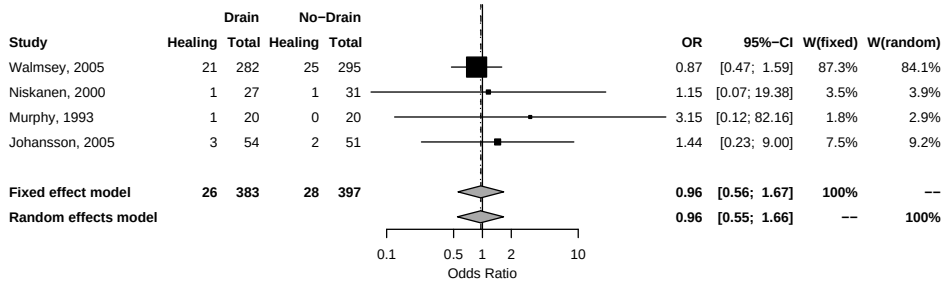


Figure 28: Knee arthroplasty forest plot

Infection

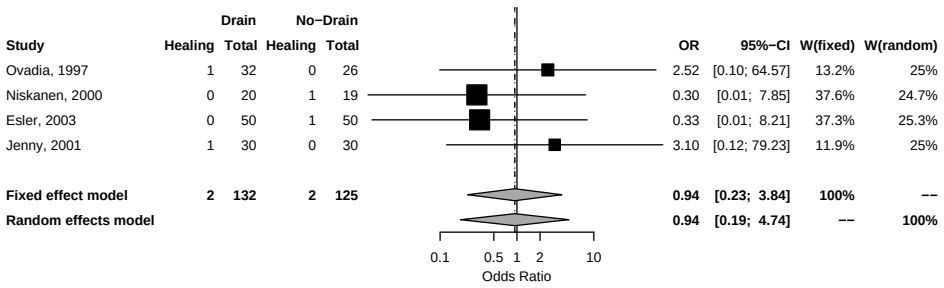


Figure 29: Clean-contaminated wounds forest plots

Infection

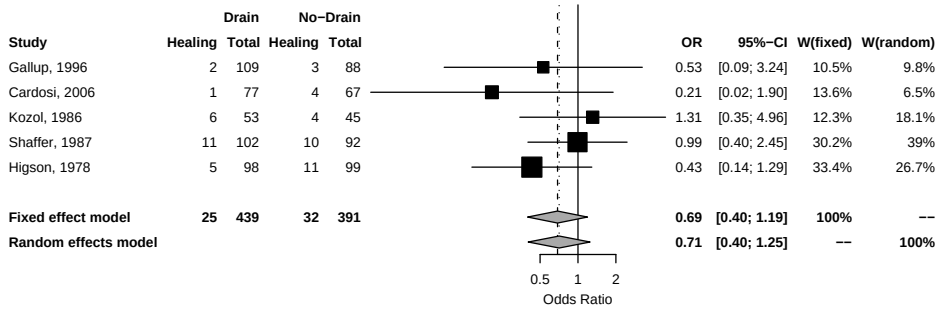
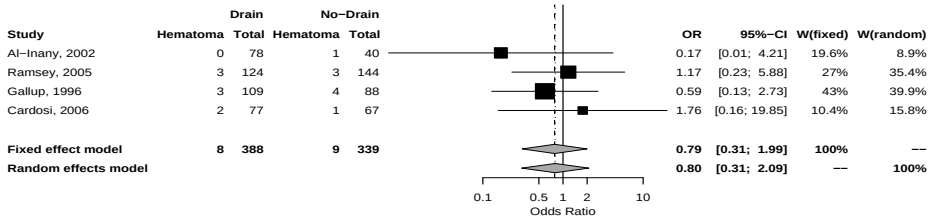
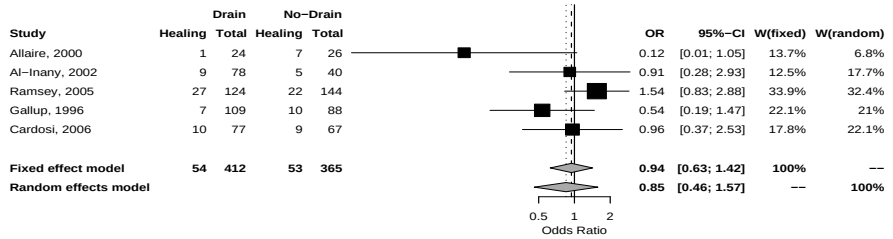


Figure 30: Obese patient forest plots

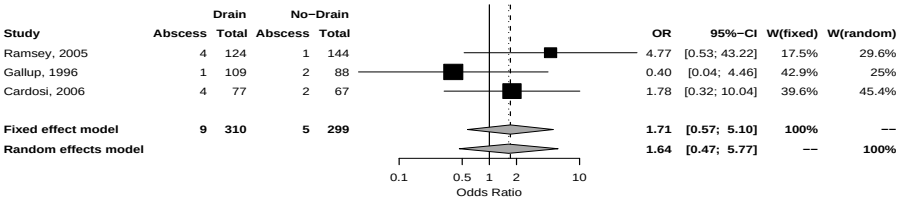
A. Hematoma



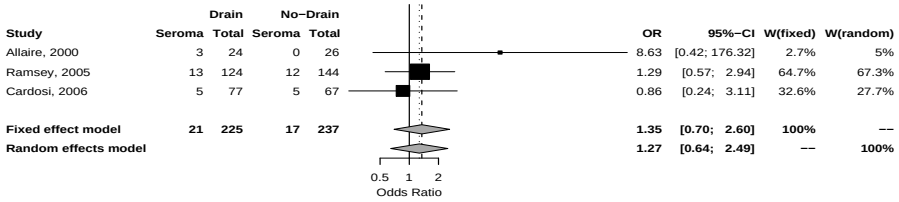
B. Healing



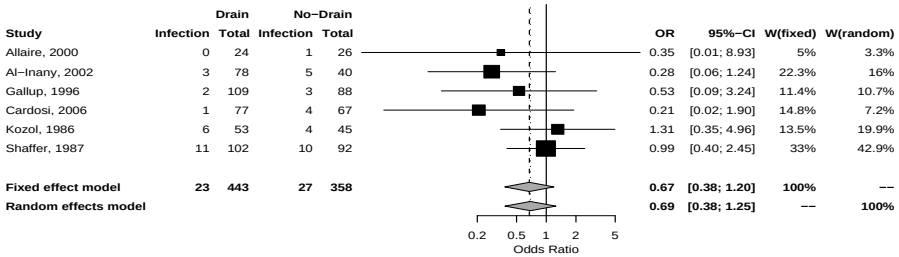
C. Abscess



D. Seroma



E. Infection



6 Discussion

The results of the cumulative analysis including breast biopsies indicate a statistically significant advantage for the drained patients with respect to hematoma and seroma outcomes. On the other hand, drainage status seems to have no significant effect with respect to healing and infection outcomes. This is the case for the abscess outcome as well, however here there is a slight trend towards favoring the no-drain group.

We also conducted a cumulative analysis excluding breast biopsies since breast tissue may be considered an organ and not subcutaneous tissue. The findings from the analysis were similar to the ones listed above: with respect to hematoma, healing and infection drainage appears to have no significant effect. The results for abscess and seroma outcomes were exactly the same as above since no breast biopsies had one of these as an outcome.

The results of the meta-analysis by procedure type indicate a statistically significant advantage for the drained patients with respect to hematoma in breast biopsy procedures and with respect to seroma in axillary lymphnode resection procedures. Other notable results are as follows:

- Hematoma: Drainage status seems to have no significant effect with respect to the outcome of hematoma in cesarean section and breast reduction procedures, procedures with abdominal wounds and procedures on obese patients.
- Healing: Drainage status seems to have no significant effect with respect to the outcome of healing in cesarean section and breast reduction procedures, procedures with abdominal wounds and procedures on obese patients.
- Abscess: Drainage status seems to have no significant effect with respect to the outcome of abscess in procedures on obese patients.
- Seroma: Drainage status seems to have no significant effect with respect to the outcome of seroma in cesarean section procedures, procedures with abdominal wounds and procedures on obese patients.
- Infection: Drainage status seems to have no significant effect with respect to the outcome of infection in cesarean section, breast biopsy, axillary lymphnode resection, hip and knee arthroplasty procedures, procedures with abdominal, femoral and clean-contaminated wounds, and procedures on obese patients.

In the next step we may consider operation time, hospital stay and whether or not the re-operation was required as covariates in the meta-regression. However there may be insufficient data available to effectively estimate these covariate effects. For example, of the 52 studies, operation time information is provided for 11 studies, hospital stay information is provided for 13 studies and information on re-operation is provided for only 3 studies.

7 References

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Houwlingen, Arends, & Stijnen (2002). Tutorial in biostatistics - advanced methods in meta-analysis: multivariate approach and meta-regression. *Statistics in Medicine*, *21*, 589–624.

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8 Appendix

8.1 Cesarean section meta-analysis output and funnel plot

Table 22: Hematoma, odds ratios and test of heterogeneity

```
Number of trials combined: 4

                         OR            95%-CI      z  p.value
Fixed effect model   1.0009  [0.3525; 2.8417] 0.0017   0.9987
Random effects model 1.0165  [0.3247; 3.1824] 0.0282   0.9775

Quantifying heterogeneity:
tau^2 = 0.0000; H = 1 [1; 2.39]; I^2 = 0% [0%; 82.5%]

Test of heterogeneity:
    Q d.f.  p.value
 2.62    3   0.4543

Method: Mantel-Haenszel method
```

Table 23: Healing, odds ratios and test of heterogeneity

```
Number of trials combined: 6

                         OR            95%-CI       z  p.value
Fixed effect model   0.9323  [0.6410; 1.3560] -0.3667   0.7138
Random effects model 0.7962  [0.4149; 1.5282] -0.6851   0.4933

Quantifying heterogeneity:
tau^2 = 0.3020; H = 1.43 [1; 2.27]; I^2 = 51.3% [0%; 80.6%]

Test of heterogeneity:
     Q d.f.  p.value
 10.26    5   0.0682

Method: Mantel-Haenszel method
```

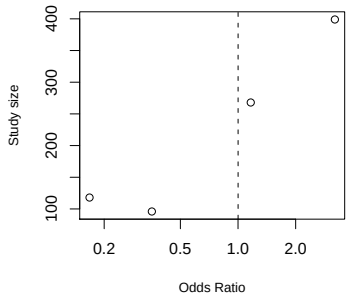
Table 24: Seroma, odds ratios and test of heterogeneity

```
Number of trials combined: 4

                         OR            95%-CI       z  p.value
Fixed effect model   0.9308  [0.5047; 1.7167] -0.2296   0.8184
Random effects model 0.8984  [0.2695; 2.9944] -0.1745   0.8615

Quantifying heterogeneity:
tau^2 = 0.7077; H = 1.4 [1; 2.44]; I^2 = 49.2% [0%; 83.2%]

Test of heterogeneity:
   Q d.f.  p.value
 5.9    3   0.1164

Method: Mantel-Haenszel method
```

Table 25: Infection, odds ratios and test of heterogeneity

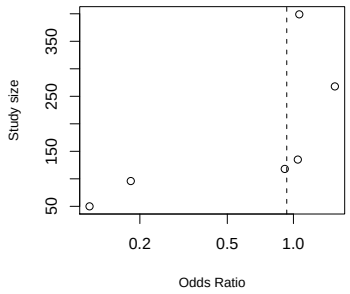
```
Number of trials combined: 5

                         OR            95%-CI       z  p.value
Fixed effect model   1.0323  [0.6175; 1.7257]  0.1213   0.9035
Random effects model 0.9468  [0.4684; 1.9140] -0.1522   0.8791

Quantifying heterogeneity:
tau^2 = 0.1893; H = 1.2 [1; 1.93]; I^2 = 30.2% [0%; 73.1%]

Test of heterogeneity:
    Q d.f.  p.value
 5.73    4   0.2204

Method: Mantel-Haenszel method
```

Figure 31: Funnel plot and rank correlation test for Hematoma meta-analysis



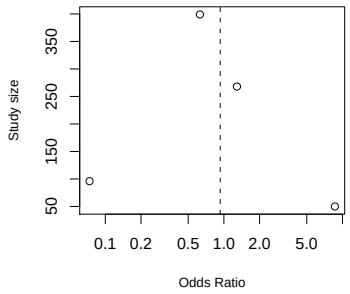

```
Rank correlation test of funnel plot asymmetry

data:  hema_cs
z = -0.6794, p-value = 0.4969
alternative hypothesis: asymmetry in funnel plot
sample estimates:
      ks    se.ks
-2.00000  2.94392
```

Figure 32: Funnel plot and rank correlation test for Healing meta-analysis



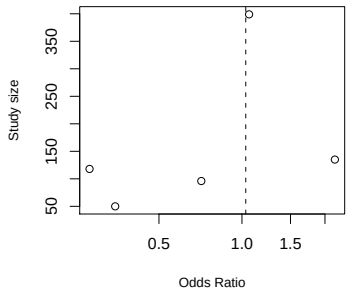

```
Rank correlation test of funnel plot asymmetry

data:  heal_cs
z = -1.6908, p-value = 0.09087
alternative hypothesis: asymmetry in funnel plot
sample estimates:
       ks     se.ks
-9.000000  5.322906
```

Figure 33: Funnel plot and rank correlation test for Seroma meta-analysis




```
Rank correlation test of funnel plot asymmetry

data:  seroma_cs
z = 0, p-value = 1
alternative hypothesis: asymmetry in funnel plot
sample estimates:
     ks   se.ks
0.00000 2.94392
```

Figure 34: Funnel plot and rank correlation test for Infection meta-analysis




```
Rank correlation test of funnel plot asymmetry

data:  infection_cs
z = -0.9798, p-value = 0.3272
alternative hypothesis: asymmetry in funnel plot
sample estimates:
       ks     se.ks
-4.000000  4.082483
```

8.2 Abdominal wounds meta-analysis output and funnel plot

Table 26: Hematoma, odds ratios and test of heterogeneity

```
Number of trials combined: 4

                         OR            95%-CI       z  p.value
Fixed effect model   0.8309  [0.2841; 2.4305] -0.3382   0.7352
Random effects model 0.8214  [0.2663; 2.5337] -0.3423   0.7321

Quantifying heterogeneity:
tau^2 = 0.0000; H = 1 [1; 1.58]; I^2 = 0% [0%; 59.9%]

Test of heterogeneity:
    Q d.f.  p.value
 1.15    3   0.7662

Method: Mantel-Haenszel method
```

Table 27: Healing, odds ratios and test of heterogeneity

```
Number of trials combined: 3

                         OR            95%-CI       z  p.value
Fixed effect model   0.7412  [0.3888; 1.4127] -0.9101   0.3628
Random effects model 0.7421  [0.3875; 1.4210] -0.8999   0.3682

Quantifying heterogeneity:
tau^2 = 0.0000; H = 1 [1; 1.83]; I^2 = 0% [0%; 70.3%]

Test of heterogeneity:
   Q d.f.  p.value
 0.7    2   0.7045

Method: Mantel-Haenszel method
```

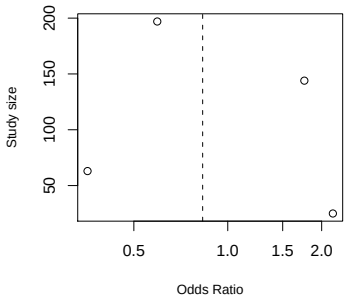
Table 28: Seroma, odds ratios and test of heterogeneity

```
Number of trials combined: 3

                         OR            95%-CI       z  p.value
Fixed effect model   0.6724  [0.2654; 1.7037] -0.8367   0.4027
Random effects model 0.6732  [0.2643; 1.7152] -0.8292   0.407

Quantifying heterogeneity:
tau^2 = 0.0000; H = 1 [1; 1.2]; I^2 = 0% [0%; 31%]

Test of heterogeneity:
   Q d.f.  p.value
 0.3    2   0.8601

Method: Mantel-Haenszel method
```

Table 29: Infection, odds ratios and test of heterogeneity

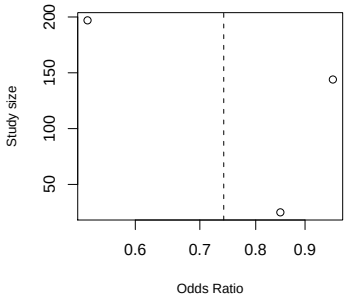
```
Number of trials combined: 7

                         OR            95%-CI       z  p.value
Fixed effect model   0.7730  [0.4947; 1.2079] -1.1304   0.2583
Random effects model 0.7923  [0.5012; 1.2524] -0.9965   0.319

Quantifying heterogeneity:
tau^2 = 0.0000; H = 1 [1; 1.5]; I^2 = 0% [0%; 55.6%]

Test of heterogeneity:
    Q d.f.  p.value
 3.95    6   0.6836

Method: Mantel-Haenszel method
```

Figure 35: Funnel plot and rank correlation test for Hematoma meta-analysis



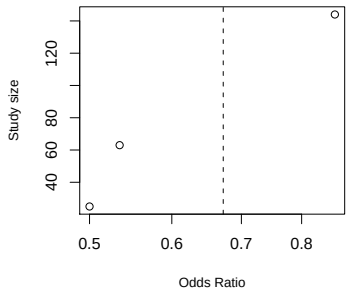

```
Rank correlation test of funnel plot asymmetry

data:  hema_aw
z = 0.6794, p-value = 0.4969
alternative hypothesis: asymmetry in funnel plot
sample estimates:
     ks   se.ks
2.00000 2.94392
```

Figure 36: Funnel plot and rank correlation test for Healing meta-analysis



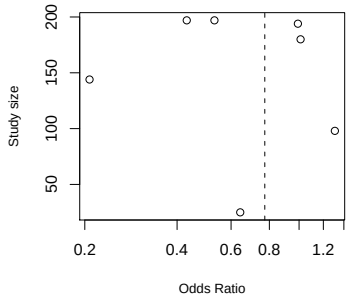

```
Rank correlation test of funnel plot asymmetry

data:  heal_aw
z = -0.5222, p-value = 0.6015
alternative hypothesis: asymmetry in funnel plot
sample estimates:
       ks     se.ks
-1.000000  1.914854
```

Figure 37: Funnel plot and rank correlation test for Seroma meta-analysis




```
Rank correlation test of funnel plot asymmetry

data:  seroma_aw
z = -0.5222, p-value = 0.6015
alternative hypothesis: asymmetry in funnel plot
sample estimates:
       ks     se.ks
-1.000000  1.914854
```

Figure 38: Funnel plot and rank correlation test for Infection meta-analysis




```
Rank correlation test of funnel plot asymmetry

data:  infection_aw
z = -1.0513, p-value = 0.2931
alternative hypothesis: asymmetry in funnel plot
sample estimates:
       ks     se.ks
-7.000000  6.658328
```

8.3 Breast reduction meta-analysis output and funnel plot

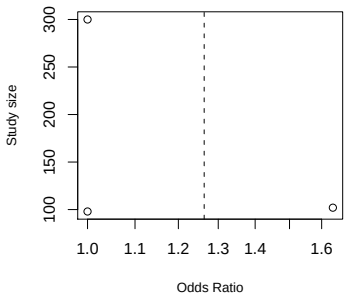
Table 30: Hematoma, odds ratios and test of heterogeneity

```
Number of trials combined: 3

                         OR            95%-CI      z  p.value
Fixed effect model   1.2638  [0.5099; 3.1326] 0.5056   0.6132
Random effects model 1.2613  [0.5062; 3.1427] 0.4984   0.6182

Quantifying heterogeneity:
tau^2 = 0.0000; H = 1 [1; 1.16]; I^2 = 0% [0%; 25.3%]

Test of heterogeneity:
    Q d.f. p.value
 0.28    2    0.87

Method: Mantel-Haenszel method
```

Table 31: Healing, odds ratios and test of heterogeneity

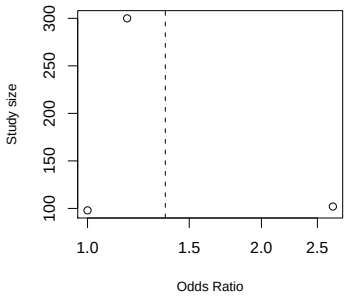
```
Number of trials combined: 3

                         OR            95%-CI      z  p.value
Fixed effect model   1.3635  [0.7309; 2.5437] 0.9745   0.3298
Random effects model 1.3475  [0.7170; 2.5326] 0.9265   0.3542

Quantifying heterogeneity:
tau^2 = 0.0000; H = 1 [1; 2.34]; I^2 = 0% [0%; 81.7%]

Test of heterogeneity:
    Q d.f.  p.value
 1.14    2   0.5656

Method: Mantel-Haenszel method
```

Figure 39: Funnel plot and rank correlation test for Hematoma meta-analysis




```
Rank correlation test of funnel plot asymmetry

data:  hema_br
z = -0.5222, p-value = 0.6015
alternative hypothesis: asymmetry in funnel plot
sample estimates:
       ks     se.ks
-1.000000  1.914854
```

Figure 40: Funnel plot and rank correlation test for Healing meta-analysis




```
Rank correlation test of funnel plot asymmetry

data:  heal_br
z = 0.5222, p-value = 0.6015
alternative hypothesis: asymmetry in funnel plot
sample estimates:
      ks    se.ks
1.000000 1.914854
```

8.4 Breast biopsy meta-analysis output and funnel plot

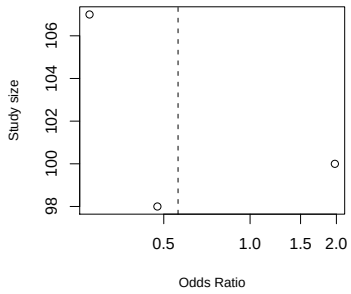
Table 32: Hematoma, odds ratios and test of heterogeneity

```
Number of trials combined: 3

                         OR            95%-CI       z  p.value
Fixed effect model   0.5608  [0.3228; 0.9741] -2.0532   0.0401
Random effects model 0.6077  [0.2096; 1.7618] -0.9172   0.359

Quantifying heterogeneity:
tau^2 = 0.6146; H = 1.82 [1; 3.36]; I^2 = 69.7% [0%; 91.1%]

Test of heterogeneity:
    Q d.f. p.value
 6.59    2   0.037

Method: Mantel-Haenszel method
```

Table 33: Infection, odds ratios and test of heterogeneity

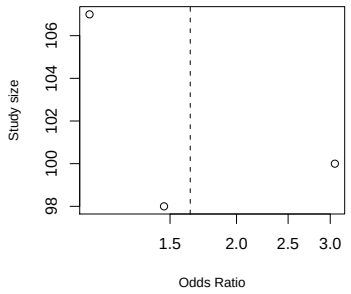
```
Number of trials combined: 3

                         OR            95%-CI      z  p.value
Fixed effect model   1.6370  [0.3149; 8.5104] 0.5860   0.5579
Random effects model 1.5915  [0.2945; 8.6004] 0.5398   0.5893

Quantifying heterogeneity:
tau^2 = 0.0000; H = 1 [1; 1.08]; I^2 = 0% [0%; 14.8%]

Test of heterogeneity:
    Q d.f.  p.value
 0.24    2   0.8851

Method: Mantel-Haenszel method
```

Figure 41: Funnel plot and rank correlation test for Hematoma meta-analysis



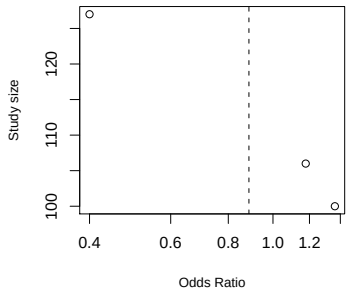

```
Rank correlation test of funnel plot asymmetry

data:  hema_bb
z = 0.5222, p-value = 0.6015
alternative hypothesis: asymmetry in funnel plot
sample estimates:
      ks    se.ks
1.000000 1.914854
```

Figure 42: Funnel plot and rank correlation test for Infection meta-analysis




```
Rank correlation test of funnel plot asymmetry

data:  infection_bb
z = 1.5667, p-value = 0.1172
alternative hypothesis: asymmetry in funnel plot
sample estimates:
      ks    se.ks
3.000000 1.914854
```

Figure 43: Funnel plot and rank correlation test for Infection meta-analysis




```
Rank correlation test of funnel plot asymmetry

data:  infection_fw
z = -0.5222, p-value = 0.6015
alternative hypothesis: asymmetry in funnel plot
sample estimates:
       ks     se.ks
-1.000000  1.914854
```

8.5 Femoral wounds meta-analysis output and funnel plot

Table 34: Healing, odds ratios and test of heterogeneity

```
Number of trials combined: 3

                         OR            95%-CI       z  p.value
Fixed effect model   0.8869  [0.3725; 2.1113] -0.2713   0.7862
Random effects model 0.9100  [0.3723; 2.2245] -0.2068   0.8362

Quantifying heterogeneity:
tau^2 = 0.0000; H = 1 [1; 2.51]; I^2 = 0% [0%; 84.1%]

Test of heterogeneity:
    Q d.f.  p.value
 1.31    2   0.5201

Method: Mantel-Haenszel method
```

8.6 Axillary lymphnode resection meta-analysis output and funnel plot

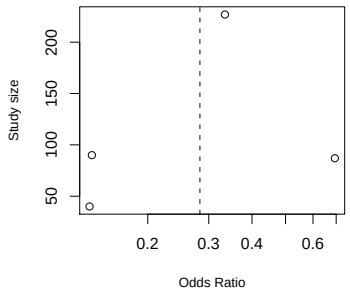
Table 35: Seroma, odds ratios and test of heterogeneity

```
Number of trials combined: 4

                         OR            95%-CI       z  p.value
Fixed effect model   0.2829  [0.1568; 0.5104] -4.1940 < 0.0001
Random effects model 0.2965  [0.1626; 0.5408] -3.9654 < 0.0001

Quantifying heterogeneity:
tau^2 = 0.0000; H = 1 [1; 2.16]; I^2 = 0% [0%; 78.5%]

Test of heterogeneity:
    Q d.f.  p.value
 2.14    3   0.5442

Method: Mantel-Haenszel method
```

Table 36: Infection, odds ratios and test of heterogeneity

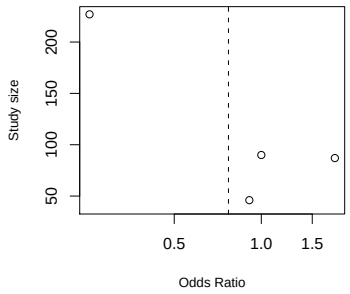
```
Number of trials combined: 4

                         OR            95%-CI       z  p.value
Fixed effect model   0.7698  [0.4032; 1.4699] -0.7927   0.428
Random effects model 0.8127  [0.3215; 2.0541] -0.4384   0.6611

Quantifying heterogeneity:
tau^2 = 0.3747; H = 1.31 [1; 2.26]; I^2 = 41.8% [0%; 80.4%]

Test of heterogeneity:
    Q d.f.  p.value
 5.16    3   0.1608

Method: Mantel-Haenszel method
```

Figure 44: Funnel plot and rank correlation test for Seroma meta-analysis



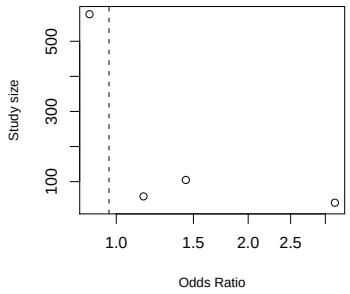

```
Rank correlation test of funnel plot asymmetry

data:  seroma_aln
z = 0, p-value = 1
alternative hypothesis: asymmetry in funnel plot
sample estimates:
     ks   se.ks
0.00000 2.94392
```

Figure 45: Funnel plot and rank correlation test for Infection meta-analysis




```
Rank correlation test of funnel plot asymmetry

data:  infection_aln
z = -0.6794, p-value = 0.4969
alternative hypothesis: asymmetry in funnel plot
sample estimates:
      ks    se.ks
-2.00000  2.94392
```

Figure 46: Funnel plot and rank correlation test for Infection meta-analysis



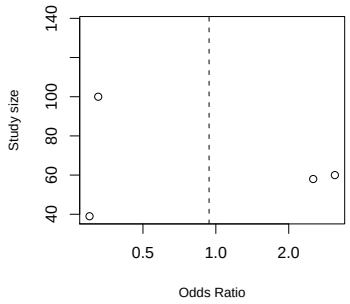

```
Rank correlation test of funnel plot asymmetry

data:  infection_ha
z = 1.3587, p-value = 0.1742
alternative hypothesis: asymmetry in funnel plot
sample estimates:
     ks   se.ks
4.00000 2.94392
```

8.7 Hip arthroplasty meta-analysis output and funnel plot

Table 37: Healing, odds ratios and test of heterogeneity

```
Number of trials combined: 4

                         OR            95%-CI       z  p.value
Fixed effect model   0.9626  [0.5555; 1.6681] -0.1358   0.892
Random effects model 0.9552  [0.5487; 1.6628] -0.1622   0.8712

Quantifying heterogeneity:
tau^2 = 0.0000; H = 1 [1; 1.34]; I^2 = 0% [0%; 44.1%]

Test of heterogeneity:
    Q d.f.  p.value
 0.82    3   0.8443

Method: Mantel-Haenszel method
```

Figure 47: Funnel plot and rank correlation test for Infection meta-analysis



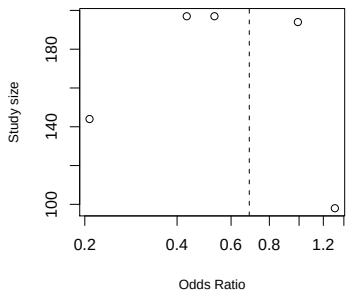

```
Rank correlation test of funnel plot asymmetry

data:  infection_ka
z = -0.6794, p-value = 0.4969
alternative hypothesis: asymmetry in funnel plot
sample estimates:
      ks    se.ks
-2.00000  2.94392
```

8.8 Knee arthroplasty meta-analysis output and funnel plot

Table 38: Healing, odds ratios and test of heterogeneity

```
Number of trials combined: 4

                         OR            95%-CI       z  p.value
Fixed effect model   0.9376  [0.2288; 3.8423] -0.0895   0.9286
Random effects model 0.9374  [0.1853; 4.7415] -0.0782   0.9377

Quantifying heterogeneity:
tau^2 = 0.0000; H = 1 [1; 1.96]; I^2 = 0% [0%; 73.9%]

Test of heterogeneity:
    Q d.f.  p.value
 1.76    3   0.6238

Method: Mantel-Haenszel method
```

Figure 48: Funnel plot and rank correlation test for Infection meta-analysis




```
Rank correlation test of funnel plot asymmetry

data:  infection_cc
z = -0.9798, p-value = 0.3272
alternative hypothesis: asymmetry in funnel plot
sample estimates:
       ks     se.ks
-4.000000  4.082483
```

8.9 Clean-contaminated wounds meta-analysis output and funnel plot

Table 39: Healing, odds ratios and test of heterogeneity

```
Number of trials combined: 5

                         OR            95%-CI       z  p.value
Fixed effect model   0.6880  [0.3979; 1.1897] -1.3382   0.1808
Random effects model 0.7084  [0.4021; 1.2480] -1.1930   0.2329

Quantifying heterogeneity:
tau^2 = 0.0000; H = 1 [1; 2.03]; I^2 = 0% [0%; 75.7%]

Test of heterogeneity:
    Q d.f. p.value
 3.43    4   0.489

Method: Mantel-Haenszel method
```

8.10 Obese patient meta-analysis output and funnel plot

Table 40: Hematoma, odds ratios and test of heterogeneity

```
Number of trials combined: 4

                         OR            95%-CI       z  p.value
Fixed effect model   0.7864  [0.3104; 1.9921] -0.5067   0.6123
Random effects model 0.7997  [0.3053; 2.0944] -0.4551   0.649

Quantifying heterogeneity:
tau^2 = 0.0000; H = 1 [1; 1.9]; I^2 = 0% [0%; 72.4%]

Test of heterogeneity:
    Q d.f. p.value
 1.66    3   0.645

Method: Mantel-Haenszel method
```

Table 41: Healing, odds ratios and test of heterogeneity

```
Number of trials combined: 5

                         OR            95%-CI       z  p.value
Fixed effect model   0.9433  [0.6257; 1.4219] -0.2789   0.7803
Random effects model 0.8507  [0.4597; 1.5745] -0.5147   0.6068

Quantifying heterogeneity:
tau^2 = 0.2072; H = 1.33 [1; 2.2]; I^2 = 43.7% [0%; 79.3%]

Test of heterogeneity:
   Q d.f.  p.value
 7.1    4   0.1306

Method: Mantel-Haenszel method
```

Table 42: Abscess, odds ratios and test of heterogeneity

```
Number of trials combined: 3

                         OR            95%-CI      z  p.value
Fixed effect model   1.7108  [0.5735; 5.1035] 0.9629   0.3356
Random effects model 1.6385  [0.4652; 5.7715] 0.7686   0.4421

Quantifying heterogeneity:
tau^2 = 0.1317; H = 1.06 [1; 3.27]; I^2 = 10.3% [0%; 90.7%]

Test of heterogeneity:
    Q d.f. p.value
 2.23    2   0.328

Method: Mantel-Haenszel method
```

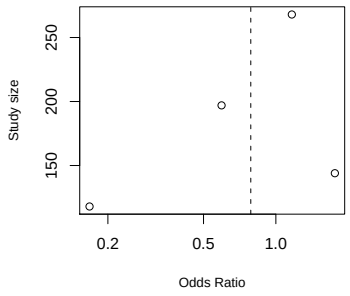
Table 43: Seroma, odds ratios and test of heterogeneity

```
Number of trials combined: 3

                         OR            95%-CI      z  p.value
Fixed effect model   1.3468  [0.6976; 2.6003] 0.8870   0.3751
Random effects model 1.2678  [0.6448; 2.4930] 0.6879   0.4915

Quantifying heterogeneity:
tau^2 = 0.0000; H = 1 [1; 3.05]; I^2 = 0% [0%; 89.2%]

Test of heterogeneity:
    Q d.f.  p.value
 1.93    2   0.3806

Method: Mantel-Haenszel method
```

Table 44: Infection, odds ratios and test of heterogeneity

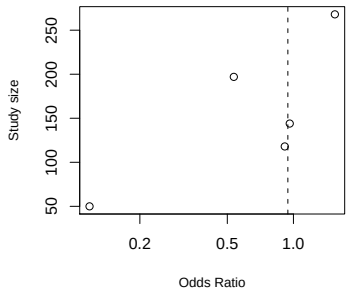
```
Number of trials combined: 6

                         OR            95%-CI      z  p.value
Fixed effect model   0.6741  [0.3801; 1.1956] -1.349   0.1773
Random effects model 0.6905  [0.3812; 1.2506] -1.222   0.2217

Quantifying heterogeneity:
tau^2 = 0.0000; H = 1 [1; 1.84]; I^2 = 0% [0%; 70.5%]

Test of heterogeneity:
   Q d.f.  p.value
 4.3    5   0.5065

Method: Mantel-Haenszel method
```

Figure 49: Funnel plot and rank correlation test for Hematoma meta-analysis



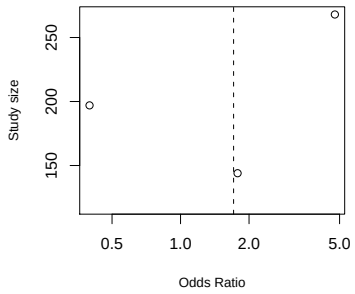

```
Rank correlation test of funnel plot asymmetry

data:  hema_op
z = 0, p-value = 1
alternative hypothesis: asymmetry in funnel plot
sample estimates:
     ks   se.ks
0.00000 2.94392
```

Figure 50: Funnel plot and rank correlation test for Healing meta-analysis



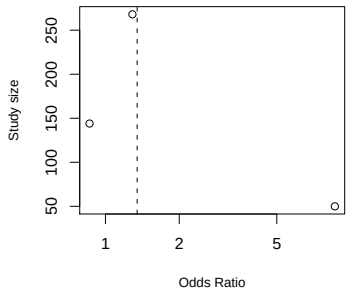

```
Rank correlation test of funnel plot asymmetry

data:  heal_op
z = -1.9596, p-value = 0.05004
alternative hypothesis: asymmetry in funnel plot
sample estimates:
       ks     se.ks
-8.000000  4.082483
```

Figure 51: Funnel plot and rank correlation test for Abscess meta-analysis



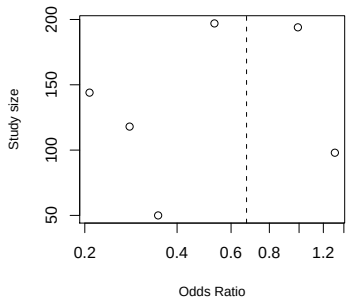

```
Rank correlation test of funnel plot asymmetry

data:  abscess_op
z = -0.5222, p-value = 0.6015
alternative hypothesis: asymmetry in funnel plot
sample estimates:
       ks     se.ks
-1.000000  1.914854
```

Figure 52: Funnel plot and rank correlation test for Seroma meta-analysis




```
Rank correlation test of funnel plot asymmetry

data:  seroma_op
z = 0.5222, p-value = 0.6015
alternative hypothesis: asymmetry in funnel plot
sample estimates:
      ks    se.ks
1.000000 1.914854
```

Figure 53: Funnel plot and rank correlation test for Infection meta-analysis




```
Rank correlation test of funnel plot asymmetry

data:  infection_op
z = -0.9393, p-value = 0.3476
alternative hypothesis: asymmetry in funnel plot
sample estimates:
       ks     se.ks
-5.000000  5.322906
```