

Fig. E-1

Flow chart for study selection. RCT = randomized controlled trial, and THR = total hip replacement.

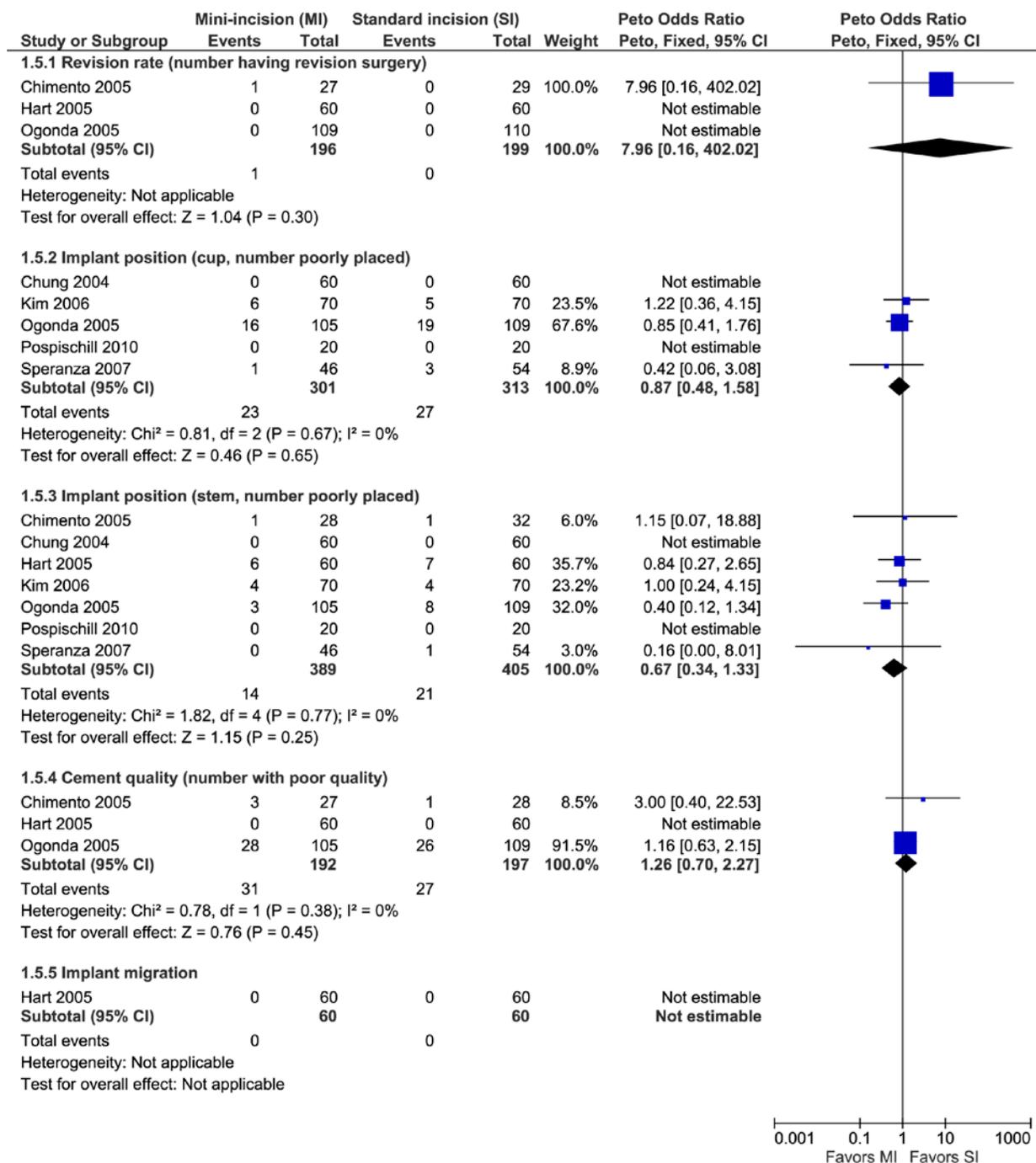


Fig. E-2

Revision rate and surrogates for long-term outcomes. CI = confidence interval, and df = degrees of freedom.

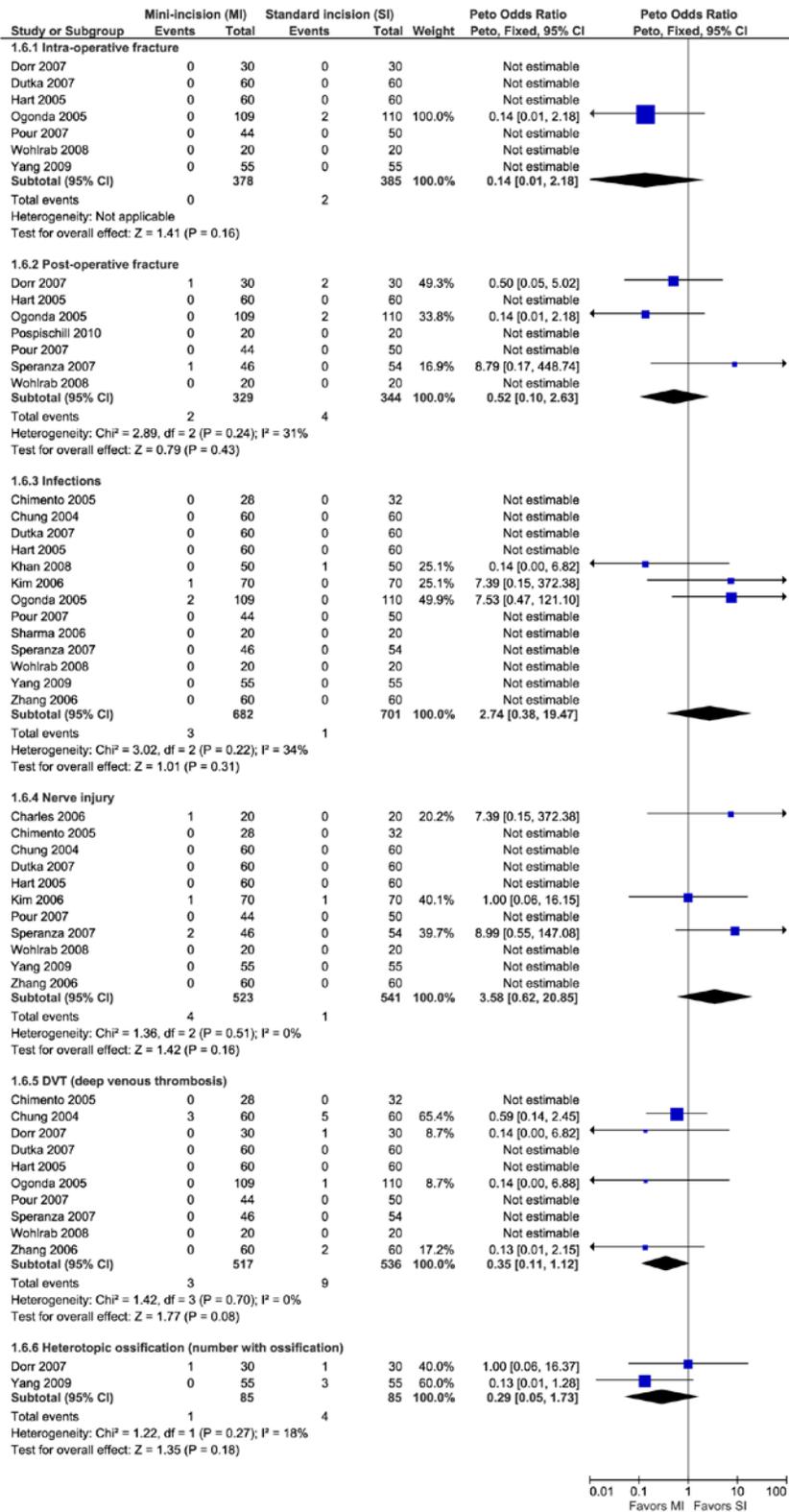


Fig. E-3

Short-term complications. CI = confidence interval, and df = degrees of freedom.

TABLE E-1 MEDLINE and Embase Search Strategy To Identify Reports of Clinical Effectiveness of Minimally Invasive Hip Arthroplasty

Query	Search
1	Arthroplasty, Replacement, Hip/
2	Total Hip Prosthesis/ use emez
3	Hip Prosthesis/
4	(hip adj3 (arthroplast\$ or replace\$ or prosthesis\$ or implant\$)).tw.
5	or/1-4 (
6	Osteoarthritis,Hip/su
7	exp Arthritis/su
8	(osteoarthritis or arthritis).tw.
9	hip.tw,hw.
10	(7 or 8) and 9
11	or/6,10
12	Hip Joint/su use mesz
13	Hip/su use mesz
14	Hip Surgery/ use emez
15	(arthroplast\$ or replace\$ or prosthesis\$ or implant\$).tw.
16	(12 or 13 or 14) and 15
17	5 or 11 or 16
18	Surgical procedures, minimally invasive/ (
19	Robotics/
20	Video-assisted Surgery/
21	(minimal\$ adj3 (invasiv\$ or access\$ or surg\$)).tw. (32039)
22	((small or single or double or mini or one or two) adj3 incision\$).tw.
23	computer aid\$.tw.
24	robotic\$.tw.
25	(key hole or keyhole).tw.
26	(less adj5 invasiv\$).tw.
27	or/18-26
28	17 and 27
29	humans/
30	animals/ or nonhuman/
31	30 not (29 and 30)
32	28 not 31
33	remove duplicates from 32

TABLE E-2 Assessment of Risk of Bias

Study	Question*								
	1	2	3	4	5	6	7	8	9
Charles 2006 <sup>27</sup> †	U	U	Y	N	Y	Y	Y	N	N
Chimento 2005 <sup>21</sup>	Y	Y	Y	Y	Y	U	U	Y	Y
Chung 2004 <sup>22</sup>	N	N	U	Y	Y	N	N	Y	Y
Dorr 2007 <sup>38</sup>	U	U	Y	Y	Y	Y	Y	Y	Y
Dutka 2007 <sup>33</sup>	N	N	Y	N	Y	N	N	Y	U
Farr 2008 <sup>20</sup> †	U	U	Y	N	U	U	U	N	U
Hart 2005 <sup>23</sup>	N	N	U	Y	Y	N	U	N	Y
Khan 2008 <sup>28</sup> †	U	U	Y	N	Y	N	Y	N	U
Kim 2006 <sup>24</sup>	N	N	Y	N	Y	Y	Y	N	U
Kiyama 2008 <sup>34</sup>	N	N	Y	N	Y	U	U	Y	U
Ogonda 2005 <sup>19</sup>	Y	Y	Y	Y	Y	Y	Y	Y	U
Pneumatics 2007 <sup>29</sup> †	U	U	Y	N	U	U	U	N	U
Pospischill 2010 <sup>32</sup>	Y	Y	Y	Y	U	U	U	Y	Y
Pour 2007 <sup>35</sup>	Y	U	Y	Y	U	U	N	Y	N
Rachbauer 2006 <sup>30</sup> †	U	U	Y	Y	U	U	U	N	U
Sharma 2006 <sup>31</sup> †	U	U	N	N	Y	Y	Y	U	U
Speranza 2007 <sup>36</sup>	Y	U	Y	N	U	U	N	Y	N
Wohlrab 2008 <sup>37</sup>	Y	U	Y	Y	N	N	N	Y	Y
Yang 2009 <sup>25</sup>	Y	U	Y	Y	U	U	U	Y	Y
Zhang 2006 <sup>26</sup>	Y	Y	Y	Y	Y	Y	U	Y	Y

\*U = uncertain. 1. Was a method of sequence generation adequate? 2. Was the treatment allocation concealed? 3. Were the groups similar at baseline regarding the most important prognostic indicators? 4. Were the eligibility criteria specified? 5. Was the outcome assessor blinded? 6. Was the care provider blinded? 7. Was the patient blinded? 8. Were point estimates and measures of variability presented for the primary outcome measures? 9. Did the analysis include an intention-to-treat analysis? †Abstract only.

TABLE E-3 Recovery After Surgery\*

Measure and Study	Measure	Mini-Incision		Standard Incision		Reported P Value
		N	Mean (Std. Dev.)	N	Mean (Std. Dev.)	
Short-term pain—analgesic requirement						
Charles 2006 <sup>27</sup>	PCA narcotic consumption ( <i>mg</i> )	18	22.8	19	19.5	0.105
Chimento 2005 <sup>21</sup>	Patient-controlled epidural anesthesia ( <i>mL</i> )	28	285 (185)	32	319 (177)	0.3
Chung 2004 <sup>22</sup>	Narcotic use ( <i>d</i> )	60	2.20	60	2.64	NS
Dorr 2007 <sup>38</sup>	Equianalgesic mg of morphine	30	31.2 (22.9)	30	41.5 (20.0)	NR
Dutka 2007 <sup>33</sup>	Nonnarcotic analgesic ( <i>no. of doses</i> )	60	16.5	60	15.8	>0.05
Dutka 2007 <sup>33</sup>	Narcotic analgesic ( <i>no. of doses</i> )	60	1.8	60	2.5	>0.05
Ogonda 2005 <sup>19</sup>	Morphine ( <i>mg</i> )	109	42.9 (97.4)	110	45.0 (96.8)	0.89
Pneumaticos 2007 <sup>29</sup>	Analgesic use	25	NR	27	NR	NS
Pour 2007 <sup>35</sup>	Equianalgesic mg of morphine	44	41.6 [range, 2.4-120]	50	37.3 [range, 6.1-113.7]	0.65
Rachbauer 2006 <sup>30</sup>	Analgesic use	60	NR	60	NR	NS
Short-term pain—other						
Charles 2006 <sup>27</sup>	Pain score (not defined)	18	3.9	19	3.7	0.129
Dorr 2007 <sup>38</sup>	10-point VAS at discharge	30	2.2 (1.0)	30	3.1 (0.9)	0.002
Dutka 2007 <sup>33</sup>	10-point VAS at discharge	60	4.8 (1.1)	60	4.1 (0.8)	>0.05
Khan 2008 <sup>28</sup>	VAS at 6 and 12 weeks	50	NR	50	NR	NS
Kim 2006 <sup>24</sup>	10-point VAS at 2 weeks and 3 months	70	NR	70	NR	>0.05
Ogonda 2005 <sup>19</sup>	100-mm VAS in first 7 days following discharge	109	33 (18.0)	110	33.6 (19.6)	0.82
Pneumaticos 2007 <sup>29</sup>	VAS	25	NR	27	NR	NS
Rachbauer 2006 <sup>30</sup>	Postoperative pain in the first week	60	Lower	60	Higher	Sig
Sharma 2006 <sup>31</sup>	10-point VAS at day 1	20	4.05	20	6.25	0.0089
Wohlrab 2008 <sup>37</sup>	VAS (not defined) at	20	26.7	20	24.6	0.65

	10 days					
Wohlrab 2008 <sup>37</sup>	VAS (not defined) at 3 months	20	8.2	20	11.9	0.076
Yang 2009 <sup>25</sup>	100-mm VAS at twenty-four hours	55	30.8 (21.8)	55	50.3 (13.7)	<0.01
Long-term pain						
Dutka 2007 <sup>33</sup>	10-point VAS at 6 months	60	0.8 (0.2)	60	0.7 (0.4)	>0.05
Kim 2006 <sup>24</sup>	10-point VAS at 6 months, 1 year, and 2 years	70	NR	70	NR	>0.05
Return to usual activities, short-term						
Rachbauer 2006 <sup>30</sup>	Time to return to daily activities	60	Shorter	60	Longer	NR
Chimento 2005 <sup>21</sup>	Required a cane at 6 weeks ( <i>no. of patients</i> )	28	9	32	15	NS
Chung 2004 <sup>22</sup>	Use of walking aids ( <i>d</i> )	60	21.4 (4.8)	60	24.8 (5.4)	NR
Dorr 2007 <sup>38</sup>	Use of single assistive device (a cane or single clutch) at discharge ( <i>no. of patients</i> )	30	26	30	16	0.005
Khan 2008 <sup>28</sup>	Dependence on walking aids at 2 and 6 weeks	50	Less	50	More	Sig
Khan 2008 <sup>28</sup>	Dependence in walking aids at 12 weeks	50	NR	50	NR	NS
Pour 2007 <sup>35</sup>	Required assistance or contact guard to walk ( <i>no. of patients</i> )	44	9	50	15	0.3
Pneumaticos 2007 <sup>29</sup>	Early walking ability	25	NR	27	NR	NS
Yang 2009 <sup>25</sup>	Walk independently and climb stairs ( <i>no. of patients</i> )	55	55	55	41	<0.01
Limp, short-term						
Chimento 2005 <sup>21</sup>	Persistent limp at 6 weeks ( <i>no. of patients</i> )	28	6	31	15	0.04
Limp, long-term						
Chimento 2005 <sup>21</sup>	Persistent limp at 1 year ( <i>no. of patients</i> )	27	0	29	0	

\*PCA = patient-controlled analgesia, NS = not significant, NR = not reported, VAS = visual analog scale, and Sig = significant.

TABLE E-4 Condition-Specific Quality of Life\*

Measure and Study	Mini-Incision		Standard Incision		Reported P Value
	N	Mean (Std. Dev.) or Median [Range]	N	Mean (Std. Dev.) or Median [Range]	
≤3 months					
Harris hip score†					
Dorr 2007 <sup>38</sup>	30	NR	30	NR	NS
Dutka 2007 <sup>33</sup>	60	81 [72-88]	60	82 [73-87]	>0.05
Ogonda 2005 <sup>19</sup>	107	84.15 (10.56)	108	83.36 (8.33)	0.54
Pour 2007 <sup>35</sup>	44	86.9 [64.9-100]	50	87.2 [51.4-99.8]	0.9
Speranza 2007 <sup>36</sup>	45	91.3 [78-100]	52	86.7 [76-100]	>0.05
Wohlrab 2008 <sup>37</sup>	20	96.1	20	91.7	0.017
Yang 2009 <sup>25</sup>	55	83.80 (5.64)	55	75.0 (7.5)	<0.01
Zhang 2006 <sup>26</sup>	60	91.4	60	78.5	<0.05
Merle d'Aubigné-Charnley score†					
Hart 2005 <sup>23</sup>	60	16.6	60	14.1	<0.02
WOMAC osteoarthritis index‡					
Charles 2006 <sup>27</sup>	16	91.99	19	89.60	0.690
Ogonda 2005 <sup>19</sup>	107	74.40 (13.88)	108	73.95 (12.90)	NR
Pour 2007 <sup>35</sup>	44	11.6 [0-40]	50	13.1 [0-51]	0.5
Speranza 2007 <sup>36</sup>	45	27.7 [20-66]	52	28.2 [22-54]	>0.05
Oxford hip score‡					
Khan 2008 <sup>28</sup>	50	NR	50	NR	NS
Ogonda 2005 <sup>19</sup>	107	24.97 (7.33)	108	25.88 (6.29)	NR
>3 months					
Harris hip score†					
Chimento 2005 <sup>21</sup>	27	94.5	29	94.5	NR
Chung 2004 <sup>22</sup>	60	95.5	60	93.5	NS
Dorr 2007 <sup>38</sup>	30	96.8	30	96.0	NR
Dutka 2007 <sup>33</sup>	60	92 [87-95]	60	88 [80-93]	>0.05
Farr 2008 <sup>20</sup>	97	Better	119	Worse	Sig
Kim 2006 <sup>24</sup>	70	93 [86-100]	70	91 [85-100]	0.7435
Pneumaticos 2007 <sup>29</sup>	25	NR	27	NR	NS
Speranza 2007 <sup>36</sup>	45	92.4 [82-100]	52	91 [78-100]	>0.05

Yang 2009 <sup>25</sup>	55	91.2 (5.4)	55	91.6 (4.8)	0.66
Zhang 2006 <sup>26</sup>	60	95.1	60	95.6	>0.05
Merle d'Aubigné- Charnley score†					
Farr 2008 <sup>20</sup>	97	Better	119	Worse	Sig
Hart 2005 <sup>23</sup>	60	17.4	60	17.3	NS
WOMAC osteoarthritis index‡					
Farr 2008 <sup>20</sup>	97	Better	119	Worse	Sig
Pour 2007 <sup>35</sup>	44	11.6 [0-40]	50	13.1 [0-51]	0.5
Speranza 2007 <sup>36</sup>	45	25.6 [20-66]	52	26 [21-54]	>0.05

\*NR = not reported, NS = not significant, Sig = significant, and WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index. †Higher scores reflect better quality of life. ‡Higher scores reflect poorer quality of life.

TABLE E-5 Intraoperative Blood Loss\*

Study	Mini-Incision		Standard Incision		Reported P Value
	N	Mean (Std. Dev.) or Median [Range] (mL)	N	Mean (Std. Dev.) or Median [Range] (mL)	
Charles 2006 <sup>27</sup>	20	460.0	20	462.5	0.966
Chimento 2005 <sup>21</sup>	28	127 (48)	32	170 (65)	0.003
Chung 2004 <sup>22</sup>	60	136.0 (41.1)	60	200.5 (65.2)	<0.01
Dorr 2007 <sup>38</sup>	30	295.0 (124.12)	30	348.3 (131.0)	0.64
Farr 2008 <sup>20</sup>	97	Less	119	More	<0.01
Hart 2005 <sup>23</sup>	60	318.8 [200-460]	60	544.4 [390-880]	NR
Khan 2008 <sup>28</sup>	50	NR	50	NR	NS
Kim 2006 <sup>24</sup>	70	445.8	70	567.5	0.1687
Ogonda 2005 <sup>19</sup>	109	314.0 [90-1310]	110	365.8 [100-1100]	0.03
Pour 2007 <sup>35</sup>	44	201 [25-500]	50	226 [100-700]	0.19
Rachbauer 2006 <sup>30</sup>	60	Less	60	More	<0.01
Yang 2009 <sup>25</sup>	55	376.2 (168.3)	55	605.0 (225.1)	<0.01
Total	683		716		

\*NR = not reported, and NS = not significant.

TABLE E-6 Length of Operation\*

Study	Mini-Incision		Standard Incision		Reported P Value
	N	Mean (Std. Dev.) or Median [Range] ( <i>min</i> )	N	Mean (Std. Dev.) or Median [Range] ( <i>min</i> )	
Charles 2006 <sup>27</sup>	20	95.2	20	87.7	0.315
Chimento 2005 <sup>21</sup>	28	70.3 (10.7)	32	70.0 (8.5)	0.4
Chung 2004 <sup>22</sup>	60	49.0 (9.4)	60	55.1 (17.9)	NR
Dorr 2007 <sup>38</sup>	30	99.69 (24.57)	30	110.67 (40.61)	0.20
Dutka 2007 <sup>33</sup>	60	118 (16)	60	113 (18)	<0.05
Farr 2008 <sup>20</sup>	97	NR	119	NR	0.37
Hart 2005 <sup>23</sup>	60	71 [55-84]	60	70 [51-86]	NR
Khan 2008 <sup>28</sup>	50	Similar	50	Similar	NR
Kim 2006 <sup>24</sup>	70	52 [48-70]	70	61 [51-80]	<0.001
Kiyama 2008 <sup>34</sup>	10	73.6 [60-81]	10	69.0 [55-80]	0.22
Ogonda 2005 <sup>19</sup>	109	60.3 (9.2)	110	65.9 (13.2)	NR
Pneumatics 2007 <sup>29</sup>	25	NR	27	NR	NS
Pour 2007 <sup>35</sup>	44	52.6 [30-100]	50	50 [34-82]	0.27
Rachbauer 2006 <sup>30</sup>	60	NR	60	NR	NS
Sharma 2006 <sup>31</sup>	20	NR	20	NR	0.207
Speranza 2007 <sup>36</sup>	46	101 [75-135]	54	117 [70-135]	>0.05
Wohlrab 2008 <sup>37</sup>	20	57	20	61	NR
Yang 2009 <sup>25</sup>	55	77.6 (13.4)	55	73.7 (14.5)	0.15
Zhang 2006 <sup>26</sup>	60	75	60	69	>0.05
Total	924		967		

\*NR = not reported, and NS = not significant.

TABLE E-7 Length of Hospital Stay\*

Study	Mini-Incision		Standard Incision		Reported P Value
	N	Mean (Std. Dev.) or Median [Range] (d)	N	Mean (Std. Dev.) or Median [Range] (d)	
Charles 2006 <sup>27</sup>	20	5.35	20	5.70	0.501
Chimento 2005 <sup>21</sup>	28	5.8 [4-13]	32	5.5 [3-15]	0.6
Chung 2004 <sup>22</sup>	60	4.41 (1.1)	60	5.34 (1.4)	<0.01
Dorr 2007 <sup>38</sup>	30	2.63 (0.55)	30	3.07 (0.98)	0.04
Dutka 2007 <sup>33</sup>	60	11.6	60	12.3	>0.05
Farr 2008 <sup>20</sup>	97	NR	119	NR	0.24
Khan 2008 <sup>28</sup>	50	NR	50	NR	NS
Ogonda 2005 <sup>19</sup>	109	3.65 (2.04)	110	3.68 (2.45)	0.94
Pneumatics 2007 <sup>29</sup>	25	NR	27	NR	NS
Pour 2007 <sup>35</sup>	44	3.92 [2-8]	50	3.79 [2-6]	0.5
Sharma 2006 <sup>31</sup>	20	Shorter	20	Longer	0.042
Speranza 2007 <sup>36</sup>	46	10 [6-20]	54	11 [6-18]	>0.05
Zhang 2006 <sup>26</sup>	60	7 [5-8]	60	13.5 [12-16]	NR
Total	649		692		

\*NR = not reported, and NS = not significant.