



**10 YEARS OF PROGRESS: IMPROVED HYSTERECTOMY  
OUTCOMES IN FINLAND 1996 – 2006**

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10 YEARS OF PROGRESS: IMPROVED HYSTERECTOMY OUTCOMES IN FINLAND  
1996 – 2006

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Running title: Improved hysterectomy outcomes in Finland 1996 - 2006

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3 35 **Abstract**  
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6 37 **Objectives:** To study the outcome of various hysterectomies in two years 1996 and 2006.  
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8 38 The hypothesis was that the change in operative practices in ten years have resulted in  
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10 39 improvements.  
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13 41 **Design:** Two prospective nationwide cohort evaluations with the same questionnaire.  
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16 43 **Setting:** All national operative hospitals in Finland.  
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19 45 **Participants:** Patients scheduled to either abdominal, vaginal or laparoscopic hysterectomy  
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21 46 for benign disease.  
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24 48 **Outcome measures:** Patients characteristics, surgery related details and complications  
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26 49 (organ injury, infection, VTE, haemorrhage).  
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29 51 **Results:** The overall complication rates fell in LH and markedly in VH (from 22.2% to 11.7%,  
30  
31 52  $p < 0.001$ ). The overall surgery-related infectious morbidity decreased in all groups and  
32  
33 53 significantly in VH (from 12.3% to 5.2%,  $p < 0.001$ ) and AH (from 9.9% to 7.7%,  $p < 0.05$ ). The  
34  
35 54 incidence of bowel lesions in VH sank from 0.5% to 0.1% and of ureter lesions in LH from  
36  
37 55 1.1% to 0.3%. In 2006 there were no deaths compared to three in 1996.  
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40 57 **Conclusions:** The rate of postoperative complications fell markedly in the decade from 1996  
41  
42 58 to 2006. This parallels with the recommendation of the recent meta-analyses by Cochrane  
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44 59 Collaboration; the order of preference of hysterectomies was first time precisely followed in  
45  
46 60 this nationwide study.  
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49 62 **Trial registration:** In the clinical trials of protocol registration system data (NCT00744172).  
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51 63

52 64 Funding: No funding  
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54 65

55 66 Keywords: Hysterectomy, complications, longitudinal cohort study  
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3 68 The 2006 study was registered in the Clinical Trials of Protocol Registration System Data  
4 69 (NCT00744172).  
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## 71 **Introduction**

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73 With the advent of laparoscopic hysterectomy (LH) in the late 1980's<sup>1</sup> the role of vaginal (VH)  
74 and abdominal hysterectomies (AH) has been a matter of re-evaluation. The rate of  
75 abdominal hysterectomies (AH) has subsequently fallen in some countries (Figure 1),<sup>2,3,4,5,6</sup>  
76 but AH still predominates in many countries as the main method for hysterectomy. Along  
77 with these changes, the attitudes have, however, gradually changed in favor of VH and LH,  
78 which present themselves as less traumatizing procedures than AH.

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80 More than twenty years ago a systematic follow-up of the advantages and disadvantages of  
81 the then novel laparoscopic method for performing hysterectomy would have been  
82 scientifically and clinically very much in order. However, the opportunity of collecting valuable  
83 pioneering data on the benefits and disadvantages of LH in comparison to the established  
84 methods (VH and AH) was never grasped. In Finland, a nationwide study on the morbidity  
85 related to AH, VH and LH for benign conditions was conducted in 1996.<sup>8</sup> Not surprisingly, the  
86 most modern method, LH, was, at that time, associated with more severe complications than  
87 the other methods. The rate of complications stood also in proportion to the experience of the  
88 surgeons – the more experienced the surgeon, the less LH-associated complications.

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90 Since the beginning of the 2000's, several smaller studies, hospital-based series of LHs<sup>2</sup> and  
91 RCTs<sup>18-19</sup> have been published. Cochrane meta-analysis recommended VH as the primary  
92 technique for hysterectomy, followed by LH when appropriate.<sup>20-21</sup> There are, however, no  
93 longitudinal follow-up studies on the results of hospital-based or nationwide studies on  
94 patients undergoing hysterectomy. Such studies are not only scientifically important but they  
95 also constitute important measures of quality control and are, as such, badly needed to help  
96 us to understand what we have learned of the different approaches to hysterectomy during  
97 all these years.<sup>22</sup> We conducted a nationwide survey on the outcomes of hysterectomies of  
98 two cohorts first in 1996 and second in 2006. In this paper we compare the results after AH,  
99 VH and LH for benign conditions in 2006<sup>6</sup> with the results 10 years previously.<sup>8</sup>

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6 105 **Methods**

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8 107 Information on all hysterectomies performed for benign conditions in Finland was  
9 108 prospectively registered from January 1st to December 31<sup>st</sup>, 2006, by the operating  
10 109 gynecologist.<sup>6</sup> Data collection was nationwide and followed the same procedure as in the  
11 110 survey ten years previously, the FINHYST 1996 study.<sup>8</sup> A dedicated form (FINHYST 2006)  
12 111 was used to collect data on preoperative, peroperative and postoperative events and  
13 112 operation-related morbidity during the patients' hospital stay and convalescence. Severe  
14 113 organ complications were defined as injuries to bladder, ureter and/or bowel. All Finnish 53  
15 114 hospitals participated and produced 5324 forms, 45 of which were censored, usually because  
16 115 the final diagnosis was a malignant condition. The final data set consisted thus of 5279  
17 116 hysterectomies; this covers 79.4% of all hysterectomies for a benign condition (5279 / 6645)  
18 117 reported to national Hospital Discharge Register. In the FINHYST 1996 study, the cohort  
19 118 coverage was higher (92.1%, N=10110) and the number of participating hospitals was 60 at  
20 119 that time. The FINHYST 2006 study was approved by the Ministry of Social Affairs and  
21 120 Health (Dnro STM/606/2005), by the Helsinki University Hospital Institutional Review Board  
22 121 (IRB) and by the Ethics Committee of the Department of Obstetrics and Gynecology of the  
23 122 Helsinki University Hospital (Dnro 457/E8/04). The 2006 study was registered in the Clinical  
24 123 Trials of Protocol Registration System Data (NCT00744172).

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26 125 Consistency of the data and missing information were thoroughly reviewed. The  
27 126 hysterectomies were divided into three groups: AH, VH, and LH.<sup>23</sup> To facilitate comparisons  
28 127 between the data sets in 1996 and 2006, each patient was defined as having had a  
29 128 complication or not. Categorical data were analyzed by the  $\chi^2$ -test or Fisher's exact  
30 129 probability test, and the means of continuous variables were analyzed pair wise with  
31 130 Student's t-test. Statistical significance was set at  $p < 0.05$ . All calculations were performed  
32 131 with the SPSS 17.0 software.

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34 133 **Results**

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3 135 The rates of VH and LH in Finland increased markedly in the decade from 1996 to 2006,  
4 136 while the rate of AH fell to less than half (Figure 2). At the same time, the rate of the less  
5 137 invasive hysterectomies, LH and VH, had surpassed AH in all hospitals and the overall  
6 138 number of hysterectomies dwindled from 10,110 to 5,279 (reduction of 47.8%). In 2006 1,7%  
7 139 of all hysterectomies were subtotal, in 1996 7,3%. In 2006, the most common indication for  
8 140 AH was fibroids 58% (in 1996 67%), for VH uterine prolapse 61% (in 1996 83%) and for LH  
9 141 fibroids 39% (in 1996 56%) and menorrhagia 30% (in 1996 47%).  
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16 143 In 2006 hysterectomy was performed on significantly older patients in the AH and LH groups  
17 144 but younger in the VH group compared to 1996 (Table 1). Also, the mean BMI had increased  
18 145 significantly in the AH and LH groups but not in the VH group. The average uterine weight  
19 146 had risen significantly in all groups, most in the AH group, while the duration of the operation  
20 147 decreased significantly for LH and for VH, but increased for AH. Perioperative hemorrhage in  
21 148 VH decreased significantly and increased in AH and in LH but not significantly in LH. In all  
22 149 groups the duration of the hospital stay was significantly reduced, mostly in the VH group.  
23 150 The convalescence period decreased significantly in the AH and VH groups but increased  
24 151 slightly in the LH group (Table 1).  
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33 153 The overall rate of complications in 1996 was 16.2% for AH, 22.2% for VH and 17.0% for LH.  
34 154 Ten years later there was a slight increase to 19.2% in complications among AH-patients  
35 155 ( $p<0.05$ ) but a significant decrease to 11.7% in the VH ( $p<0.001$ ) and a non-significant  
36 156 decrease to 15.5% in LH. The overall occurrence of organ injuries was significantly reduced  
37 157 only in the LH group from 2.8% to 1.7% ( $p<0.05$ ). Of the severe organ complications bowel  
38 158 injuries were significantly less common only in the VH group in 2006 compared to 1996 and  
39 159 there was no difference in this respect in the AH and LH groups (Figure 3). Similarly, ureter  
40 160 lesions occurred significantly less often only in the LH group in 2006 than in 1996.  
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48 162 The use antibiotic prophylaxis increased from 82.1% to 97.5% ( $p<0.001$ ) in a decade, and  
49 163 also the selection of antibiotics changed. In 1996 metronidazole was given as a single  
50 164 prophylactic agent to 66.7% of all patients, but in 2006 to only 9.9%. In 2006 cefuroxime was  
51 165 the primary choice of antimicrobial agent alone or in combination with metronidazole for  
52 166 82.1% but in 1996 only for 15.3%. There were concomitantly significant reductions in the  
53 167 overall rate of infections; in the AH group from 9.9% to 7.7% ( $p<0.05$ ), in the VH group from  
54 168 12.3% to 5.2% ( $p<0.001$ ) but a non-significant change from 17.0% to 15.4% in the LH group.  
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5 170 Also, the use of pharmacological thrombosis prophylaxis had risen from 35.4% in 1996 to  
6 171 64.8% in 2006 ( $p < 0.001$ ) and there was a concomitant reduction in VTEs in all groups, which  
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8 172 was significant in the LH group (Figure 3). In 2006, there were no surgery-related deaths,  
9  
10 173 whereas in 1996 there was one death in each hysterectomy group. The occurrence of  
11 174 postoperative hemorrhage in the LH group increased significantly from 1996 to 2006 (Figure  
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13 175 3).

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16 177 The intraoperative detection of organ injuries in LH increased from 60% in 1996 to 75% in  
17 178 2006. Postoperative ileus occurred at a similar rate in 1996 and 2006: AH 1.0% vs. 0.6%, LH  
18 179 0.3% vs. 0.2%, and VH 0.1% vs. 0.2%. The incidence of urinary retention was significantly  
19 180 higher ( $p < 0.001$ ) in the VH group in 1996 (3.1%) than in 2006 (1.6%) while in the AH group it  
20 181 was 0.5% both in 1996 and 2006 and in the LH group 0.9% and 0.5% in 1996 and 2006,  
21 182 respectively.  
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28 184 By 2006 the percentage of surgeons with experience of more than 30 hysterectomies had  
29 185 risen most markedly among surgeons performing LH: from 62% in 1996 to 73% in 2006 while  
30 186 there was no change for VH (78% in 1996, 76% in 2006) but for AH there was a sinking trend  
31 187 from 91% in 1996 to 75% in 2006. The experience of the surgeons was associated to the  
32 188 occurrence of organ injuries. Surgeons who had performed more than 30 hysterectomies in  
33 189 1996, had significantly fewer ureter and bladder injuries, especially in the LH group, than the  
34 190 less experienced surgeons (Table 2). The same was the case for bowel injuries in 1996 in  
35 191 the VH group. In 2006, these differences were no longer present.  
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## 45 194 **Discussion**

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48 196 The role of laparoscopic hysterectomy (LH) compared to the traditional abdominal (AH) and  
49 197 vaginal hysterectomy (VH) has been debated ever since the laparoscopic technique was  
50 198 introduced. It has been argued that LH is associated with higher expenses, longer operation  
51 199 times and a higher rate of complications. Large and comprehensive RCT-studies have been  
52 200 badly needed to give answers to these questions. Such studies need to be very large, even  
53 201 to the point of being unfeasible, if they are to have sufficient statistical power.<sup>22</sup> Furthermore  
54 202 they would also need to be set up so that they discount the effect of the individual surgeon,  
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3 203 the surgeon's experience and the effect of sophisticated surgical centres compared to  
4 204 ordinary hospitals. National registry-based observational surveys on large numbers of  
5 205 consecutive patients with prospective data collection are an alternative to cumbersome and,  
6 206 maybe, unrealistic RCT's and document effectiveness because they reflect clinical reality in  
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8 207 the hands of the "average" gynecological surgeon.<sup>22</sup> This alternative was chosen for the  
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10 208 present nationwide study, which compares some clinical determinants related to  
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12 209 hysterectomies (AH, VH and LH) and hysterectomy-related morbidity in 2006 with 1996 in  
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14 210 Finland.  
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18 212 In the present study the growth of the popularity of VH was especially gratifying: the rate of  
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20 213 VH increased from 18% in 1996 to 44% in 2006 (Figure 2), while the total number of  
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22 214 complications, operation time, hemorrhage and bowel lesions related to VH decreased. All  
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24 215 this took place despite the fact that the patients in 2006 were younger and were operated on  
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26 216 for uterine descent less frequently – circumstances claimed to pose more operative  
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28 217 challenges and yield complications. We believe that the vaginal approach should be used  
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30 218 whenever possible.  
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33 220 The rate of LH increased also (from 24% to 36%). The current rate of LHs in Finland is high  
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35 221 compared to our neighbouring Nordic countries (4-7%)<sup>4,12,15</sup> and globally (Figure 1).  
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37 222 Worldwide, only Taiwan has a higher rate of LH, where the rate of LH has soared from 5 % in  
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39 223 1996 to 40 % in 2005.<sup>5</sup> In consequence, we have a much lower rate of AH (24%) compared  
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41 224 to many other countries, e.g., the USA (68%)<sup>13</sup> and the other Nordic countries Sweden  
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43 225 (60%)<sup>15</sup>, Denmark (59%),<sup>4</sup> Norway (78%).<sup>12</sup> According to a recent meta-analysis by the  
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45 226 Cochrane collaboration, the order of preference of hysterectomies should be VH and LH  
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47 227 followed by AH.<sup>21</sup> This study shows that this is precisely the sequence of preferences  
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49 228 followed in Finland.  
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53 230 The main finding of this study is that the overall complication rates related to VH and LH have  
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55 231 decreased in Finland. Another important observation was that, of the severe organ lesions,  
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57 232 ureter complications related to LH – one of the main concerns in 1996<sup>8</sup> – have decreased  
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59 233 highly significantly (from 1.1% to 0.3%). This finding is in accordance with a retrospective  
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234 nationwide registry study on the complications of LH, which reported a continuously  
235 decreasing trend from 1993 to 2005 in ureter injuries in Finland.<sup>24</sup> Also, the fact that LH-  
236 related bladder complications sank from 1.3% to 1.0% supports the notion that surgeons



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3 237 doing this operation have steadily gained experience and are better aware of the need to  
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5 238 avoid harming the bladder and ureters. The rate of VH-associated bowel complications sank  
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7 239 also significantly (Figure 3). For AH there was a slight increase in the occurrence of total  
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9 240 complications (from 16% in 1996 to 19% in 2006), but this only reflects the fact that more  
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11 241 severe and advanced cases required the abdominal approach in 2006.

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13 243 The reduction in the number of infections, especially urinary tract infections, was probably  
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15 244 due to the increased prophylactic use of antibiotics. The reduction of thromboembolic events  
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17 245 is most likely due to a consequence of increased and appropriate use of thromboprophylaxis.  
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19 246 The aim to reduce both of these complications was discussed already some ten years ago at  
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21 247 a consensus meeting with the members of the Society of Gynecological Surgery in Finland,  
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23 248 and a unified, common prophylaxis management system with antibiotics and antithrombotics  
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25 249 was introduced and implemented.<sup>25</sup>

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27 251 National reports on the outcomes of surgical procedures need attention in terms of data  
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29 252 coverage. We believe that one of the main reasons for the fact that in the FINHYST 1996  
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31 253 study the cohort coverage was higher (92%) than in 2006 (79%) is related to the  
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33 254 circumstance that the approval of the ethics committee in 1996 did not require us to collect  
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35 255 the patients' social security numbers. The survey in 2006 was run according to new  
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37 256 regulations which require that each patient provides full disclosure of her identity and written  
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39 257 informed consent. Since all other facets of the studies and the data collection were identical  
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41 258 between the two studies, these requirements remain the only explanatory variable for the  
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43 259 reduced participation coverage.

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45 261 The overall maximum rates of the most severe organ injuries (bladder, ureter, bowel) in all  
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47 262 types of hysterectomies in Finland were 0.7% - 2.8% in 1996 and 0.7 - 1.7% in 2006. This  
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49 263 improvement is encouraging and similar trends have been reported in other countries.<sup>2</sup> This  
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51 264 positive development has taken place in a time of a markedly decreasing need for  
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53 265 hysterectomies mostly as a consequence of many new and effective conservative treatments  
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55 266 of various bleeding problems (hormonal IUD, thermoablation etc.). Furthermore, in 2006,  
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57 267 compared to 1996, our patients were proportionately older, more obese and had a higher  
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59 268 uterine weight, but still the duration of hospital stay in all hysterectomy types and the  
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61 269 operation time for LH and VH was reduced (Table 1). Evidently, the need for hysterectomy  
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63 270 will persist, but it will not be as high as in the late 1990's.<sup>26,27</sup> The outlook is that

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3 271 hysterectomies will be safer than before. Recent indications for hysterectomies in Finland  
4 272 were more properly scrutinized and patients undergoing these procedures were more severely  
5 273 affected than a decade earlier.  
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9 275 Since the introduction of laparoscopic hysterectomy in Finland in the 1990's, gynecological  
10 276 surgeons have collaborated actively in clinical practice and training. This has resulted in a  
11 277 unified system of data collection for research and quality control. With the first FINHYST  
12 278 study in 1996 we identified matters needing improvement, after which practices were  
13 279 changed, training was increased and collaboration on a national level was implemented. As a  
14 280 consequence of this fruitful and collegial collaboration, hysterectomy-associated morbidity  
15 281 has decreased and patients are selected more appropriately for the traditional abdominal,  
16 282 vaginal or endoscopic route.  
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## 25 285 **References**

- 26 286
- 27 287 1. Reich H, DiCaprio J, McGlynn F. Laparoscopic hysterectomy. *J Gynecol Surg* 1989; 5:  
28 288 213-16.  
29 289
  - 30 290 2. Donnez O, Jadoul P, Squifflet J, Donnez J. A series of 3190 laparoscopic hysterectomies  
31 291 for benign disease from 1990 to 2006: evaluation of complications compared with vaginal and  
32 292 abdominal procedures. *Br J Obstet Gynaecol* 2009;116:492-500.  
33 293
  - 34 294 3. David-Montefiore E, Rouzier R, Chapron C, Darai E and the Collegiale d'Obstétrique et  
35 295 Gynegologie de Paris-Ile de France. Surgical routes and complications of hysterectomy for  
36 296 benign disorders: a prospective observational study in French university hospitals. *Hum*  
37 297 *Reprod* 2007;22:260-65.  
38 298
  - 39 299 4. Hansen CT, Møller C, Daugbjerg J, Kehlet H, Ottesen B. Establishment of a national  
40 300 Danish hysterectomy database: preliminary report on the first 13 425 hysterectomies *Acta*  
41 301 *Obstet Gynecol* 2008;87,546-557.  
42 302
- 43  
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2  
3 303 5. Wu M, Huang K, Long C, Tsai E, Tang C. Trends in various types of hysterectomy and  
4 304 distribution by patient age, surgeon age, and hospital accreditation: 10-year population-based  
5 305 study in Taiwan. *J Minim Invasive Gynecol* 2010;17:612-19.  
6 306  
7  
8  
9 307 6. Brummer TH, Jalkanen J, Fraser J et al. FINHYST 2006 - National prospective 1-year  
10 308 survey of 5 279 hysterectomies. *Hum Reprod* 2009;24:2515-2522.  
11 309  
12  
13 310 7. Maresh MJA, Metcalfe MA, Mc Pherson K et al. The VALUE national hysterectomy study:  
14 311 description of the patients and their surgery. *Br J Obstet Gynaecol* 2002;109: 302-312.  
15 312  
16  
17 313 8. Mäkinen J, Johansson J, Tomas C et al. Morbidity of 10 110 hysterectomies by type of  
18 314 approach. *Human Reprod.* 2001;16:1473-8.  
19 315  
20  
21 316 9. Chapron C, Laforest L, Ansquer Y, Fauconnier A, Fernandez B, Breart G, Dubuisson JB  
22 317 Hysterectomy techniques used for benign pathologies: results of a French multicentre study.  
23 318 *Hum Reprod* 1999;14:2464-2470.  
24 319  
25  
26 320 10. Farquhar C, Steiner C. Hysterectomy rates in the United States 1990-1997. *Obstet*  
27 321 *Gynecol* 2002;99:229-243.  
28 322  
29  
30 323 11. Møller C, Kehlet H, Utzon J, Ottesen B. Hysterectomy in Denmark. An analyses of  
31 324 postoperative hospitalisation, morbidity and readmission. *Dan Med Bull* 2002;49:353-57 (in  
32 325 Danish).  
33 326  
34  
35 327 12. Oma J. Which factors affect the choice of method for hysterectomy in benign disease.  
36 328 *Tidsskr Nor Laegeforen* 2004;124: 92-4 (in Norwegian).  
37 329  
38  
39 330 13. Whiteman MK, Hillis SD, Jamieson DJ, Morrow B, Podgornik MN, Brett KM, Marchbanks  
40 331 PA. Inpatient hysterectomy surveillance in the United States, 2000–2004. *Am J Obstet*  
41 332 *Gynecol* 2008;198:34-6.  
42 333  
43  
44 334 14. Kolkman W, Trimbos-Kemper T, Jansen F. Operative laparoscopy in the Netherlands:  
45 335 Diffusion and acceptance. *Eur J Obstet Gynecol Reprod Biol* 2007;130:245-48.  
46 336  
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3 337 15. Persson P, Hellborg T, Brynhildsen J, Fredrikson M, Kjølhede P. Attitudes to mode of  
4 338 hysterectomy - a survey-based study among Swedish gynecologists. *Acta Obstet Gynecol*  
5 339 *Scand* 2009;88:267-74.  
6  
7 340  
8  
9 341 16. Hill E, Graham M, Shelley J. Hysterectomy trends in Australia – between 2000 / 01 and  
10 342 2004 /05. *ANZJOG* 2010;50:153–58.  
11 343  
12  
13 344 17. Stang A, Merrill RM, Kuss O. Nationwide rates of conversion from laparoscopic or vaginal  
14 345 hysterectomy to open abdominal hysterectomy in Germany. *Eur J Epidemiol* 2011;26:125-33.  
15 346  
16  
17 347 18. Garry R, Fountain J, Mason S et al. The eVALuate study: two parallel randomised trials,  
18 348 one comparing laparoscopic with abdominal hysterectomy, the other comparing laparoscopic  
19 349 with vaginal hysterectomy. *Br Med J* 2004; 328:129-136.  
20 350  
21  
22 351 19. Johnson N, Barlow D, Lethaby A, Tavender E, Curr E, Garry R. Methods of  
23 352 hysterectomy: a systematic review and meta-analysis of randomised controlled trials. *Br Med*  
24 353 *J* 2005;330:1478-1486.  
25 354  
26  
27 355 20. Johnson N, Barlow D, Lethaby A, Tavender E, Curr E, Garry R. Surgical approach to  
28 356 hysterectomy for benign gynaecological disease. *Cochrane database of systematic*  
29 357 *reviews* 2006; Issue 2: Art. No.:CD003677.  
30 358  
31  
32 359 21. Nieboer TE, Johnson N, Lethaby A, Tavender E, Curr E, Garry R, van Voorst S, Mol  
33 360 BWJ, Kluivers KB. Surgical approach to hysterectomy for benign gynaecological disease.  
34 361 *Cochrane database of systematic reviews* Issue 3, 2010; Art. No.: CD003677.  
35 362  
36  
37 363 22. Claerhout F, Deprest J. Laparoscopic hysterectomy for benign diseases. In: *Best Practice*  
38 364 *and Research Clinical Obstetrics and Gynaecology, Hysterectomy*, eds. Thakar R and  
39 365 Manyonda I. Elsevier. 2005;19:357-75.  
40 366  
41  
42 367 23. Kovac SR. Guidelines to determine the root of hysterectomy. *Obstet Gynecol* 1995;85:  
43 368 18-23.  
44 369  
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3 370 24. Brummer TH, Seppälä T, Härkki P. National learning curve of laparoscopic  
4 371 hysterectomy and trends in hysterectomy in Finland 2000-2005. Hum Reprod 2008;23:840-  
5 372 45.  
6  
7 373  
8  
9 374 25. GKS, The society of gynaecological surgery in Finland, webpage, in Finnish. Suositukset  
10 375 2007 (recommendations) available at: [www.terveysportti.fi/kotisivut/sivut.koti?p\\_sivusto=434](http://www.terveysportti.fi/kotisivut/sivut.koti?p_sivusto=434) .  
11  
12 376 Accessed on July 2012 (in Finnish).  
13  
14 377  
15  
16 378 26. Roberts TE, Tsourapas A, Middleton LJ et al. Hysterectomy, endometrial ablation, and  
17 379 levomorgestrel releasing intrauterine system (Mirena) for treatment of heavy menstrual  
18 380 bleeding: cost effectiveness analysis. Br Med J 2011;342, d 2202.  
19  
20 381  
21  
22 382 27. Qvistad E, Langebrenne A. Should we recommend hysterectomy more often to  
23 383 premenopausal and climacteric women? Acta Obstet Gynecol Scand 2011;90:811-14.  
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### 31 **Authors' contributions**

- 32 388  
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34 389 Authors: Juha Mäkinen (JM), Tea Brummer (TB), Jyrki Jalkanen (JJ), Anna-mari heikkinen  
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45 395 Figures: TB and JM.  
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48 397 Tables: TB and JM  
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51 399 Study design: all authors  
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55 401 Permissions: TB, PH, JS and JM  
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58 403 Data collection: TB and PH  
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4 405 Data analysis: TB, PH and JM  
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8 407 Data interpretation: all authors  
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10 408  
11 409 Writing: all authors  
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13 410  
14 411 Conflict of interest: No conflict of interest related to this article  
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18 413 Role of funding source. No source of funding  
19  
20 414  
21 415 Ethics committee approval: The Finhyst 2006 study was approved by the ministry of social  
22 416 affairs and health (Dnro STM/606/2005), by the Helsinki University Hospital Institutional  
23 417 Review Board (IRB) and by the ethics committee of the department of Obstetrics and  
24 418 Gynaecology of the Helsinki University Hospital (Dnro 457/E8/04). The 2006 study was  
25 419 registered in the Clinical Trials of Protocol Registration System Data (NCT00744172).  
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Figure 1

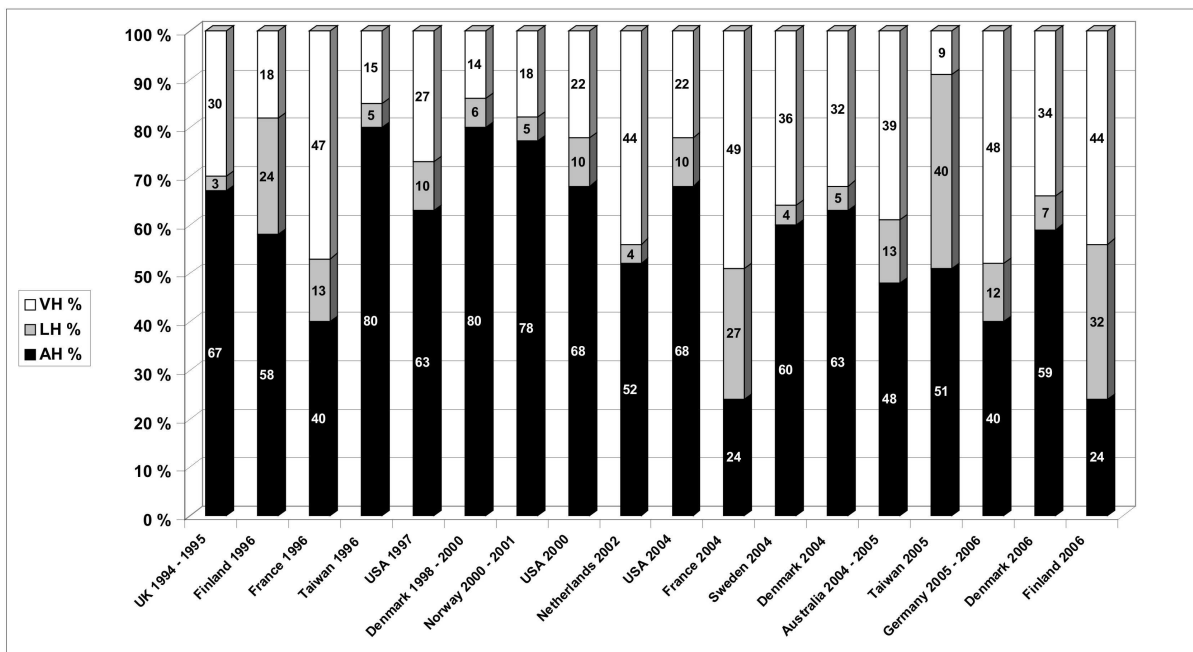
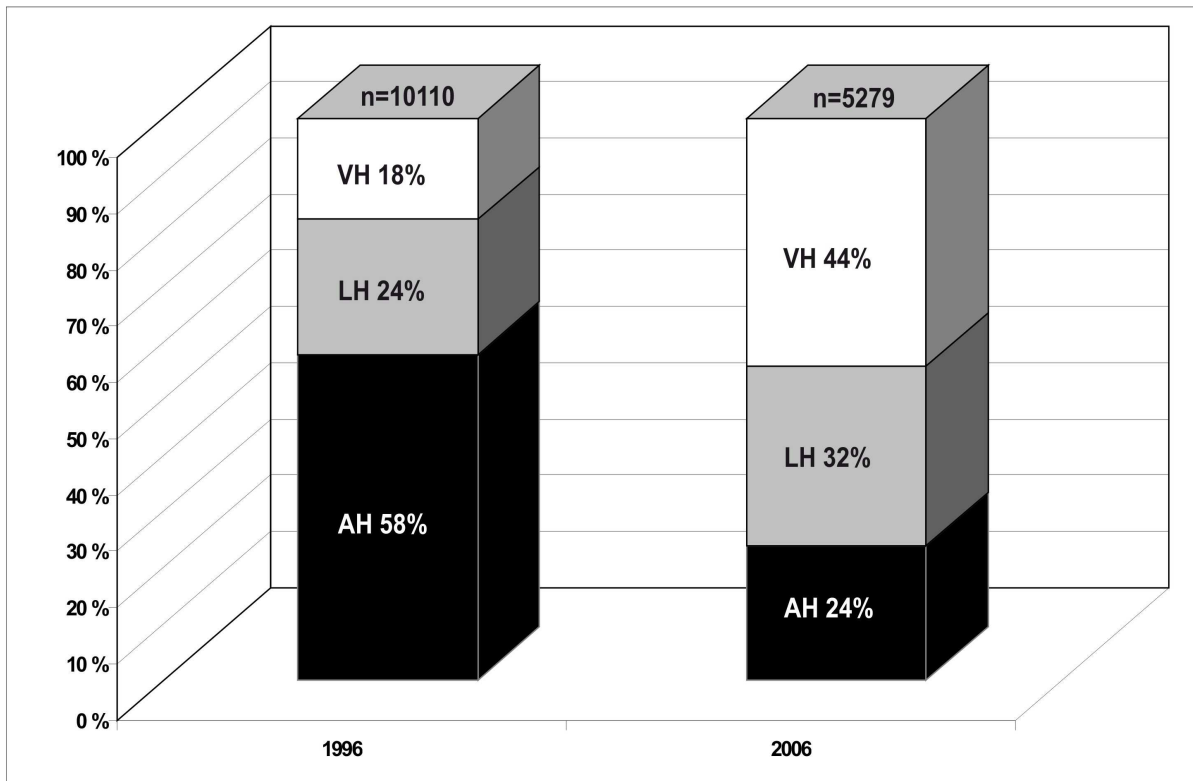




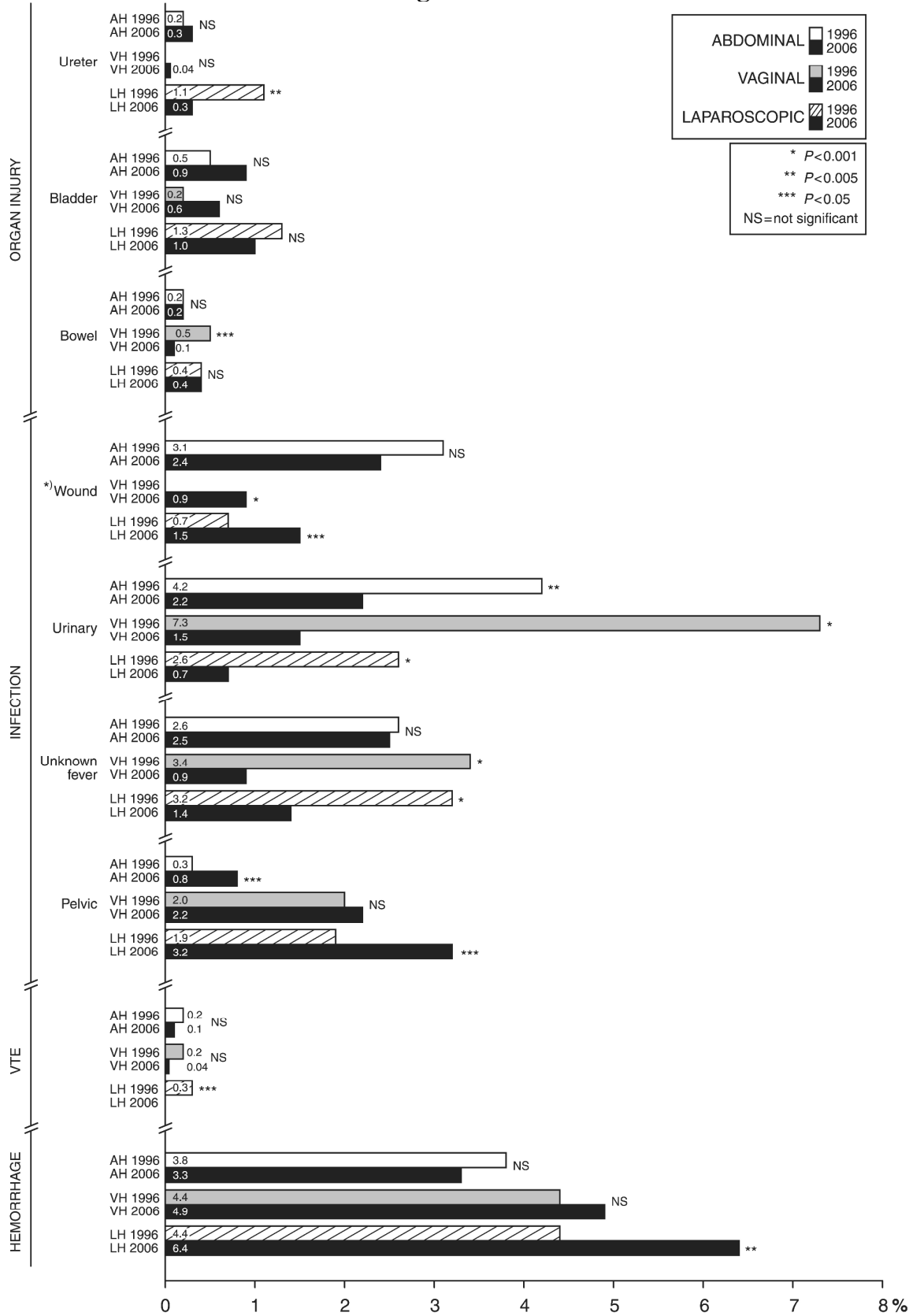
Figure 2



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Figure 3



## Legends to the figures:

Figure 1. Rates of abdominal, vaginal and laparoscopic hysterectomies in various countries from 1994 to 2006.

### Footnote

Figures from France represent samples from University clinics only, otherwise national data are presented, apart from the UK, which excludes Wales, and represents 45% of national hysterectomies. References: UK 1994-1995,<sup>7</sup> Finland 1996,<sup>8</sup> France 1996,<sup>9</sup> Taiwan 1996,<sup>5</sup> USA 1997,<sup>10</sup> Denmark 1998-2000,<sup>11</sup> Norway 2000-2001,<sup>12</sup> USA 2000,2004,<sup>13</sup> Netherlands 2002,<sup>14</sup> France 2004,<sup>9</sup> Sweden 2004,<sup>15</sup> Denmark 2004,<sup>4</sup> Australia 2005-2005,<sup>16</sup> Taiwan 2005,<sup>5</sup> Germany,<sup>17</sup> Denmark 2006,<sup>4</sup> and Finland 2006,<sup>6</sup>

Figure 2. Rate of hysterectomies by type in Finland in 1996 and 2006.

### Footnote

AH = abdominal hysterectomy  
VH = vaginal hysterectomy  
LH = laparoscopic hysterectomy

Figure 3. Complications related to abdominal, vaginal and laparoscopic hysterectomies in 1996 and 2006

### Footnote

VTE, venous thromboembolism.

\* Pelvic infection data from 1996 comprise all intra-abdominal and vaginal infections, whereas in 2006 late onset of pelvic infection was defined as pelvic abscess or hematoma

\*\* N of patients. A patient may have had more than one complication.

\*) including vaginal cuff infection

Table 1. Patient characteristics and surgery-related details (mean +/- SD) by hysterectomy method in 1996 and 2006.

	ABDOMINAL				VAGINAL				LAPAROSCOPIC			
	1996 (N=5875)		2006 (N=1255)		1996 (N=1801)		2006 (N=2345)		1996 (N=2434)		2006 (N=1679)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age	48,8	8,7	50,1	8,8	58,6	13,2	55,0	11,8	47,0	7,5	49,2	8,5
BMI (kg/m <sup>2</sup> )	26,3	4,5	27,1	5,3	26,3	3,9	26,4	4,4	24,9	3,9	26,1	4,6
Oper time (min)	86	31	93	37	88	32	78	33	124	48	108	43
Hemorrhage (ml)	305	312	355	360	342	353	203	269	262	271	270	669
Uterine weight (g)	290	302	433	425	109	84	131	110	195	108	210	146
Hospital stay (days)	6.0	2,2	3,8	1,8	5,9	2,7	2,3	1,5	3,4	2,0	2,0	1,4
Convalescence (days)	34.4	5.3	32,3	4,6	34.0	8.8	29,4	8,0	21.5	8.8	22,0	6,3

All pairs (1996 vs. 2006)  $p < 0.001$ , except in LH for hemorrhage ( $P = 0.603$ ) and in VH for BMI ( $P = 0.484$ )

Table 2. Rate and number of ureter, bladder and bowel injuries in various hysterectomies in Finland in relation to surgeon's experience (more than 30 vs 30 or less than 30 hysterectomies) in 1996 and 2006

	ABDOMINAL				VAGINAL				LAPAROSCOPIC			
	1996 (N=5875)		2006 (N=1255)		1996 (N=1801)		2006 (N=2345)		1996 (N=2434)		2006 (N=1679)	
	%	n	%	n	%	n	%	n	%	n	%	n
Ureter injury												
≤ 30		-	0,4	1		-		-	2,2	20	0,3	1
> 30	0,2	9	0,3	3		-	0,04	1	0,5 **	7	0,2	3
Bladder injury												
≤ 30		-	1,1	3		-	0,6	3	2,0	18	1,3	5
> 30	0,5	28	0,7	7	0,4	4	0,5	9	0,8 *	12	1,0	12
Bowel injury												
≤ 30		-		-	1,3	5	0,2	1	0,4	4	0,3	1
> 30	0,2	12	0,3	3	0,3 *	4	0,06	1	0,3	5	0,4	5

\* P = 0.05

\*\* P < 0.001

Other comparisons (≤30 vs > 30): not significant

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## Patient Consent Form

The form was used only in Finnish (belowe).

The ethics committee in 1996 did not require us to collect the patients' social security numbers or consent forms. The survey in 2006 was run according to new regulations which require that each patient provides full disclosure of her identity and written informed consent (in Finnish).

### Potilastiedote Finhyst 2006 kohdunpoistotutkimuksesta

Olette tulossa kohdunpoistoleikkaukseen. Suomessa näitä leikkauksia tehdään vuosittain noin 10 000 ja se on yksi tavallisimmista naisille tehtävistä kirurgisista toimenpiteistä. Finhyst 2006 - tutkimuksen avulla haluamme selvittää koko maassa vuoden 2006 kohdunpoistoleikkauksien hoitotuloksia ja turvallisuutta.

Tietosuojan turvaamiseksi kohdunpoistoon liittyvät tiedot kerätään suljettuun tietokonerekisteriin ja ne käsitellään täysin luottamuksellisesti. Kerättävät tiedot rajoittuvat vain välittömästi kohdunpoistoleikkaukseen liittyviin seikkoihin. Tutkimukseen osallistuminen on teille täysin vapaaehtoista; siihen osallistuminen tai osallistumisesta kieltäytyminen ei vaikuta millään tavalla teille jo hoitopaikassanne suunniteltuun hoitoon, josta vastaa teidät leikkaava lääkäri.

Kotiutuessanne saatte toipumistanne koskevan kyselylomakkeen ja toivomme teidän täyttävän ja postittavan ne 8 viikon kuluttua leikkauksestanne kirjekuorella, jonka saatte kyselylomakkeiden mukana.

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## Study protocol

The questionnaire sheets were used only in Finnish (below).

Data collection was nationwide and followed the same procedure in both annual cohorts of 1996 and 2006. The forms (FINHYST 1996 and 2006) were used to collect data on preoperative, peroperative and postoperative events and operation-related morbidity during the patients' hospital stay and convalescence.

### FINHYST 2006 (Leikkaava lääkäri täyttää) Sivun 1

Rengasta oikea vaihtoehto. Lomake täytetään kaikista muista kohdunpoistoista paitsi syövästä, borderline munasarjakasvaimista ja synnytyksen jälkeisistä kohdunpoistoista

Potilaan nimi ja SOTU (miehellään tarra): \_\_\_\_\_

Sairaala \_\_\_\_\_

Toimenpidepäivä: \_\_\_\_\_ Lomakkeen täyttöpäivä: \_\_\_\_\_

Leikkaaja: **1.** erikoislääkäri / **2.** erikoistuva lääkäri

Leikkaajan kokemus ko. leikkauksessa: **1.** alle 10 kpl / **2.** 10-30 kpl / **3.** yli 30 kpl

Kohdunpoisto:

**1. a.** Abdominaalinen totaali / **b.** abdominaalinen amputaatio

**2. a.** LH (uterinat yläkautta) / **b.** LAVH (uterinat alakautta) / **c.** laparoskooppinen amputaatio

**3.** Vaginaalinen

**4.** Konversio (mistä mihin \_\_\_\_\_, syy \_\_\_\_\_)

**5.** Kohdun paloittelu sen ulos saamiseksi

**TÄRKEIN** preoperatiivinen syy miksi leikattiin (vain **YKSI** vaihtoehto): ICD-10 \_\_\_\_\_

**1.** Myoma(t)

**2.** Menorrhagia

**3.** Dysmenorrhea

**4.** Endometrioosi

**5.** Laskeumat

**6.** Adnextuumori

**7.** Muu, mikä \_\_\_\_\_

Muuttuiko tärkein diagnoosi leikkauksen jälkeen? **1.** ei / **2.** kyllä: uusi dg (ICD-10) \_\_\_\_\_

Potilaan pituus \_\_\_\_\_ cm, paino \_\_\_\_\_ kg

Pariteetti: \_\_\_\_\_ joista alatesynnytyksiä \_\_\_\_\_ kpl ja sektioita \_\_\_\_\_ kpl

Aikaisemmat muut vatsanalueen leikkaukset: laparoskopioita \_\_\_\_\_ kpl, laparotomioita \_\_\_\_\_ kpl

Antibioottiprofylaksia:

**1.** ei

**2.** kyllä: **a.** kefuroksiimi / **b.** metronidatsoli / **c.** muu, mikä \_\_\_\_\_ + annos \_\_\_\_\_

Lääkkeellinen tromboosiprofylaksia:

**1.** ei

**2.** kyllä: **a.** minihepariini / **b.** muu, mikä \_\_\_\_\_ + annos \_\_\_\_\_ + kesto (vrk) \_\_\_\_\_

Leikkauksen kesto (min) (aika 1. viillosta sulkuun) \_\_\_\_\_

Arvioitu/mitattu vuoto (ml) \_\_\_\_\_

Uteruksen paino ilman adnexeja (g) \_\_\_\_\_

Leikkaajan arvio leikkauksen vaikeudesta:

**1.** erittäin helppo / **2.** helppo / **3.** tavallinen / **4.** vaikea / **5.** erittäin vaikea, miksi \_\_\_\_\_



Hemostaasimenetelmä(t):

1. Ligatuurat
2. Bipolaaripoltto
3. Monopolaaripoltto
4. Ultraääniveitsi
5. Muu (Esim. Ligasure), mikä \_\_\_\_\_

Liitännäistoimenpiteitä: Sivu 2

1. Ei
2. Kyllä
- A. a. toisen adneksin poisto / b. molempien adnexien poisto
- B. Vaginaaliset plastiat: a. KA / b. KP
- C. Inkontinenssin korjaus: a. TVT / b. TOT / c. muu \_\_\_\_\_
- D. Enteroseelen korjaus
- E. Leikkausta hankaloittavien kiinnikkeiden irrottelu
- F. Muu, mikä \_\_\_\_\_

Leikkauksen **aikana** havaittu komplikaatio:

1. Ei
2. Kyllä
- A. Yli 1000ml leikkausvuoto
- B. Verisuonivaurio: a. epigastricasuonet / b. suuret suonet (aorta, v.cava, iliacat) / c. muu suoni, mikä \_\_\_\_\_
- C. Rakkovaurio
- D. Uretervaurio
- E. Suolivaurio
- F. Tekniset laiteongelmat, mikä \_\_\_\_\_
- G. Muu, mikä \_\_\_\_\_

Miten komplikaatio hoidettiin \_\_\_\_\_

Leikkauksen **jälkeen** osastolla todettu komplikaatio:

1. Ei
2. Kyllä
- A. Reoperaatio, syy \_\_\_\_\_
- B. Postoperatiivinen vuoto/hematoma
- C. Haavainfektio (vaatinut antibiootin, punktion tai dreneerauksen)
- D. Virtsatieinfektio (Uricult > 10<sup>5</sup>)
- E. Epäselvä kuumeilu (aksillaarinen lämpö  $\geq 38^{\circ}\text{C}$ )
- F. Syvä laskimotromboosi
- G. Keuhkoembolia
- H. Rakkovaurio
- I. Uretervaurio
- J. Suolenvetovaikeus
- K. Suolivaurio
- L. Hernia, mikä \_\_\_\_\_
- M. Muu ongelma, mikä \_\_\_\_\_

Miten komplikaatio hoidettiin \_\_\_\_\_

Potilas sai verensiirron

1. Ei
  2. Kyllä a. ennen leikkausta \_\_\_\_ punasoluyksikkö/ b. leikkauksen aikana \_\_\_\_ punasoluyksikköä/ c. leikkauksen jälkeen \_\_\_\_ punasoluyksikköä
- Kotiutuspäivämäärä \_\_\_\_\_ Sairasloma (vrk) \_\_\_\_\_ (sisältää sairaalassa oloajan)

**FINHYST 2006 JÄLKIKOMPLIKAATIOLOMAKE** (Lääkäri täyttää)

Täytetään vain mikäli potilas joutuu uudestaan sairaalaan komplikaation takia

Potilaan nimi ja SOTU (mielellään tarra): \_\_\_\_\_

Sairaala: \_\_\_\_\_

Kohdunpoistopäivä: \_\_\_\_\_

Lomakkeen täyttöpäivä: \_\_\_\_\_

Komplikaation toteamispäivä \_\_\_\_\_

Havaittu komplikaatio:

1. Reoperaatio, syy \_\_\_\_\_

2. Verensiirtoon johtanut anemia

3. Haavainfektio (vaatinut antibiootin, punktion tai dreneerauksen)

4. Virtsatieinfektio (Uricult > 10<sup>5</sup>)

5. Epäselvä kuumeilu (Aksillaarinen lämpö  $\geq 38$  °C)

6. Lantionpohjan infektio (hematoma ja/tai abskessi)

7. Syvä laskimotromboosi

8. Keuhkoembolia

9. Rakkovaurio

10. Uretervaurio

11. Suolenvetovaikeus

12. Suolivaurio

13. Hernia, mikä \_\_\_\_\_

14. Muu ongelma, mikä \_\_\_\_\_

Miten komplikaatio hoidettiin

Sairaalassa oloaika (vrk) \_\_\_\_\_

Uusi sairasloma (lisä vrk) \_\_\_\_\_

Potilas **1.** on työssä / **2.** ei ole työssä

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found	P2 P2
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	P3
Objectives	3	State specific objectives, including any prespecified hypotheses	P3
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	P4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	P4
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants (b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	P4 P4
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	P4
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	P4
Bias	9	Describe any efforts to address potential sources of bias	P4
Study size	10	Explain how the study size was arrived at	P4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	P4
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy (e) Describe any sensitivity analyses	P4 P4 P4 P4

Continued on next page

<b>Results</b>		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time <i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure <i>Cross-sectional study</i> —Report numbers of outcome events or summary measures
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
<b>Discussion</b>		
Key results	18	Summarise key results with reference to study objectives
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	Discuss the generalisability (external validity) of the study results
<b>Other information</b>		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

## Structured abstract

**Objectives:** To study the outcome of various hysterectomies in two years 1996 and 2006. The hypothesis was that the change in operative practices in ten years have resulted in improvements.

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**Participants:** Patients scheduled to either abdominal, vaginal or laparoscopic hysterectomy for benign disease.

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**Results:** The overall complication rates fell in LH and markedly in VH (from 22.2% to 11.7%,  $p < 0.001$ ). The overall surgery-related infectious morbidity decreased in all groups and significantly in VH (from 12.3% to 5.2%,  $p < 0.001$ ) and AH (from 9.9% to 7.7%,  $p < 0.05$ ). The incidence of bowel lesions in VH sank from 0.5% to 0.1% and of ureter lesions in LH from 1.1% to 0.3%. In 2006 there were no deaths compared to three in 1996.

**Conclusions:** The rate of postoperative complications fell markedly in the decade from 1996 to 2006. This parallels with the recommendation of the recent meta-analyses by Cochrane Collaboration; the order of preference of hysterectomies was first time precisely followed in this nationwide study.

**Trial registration:** In the clinical trials of protocol registration system data (NCT00744172).



**10 YEARS OF PROGRESS: IMPROVED HYSTERECTOMY  
OUTCOMES IN FINLAND 1996 – 2006**

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<b>Primary Subject Heading</b>:	Obstetrics and gynaecology
Secondary Subject Heading:	Epidemiology, Surgery
Keywords:	GYNAECOLOGY, Minimally invasive surgery < GYNAECOLOGY, Clinical audit < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

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## SUMMARY

## 1. Article focus

- Morbidity related to any type of hysterectomy: differences and similarities in 1996 and 2006
- Evaluation of the perioperative factors related to the change in outcome from 1996 to 2006
- Outcome changes related to the experience of the gynecologic surgeon

## 2. Key messages

- Very significant decrease in overall complications between 1996 and 2006
- First study thus far where the order of preference of hysterectomies (in 2006) is precisely followed, as recommended by the Cochrane collaboration
- Severe organ injuries in laparoscopic hysterectomies in 1996 were overcome by 2006 and the incidence of ureteral injuries sank especially much

## 3. Strengths and limitations

- The strength of the study is that it is prospective and nationwide and spans a time frame of 10 years. Participation was anonymous and voluntary.
- The limitations are the difference of the background of the study populations in 1996 and 2006, and data coverage (79%) in 2006. Differences in study populations cannot be corrected for, but any selection bias in the population was checked by analysis of data in the national register of the Patient Insurance Center in Finland. This post-study evaluation showed that the complication rates were similar for non-participants and for participants.

## Structured abstract

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10 YEARS OF PROGRESS: IMPROVED HYSTERECTOMY OUTCOMES IN FINLAND  
1996 – 2006 **A LONGITUDINAL OBSERVATION STUDY**

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Running title: Improved hysterectomy outcomes in Finland 1996 - 2006

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5 36 **Abstract**6  
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8 38 Background The morbidity associated with hysterectomy has been studied cross-sectionally  
9 39 in observational studies, case-controlled and randomized trials, large hospital based series  
10 40 and meta-analyses but never longitudinally. We compared hysterectomy practices and  
11 41 patient outcomes of cohorts operated in 1996 and 2006.

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14 43 Methods A nationwide, prospective evaluation of women undergoing abdominal  
15 44 **hysterectomy** (AH), vaginal **hysterectomy** (VH) or laparoscopic hysterectomy (LH) for  
16 45 benign conditions was made in 1996 (N=10110) and was followed by this trial in 2006  
17 46 (N=5276). All hospitals in Finland participated. Patient characteristics, surgery-related  
18 47 outcomes and complications were analyzed.

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21 49 Findings In 1996, AH was the main approach (58%), but was surpassed within a decade by  
22 50 VH and LH (together, 76% of all hysterectomies in 2006). **The overall rate of**  
23 51 **complications declined from 17.5 % in 1996 to 14.7 % in 2006 (p<0.001). By operation**  
24 52 **type, a decrease was also observed in LH (from 17.0 % to 15.5. %, NS) and markedly in**  
25 53 VH (from 22.2% to 11.7%, p<0.001). The overall surgery-related infectious morbidity  
26 54 decreased in all groups and significantly in VH (from 12.3% to 5.2%, p<0.001) and AH (from  
27 55 9.9% to 7.7%, p<0.05). The **rate** of bowel lesions in VH sank from 0.5% to 0.1% and of ureter  
28 56 lesions in LH from 1.1% to 0.3%. In 2006 there were no deaths compared to three in 1996.

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31 58 Interpretation The rate of postoperative complications fell markedly from 1996 to 2006. This  
32 59 seems to be associated with better training of gynecological surgeons, more widespread **and**  
33 60 **appropriate** use of prophylactic antibiotics and antithrombotics, and better targeting of  
34 61 patient selection for each specific type of hysterectomy. **Furthermore**, this study is the only  
35 62 one thus far where the order of preference of hysterectomies is precisely followed  
36 63 nationwide, as recommended in a recent meta-analysis by the Cochrane collaboration.

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39 65 Funding: No funding

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42 67 Keywords: Hysterectomy, complications, longitudinal cohort study

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3 69 The 2006 study was registered in the Clinical Trials of Protocol Registration System Data  
4 70 (NCT00744172).

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8 72 **Introduction**

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11 74 With the advent of laparoscopic hysterectomy (LH) in the late 1980's<sup>1</sup> the role of vaginal (VH)  
12 75 and abdominal hysterectomies (AH) has been a matter of re-evaluation. The rate of  
13 76 abdominal hysterectomies (AH) has subsequently fallen in some countries (Figure 1),<sup>2,3,4,5,6</sup>  
14 77 but AH still predominates in many countries as the main method for hysterectomy. Along  
15 78 with these changes, the attitudes have, however, gradually changed in favor of VH and LH,  
16 79 which present themselves as less traumatizing procedures than AH.

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23 81 More than twenty years ago a systematic follow-up of the advantages and disadvantages of  
24 82 the then novel laparoscopic method for performing hysterectomy would have been  
25 83 scientifically and clinically very much in order. However, the opportunity of collecting valuable  
26 84 pioneering data on the benefits and disadvantages of LH in comparison to the established  
27 85 methods (VH and AH) was never grasped. In Finland, a nationwide study on the morbidity  
28 86 related to AH, VH and LH for benign conditions was conducted in 1996.<sup>8</sup> Not surprisingly, the  
29 87 most modern method, LH, was, at that time, associated with more severe complications than  
30 88 the other methods. The rate of complications stood also in proportion to the experience of the  
31 89 surgeons – the more experienced the surgeon, the less LH-associated complications.

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39 91 Since the beginning of the 2000's, several smaller studies, hospital-based series of LHs<sup>2</sup> and  
40 92 RCTs<sup>18-19</sup> have been published. Cochrane meta-analysis recommended VH as the primary  
41 93 technique for hysterectomy, followed by LH when appropriate.<sup>20-21</sup> There are, however, no  
42 94 longitudinal follow-up studies on the results of hospital-based or nationwide studies on  
43 95 patients undergoing hysterectomy. Such studies are not only scientifically important but they  
44 96 also constitute important measures of quality control and are, as such, badly needed to help  
45 97 us to understand what we have learned of the different approaches to hysterectomy during  
46 98 all these years.<sup>22</sup> We conducted a nationwide survey on the outcomes of hysterectomies of  
47 99 two cohorts first in 1996 and second in 2006. In this paper we compare the results after AH,  
48 100 VH and LH for benign conditions in 2006<sup>6</sup> with the results 10 years previously.<sup>8</sup>

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6 106 **Methods**

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8 108 Information on all hysterectomies performed for benign conditions in Finland was  
9 109 prospectively registered from January 1st to December 31<sup>st</sup>, 2006, by the operating  
10 110 gynecologist.<sup>6</sup> Data collection was nationwide and followed the same procedure as in the  
11 111 survey ten years previously, the FINHYST 1996 study.<sup>8</sup> A dedicated form (FINHYST 2006)  
12 112 was used to collect data on preoperative, peroperative and postoperative events and  
13 113 operation-related morbidity during the patients' hospital stay and convalescence. Severe  
14 114 organ complications were defined as injuries to bladder, ureter and/or bowel. All Finnish 53  
15 115 hospitals participated and produced 5324 forms, 45 of which were censored, usually because  
16 116 the final diagnosis was a malignant condition. The final data set consisted thus of 5279  
17 117 hysterectomies; this covers 79.4% of all hysterectomies for a benign condition (5279 / 6645)  
18 118 reported to national Hospital Discharge Register. In the FINHYST 1996 study, the cohort  
19 119 coverage was higher (92.1%, N=10110) and the number of participating hospitals was 60 at  
20 120 that time. The FINHYST 2006 study was approved by the Ministry of Social Affairs and  
21 121 Health (Dnro STM/606/2005), by the Helsinki University Hospital Institutional Review Board  
22 122 (IRB) and by the Ethics Committee of the Department of Obstetrics and Gynecology of the  
23 123 Helsinki University Hospital (Dnro 457/E8/04). The 2006 study was registered in the Clinical  
24 124 Trials of Protocol Registration System Data (NCT00744172).

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26 126 Consistency of the data and missing information were thoroughly reviewed. The  
27 127 hysterectomies were divided into three groups: AH, VH, and LH.<sup>23</sup> To facilitate comparisons  
28 128 between the data sets in 1996 and 2006, each patient was defined as having had a  
29 129 complication or not. Categorical data were analyzed by the  $\chi^2$ -test or Fisher's exact  
30 130 probability test, and the means of continuous variables were analyzed pair wise with  
31 131 Student's t-test. Statistical significance was set at  $p < 0.05$ . All calculations were performed  
32 132 with the SPSS 17.0 software.

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34 134 **Results**

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3 136 The **proportions** of VH and LH in Finland increased markedly in the decade from 1996 to  
4 137 2006, while the **proportion** of AH fell to less than half (Figure 2). At the same time, the  
5 138 **proportion** of the less invasive hysterectomies, LH and VH, had surpassed AH in all  
6 139 hospitals and the overall number of hysterectomies dwindled from 10,110 to 5,279 (reduction  
7 140 of 47.8%). In 2006 1,7% of all hysterectomies were subtotal, in 1996 7,3%. In 2006, the  
8 141 most common indication for AH was fibroids 58% (in 1996 67%), for VH uterine prolapse  
9 142 61% (in 1996 83%) and for LH fibroids 39% (in 1996 56%) and menorrhagia 30% (in 1996  
10 143 47%).  
11 144

12 145 In 2006 hysterectomy was performed on significantly older patients in the AH and LH groups  
13 146 but younger in the VH group compared to 1996 (Table 1). Also, the mean BMI had increased  
14 147 significantly in the AH and LH groups but not in the VH group. The average uterine weight  
15 148 had risen significantly in all groups, most in the AH group, while the duration of the operation  
16 149 decreased significantly for LH and for VH, but increased for AH. Perioperative hemorrhage in  
17 150 VH decreased significantly and increased in AH and in LH but not significantly in LH. In all  
18 151 groups the duration of the hospital stay was significantly reduced, mostly in the VH group.  
19 152 The convalescence period decreased significantly in the AH and VH groups but increased  
20 153 slightly in the LH group (Table 1).  
21 154

22 155 **The overall complication rate related to any type of hysterectomy declined very**  
23 156 **significantly from 17.5 % in 1996 to 14.7 % in 2006 (<0.001).** The rate of complications in  
24 157 1996 was 16.2% for AH, 22.2% for VH and 17.0% for LH. Ten years later there was a slight  
25 158 increase to 19.2% in complications among AH-patients ( $p<0.05$ ) but a significant decrease to  
26 159 11.7% in the VH ( $p<0.001$ ) and a non-significant decrease to 15.5% in LH. The overall  
27 160 occurrence of organ injuries was significantly reduced only in the LH group from 2.8% to  
28 161 1.7% ( $p<0.05$ ). Of the severe organ complications bowel injuries were significantly less  
29 162 common only in the VH group in 2006 compared to 1996 and there was no difference in this  
30 163 respect in the AH and LH groups (Figure 3 **or table 3**). Similarly, ureter lesions occurred  
31 164 significantly less often only in the LH group in 2006 than in 1996.  
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33 166 The use antibiotic prophylaxis increased from 82.1% to 97.5% ( $p<0.001$ ) in a decade, and  
34 167 also the selection of antibiotics changed. In 1996 metronidazole was given as a single  
35 168 prophylactic agent to 66.7% of all patients, but in 2006 to only 9.9%. In 2006 cefuroxime was  
36 169 the primary choice of antimicrobial agent alone or in combination with metronidazole for  
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3 170 82.1% but in 1996 only for 15.3%. There were concomitantly significant reductions in the  
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5 171 overall rate of infections; in the AH group from 9.9% to 7.7.% ( $p<0.05$ ), in the VH group from  
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7 172 12.3% to 5.2% ( $p<0.001$ ) but a non-significant change from 17.0% to 15.4% in the LH group.  
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10 174 Also, the use of pharmacological thrombosis prophylaxis had risen from 35.4% in 1996 to  
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12 175 64.8% in 2006 ( $p<0.001$ ) and there was a concomitant reduction in VTEs in all groups, which  
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14 176 was significant in the LH group (Figure 3 or table 3). In 2006, there were no surgery-related  
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16 177 deaths, whereas in 1996 there was one death in each hysterectomy group. The occurrence  
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18 178 of postoperative hemorrhage in the LH group increased significantly from 1996 to 2006  
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20 179 (Figure 3).  
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23 181 The intraoperative detection of organ injuries in LH increased from 60% in 1996 to 75% in  
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25 182 2006. Postoperative ileus occurred at a similar rate in 1996 and 2006: AH 1.0% vs. 0.6%, LH  
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27 183 0.3% vs. 0.2%, and VH 0.1% vs. 0.2%. The incidence of urinary retention was significantly  
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29 184 higher ( $p<0.001$ ) in the VH group in 1996 (3.1%) than in 2006 (1.6%) while in the AH group it  
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31 185 was 0.5% both in 1996 and 2006 and in the LH group 0.9% and 0.5% in 1996 and 2006,  
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33 186 respectively.  
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36 188 By 2006 the percentage of surgeons with experience of more than 30 hysterectomies had  
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38 189 risen most markedly among surgeons performing LH: from 62% in 1996 to 73% in 2006 while  
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40 190 there was no change for VH (78% in 1996, 76% in 2006) but for AH there was a sinking trend  
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42 191 from 91% in 1996 to 75 % in 2006. The experience of the surgeons was associated to the  
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44 192 occurrence of organ injuries. Surgeons who had performed more than 30 hysterectomies in  
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46 193 1996, had significantly fewer ureter and bladder injuries, especially in the LH group, than the  
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48 194 less experienced surgeons (Table 2). The same was the case for bowel injuries in 1996 in  
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50 195 the VH group. In 2006, these differences were no longer present.  
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## 55 199 **Discussion**

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57 201 The role of laparoscopic hysterectomy (LH) compared to the traditional abdominal (AH) and  
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59 202 vaginal hysterectomy (VH) has been debated ever since the laparoscopic technique was  
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203 introduced. It has been argued that LH is associated with higher expenses, longer operation  
times and a higher rate of complications. Large and comprehensive RCT-studies have been

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3 204 badly needed to give answers to these questions. Such studies need to be very large, even  
4 205 to the point of being unfeasible, if they are to have sufficient statistical power.<sup>22</sup> Furthermore  
5 206 they would also need to be set up so that they discount the effect of the individual surgeon,  
6 207 the surgeon's experience and the effect of sophisticated surgical centres compared to  
7 208 ordinary hospitals. National registry-based observational surveys on large numbers of  
8 209 consecutive patients with prospective data collection are an alternative to cumbersome and,  
9 210 maybe, unrealistic RCT's and document effectiveness because they reflect clinical reality in  
10 211 the hands of the "average" gynecological surgeon.<sup>22</sup> This alternative was chosen for the  
11 212 present nationwide study, which compares some clinical determinants related to  
12 213 hysterectomies (AH, VH and LH) and hysterectomy-related morbidity in 2006 with 1996 in  
13 214 Finland.

14 215  
15 216 In the present study the growth of the popularity of VH was especially gratifying: the rate of  
16 217 VH increased from 18% in 1996 to 44% in 2006 (Figure 2), while the total number of  
17 218 complications, operation time, hemorrhage and bowel lesions related to VH decreased. All  
18 219 this took place despite the fact that the patients in 2006 were younger and were operated on  
19 220 for uterine descent less frequently – circumstances claimed to pose more operative  
20 221 challenges and yield complications. We believe that the vaginal approach should be used  
21 222 whenever possible.

22 223  
23 224 The rate of LH increased also (from 24% to 36%). The current rate of LHs in Finland is high  
24 225 compared to our neighbouring Nordic countries (4-7%)<sup>4,12,15</sup> and globally (Figure 1).  
25 226 Worldwide, only Taiwan has a higher rate of LH, where the rate of LH has soared from 5 % in  
26 227 1996 to 40 % in 2005.<sup>5</sup> In consequence, we have a much lower rate of AH (24%) compared  
27 228 to many other countries, e.g., the USA (68%)<sup>13</sup> and the other Nordic countries Sweden  
28 229 (60%)<sup>15</sup>, Denmark (59%),<sup>4</sup> Norway (78%).<sup>12</sup> According to a recent meta-analysis by the  
29 230 Cochrane collaboration, the order of preference of hysterectomies should be VH and LH  
30 231 followed by AH.<sup>21</sup> This study shows that this is precisely the sequence of preferences  
31 232 followed in Finland.

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33 234 The main finding of this study is that the overall complication rates related to VH and LH have  
34 235 decreased in Finland. Another important observation was that, of the severe organ lesions,  
35 236 ureter complications related to LH – one of the main concerns in 1996<sup>8</sup> – have decreased  
36 237 highly significantly (from 1.1% to 0.3%). This finding is in accordance with a retrospective

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3 238 nationwide registry study on the complications of LH, which reported a continuously  
4 239 decreasing trend from 1993 to 2005 in ureter injuries in Finland.<sup>24</sup> Also, the fact that LH-  
5 240 related bladder complications sank from 1.3% to 1.0% supports the notion that surgeons  
6 241 doing this operation have steadily gained experience and are better aware of the need to  
7 242 avoid harming the bladder and ureters. The rate of VH-associated bowel complications sank  
8 243 also significantly (Figure 3). For AH there was a slight increase in the occurrence of total  
9 244 complications (from 16% in 1996 to 19% in 2006), but this only reflects the fact that more  
10 245 severe and advanced cases required the abdominal approach in 2006.  
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12 247 The reduction in the number of infections (**Figure 3 or table 3**), especially urinary tract  
13 248 infections, was probably due to the increased prophylactic use of antibiotics. The reduction of  
14 249 thromboembolic events is most likely due to a consequence of increased and appropriate use  
15 250 of thromboprophylaxis. The aim to reduce both of these complications was discussed already  
16 251 some ten years ago at a consensus meeting with the members of the Society of  
17 252 Gynecological Surgery in Finland, and a unified, common prophylaxis management system  
18 253 with antibiotics and antithrombotics was introduced and implemented.<sup>25</sup> **Of the other**  
19 254 **Scandinavian countries infectious morbidity related to hysterectomies in Sweden in**  
20 255 **2003 - 2006 was 12.0% for AH, 15.0% for LH and 9.9% for VH.** <sup>26</sup> **Much lower rates were**  
21 256 **entered into the Danish hysterectomy database: in 2006 there were postoperative**  
22 257 **infections (excluding urinary tract infections) in only 2% of all hysterectomies.** <sup>4</sup>  
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24 259  
25 260 **Data coverage is a limitation of our study.** We believe that one of the main reasons for the  
26 261 fact that in the FINHYST 1996 study the cohort coverage was higher (92%) than in 2006  
27 262 (79%) is related to the circumstance that the approval of the ethics committee in 1996 did not  
28 263 require us to collect the patients' social security numbers. The survey in 2006 was run  
29 264 according to new regulations which require that each patient provides full disclosure of her  
30 265 identity and written informed consent. Since all other facets of the studies and the data  
31 266 collection were identical between the two studies, these requirements remain the only  
32 267 explanatory variable for the reduced participation coverage. **The lower recruitment in 2006**  
33 268 **made us perform a type of data verification. We examined the data from the national**  
34 269 **register of the Patient Insurance Center, to which patients self-report complications,**  
35 270 **usually in pursuit of economical compensation. The rate of complications was similar**  
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3 271 **among those who had been recruited to FINHYST 2006 and those who were unable to**  
4 **participate. This observation would exclude selection bias in our study cohort.**  
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8 274 In 2006, compared to 1996, our patients were proportionately older, more obese and had a  
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10 275 higher uterine weight, but still the duration of hospital stay in all hysterectomy types and the  
11 276 operation time for LH and VH was reduced (Table 1). Evidently, the need for hysterectomy  
12 277 will persist, but it will not be as high as in the late 1990's.<sup>27,28</sup> The outlook is that  
13 278 hysterectomies will be safer than before. Recent indications for hysterectomies in Finland  
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15 279 were more properly scrutinized and patients undergoing these procedures were more severely  
16 280 affected than a decade earlier. . **Of course, it would have been ideal to adjust the**  
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18 281 **complication rates of the different types of hysterectomy by the population difference**  
19 282 **because the patients in the three groups AH, VH and LH were very different in 1996**  
20 283 **and 2006 but this was not possible. Consequently, a definite conclusion whether the**  
21 284 **improvements in some parameters are a result of real clinical improvement rather than**  
22 285 **just a change in the populations cannot be drawn. However, the very significant**  
23 286 **decrease in overall complication rate in all hysterectomies between 1996 and 2006**  
24 287 **indicate that clinical improvement was real. Moreover, the overall maximum rates of the**  
25 288 most severe organ injuries (bladder, ureter, bowel) in all types of hysterectomies in Finland  
26 289 were 0.7% - 2.8% in 1996 and 0.7 - 1.7% in 2006. This improvement is encouraging and  
27 290 similar trends have been reported in other countries.<sup>2</sup> This positive development has taken  
28 291 place in a time of a markedly decreasing need for hysterectomies mostly as a consequence  
29 292 of many new and effective conservative treatments of various bleeding problems (hormonal  
30 293 IUD, thermoablation etc.)  
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296 Since the introduction of laparoscopic hysterectomy in Finland in the 1990's, gynecological  
297 surgeons have collaborated actively in clinical practice and training. This has resulted in a  
298 unified system of data collection for research and quality control. With the first FINHYST  
299 study in 1996 we identified matters needing improvement, after which practices were  
300 changed, training was increased and collaboration on a national level was implemented. As a  
301 consequence of this fruitful and collegial collaboration, hysterectomy-associated morbidity  
302 has decreased and patients are selected more appropriately for the traditional abdominal,  
303 vaginal or endoscopic route.

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306 **References**

307

308 1. Reich H, DiCaprio J, McGlynn F. Laparoscopic hysterectomy. *J Gynecol Surg* 1989; 5:

309 213-16.

310

311 2. Donnez O, Jadoul P, Squifflet J, Donnez J. A series of 3190 laparoscopic hysterectomies  
312 for benign disease from 1990 to 2006: evaluation of complications compared with vaginal and  
313 abdominal procedures. *Br J Obstet Gynaecol* 2009;116:492-500.

314

315 3. David-Montefiore E, Rouzier R, Chapron C, Darai E and the Collegiale d'Obstétrique et  
316 Gynéologie de Paris-Ile de France. Surgical routes and complications of hysterectomy for  
317 benign disorders: a prospective observational study in French university hospitals. *Hum*  
318 *Reprod* 2007;22:260-65.

319

320 4. Hansen CT, Møller C, Daugbjerg J, Kehlet H, Ottesen B. Establishment of a national  
321 Danish hysterectomy database: preliminary report on the first 13 425 hysterectomies *Acta*  
322 *Obstet Gynecol* 2008;87,546-557.

323

324 5. Wu M, Huang K, Long C, Tsai E, Tang C. Trends in various types of hysterectomy and  
325 distribution by patient age, surgeon age, and hospital accreditation: 10-year population-based  
326 study in Taiwan. *J Minim Invasive Gynecol* 2010;17:612-19.

327

328 6. Brummer TH, Jalkanen J, Fraser J et al. FINHYST 2006 - National prospective 1-year  
329 survey of 5 279 hysterectomies. *Hum Reprod* 2009;24:2515-2522.

330

331 7. Maresh MJA, Metcalfe MA, Mc Pherson K et al. The VALUE national hysterectomy study:  
332 description of the patients and their surgery. *Br J Obstet Gynaecol* 2002;109: 302-312.

333

334 8. Mäkinen J, Johansson J, Tomas C et al. Morbidity of 10 110 hysterectomies by type of  
335 approach. *Human Reprod.* 2001;16:1473-8.

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2  
3 337 9. Chapron C, Laforest L, Ansquer Y, Fauconnier A, Fernandez B, Breart G, Dubuisson JB  
4 338 Hysterectomy techniques used for benign pathologies: results of a French multicentre study.  
5 339 Hum Reprod 1999;14:2464-2470.  
6  
7 340  
8  
9 341 10. Farquhar C, Steiner C. Hysterectomy rates in the United States 1990-1997. Obstet  
10 342 Gynecol 2002;99:229-243.  
11 343  
12  
13 344 11. Møller C, Kehlet H, Utzon J, Ottesen B. Hysterectomy in Denmark. An analyses of  
14 345 postoperative hospitalisation, morbidity and readmission. Dan Med Bull 2002;49:353-57 (in  
15 346 Danish).  
16 347  
17  
18 348 12. Oma J. Which factors affect the choice of method for hysterectomy in benign disease.  
19 349 Tidsskr Nor Lægeforen 2004;124: 92-4 (in Norwegian).  
20 350  
21 351 13. Whiteman MK, Hillis SD, Jamieson DJ, Morrow B, Podgornik MN, Brett KM, Marchbanks  
22 352 PA. Inpatient hysterectomy surveillance in the United States, 2000–2004. Am J Obstet  
23 353 Gynecol 2008;198:34-6.  
24 354  
25  
26 355 14. Kolkman W, Trimbos-Kemper T, Jansen F. Operative laparoscopy in the Netherlands:  
27 356 Diffusion and acceptance. Eur J Obstet Gynecol Reprod Biol 2007;130:245-48.  
28 357  
29  
30 358 15. Persson P, Hellborg T, Brynhildsen J, Fredrikson M, Kjølhede P. Attitudes to mode of  
31 359 hysterectomy - a survey-based study among Swedish gynecologists. Acta Obstet Gynecol  
32 360 Scand 2009;88:267-74.  
33 361  
34  
35 362 16. Hill E, Graham M, Shelley J. Hysterectomy trends in Australia – between 2000 / 01 and  
36 363 2004 /05. ANZJOG 2010;50:153–58.  
37 364  
38  
39 365 17. Stang A, Merrill RM, Kuss O. Nationwide rates of conversion from laparoscopic or vaginal  
40 366 hysterectomy to open abdominal hysterectomy in Germany. Eur J Epidemiol 2011;26:125-33.  
41 367  
42  
43 368 18. Garry R, Fountain J, Mason S et al. The eVALuate study: two parallel randomised trials,  
44 369 one comparing laparoscopic with abdominal hysterectomy, the other comparing laparoscopic  
45 370 with vaginal hysterectomy. Br Med J 2004; 328:129-136.  
46  
47  
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4  
5 372 19. Johnson N, Barlow D, Lethaby A, Tavender E, Curr E, Garry R. Methods of  
6 373 hysterectomy: a systematic review and meta-analysis of randomised controlled trials. Br Med  
7 374 J 2005;330:1478-1486.  
8  
9 375  
10  
11 376 20. Johnson N, Barlow D, Lethaby A, Tavender E, Curr E, Garry R. Surgical approach to  
12 377 hysterectomy for benign gynaecological disease. Cochrane database of systematic  
13 378 reviews 2006; Issue 2: Art. No.:CD003677.  
14  
15 379  
16  
17 380 21. Nieboer TE, Johnson N, Lethaby A, Tavender E, Curr E, Garry R, van Voorst S, Mol  
18 381 BWJ, Kluivers KB. Surgical approach to hysterectomy for benign gynaecological disease.  
19 382 Cochrane database of systematic reviews Issue 3, 2010; Art. No.: CD003677.  
20  
21 383  
22  
23 384 22. Claerhout F, Deprest J. Laparoscopic hysterectomy for benign diseases. In: Best Practice  
24 385 and Research Clinical Obstetrics and Gynaecology, Hysterectomy, eds. Thakar R and  
25 386 Manyonda I. Elsevier. 2005;19:357-75.  
26  
27 387  
28  
29 388 23. Kovac SR. Guidelines to determine the root of hysterectomy. Obstet Gynecol 1995;85:  
30 389 18-23.  
31  
32 390  
33  
34 391 24. Brummer TH, Seppälä T, Härkki P. National learning curve of laparoscopic  
35 392 hysterectomy and trends in hysterectomy in Finland 2000-2005. Hum Reprod 2008;23:840-  
36 393 45.  
37  
38 394  
39  
40 395 25. GKS, The society of gynaecological surgery in Finland, webpage, in Finnish. Suositukset  
41 396 2007 (recommendations) available at: [www.terveysportti.fi/kotisivut/sivut.koti?p\\_sivusto=434](http://www.terveysportti.fi/kotisivut/sivut.koti?p_sivusto=434) .  
42 397 Accessed on July 2012 (in Finnish).  
43  
44 398  
45  
46 399 **26. Löfgren M, Sundström Poromaa I, Stjerndahl JH, Renström B. (2004) Postoperative**  
47 400 **infections and antibiotic prophylaxis for hysterectomy in Sweden: A study by the**  
48 401 **Swedish National Register for Gynecologic Surgery. Acta Obstet Gynecol Scand 83:**  
49 402 **1202-1207.**  
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6 407 27. Roberts TE, Tsourapas A, Middleton LJ et al. Hysterectomy, endometrial ablation, and  
7  
8 408 levomorgestrel releasing intrauterine system (Mirena) for treatment of heavy menstrual  
9  
10 409 bleeding: cost effectiveness analysis. Br Med J 2011;342, d 2202.  
11 410  
12  
13 411 28. Qvistad E, Langebrekke A. Should we recommend hysterectomy more often to  
14  
15 412 premenopausal and climacteric women? Acta Obstet Gynecol Scand 2011;90:811-14.  
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21 416 **Authors' contributions**  
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24 418 Authors: Juha Mäkinen (JM), Tea Brummer (TB), Jyrki Jalkanen (JJ), Anna-mari heikkinen  
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26 419 (A-MH), Jaana Fraser (JF), Eija Tomas (ET), Päivi Härkki (PH) and Jari Sjöberg (JS)  
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41 428 Study design: all authors  
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44 430 Permissions: TB, PH, JS and JM  
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48 432 Data collection: TB and PH  
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55 436 Data interpretation: all authors  
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58 438 Writing: all authors  
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4 440 Conflict of interest: No conflict of interest related to this article

6 441

8 442 Role of funding source. No source of funding

9 443

11 444 Ethics committee approval: The Finhyst 2006 study was approved by the ministry of social

12 445 affairs and health (Dnro STM/606/2005), by the Helsinki University Hospital Institutional

14 446 Review Board (IRB) and by the ethics committee of the department of Obstetrics and

16 447 Gynaecology of the Helsinki University Hospital (Dnro 457/E8/04). The 2006 study was

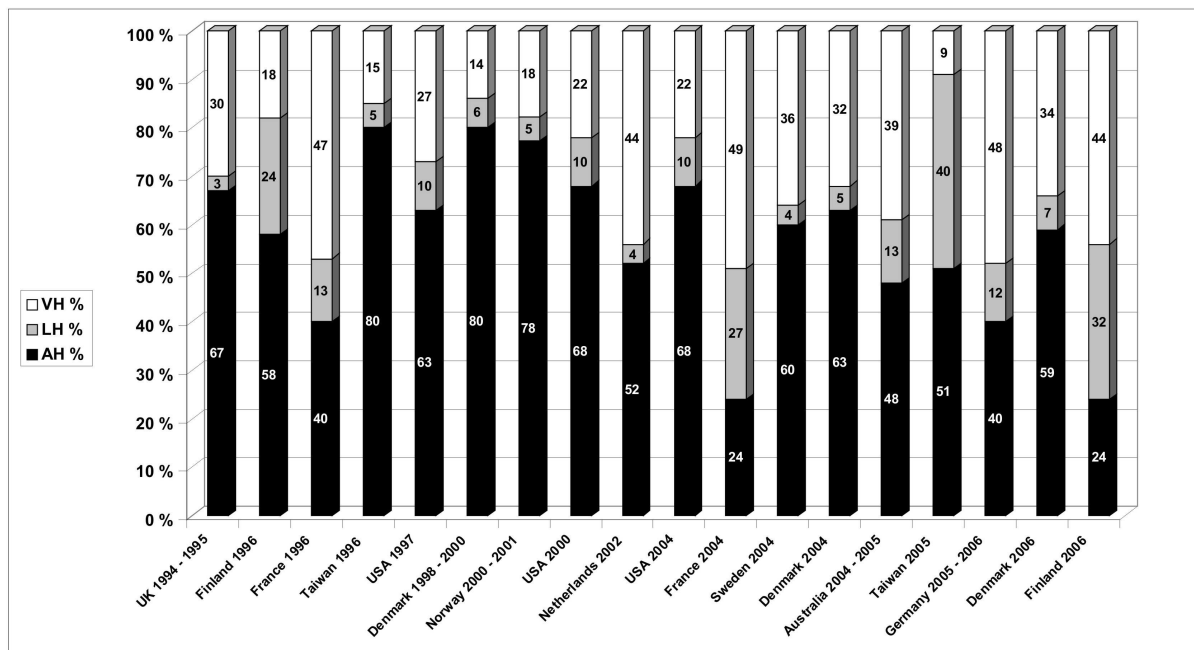
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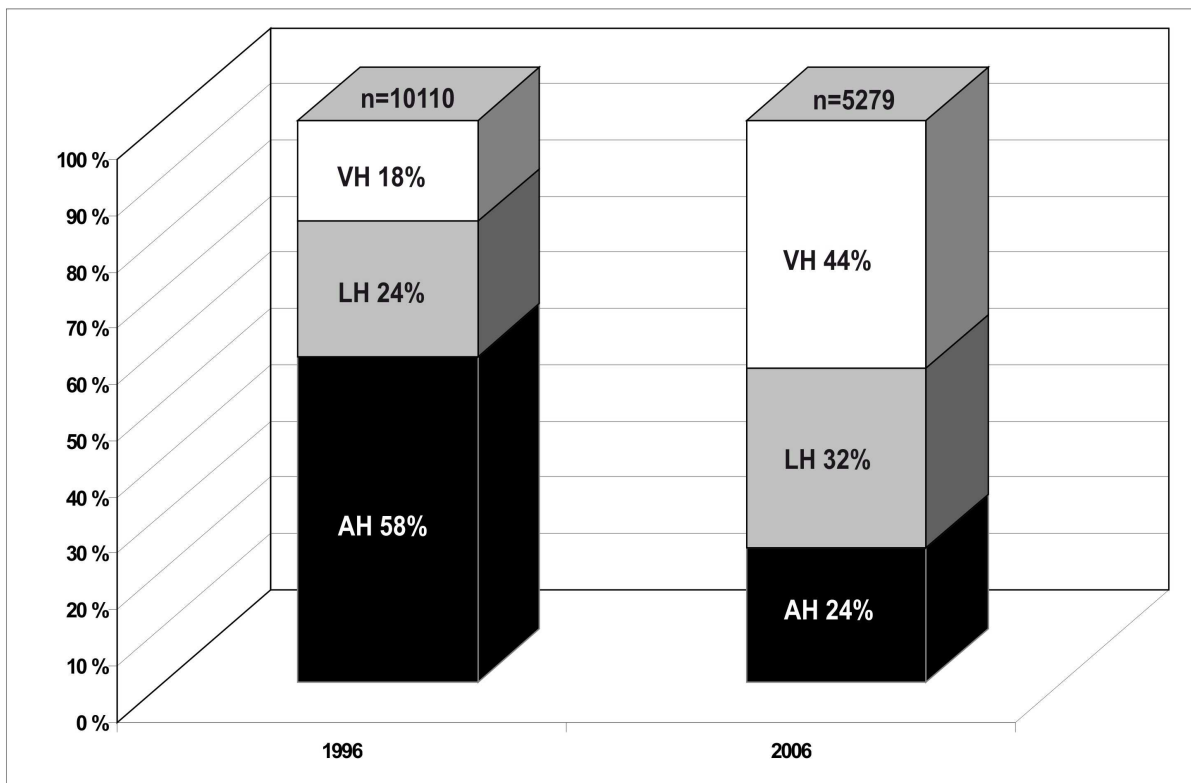
Figure 1





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Figure 2



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## Legends to the figures:

Figure 1. **PROPORTIONS** of abdominal, vaginal and laparoscopic hysterectomies in various countries from 1994 to 2006.

### Footnote

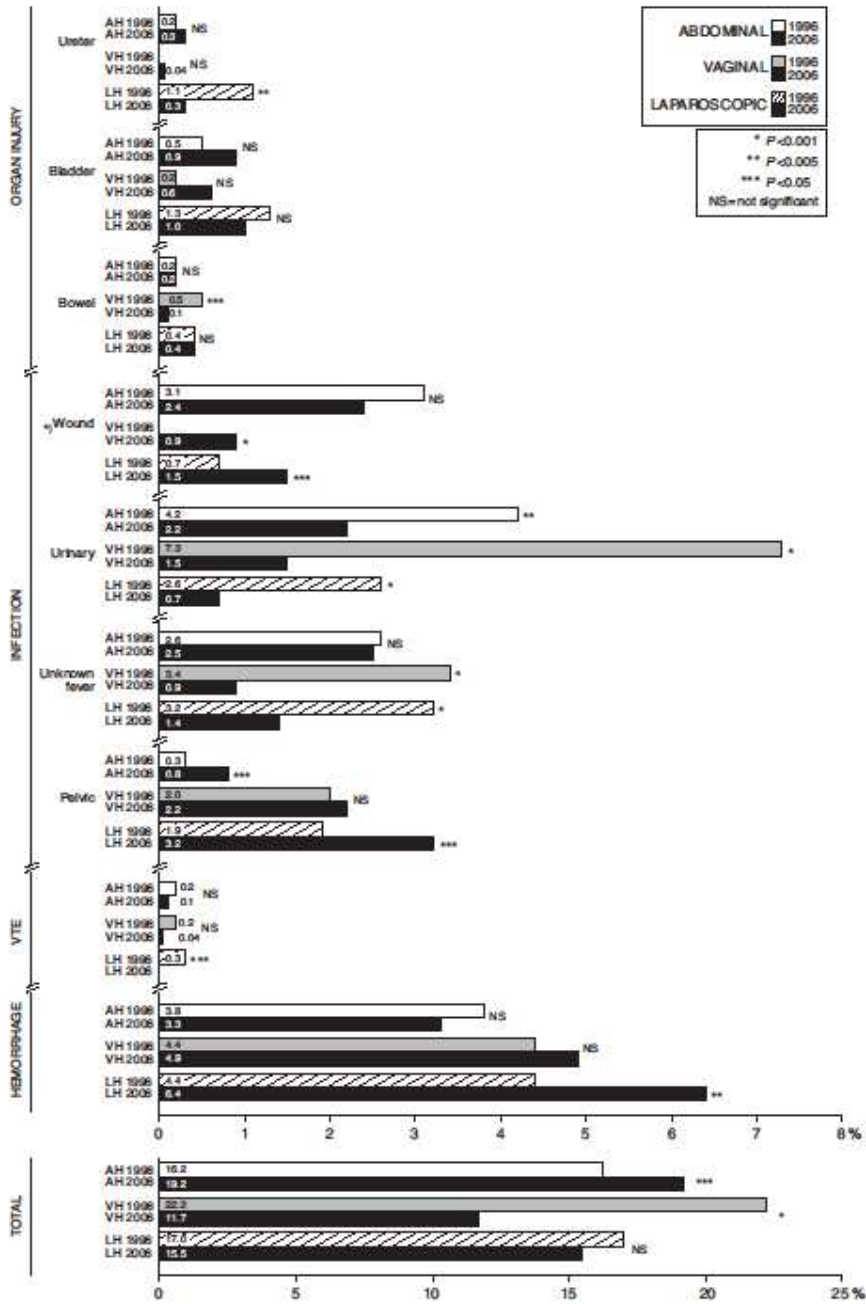
Figures from France represent samples from University clinics only, otherwise national data are presented, apart from the UK, which excludes Wales, and represents 45% of national hysterectomies. References: UK 1994-1995,<sup>7</sup> Finland 1996,<sup>8</sup> France 1996,<sup>9</sup> Taiwan 1996,<sup>5</sup> USA 1997,<sup>10</sup> Denmark 1998-2000,<sup>11</sup> Norway 2000-2001,<sup>12</sup> USA 2000,2004,<sup>13</sup> Netherlands 2002,<sup>14</sup> France 2004,<sup>9</sup> Sweden 2004,<sup>15</sup> Denmark 2004,<sup>4</sup> Australia 2005-2005,<sup>16</sup> Taiwan 2005,<sup>5</sup> Germany,<sup>17</sup> Denmark 2006,<sup>4</sup> and Finland 2006,<sup>6</sup>

Figure 2. **PROPORTION** of hysterectomies by type in Finland in 1996 and 2006.

### Footnote

AH = abdominal hysterectomy  
VH = vaginal hysterectomy  
LH = laparoscopic hysterectomy

Figure 3



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3 Figure 3. Complications related to abdominal, vaginal and laparoscopic hysterectomies in 1996 and  
4 2006  
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7 Footnote  
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10 VTE, venous thromboembolism.

11 \* Pelvic infection data from 1996 comprise all intra-abdominal and vaginal infections,  
12 whereas in 2006 late onset of pelvic infection was defined as pelvic abscess or hematoma

13 \*\* N of patients. A patient may have had more than one complication.

14 \*) including vaginal cuff infection  
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Table 1. Patient characteristics and surgery-related details (mean +/- SD) by hysterectomy method in 1996 and 2006.

	ABDOMINAL				VAGINAL				LAPAROSCOPIC			
	1996 (N=5875)		2006 (N=1255)		1996 (N=1801)		2006 (N=2345)		1996 (N=2434)		2006 (N=1679)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age	48,8	8,7	50,1	8,8	58,6	13,2	55,0	11,8	47,0	7,5	49,2	8,5
BMI (kg/m <sup>2</sup> )	26,3	4,5	27,1	5,3	26,3	3,9	26,4	4,4	24,9	3,9	26,1	4,6
Oper time (min)	86	31	93	37	88	32	78	33	124	48	108	43
Hemorrhage (ml)	305	312	355	360	342	353	203	269	262	271	270	669
Uterine weight (g)	290	302	433	425	109	84	131	110	195	108	210	146
Hospital stay (days)	6.0	2,2	3,8	1,8	5,9	2,7	2,3	1,5	3,4	2,0	2,0	1,4
Convalescence (days)	34.4	5.3	32,3	4,6	34.0	8.8	29,4	8,0	21.5	8.8	22,0	6,3

All pairs (1996 vs. 2006)  $p < 0.001$ , except in LH for hemorrhage ( $P = 0.603$ ) and in VH for BMI ( $P = 0.484$ )

Table 2. Rate and number of ureter, bladder and bowel injuries in various hysterectomies in Finland in relation to surgeon's experience (more than 30 vs 30 or less than 30 hysterectomies) in 1996 and 2006

	ABDOMINAL				VAGINAL				LAPAROSCOPIC			
	1996 (N=5875)		2006 (N=1255)		1996 (N=1801)		2006 (N=2345)		1996 (N=2434)		2006 (N=1679)	
	%	n	%	n	%	n	%	n	%	n	%	n
Ureter injury												
≤ 30		-	0,4	1		-		-	2,2	20	0,3	1
> 30	0,2	9	0,3	3		-	0,04	1	0,5 **	7	0,2	3
Bladder injury												
≤ 30		-	1,1	3		-	0,6	3	2,0	18	1,3	5
> 30	0,5	28	0,7	7	0,4	4	0,5	9	0,8 *	12	1,0	12
Bowel injury												
≤ 30		-		-	1,3	5	0,2	1	0,4	4	0,3	1
> 30	0,2	12	0,3	3	0,3 *	4	0,06	1	0,3	5	0,4	5

\* P = 0.05

\*\* P < 0.001

Other comparisons (≤30 vs > 30): not significant

Table 3. The rate and number of complications in various hysterectomies in 1996 and 2006

	ABDOMINAL					VAGINAL					LAPAROSCOPIC				
	1996 N=5875		2006 N=1255			1996 N=1801		2006 N=2345			1996 (N=2434)		2006 (N=1679)		
	%	n	%	N	P	%	n	%	n	P	%	n	%	n	P
<b>ORGAN INJURY</b>															
<b>Ureter</b>	0.2	9	0.3	4	0.212	-	0	0.04	1	0.381	1.1	27	0.3	5	<b>0.004</b>
<b>Bladder</b>	0.5	29	0.9	11	0.099	0.2	4	0.6	14	0.069	1.3	31	1.0	17	0.443
<b>Bowel</b>	0.2	12	0.2	3	0.807	0.5	9	0.1	2	<b>0.010</b>	0.4	9	0.4	7	0.811
<b>Total/patient</b>	0.9	50	1.4	18	0.054	0.7	13	0.7	17	0.991	2.8	67	1.7	29	<b>0.032</b>
<b>INFECTION</b>															
<b>Wound</b>	3.1	180	2.4	30	0.200			0.9	20	<b>&lt;0.001</b>	0.7	17	1.5	25	<b>0.013</b>
<b>Urinary</b>	4.2	245	2.2	28	<b>0.001</b>	7.3	129	1.5	36	<b>&lt;0.001</b>	2.6	63	0.7	11	<b>&lt;0.001</b>
<b>Unknown fever</b>	2.6	152	2.5	32	0.939	3.4	62	0.9	22	<b>&lt;0.001</b>	3.2	79	1.4	23	<b>&lt;0.001</b>
<b>Pelvic *</b>	0.3	19	0.8	10	<b>0.017</b>	2.0	36	2.2	51	0.695	1.9	47	3.2	54	<b>0.009</b>
<b>Total /patient **</b>	9.9	583	7.7	97	<b>0.016</b>	12.3	222	5.2	122	<b>&lt;0.001</b>	8.3	201	6.7	113	0.070
<b>TROMBOEMB.</b>	0.2	9	0.1	1	0.528	0.2	4	0.04	1	0.099	0.3	7	-	0	<b>0.028</b>
<b>HEMORRHAGE</b>	3.8	221	3.3	42	0.479	4.4	79	4.9	114	0.472	4.4	107	6.4	108	<b>0.004</b>
<b>TOTAL /PATIENT **</b>	16.2	952	19.2	241	0.010	22.2	400	11.7	275	<b>&lt;0.001</b>	17.0	413	15.4	258	0.172

\* Pelvic infection data from 1996 comprise all intra-abdominal and vaginal infections, whereas in 2006 was defined as abscess or hematoma

\*\* N of patients. A patient may have had more than one complication.

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found	P2 P2
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	P3
Objectives	3	State specific objectives, including any prespecified hypotheses	P3
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	P4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	P4
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants (b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	P4 P4 P4
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	P4
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	P4
Bias	9	Describe any efforts to address potential sources of bias	P4
Study size	10	Explain how the study size was arrived at	P4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	P4
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy (e) Describe any sensitivity analyses	P4 P4 P4 P4

Continued on next page



<b>Results</b>		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time <i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure <i>Cross-sectional study</i> —Report numbers of outcome events or summary measures
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
<b>Discussion</b>		
Key results	18	Summarise key results with reference to study objectives
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	Discuss the generalisability (external validity) of the study results
<b>Other information</b>		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

## Patient Consent Form

The form was used only in Finnish (belowe).

The ethics committee in 1996 did not require us to collect the patients' social security numbers or consent forms. The survey in 2006 was run according to new regulations which require that each patient provides full disclosure of her identity and written informed consent (in Finnish).

### Potilastiedote Finhyst 2006 kohdunpoistotutkimuksesta

Olette tulossa kohdunpoistoleikkaukseen. Suomessa näitä leikkauksia tehdään vuosittain noin 10 000 ja se on yksi tavallisimmista naisille tehtävistä kirurgisista toimenpiteistä. Finhyst 2006 - tutkimuksen avulla haluamme selvittää koko maassa vuoden 2006 kohdunpoistoleikkauksien hoitotuloksia ja turvallisuutta.

Tietosuojan turvaamiseksi kohdunpoistoon liittyvät tiedot kerätään suljettuun tietokonerekisteriin ja ne käsitellään täysin luottamuksellisesti. Kerättävät tiedot rajoittuvat vain välittömästi kohdunpoistoleikkaukseen liittyviin seikkoihin. Tutkimukseen osallistuminen on teille täysin vapaaehtoista; siihen osallistuminen tai osallistumisesta kieltäytyminen ei vaikuta millään tavalla teille jo hoitopaikassanne suunniteltuun hoitoon, josta vastaa teidät leikkaava lääkäri.

Kotiutuessanne saatte toipumistanne koskevan kyselylomakkeen ja toivomme teidän täyttävän ja postittavan ne 8 viikon kuluttua leikkauksestanne kirjekuorella, jonka saatte kyselylomakkeiden mukana.

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## Study protocol

The questionnaire sheets were used only in Finnish (below).

Data collection was nationwide and followed the same procedure in both annual cohorts of 1996 and 2006. The forms (FINHYST 1996 and 2006) were used to collect data on preoperative, peroperative and postoperative events and operation-related morbidity during the patients' hospital stay and convalescence.

### FINHYST 2006 (Leikkaava lääkäri täyttää) Sivun 1

Rengasta oikea vaihtoehto. Lomake täytetään kaikista muista kohdunpoistoista paitsi syövästä, borderline munasarjakasvaimista ja synnytyksen jälkeisistä kohdunpoistoista

Potilaan nimi ja SOTU (miehellään tarra): \_\_\_\_\_

Sairaala \_\_\_\_\_

Toimenpidepäivä: \_\_\_\_\_ Lomakkeen täyttöpäivä: \_\_\_\_\_

Leikkaaja: **1.** erikoislääkäri / **2.** erikoistuva lääkäri

Leikkaajan kokemus ko. leikkauksessa: **1.** alle 10 kpl / **2.** 10-30 kpl / **3.** yli 30 kpl

Kohdunpoisto:

**1. a.** Abdominaalinen totaali / **b.** abdominaalinen amputaatio

**2. a.** LH (uterinat yläkautta) / **b.** LAVH (uterinat alakautta) / **c.** laparoskooppinen amputaatio

**3.** Vaginaalinen

**4.** Konversio (mistä mihin \_\_\_\_\_, syy \_\_\_\_\_)

**5.** Kohdun paloittelu sen ulos saamiseksi

**TÄRKEIN** preoperatiivinen syy miksi leikattiin (vain **YKSI** vaihtoehto): ICD-10 \_\_\_\_\_

**1.** Myoma(t)

**2.** Menorrhagia

**3.** Dysmenorrhea

**4.** Endometrioosi

**5.** Laskeumat

**6.** Adnextuumori

**7.** Muu, mikä \_\_\_\_\_

Muuttuiko tärkein diagnoosi leikkauksen jälkeen? **1.** ei / **2.** kyllä: uusi dg (ICD-10) \_\_\_\_\_

Potilaan pituus \_\_\_\_\_ cm, paino \_\_\_\_\_ kg

Pariteetti: \_\_\_\_\_ joista alatiesynnytyksiä \_\_\_\_\_ kpl ja sektioita \_\_\_\_\_ kpl

Aikaisemmat muut vatsanalueen leikkaukset: laparoskopioita \_\_\_\_\_ kpl, laparotomioita \_\_\_\_\_ kpl

Antibioottiprofylaksia:

**1.** ei

**2.** kyllä: **a.** kefuroksiimi / **b.** metronidatsoli / **c.** muu, mikä \_\_\_\_\_ + annos \_\_\_\_\_

Lääkkeellinen tromboosiprofylaksia:

**1.** ei

**2.** kyllä: **a.** minihepariini / **b.** muu, mikä \_\_\_\_\_ + annos \_\_\_\_\_ + kesto (vrk) \_\_\_\_\_

Leikkauksen kesto (min) (aika 1. viillosta sulkuun) \_\_\_\_\_

Arvioitu/mitattu vuoto (ml) \_\_\_\_\_

Uteruksen paino ilman adnexeja (g) \_\_\_\_\_

Leikkaajan arvio leikkauksen vaikeudesta:

**1.** erittäin helppo / **2.** helppo / **3.** tavallinen / **4.** vaikea / **5.** erittäin vaikea, miksi \_\_\_\_\_

Hemostaasimenetelmä(t):

1. Ligatuurat
2. Bipolaaripoltto
3. Monopolaaripoltto
4. Ultraääniveitsi
5. Muu (Esim. Ligasure), mikä \_\_\_\_\_

Liitännäistoimenpiteitä: Sivu 2

1. Ei
2. Kyllä
- A. a. toisen adneksin poisto / b. molempien adnexien poisto
- B. Vaginaaliset plastiat: a. KA / b. KP
- C. Inkontinenssin korjaus: a. TVT / b. TOT / c. muu \_\_\_\_\_
- D. Enteroseelen korjaus
- E. Leikkausta hankaloittavien kiinnikkeiden irrottelu
- F. Muu, mikä \_\_\_\_\_

Leikkauksen **aikana** havaittu komplikaatio:

1. Ei
2. Kyllä
- A. Yli 1000ml leikkausvuoto
- B. Verisuonivaurio: a. epigastricasuonet / b. suuret suonet (aorta, v.cava, iliacat) / c. muu suoni, mikä \_\_\_\_\_
- C. Rakkovaurio
- D. Uretervaurio
- E. Suolivaurio
- F. Tekniset laiteongelmat, mikä \_\_\_\_\_
- G. Muu, mikä \_\_\_\_\_

Miten komplikaatio hoidettiin \_\_\_\_\_

Leikkauksen **jälkeen** osastolla todettu komplikaatio:

1. Ei
2. Kyllä
- A. Reoperaatio, syy \_\_\_\_\_
- B. Postoperatiivinen vuoto/hematoma
- C. Haavainfektio (vaatinut antibiootin, punktion tai dreneerauksen)
- D. Virtsatieinfektio (Uricult > 10<sup>5</sup>)
- E. Epäselvä kuumeilu (aksillaarinen lämpö  $\geq 38^{\circ}\text{C}$ )
- F. Syvä laskimotromboosi
- G. Keuhkoembolia
- H. Rakkovaurio
- I. Uretervaurio
- J. Suolenvetovaikeus
- K. Suolivaurio
- L. Hernia, mikä \_\_\_\_\_
- M. Muu ongelma, mikä \_\_\_\_\_

Miten komplikaatio hoidettiin \_\_\_\_\_

Potilas sai verensiirron

1. Ei
  2. Kyllä a. ennen leikkausta \_\_\_\_ punasoluyksikkö/ b. leikkauksen aikana \_\_\_\_ punasoluyksikköä/ c. leikkauksen jälkeen \_\_\_\_ punasoluyksikköä
- Kotiutuspäivämäärä \_\_\_\_\_ Sairasloma (vrk) \_\_\_\_\_ (sisältää sairaalassa oloajan)

**FINHYST 2006 JÄLKIKOMPLIKAATIOLOMAKE** (Lääkäri täyttää)

Täytetään vain mikäli potilas joutuu uudestaan sairaalaan komplikaation takia

Potilaan nimi ja SOTU (miehellään tarra): \_\_\_\_\_

Sairaala: \_\_\_\_\_

Kohdunpoistopäivä: \_\_\_\_\_

Lomakkeen täyttöpäivä: \_\_\_\_\_

Komplikaation toteamispäivä \_\_\_\_\_

Havaittu komplikaatio:

**1.** Reoperaatio, syy \_\_\_\_\_

**2.** Verensiirtoon johtanut anemia

**3.** Haavainfektio (vaatinut antibiootin, punktion tai dreneerauksen)

**4.** Virtsatieinfektio (Uricult > 10<sup>5</sup>)

**5.** Epäselvä kuumeilu (Aksillaarinen lämpö  $\geq 38$  °C)

**6.** Lantionpohjan infektio (hematoma ja/tai abskessi)

**7.** Syvä laskimotromboosi

**8.** Keuhkoembolia

**9.** Rakkovaurio

**10.** Uretervaurio

**11.** Suolenvetovaikeus

**12.** Suolivaurio

**13.** Hernia, mikä \_\_\_\_\_

**14.** Muu ongelma, mikä \_\_\_\_\_

Miten komplikaatio hoidettiin

Sairaalassa oloaika (vrk) \_\_\_\_\_

Uusi sairasloma (lisä vrk) \_\_\_\_\_

Potilas **1.** on työssä / **2.** ei ole työssä

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8 2 10 YEARS OF PROGRESS: IMPROVED HYSTERECTOMY OUTCOMES IN FINLAND  
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10 3 | 1996 – 2006 **A LONGITUDINAL OBSERVATION STUDY**  
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14 7

15 7 Juha Mäkinen <sup>a</sup>, M.D., Ph.D.  
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Running title: Improved hysterectomy outcomes in Finland 1996 - 2006

## Abstract

Background The morbidity associated with hysterectomy has been studied cross-sectionally in observational studies, case-controlled and randomized trials, large hospital based series and meta-analyses but never longitudinally. We compared hysterectomy practices and patient outcomes of cohorts operated in 1996 and 2006.

Methods A nationwide, prospective evaluation of women undergoing abdominal **hysterectomy** (AH), vaginal **hysterectomy** (VH) or laparoscopic hysterectomy (LH) for benign conditions was made in 1996 (N=10110) and was followed by this trial in 2006 (N=5276). All hospitals in Finland participated. Patient characteristics, surgery-related outcomes and complications were analyzed.

Findings In 1996, AH was the main approach (58%), but was surpassed within a decade by VH and LH (together, 76% of all hysterectomies in 2006). **The overall complication rates fell. The overall rate of complications declined from 17.5 % in 1996 to 14.7 % in 2006 (p<0.001). By operation type, a decrease was also observed in LH (from 17.0 % to 15.5 %, NS)** and markedly in VH (from 22.2% to 11.7%, p<0.001). The overall surgery-related infectious morbidity decreased in all groups and significantly in VH (from 12.3% to 5.2%, p<0.001) and AH (from 9.9% to 7.7%, p<0.05). The **rate incidence** of bowel lesions in VH sank from 0.5% to 0.1% and of ureter lesions in LH from 1.1% to 0.3%. In 2006 there were no deaths compared to three in 1996.

Interpretation The rate of postoperative complications fell markedly from 1996 to 2006. This seems to be associated with better training of gynecological surgeons, more widespread **and appropriate** use of prophylactic antibiotics and antithrombotics, and better targeting of patient selection for each specific type of hysterectomy. **Furthermore, this** study is the only one thus far where the order of preference of hysterectomies is precisely followed nationwide, as recommended in a recent meta-analysis by the Cochrane collaboration.

Funding: No funding

Keywords: Hysterectomy, complications, longitudinal cohort study

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7 69  
8 70 The 2006 study was registered in the Clinical Trials of Protocol Registration System Data  
9 71 (NCT00744172).  
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## 11 73 **Introduction**

12 74  
13 75 With the advent of laparoscopic hysterectomy (LH) in the late 1980's<sup>1</sup> the role of vaginal (VH)  
14 76 and abdominal hysterectomies (AH) has been a matter of re-evaluation. The rate of  
15 77 abdominal hysterectomies (AH) has subsequently fallen in some countries (Figure 1),<sup>2,3,4,5,6</sup>  
16 78 but AH still predominates in many countries as the main method for hysterectomy. Along  
17 79 with these changes, the attitudes have, however, gradually changed in favor of VH and LH,  
18 80 which present themselves as less traumatizing procedures than AH.  
19 81

20 82 More than twenty years ago a systematic follow-up of the advantages and disadvantages of  
21 83 the then novel laparoscopic method for performing hysterectomy would have been  
22 84 scientifically and clinically very much in order. However, the opportunity of collecting valuable  
23 85 pioneering data on the benefits and disadvantages of LH in comparison to the established  
24 86 methods (VH and AH) was never grasped. In Finland, a nationwide study on the morbidity  
25 87 related to AH, VH and LH for benign conditions was conducted in 1996.<sup>8</sup> Not surprisingly, the  
26 88 most modern method, LH, was, at that time, associated with more severe complications than  
27 89 the other methods. The rate of complications stood also in proportion to the experience of the  
28 90 surgeons – the more experienced the surgeon, the less LH-associated complications.  
29 91

30 92 Since the beginning of the 2000's, several smaller studies, hospital-based series of LHs<sup>2</sup> and  
31 93 RCTs<sup>18-19</sup> have been published. Cochrane meta-analysis recommended VH as the primary  
32 94 technique for hysterectomy, followed by LH when appropriate.<sup>20-21</sup> There are, however, no  
33 95 longitudinal follow-up studies on the results of hospital-based or nationwide studies on  
34 96 patients undergoing hysterectomy. Such studies are not only scientifically important but they  
35 97 also constitute important measures of quality control and are, as such, badly needed to help  
36 98 us to understand what we have learned of the different approaches to hysterectomy during  
37 99 all these years.<sup>22</sup> We conducted a nationwide survey on the outcomes of hysterectomies of  
38 100 two cohorts first in 1996 and second in 2006. In this paper we compare the results after AH,  
39 101 VH and LH for benign conditions in 2006<sup>6</sup> with the results 10 years previously.<sup>8</sup>  
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## Methods

Information on all hysterectomies performed for benign conditions in Finland was prospectively registered from January 1st to December 31<sup>st</sup>, 2006, by the operating gynecologist.<sup>6</sup> Data collection was nationwide and followed the same procedure as in the survey ten years previously, the FINHYST 1996 study.<sup>8</sup> A dedicated form (FINHYST 2006) was used to collect data on preoperative, peroperative and postoperative events and operation-related morbidity during the patients' hospital stay and convalescence. Severe organ complications were defined as injuries to bladder, ureter and/or bowel. All Finnish 53 hospitals participated and produced 5324 forms, 45 of which were censored, usually because the final diagnosis was a malignant condition. The final data set consisted thus of 5279 hysterectomies; this covers 79.4% of all hysterectomies for a benign condition (5279 / 6645) reported to national Hospital Discharge Register. In the FINHYST 1996 study, the cohort coverage was higher (92.1%, N=10110) and the number of participating hospitals was 60 at that time. The FINHYST 2006 study was approved by the Ministry of Social Affairs and Health (Dnro STM/606/2005), by the Helsinki University Hospital Institutional Review Board (IRB) and by the Ethics Committee of the Department of Obstetrics and Gynecology of the Helsinki University Hospital (Dnro 457/E8/04). The 2006 study was registered in the Clinical Trials of Protocol Registration System Data (NCT00744172).

Consistency of the data and missing information were thoroughly reviewed. The hysterectomies were divided into three groups: AH, VH, and LH.<sup>23</sup> To facilitate comparisons between the data sets in 1996 and 2006, each patient was defined as having had a complication or not. Categorical data were analyzed by the  $\chi^2$ -test or Fisher's exact probability test, and the means of continuous variables were analyzed pair wise with Student's t-test. Statistical significance was set at  $p < 0.05$ . All calculations were performed with the SPSS 17.0 software.

## Results

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7 137 The **rates proportions** of VH and LH in Finland increased markedly in the decade from 1996  
8 138 to 2006, while the **rate- proportion of** AH fell to less than half (Figure 2). At the same time,  
9  
10 139 the **proportion rate** of the less invasive hysterectomies, LH and VH, had surpassed AH in all  
11 140 hospitals and the overall number of hysterectomies dwindled from 10,110 to 5,279 (reduction  
12  
13 141 of 47.8%). In 2006 1,7% of all hysterectomies were subtotal, in 1996 7,3%. In 2006, the  
14 142 most common indication for AH was fibroids 58% (in 1996 67%), for VH uterine prolapse  
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16 143 61% (in 1996 83%) and for LH fibroids 39% (in 1996 56%) and menorrhagia 30% (in 1996  
17 144 47%).

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20 146 In 2006 hysterectomy was performed on significantly older patients in the AH and LH groups  
21 147 but younger in the VH group compared to 1996 (Table 1). Also, the mean BMI had increased  
22  
23 148 significantly in the AH and LH groups but not in the VH group. The average uterine weight  
24 149 had risen significantly in all groups, most in the AH group, while the duration of the operation  
25  
26 150 decreased significantly for LH and for VH, but increased for AH. Perioperative hemorrhage in  
27 151 VH decreased significantly and increased in AH and in LH but not significantly in LH. In all  
28 152 groups the duration of the hospital stay was significantly reduced, mostly in the VH group.  
29  
30 153 The convalescence period decreased significantly in the AH and VH groups but increased  
31 154 slightly in the LH group (Table 1).

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34 156 **The overall complication rate related to any type of hysterectomy declined very**  
35 157 **significantly from 17.5 % in 1996 to 14.7 % in 2006 (<0.001).** The **overall** rate of  
36  
37 158 complications in 1996 was 16.2% for AH, 22.2% for VH and 17.0% for LH. Ten years later  
38 159 there was a slight increase to 19.2% in complications among AH-patients ( $p<0.05$ ) but a  
39  
40 160 significant decrease to 11.7% in the VH ( $p<0.001$ ) and a non-significant decrease to 15.5% in  
41 161 LH. The overall occurrence of organ injuries was significantly reduced only in the LH group  
42  
43 162 from 2.8% to 1.7% ( $p<0.05$ ). Of the severe organ complications bowel injuries were  
44 163 significantly less common only in the VH group in 2006 compared to 1996 and there was no  
45 164 difference in this respect in the AH and LH groups (Figure 3 **or table 3**). Similarly, ureter  
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47 165 lesions occurred significantly less often only in the LH group in 2006 than in 1996.

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50 167 The use antibiotic prophylaxis increased from 82.1% to 97.5% ( $p<0.001$ ) in a decade, and  
51 168 also the selection of antibiotics changed. In 1996 metronidazole was given as a single  
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53 169 prophylactic agent to 66.7% of all patients, but in 2006 to only 9.9%. In 2006 cefuroxime was  
54 170 the primary choice of antimicrobial agent alone or in combination with metronidazole for

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7 171 82.1% but in 1996 only for 15.3%. There were concomitantly significant reductions in the  
8 172 overall rate of infections; in the AH group from 9.9% to 7.7.% ( $p<0.05$ ), in the VH group from  
9 173 12.3% to 5.2% ( $p<0.001$ ) but a non-significant change from 17.0% to 15.4% in the LH group.

11 174  
12  
13 175 Also, the use of pharmacological thrombosis prophylaxis had risen from 35.4% in 1996 to  
14 176 64.8% in 2006 ( $p<0.001$ ) and there was a concomitant reduction in VTEs in all groups, which  
15 177 was significant in the LH group (Figure 3 [or table 3](#)). In 2006, there were no surgery-related  
16  
17 178 deaths, whereas in 1996 there was one death in each hysterectomy group. The occurrence  
18 179 of postoperative hemorrhage in the LH group increased significantly from 1996 to 2006  
19  
20 180 (Figure 3).

21 181  
22  
23 182 The intraoperative detection of organ injuries in LH increased from 60% in 1996 to 75% in  
24 183 2006. Postoperative ileus occurred at a similar rate in 1996 and 2006: AH 1.0% vs. 0.6%, LH  
25 184 0.3% vs. 0.2%, and VH 0.1% vs. 0.2%. The incidence of urinary retention was significantly  
26  
27 185 higher ( $p<0.001$ ) in the VH group in 1996 (3.1%) than in 2006 (1.6%) while in the AH group it  
28 186 was 0.5% both in 1996 and 2006 and in the LH group 0.9% and 0.5% in 1996 and 2006,  
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30 187 respectively.

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33 189 By 2006 the percentage of surgeons with experience of more than 30 hysterectomies had  
34 190 risen most markedly among surgeons performing LH: from 62% in 1996 to 73% in 2006 while  
35 191 there was no change for VH (78% in 1996, 76% in 2006) but for AH there was a sinking trend  
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37 192 from 91% in 1996 to 75 % in 2006. The experience of the surgeons was associated to the  
38 193 occurrence of organ injuries. Surgeons who had performed more than 30 hysterectomies in  
39 194 1996, had significantly fewer ureter and bladder injuries, especially in the LH group, than the  
40  
41 195 less experienced surgeons (Table 2). The same was the case for bowel injuries in 1996 in  
42 196 the VH group. In 2006, these differences were no longer present.

## 43 44 197 45 198 46 47 199 **Discussion**

48 200  
49 201 The role of laparoscopic hysterectomy (LH) compared to the traditional abdominal (AH) and  
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51 202 vaginal hysterectomy (VH) has been debated ever since the laparoscopic technique was  
52 203 introduced. It has been argued that LH is associated with higher expenses, longer operation  
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54 204 times and a higher rate of complications. Large and comprehensive RCT-studies have been

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7 205 badly needed to give answers to these questions. Such studies need to be very large, even  
8 206 to the point of being unfeasible, if they are to have sufficient statistical power.<sup>22</sup> Furthermore  
9 207 they would also need to be set up so that they discount the effect of the individual surgeon,  
10 208 the surgeon's experience and the effect of sophisticated surgical centres compared to  
11 209 ordinary hospitals. National registry-based observational surveys on large numbers of  
12 210 consecutive patients with prospective data collection are an alternative to cumbersome and,  
13 211 maybe, unrealistic RCT's and document effectiveness because they reflect clinical reality in  
14 212 the hands of the "average" gynecological surgeon.<sup>22</sup> This alternative was chosen for the  
15 213 present nationwide study, which compares some clinical determinants related to  
16 214 hysterectomies (AH, VH and LH) and hysterectomy-related morbidity in 2006 with 1996 in  
17 215 Finland.

18 216  
19 217 In the present study the growth of the popularity of VH was especially gratifying: the rate of  
20 218 VH increased from 18% in 1996 to 44% in 2006 (Figure 2), while the total number of  
21 219 complications, operation time, hemorrhage and bowel lesions related to VH decreased. All  
22 220 this took place despite the fact that the patients in 2006 were younger and were operated on  
23 221 for uterine descent less frequently – circumstances claimed to pose more operative  
24 222 challenges and yield complications. We believe that the vaginal approach should be used  
25 223 whenever possible.

26 224  
27 225 The rate of LH increased also (from 24% to 36%). The current rate of LHs in Finland is high  
28 226 compared to our neighbouring Nordic countries (4-7%)<sup>4,12,15</sup> and globally (Figure 1).  
29 227 Worldwide, only Taiwan has a higher rate of LH, where the rate of LH has soared from 5 % in  
30 228 1996 to 40 % in 2005.<sup>5</sup> In consequence, we have a much lower rate of AH (24%) compared  
31 229 to many other countries, e.g., the USA (68%)<sup>13</sup> and the other Nordic countries Sweden  
32 230 (60%)<sup>15</sup>, Denmark (59%),<sup>4</sup> Norway (78%).<sup>12</sup> According to a recent meta-analysis by the  
33 231 Cochrane collaboration, the order of preference of hysterectomies should be VH and LH  
34 232 followed by AH.<sup>21</sup> This study shows that this is precisely the sequence of preferences  
35 233 followed in Finland.

36 234  
37 235 The main finding of this study is that the overall complication rates related to VH and LH have  
38 236 decreased in Finland. Another important observation was that, of the severe organ lesions,  
39 237 ureter complications related to LH – one of the main concerns in 1996<sup>8</sup> – have decreased  
40 238 highly significantly (from 1.1% to 0.3%). This finding is in accordance with a retrospective  
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7 239 nationwide registry study on the complications of LH, which reported a continuously  
8 240 decreasing trend from 1993 to 2005 in ureter injuries in Finland.<sup>24</sup> Also, the fact that LH-  
9 241 related bladder complications sank from 1.3% to 1.0% supports the notion that surgeons  
10 242 doing this operation have steadily gained experience and are better aware of the need to  
11 243 avoid harming the bladder and ureters. The rate of VH-associated bowel complications sank  
12 244 also significantly (Figure 3). For AH there was a slight increase in the occurrence of total  
13 245 complications (from 16% in 1996 to 19% in 2006), but this only reflects the fact that more  
14 246 severe and advanced cases required the abdominal approach in 2006.

15 247  
16 248 The reduction in the number of infections (**Figure 3 or table 3**), especially urinary tract  
17 249 infections, was probably due to the increased prophylactic use of antibiotics. The reduction of  
18 250 thromboembolic events is most likely due to a consequence of increased and appropriate use  
19 251 of thromboprophylaxis. The aim to reduce both of these complications was discussed already  
20 252 some ten years ago at a consensus meeting with the members of the Society of  
21 253 Gynecological Surgery in Finland, and a unified, common prophylaxis management system  
22 254 with antibiotics and antithrombotics was introduced and implemented.<sup>25</sup> **Of the other**  
23 255 **Scandinavian countries infectious morbidity related to hysterectomies in Sweden in**  
24 256 **2003 - 2006 was 12.0% for AH, 15.0% for LH and 9.9% for VH.** <sup>26</sup> **Much lower rates were**  
25 257 **entered into the Danish hysterectomy database: in 2006 there were postoperative**  
26 258 **infections (excluding urinary tract infections) in only 2% of all hysterectomies.** <sup>4</sup>

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29 261 **Data coverage is a limitation of our study. National reports on the outcomes of surgical**  
30 262 **procedures need attention in terms of data coverage.** We believe that one of the main  
31 263 reasons for the fact that in the FINHYST 1996 study the cohort coverage was higher (92%)  
32 264 than in 2006 (79%) is related to the circumstance that the approval of the ethics committee in  
33 265 1996 did not require us to collect the patients' social security numbers. The survey in 2006  
34 266 was run according to new regulations which require that each patient provides full disclosure  
35 267 of her identity and written informed consent. Since all other facets of the studies and the data  
36 268 collection were identical between the two studies, these requirements remain the only  
37 269 explanatory variable for the reduced participation coverage. **The lower recruitment in 2006**  
38 270 **made us perform a type of data verification. We examined the data from the national**  
39 271 **register of the Patient Insurance Center, to which patients self-report complications,**  
40 272 **usually in pursuit of economical compensation. The rate of complications was similar**

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7 273 among those who had been recruited to FINHYST 2006 and those who were unable to  
8 274 participate. This observation would exclude selection bias in our study cohort.  
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11 276 2006, compared to 1996, our patients were proportionately older, more obese and had a higher  
12 277 uterine weight, but still the duration of hospital stay in all hysterectomy types and the  
13 278 operation time for LH and VH was reduced (Table 1). Evidently, the need for hysterectomy  
14 279 will persist, but it will not be as high as in the late 1990's.<sup>27,28</sup> The outlook is that  
15 280 hysterectomies will be safer than before. Recent indications for hysterectomies in Finland  
16 281 were more properly scrutinized and patients undergoing these procedures were more severely  
17 282 affected than a decade earlier. Of course, it would have been ideal to adjust the  
18 283 complication rates of the different types of hysterectomy by the population difference  
19 284 because the patients in the three groups AH, VH and LH were very different in 1996  
20 285 and 2006 but this was not possible. Consequently, a definite conclusion whether the  
21 286 improvements in some parameters are a result of real clinical improvement rather than  
22 287 just a change in the populations cannot be drawn. However, the very significant  
23 288 decrease in overall complication rate in all hysterectomies between 1996 and 2006  
24 289 indicate that clinical improvement was real. Moreover, t

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25 290 The overall maximum rates of the most severe organ injuries (bladder, ureter, bowel) in all  
26 291 types of hysterectomies in Finland were 0.7% - 2.8% in 1996 and 0.7 - 1.7% in 2006. This  
27 292 improvement is encouraging and similar trends have been reported in other countries.<sup>2</sup> This  
28 293 positive development has taken place in a time of a markedly decreasing need for  
29 294 hysterectomies mostly as a consequence of many new and effective conservative treatments  
30 295 of various bleeding problems (hormonal IUD, thermoablation etc.)

31 296 ~~Furthermore, in 2006, compared to 1996, our patients were proportionately older, more~~  
32 297 ~~obese and had a higher uterine weight, but still the duration of hospital stay in all~~  
33 298 ~~hysterectomy types and the operation time for LH and VH was reduced (Table 1). Evidently,~~  
34 299 ~~the need for hysterectomy will persist, but it will not be as high as in the late 1990's.<sup>26,27</sup> The~~  
35 300 ~~outlook is that hysterectomies will be safer than before. Recent indications for~~  
36 301 ~~hysterectomies in Finland were more properly scrutinized and patients undergoing these~~  
37 302 ~~procedures were more severely affected than a decade earlier.~~

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41 304 Since the introduction of laparoscopic hysterectomy in Finland in the 1990's, gynecological  
42 305 surgeons have collaborated actively in clinical practice and training. This has resulted in a  
43 306 unified system of data collection for research and quality control. With the first FINHYST  
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study in 1996 we identified matters needing improvement, after which practices were changed, training was increased and collaboration on a national level was implemented. As a consequence of this fruitful and collegial collaboration, hysterectomy-associated morbidity has decreased and patients are selected more appropriately for the traditional abdominal, vaginal or endoscopic route.

## References

1. Reich H, DiCaprio J, McGlynn F. Laparoscopic hysterectomy. *J Gynecol Surg* 1989; 5: 213-16.
2. Donnez O, Jadoul P, Squifflet J, Donnez J. A series of 3190 laparoscopic hysterectomies for benign disease from 1990 to 2006: evaluation of complications compared with vaginal and abdominal procedures. *Br J Obstet Gynaecol* 2009;116:492-500.
3. David-Montefiore E, Rouzier R, Chapron C, Darai E and the Collegiale d'Obstétrique et Gynéologie de Paris-Ile de France. Surgical routes and complications of hysterectomy for benign disorders: a prospective observational study in French university hospitals. *Hum Reprod* 2007;22:260-65.
4. Hansen CT, Møller C, Daugbjerg J, Kehlet H, Ottesen B. Establishment of a national Danish hysterectomy database: preliminary report on the first 13 425 hysterectomies *Acta Obstet Gynecol* 2008;87,546-557.
5. Wu M, Huang K, Long C, Tsai E, Tang C. Trends in various types of hysterectomy and distribution by patient age, surgeon age, and hospital accreditation: 10-year population-based study in Taiwan. *J Minim Invasive Gynecol* 2010;17:612-19.
6. Brummer TH, Jalkanen J, Fraser J et al. FINHYST 2006 - National prospective 1-year survey of 5 279 hysterectomies. *Hum Reprod* 2009;24:2515-2522.
7. Maresh MJA, Metcalfe MA, Mc Pherson K et al. The VALUE national hysterectomy study: description of the patients and their surgery. *Br J Obstet Gynaecol* 2002;109: 302-312.

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4  
5  
6  
7 341  
8 342 8. Mäkinen J, Johansson J, Tomas C et al. Morbidity of 10 110 hysterectomies by type of  
9 343 approach. *Human Reprod*. 2001;16:1473-8.  
10 344  
11 345 9. Chapron C, Laforest L, Ansquer Y, Fauconnier A, Fernandez B, Breart G, Dubuisson JB  
12 346 Hysterectomy techniques used for benign pathologies: results of a French multicentre study.  
13 347 *Hum Reprod* 1999;14:2464-2470.  
14 348  
15 349 10. Farquhar C, Steiner C. Hysterectomy rates in the United States 1990-1997. *Obstet*  
16 350 *Gynecol* 2002;99:229-243.  
17 351  
18 352 11. Møller C, Kehlet H, Utzon J, Ottesen B. Hysterectomy in Denmark. An analyses of  
19 353 postoperative hospitalisation, morbidity and readmission. *Dan Med Bull* 2002;49:353-57 (in  
20 354 Danish).  
21 355  
22 356 12. Oma J. Which factors affect the choice of method for hysterectomy in benign disease.  
23 357 *Tidskr Nor Laegeforen* 2004;124: 92-4 (in Norwegian).  
24 358  
25 359 13. Whiteman MK, Hillis SD, Jamieson DJ, Morrow B, Podgornik MN, Brett KM, Marchbanks  
26 360 PA. Inpatient hysterectomy surveillance in the United States, 2000–2004. *Am J Obstet*  
27 361 *Gynecol* 2008;198:34-6.  
28 362  
29 363 14. Kolkman W, Trimbos-Kemper T, Jansen F. Operative laparoscopy in the Netherlands:  
30 364 Diffusion and acceptance. *Eur J Obstet Gynecol Reprod Biol* 2007;130:245-48.  
31 365  
32 366 15. Persson P, Hellborg T, Brynhildsen J, Fredrikson M, Kjølhede P. Attitudes to mode of  
33 367 hysterectomy - a survey-based study among Swedish gynecologists. *Acta Obstet Gynecol*  
34 368 *Scand* 2009;88:267-74.  
35 369  
36 370 16. Hill E, Graham M, Shelley J. Hysterectomy trends in Australia – between 2000 / 01 and  
37 371 2004 /05. *ANZJOG* 2010;50:153–58.  
38 372  
39 373 17. Stang A, Merrill RM, Kuss O. Nationwide rates of conversion from laparoscopic or vaginal  
40 374 hysterectomy to open abdominal hysterectomy in Germany. *Eur J Epidemiol* 2011;26:125-33.  
41 375  
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18. Garry R, Fountain J, Mason S et al. The eVALuate study: two parallel randomised trials, one comparing laparoscopic with abdominal hysterectomy, the other comparing laparoscopic with vaginal hysterectomy. *Br Med J* 2004; 328:129-136.
19. Johnson N, Barlow D, Lethaby A, Tavender E, Curr E, Garry R. Methods of hysterectomy: a systematic review and meta-analysis of randomised controlled trials. *Br Med J* 2005;330:1478-1486.
20. Johnson N, Barlow D, Lethaby A, Tavender E, Curr E, Garry R. Surgical approach to hysterectomy for benign gynaecological disease. *Cochrane database of systematic reviews* 2006; Issue 2: Art. No.:CD003677.
21. Nieboer TE, Johnson N, Lethaby A, Tavender E, Curr E, Garry R, van Voorst S, Mol BWJ, Kluivers KB. Surgical approach to hysterectomy for benign gynaecological disease. *Cochrane database of systematic reviews* Issue 3, 2010; Art. No.: CD003677.
22. Claerhout F, Deprest J. Laparoscopic hysterectomy for benign diseases. In: *Best Practice and Research Clinical Obstetrics and Gynaecology, Hysterectomy*, eds. Thakar R and Manyonda I. Elsevier. 2005;19:357-75.
23. Kovac SR. Guidelines to determine the root of hysterectomy. *Obstet Gynecol* 1995;85: 18-23.
24. Brummer TH, Seppälä T, Härkki P. National learning curve of laparoscopic hysterectomy and trends in hysterectomy in Finland 2000-2005. *Hum Reprod* 2008;23:840-45.
25. GKS, The society of gynaecological surgery in Finland, webpage, in Finnish. Suositukset 2007 (recommendations) available at: [www.terveysportti.fi/kotisivut/sivut.koti?p\\_sivusto=434](http://www.terveysportti.fi/kotisivut/sivut.koti?p_sivusto=434). Accessed on July 2012 (in Finnish).
- 26. Löfgren M, Sundström Poromaa I, Stjern Dahl JH, Renström B. (2004) Postoperative infections and antibiotic prophylaxis for hysterectomy in Sweden: A study by the**

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7 409 Swedish National Register for Gynecologic Surgery. Acta Obstet Gynecol Scand 83:  
8 410 1202-1207.

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15  
16 415 276. Roberts TE, Tsourapas A, Middleton LJ et al. Hysterectomy, endometrial ablation, and  
17 416 levomorgestrel releasing intrauterine system (Mirena) for treatment of heavy menstrual  
18 417 bleeding: cost effectiveness analysis. Br Med J 2011;342, d 2202.

19  
20  
21 419 287. Qvistad E, Langebrette A. Should we recommend hysterectomy more often to  
22 420 premenopausal and climacteric women? Acta Obstet Gynecol Scand 2011;90:811-14.

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37 430 Literature search: TB, PH and JM.

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40 432 Figures: TB and JM.

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43 434 Tables: TB and JM

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45 436 Study design: all authors

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456 registered in the Clinical Trials of Protocol Registration System Data (NCT00744172).  
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