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ORIGINAL ARTICLE *Fertility control*

Uterine perforation caused by intrauterine devices: clinical course and treatment

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STUDY QUESTIONS: What are the symptoms of uterine perforation caused by modern copper intrauterine devices (Cu-IUDs) and the levonorgestrel-releasing intrauterine system (LNG-IUS); how is perforation detected and what are the findings in abdominal surgery?

SUMMARY ANSWER: Symptoms are mostly mild and ~30% of women are asymptomatic. Surgical findings are mainly minimal; no visceral complications were found in this study. However, adhesions as well as pregnancies seem to be more common among women using Cu-IUDs.

WHAT IS KNOWN ALREADY: Prior studies and case reports have suggested that uterine perforation by modern IUDs/IUSs is rarely serious.

STUDY DESIGN, SIZE, DURATION: A retrospective study of 75 patients (54 LNG-IUS and 21 Cu-IUD) treated surgically for uterine perforation between 1996 and 2009.

PARTICIPANTS/MATERIALS, SETTING, METHODS: The patients treated for uterine perforation by an IUD/IUS at clinics of the Helsinki and Uusimaa Hospital District were identified using the National Care Register for Health Institutions in Finland. The clinical data were collected from individual patient records.

MAIN RESULTS AND THE ROLE OF CHANCE: The majority of patients ($n = 53$; 71%) had mild symptoms of abnormal bleeding or abdominal pain or both, in combination with missing IUD/IUS threads. Asymptomatic patients ($n = 22$; 29%) were examined because of missing threads or pregnancy. Failure to remove the IUD/IUS by pulling visible threads was the reason for referral in seven women (9%) requesting removal of the device. Eleven women (15%) were pregnant. Misplaced IUDs/IUSs were localized by a combination of vaginal ultrasonography (US) and X-ray, hysteroscopy or curettage. Only after this were patients treated by means of laparoscopy. The majority ($n = 44$; 65%) of the 68 intra-abdominal devices were located in the omentum, the remaining 24 (35%) around the uterus. Partial perforation or myometrial embedding was diagnosed in all seven cases (9%) with visible threads, but unsuccessful removal by pulling. During laparoscopy, filmy adhesions were found in 21 patients (30%). Pregnancy (33 versus 7%, $P = 0.009$) and intra-abdominal adhesions (58 versus 20%, $P = 0.002$) were significantly more common in the Cu-IUD group. Infections were rare; one non-specific acute abdominal infection, later found to be unrelated to the IUD, led to laparoscopy and in four cases the IUD was surrounded by pus, but there were no symptoms of infection.

LIMITATIONS, REASONS FOR CAUTION: The study setting revealed only surgically treated symptomatic patients and asymptomatic women attending regular follow-up. Women not treated, but only followed or not attending follow-up, were not identified, excluding the possibility to analyse missed undiagnosed perforations, or conservative follow-up as a treatment option.

WIDER IMPLICATIONS OF THE FINDINGS: As surgical findings are minimal, asymptomatic women may need no treatment at all. An alternative form of contraception is, however, important as pregnancies do occur. If a woman plans a pregnancy, a misplaced LNG-IUS should be removed, as it may act as a contraceptive.

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lectured in educational events organized by MSD Finland (part of Merck & Co. Inc.) and served on the advisory board for contraception of this company. The other authors have no conflicts of interest to declare.

Key words: IUD / IUS / perforation / clinical course

Introduction

Globally, intrauterine devices (IUDs) are a major form of contraception. With 14% of women worldwide using an IUD, it is the second most popular form of contraception after female sterilization (World Population Bureau, 2008). In addition to efficient contraception, the levonorgestrel-releasing intrauterine system (LNG-IUS) is a treatment of choice for menorrhagia as well as dysmenorrhoea and as part of hormone replacement therapy (Andersson *et al.*, 1992; Milsom, 2007; Heikinheimo and Gemzell-Danielsson, 2012). Cu-IUDs are also still widely used and are of interest to women wishing to use non-hormonal contraception.

In Finland, 23% of fertile women use IUDs (Olivieira da Silva *et al.*, 2011). After the introduction of the LNG-IUS in the 1990s, all IUD use has increased significantly in Finland. Currently 85% of inserted IUDs in Finland are LNG-IUSs. The remaining 15% of inserted devices are copper IUDs (Cu-IUDs; Bayer AG, Berlin, Germany, 2010).

A rare complication of IUD contraception is uterine perforation. Known associated factors are the post-partum period and lactation as well as an inadequate insertion technique (Heinemann *et al.*, 2011; Kaislasuo *et al.*, 2012). Previously reported perforation incidence rates are 0.4–2.2/1000 insertions with Cu-IUDs and 0.68–2.6/1000 insertions with the LNG-IUS (Andersson *et al.*, 1998; Caliskan *et al.*, 2003; van Maudenhoven *et al.*, 2006; Heinemann *et al.*, 2011). Our own recent study found an incidence rate of 0.4/1000 insertions for both types of devices (Kaislasuo *et al.*, 2012).

The accepted treatment for IUD-associated perforations has been abdominal surgery, initially via laparotomy and, as surgical techniques have developed, via laparoscopy. Case reports show that misplaced IUDs have caused bowel perforations and adhesions leading to peritonitis (Zakin *et al.*, 1981; Gill *et al.*, 2012). However, as many investigators have found minimal or no adhesions with both modern non-irritating polyethylene-framed Cu-IUDs and the LNG-IUS, the need to remove intra-abdominal IUDs in asymptomatic cases has repeatedly been questioned (Adoni and Ben Chetrit, 1991; Markovitch *et al.*, 2002; Haimov-Kohman *et al.*, 2003b). Rare bowel complications or widespread adhesions do cause symptoms and these need to be treated. In contrast to life-threatening symptoms described in case reports (Zakin *et al.*, 1981), larger studies concerning IUD-associated perforations indicate that the majority of perforations are either asymptomatic or associated with mild symptoms such as abnormal bleeding or mild pain or both, combined with missing threads or unintended pregnancy (Heinemann *et al.*, 2011; van Grootheest *et al.*, 2011).

The purpose of this retrospective population-based study was to examine the clinical course and treatment of patients with uterine perforation caused by modern Cu-IUDs and the LNG-IUS by assessing symptoms, method of detection, type of surgical treatment and findings.

Materials and Methods

Patients were identified in the National Care Register for Health Institutions in Finland, later called the Hospital Register. The register contains ICD-10 (International Classification of Diseases, 2010) and operation codes on all patients treated at Finnish hospitals. As there is no specific ICD-10 code for IUD/IUS-associated perforation, women with potential uterine perforation were identified in the Hospital Register by using the operation codes of the Nordic Medico-Statistical Committees (NOMESCO) Classification of Surgical Procedures, available since 1997, for removal of an intra-abdominal or intrauterine foreign object (JAL10-JAL11, JAL20-JAL22), combined with the ICD-10 codes concerning gynaecological procedures related to IUD/IUS complications (T83.3, T19.3), insertion and follow-up (Z30). As ICD-10 codes were introduced in Finland in 1996, women treated from 1 January 1996 to 31 December 2009 were included in the analysis. Combining diagnostic and operation codes gave us 3909 patients. By excluding codes unrelated to possible perforation, as well as male patients, 370 patients with probable surgically treated uterine perforation were found nationwide. Records of all 108 patients treated at the clinics of the hospital district of Helsinki and Uusimaa were examined by J.K., resulting in identification of 78 patients with surgically treated uterine perforations and 30 patients treated for other IUD/IUS-related reasons. As the type of IUD could not be determined in three cases, 75 patients were included in the study. All data used in the study were derived from hospital records covering referral for examination and treatment, background information on the patient as well as reports on findings and treatment.

Ethics approval

The Ethics Committee of the Hospital District of Helsinki and Uusimaa gave a positive statement concerning the study. The Ministry of Social Affairs and Health and the National Institute for Health and Welfare gave permission to use the nationwide register and medical record data for the research. Final permission for the study was granted by the Hospital District of Helsinki and Uusimaa.

Statistical analysis

Data analysis was performed using the Predictive Analysis Software (PASW18; SPSS Inc., Chicago, IL, USA). The subjects were analysed both as one group as well as in separate groups by type of device (LNG-IUS versus Cu-IUD) using the Mann–Whitney, χ^2 and Fisher's exact tests as appropriate. Statistical significance was set at $P \leq 0.05$.

Results

Demographics

Patient demographics grouped by the type of device is shown in Table I. Of the 75 patients, 54 (72%) used an LNG-IUS and 21 (28%) a Cu-IUD. No statistically significant differences emerged between the two groups in the various demographic characteristics.

Table I Demographics of patients with surgically removed perforating IUDs/IUSs.

n = 75	LNG-IUS (*n* = 54)	Cu-IUD (*n* = 21)[a]
Age (years)		
Median (range)	34 (20–65)	35 (24–47)
BMI (kg/m^2)		
Median (range)	23.2 (17.9–39.6)	22.8 (19.7–36.5)
Data not available	6	2
Nulliparous	1 (2)	0
Parous		
	53 (98)	21 (100)
Median (range)	2 (0–6)	2 (1–6)
History of vaginal delivery (VD)		
Yes	48 (89)	17 (81)
VD/woman, median (range)	2 (0–6)	2 (0–4)
No	6 (11)	4 (19)
History of Caesarean section (CS)		
Yes	13 (24)	5 (24)
CS/woman, median (range)	0 (0–3)	0 (0–3)
No	41 (76)	16 (76)
History of miscarriage (M)		
Yes	12 (22)	6 (29)
M/woman, median (range)	0 (0–3)	0 (0–2)
No	42 (78)	15 (71)
History of termination of pregnancy (TOP)		
Yes	13 (24)	6 (29)
TOP/woman, median (range)	0 (0–2)	0 (0–2)
No	41 (76)	15 (71)
Previous IUD use		
Yes	10 (19)	3 (14)
No	10 (19)	4 (19)
Data not available	34	14
History of abdominal surgery (incl. curettage)		
Yes	29 (54)	14 (67)
No	25 (46)	7 (33)
Endometriosis (laparoscopy)	3 (6)	1 (5)
Salpingectomy (ectopic pregnancy)	0	2 (10)
Curettage	13 (24)	8 (38)
Multiple curettages	5/13 (38)	2/8 (25)
Leep treatment	5 (9)	0
Gastrointestinal surgery	4 (7)	3 (14)

The data are presented as *n* (%) unless stated otherwise.
[a]Fincoid 1, FlexiT 1, NovaT380Ag 13, unspecified type of Cu-IUD 6.

Time from insertion to diagnosis and treatment

The median time from insertion to diagnosis was 5 months (range 0 days to 69 months). Although 26 (49%) patients experienced immediate symptoms (<5 days) after insertion, only 12 of them (46%) sought treatment within a month (median 53 days, range 0 days to 15 months). The manner of presentation against time from insertion to diagnosis is shown in Table II. After diagnosis, most patients were treated without delay, the median time being 21 days (range 0 days to 16 months).

Symptoms

The majority of women ($n = 53$; 71%) were symptomatic and sought treatment (Fig. 1). Symptoms were mainly mild, either abnormal bleeding or mild lower abdominal pain, or both. Asymptomatic patients ($n = 22$; 29%) were diagnosed during routine follow-up visits ($n = 16$) or because of unintended pregnancy ($n = 6$). One intra-abdominal IUD was found during a hysterectomy performed for other reasons; the patient had forgotten the presence of the IUD.

The onset of symptoms was precisely defined for only 28 (53%) of the symptomatic patients, representing 37% of all women in the study. Symptoms were immediate in the majority of these cases: within 24 h in 21 patients (75%) and within 1–5 days for 5 patients (18%). All 26 patients with onset of symptoms within 5 days presented with pain; in 6 cases combined with bleeding. The only patient with symptoms of infection had had the IUD inserted 4 years prior to symptoms and presented with an unintended pregnancy.

Pregnancies

Altogether, there were 11 pregnancies (15%), 10 intrauterine and 1 tubal. Pregnancies occurred more often following perforation with a Cu-IUD ($n = 7/21$; 33%) than with the LNG-IUS (4/54; 7%, $P = 0.009$; Fig. 1). The patient with a tubal pregnancy used a LNG-IUS and she underwent laparoscopic surgery as a result of acute intra-abdominal bleeding. Five pregnant women (45%) experienced symptoms of pain and/or bleeding. While two women with Cu-IUDs continued their pregnancies successfully, seven (Cu-IUD = 4, LNG-IUS = 3) chose termination of pregnancy and one patient with a Cu-IUD had a miscarriage. Ten IUDs in the pregnant women were located intra-abdominally and one Cu-IUD intramurally.

Diagnosis

The main reason for referral was missing threads ($n = 50$; 67%); for 24 patients (32%) this was the only finding. Other reasons were abnormal bleeding and/or abdominal pain ($n = 32$; 43%) and pregnancy ($n = 11$; 15%). Seven (9%) intramural or partially perforated devices could not be removed by pulling visible threads. All these women requested the removal of the device; three were asymptomatic, two experienced disturbing bleeding and two bleeding and pain. Diagnosis was made by a specialist in all cases, either at the treating hospital ($n = 64$; 85%) or by a private gynaecologist with access to vaginal US ($n = 11$; 15%). Personnel at primary health care or family planning clinics

Table II Manner of presentation for women with known time of insertion ($n = 59$).

Time from insertion to diagnosis (days)	Asymptomatic, follow-up ($n = 11$)	Symptomatic (pain/bleeding) ($n = 41$)	Pregnancy ($n = 7$)
≤30	1	12	–
31–90	–	6	–
91–180	3	6	2
>180	7	17	5

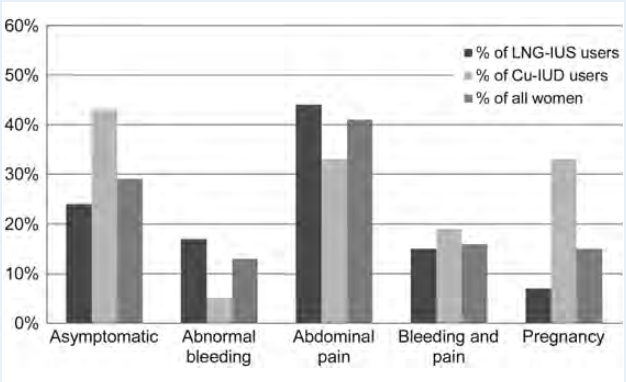

Figure 1 Clinical symptoms of the patients [$n = 75$ (LNG-IUS 54, Cu-IUD 21)].

had suspected uterine perforation at the time of referral in 12 patients (16%).

The primary diagnostic examination was commonly vaginal US ($n = 70$; 93%) and if not sufficient for diagnosis, the secondary examination was most often abdominal X-ray ($n = 57$; 76%). If needed, hysteroscopy ($n = 20$; 27%) or curettage ($n = 8$; 11%) was used for both diagnosis and treatment. Curettage was performed in six pregnant patients for termination of pregnancy and in two patients with abnormal bleeding. Only after at least one of the above mentioned diagnostic examinations was laparoscopy the treatment method. Computerized tomography (CT) was used once, as US and X-ray failed to give a clear location of an IUD.

Location of IUD, treatment and adhesions

The majority of patients ($n = 70$; 93%) underwent abdominal surgery; 69 patients underwent laparoscopy and 1 pregnant patient had the device removed during Caesarean section. In addition to the 68 intra-abdominal IUDs, two partially perforating devices were removed by laparoscopy. All intramurally embedded IUDs and one partially perforating IUD were removed by means of hysteroscopy ($n = 5$; 7%). The locations of the removed devices are shown in Table III.

Surgical findings were mainly minimal. No symptomatic IUD-related infections were diagnosed, but in four Cu-IUD cases the device located intra-abdominally was embedded in pus. One pregnant patient with a LNG-IUS showed symptoms of infection, which were found to be unrelated to the IUS in laparoscopy. In addition, in two women small haematomas and in two women areas of uterine erythema related to acute perforation were found. These four women with LNG-IUS perforation suffered acute pain at insertion.

The majority of patients had no intra-abdominal adhesions (Table III). Adhesions were observed in 7 (35%) of the asymptomatic women and in 14 (28%) of the symptomatic women. Adhesions occurred more often following perforation with Cu-IUDs (11/19, 58%) versus LNG-IUSs (10/51; 20%, $P = 0.002$). In addition, adhesions in LNG-IUS patients were more filmy and small and in 4 out of 10 cases (40%) unrelated to the location of the device. In contrast, in all patients with Cu-IUD perforation and adhesions the device was embedded in adhesions and the adhesions were denser. The location of the device (omental versus pelvic) did not statistically correlate with adhesion formation ($P = 0.54$). Adhesions found at surgery were most common in women treated 1–6 months after insertion. Table IV shows adhesions in correlation with time from insertion to diagnosis.

The majority ($n = 53$; 71%) of the women were treated as day-cases. However, 11 women (15%) stayed 2 days because of hospital policy and 10 (13%) stayed 3–7 days because of suspected infection ($n = 3$) or acute abdominal pain shortly after insertion ($n = 7$). A total of 23 patients (31%) underwent multiple procedures; hysteroscopy or curettage prior to laparoscopy. The procedure was performed simultaneously in 11 patients (48%), while 12 patients (52%) spent two separate days at the hospital.

Discussion

We found that uterine perforation with modern devices is rarely dangerous, as reported in recent publications (van Grootheest *et al.*, 2011; Gill *et al.*, 2012). The majority of women experienced symptoms resulting in a consultation. The most common symptom was abdominal pain with or without abnormal bleeding, but one-third of the women were asymptomatic. Although half of the symptomatic patients experienced immediate symptoms, many waited before seeking treatment. This reflects the fact that women are usually counselled concerning post-insertion abdominal pain lasting a few days. After the diagnosis, one-third waited for a procedure for more than 1 month, reflecting the fact that symptoms often were neither acute nor severe.

The patients were identified in the National Care Register, using the operative codes for removal of an intra-abdominal or intrauterine foreign body. We assume that the majority of patients undergoing abdominal surgery in Finland were identified during the study period of 15 years, as these types of procedures have their own surgical codes. In this study, however, we found mainly women treated for suspected perforation and attending follow-ups, suspected pregnancy

Table III Findings at laparoscopic surgery.

	Location of removed IUS/IUD, *n* (%)	Intra-abdominal adhesions at surgery, *n* (%)[a]		
		All patients 21/70 (28)	LNG-IUS 10/51 (20)	Cu-IUD 11/19 (58)
Intra-abdominal:	68/75 (91)	20/68 (29)	10/50 (20)	10/18 (56)
Omentum	44/68 (65)	15/44 (34)	10/35 (29)	5/9 (56)
Pelvis:	24/68 (35)	5/24 (21)	0/15 (–)	5/9 (56)
Pouch of Douglas	10/24 (42)	2/10 (20)	0/8 (–)	2/2 (100)
Near the ovaries	13/24 (54)	3/13 (23)	0/6 (–)	3/7 (43)
Bladder pouch	1/24 (4)	0/1 (–)	0/1 (–)	–
In utero—intramurally embedded	4/75 (5)	0/4 (–)	–	–
Partial perforation	3/75 (4)	1/2 (50)	0/1 (–)	1/1 (100)

[a]Women treated with hysteroscopy are excluded from adhesion calculations (two intramural LNG-IUS, two intramural Cu-IUD, one partially perforated LNG-IUS).

Table IV Intra-abdominal adhesions at laparoscopy in women with known time of insertion.

Time from insertion to surgery (days)	Intra-abdominal adhesions at laparoscopic surgery, *n* (%)		
	LNG-IUS (*n* = 43)	Cu-IUD (*n* = 14)	Combined (*n* = 57)
≤30	1/10 (10)	1/2 (50)	2/12 (17)
31–90	1/4 (25)	1/1 (100)	2/5 (40)
91–180	3/4 (75)	2/2 (100)	5/6 (83)
>180	2/25 (8)	4/9 (44)	6/34 (18)

or unsuccessful removal of an IUD/IUS. Women not treated, but only followed, were not identified, excluding the possibility to analyse conservative follow-up as a treatment option.

The diagnosis of IUD/IUS perforation is usually straightforward after suspicion of a misplaced device arises. A combination of vaginal US and abdominal X-ray is usually sufficient to diagnose a perforation. In the present study, vaginal US was used in nearly all cases, and abdominal X-ray was needed for diagnosis in 75% of the cases. If vaginal US is unavailable, X-ray makes it possible to differentiate between a perforation and an expulsion when threads are not found and uterine perforation is suspected. In hospital settings, CT or magnetic resonance imaging is good alternative for further preoperative examination if suspicion of visceral complication arises (Boortz *et al.*, 2012).

The traditional form of treatment has been laparotomy, but with developing surgical techniques, laparoscopy, being less invasive and more safe, is nowadays the treatment of choice. In our study, all patients with an intra-abdominal device could successfully be treated by laparoscopy, including those with adhesions. All adhesions, either IUD-associated or clearly non-related, were local and occurred more often with a Cu-IUD. Although adhesions were found in 30% of the laparoscopies, none led to laparotomy, unlike in the large case series reviewed by Gill *et al.* (2012), where adhesions were a common cause of laparotomy. Similarly, we found no visceral complications caused by the perforating IUDs/IUSs and no correlation between symptoms and intra-abdominal adhesions in surgery. Although the groups were small, adhesions were surprisingly most common between 1 and 6 months from insertion. It is, however, impossible to predict when these had formed. It is widely accepted that adhesion formation starts immediately after surgery (Brokelman *et al.*, 2011). Partially perforating or embedded devices could be removed by minimally invasive hysteroscopy, a procedure significantly easier for both the patient and the physician.

Both a misplaced Cu-IUD and a LNG-IUS increase the risk of contraceptive failure. However, we found a significant difference in pregnancy rates between women using a Cu-IUD versus a LNG-IUS. This may reflect the different mechanisms of action of the devices. The contraceptive effect of Cu-IUDs relies on local sterile endometrial inflammation as well as on the toxic effect of Cu ions on spermatozoa (Ortiz and Croxatto, 2007). These mechanisms may also explain why adhesions occurred more often in connection with Cu-IUDs. The absence of these uterine reactions in cases of perforating Cu-IUDs increases the risk of unplanned pregnancy. In contrast, the mechanism of action of the LNG-IUS is suppression of the endometrium and thickening of the cervical mucus (Luukkainen *et al.*, 2001; Lewis *et al.*, 2010). With the LNG-IUS *in utero*, plasma levels of LNG are low (Nilsson *et al.*, 1986) and changes in ovarian function are minimal (Luukkainen *et al.*, 2001). An intraperitoneally displaced LNG-IUS, however, results in circulating levels of LNG similar to those seen during the use of combined oral contraceptives (Haimov-Kohman *et al.*, 2003a). It has been suggested that these levels are high enough to prevent ovulation and thus pregnancy, as well as adhesion formation, owing to the anti-inflammatory properties of LNG (Haimov-Kohman *et al.*, 2003b). Nevertheless, 7% of the patients with misplaced LNG-IUSs were pregnant at the time when the perforation was diagnosed.

Conclusions

The majority of women with IUD/IUS perforation experience mild symptoms of abnormal bleeding or mild lower abdominal pain, or both. These symptoms or missing threads in asymptomatic or pregnant women using an IUD/IUS should lead to suspicion of perforation. The diagnosis is easily made by way of vaginal US and/or abdominal X-ray. The method of treatment is laparoscopy. Surgical findings are mainly

minimal, with possible adhesions mostly being filmy or local and treatable by way of modern laparoscopic techniques. Adhesions as well as pregnancies are more common in connection with Cu-IUDs, which might be explained by the different mechanisms of action of Cu-IUDs versus the LNG-IUS. Asymptomatic women may need no treatment at all if the risk of pregnancy is low or contraception is not needed. In fertile-aged, sexually active women an additional form of contraception is important, as unplanned pregnancies occur, especially in association with misplaced Cu-IUDs. However, further studies based on long-term data are needed to assure the safety of this treatment option. In the case of expectant management detailed patient information is essential and the decision-making must be shared with the woman.

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Authors' roles

All authors participated equally in the study design, analysis of the data, manuscript drafting and critical discussion.

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Conflict of interest

O.H. has lectured and designed educational events with Bayer AG and MSD, and serves occasionally on scientific advisory boards for these companies. S.S. has lectured in educational events organized by MSD Finland (part of Merck & Co. Inc.) and served on the advisory board for contraception of this company. The other authors have no conflicts of interest to declare.

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