ORIGINAL ARTICLE

The Timing of Surgery for Undescended Testis

A retrospective multicenter analysis

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SUMMARY

Background: In Germany, it is recommended that the surgical treatment of an undescended testis should be carried out between the ages of 6 months and 1 year to lower the risks of subfertility and testicular carcinoma. Although this recommendation has appeared in the German guidelines from 2007 onward, orchidopexy is still frequently performed at later ages.

Method: We retrospectively analyzed data from seven pediatric surgical services in the German state of Baden-Württemberg on all boys who underwent orchidopexy from 2009 to 2012. We classified the timing of surgery as Age Group I (before the first birthday), Age Group II (between the first and second birthdays), and Age Group III (after the second birthday). We determined whether preoperative hormonal treatment was given and distinguished primary from secondary undescended testis.

Results: Among 2213 boys who underwent orchidopexy, 1850 had primary and 363 had secondary undescended testis. Of those with primary undescended testis, the percentages of boys who underwent surgery in Age Groups I, II, and III were (respectively, with 95% confidence intervals): 18.7% (17–20.6%), 24.4% (22.5–26.5%), and 57% (54.6–59.2%). A small percentage of boys in each group also received preoperative hormonal treatment. From 2009 to 2012, there was a secular trend favoring earlier orchidopexy. In 2012, 28 boys (14.2% [9.7–20.0%]) had orchidopexy in outpatient pediatric surgery practices before their first birthday, while 68 did on hospital inpatient services (40.7% [33.2–48.6%]).

Conclusion: Most of the patients studied had surgery at a later age than recommended. Adherence to the guidelines in this respect is nonetheless relatively good in Germany compared to other countries, as studies from abroad have yielded findings that are just as bad or worse.

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At birth, 1.8% to 8.4% of boys have a primary undescended testis (1, e1–e9); among premature neonates, the figure is as high as 30% (2, e10). This rate drops to 0.8–1.3% by the third month of life (e11), after which spontaneous descent of the testis is unlikely (e10, e12). An increased incidence of the condition since the 1950s has been described by some, but this observation is disputed (1, e3, e5).

In secondary undescended testis, unlike primary undescended testis, the testicle(s) are initially in the correct, intrascrotal anatomical position and then travel upward because of inadequate longitudinal growth or restraining fibrous portions or the spermatic cord, or other factors (e13).

A much-discussed late sequela of primary undescended testis is the potential impairment of fertility in adulthood. The normal scrotal temperature of around 33°C promotes hormonal changes through which gonocytes mature into adult spermatogonia (Ad spermatogonia); these, in turn, constitute the pool from which spermatocytes later develop (3, e14, e15). If the testis is malpositioned, gonocytes may persist and spermatogonia fail to mature (4). Similar, qualitatively less marked histological changes have also been found in the contralateral, orthotopic testis (e16). In many studies, various findings reflecting this morphological developmental disturbance have been identified as potential markers of impaired fertility:

- abnormally low testicular volume or testicular growth (e17–e19),
- altered histomorphological features (5, e14, e20–e22),
- altered sperm quality (e23–e27).

In a meta-analysis, there was a consistent finding across studies to the effect that early surgery positively affects features that are taken to be markers of fertility (6). It must be pointed out, however, that a Cochrane analysis revealed a markedly lower probability of fathering a child (i.e., direct evidence of fertility) in comparison to the normal population only in men with bilateral undescended testis, and not in those with a single undescended testis (7). As early as 1975, a study found orchidopexy to be beneficial for fertility if performed on boys with unilateral undescended testis

TABLE 1

Findings of the multicenter study

	0–12 months			12–24 months			> 24 months		
	n	%	95% CI	n	%	95% CI	n	%	95% CI
Primary undescended testis									
2009–2012 n = 1850	346	18.7	17.0–20.6	452	24.4	22.5–26.5	1 053	57.0	54.6–59.2
2009 n = 601	80	13.3	10.7–16.3	154	25.6	22.2–29.3	367	61.1	57.0–65.0
hCG i.m.	13	2.2	1.2–3.7	41	6.8	4.9–9.1	26	4.3	2.9–6.3
GnRH intranasal	7	1.6	0.5–2.4	14	2.3	1.3–3.9	24	4.0	2.6–5.9
hCG + GnRH	16	2.7	1.5–4.3	18	2.99	1.8–4.7	9	1.5	0.7–2.8
2010 n = 522	103	19.7	16.4–23.4	108	21.0	17.3–24.4	311	59.6	55.2–63.8
hCG i.m.	8	1.5	0.7–3.0	17	3.3	1.9–5.2	18	3.5	2.1–5.4
GnRH intranasal	8	1.5	0.7–3.0	3	0.6	0.1–1.7	11	2.1	1.1–3.7
hCG + GnRH	22	4.2	2.7–6.3	25	4.8	3.1–7.0	10	1.9	0.9–3.4
2011 n = 363	67	18.5	14.6–22.8	101	27.8	23.3–32.7	195	53.7	48.4–58.9
hCG i.m.	5	1.4	0.5–3.2	4	1.1	0.3–2.8	4	1.1	0.3–2.8
GnRH intranasal	5	1.4	0.5–3.2	3	0.8	0.2–2.4	7	1.9	0.8–3.9
hCG + GnRH	12	3.3	1.7–5.7	17	4.7	2.8–7.4	5	1.4	0.5–3.2
2012 n = 364	96	26.4	21.9–31.2	88	24.2	19.9–28.9	180	49.5	44.2–54.7
hCG i.m.	1	0.3	0.0–1.5	7	1.9	0.8–3.9	8	2.2	1.0–4.3
GnRH intranasal	9	2.5	1.1–4.6	4	1.1	0.3–2.8	9	2.5	1.1–4.6
hCG + GnRH	13	3.6	1.9–6.0	13	3.6	1.9–6.0	5	1.4	0.5–3.2
Outpatient practices									
2009 n = 397	36	9.1	6.4–12.3	95	23.9	19.8–28.4	266	67.0	62.4–71.6
2010 n = 341	48	14.1	10.6–18.2	60	17.6	13.7–22.1	233	68.3	63.1–73.2
2011 n = 215	27	12.6	8.4–17.7	58	27.0	21.2–33.4	130	60.5	53.6–67.1
2012 n = 197	28	14.2	9.7–20.0	40	20.3	14.9–26.6	129	65.5	58.4–72.1
Inpatient hospital services									
2009 n = 204	44	21.6	16.1–27.9	59	28.9	22.8–35.7	101	49.5	42.5–56.6
2010 n = 181	55	30.4	23.8–37.7	48	26.5	20.3–33.6	78	43.1	35.8–50.7
2011 n = 148	40	27.0	20.1–34.9	43	29.1	21.9–37.1	65	43.9	35.8–52.3
2012 n = 167	68	40.7	33.2–48.6	48	28.7	22.0–36.2	51	30.5	23.6–38.1
Secondary undescended testis 2009–2012 n = 363									
2009 n = 36	2	5.6	0.7–18.7	11	30.6	16.6–48.1	23	63.9	46.2–80.2
2010 n = 132	3	2.3	0.5–6.5	7	5.3	2.2–10.6	122	92.4	86.5–96.3
2011 n = 84	2	2.4	0.3–8.3	3	3.6	0.7–10.1	79	94.1	86.7–98.0
2012 n = 111	1	0.9	0.0–4.9	4	3.6	1.0–9.0	106	95.5	90.0–99.0

CI, confidence interval; hCG, human chorionic gonadotropin; GnRH, gonadotropin-releasing hormone

before their second birthday (e24). More recent studies have shown a fertility advantage for orchidopexy performed at the age of nine months, as compared to three years (8, e28, e29). A single study showing no advantage from early surgery was based on a small number of cases and may have been inadequately powered (e30).

Along with orchidopexy, some authors recommend preoperative treatment with intranasal gonadotropin-releasing hormone (GnRH) and/or intramuscular human chorionic gonadotropin (hCG) (9). According to some studies, treatment with GnRH analogues improves the fertility index, while hCG can sometimes induce further testicular descent even after the age of 6 months and thereby favorably affect testicular histomorphology (9, 10; e31). However, hormonal treatment is not generally recommended because of its potential side effects, including lasting damage to testicular

tissue (11, 12, e32), and the risk of further delay of the necessary operation (13).

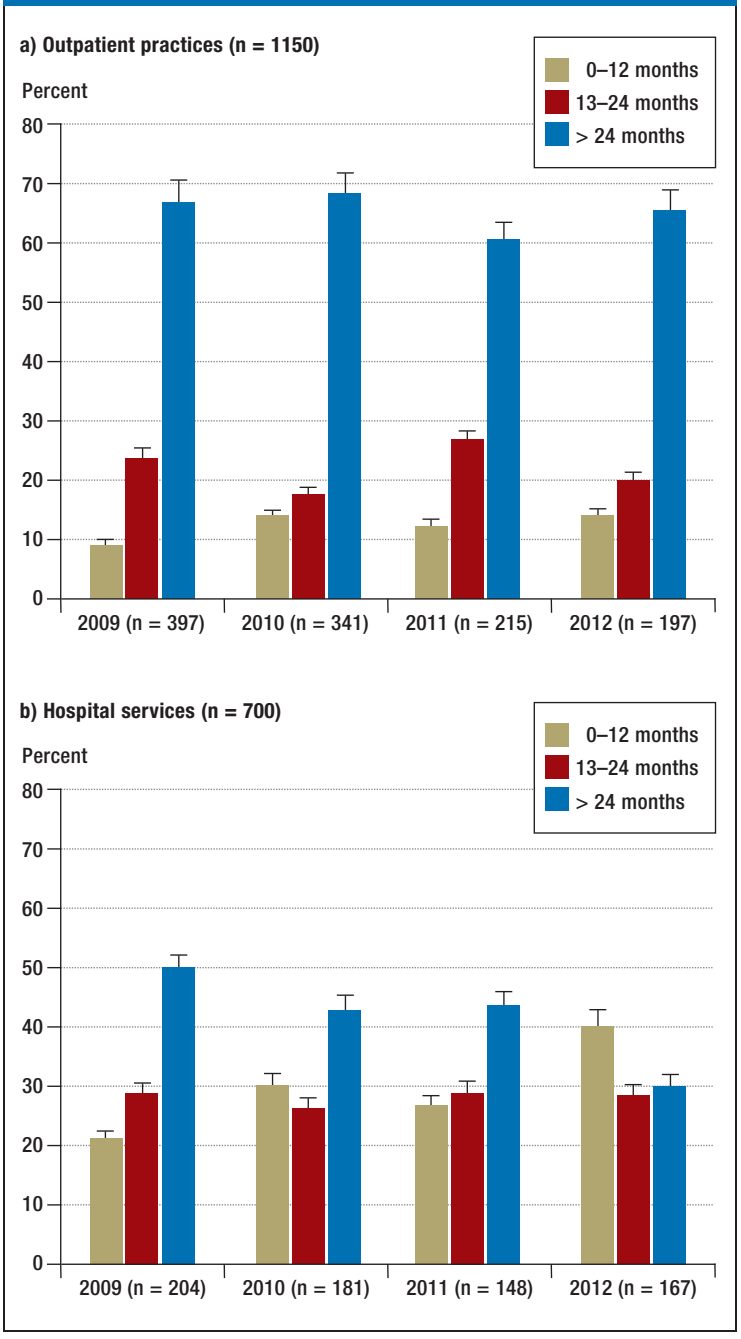
In addition to its potentially deleterious effect on fertility, numerous studies have indicated that undescended testis is associated with a higher-than-normal risk of testicular carcinoma. This risk may be due to the persistence of gonocytes with pluripotential stem-cell properties that can give rise to a carcinoma in situ (CIS) (e33). The age-standardized incidence rates of testicular carcinoma in Western populations has been estimated at 3.8 to 7.8 per 100 000 men (e34). This rare tumor thus accounts for only about 1% of cancers in men (e35) but is nonetheless the most common type of cancer in men aged 15 to 34 (e36). A review of pertinent studies revealed that men with a history of undescended testis had a 1.5- to 7.5-fold higher risk of testicular carcinoma in comparison to the normal population (6). When orchidopexy is not performed until the age of 10 years or later, this risk is elevated 2.9- to 32-fold (6, 14). It is currently debated whether orchidopexy before age 10 completely eliminates the excess risk or merely lowers it to a risk that is, at most, 2.6 times that of the normal population (6, 15, 40, e37). In any case, it is clear that only an orthopic position of the testis within the scrotum enables self-examination and facilitates the early detection of testicular tumors (40).

The increasing evidence for potential late sequelae of undescended testis has led to a repeated updating of the national and international treatment recommendations on the timing of surgery. A Cochrane Review is now in preparation (e38). In Germany, the current recommendation is that of the AWMF guideline of 2009, i.e., that the operation should be performed before the child's first birthday (e39). In this article, we present the findings of a retrospective, multicenter study of the implementation of the AWMF guideline in pediatric surgical units in the German state of Baden-Württemberg and compare them with the available data from other countries.

Materials and methods

Five pediatric surgical practices performing outpatient surgery (Reutlingen, Stuttgart, Tübingen, Ulm) and two inpatient hospital services of pediatric surgery (Stuttgart, Tübingen) retrospectively evaluated their data on all boys who underwent orchidopexy from 2009 to 2012. Data were obtained on all boys who had been given the specific diagnostic code for undescended testis of the International Statistical Code of Diseases and Related Health Problems, 10th Revision, in its German modification (ICD-10-G), as well as the specific German Operation and Procedure Code (*Operationen- und Prozedurenschlüssel,* OPS) for the surgical treatment of undescended testis. In the evaluation, it was noted whether each patient had been treated for primary or secondary undescended testis, which side was affected, and whether preoperative hormonal treatment was given (beta-hCG, GnRH analogues, or a combination of the two). As the current guidelines recommend surgery either before the age of 12 months or before the age of 24 months, the patients were classified in one of three groups depending on whether they had been operated on before their first birthday, between the first and second birthdays, or after their second birthday. Ethical approval was given by the state medical association of Baden-Württemberg. The statistical analysis was performed with JMP 10.0.2. Group sizes were expressed as percentages with a 95% confidence interval (95% CI), and trends were calculated with Pearson's chi-squared test at a 5% significance level. A logistic

FIGURE 1



Differences between a) outpatient practices and b) hospital services with respect to the percentage of orchidopexies in each age category

TABLE 2

Age at time of orchidopexy: an international comparison

Source	Country	Number of orchidopexies	Distinction between primary and secondary undescended testis? (indirect signs)	Time period	Mean age on diagnosis (months)	Mean age at surgery (months)	< 12 months (%) (x/n)	< 24 months (%) (x/n)	Variables: earlier surgery	Variables: later surgery	Trend toward earlier surgery 1: year, mean age at surgery (mo.) 2: year, percentage younger than x mo.
Studies based on nationwide databases											
McCabe JE, 2008 (22)	GB	36 847	no (2^{nd} peak at ages 7 to 9)	1997–2005	–	–		23.8 (8770/ 34 847)	operation by pediatric surgeon	operation by general surgeon or urologist	trend (descriptive): 2: 1997, 16 < 24 2: 2005, 29 < 24
Kokorowski PJ, 2010 (20)	USA	28 204	no	1999–2008	–	52.8	18 (5031/28 204)	43 (12 165/28 204)	ethnic origin, non-Hispanic white; private health insurance	ethnic origin, black or Hispanic; government health insurance	no trend 2: 1999, 40 < 24 2: 2003, 44 < 24 2: 2008, 42 < 24
Capello SA, 2006 (17)	USA	26 575	no	1984–2002	–	–	–	–	–	–	trend (descriptive): 2: 1984–88, 20 < 24 2: 1998–93, 28 < 24 2: 1994–98, 32 < 24 2: 1999–02, 38 < 24
Springer A, 2013 (25)	A	19 998	no (2^{nd} peak at ages 6 to 10)	1993–2009	–	62.4	2.7 (539/19 998)	22.89 (4573/19 998)	treatment in the Tyrol (Austrian state)	–	trend (significant): 1: 1993, 72.0 1: 2004, 51.6 2: 1993, 15.2 < 24 2: 2004, 26 < 24
Pettersson A, 2007 (15)	S	16 983	no	1964–1999	–	103.2	–	4.2	–	–	trend (descriptive): 2: 1964–69, 27 > 156 2: 1970–74, 15 > 156 2: 1975–79, 11 > 156 2: 1980–84, 7 > 156 2: 1985–89, 5 > 156
Jensen MS, 2011 (19)	DK	5 473	no	1995–2009	trend: 1995–1997, 40 1998–2000, 37 2001–2003, 35	–	–	–	–	–	trend (significant): 1: 1995–1997, 46 1: 1998–2000, 43 1: 2001–2003, 40
Yiee JH, 2012 (28)	USA	1 365	no (patients over age 5 yr were excluded)	2002–2007	8.2	–	–	87 (< 18 months) n	private health insurance, frequent check-ups, referral by a pediatrician, availablity of a laparoscopy unit	–	–
Chen YF, 2013 (18)	CN	547	no	1997–2009	12	44.7	20.08 (110/547)	–	early diagnosis, urban rather than rural setting	frequent medical visits, youger diagnosing physician, older surgeon	no trend

Source	Country	Number of orchidopexies	Distinction between primary and secondary undescended testis? (indirect signs)	Time period	Mean age on diagnosis (months)	Mean age at surgery (months)	< 12 months (%) (x/n)	< 24 months (%) (x/n)	Variables: earlier surgery	Variables: later surgery	Trend toward earlier surgery 1: year, mean age at surgery (mo.) 2: year, percentage younger than x mo.
Single-center studies											
Bayne AP, 2011 (16)	USA	677	no	2002–2009	45.2	50.4	–	–	earlier surgery if genital anomaly or abdominal testis	–	–
Nah SA, 2014 (24)	SGP	513	yes (2^{nd} peak at age 6 yr)	2007–2011	(13.2 median)	(19.2 median)	23 (120/513)	58 (297/513)	association with urogenital malformations	–	–
Upadhyay V, 2001 (27)	NZ	325	no	1996–1998	45.2	52.2		–	–		–
Moslemi MK, 2013 (23)	IR	252	no	2005–2009	–	53.3		17	–	–	–
Zöller G, 2005 (29)	D	127	yes	2002–2004	–	–	–	13.4	–	–	no trend: 2: 1990–94, 17 < 24 2: 1995–99, 20 < 24 2: 2000–04, 13 < 24
Lim KT, 2003 (30)	IRL	97	no	1996–1999	80.4	67.2	–	28.9 (28/97)	–	–	–
Multicenter studies											
Marchetti F, 2012 (21)	I	88	no	2002–2004	–	22.8	13 (12/88)	64 (56/88)	–	–	–
Steckler RE, 1995 (26)	USA	329	no	1991–1993	–	51.6	17 (56/329)	44 (145/329)	–	–	–
Bruijnen CJP, 2008 (31)	NZ	788	no	1997–2007	54.3	–	–	42.5 (335/788)	–	–	no trend
Present study, 2014	D	1850	yes	2009–2012	–	–	18.6 (346/1850)	43 (797/1850)	Surgery in hospital providing maximal care	Surgery in pediatric surgical outpatient practice	trend: 2: 2009, 13 < 12 2: 2010, 20 < 12 2: 2011, 18 < 12 2: 2012, 26 < 12

yr, year
GB, United Kingdom; USA, United States of America; A, Austria; S, Sweden; DK, Denmark; CN, People's Republic of China; SGP, Singapore; NZ, New Zealand; RIL, Republic of Ireland; I, Italy; D, Germany.

regression analysis was performed on the variables "year of surgery" and "inpatient versus outpatient treatment." The findings were compared with data from other countries on the timing of orchidopexy. Furthermore, a targeted literature search was carried out in the PubMed, World of Science (WoS), and Cochrane Library databases for study reports in English or German, with the key words "orchidopexy" and "cryptorchidism" and/or "undescended testis" and "age" or "timing." Each retrieved publication was considered in this review if it gave information on the patients' age at the time of surgery, and as long as the study involved a cohort of at least 80 patients who were born in 1990 or afterward, and who were studied postoperatively over a well-defined period of time.

Results

Findings of the present study

An overview of the findings is provided in *Table 1*. Over the period of this study, significantly fewer orchidopexies were performed for primary undescended testis ($p \leq 0.001$) and significantly more for secondary undescended testis ($p \leq 0.001$). The overall trend was for earlier orchidopexy ($p \leq 0.001$); this trend was observable both in the inpatient setting ($p = 0.0026$) and in the outpatient setting ($p = 0.05$), with a significant difference between the two settings in the chi-squared test *(Figure 1)*. The two settings did not differ significantly with respect to the percentage of patients given hormonal treatment before surgery. The logistic regression analysis on the effect of the calendar year (2009 through 2012) and the effect of inpatient versus outpatient treatment revealed a positive effect of a later calendar year on early surgery ($2012 > 2011 > 2010 > 2009$, $p = 0.0002$), as well as a positive effect of inpatient treatment on early surgery ($p \leq 0.0001$). Of the 363 boys with secondary undescended testis, 44 (12%, 95% CI 9–15.9%) received preoperative hormonal treatment.

Literature search

An overview of the available data from a total of 17 other studies is shown in *Table 2* (15–31). The following variables relating to the treatment of undescended testis are displayed:

- mean age at presentation with undescended testis (4 studies) (16, 19, 27, 28)
- mean age at orchidopexy (11 studies) (15, 16, 18, 20, 23, 25–27, 30, 31)
- data on trends toward earlier surgery (9 studies) (15, 17–20, 22, 25, 29, 31)
- percentages of patients who underwent surgery before their first birthday (6 studies) or before their second birthday (12 studies) (15, 20–26, 28–31)
- correlations with variables that seem linked to earlier or later surgery (7 studies) (16, 18, 20, 22, 24, 25, 28)
- percentages of patients that received hormonal treatment (2 studies) (21, 29)

14 studies did not distinguish primary from secondary undescended testis. More common orchidopexies between the ages of about 6 to 10 years were described in three studies (22, 24, 25). One study indirectly excluded cases of secondary undescended testis by not including orchidopexies performed on boys over the age of five years (28). One study report provided only the median (not the mean) age of patients at the times of presentation and orchidopexy and therefore could not be fully considered in the evaluation (24).

In most studies *(Figure 2a),* the mean age at orchidopexy ranged from 42 to 67 months (16, 18–20, 23, 25–27, 30, 31), with markedly better results reported in a study from Italy (21). In three of four studies, the mean age at presentation was very late (16, 19, 27, 28). A comparison of the studies that included data on the percentages of orchidopexies done under the age of 24 months and under the age of 12 months *(Figures 2c and d)* reveals a trend toward earlier surgery.

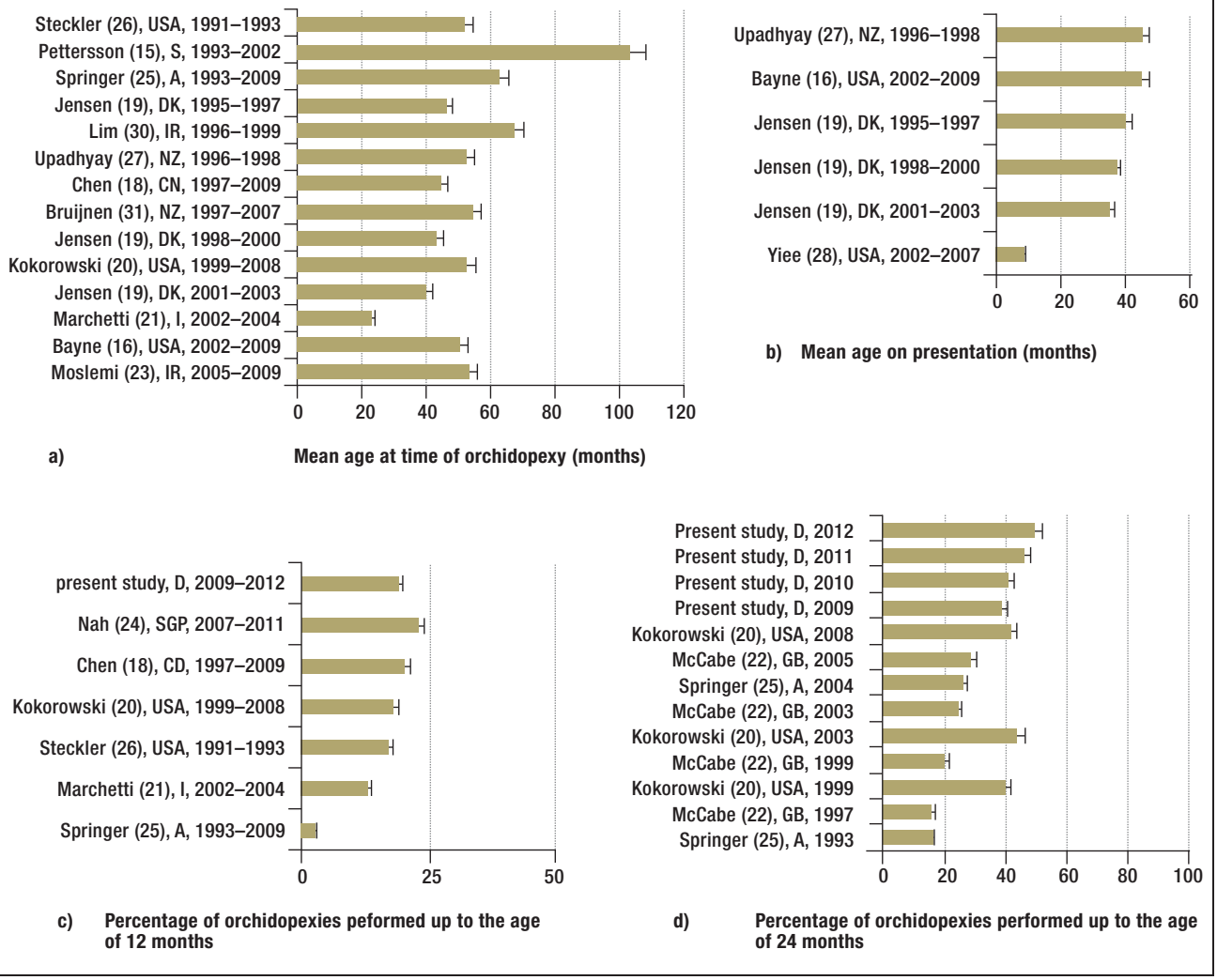
Hormonal treatment was given to 40 of 127 patients (31%) in one study (21), 35 of 127 patients (27.5%) in another (29), and 21.0% of the patients in the present study (95% CI, 19.3–22.8%), with the mean age at the start of hormonal treatment considerably older than 12 months. The variables potentially linked to early or late surgery are listed in *Table 2*.

Discussion

Over the past few decades, the recommended age for orchidopexy has been consistently lowered in all pertinent medical recommendations. In 1975, the American Academy of Pediatrics (AAP) still recommended surgery at the age of four to six years for primary undescended testis (32). Once it became clear that the histological changes in testicular tissue associated with this condition are not congenital, but in fact develop from the age of six months onward (33), the AAP in its recommendations of 1996 favored performing orchidopexy at around one year of age (34). Comparable modifications in European recommendations were seen somewhat later: the first AWMF guideline recommending orchidopexy before the second birthday appeared in 1999 (e40), and the European Association of Urologists followed suit in 2001 (35). In 2007, the Nordic Consensus recommendations were updated to favor orchidopexy between the ages of 6 and 12 months (36). The AWMF guidelines were also modified to this effect, beginning in 2007: the earliest indication of a recommendation for orchidopexy from 6 to 12 months appeared in an unofficial, preliminary version of the 2008 guidelines (e44), and the recommendation was officially accepted by the German specialty societies and published in 2009 (e39).

Multiple articles appeared on this subject in Germany as early as 2005, with reference to the AAP recommendations of 1996 (2, e41–e43). Further publications in *Deutsches Ärzteblatt* and regional medical periodicals

FIGURE 2



International comparison with respect to mean age at time of orchidopexy (a), mean age on presentation (b), and the percentage of orchidopexies performed up to the age of 12 (c) or 24 (d) months.
GB, United Kingdom; USA, United States of America; A, Austria; S, Sweden; DK, Denmark; CN, People's Republic of China; SGP, Singapore; NZ, New Zealand; RIL, Republic of Ireland; I, Italy; D, Germany.

were intended to raise consciousness of the need for early surgical treatment among physicians in all of the affected specialties (29, e24, e44–e55).

The implementation of these recommendations has been analyzed in studies around the world. The German data available before the present report, which were derived from a retrospective single-center study for the years 2002 to 2004, showed surgery being performed after the second birthday in more than 80% of patients (29). That study, however, was considered too small to be representative (e54). Our current findings, from the years 2009 to 2012, are somewhat more encouraging, with 18.7% of patients (95% CI, 17–20.6%) undergoing orchidopexy before their first birthday in conformity with the guidelines, although 57% (1053 of 1850 patients; 95% CI, 54.6–59.2%) still underwent orchidopexy after their second birthday. Treatment in an inpatient setting was positively associated with earlier orchidopexy. A possible and reasonable explanation for this may be that younger children are preferentially referred for inpatient treatment because of the better pediatric anesthesiological infrastructure available in hospitals as opposed to ambulatory surgical practices.

The available data from other countries reveal a marked increase in the percentages of orchidopexies being carried out under the ages of 24 months and 12 months *(Figures 2c and d)*. Of all studies, the present one showed the highest percentage of boys undergoing orchidopexy under the age of 12 months, possibly because the analysis distinguished primary from secondary undescended testis. Yet the percentage of boys undergoing surgery in their first year is still very low in all studies, without exception.

In eight studies that were carried out in comparable periods of time, the mean age at orchidopexy ranged from 45 to 62 months (16, 18–20, 23, 25–27); a relatively low mean age of 22.8 months was only reported in a single study (21). This may be due to a bias in data collection, as the data in that study were taken from questionnaires voluntarily filled out by pediatricians in private practice, rather than being obtained from a representative patient cohort over a given period of time. Another study with better-than-average results showed that 87% of all orchidopexies (in 1192 of 1365 patients) had been carried out under the age of 18 months. The data that led to this conclusion were derived from a private health-insurance carrier, with the exclusion of patients with low birth weight, premature birth, and orchidopexy after the age of five years (among others); thus, there was no representative overall cohort in this study either (28). Various factors seemingly linked to early surgery *(Table 2)* were inconsistent across studies. Above all, improved care is to be achieved through a change in the treating physicians' behavior.

Only two studies included an evaluation of whether hormonal treatment was provided. As in the present study, many children were only given hormonal treatment after their first birthday, or postoperatively (21, 29). This reflects the low importance attached to hormonal treatment in clinical practice. Preoperative hormonal treatment is no longer recommended in the Nordic Consensus (36), the Swiss guidelines (e56), or other international recommendations (37, e60), but it was recommended as a complement to orchidopexy by the European Association of Urologists (2001) and in the AWMF guidelines of 1999 and 2007 (35, e39, e40). In the current, 2013 version of these guidelines, hormonal treatment is described as an option alongside surgery, but there is an explicit recommendation against giving hormonal treatment after the child's first birthday (38).

It is now well known that the mere knowledge that a particular recommendation is contained in a medical guideline does not automatically lead to its implementation (39, e57). From the present data, we can only speculate on the disease-specific reservations that physicians might have regarding the treatment of undescended testis. To alleviate concern about potential surgical complications, physicians should be made aware that the complications of orchidopexy (anesthesia-related incidents, hemorrhage, wound infection, recurrent undescended testis, testicular atrophy, injury to the vas deferens) are no more common when the procedure is performed in the child's first year than when it is peformed later, as long as it takes place in a unit with the requisite experience in pediatric surgery and pediatric urology (5, e58). The rare reported cases of spontaneous testicular descent after the age of six months should not be cited to support a general policy of watchful waiting. Such observations are likely to be based on a lack of differential diagnostic clarity, with a missed distinction between retractile and undescended testis (e59).

Limitations

One limitation of the present study is that it was restricted to a group of pediatric surgical units that are located near one another in a relatively small geographical area within a single German state. No comparable data are available for other pediatric surgical units in Baden-Württemberg, or for the other German states. The findings of the present study are, however, comparable with those of other studies from outside Germany.

This study does not include any information on orchidopexies performed by urologists or general surgeons. Interestingly, a British study found that boys operated on by pediatric surgeons were significantly younger than those operated on by urologists or general surgeons (22).

A further limitation of this study is that the patients' age at presentation was not determined. In four of the five studies containing data of this type, the mean age at presentation ranged from 35 to 45 months (16, 19, 27), and 57.6% of all patients (310 of 547 patients) were already past their first birthday at the time of presentation (18) *(Figure 2b)*. We cannot exclude late presentation as a possible cause of delayed surgical treatment among the patients in the present study. This limitation is a consequence of retrospective data acquisition.

Overview

Even though early orchidopexy for primary undescended testis is now widely advocated in Germany and other countries, and even though the AWMF guideline of 2009 contains a recommendation for orchidopexy between the ages of 6 and 12 months, only 18.7% of the patients in this study actually underwent orchidopexy in the recommended age range. Studies from abroad show comparably inadequate implementation of the existing guidelines.

We conclude that the AWMF guideline on undescended testis clearly needs to be more intensively disseminated and more consistently implemented.

KEY MESSAGES

- It is recommended in the AWMF guideline that orchidopexy for primary undescended testis should be performed between the ages of 6 and 12 months. The same recommendation is found in the guidelines of the American Academy of Pediatrics (AAP) and the Nordic Consensus.
- Only 18.7% of the boys in this study underwent orchidopexy at age 6–12 months as recommended in the guidelines.
- The findings of comparable studies in other countries are just as bad.
- Little importance is attached to hormonal treatment in clinical practice.
- The AWMF guideline should be more consistently implemented.

Conflict of interest statement
The authors state that they have no conflict of interest.

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ORIGINAL ARTICLE

The Timing of Surgery for Undescended Testis

A retrospective multicenter analysis

Georg Hrivatakis, Wolfgang Astfalk, Andreas Schmidt, Andreas Hartwig, Thomas Kugler, Thomas Heim, Axel Clausner, Albrecht Frunder, Harduin Weber, Steffan Loff, Joerg Fuchs, Verena Ellerkamp

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