


## Original Research Article

## Diagnostic Accuracy of Ultrasonography in Detecting Unapparent Contralateral Inguinal Hernia in Children

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**Abstract: Background:** Paediatric inguinal hernias commonly result from congenital persistence of processus vaginalis (PV) and usually require surgical correction. This patent processus vaginalis can be bilateral and if one side is clinically unapparent during the surgery for the contralateral side, a metachronous hernia may result leading to a second operation and anaesthesia. Preoperative groin ultrasonography has been suggested as a tool to reduce the incidence of metachronous contralateral inguinal hernia. **Objectives:** This study aims to determine the diagnostic accuracy of ultrasonography in detecting clinically unapparent contralateral inguinal hernia in children. The study also aims to determine whether the exploration of the groin in paediatric inguinal hernia based on ultrasonography findings is justified. **Patients and Methods:** This is a fourteen-month prospective study of 42 patients that presented to the Paediatric Surgery Units of the University of Nigeria Teaching Hospital, Ituku/Ozalla, Enugu State, with clinically apparent unilateral inguinal, inguinoscrotal/inguinolabial hernias. All patients had an ultrasound of the contralateral inguinal region to detect unapparent inguinal hernia based on Toki's classification using a high-resolution 7.5-11MHz linear transducer. Patients with positive ultrasonography findings had contralateral inguinal exploration. Ultrasound and intra-operative features were compared to determine the diagnostic accuracy of ultrasonography. A structured proforma was used to collect data and SPSS statistics version 25.0 was used to analyze the data. Test of significance was applied where appropriate using fisher's exact test. The confidence interval was calculated at a 95% level and a p-value of 0.05 was considered to be statistically significant. **Results:** The mean age of the patients was 3 years (range of 1 month to 15 years) and the median Body Mass Index (BMI) was 14.3kg/m<sup>2</sup>(range of 11.1kg/m<sup>2</sup> to 20.1kg/m<sup>2</sup>). A total of 7 patients (16.7%) had a clinically unapparent contralateral inguinal hernia which was identified by preoperative ultrasonography and confirmed at the operation. One patient with negative ultrasound was found at a follow-up to have a metachronous contralateral hernia. Ultrasonography had a sensitivity of 87.5%, and specificity of 100% in the diagnosis of metachronous contralateral inguinal hernia. The positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy were 100%, 97.1%, and 97.6% respectively. **Conclusion:** This study shows that ultrasonography as a tool in screening for unapparent contralateral inguinal hernia in children has high diagnostic accuracy. Using this as an adjunct to the clinical evaluation of children with inguinal hernia might minimize misdiagnosis of unapparent contralateral inguinal hernia in this age group.

**Keywords:** Diagnostic Accuracy, Ultrasonography, Unapparent Contralateral Inguinal Hernia, Children.

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## INTRODUCTION

Paediatric inguinal hernias are usually indirect hernias, and they result from congenital persistence of the processus vaginalis [1, 2]. It is a common condition requiring surgical repair in children. Herniotomy is the most common procedure in paediatric patients [1-4]. The incidence of inguinal hernia is approximately 3% - 5% and preterm are more susceptible with incidences as high as 16% to 25%.<sup>1,5</sup> In newborns with a birth weight of less than 1000g, it may be up to 30% [6, 7]. The inguinal hernia is more often found on the right (60%) than the left (30%) with bilateral occurring in 10% [8].

The incidence of metachronous contralateral inguinal hernias in children after unilateral hernia repair is 5.8 - 31% [9-11]. High incidence of patent PV on the contralateral side has been reported which also points to a possible occurrence of inguinal hernia there in the near future [12, 13]. The incidence of contralateral patent processus vaginalis (CPPV) is 20-50% [4-15]. In premature neonates, this incidence correlates fairly well with metachronous contralateral inguinal hernia and is up to 100% while in term neonates it is about 80% [1-16].

Despite all this evidence, controversies abound on its clinical relevance which can put to rest the debate as to whether surgeons should explore the contralateral side in patients presenting with unilateral inguinal hernia [5].

The diagnosis of inguinal hernia is clinical and presents mainly as an inguinal swelling with positive expansile cough impulse [17]. Synchronous contralateral groin exploration for a clinically unapparent inguinal hernia is a practice that was proposed to reduce the incidence of metachronous surgeries and anaesthesia for contralateral hernias [17]. Routine exploration of the contralateral side has been shown to result in a large number of negative explorations 80 – 90% [18].

It is therefore important to clearly identify the patients that will truly require contralateral exploration so as to avoid a second anaesthesia, minimize parental and patient inconveniences, avoid the chance of incarceration and reduce cost, and also reduce negative contralateral exploration [3]. Contralateral inguinal exploration is not without some potential risks which include injury to the contents of the spermatic cord, wound infection, increased pain, increased cost, and prolongation of the operation time.<sup>3</sup> Medical history and physical examination of the contralateral inguinal region are not able to reveal these occult inguinal hernias that resulted from asymptomatic patent PV.

If hernia development in the contralateral groin could be predicted, the surgeon's recommendation regarding contralateral inguinal exploration can be made more accurately. In order to detect clinically unapparent inguinal hernias and minimize the incidence of negative

contralateral groin exploration, many techniques have been employed which include laparoscopy, herniography, and diagnostic pneumoperitoneum [19]. However their results and routine applicability remain questionable, especially in our sub-region where laparoscopy is not readily available [20].

Ultrasonography has been identified as an important tool for this very purpose. It has gained popularity due to its non-invasiveness, wide availability, relative affordability and safety with no risk of radiation exposure. Ultrasonography is a diagnostic tool that can detect CPPV preoperatively using a 7.5MHz -11MHz superficial linear transducer. The detected patent PV is classified according to a criterion outlined by Toki and colleagues [21]. The presence of patent PV is not equivalent to an inguinal hernia. Toki *et al.*, reported a statistically significant reduction in the rate of development of contralateral inguinal hernia following unilateral herniotomy, before and after the application of ultrasonography [21, 22]. It was advocated that contralateral herniotomy should be performed when ultrasonography shows Toki types I through IV [22].

Hence the need to assess the diagnostic accuracy of ultrasonography in the detection of occult contralateral inguinal hernia and also to determine whether exploration of the contralateral groin in paediatric inguinal hernia based on ultrasonography findings is justified.

## METHODS

The study was a fourteen-month prospective study of patients that presented to the Paediatric surgery units of University of Nigeria Teaching Hospital (UNTH) from March 2021 to May 2022 with unilateral inguinal, inguinoscrotal /inguinolabial hernia that are 15 years and less.

All patients had inguinal ultrasonography of the contralateral side to assess for and detect unapparent contralateral inguinal hernia based on Toki's classification.

The ultrasonography was performed with the patient in a supine position using a high-resolution 7.5MHz-11MHz linear array transducer and 3.5MHz curve-linear transducer.

The probe was initially placed on the scrotum to visualize the testis in male patients and then moved through the inguinal canal to identify the deep ring. In female patients, the probe will be placed on the inguinal canal to locate the deep ring directly.

The patent PV was examined during both increasing intra-abdominal pressure and while maintaining normal pressure. The inguinal canal will appear as a tubular hypoechoic structure proximal to the peritoneal cavity. The length of the inguinal canal was

measured and the width was measured at the deep ring, at the midpoint and at the distal end of the canal.

The findings obtained from ultrasonography were classified according to Toki's criteria. Toki Type I – IV was regarded as positive in this study.

Patients with the types mentioned above had an exploration of the contralateral inguinal canal in the same sitting after repairing the clinically detected hernia. The surgeon was blinded to the Toki Type that was obtained via ultrasound.

All patients with negative ultrasonography features were followed up for 6 months to assess for the presence of a metachronous hernia in the paediatric surgical outpatient clinic and where it is not possible via phone calls.

Ethical approval for this research was obtained from the Ethics and Research Committee of UNTH, Ituku/Ozalla, Enugu State. The study, surgery and possible complications were well explained to the patient's caregiver. Written informed consent for both the surgery and the study was obtained for each case. Patients who decline this written consent were excluded from the study and it did not affect their overall hospital care. The researcher bore the cost of ultrasonography since it is not a routine investigation for inguinal hernias.

Data collection included patients' demographic characteristics, clinical features, investigations and intra-operative findings using a proforma. The patients with bilateral inguinal hernia, emergency presentations, associated contra-lateral undescended testis, recurrent unilateral inguinal hernia and those who did not give consent were all excluded from the study.

The sample size was calculated using the following formula:

$$nf = n / (1 + n/N)$$

Where

nf = Desired sample size when the population is < 10,000

n = Desired sample size when the population is 10,000

N = Estimate of the population size.

In UNTH, we see an average of two cases of hernia per week, making it a total of 104 patients who would have been seen over 52 weeks (1 year) (Unpublished data from surgical outpatient clinic register UNTH). The estimated population size is 104.

$$n = 2Z^2 2pq/d^2d^2$$

Where

Z = Standard normal deviation, usually at 1.96 (95% confidence level)

p = Prevalence of the condition under study. The prevalence of inguinal hernia in children is 20 per 1000 live births which is 2% [23, 24].

Therefore  $p = 0.020$

$$q = 1.0 - p$$

$$= 1.0 - 0.020$$

$$= 0.98$$

d = Degree of accuracy desired, usually set at 0.05

$$n = ( 2 \times (1.96)^2 \times 0.020 \times 0.98 ) / (0.05)^2$$

$$n = 0.15059072 / 0.0025$$

$$n = 60.24$$

$$nf = n / ( 1 + n/N )$$

$$= 60.24 / ( 1 + 60.24/104 )$$

$$= 60.24 / 1.57923076$$

$$nf = 38.14515366$$

$$nf = 38.2$$

Attrition

Considering an attrition rate of 10% the needed sample size would be

$$N = 38.2/0.9$$

$$N = 42.38$$

$$N = 42$$

The sample size for the study = 42.

All patients that met the inclusion criteria were sent for ultrasonography scan. An ultrasound machine used was LOGIQ C3 Premium.

The preoperative ultrasonography results of the patients with CPPV were classified according to the criteria of Toki *et al.*, in which the findings, along with an increase in the intra-abdominal pressure or without it, will be categorized into six types. Toki's Classification includes the following.

**Type I** – intra-abdominal organ was observed in the inguinal canal

**Type II** – the patent PV was seen as a cyst at the internal ring of the inguinal canal.

**Type III** - the patent PV was widened with increases in abdominal pressure. (The length of the patent PV was longer than 20mm).

**Type IV** – the patent PV contains moving fluid without patent PV widening.

**Type V** – the patent PV was widened with increases in abdominal pressure (the length is shorter than 20mm).

**Type VI** – other findings

Toki's type I, II, III and IV were regarded as positive and potential candidates for contralateral inguinal herniotomy.

All the surgeries were done under general anaesthesia and post-operatively, each patient was observed in the ward and discharged the same day when considered fit. They were counseled on the need to return to the hospital in case of any eventuality. They were seen in the clinic for wound inspection and subsequent follow-up as indicated.

All those patients with negative ultrasonography features were followed up at monthly

intervals for a minimum of six months, checking for the appearance of a demonstrable inguinal hernia.

The results were entered into the proforma for evaluation of the parameters.

The data was collated and statistical analysis was done using the Statistical Package for Social Sciences (SPSS) version 25.0. Ultrasonography findings were compared with intraoperative findings while the incidence, sensitivity, specificity and positive predictive value were obtained. The results were presented in tables, figures and charts. Fisher’s exact test was used to

test for the level of significance of variables. The confidence interval was calculated at a 95% probability level and (p < 0.05 was deemed significant).

## RESULTS

### Sociodemographic Characteristics

A majority, 25 (59.5%), were between the ages of 1 – 5 years. The mean age was 3 years (Standard deviation = 4), while the median was 2 years (Interquartile Range = 1 – 4). The median BMI was 14.3 kg/m<sup>2</sup> (Standard deviation = 3.2) as shown in Table 1 below.

**Table 1: Sociodemographic Characteristics of Participants**

Variable		Frequency (N = 42)	Percentage
Age (in years)	< 1	8	19.0
	1 – 5	25	59.5
	6– 10	5	12.0
	11 – 15	4	9.5
BMI (kg/m <sup>2</sup> )	Median	14.3	SD = 3.2
			IQR =12 – 017

SD = Standard deviation; IQR = Interquartile Range

### Preoperative Examination Findings amongst Participants

The mean duration of swelling was 7 months. A majority, 26 (61.9%), of the groin swelling amongst

participants were located on the right side; the extent of the swelling was primarily inguinoscrotal hernia – 34 (81.0%) as shown in Table 2 below.

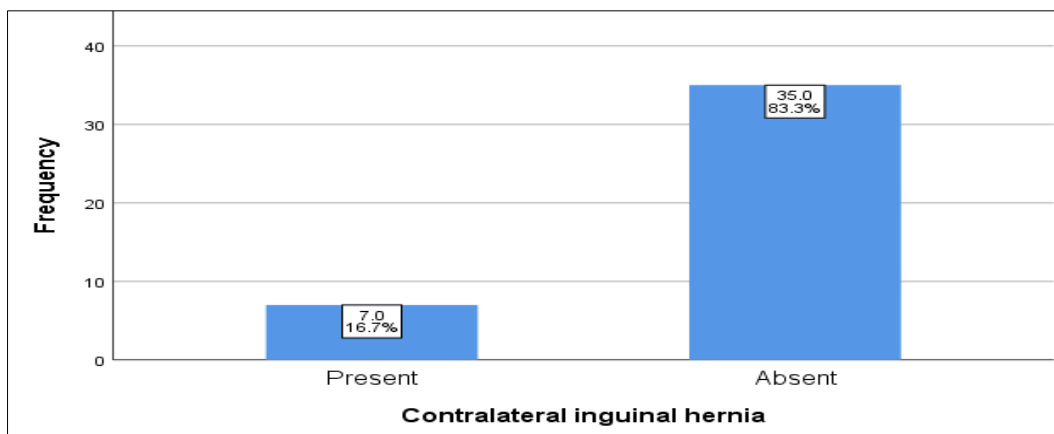
**Table 2: Showing Preoperative Examination Findings amongst Participants**

Variable		Frequency (N = 42)	Percentage
Groin swelling	Right	26	61.9
	Left	16	38.1
Extent of swelling	Bubonocele	5	11.8
	Funicular	2	4.8
	Inguinoscrotal hernia	34	81.0
	Inguinolabial	1	2.4

### Incidence of Inguinal Hernia in Children

Figure 1 shows that the incidence of unapparent contralateral inguinal hernia was 16.7%.

83.3% of participants have no ultrasonography feature of potential contralateral inguinal hernia.



**Figure 1: A simple bar chart showing the incidence of unapparent contralateral inguinal hernia in children**

### 5.4 Toki's Classification of Participants

Amongst participants with contralateral inguinal hernia, Toki's classification Type I (which corresponds to the detection of a herniated intra-abdominal viscus in the inguinal canal with increment and normal intra-abdominal pressure) was seen in 2 patients (28.6%).

Toki's classification Type III (which corresponds with a widening of the patent PV with an increase in intra-abdominal pressure with the length of the patent PV longer than 20mm), was seen in 5 participants (71.4%) as shown in figure 2 below.

Other classifications were not seen in the study.

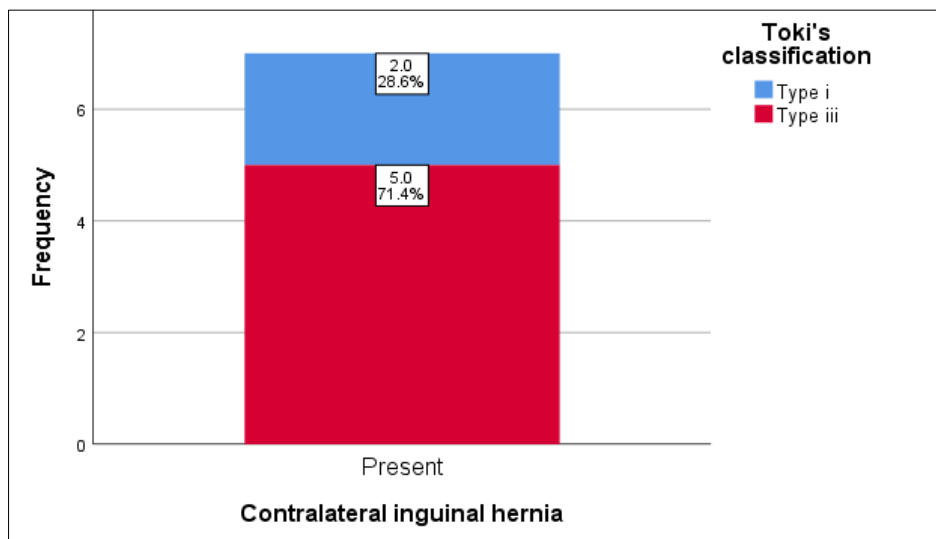


Figure 2: A stacked bar chart showing ultrasonographic findings in children with contralateral inguinal hernia

### The Sidedness of the Contralateral Inguinal Hernia among the Participants

Amongst children with contralateral inguinal hernia detected by ultrasonography, 42.9% of

participants had a contralateral inguinal hernia on the right, while 57.1% had it on the left side. This is as shown in Table 3 below:

Table 3: Showing the Sidedness of the Contralateral Inguinal Hernia among the Participants

Sidedness of the Contralateral inguinal hernia	Frequency (N = 7)	Percentage
Right inguinal hernia	3	42.9
Left inguinal hernia	4	57.1

### Intra Operative Findings in Children with Potential Contralateral Hernia

Amongst children with potential contralateral inguinal hernia, patent PV only, patent PV plus well-

developed sac with fluid, and patent PV plus well-developed sac with bowel or any other structure were present respectively 2 (28.6%), 4 (57.1%) and 1 (14.3%) times, as shown in Table 3 below.

Table 4: Showing the Intraoperative Findings in Children with Potential Contralateral Inguinal Hernia

Intra-operative findings:	Frequency (N = 7)	Percentage
Patent PV only	2	28.6
Well-developed sac with fluid	4	57.1
Well-developed sac with bowel or any other structure	1	14.3

### 5.7 The Sensitivity and Specificity of Ultrasonography in Detecting Unapparent Contralateral Inguinal Hernia in Children

All children with ultrasonography diagnosis of potential contralateral inguinal hernia had a corresponding positive finding during groin exploration – this gives specificity of 100.0%; amongst those who

had negative ultrasound finding, 2.9% eventually developed contralateral inguinal hernia (which was diagnosed clinically and confirmed intra-operatively) – this gives a sensitivity of 87.5%. There was a statistically significant relationship between both variables ( $p < 0.05$ ), as shown in table 4 below:

**Table 5: Showing the Sensitivity and Specificity of Ultrasonography in Detecting Unapparent Contralateral Inguinal Hernia in Children**

Variable		Groin exploration for contralateral inguinal hernia/ Subsequent clinical diagnosis of contralateral hernia		X <sup>2a</sup>	p-Value
		Operation +ve	Operation -ve		
Potential contralateral inguinal hernia (Ultrasonography)	USS +ve	7 (87.5)	0 (0.0)	-	<b>0.001*</b>
	USS -ve	1 (12.5)	34 (100.0)		
	<b>Total</b>	<b>8 (100.0)</b>	<b>34 (100.0)</b>		

X<sup>2a</sup> = Fisher’s Exact Test; \*Test statistics is significant at 0.05 level

**5.8 The Positive and Negative Predictive Value of Ultrasonography in Detecting Unapparent Contralateral Inguinal Hernia in Children**

The probability that a child with positive groin exploration will have a corresponding positive finding on ultrasonography is 100.0% - this gives a positive predictive value (PPV) of 100.0%; while the probability

that a child with negative groin exploration finding or negative subsequent clinical diagnosis of contralateral hernia will have corresponding negative finding on ultrasonography is 97.1% - this gives a negative predictive value (NPV) of 97.1%. There was a statistically significant relationship between both variables (p < 0.05), as shown in table 6 below:

**Table 6: Showing the Positive Predictive Value and Negative Predictive Value of Ultrasonography in Detecting Unapparent Contralateral Inguinal Hernia in Children**

Variable		Groin exploration for contralateral inguinal hernia/ Subsequent clinical diagnosis of contralateral hernia			X <sup>2a</sup>	p-Value
		Operation +ve	Operation -ve	Total		
Potential contralateral inguinal hernia (Ultrasonography)	USS +ve	7 (100.0)	0 (0.0)	7 (100.0)	-	<b>0.001*</b>
	USS -ve	1 (2.9)	34 (97.1)	35 (100.0)		

X<sup>2a</sup> = Fisher’s Exact Test; \*Test statistics is significant at 0.05 level

**Table 7: Showing the Representation and Mathematics Formular for Sensitivity, Specificity, Positive Predictive Value and Negative Predictive Value**

	Event present	Event absent	Predictive value
Ultrasonography positive	A(True positive)	B(False positive)	Positive predictive value a/(a + b)
Ultrasonography Negative	C(False negative)	D(True negative)	Negative predictive value d/(c + d)
	<b>Sensitivity a/(a + c)</b>	<b>Specificity d/(b + d)</b>	

Sensitivity:  $7 / (7 + 1) \times 100 = 87.5\%$   
 Specificity:  $34 / (34 + 0) \times 100 = 100\%$   
 PPV:  $7 / (7 + 0) \times 100 = 100\%$   
 NPV:  $34 / (1 + 34) \times 100 = 97.1\%$   
 Accuracy:  $7 + 34 / (7 + 34 + 1 + 0) \times 100 = 97.6\%$

**DISCUSSION**

This study aimed at assessing the diagnostic accuracy of ultrasonography in the detection of unapparent contralateral inguinal hernias in children. All patients with unilateral inguinal hernia had inguinal ultrasonography of the contralateral side. This was done to assess for and detect unapparent contralateral inguinal hernia based on Toki’s classification which was followed by contralateral groin exploration of those with positive features.

Paediatric inguinal hernias usually result from congenital persistence of PV and herniotomy is the most common procedure in paediatric patients [1-4]. In this study, 61.9% (26 out of 42 patients) had a right inguinal

hernia while 38.1%; (16 out of 42 patients) had a left inguinal hernia. They are similar to the 60% and 30% that were reported respectively in the literature [8]. Momor JT also reported that 54% of paediatric inguinal hernias do occur on the right while 35% are seen on the left [59]. The overall incidence of metachronous contralateral inguinal hernias in children after unilateral hernia repair is 5.6 - 31% [9-11]. The incidence of unapparent contralateral inguinal hernia as demonstrated by this study is 16.7% (7 out of 42 patients) which is similar to what is commonly reported [9-25].

Toki’s classification type III was seen in 71.4% (5 out of the 7 patients with positive ultrasonography features) which aligned with the 71% demonstrated by

Toki *et al.*, [26]. However 28.6% (2 out of 7 positive patients) seen in this study was above the 14% that was observed by Toki for type I [26]. Smaller sample size may have contributed to this observation. Toki's type I to IV was considered significant in this study, but patients with type II and IV was not found. Toki's type II is commonly seen in females who constituted only 4.8% (2 out of 42) of the study population. Toki's type IV is a mild type which requires a more diligent search, however, some researchers reported it as not significant [24, 25].

Among those who had negative ultrasound findings, 2.9% (1 out of 35 patients) eventually developed contralateral inguinal hernia during the 6 months of follow up giving this procedure a sensitivity of 87.5%. However, all patients that were identified as unapparent contralateral inguinal hernias using ultrasonography were confirmed to have contralateral inguinal hernia intra-operatively. This gives a specificity of 100%. In other studies, sensitivity ranges from 85 to 100% while specificity ranged from 22.2% to 100% [22-31].

Diagnostic accuracy was calculated to be 97.6% which was similar to what is commonly reported [22-31]. Since all the patients with positive ultrasound features were confirmed to have a contralateral inguinal hernia, it therefore, implies that the probability that a child with positive groin exploration will have a corresponding positive ultrasound finding is very high. Hence the PPV was noted to be 100%. PPV as reported in the literature ranged from 83.3% to 100 [22-31]. Also the probability that a child with negative groin exploration will have a negative ultrasonography finding is 97.1% which is the NPV. In literature, NPV was reported to range from 40% to 100% [22-31]. The implication of these findings is evident. The diagnostic performance of ultrasonography is very good in detecting unapparent contralateral inguinal hernia (Accuracy of 97.6%). This was in keeping with the diagnostic accuracy as reported by Kojima *et al.*, [30], which was also noted in a systematic review and meta-analysis by Dreuning *et al.*, [31], 2.4% (1 out of 35 patients) cases of misdiagnosis were noted with the use of ultrasonography on the contralateral side. Toki *et al.*, and Kojimo *et al.*, [30], reported 1.5% and 3% respectively as their percentage cases of misdiagnosis with ultrasonography [22-30]. However without ultrasonography, they reported up to 10% misdiagnosis [22-31]. Therefore ultrasonography was found to be more efficient and offers more advantages than clinical examination alone. The difference observed in this study may be due to the fact that one senior surgeon performed the ultrasound in Toki's work unlike in this study where the ultrasound was performed by independent radiologists with varying experience. It may also be due to the imperfection of ultrasonography as a diagnostic tool in detecting unapparent contralateral inguinal hernia.

In the study, 57.1% of patients with contralateral hernia had left-sided inguinal hernia which corroborates with the findings of other studies which asserted that left-sided hernia was associated with increased risk of contralateral hernia [3-32]. However, some researchers demonstrated that the side of the first hernia did not affect the risk of a contralateral hernia [27-29], 59.5% of our patients were within 1 to 5 years of age with a median BMI of 14.3kg/m<sup>2</sup> which corroborates with what was reported in the literature [26]. 81.0% of our patients presented with inguinoscrotal hernia with a mean duration of 7 months which is similar to what was reported by Osuoji *et al.*, [33].

### Limitations of the Study

The study lasted for fourteen months with follow-up limited to only six months. More patients may develop contralateral inguinal hernia if followed up for a longer duration. Type II and IV could be seen with a larger sample size.

## CONCLUSION

This study shows that ultrasonography is a useful tool in the screening for unapparent contralateral inguinal hernias in children and has high diagnostic accuracy in the detection of these unapparent contralateral inguinal hernias. Exploration of the groin in paediatric inguinal hernia based on ultrasonography findings is justified.

Using this as an adjunct to the clinical evaluation of children with inguinal hernia might minimize misdiagnosis of unapparent contralateral inguinal hernia in this age group.

### RECOMMENDATION

From the findings in this study, ultrasonography of the contralateral groin is recommended for patients with unilateral inguinal hernia.

Contralateral groin exploration is recommended when Toki's ultrasonography criteria are Type I and III.

A larger population study may be needed to assess the other types in Toki's criteria.

A longer duration of patient follow-up may be needed for better assessment of contralateral hernia among those adjudged negative by ultrasonography.

### DECLARATIONS

#### Ethics Approval and Consent to Participate

This sub-study was conducted by the Declaration of Helsinki and was approved by the Health Research Ethics Committee of the University of Nigeria Teaching Hospital. All participants provided individual written consent to participate in the study, and the personal privacy of the participants is well protected.

- Ethical approval was obtained from the Health Research Ethics Committee of the University of Nigeria Teaching Hospital (UNTH).

UNTH HREC registration number:  
NHREC/05/01/2008B-FWA00002458-1RB00002323  
Health research committee assigned number:  
UNTH/CSA/329/VOL.5

#### Consent to Participate

Consent to participate was obtained from all participants before commencing the study.

For individuals younger than 7 years old, informed consent (assent) to participate was obtained from their parents or legal guardians.

**Clinical Trial Number:** Not applicable

**Consent for Publication:** Not applicable

**Availability of Data and Materials:** All data generated and analyzed during the current study are included in this published article.

**Competing Interests:** The authors declare no competing interests.

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#### AUTHOR'S CONTRIBUTION

SA- involved in conception, design, literature review, performed most of the surgeries, follow up, data collection and analysis, interpretation, manuscript drafting, and revision

SE- involved in design, analysis, interpretation, manuscript revision, and approval of final version

UE- involved in design, literature review, performed some of the surgeries, data collection and analysis, interpretation, manuscript drafting, and revision

AO- involved in manuscript revision, approval of final version.

IA- involved in manuscript revision, approval of final version

PA- involved in manuscript revision, approval of final version

All authors read and approved the final manuscript

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