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Clinical Study

Morphology of Umbilical Hernia in Senegalese Children and Its Impact on the Clinical Presentation

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Keywords
Gandiaye classification
Umbilical hernia

Abbreviations
HIC - High-income countries
RUS - Redundant umbilical skin
UC - Umbilical cord
UH - Umbilical hernia

Abstract

Introduction: *Umbilical hernia is common in African children. However, studies on its morphology are scarce in sub-Saharan Africa. We aimed to characterize its morphology in Senegalese children and evaluate its impact on the clinical presentation.*

Methods: *We conducted a prospective analytic study for 6 months (March to September 2023) at the Albert Royer National Children's Hospital Centre in Dakar, Senegal. The association between parameters was studied with appropriate statistical tests.*

Results: *This study included 145 patients of umbilical hernia, of whom 121 (63.4%) were having normal overlying skin. A flat umbilicus was found in 16 patients (16%), and a conical umbilical hernia in 70 patients (48.3%). Medium-sized defects (0.5 - 1.5 cm) were found in 57 patients (39.3%), and redundant umbilical skin (RUS) was found in 111 patients (76.6%). The shape of the umbilical hernia and RUS was linked to the size of the fascial defect (p = 0.001 and 0.047, respectively). The 3 latter parameters were associated with the clinical presentation (p=0.026; 0.000 and <0.001, respectively). We found an association between the shape of an umbilical hernia and the extent of the RUS (p=0.000).*

Conclusion: *In Senegalese children, umbilical hernias frequently have normal overlying skin with a conical shape. However, umbilical hernia with a flat umbilicus is not exceptional. The fascial defect is usually medium, and redundant umbilical skin is present. Morphology of umbilical hernia is associated with its clinical presentation.*

INTRODUCTION

Umbilical hernia (UH) is estimated to occur in 25 to 58% of African children.[1] Its clinical presentation includes 3 types: simple UH (non-painful umbilical bulging as the only symptom), symptomatic UH (additional to the umbilical swelling, recurrent umbilical pain is reported), or complicated (which includes incarcerated and strangulated UH presenting with painful umbilical swelling, vomiting or obstipation with or without bowel ischemia respectively).[2] It is one of the commonest disease of pediatric surgical practice in Africa, where it is often symptomatic or complicated. It is significantly different from high-income countries (HIC), where complications are exceptional.[1,3,4] The higher rate of complications in African children resulted in recommendation against conservative management of UM as it is practiced in HIC. Some African authors suggest immediate repair of UH at diagnosis as it is done for inguinal hernia.[5,6]

The African literature on pediatric UH mainly covers its epidemiology, management, and outcomes.[7] The morphology of UH in African children is not adequately studied. Authors rarely give importance to it, such that only one report has studied it partially.[8] Many authors briefly allude to umbilical morphology while describing umbilical reconstruction (umbilicoplasty) after UH repair.[9]

Morphology of UH is important in the context of planning umbilicoplasty. Further, the morphology of UH was reported to impact the clinical presentation, that small and medium-sized defects being frequently encountered in complicated UH.[3] Therefore, we aimed to study the morphology of UH in Senegalese children by introducing a new classification that is easy to use and is based on the geometrical aspect of the umbilical swelling. Secondarily, we aimed to analyze the association between UH morphology and their clinical presentation.

PATIENTS AND METHODS

Study Setting and Design

We conducted a prospective analytical study for 6 months, from 17 March to 17 September 2023, at the Pediatric Surgical Department of Albert Royer National Children's Hospital Center. Established in 2010, it is one of the leading pediatric surgical departments in Senegal, managing patients from all regions of Senegal and neighboring countries such as Gambia, Guinea, and Mauritania.

Study Population

We included patients from 0 to 15 years of age diagnosed with UH during the study period whose parents or legal guardians freely consented to participate in the study. Helsinki Declaration of the World Medical Association was strictly observed. Patients presenting with recurrent UH were not included.

The study comprised of 145 patients, with a median age of 3 years (range 0.8 to 15 years). There were 94 males (64.8%) and 51 females (53.2%). About 20 patients had a medical comorbidity (13.8%) and 27 (18.6%) had a surgical comorbidity, of which 13 (9%) had an additional hernia (inguinal or epigastric). There were 84 patients (57.9%) with simple UH, 47 (32.4%) with symptomatic UH and 14 (9.7%) with incarcerated UH.

Data Collection

Senior Residents of our department physically examined patients using a measuring tape and a marker. Patients were examined in standing and in dorsal decubitus positions. The aspect of the skin overlying the hernia was noted on inspection in either position. For measuring the defect size, the patient was made to lie down on dorsum, the hernia was reduced and the examiner's fingers located the defect's margins which were marked using a skin marking pen. The marked distance was then measured using a scale. (Fig. 1) For measuring the redundant umbilical skin (RUS), the patient still lying on dorsum, the hernia

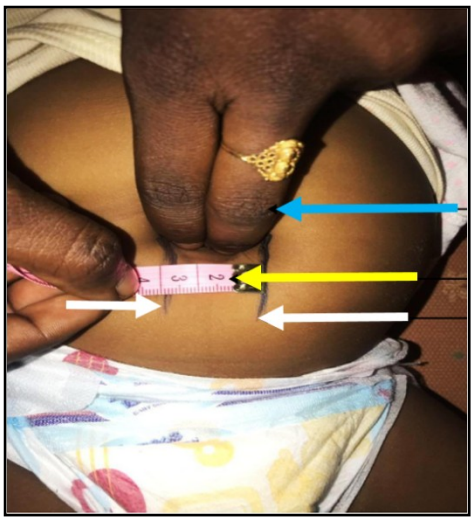

Fig. 1: Technique of measuring the fascial defect
The defect is delineated by fingers (blue arrow) and marked with ink (white arrows). Using a measuring tape (yellow arrow) the marked defect is measured

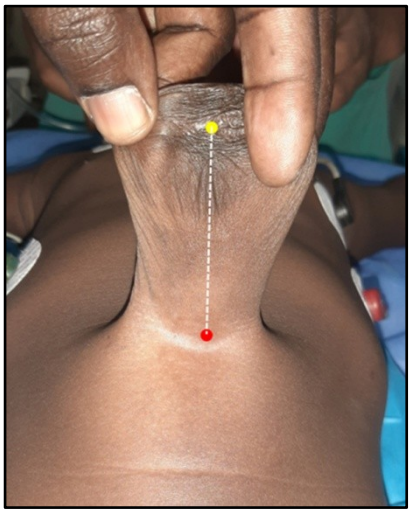

Fig 2. Measurement of Redundant Umbilical Skin
After reducing the umbilical hernia, the apex of the hernia is identified (yellow dot) as well as the lowest point of the lower umbilical crease (red dot). The distance between these two dots (interrupted white line) represents the length of redundant umbilical skin

was reduced, and two points were marked on the apex and the lowest point of the lower umbilical crease.(Fig. 2) With a measuring tape, the distance between these two points was measured as RUS. For recording the shape of the hernia, the patient was standing up without reducing the hernia. In children who were too young to stand on their own, the parents held them in an erect position. We devised a new *Gandiaye classification*, which categorizes the shape of UH depending on the geometrical aspect (conical, ellipsoidal, ovoidal, and spherical). These data were registered on a predesigned questionnaire and encoded on an Excel (Microsoft Office TM 2020) spreadsheet.

Study Variables

The parameters studied include: (a) appearance of the overlying skin (normal, hyperchromic or hypochromic), (b) defect size, categorized based on *Lassaletta's classification* (small, medium, and large defect)[10], (c) shape of the hernia, using the *Gandiaye classification of UH* (conical, ellipsoidal, ovoidal, and spherical), and (d) RUS (0.5 - 1.5 cm, and 1.6 - 5 cm).

Statistical Analysis

Analysis was performed using Statistical Package for Social Sciences software (IBM SPSS version 26). Categorical variables were presented as frequencies and continuous variables as mean (with standard deviation) or median (with first and third quartiles) depending on their Gaussian distribution. The relationship between UH defect size and overlying skin, UH shape, and RUS was accordingly evaluated using Pearson's chi-squared test and Monte Carlo exact test. The impact of UH morphology on clinical presentation was studied by comparing the morphological parameters in the 3 clinical presentation groups, using the same statistical tests accordingly. Statistical significance was set at P - value<0.05.

RESULTS

This study enrolled 145 patients. Of these, 121 patients (83.4%) had normal overlying skin color, while 20 patients (13.8%) had hyperchromic skin, and 4 (2.8%) had hypochromic skin. (Fig 3) The median fascial defect size was 1 cm (Range 0.7 – 2 cm).

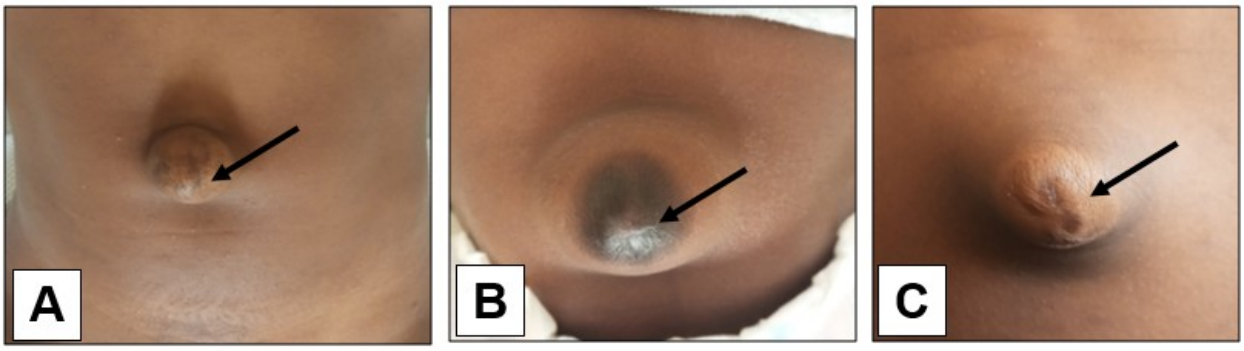

Fig 3. Overlying skin of umbilical hernia.
Skin colour is (A) normochromic, (B) hyperchromic and (C) hypochromic

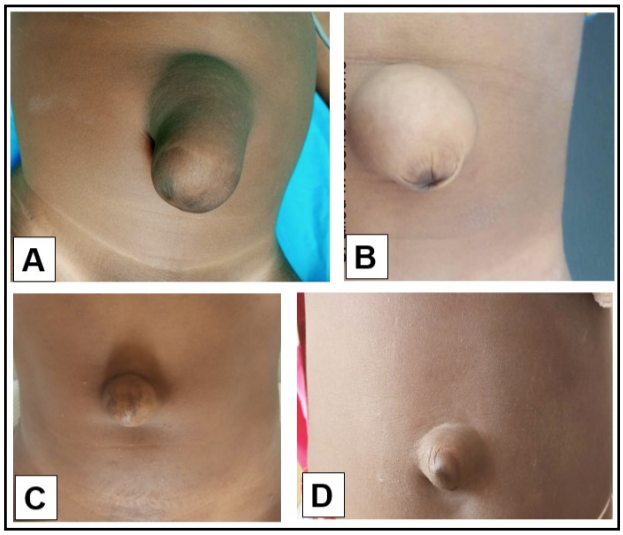

Fig 4. Gandiaye classification of umbilical hernia
(A) Conical shape, (B) Ovoidal shape, (C) Spherical shape, (D) Ellipsoidal shape

Table 1. Shape of the umbilical hernia (The *Gandiaye classification*)

Shape of Hernia	Number	Percentage
Flat umbilicus	16	11
Elevated umbilicus	82	89
Conical	70	48.3
Ovoidal	24	16.4
Ellipsoidal	24	16.4
Spherical	11	7.6

According to the Lassaletta's classification, small-sized defect (< 0.5 cm) was found in 46 patients (31.7%), medium-sized defect (0.5 – 1.5 cm) in 57 patients (39.3%), and large-sized defect (> 1.5 cm) in 42 patients (29%).

Sixteen patients (11%) had flat umbilicus. In contrast, 129 others (89%) presented with an elevated umbilicus with different geometrical aspects, as reported in Table 1. (Fig 4)

The median size of RUS was 1 cm (Range 0.5 –5 cm). About 34 patients (23.4%) had no RUS; it was found in 111 others (76.6%). Among the latter, it ranged from 0.5 to 1.5 cm in 78 patients (70.3%), from 1.5 to 5 cm in 33 patients (29.7%), and none had more than 5 cm. Analysis of the relation between the defect size and aspect of the overlying skin, UH shape, and RUS is represented in Table 2. Flat umbilicus and spherical UH were more frequent associated with small defect size, ovoidal UH with increased defect size and ellipsoidal UH with medium-sized defects. RUS proportionally increased with the defect size.

In Table 3, the impact of UH morphology on clinical presentation is depicted. We noticed that UH with a flat umbilicus was mainly symptomatic while the other shapes tended to present mainly as simple UH. Small-size defects tend to be more symptomatic, while medium and large-size defects usually presented as simple UH. Additionally, the frequency of incarcerated and symptomatic UH decreased with increasing defect size. Umbilical hernias without RUS were mainly symptomatic, while those with RUS were often simple UH. When UH with a flat umbilicus naturally does not have RUS, spherical UH all had RUS ranging from 0.5 to 1.5 cm. (Table 4)

Table 2. Clinical features of umbilical hernia

Defect size	Small *n* (%)	Medium *n* (%)	Large *n* (%)	p-value
Skin Colour				0.65 ‡
Normal	41(33.9)	46 (38.0)	34 (28.1)	
Hyper chromic	4 (20)	10 (50)	6 (30)	
Hypo chromic	1 (25)	1 (25)	2 (25)	
UH shape				<0.001 ‡
Flat	11 (68.8)	5 (31.2)	0	
Conical	21 (30)	27 (38.6)	22 (31.4)	
Ovoidal	3 (12.5)	8 (33.3)	13 (54.2)	
Ellipsoidal	6 (25)	11 (45.8)	7 (29.2)	
Spherical	5 (45.5)	6 (54.5)	0	
RUS				0.047 †
Absent	17 (50)	11 (32.4)	6 (16.4)	
0.5 – 1.5	21 (26.9)	35 (44.9)	22 (28.2)	
1.5 – 5	8 (24.2)	11 (33.3)	14 (42.5)	

RUS: Redundant umbilical skin
‡Monte-Carlo Exact test, †Pearson's chi-square test

DISCUSSION

The umbilicus is the only natural scar in the human body that plays an esthetic role. Hence a sizable number of patients with UH present because of esthetic concerns.[11] However, in Africa, majority of patients present with painful episodes, which led UH to be extensively studied in this continent.[3,4,6,12] However, no study was entirely dedicated to its morphology, as most of them partially discussed that aspect when studying umbilicoplasty after UH repair.[9,11,13] In this study, 8 in 10 patients presented with normal color of the skin over the hernia, while a tenth presented with hyperchromic skin. However, the aspect of the overlying skin did not show an association with the defect size or the clinical presentation. We hypothesize that this could be linked to the width of the umbilical cord (UC). Large size UC would need more dressings, resulting in a hyperchromic scar, while normal-sized UC would allow rapid healing with normal overlying skin.[14,15] Hypochromic skin over the hernia can be explained by a deep wound after umbilical cord separation or early exposure to sun rays.[15]

Based on the report of Lassaletta et al. in 1975[10], the size of fascial defect in UH is categorized into three types. They observed that small-size defects may spontaneously close more rapidly than larger ones, in which spontaneous closure could happen around four years or more.[10] Therefore, in HIC, the defect size is used to predict the time to spontaneous closure.[16] In our study, the smaller the defect, the higher the frequency of symptomatic or incarcerated UH. In African children, high frequency of complications prompted extensive studies on their risk factors, among which our findings on the size of the fascial defect confirmed the association of smaller size defects with more complications.[3,8,17–18] For this reason, some authors suggested routine early repair of small and medium-sized defect UH.[5, 6] In contrast to the practice in HIC, smaller defect size in African children prompts early repair of UH.

An UH can be of various geometric shapes. In this study, conical UH was the most common, followed by ovoidal, spherical, and ellipsoidal shapes. A tenth of our patients had a flat, normal-looking umbilicus. This emphasizes that UH can occur in children with normal-looking umbilicus, which is found exclusively in small-size defects. Therefore, in African children, systematic umbilical palpation should be performed even in well-looking child complaining of abdominal pain, which may be due to herniation of the omentum.[2] Additionally, the shape of UH was associated with the clinical presentation. It means, the clinician could predict the occurrence of complications or symptoms based on the defect size and shape. Umbilical hernias with flat umbilicus should be operated early as they are mainly symptomatic.

RUS adversely affects the esthetic appeal of the umbilicus.[9,10] The degree of RUS is linked to the size of the fascial defect; the wider it is, the more

Table 3. Impact of UH morphology on clinical presentation

Clinical Presentation	Incarcerated *n* (%)	Simple *n* (%)	Symptomatic *n* (%)	*P*-value
Skin Colour				0.484 ‡
Normal	14 (11.6)	68 (56.2)	39 (32.2)	
Hyperchromic	0	14 (70)	6 (30)	
Hypochromic	0	2 (50)	2 (50)	
UH shape				0.026 ‡
Flat	0	5 (31.2)	11 (68.8)	
Conical	11 (15.7)	42 (60)	17 (24.3)	
Ovoidal	0	16 (66.7)	8 (33.3)	
Ellipsoidal	3 (12.5)	14 (58.3)	7 (29.2)	
Spherical	0	7 (63.6)	4 (36.4)	
Defect size				0.000 ‡
Small	8 (17.4)	15 (32.6)	23 (50)	
Medium	5 (8.8)	32 (56.1)	20 (35.1)	
Large	1 (2.4)	37 (88.1)	4 (9.5)	
RUS				<0.001 ‡
Absent	1 (2.9)	12 (35.3)	21 (61.8)	
0.5 – 1.5	7 (9)	53 (67.9)	18 (23.1)	
1.6 – 5	6 (18.2)	19 (57.6)	8 (24.2)	

RUS: Redundant umbilical skin, ‡ By Monte-Carlo Exact test

Table 4. Relationship between the shape of umbilical hernia and RUS

RUS	Absent *n* (%)	0.5-1.5 cm *n* (%)	1.6-5 cm *n* (%)
UH shape			
Flat	16 (100)	0	0
Conical	4 (7.1)	41 (58.6)	24 (34.3)
Ovoidal	1 (4.2)	15 (62.5)	8 (33.3)
Ellipsoidal	12 (50)	11 (45.8)	1 (4.2)
Spherical	0	11 (100)	0

‡- P-value calculated by Monte-Carlo Exact test is <0.0001
RUS: Redundant umbilical skin

abdominal viscera would pass through and cause stretching of the umbilical skin. Since the skin is elastic, RUS gets extended as long as the defect remains wide. This is reinforced by the observation that RUS is more common in simple UH, as symptomatic and incarcerated UH mainly occur in small and medium-size defects.[3] Concerning the cosmetic aspect, we believe that assessing RUS is as important as assessing the size of the fascial defect. Knowing the degree of RUS is essential in planning umbilicoplasty as to which technique to be used. Usually, an umbilicoplasty is needed if RUS exceeds 1.5 cm.[9] Based on that, spherical and ellipsoidal UH do not need umbilicoplasty, while a third of conical and ovoidal UH will need it. However, a definitive indication of umbilicoplasty should be made after the closure of fascial defect and tacking the dermis to the fascia during the UH repair. Some UH with considerable RUS may not finally require an umbilicoplasty after these steps.(Fig 5) Further, the long-term benefits of umbilicoplasty is still debatable as umbilicoplasty in UH with RUS uses flaps, which leave an additional scar and some additional complications such as surgical site infection, keloid, and stitch granuloma.[9] It is known that umbilical shape in children keeps varying up to adolescence and hence patient satisfaction with umbilical cosmesis after umbilicoplasty may also vary with age.[20]

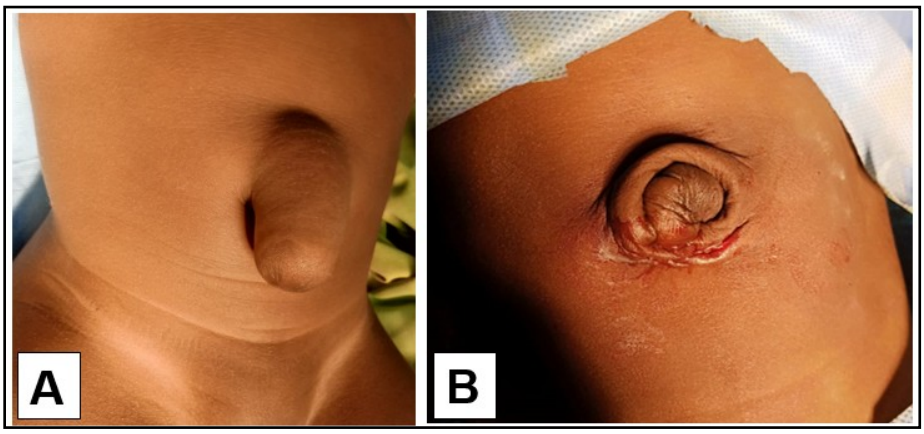

Fig 5. Cosmesis of umbilical hernia repair

(A) Presence of redundant umbilical skin may cause to consider the inevitability of an umbilicoplasty. However, (B) after fascial closure and dermis tacking to the fascia, redundant skin is less apparent, thereby obviating the need for umbilicoplasty.

Future studies must evaluate the subjective satisfaction of umbilical shape in children who underwent UH repair.

CONCLUSION

Morphology of UH in Senegalese children is dominated by medium-sized, conical shaped hernia with normal-looking overlying skin colour and RUS. In some children UH presented with a normal-looking umbilicus. This emphasizes the necessity of umbilical palpation in children complaining of recurrent abdominal pain. The defect size, umbilical shape, and extent of RUS were associated with the clinical presentation of UH.

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