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Original Research Article

Clinical, anthropometric, and intraoperative anatomical profile of adult inguinal hernia: A hospital-based cross-sectional study

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Abstract

Background: Inguinal hernia is a common surgical condition, yet detailed hospital-based data from Indian tertiary care centres examining clinical profile, anthropometric characteristics, and intraoperative anatomical findings remain limited. Understanding these factors is important for improving surgical planning and outcomes.

Objective: To study the clinical profile, anthropometric characteristics, and intraoperative findings in adult patients undergoing elective surgical repair of inguinal hernia at a tertiary care teaching hospital.

Materials and Methods: This descriptive cross-sectional hospital-based study was conducted over 12 months at R.G. Kar Medical College and Hospital, Kolkata. A total of 97 Adult patients aged 18–80 years admitted for elective inguinal hernia repair were selected using simple random sampling. Clinical details, anthropometric measurements, and intraoperative findings were recorded. Data were analysed using Chi-square tests, with $p < 0.05$ considered statistically significant.

Results: The mean age of patients was 47 ± 18.3 years, with a marked male predominance (96.9%). Most patients had a normal BMI (73.2%). Right-sided hernia (45.36%) and indirect inguinal hernia (73.2%) were the most common presentations. Posterior wall defects were observed in 26.8% of cases and were significantly associated with increasing age ($p < 0.001$). The mean deep inguinal ring diameter was 3.41 ± 1.18 cm. The majority of surgeries were completed without intraoperative difficulty.

Conclusion: Inguinal hernia predominantly affects adult males and is influenced by age-related anatomical changes. Indirect hernias are more common in younger patients, while direct hernias and posterior wall defects increase significantly with age. Intraoperative assessment of deep inguinal ring size and posterior wall integrity is important for guiding effective surgical repair.

Keywords: Inguinal hernia; Anthropometry, Body mass index, Deep inguinal ring, Posterior wall defect, Intraoperative findings

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1. Background

Inguinal hernia repair is one of the most commonly performed elective procedures in general surgery, with global estimates exceeding 20 million operations annually.[1] The burden of inguinal, femoral, and abdominal wall hernias continues to rise, particularly among older adults, reflecting demographic transitions, increasing life expectancy, and greater exposure to occupational and lifestyle-related risk factors. Despite advances in surgical techniques and prosthetic materials, inguinal hernia remains a significant cause of morbidity and healthcare utilization worldwide. A sound understanding of inguinal canal anatomy is fundamental to the safe and effective management of inguinal hernias.[2] The inguinal canal is an oblique passage within the lower abdominal wall, extending between the deep (internal) inguinal ring and the superficial (external) inguinal ring, with an average length of 4–6 cm in adults. The deep inguinal ring is a lateral defect in the transversalis fascia, while the superficial ring is a medial opening in the external oblique aponeurosis. The canal is bounded anteriorly by the external oblique aponeurosis and, laterally, by fibers of the internal oblique muscle; posteriorly by the transversalis fascia, extraperitoneal tissue, and conjoint tendon; superiorly by the arching fibers of the internal oblique and transversus abdominis; and inferiorly by the inguinal and lacunar ligaments. The spermatic cord in males and the round ligament in females traverse the canal along with associated neurovascular structures. The integrity of these anatomical components, particularly the posterior wall and inguinal rings, plays a critical role in preventing herniation. Inguinal hernias account for approximately 75% of all abdominal wall hernias and carry a lifetime risk of about 27% in men and 3% in women.[3] The marked male predominance has been attributed to inherent anatomical differences, delayed closure of the processus vaginalis, and greater exposure to factors that increase intra-abdominal pressure, such as heavy physical labor, chronic cough, and prostatic obstruction. Clinically, inguinal hernias are classified as indirect or direct based on their anatomical relationship to the inferior epigastric vessels and underlying pathophysiology. Indirect hernias are more common in younger individuals and are often congenital

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in origin, whereas direct hernias are typically acquired and associated with progressive weakening of the posterior wall of the inguinal canal. Morphometric studies of the inguinal canal have enhanced anatomical understanding but remain limited, particularly in live clinical settings. Cadaveric studies, such as that conducted by Kumar V et al have reported an average inguinal canal length of approximately 38 mm in males, with deep inguinal ring diameters ranging from 9 to 13 mm.[4] However, cadaver-based measurements may not accurately reflect intraoperative findings in patients with hernias, as dynamic factors such as muscle tone, tissue distension, and pathological enlargement of the inguinal rings are absent. Furthermore, Indian hospital-based studies correlating anthropometric parameters, such as body mass index, with intraoperative anatomical findings remain scarce. This study fills that void with a snapshot of the condition across a mixed urban-rural group from West Bengal. The findings could steer efforts to prevent hernias, fine-tune operative strategies, help teaching hospitals manage resources better, and lay groundwork for trials testing new repair methods. The present study was undertaken with an aim to study the clinical profile, anthropometric characteristics, and intraoperative findings in adult patients undergoing elective surgical repair of inguinal hernia at a tertiary care teaching hospital.

2. Materials and Methods

This descriptive cross-sectional hospital-based study was carried out over a period of 12 months in the Departments of Anatomy and Surgery at R.G. Kar Medical College and Hospital, Kolkata, a tertiary care teaching institution in West Bengal. Adult patients aged between 18 and 80 years, of either sex, who were admitted for elective surgical repair of inguinal hernia in the Department of Surgery were considered for inclusion. The sample size was calculated using the formula $4pq/l^2$, taking the prevalence of inguinal hernia as 69.28%, and after adding 10% to compensate for possible non-response, a final sample size of 97 patients was obtained. Participants were selected using a simple random sampling technique. Patients who declined consent, had a current history of communicable disease, or had any congenital deformity were excluded from the study. Prior to enrolment, written informed consent was obtained from all participants. Ethical clearance was granted by the Institutional Ethics Committee, and necessary permission was obtained from the Heads of the Departments concerned. A detailed clinical history was recorded for each participant, including age, gender, religion, place of residence, socioeconomic status, occupation, and any relevant past medical or surgical history. Intraoperative findings such as the type of inguinal hernia, surgical procedure performed, presence of posterior wall defects of the inguinal canal, and any technical difficulty encountered during surgery were also documented. Anthropometric measurements included height, weight, body mass index (BMI), and the size of the superficial inguinal ring. Height was measured using a stadiometer to the nearest centimeter with the patient standing barefoot in an erect posture, while weight was recorded to the nearest 500 grams using a calibrated dial-type weighing scale. All measurements were obtained preoperatively by the same observer to reduce inter-observer variation. BMI was calculated from height and weight and classified according to World Health Organization criteria using WHO AnthroPlus software. During surgery, the size of the superficial inguinal ring was measured under strict aseptic precautions by first assessing the circumference with a surgical suture material (silk or catgut), which was subsequently measured using a divider and metallic scale after adequate exposure of the inguinal canal and before mesh placement. Data were recorded on a predesigned and pretested data collection form prepared after an extensive review of relevant literature. The collected data were entered into Microsoft Excel 2016 and analysed using IBM SPSS version 26.0 Armonk, NY. Descriptive statistics were used to summarize the data, and the Chi-square test was applied to assess differences in proportions. A p-value of less than 0.05 was considered statistically significant.

3. Results

The mean age of the patients was 47 $\pm$ 18.3 years (range: 17–80 years), with the highest proportion belonging to the 18–30 year age group (29.9%), followed by those aged 46–60 years and above 60 years (27.8% each). The study population was predominantly male (96.9%). The mean body weight and height were 66.18 $\pm$ 8.37 kg and 1.71 $\pm$ 0.05 m, respectively, with a mean BMI of 22.6 $\pm$ 3.2 kg/m^2. Based on BMI classification, the majority of patients were within the normal range (73.2%), while 26.8% were overweight or obese. More than half of the participants belonged to the lower socioeconomic group (55.67%). Farmers constituted the largest occupational group (40.2%), followed by service personnel (20.6%), with smaller proportions comprising retired individuals, students, shopkeepers, and others. With respect to associated comorbidities, chronic obstructive pulmonary disease (22.7%) and benign prostatic hyperplasia (15.4%) were the most common, while 34.0% of patients had no documented comorbidity. (Table 1)

Right-sided inguinal hernia was slightly more common (45.36%) than left-sided hernia (43.3%), while 11.34% of patients had bilateral involvement. Indirect inguinal hernia constituted the majority of cases (73.2%), whereas direct hernia was observed in 26.8% of patients. A posterior wall defect of the inguinal canal was noted intraoperatively in 26.8% of cases. The diameter of the deep inguinal ring ranged from 1.5 to 6.0 cm, with a mean value of 3.41 $\pm$ 1.18 cm and a median of 3.5 cm. Most surgeries were completed without any intraoperative difficulty (95.9%); however, isolated findings such as sliding hernia, inflamed appendix, huge omentocele, and undescended testis were each encountered in one patient (1.0% each). (Table 2)

Table 3 demonstrates the association of age with gender distribution, hernia characteristics, and posterior wall integrity. Male predominance was observed across all age groups, with no statistically significant association between age and gender distribution ($p = 0.913$). The side of hernia (right, left, or bilateral) also did not vary significantly with age ($p = 0.559$). However, a statistically significant association was noted between age and type of

inguinal hernia, with indirect hernias being predominant in younger age groups and a progressive increase in direct hernias observed with advancing age, particularly among patients older than 60 years ($p < 0.001$). Similarly, posterior wall defects were significantly more common in the elderly population, with more than half of patients aged above 60 years exhibiting posterior wall laxity, indicating a strong age-related association ($p < 0.001$).

Although bilateral and right-sided hernias were more frequently observed among male patients, no statistically significant association was found between gender and hernia location ($p = 0.657$). Indirect inguinal hernia was the predominant type in both genders; however, all female patients presented with indirect hernias, while direct hernias were observed exclusively among males. Despite this observation, the association between gender and type of hernia did not reach statistical significance ($p = 0.287$). Similarly, posterior wall defects were observed only in male patients, but this difference was not statistically significant ($p = 0.287$). (Table 4)

The vast majority of surgeries were completed without any intraoperative difficulty, accounting for over 95% of cases in both genders. Rare intraoperative findings such as sliding hernia, inflamed appendix, huge omentocele, and undescended testis were observed exclusively among male patients, each constituting approximately 1% of cases. There was no statistically significant association between gender and the occurrence of intraoperative difficulties ($p = 0.998$), indicating comparable intraoperative outcomes across genders. (Table 5)

Table 1. *Demographic, anthropometric, socioeconomic, occupational characteristics and associated comorbidities of study participants (n = 97)*

Variable	Category	n (%) / Mean ± SD
Age (years)	Mean ± SD (Range)	47 ± 18.3 (17–80)
Age (years)	18–30 years	29 (29.9)
Age (years)	31–45 years	14 (14.4)
Age (years)	46–60 years	27 (27.8)
Age (years)	>60 years	27 (27.8)
Gender	Male	94 (96.9)
Gender	Female	3 (3.1)
Weight (kg)	Mean ± SD	66.18 ± 8.37
Height (m)	Mean ± SD	1.71 ± 0.05
BMI (kg/m^2)	Mean ± SD	22.6 ± 3.2
BMI Category	Normal	71 (73.2)
BMI Category	Overweight / Obese	26 (26.8)
Socioeconomic Status	Low	54 (55.67)
Socioeconomic Status	Middle	43 (44.33)
Occupation	Farmers	39 (40.2)
Occupation	Service personnel	20 (20.6)
Occupation	Retired	8 (8.2)
Occupation	Students	8 (8.2)
Occupation	Shopkeepers	7 (7.2)
Occupation	Others	15 (15.6)
Associated Comorbidities	COPD	22 (22.7)
Associated Comorbidities	Benign prostatic hyperplasia	15 (15.4)
Associated Comorbidities	Diabetes mellitus	9 (9.3)
Associated Comorbidities	Chronic cough	6 (6.2)
Associated Comorbidities	Obesity	6 (6.2)
Associated Comorbidities	No comorbidity	33 (34.0)

Table 2. *Hernia characteristics, deep inguinal ring morphometry and intraoperative findings (n = 97)*

Parameter	Category	n (%) / Value
Side of Inguinal Hernia	Right	44 (45.36)
Side of Inguinal Hernia	Left	42 (43.3)
Side of Inguinal Hernia	Bilateral	11 (11.34)
Type of Hernia	Indirect	71 (73.2)
Type of Hernia	Direct	26 (26.8)
Posterior Wall Defect	Present	26 (26.8)
Posterior Wall Defect	Absent	71 (73.2)
Deep Inguinal Ring Diameter (cm)	Range	1.5 – 6.0
Deep Inguinal Ring Diameter (cm)	Mean ± SD	3.41 ± 1.18
Deep Inguinal Ring Diameter (cm)	Median	3.5
Intraoperative Findings	No difficulty	93 (95.9)
Intraoperative Findings	Sliding hernia	1 (1.0)
Intraoperative Findings	Inflamed appendix	1 (1.0)
Intraoperative Findings	Huge omentocele	1 (1.0)
Intraoperative Findings	Undescended testis	1 (1.0)

Table 3. *Association of age group with gender, hernia characteristics, and posterior wall defect (n = 97)*

Variable	Category	15–30 yrs (n=29)	31–45 yrs (n=14)	46–60 yrs (n=27)	>60 yrs (n=27)	p value
Gender	Female	1 (3.4)	0 (0.0)	1 (3.7)	1 (3.7)	0.913
Gender	Male	28 (96.6)	14 (100)	26 (96.3)	26 (96.3)	0.913
Hernia location	Bilateral	3 (10.3)	0 (0.0)	5 (18.5)	3 (11.1)	0.559
Hernia location	Left	10 (34.5)	7 (50.0)	12 (44.4)	13 (48.1)	0.559
Hernia location	Right	16 (55.2)	7 (50.0)	10 (37.0)	11 (40.7)	0.559
Type of hernia	Direct	2 (6.9)	1 (7.1)	6 (22.2)	17 (63.0)	<0.001
Type of hernia	Indirect	27 (93.1)	13 (92.9)	21 (77.8)	10 (37.0)	<0.001
Posterior wall defect	Present	2 (6.9)	3 (21.4)	5 (18.5)	16 (59.3)	<0.001
Posterior wall defect	Absent	27 (93.1)	11 (78.6)	22 (81.5)	11 (40.7)	<0.001

Table 4. *Association of gender with hernia characteristics and posterior wall defect (n = 97)*

Variable	Category	Female (n=3)	Male (n=94)	p value
Hernia location	Bilateral	0 (0.0)	11 (11.7)	0.657
Hernia location	Left	2 (66.7)	40 (42.6)	0.657
Hernia location	Right	1 (33.3)	43 (45.7)	0.657
Type of hernia	Direct	0 (0.0)	26 (27.7)	0.287
Type of hernia	Indirect	3 (100.0)	68 (72.3)	0.287
Posterior wall defect	Present	0 (0.0)	26 (27.7)	0.287
Posterior wall defect	Absent	3 (100.0)	68 (72.3)	0.287

Table 5: Intraoperative findings according to gender (n = 97)

Table 5

Intraoperative finding	Female n (%)	Male n (%)	Total
No difficulty	3 (100.0)	90 (95.7)	93
Inflamed appendix	0 (0.0)	1 (1.1)	1
Huge omentocele	0 (0.0)	1 (1.1)	1
Sliding hernia	0 (0.0)	1 (1.1)	1
Undescended testis	0 (0.0)	1 (1.1)	1

Chi-square = 0.133, df = 4, p = 0.998 (Not significant)

4. Discussion

In the present study, the mean age of patients was 47 years, with a notable representation in the 18–30, 46–60, and above 60-year age groups. This age pattern is in keeping with observations from several Indian studies, where inguinal hernia has been shown to occur most commonly in middle and older age groups. Agarwal[5] (2023) reported that nearly two-fifths of patients were older than 50 years, while Bhavikatti et al.[6] identified the highest incidence in the 46–60-year age bracket. Similarly, Bidwai[7] (2026) documented a mean age of 44.87 years, suggesting that the disease predominantly affects individuals during the most economically active phase of life. The cumulative effect of physical strain over time, along with age-related weakening of the abdominal wall, likely explains this trend. A marked male predominance was observed in the current study, with males accounting for 96.9% of cases. This finding closely parallels those of Agarwal,[5] Kumar D et al,[8] Bhavikatti et al[6] and all of whom reported male proportions exceeding 90%. The striking gender disparity has been consistently attributed to anatomical differences in the inguinal region and greater exposure of men to risk factors such as heavy physical work. In the present cohort, farmers and service personnel constituted the majority of patients, occupations that typically involve prolonged standing, lifting, or exertion. Comparable occupational trends were reported by Kumar D et al.[8] where agriculturists formed the largest group. Agarwal5 also identified lifting heavy weights as the most common precipitating factor. Together, these findings reinforce the role of sustained increases in intra-abdominal pressure in the development of inguinal hernia. Medical conditions known to contribute to raised intra-abdominal pressure were frequently encountered in this study. Chronic obstructive pulmonary disease and chronic cough were present in a substantial proportion of patients. Similar associations have been reported by Agarwal5 and Bhavikatti et al[6] both of whom identified respiratory illnesses and smoking as important risk factors. Bhavikatti et al.[6] further noted that smoking, chronic cough, and heavy manual labor were significantly associated with postoperative complications, underscoring the clinical relevance of identifying and addressing these factors during preoperative evaluation. Regarding laterality, right-sided hernias were marginally more common than left-sided hernias in the present study, with bilateral involvement seen in 11.34% of patients. Right-side predominance has been a consistent finding across multiple studies, including those by Agarwal,[5] Bhavikatti et al,[6] Kumar D et al,[8] and Krishan et al.[9] The higher incidence on the right side is commonly attributed to delayed descent of the right testis, later closure of the processus vaginalis and bowel–mesenteric attachments that favor herniation toward the right groin.[10–12] The relatively higher proportion of bilateral hernias observed in this study compared to some earlier reports may be related to the inclusion of older patients, in whom generalized weakening of the posterior wall is more likely. Indirect inguinal hernia was the most frequent type encountered, accounting for 73.2% of cases. This observation is in agreement with findings from Agarwal,[5] Kumar D et al[8] and Bhavikatti et al6 all of whom reported indirect hernias

as the predominant type. A significant association between age and hernia type was noted in the present study, with indirect hernias being more common in younger patients and a progressive increase in direct hernias with advancing age. This pattern reflects age-related degeneration of the posterior wall and supports the widely accepted concept that direct hernias are largely acquired in nature. Assessment of deep inguinal ring morphology revealed a mean diameter of 3.41 cm in the present study. This measurement is larger than those reported in cadaveric studies and earlier clinical series. Kumar V et al4 documented considerably smaller dimensions in cadaveric specimens, while Anitha et al.[13] reported mean diameters of approximately 2.36 cm in live patients. The larger ring diameter observed in this study likely reflects pathological dilatation secondary to chronic herniation and prolonged raised intra-abdominal pressure, highlighting the limitations of extrapolating cadaveric measurements to clinical practice. Posterior wall defects were identified in over one-quarter of patients, with a strong association with increasing age. More than half of patients above 60 years demonstrated posterior wall laxity. This finding aligns with Desarda's physiological observations,[14] which emphasize the central role of posterior wall weakness in the development of inguinal hernia. According to this concept, loss of muscle tone and failure of the dynamic shutter mechanism of the inguinal canal predispose to herniation, particularly in elderly individuals. The present findings support this theory and help explain the higher incidence of direct hernias in older patients. Mesh selection remains a critical determinant of long-term surgical success. Given the significant deep inguinal ring dilatation and posterior wall defects observed in this study, the use of adequately sized mesh becomes essential. Recommendations for larger mesh sizes, as advocated by Anitha et al.[13] are particularly relevant in view of postoperative mesh shrinkage and the need to cover the entire myopectineal orifice to minimize recurrence. Most surgeries in the present study were completed without intraoperative difficulty. Uncommon findings such as sliding hernia, Amyand's hernia, large omentoceles, and undescended testis were encountered infrequently and exclusively in male patients. Although rare, these findings are well-documented in the literature and reflect the wide spectrum of presentations associated with inguinal hernia. The absence of major intraoperative challenges in the majority of cases underscores the effectiveness of careful preoperative assessment and standardized surgical technique. The present study has several strengths. It was conducted in a tertiary care teaching hospital with standardized surgical practices, allowing for uniform intraoperative assessment of hernia characteristics. The use of random sampling, clearly defined inclusion and exclusion criteria, and measurements taken by a single observer minimized selection and inter-observer bias. Additionally, the intraoperative assessment of deep inguinal ring size and posterior wall integrity provides objective anatomical data that are not routinely documented in many clinical studies. However, certain limitations must be acknowledged. The study was hospital-based and cross-sectional in design, which limits the generalizability of the findings to the wider community. The relatively small sample size and marked male predominance restrict meaningful subgroup analysis, particularly among female patients.

5. Conclusion

The present study demonstrates that inguinal hernia predominantly affects adult males, with indirect hernias being more common in younger individuals and a significant increase in direct hernias and posterior wall defects with advancing age. Right-sided involvement was slightly more frequent, while bilateral hernias were more commonly observed in older patients. The findings highlight a clear association between age and posterior wall laxity, emphasizing the role of age-related anatomical weakening in the development of inguinal hernia. Measurement of the deep inguinal ring revealed considerable variability, underscoring the importance of intraoperative anatomical assessment during hernia repair.

6. Source of Funding

None.

7. Conflict of Interest

None.

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