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Original Research Paper

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ROLE OF LOW-LYING PUBIC TUBERCLE IN THE DEVELOPMENT OF INGUINAL HERNIA

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ABSTRACT

Background & Objectives: Inguinal hernia is among the most common conditions requiring elective general surgical intervention, yet the contribution of skeletal pelvic morphology to individual susceptibility remains incompletely characterised. The pubic tubercle serves as the medial anchor of the inguinal ligament; its vertical position determines the obliquity of the ligament and, consequently, the mechanical configuration of the inguinal floor. This study aimed to determine the relationship between a low-lying pubic tubercle and the development of inguinal hernia, to evaluate the clinical profile of patients with inguinal hernia, and to determine the pubo-spinal distance (Ami's Line) and its association with inguinal hernia. **Methods:** A prospective observational study was conducted at Kanachur Institute of Medical Sciences, Mangalore over 18 months. Sixty consecutive patients aged ≥18 years presenting with uncomplicated inguinal hernia and scheduled for surgical repair were enrolled. The pubo-spinal distance (Ami's Line) was measured both clinically and radiologically. Radoievitch's Angle was used to assess pelvic inclination. Measurements were compared against published normative reference values (Garg et al., n=70 non-hernia controls). Statistical analysis included Kruskal-Wallis test, one-sample t-test, Pearson correlation, and Bland-Altman analysis. Statistical significance was set at $p < 0.05$. **Results:** The mean patient age was 52.1 ± 12.9 years; 95% were male. Right-sided hernias were most prevalent (45.0%). Indirect hernia was the most common subtype (43.3%), followed by direct hernia (40.0%). All three primary anatomical measurements differed significantly from published normal population values: Ami's Line (Clinical) was elevated by +0.527 cm ($p<0.001$), Ami's Line (Radiological) by +0.723 cm ($p<0.001$), and Radoievitch's Angle was reduced by 7.41° ($p<0.001$). Radoievitch's Angle varied significantly across hernia subtypes (Kruskal-Wallis $p=0.031$), with direct hernia patients recording the lowest mean values. Clinical and radiological Ami's Line measurements showed excellent concordance ($r=0.974$, $p<0.001$). **Conclusion:** Patients with inguinal hernia demonstrate a measurably abnormal pelvic configuration characterised by a low-lying pubic tubercle and reduced pelvic inclination compared to the normal population. Radoievitch's Angle differed significantly across hernia subtypes, being lowest in direct hernias. Clinical examination is a reliable method for assessing pubic tubercle position. These findings support the incorporation of pelvic morphological assessment into inguinal hernia evaluation and highlight low-lying pubic tubercle as a potential anatomical risk factor for hernia development.

KEYWORDS : Inguinal Hernia, Pubic Tubercle, Ami's Line, Pubo-spinal distance, Radoievitch's Angle, Pelvic Morphology, Hernia aetiology

INTRODUCTION

Inguinal hernia is one of the most prevalent surgical conditions worldwide, with approximately 27% of men estimated to develop the condition during their lifetime [1]. Anatomically, an inguinal hernia represents a failure of the fibromuscular inguinal floor to contain intra-abdominal contents, manifesting as a protrusion through the inguinal canal or directly through Hesselbach's triangle [2]. The aetiology of inguinal hernia is multifactorial, encompassing known risk factors such as male sex, advancing age, chronic raised intra-abdominal pressure, connective tissue disorders, and a positive family history [3].

The pubic tubercle is the medial attachment of the inguinal ligament, which forms the floor of the inguinal canal. The vertical position of the pubic tubercle relative to the interspinal line — a parameter quantified as Ami's Line or the pubo-spinal distance — directly determines the obliquity of the inguinal ligament. A low-lying pubic tubercle flattens the inguinal ligament, rendering the inguinal floor more horizontal and theoretically increasing its susceptibility to herniation by compromising the shutter mechanism of the inguinal canal [4].

Radoievitch's Angle, a measure of pelvic inclination, provides a complementary assessment of pelvic orientation that may influence intra-abdominal pressure transmission to the inguinal region. Despite the theoretical plausibility of these relationships, robust prospective data correlating pelvic skeletal morphology with inguinal hernia development remains limited. The present study was designed to address this gap by prospectively measuring Ami's Line and Radoievitch's Angle in a cohort of patients with surgically confirmed inguinal hernia and comparing these values to established normative references.

AIMS AND OBJECTIVES

Aim: To evaluate the role of a low-lying pubic tubercle in the development of inguinal hernia.

Specific Objectives:

1. To evaluate the clinical profile of patients presenting with inguinal hernia.
2. To determine the pubo-spinal distance (Ami's Line) and its association with inguinal hernia using clinical and radiological measurement.
3. To assess pelvic inclination (Radoievitch's Angle) across inguinal hernia subtypes.

MATERIALS AND METHODS

Study Design and Setting: Prospective observational study conducted in the Department of General Surgery, Kanachur Institute of Medical Sciences (KIMS), Natekal, Mangalore — a tertiary care teaching hospital. Study duration was 18 months following Institutional Ethics Committee approval.

Participants: Sixty consecutive patients aged 18 years or above with uncomplicated inguinal hernia who provided written informed consent were enrolled. Patients were excluded if the hernia was complicated by hydrocele, undescended testis, irreducibility, strangulation, obstruction, or abdominopelvic mass altering pelvic anatomy, or if there was a history of pelvic fracture, pelvic surgery, or congenital pelvic anomaly.

Measurements: All patients were assessed supine on a firm surface with legs fully extended. The interspinal line (SS line)

was marked connecting both anterior superior iliac spines. The perpendicular distance from the palpated pubic tubercle on the hernia side to the SS line was measured in centimetres — this is Ami's Line (ST line). The same measurement was obtained radiologically. Radoievitch's Angle was measured to assess pelvic inclination. All data were recorded on a standardised proforma.

Statistical Analysis: Data were analysed using SPSS version 17. Continuous variables are expressed as mean ± SD. One-sample t-tests compared hernia patients against published normative values (Garg et al., n=70 non-hernia controls; Ami's Line reference 7.27 cm; Radoievitch's Angle reference 40.91°). Kruskal-Wallis test assessed differences across hernia subtypes. Pearson correlation and Bland-Altman analysis assessed clinical vs radiological agreement. Chi-square and one-way ANOVA were used for categorical and group comparisons. Statistical significance was set at $p < 0.05$.

RESULTS

Sixty patients were enrolled. The mean age was 52.1 ± 12.9 years (range 18–74 years). Male patients accounted for 95.0% (n=57). Right-sided hernias were most prevalent (45.0%, n=27), followed by left-sided (28.3%, n=17) and bilateral (26.7%, n=16). Indirect hernia was the most common subtype (43.3%, n=26), followed by direct hernia (40.0%, n=24); pantaloon and mixed types accounted for the remaining 16.7%. The median symptom duration before presentation was 7 months (range 1–96 months).

Table 1: Demographic and Clinical Profile (n = 60)

Characteristic	Category	n (%)
Mean Age (years)	52.1 ± 12.9	Range: 18–74
Sex	Male	57 (95.0%)
	Female	3 (5.0%)
Side of Hernia	Right	27 (45.0%)
	Left	17 (28.3%)
	Bilateral	16 (26.7%)
Hernia Subtype	Indirect	26 (43.3%)
	Direct	24 (40.0%)
	Pantaloon / Mixed	10 (16.7%)
Median Symptom Duration	7 months	Range: 1–96 months

Table 2: Ami's Line and Radoievitch's Angle — Hernia Patients vs Normal Population Reference Values

Measurement	Hernia Mean ± SD	Normal Reference	Difference	p value
Ami's Line Clinical (cm)	7.797 ± 1.09	7.27 cm	+0.527	<0.001 ★
Ami's Line Radiological (cm)	7.993 ± 1.07	7.27 cm	+0.723	<0.001 ★
Radoievitch's Angle (°)	33.50 ± 6.84	40.91°	−7.41	<0.001 ★

★ $p < 0.001$. Normal reference values from Garg et al. (PMC8842645), n=70 non-hernia controls. One-sample t-test; robust to non-normality at n=60 by Central Limit Theorem.

Table 3: Radoievitch's Angle Across Hernia Subtypes (Kruskal-Wallis Analysis)

Hernia Subtype	n	Mean Angle (°)	Median (°)	p value
Indirect	26	35.2	35.0	★
Direct	24	31.4	31.0	★
Pantaloon / Mixed	10	34.1	34.5	★
Overall (Kruskal-Wallis)	60	33.5 ± 6.84	H = 8.88	0.031★

★ $p < 0.05$. Direct hernia patients consistently recorded the lowest Radoievitch's Angle values across all subgroups.

Table 4: Clinical vs Radiological Ami's Line — Agreement Analysis

Statistic	Value	Interpretation
Pearson Correlation (r)	0.974	Excellent concordance
p value	< 0.001	Highly significant
Bland-Altman Mean Bias	+0.197 cm	Radiological > Clinical
Limits of Agreement	−0.001 to +0.394 cm	Narrow; clinically acceptable

Clinical examination is a valid and reliable substitute for radiological measurement for assessing pubic tubercle position.

Table 5: Statistical Power and Effect Size Summary

Measurement	Cohen's d / H	Power (n=60)	Significance
Ami's Line Clinical vs Normal	d = 0.483	~80%	p < 0.001
Ami's Line Radiological vs Normal	d = 0.677	~93%	p < 0.001
Radoievitch's Angle vs Normal	d = 1.082	>99%	p < 0.001
Radoievitch's Angle across subtypes	H = 8.88	Adequate	p = 0.031

DISCUSSION

The present study investigated the role of pelvic skeletal morphology in the aetiology of inguinal hernia by prospectively assessing Ami's Line and Radoievitch's Angle in sixty patients with surgically confirmed inguinal hernia. The results provide robust evidence that patients with inguinal hernia exhibit a measurably distinct pelvic configuration compared to the normal population, characterised by a lower-lying pubic tubercle and reduced pelvic inclination.

All three primary anatomical measurements differed significantly from published normative reference values. Ami's Line (Clinical) was elevated by +0.527 cm ($p<0.001$) and Ami's Line (Radiological) by +0.723 cm ($p<0.001$), confirming that the pubic tubercle lies more inferiorly in hernia patients relative to the interspinal plane. A low-lying pubic tubercle flattens the inguinal ligament, reducing the obliquity of the inguinal canal. This geometrical change diminishes the efficacy of the shutter mechanism — whereby contraction of the internal oblique and transversus abdominis muscles narrows the canal from above — thereby increasing mechanical stress on the inguinal floor and predisposing to herniation [4,5].

Radoievitch's Angle was reduced by 7.41° in hernia patients compared to published controls ($p<0.001$), indicating a flatter, more anteriorly inclined pelvis. This pelvic configuration may alter the direction and magnitude of intra-abdominal pressure transmission to the inguinal region. Critically, Radoievitch's Angle differed significantly across hernia subtypes (Kruskal-Wallis H=8.88, p=0.031), with direct hernia patients recording the lowest mean values. This is consistent with the hypothesis that a more horizontal pelvic orientation disproportionately weakens the posterior inguinal wall (Hesselbach's triangle), the site of direct herniation [6].

The clinical profile of this cohort — male predominance (95%), peak incidence in the 41–60 year age group, right-sided predominance, and indirect hernia as the most common subtype — is consistent with established epidemiological data and further validates the study population [7,8]. The right-sided preponderance likely reflects the later descent of the right testis and the consequent prolonged patency of the right processus vaginalis during foetal development.

The strong agreement between clinical and radiological measurement of Ami's Line (r=0.974, $p<0.001$; Bland-Altman bias +0.197 cm with narrow limits of agreement) confirms that clinical palpation of the pubic tubercle is a reliable and practical method for this assessment, eliminating the need for

routine imaging in the preoperative anatomical evaluation of hernia patients [9].

Limitations

The sample of sixty patients limits statistical power for subgroup analyses, particularly for the pantaloon and mixed hernia subtypes. Single-institution recruitment may affect generalisability. Clinical landmark measurement is subject to inter-observer variability. The cross-sectional design allows identification of associations but cannot establish causality. A larger multicentre prospective study involving at least 250 patients is recommended to confirm these findings.

CONCLUSION

This study demonstrates that patients with inguinal hernia have a measurably abnormal pelvic configuration compared to the normal population, characterised by a significantly low-lying pubic tubercle (Ami's Line elevated by +0.527 cm clinically and +0.723 cm radiologically, $p<0.001$) and reduced pelvic inclination (Radoievitch's Angle reduced by 7.41°, $p<0.001$). Radoievitch's Angle differed significantly across hernia subtypes ($p=0.031$), with direct hernias associated with the lowest values, supporting a mechanical role for pelvic morphology in determining the pattern of herniation.

Clinical examination is a valid and reliable alternative to radiological measurement for assessing pubic tubercle position ($r=0.974$). These findings support the role of pelvic skeletal architecture as an anatomical risk factor for inguinal hernia development. Systematic preoperative measurement of Ami's Line and Radoievitch's Angle may enrich hernia risk stratification. Multicentre prospective trials with extended follow-up are recommended to validate these associations and explore their clinical applications.

REFERENCES

[1] Kingsnorth A, LeBlanc K. Hernias: inguinal and incisional. Lancet. 2003;362(9395):1561–1571.
[2] Fitzgibbons RJ Jr, Forse RA. Groin hernias in adults. N Engl J Med. 2015;372 (8):756–763.
[3] Ruhl CE, Everhart JE. Risk factors for inguinal hernia among adults in the US population. Am J Epidemiol. 2007;165(10):1154–1161.
[4] Anson BJ, Morgan EH, McVay CB. Surgical anatomy of the inguinal region based upon a study of 500 body-halves. Surg Gynecol Obstet. 1960;111:707–725.
[5] Liem MS, van der Graaf Y, Beemer FA, van Vroonhoven TJ. Increased risk for inguinal hernia in patients with Ehlers-Danlos syndrome. Surgery. 1997;122 (1):114–115.
[6] Garg PK, Bhatt SP. Role of pubic tubercle in the development of inguinal hernia. PubMed Central PMC8842645. J Surg Res. 2022.
[7] Burcharth J, Pedersen M, Bisgaard T, Pedersen C, Rosenberg J. Nationwide prevalence of groin hernia repair. PLoS One. 2013;8(1):e54367.
[8] Primatesta P, Goldacre MJ. Inguinal hernia repair: incidence of elective and emergency surgery, readmission and mortality. Int J Epidemiol. 1996;25(4):835–839.
[9] Skandalakis JE, Colborn GL, Androulakis JA, et al. Embryologic and anatomic basis of inguinal herniorrhaphy. Surg Clin North Am. 1993;73(4):799–836.
[10] Stoppa RE. The treatment of complicated groin and incisional hernias. World J Surg. 1989;13(5):545–554.