Surgery Section

Calibre of the External Urethral Meatus in Indian Population: A Cross-sectional Study

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ABSTRACT

Introduction: Transurethral resection instruments are designed as per western standards and are often found to be larger for Indian patients, leading to urethral trauma during instrumentation or higher incidence of urethral strictures postoperatively.

Aim: To assess and record the calibre of the External Urethral Meatus (EUM) among Indian male and female population.

Materials and Methods: This cross-sectional study was done at a tertiary health care centre over a period of one and half years from July 2016 to December 2017. All male and female patients above the age of 12 years undergoing lower urinary tract instrumentation at the institute underwent assessment for EUM calibre. A total of 1,127 males and 182 females were enrolled in the study. Descriptive statistics (mean, Standard Deviation, and range) were performed for age, height and the EUM in males and females. Linear regression analysis was used to analyse

the correlation between EUM calibre and age; and EUM calibre and body height. The correlation was considered statistically significant when $p < 0.05$.

Results: The mean EUM calibre of the male population was observed to be 23.23±1.60 Fr (French scale) and that of the female population was 23.58±2.00 Fr. On linear regression analysis, a significant but weak correlation was found between EUM calibre and body height in male (R^2 value: 0.024, p-value <0.0001). On the other hand, no correlation was observed between EUM calibre and body height in females (R^2 value: 0.009, p-value=0.196).

Conclusion: The average calibre of the EUM in Indian males was 23.23 Fr which is about 3 Fr smaller than the standard transurethral resectoscope sheath. Thus, use of larger sized sheaths may result in urethral stricture in narrow calibre urethra.

INTRODUCTION

The EUM is the doorway to all instrumentation of the lower urinary tract and its calibre is an important factor while introducing any instrument [1]. Western literature and western standards have been used in designing instruments throughout surgical practice including urology [2]. These instruments are often found to be of a larger calibre for the Indian population leading to tissue trauma or an inability to perform a particular procedure with a particular instrument [1,2]. Inter-racial differences in the calibre of the EUM have not been defined. EUM calibre in paediatric males, its growth with age and its application to hypospadias repair has been well-defined [1-3]. Data pertaining to adult EUM calibre is scarce [1-6]. Hence, the present study was conducted with an aim to document the EUM calibre, in the French scale, in the Indian male and female population. This would then help to devise endourology instruments more suitable to our population to reduce urethral trauma and the subsequent decrease in incidence of urethral strictures.

MATERIALS AND METHODS

This cross-sectional study was conducted at Lokmanya Tilak Municipal Medical College and General Hospital, Mumbai, Maharashtra, India, from July 2016 to December 2017. Valid, written informed consent was taken of all patients who participated in the study. The study was approved by the Institutional Ethics Committee (IEC) (Serial No. IEC/114/16).

The calibre of the EUM in male and female patients undergoing lower urinary tract instrumentation were measured.

Inclusion criteria: All male and female patients above the age of 12 years undergoing per urethral instrumentation for diagnostic and/or therapeutic purpose were included in the study. Only those males who had undergone circumcision in the first year of life were included in the group of circumcised males.

Exclusion criteria: The exclusion criteria were patients with indwelling urethral catheter, balanitis xerotica obliterans, hypospadias, epispadias, patients with prior history of per urethral instrumentation and those undergoing surgical procedure on the urethra.

Study Procedure

A stainless steel urethral meatal calibrator (Kalelkar Surgical, Mumbai, India) was inserted per urethra under aseptic precautions and with adequate lubrication (2% lignocaine jelly) after the local parts had been prepared for the planned endoscopic procedure. This calibrator was in the shape of an elongated cone with serial graduations on it, which were marked in the French scale from 15-30 Fr [Table/Fig-1]. For males, the calibrator was inserted per EUM and allowed to pass under gravity and the mark on the calibrator at the level of the EUM was noted as the EUM calibre. For females, the calibrator was passed per EUM until a point where early blanching of the EUM mucosa occurred and at that point, the mark on the calibrator at the EUM was recorded as the EUM calibre. On instances

[Table/Fig-1]: Stainless steel urethral meatal calibrator (Kalelkar Surgical, Mumbai, India).

where the EUM lay between two graduations on the calibrator, the smaller mark was noted as the EUM calibre.

Height and weight of the patients were also recorded. For male patients a note was also made of whether they had undergone circumcision. A total of 1,127 males and 182 females were studied. This unequal gender distribution was observed since predominant population of patients undergoing surgery in Department of Urology were males.

STATISTICAL ANALYSIS

Descriptive statistics (mean, Standard Deviation (SD), and range) were performed for age, height and the EUM in males (overall, circumcised and uncircumcised) and females. The mean EUM calibre in circumcised and non circumcised males was compared with the unpaired t-test. Linear regression analysis was used to analyse the correlation between EUM calibre and age; and EUM calibre and body height. The correlation was considered statistically significant when p<0.05. Nomograms for male and female EUM calibres were prepared using the ggplot2 package in R software (Version: 3.3.6).

RESULTS

The study included 1127 males and 182 females, 400 of the males were circumcised and 727 were not. The mean age of the male and female participants was 45.54±17.39 and 41.69±16.33 respectively [Table/Fig-2].

Variables	Males (mean±SD)	Females (mean±SD)
Age (years)	45.54±17.39	41.69±16.33
Height (m)	1.63±0.06	1.52±0.08
Weight (kg)	60.62±11.4 9	56.27±9.67
BMI (kg/m²)	22.60±.83	24.19±3.77

[Table/Fig-2]: Demographic details of the study population.

The mean EUM calibre of the male and female participants was 23.23±1.60 and 23.58±2.00 respectively. The difference between the mean EUM in circumcised males compared to non circumcised males was statistically significant (p<0.001) [Table/Fig-3]. The mean EUM calibre in different age groups in both males and females is shown in [Table/Fig-4].

Group	N	Mean EUM calibre (Fr)
All males	1127	23.23±1.60
Circumcised males	400	22.82±1.72
Non circumcised males	727	23.45±1.48
		p<0.001¥
Females	182	23.58±2.00

[Table/Fig-3]: EUM calibre of males and females.
¥=unpaired t-test; A p-value <0.05 is considered to be statistically significant

| Age group (yrs)	n		Mean EUM calibre (Fr)	
	Males	Females	Males	Females
13-15	3	7	22.66±1.25	24.85±1.46
16-20	50	11	23.25±1.45	23.61±2.80
21-30	263	32	23.07±1.40	23.00±1.64
31-40	206	49	23.46±1.49	23.43±1.92
41-50	134	12	23.17±1.64	23.50±2.33
51-60	194	42	23.23±1.87	24.43±1.85
61-70	201	20	23.29±1.66	23.70±1.35
71-80	76	9	23.10±1.76	23.00±2.05
Total	1127	182	23.23+1.60	23.58±2.00

[Table/Fig-4]: EUM calibre in different age groups.

[Table/Fig-5] shows the percentages of patients with different EUM calibres in males and females. Nomograms for the male and female

populations is shown in [Table/Fig-6] and [Table/Fig-7] respectively. On linear regression analysis, a significant but weak correlation was found between EUM calibre and body height in males (R^2 value=0.024, p<0.0001). There was no significant correlation between EUM calibre and body height in females (R^2 value=0.009, p-value=0.196); or between EUM calibre and age in either sex [Table/Fig-8].
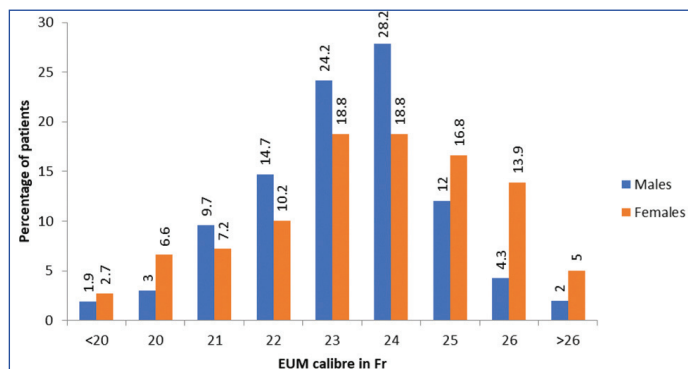
[Table/Fig-5]: Percentage of patients with different EUM calibres in males and females.
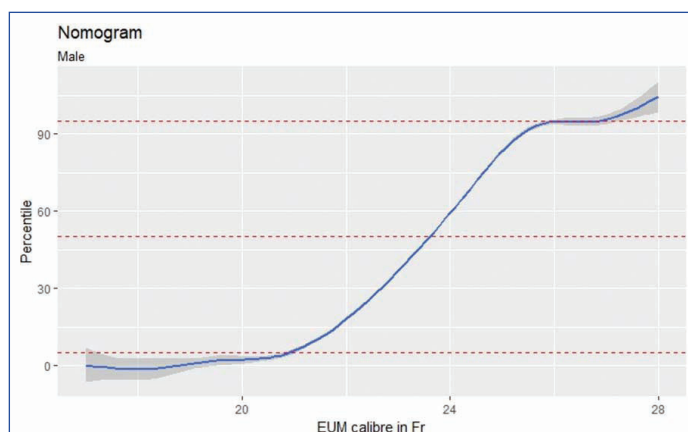
[Table/Fig-6]: Nomograms of EUM calibre in the male population (The red lines indicate the 5th, 50th and the 95th centiles).
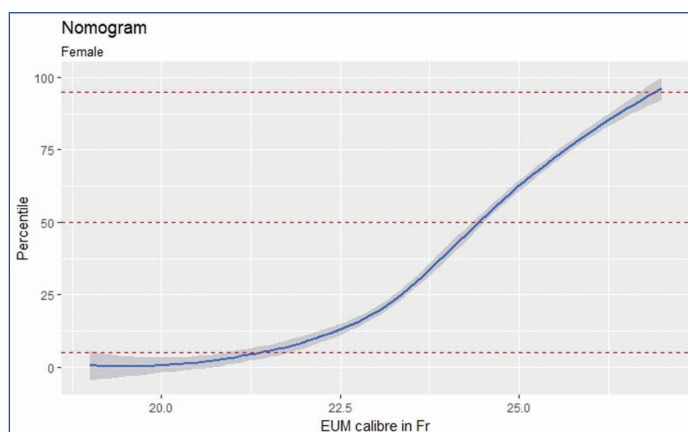
[Table/Fig-7]: Nomograms of EUM calibre in the female population (The red lines indicate the 5th, 50th and the 95th centiles).

Variable correlated with EUM calibre	Correlation coefficient (95% Confidence interval)	p-value
Males		
Age	-0.008 (-0.066-0.051)	0.796
Height	0.156 (0.098-0.214)	<0.0001
Females		
Age	0.116 (-0.031-0.263)	0.120
Height	-0.097 (-0.244-0.050)	0.196

[Table/Fig-8]: Correlations between EUM calibre and age and body height in males and females.

Also, 559 of the 605 males (92.4%) and 60 of the 82 females (73.2%) above the age of 40 years had an EUM calibre of less than 26 Fr which is the calibre of the standard Trans urethral resection (TUR) sheath used for Transurethral Resection of the Prostate (TURP) and bladder masses.

DISCUSSION

The earliest work on EUM calibre was done by Thompson R in 1918 wherein he reported the mean EUM calibre in inches in male patients of different age groups and also described different shapes of the EUM [5]. Since then, there have been a lot of studies regarding EUM calibre in the paediatric age group; but data regarding EUM calibre in the adult males and females is scarce [1-6]. [Table/Fig-9] shows the summary of available literature on calibre of EUM in adult and paediatric population [4-7].

Authors	Publication year	Gender and number	Location	Mean EUM
Thompson R [5]	1918	Male: 135	London, United Kingdom	26.67 Fr
Berry CD and Cross RR [7]	1956	Male: 200	Illionis, United State	Mean EUM not measured, Circumcised males had smaller EUM calibre compared to non circumcised males
Chang YL et al., [4]	2010	Female: 23	Taipei, Taiwan	23.7±1.9 Fr
Bhat GS et al., [6]	2014	Male: 304	Bangalore, India	28.49±3.06 Fr
Present study	2022	Male: 1127 Female: 182	Mumbai, India	Male: 23.23±1.60 Female: 23.58±2.00 Circumcised males had smaller EUM calibre compared to non circumcised males

[Table/Fig-9]: Table showing comparison of our study with published literature [4-7].

According to Thompson's study on males (1918, London, United Kingdom, N=135) the mean EUM length when measured as a vertical slit in adult males was 0.35 inches which in the French scale is 26.67 Fr [5]. This was 3 Fr larger than the mean EUM calibre of Indian males in present study. Berry CD and Cross RR (1956, Illinois, United State, N=200) calibrated the EUM in 100 circumcised and 100 non circumcised American males using a bougie à boule. Although they did not report a mean EUM calibre, they observed that circumcised males had a significantly smaller EUM calibre compared to non circumcised males [7]. This was similar to present study observation. Although a definite explanation for this finding has not been described, it is thought that the comparatively narrow EUM in circumcised males results from the EUM being vulnerable to irritation and trauma due to lack of protection by the prepuce during the early 'growing' years of life. This is substantiated by the finding in Berry CD and Cross RR that men who underwent circumcision within the first year of life had a higher incidence of smaller EUM calibre than those who underwent circumcision later in life [7]. Bhat GS et al., (2014, Bangalore, India, N=304) reported their study of 340 non circumcised Indian males in which they found the mean EUM calibre on maximum stretch to be 28.49±3.06 Fr. They had also used the metal meatal calibrator [6].

The only data available regarding EUM calibre in adult females is Chang YL et al., (2009, Taipei, Taiwan) of 23 Taiwanese females in which the mean EUM calibre, measured with a bougie à boule, was 23.7±1.9 Fr [4]. This was comparable to the finding in present study population.

Orkiszewski M and Madej J, Litvak AS et al., Lin Ty et al., in their studies on EUM calibre in boys of different age groups (all under 12 years) concluded that the size of the meatus increases with age [2,3,8]. Orkiszewski M and Madej J, also noted that there was no correlation between meatal width and body length [2]. With regards to the adult population, Chang YL et al., in their study on adult Taiwanese females and Bhat GS et al., in their study on adult Indian males, found no association between age and the EUM calibre [4,6]. This was again confirmed by present study in both the adult male and female populations. However, there was a weak but significant association between EUM calibre and body height in adult males but not in adult females. Chang YL et al., in their study

on Taiwanese females had noted no association between EUM calibre and body height, body weight and BMI [4]. For the significant correlation between EUM calibre and height in males, it is proposed that the EUM calibre would be associated with penile length and penile circumference. A positive association between penile length and circumference, with body height, has been demonstrated in studies by Aslan Y et al., Ponchietti R et al., and Promodu K et al., in the Turkish, Italian and Indian populations respectively [9-11]. This could explain the correlation of EUM calibre with body height in males; although further studies would be required to substantiate this finding.

The EUM being the narrowest part of the urethra, its calibre is an important determinant for lower urinary tract instrumentation. A majority of the male patients above the age of 40 years (92.3%) had an EUM calibre of less than 26 Fr and thus small to allow insertion of the standard 26 Fr transurethral resectoscope sheath. This leads to a majority of the patients, undergoing transurethral resection of the prostate or a bladder mass, to undergo an Otis internal urethrotomy. Walton JK et al., in their study of 59 patients undergoing TURP also observed that 37% of their patients undergoing TURP had the EUM calibre too small to allow the insertion of the 26 Fr resectoscope sheath. They suggested postoperative self-dilatation following internal meatotomy with a plastic spigot to prevent meatal stenosis [12]. Nielsen KK and Nordling J in their study on Danish males undergoing TURP concluded that a narrow urethra predisposed to the development of post-TUR urethral strictures [13]. EUM length, width and anatomical morphology in Brazilian males undergoing transurethral prostate and bladder surgery was studied by Vieiralves RR et al., and they noted that the urethral meatus was the most important aspect while performing lower urinary tract endoscopy and it could predict the need for meatotomy and the risk for subsequent meatal stenosis [14]. Present study represents the largest data from the Indian population.

Limitation(s)

Since study was conducted in a single tertiary care centre, it may not be truly representative of diverse Indian population. There is a need for multicentric study which should be conducted in different parts of country.

CONCLUSION(S)

The EUM calibre is weakly correlated to body height in males and is also larger in non circumcised males. The average calibre of the EUM in Indian males is 23.23 Fr which is about 3 Fr smaller than the standard transurethral resectoscope sheath which explains the increased risk of urethral strictures due to the use of an instrument in a urethra of insufficient calibre.

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