Orchidometer – Useful office practice tool for assessment of male puberty.

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Abstract:
Orchidometry is a method of measuring the testicular volume using orchidometer. Objectives were to use orchidometer for assessment of male puberty, to compare it with physical growth parameters and to compare orchidometry with Tanner’s Sexual Maturity Rating (SMR). Subjects were classified into adolescent staging by age, SMR & orchidometry. Results prove that orchidometry can substitute SMR staging in adolescent male, which is a time tested method. It is a rapid, non-invasive, easy & more objective method to assess male puberty in a busy office practice. Early identification of abnormal pubertal growth, counseling, appropriate follow-up & referral are possible using orchidometry.

Key words: Orchidometry, Tanner’s SMR, testicular volume, Prader’s Orchidometer

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Introduction
Testicles are vital part of male anatomy which produce and store sperms & testosterone. Approximately 80 – 90 % of testicular volume is made up of seminiferous tubules & germ cells. Thus, reduction in number of these cells is manifested by reduction in testicular volume. Reliable & accurate determination of testicular volume is of great benefit in evaluating a patient with a verity of disorders affecting testicular growth, development & function.

Largest amount of testicular growth occurs during puberty. There is strong relationship between testicular volume and testicular function which is reflected by sperm count, sperm motility & hormone levels.

Tanner’s SMR is a time tested clinical method for puberty assessment for both sexes which indirectly assesses the gonadal function but it is a subjective method and requires training and skilled personnel.

Prader’s orchidometer is a series of oval beads strung together in order of increasing size which are compared to male’s testicles. Each oval has a number on it which corresponds to millilitre in amount (1,2,3,4,5,6,8,10,12,15,20 & 25). This method of measuring testicular volume is called orchidometry.
assessment findings, WHO staging (early, middle & late adolescence) was done for each study subject.

SMR staging by Tanner’s criteria was done by another researcher for all the study subjects (Table-1) in a separate office. Pictorial chart of SMR was also kept in the same clinic for precise assessment. All study subjects were classified into early, middle & late adolescence using SMR staging.

**Table 1: Tanner’s SMR**

<table>
<thead>
<tr>
<th>SMR</th>
<th>Pubic hair</th>
<th>Penis</th>
<th>Scrotum</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>None</td>
<td>Preadolescent</td>
<td>Preadolescent</td>
</tr>
<tr>
<td>2</td>
<td>Scanty, Long, slightly pigmented</td>
<td>Minimal change/enlargement</td>
<td>Enlarged scrotum, pink structure altered</td>
</tr>
<tr>
<td>3</td>
<td>Darker, starting to curl, small amount</td>
<td>Lengthens</td>
<td>Larger</td>
</tr>
<tr>
<td>4</td>
<td>Resembles adult type but less quantity, coarse, curly</td>
<td>Larger; glans and breadth increase in size</td>
<td>Larger, larger and scrotum dark</td>
</tr>
<tr>
<td>5</td>
<td>Adult distribution, spread to medial surface of thighs</td>
<td>Adult size</td>
<td>Adult size</td>
</tr>
</tbody>
</table>

**Testicular volume estimation**

Estimation was done in a warm room by another pair of researchers. Right testis was measured first followed by left for uniformity of data collection. With the boy in supine and crossed-legged position, the testis was gently isolated & distinguished from the epididymis. Scrotal skin was stretched without compressing the testis. Using a Prader orchidometer, a manual side by side comparison between the testis & beads made to identify the bead most similar to the testis.

**Testicular volume measurement by Orchidometry**

All study subjects were classified into early, middle & late adolescence using testicular volume. All study subjects were classified into early, middle & late adolescence using testicular volume. 

**Table-2: Adolescent stages according to testicular volume (ml)**

<table>
<thead>
<tr>
<th>SMR</th>
<th>Adolescent stage</th>
<th>Testicular volume (ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Early</td>
<td>1-3</td>
</tr>
<tr>
<td>2</td>
<td>Middle</td>
<td>4-8</td>
</tr>
<tr>
<td>3</td>
<td>Late</td>
<td>9-12</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>13-15</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>16 or more</td>
</tr>
</tbody>
</table>

Subjective bias was avoided by examining all the subjects in separate OPD clinic by different investigators blinded to each other. Each investigator recorded the results on separate study proforma. Appropriate statistical software package was used for statistical analysis.

Adolescents were grouped in to early, middle & late stages according to age, SMR and testicular volume. Adolescent staging according to age was correlated with staging according to SMR as well as staging according to orchidometry using chi square test and Kruskal Wallis (non-parametric ANOVA) test.

Finally comparison between adolescent staging according to SMR and according to orchidometry was done using chi square test.

Subjects with precautious or delayed puberty on the basis of the results were counselled and referred appropriately. Subjects with borderline findings were advised for a scheduled follow-up. Normal subjects were also given a schedule for routine follow-up for pubertal assessment according to Indian Academy of Pediatrics (IAP) guidelines.
Observation
A total of 300 adolescent male subjects were enrolled in the study. The mean height, weight and testicular volume according to WHO staging is shown below.

<table>
<thead>
<tr>
<th>WHO staging</th>
<th>Testicular volume (ml)</th>
<th>Height (cms)</th>
<th>Weight (Kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>Early</td>
<td>2.96</td>
<td>2.43</td>
<td>134.18</td>
</tr>
<tr>
<td>Middle</td>
<td>12.41</td>
<td>6.02</td>
<td>149.42</td>
</tr>
<tr>
<td>Late</td>
<td>23.07</td>
<td>4.17</td>
<td>166.64</td>
</tr>
</tbody>
</table>

No. of adolescents in early, middle and late stage according to age were 116, 83 & 101 respectively. No. of adolescents classified in early, middle and late stage according to SMR were 128, 72 & 100 respectively.

According to orchidometry the number of adolescents in early, middle & late stage was 131, 60, and 109 respectively.

Figure 1 shows comparison between adolescent staging according to age and according to SMR

![Figure 1](image1.png)

Fig. 2 shows comparison between adolescence staging according to age & orchidometry.

![Figure 2](image2.png)
Fig. 3 shows comparison between adolescence staging according to SMR as compared to orchidometry.

Results

- Age & testicular volume are positively correlated (coefficient of determination $R^2 = 0.8177$). Figure 4: correlation between age and testicular volume

- Height & testicular volume are also positively correlated (coefficient of determination $R^2 = 0.7831$). Coefficient of correlation $R^2$: 0.8177
There is significant correlation between adolescent staging according to age and according to SMR. (chi-square test \( p=0.5026; \) Kruskal Wallis test, non-parametric ANOVA, KW value is 244.09, \( P<0.0001 \) ) As the age increases SMR also increases.

There is significant correlation between adolescent staging according to age and according to orchidometry. (chi square test \( p=0.0856; \) Kruskal Wallis test, non-parametric ANOVA, KW value is 230.04, \( P<0.0001 \) ) As the age increases, testicular volume also increases.

There is a good correlation between adolescent staging according to SMR & Orchidometry (chi square test \( P=0.4690 \) ) suggesting that there is no significant difference between staging according to SMR and that according to orchidometry. So, both the methods can be used interchangeably.

**Discussion**

Many testicular volume measurement techniques have been developed and evaluated, including the Seager callipers, the Takihara elliptical punched-ring orchidometer and ultrasonography.\(^{16}\) Evidence suggests that ultrasonography is the most accurate method, in part due to the enhanced ability to define the boundaries between the testis and surrounding extraneous tissues.\(^{16,17,18}\) However, due to its cost, issues of patient acceptance and time required, ultrasonography is not used routinely for this purpose clinically. Studies have shown that there is a linear relationship between testicular volume by orchidometry and by ultrasonography.\(^{5,15,18}\) As orchidometry essentially requires palpation of testes, it also helps to reveal consistency of testes and help to identify associated anomalies like malignancy, cryptorchidism etc.\(^{1,2,19}\) Tanner staging can be used as the ‘gold standard’ for rating pubertal development. As it is limited to only visual inspection of the subject’s secondary sex characteristics and comparison of finding with photographs and description, assessment of peripubertal testicular volume is more accepted by pediatric endocrinologists. Orchidometry is cost effective, requires less expertise and saves time. It has been shown that Prader’s orchidometer gives good correlation even in different examiner’s hand and it is an objective and reliable method.\(^{18}\) It gives accurate results and requires less expertise to apply orchidometry.\(^{12,14,20}\) So, health workers can be trained for orchidometry to screen adolescents for early identification of referral. The method is also practical in office practice, community screening, adolescent OPD & teen clinic under ARSH/RCH II at SC, PHC and CHC level.\(^{7,21}\)

**Limitations of the study:** As a cross-sectional study, only current adolescence status was assessed but not the rate of growth during pubertal period.
Conclusion

- Orchidometry is an objective method for assessment of testicular function.
- SMR has been a time tested method for pubertal assessment. Results of the study show that orchidometry correlates well with SMR & can be used interchangeably.
- A Normal adolescent male can be counseled for his biological growth on the basis of the orchidometry.
- Orchidometry can also be used for early identification, follow up and referral of abnormal pubertal growth.

Recommendations

- Orchidometer is strongly recommended as a screening tool for pubertal assessment, particularly in view of the Adolescent Friendly Health Services Initiative by the Government.

Disclosure

This manuscript has been read and approved by all authors. This paper is unique and is not under consideration by any other publication and has not been published elsewhere. The authors of this paper report no conflicts of interest.

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