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The easy and effective preoperative method for determination of the difference between the lengths of the convex and concave penile surfaces for patients with simple erectile deformity

European Urology Supplements 2019;18(3):e2517

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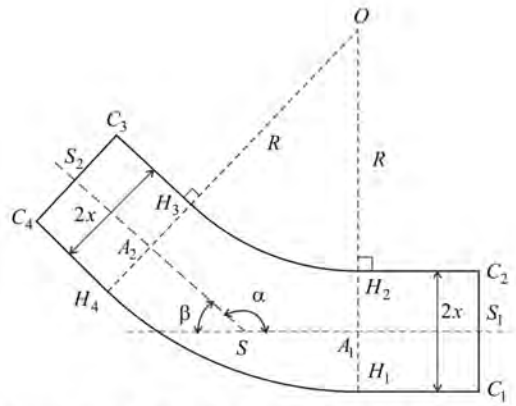
Introduction & Objectives: There is a shortening of one of the penis's sides during erection in cases of erectile deformity (ED): Peyronie's disease, congenital curvature. The difference between the length of the convex and concave surfaces (l) is the distance which the penis “lost” as a result of the disease itself. The main task in the treatment of ED is directed that l disappears and the penis becomes functionally direct. Objective: the development of the method that would allow to calculate correctly the difference between the convex and concave surfaces of the erect penis.

Materials & Methods: The description of the method is presented in Fig. 1.

We tested this method on 47 patients with varying degrees of simple ED. The curvature angle (ß) ranged from 23^0 to 94^0. ß was measured with a protractor and all distances were measured with a soft ruler. To control the results, we measured the length of the convex and concave surfaces of the penis in the traditional way using a soft ruler and then we calculated the difference between them - *l*.



Schematic figure of a simple penis curvature (longitudinal plane).

- $C_1C_2H_2H_1$ and $C_3C_4H_4H_3$ - the rectangular fragments of straight penis's areas, which are situated proximal and distal to the area of erectile deformity (ED);
- $H_1H_2H_3H_4$ - the curvilinear fragment of the body of the penis, corresponding to the area of curvature;
- S_1A_1 (и S_1S) – the symmetry axis of the straight-line fragment $C_1C_2H_2H_1$;
- S_2A_2 (и S_2S) – the symmetry axis of the straight-line fragment $C_3C_4H_4H_3$;
- $C_1S_1 = C_2S_1 = x$ - the radius of circumference of the proximal and distal fragment of the penis outside the ED area;
- O - the center of the circle whose arcs are H_1H_4 and H_2H_3;
- $OH_2 = OH_3 = R$ - the radius of the circle whose arc is the arc H_2H_3 (OH_2 is perpendicular to C_2H_2, and OH_3 is perpendicular to C_3H_3);
- $OH_1 = OH_4 = R + 2x$ - the radius of the circle containing the arc H_1H_4;
- $\angle A_1SA_2 = \alpha$ (the angle, measured in radians);
- H_1H_4 – the arc, corresponding to the convex side of the penis's curvature;
- H_2H_3 – the arc, corresponding to the concave side of the penis's curvature;
- β – the angle of the simple curvature of the penis ($\beta = \pi - 2\alpha$, the angle is also given in radians);

The determination of the distance of the lengths of the arcs, corresponding to the arcs of the curvature of the penis.

$$H_1H_4 = (R+2x)(\pi-\alpha), \qquad H_2H_3 = R(\pi-\alpha).$$

The determination of the difference between the lengths of the convex and concave surfaces of the penis (*l*) (difference between arcs H_1H_4 and H_2H_3) **provided that the length of bodies' circumference $C_1C_2H_2H_1$ (L_1) and $C_3C_4H_4H_3$ (L_2) are equal! That is $L_1 = L_2 = L$.**

$$l = H_1H_4 - H_2H_3 = (R+2x)(\pi-\alpha) - R(\pi-\alpha) =$$

$$= 2x(\pi-\alpha) = 2x\beta = \frac{L\beta}{\pi} = \frac{L\beta}{180^0}, \qquad (1)$$

ß – the angle of curvature of the penis, given in degrees, L – the length of the penis's circumference

The diameter of the penis may vary before and after the curvature. This is due to the fact that as a rule the proximal part of the penis is larger in diameter than its distal part. In this case the formula (1) takes the following form:

$$l = \left(\frac{L_1}{2} + \frac{L_2}{2}\right)\left(1 - \frac{\alpha}{90^0}\right) = \frac{\beta\,(L_1+L_2)}{360^0},$$

$$l = \frac{\beta \times (L_1 + L_2)}{360^0}$$

***l* – the difference between the lengths of the convex and concave surfaces of the penis (mm),**
ß – the angle of curvature of the penis, given in degrees (^{0}),
L_1 – the length of the penis's circumference which is distal to the area of curvature (mm),
L_2 – the length of the penis's circumference which is proximal to the area of curvature (mm).

The formula can be calculated automatically on the website CurvUro.com

Results: It is enough to know only 2 parameters to find out *l*: ß and the length of the penis's circumference (L). *l* is directly proportional to ß and L (fig. 1). We didn't get statistically significant differences (t-test; p>0.05) comparing the results of our method with the ones of the traditional

measuring method of *l*. At the same time, the traditional method of measurement has a significant drawback, as it requires more time for correct marking and measurement. So the erection often reduces or disappears.

Conclusions: Our developed method makes the calculation of *l* to be simple and accurate. It is very important to know both for operative and conservative treatment, and for monitoring the results.

In case of shortening operations, before the operation both the surgeon and the patient can know how much the length of the penis will decrease due to shortening of the convex surface of the penis. This allows to avoid discontent from the patient after the operation.

In case of lengthening operations, the knowledge of *l* makes it possible to predict in advance the longitudinal size of the graft. This information is important for two reasons: 1) it guarantees effective correction of ED (the probability of hypercorrection/residual curvature decreases), 2) it helps the surgeon to choose the particular type of graft.