

SHOULD ENDOSCOPIC SURGERY BE USED IN INFANTS WITH CONGENITAL HYDRONEPHROSIS?

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AIM OF THE STUDY

Although open pyeloplasty by Anderson-Hynes is still considered to be the golden standard for treatment of this pathology, minimally invasive manipulations are discussed as alternative methods (endopyelotomy, balloon dilatation, Acucise access). The effectiveness of these methods is different [1], and some of the authors completely deny use of endoscopic procedures (especially – balloon dilatation) in treatment of congenital hydronephrosis in young children [2,3]. Analysis of biomechanical parameters of pathological tissue is essential for evaluation of these methods in treatment of congenital hydronephrosis.

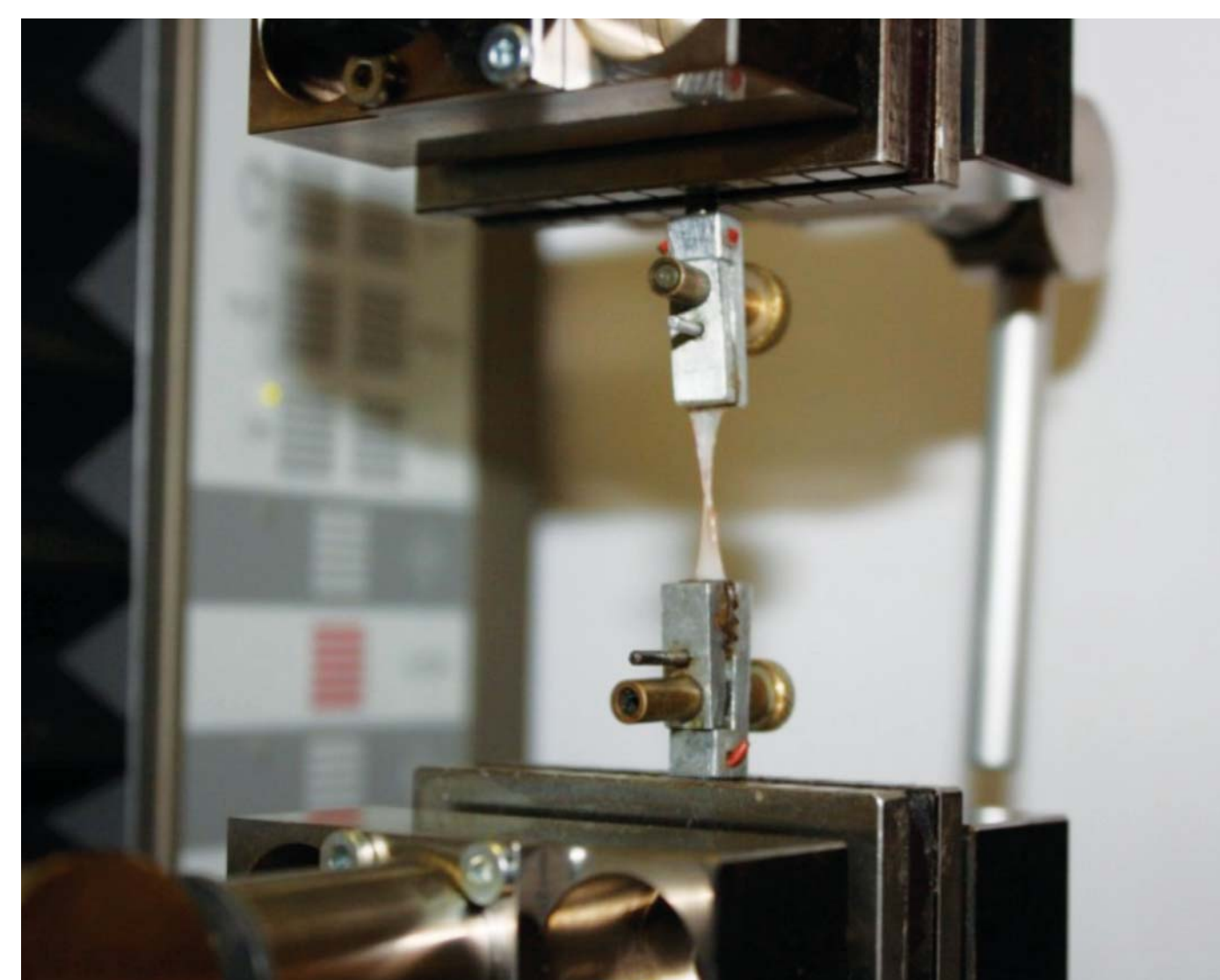
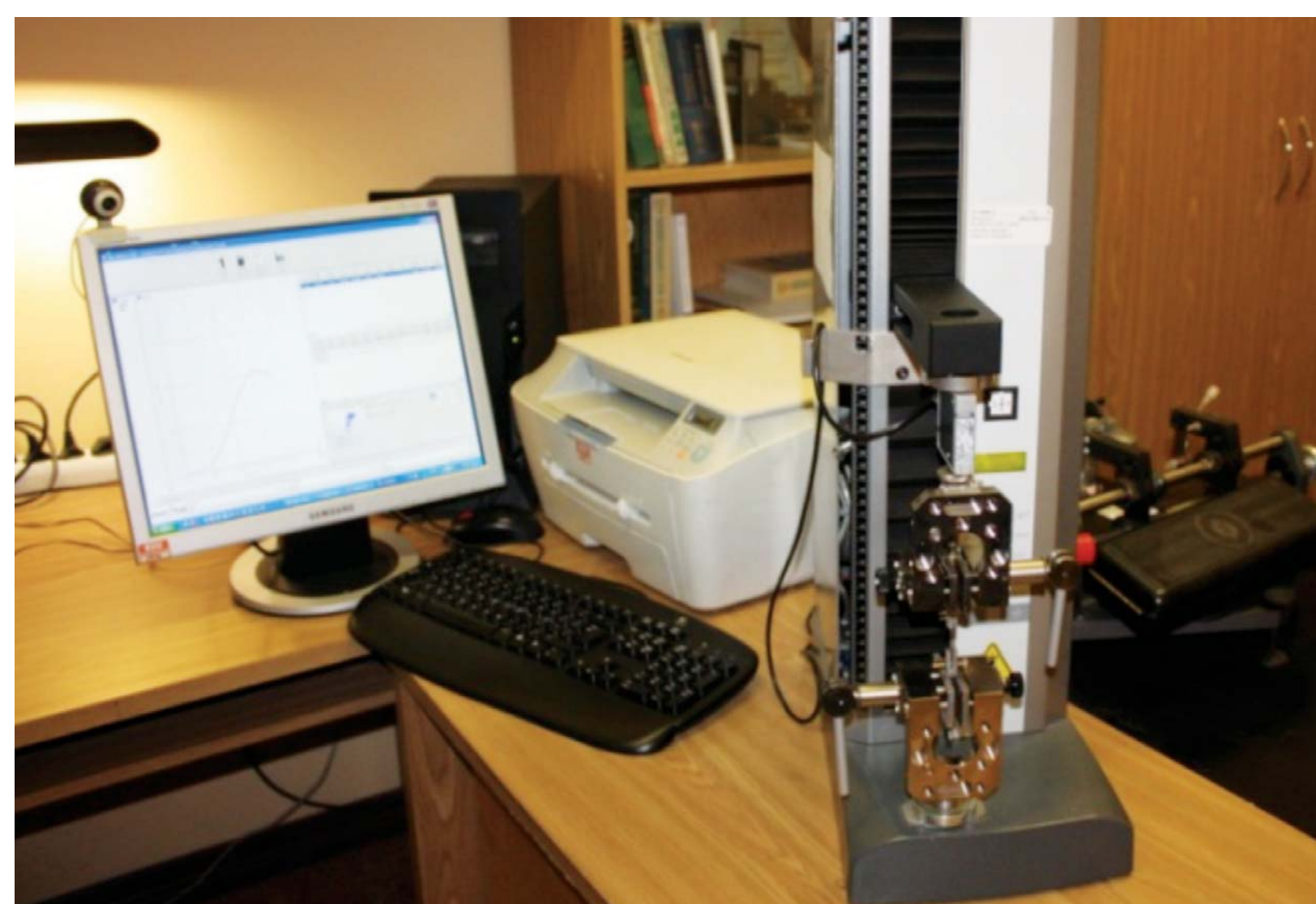


Figure 1A. View of the experimental Zwick-Roell Test System.

Figure 1B. Longitudinal deformation of sample.



Figure 2. View of the experimental apparatus.

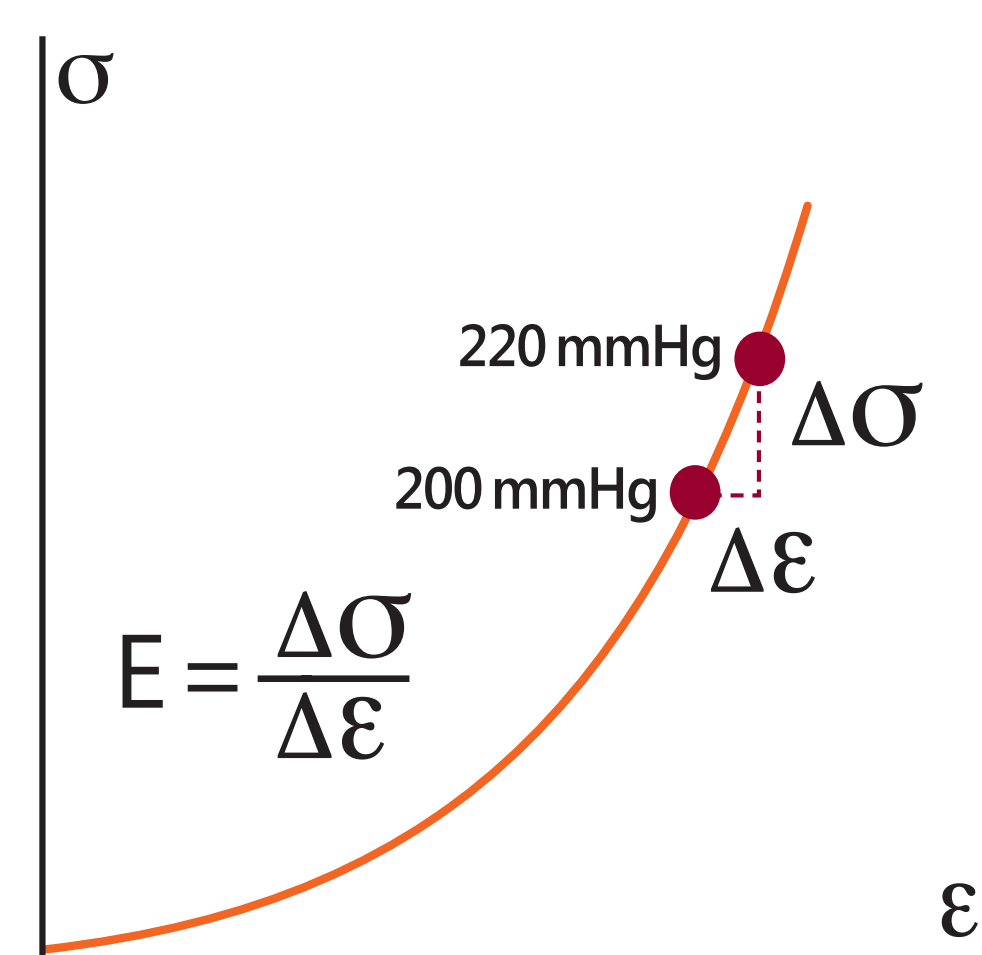


Figure 3. Determination of incremental modulus of elasticity.

RESULTS

In longitudinal tension values of failure strain and failure stress were more higher in pathology, compared to controls (Table 1).

Circumferential strain at different pressures (0–240 mmHg) showed that pathological samples were less deformable (Figure 4A, Figure 4B). At the inner pressure 200 mmHg strain and internal stress were more less in pathology than in controls ($p < 0.0015$) (Figure 5; Table 2). Wall thickness was 0.83 ± 0.13 mm in pathology, compared to 0.45 ± 0.03 mm in controls ($p = 0.00003$).

Table 2. Circumferential stress, strain and incremental modulus of elasticity in control and patient groups samples, when applying different inner pressure ($p < 0.05$).

| | σ (kPa) ($p=200$ mmHg) | σ (kPa) ($p=220$ mmHg) | σ (kPa) ($p=240$ mmHg) | ϵ (%) ($p=200$ mmHg) | ϵ (%) ($p=220$ mmHg) | E (%) (220-200 mmHg) | E (%) (240-220 mmHg) |
|----------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-------------------------|--------------------------|
| Controls | 167.89 ± 63.06 | 187.01 ± 70.73 | 205.61 ± 78.05 | 58.67 ± 12.85 | 59.55 ± 13.09 | 60.11 ± 13.1 | 3614.47 ± 1284.86 |
| Patients | 53.43 ± 10.57 | 66.16 ± 12.94 | 25.12 ± 10.84 | 26.21 ± 10.89 | 27.24 ± 10.93 | 701.68 ± 94.9 | 778.96 ± 123.52 |

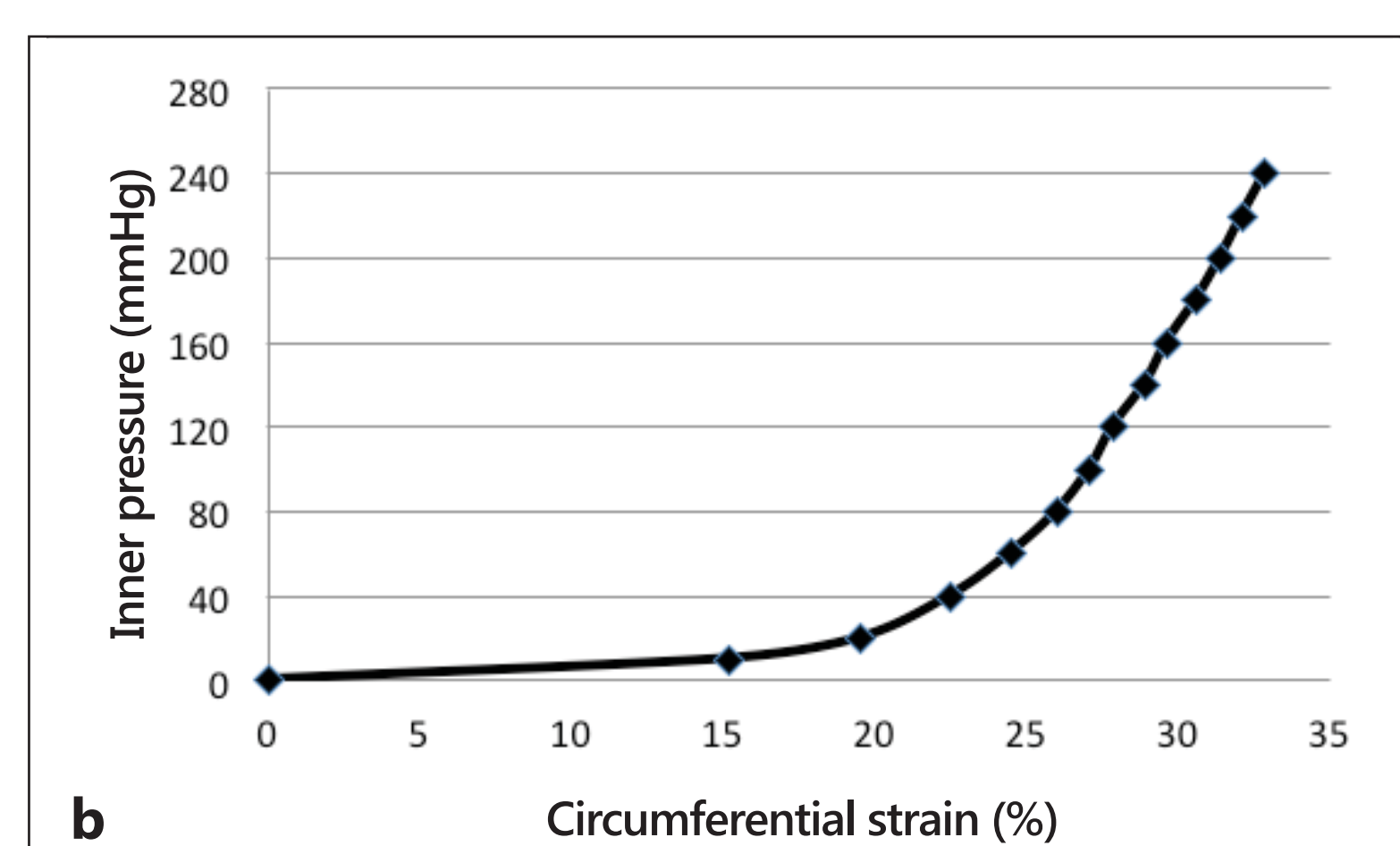
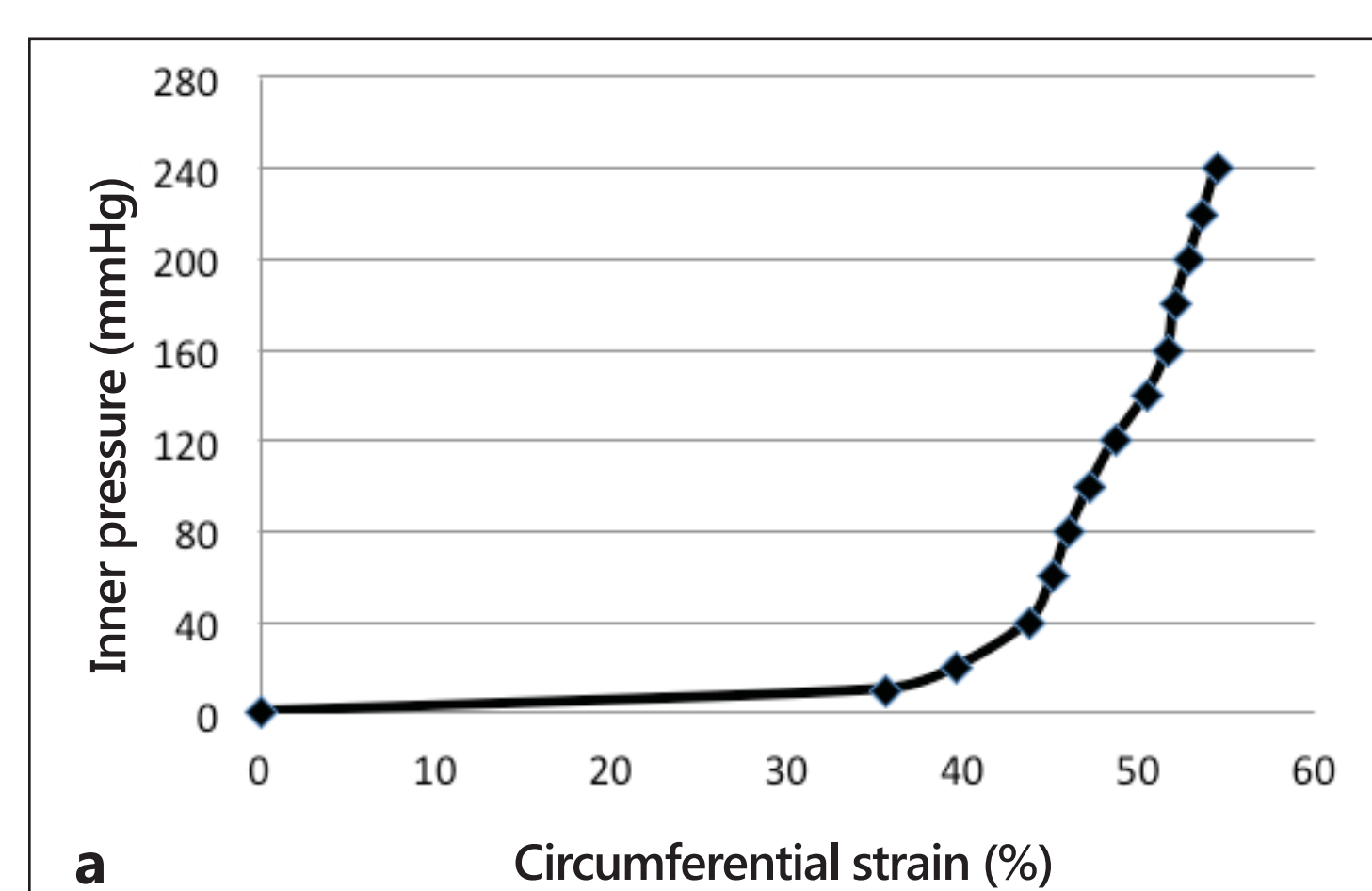


Figure 5. Relationship between inner pressure and strain in control (a) and patients (b) groups pyeloureteral segments.

METHODS

13 samples of PUS from white race, both gender newborns (age 175.5 ± 109.7 days, weight 7.6 ± 1.8 kg) were collected during open pyeloplasty by Anderson-Hynes from 2011 to 2013, after approval of ethical committee. All of these patients suffered from III to IV grade congenital hydronephrosis (after SFU). 10 samples for control group were collected during autopsies of 6 children (age 50.6 ± 35.0 days, weight 5.6 ± 1.7 kg) without pathology of genitourinary tract.

Wall thickness was measured in all samples.

Longitudinal tension was performed in 5 pathological and 5 control samples. Zwick-Roell Test System with load cell 50 N, connected to PC, was used (Figure 1A). Samples were deformed longitudinally with speed 5 mm/min until tissue rupture (Figure 1B). Failure stress, failure (maximal) strain and tangential elasticity modulus were estimated for each sample.

Circumferential strain of 8 pathology samples and 5 control samples was measured, using tubular specimens. Ends of ureters were connected to special pressure tool, establishing closed system (Figure 2). Pressure in PUS was increased gradually (step 20 mm Hg) from 0 to 240 mmHg. Maximal strain, maximal stress and incremental modulus of elasticity (between two value of internal pressure) for each group were depicted as median value with standard deviation (Figure 3).

CONCLUSIONS

Pyeloureteral segment tissue in congenital hydronephrosis patients is more deformable longitudinally, less – transverse. The increase of intraluminal pressure during treatment procedure may cause early structural damage of pathological tissue. Morphological research will be continued.

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Table 1. Longitudinal stress, strain and modulus of elasticity in control and patient groups samples ($p < 0.05$).

| | σ (kPa) | ϵ (%) | E (%) |
|----------|----------------------|------------------------|----------------------|
| Controls | 0.922 ± 0.148 | 36.262 ± 3.204 | 4.482 ± 0.502 |
| Patients | 1.24 ± 0.206 | 71.8325 ± 9.501 | 3.65 ± 0.235 |

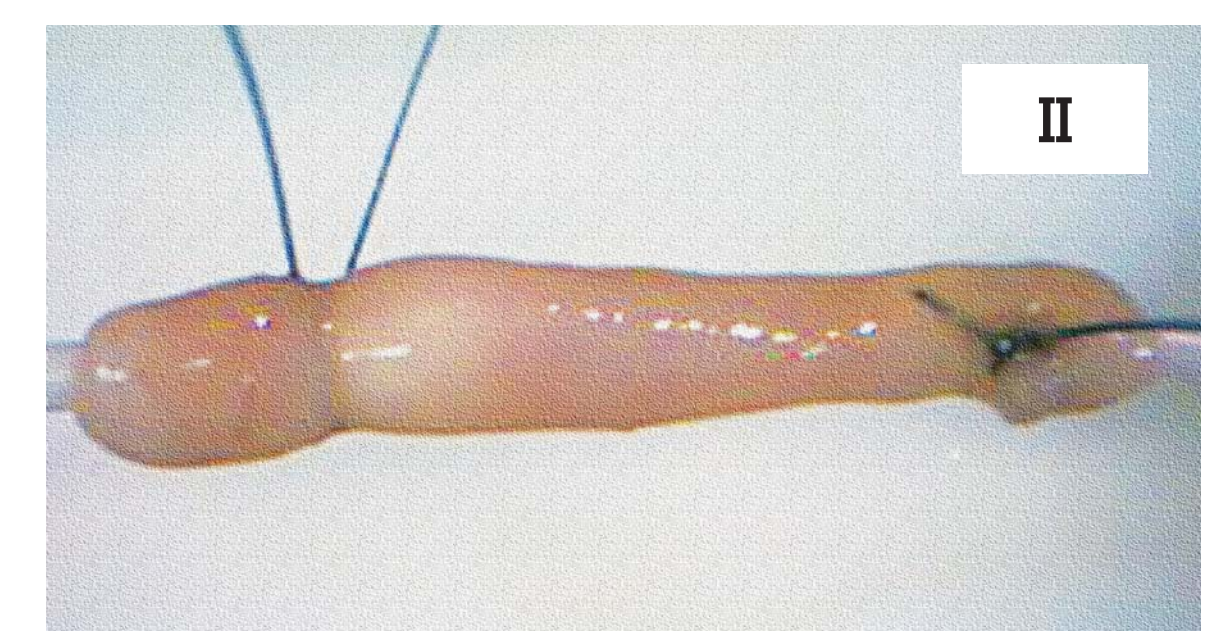
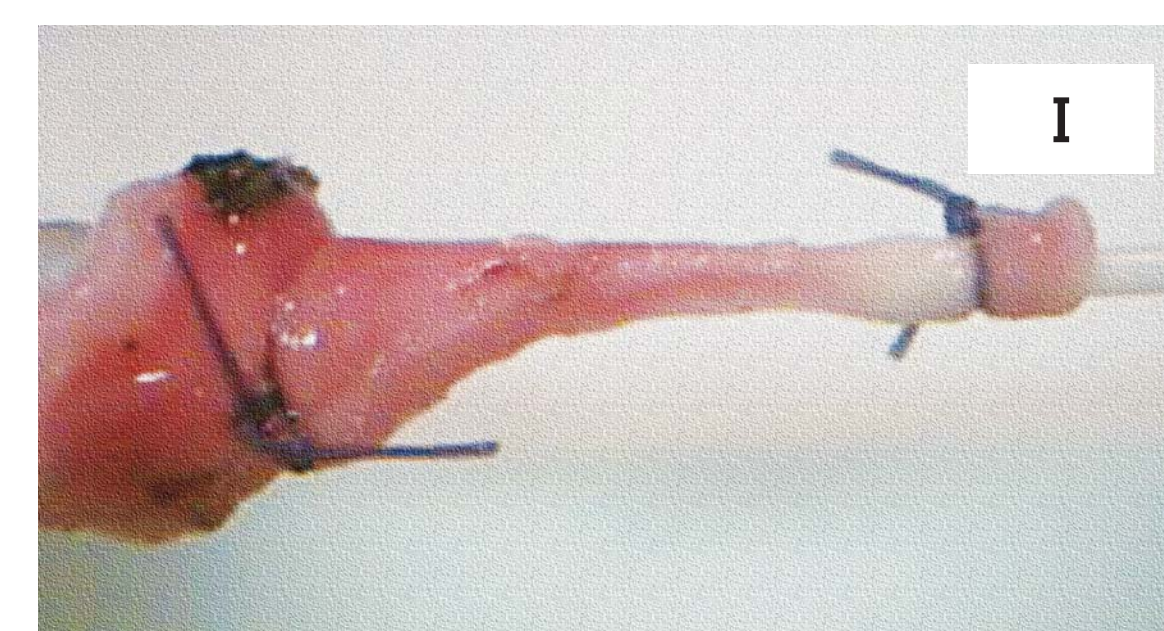


Figure 4A. Pathological pyeloureteral segment (I) and normal pyeloureteral segment (II) pressurized with a pressure 0 mmHg.

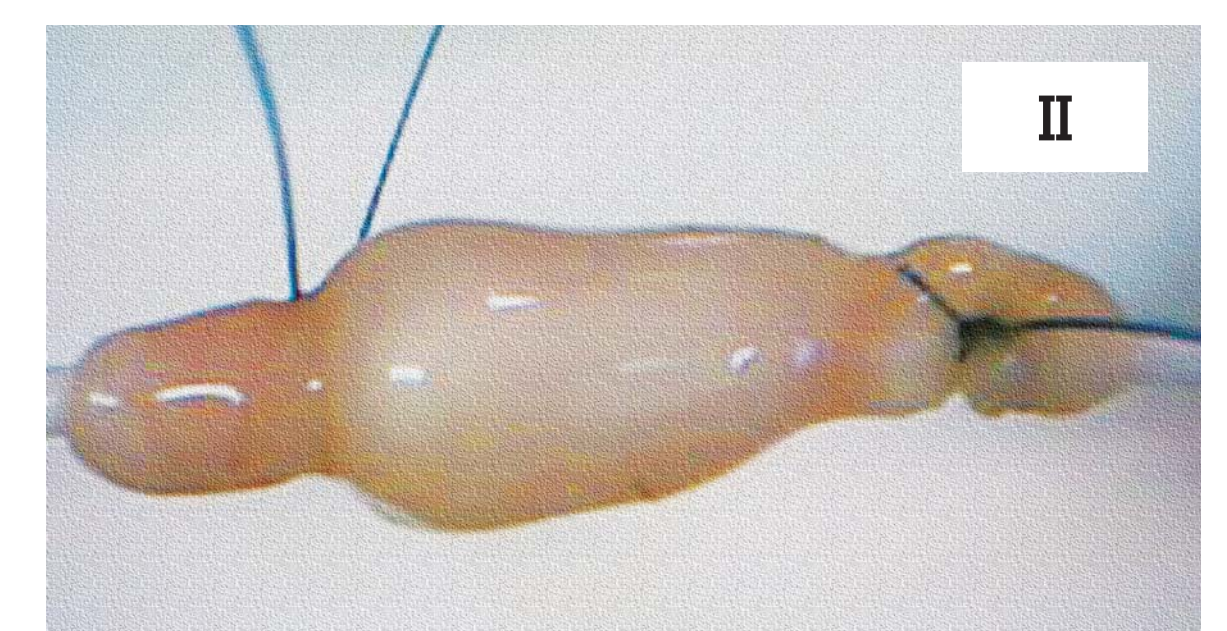


Figure 4B. Pathological pyeloureteral segment (I) and normal pyeloureteral segment (II) pressurized with a pressure 240 mmHg.