Title

MP06-08 DEVELOPMENT OF THE ANTERIOR URETHRAL STRICTURE DISEASE STAGING WITH CLINICAL VALIDATION USING A PATIENT-CENTERED SURGICAL OUTCOME MEASURE

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MP06-07

FROM CONSENSUS TO VALIDATION: DESIGN AND DEVELOPMENT OF A HIGH-FIDELITY HYDROGEL SIMULATION MODEL FOR URETHROPLASTY PROCEDURES

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INTRODUCTION AND OBJECTIVE: Urethroplasty is the gold standard treatment for urethral stricture repair; however, it is a technically difficult operation due to complex anatomy, large learning curves, lack of intraoperative teaching, and variations in approaches. Utilizing the consensus-building Delphi process, we sought to create a high-fidelity, non-biohazardous, simulation model to train excision and primary anastomosis or graft urethroplasties.

METHODS: 20 high volume reconstructive urologists were recruited to complete the Delphi process aimed to reach expert consensus on necessary parameters and design specifications for the simulation model. Consensus>80% was reached regarding procedural realism, anatomical realism, and educational effectiveness. Using previously validated 3D printing and hydrogel molding techniques, researchers fabricated a hydrogel model that incorporated all the expert determined aspects. Prototypes were sent to 55% of the experts who performed a skin-to-skin urethroplasty simulation (Figure 1) as well as a questionnaire evaluating the model to determine if the consensus defined steps were met. The questionnaire utilized a 5-point Likert scale where agreement=4/5, neutral=3, and disagreement=1/2.

RESULTS: 91%, 82%, and 100% agreed the model procedurally replicates: the steps necessary to complete the procedure, tissue textures/behaviors, and anatomical relationships including urethral spatulation (91%), suture placement (91%), perineal incision/exposure (91%), and urethral dissection/exposure (100%). 82%, 91%, 64%, 91%, 55%, and 91% agreed it anatomically replicates the; perineum, urethra, fascia over urethra, corpora cavernosa and spongiosum, and bulbospongiosus muscle. 100%, 100%, 100%, 91% and 82% agreed it offers: a safe/non-biohazardous training platform, is useful for teaching/practicing, improving the technical skills, can assess user's ability to perform this procedure and provides useful error feedback.

CONCLUSIONS: We successfully designed a high-fidelity, non-biohazardous, simulation model for urethroplasty procedures utilizing expert consensus which displayed high procedural realism, anatomical realism, and educational effectiveness. Ultimately, this model can be used to improve current urethroplasty training.

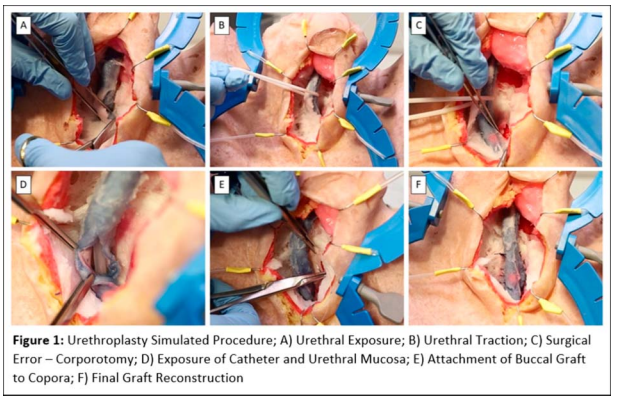

Figure 1: Urethroplasty Simulated Procedure; A) Urethral Exposure; B) Urethral Traction; C) Surgical Error – Corporotomy; D) Exposure of Catheter and Urethral Mucosa; E) Attachment of Buccal Graft to Copora; F) Final Graft Reconstruction

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MP06-08

DEVELOPMENT OF THE ANTERIOR URETHRAL STRICTURE DISEASE STAGING WITH CLINICAL VALIDATION USING A PATIENT-CENTERED SURGICAL OUTCOME MEASURE

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INTRODUCTION AND OBJECTIVE: We created a staging system based on the Length Segment Etiology (LSE) classification published by the Trauma and Urologic Reconstruction Network of Surgeons (TURNS) where each stage/substage represents a unique subset of anterior urethral stricture disease (aUSD), inferring location, expected repair type, and surgical outcome.

METHODS: Stage development adhered to the aUSD outcomes principles from prior TURNS work on this cohort of 2,396 patients using multivariate logistic regressions and Kaplan Meier curves: 1) penile > (have a higher functional recurrence rate than) bulbar strictures; 2) longer > shorter strictures; 3) adverse pathophysiology etiology (e.g. radiation) > trauma/idiopathic etiology. A novel patient-centered surgical outcome (PCSO) score was used for stage validation, which combined functional success (defined as no secondary repair; 2=success, 0=failure), meatus location (2=orthotopic, 1=penile, 0=perineal) and number of surgeries (2=single-stage, 0=multi-stage), into a single score (Range 0 to 6). Mean PCSO scores were compared to ensure substage ordering ranked from highest (best outcomes) to lowest.

RESULTS: Five stages were ultimately created, summarized as follows: *Stage 1*: Short bulbar strictures; *Stage 2*: Long bulbar strictures; *Stage 3*: penile strictures of favorable etiology; *Stage 4*: penile strictures of adverse pathology and *Stage 5:* pan-urethral (three-segment) strictures. Stage/substage functional success outcomes are shown in the Table 1, broken down by single-stage orthotopic meatus repair (both anastomotic and substitution/graft) (percentage overall and functional success) 2) single-stage non-orthotopic (penile/perineal) meatus repairs and 3) multi-stage orthotopic meatus repairs. Mean PCSO showed a statistically significant ($p<0.001$) decline by stage.

CONCLUSIONS: Each stage and substage of this novel LSE Staging System was shown to provide unique information on stricture characteristics, repair, and surgical outcomes. Similar to TNM staging in cancer, the LSE staging system will improve our ability to communicate stricture complexity/severity with our patients, and more easily organize aUSD for multi-institutional outcomes studies and clinical trial recruitment purposes.

LSE Stage		Number	LSE Staging Criteria			Patient-Centered Surgical Outcome (PCSO)	Surgical Subtype (% performed within substage, (% functional success))					Overall Functional Success
			Location	Length	Etiology		Single Stage Orthotopic (Anastomotic)	Single Stage Orthotopic (Substitution)	Two-Stage Orthotopic	Single Stage Penile	Single Stage Perineal	
1	1A	517	S1a	L1	1,2,3a	5.92	91 (96)	9 (95)	0 (NA)	0 (NA)	0 (NA)	96%
	1B	60	S1b			5.83	80 (94)	20 (83)	0 (NA)	0 (NA)	0 (NA)	92%
2	2A	497	S1a	L2/L3		5.82	23 (91)	76 (92)	0.4 (0)	0 (NA)	0 (NA)	91%
	2B	200	S1b			5.73	6 (100)	94 (86)	0 (NA)	0 (NA)	0 (NA)	86%
	2C	280	S1	Any	3b, 3c, 4/6, 5	5.69	37 (91)	62 (82)	1 (100)	0 (NA)	0 (NA)	86%
3	3A	266	S2a, S2b	Any	1, 2, 3a	5.43	7 (95)	77 (82)	5 (92)	6 (94)	5 (92)	84%
	3B	129	S2c, S2d			5.22	2 (100)	55 (89)	8 (80)	28 (92)	7 (100)	90%
4	4A	247	S2	L1/L2	3b, 3c, 4/6, 5	4.97	2 (75)	50 (84)	23 (86)	21 (92)	4 (100)	87%
	4B	77		L3		4.62	1 (100)	39 (93)	27 (71)	8 (100)	25 (89)	87%
5		123	S3	L2/L3	Any	4.51	0 (NA)	37 (72)	18 (91)	9 (100)	36 (89)	84%

(L): **L1** = < 2cm; **L2** = 2 to 7 cm; **L3** = >7 cm
(S): **S1a** = proximal bulbar; **S1b** = distal bulbar; **S2a** = penile + bulbar; **S2b** = penile; **S2c** = penile + fossa/meatus; **S2d** = fossa/meatus; **S3** = bulbar/penile/fossa
(E): **E1** = external trauma; **E2** = idiopathic; **E3a** = internal trauma/iatrogenic; **E3b** = urethroplasty recurrence; **E3c** = radiation; **E5** = hypospadias; **E4/6** = lichen sclerosus

Table: Length, Urethral Segment, Etiology Staging System with Surgical Subtypes and Functional Success Rates

Source of Funding: None