PD15-09

The impact of SWL hands-on training on maintaining high success rate and identification of performance improvement factors

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Backgrounds

- Shock wave lithotripsy (SWL) for the clinical treatment of urinary stones was first introduced by Chaussy et al.
- SWL is currently used worldwide due to its simple operability and low invasiveness, and has become the first-line treatment for many types of urinary stones.
- However, the overall success rate is affected by patient factors (skin-to-stone distance, abdominal fat distribution, renal function, stone density, and size and location), and treatment factors (firing rate, shock wave intensity, body position, and medication).
- Therefore, consistency in the **success rate** of this treatment, which ranges **between 61 and 96 %**, is not maintained.

Backgrounds

- We reported earlier that **hands-on training (HOT) significantly improved the SWL success rate from 66.3% to 87.2%.** (Okada A et al. Urolithiasis 2013)

Urolithiasis
DOI 10.1007/s00240-013-0586-3

ORIGINAL PAPER

Impact of official technical training for urologists on the efficacy of shock wave lithotripsy

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Received: 7 March 2013 / Accepted: 19 June 2013

Abstract To evaluate the efficacy of company-initiated training of urologists on shock wave lithotripsy (SWL) treatment results, we retrospectively assessed 602 patients who underwent SWL in Nagoya City University Hospital between January 2004 and June 2011 using Lithotripter S (Dornier MedTech, Japan). Training provided by a SWL were determined to be training and prone position for distal ureter stones by multivariate analysis and ultrasonic detection for renal and proximal ureter stones by univariate analysis. Skills in targeting stones using ultrasonography and selecting the proper therapeutic position are essential for improving the success rate of stone removal

Objectives

In this study, we tracked SWL outcome by urologists who completed the training and analyzed factors that contribute to further success of treatment.

Methods

- **Subjects**
  Among SWL treatments conducted from December 2011 to May 2018, **458 cases** evaluated by **CT after 3 months** were retrospectively analyzed.

- **Hands-on-training (HOT)**
  The HOT has been held **once a year (9 times)**, and **all 20 urologists** who were in charge of operation received one or more HOTs.

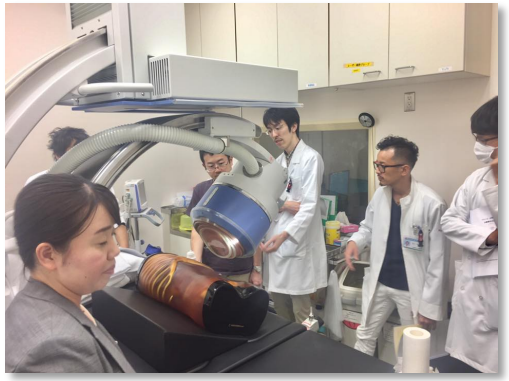
Methods

The regimen of 1 day HOT

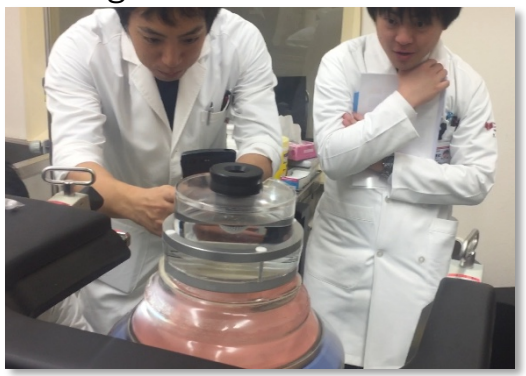
1. 09: 00- SWL Basic Course
   - ① Learning the principle of SWL
   - ② Understanding appropriate case selection
   - ③ Learning the method of fragmentation
   - ④ Understanding expulsive therapy
2. 10: 30- Practical training using **the human body phantom**
   - ① renal-upper ureter stones: **Dual targeting** using **ultrasonic phantom**
   - ② Mid-lower ureter stones: Targeting using **X-ray phantom**
3. 11: 30- Fragmentation training using model stones
4. 13: 30- Actual treatment of 2 patients

①Learning the principle of SWL

②Understanding appropriate case selection



③Learning the method of fragmentation

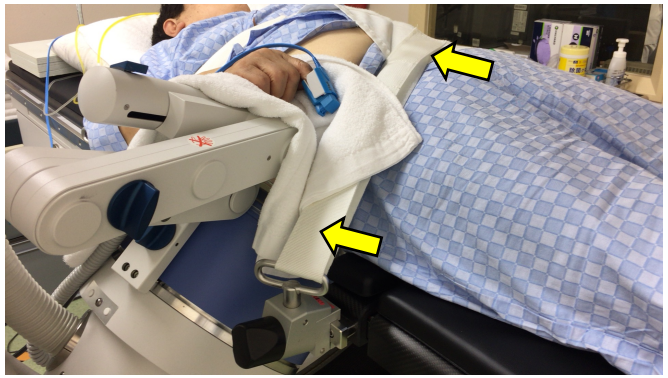


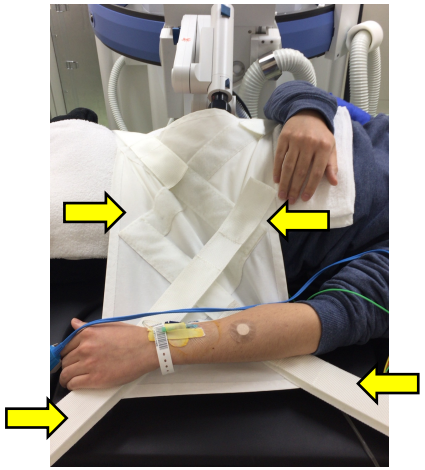
④Understanding expulsive therapy

Methods

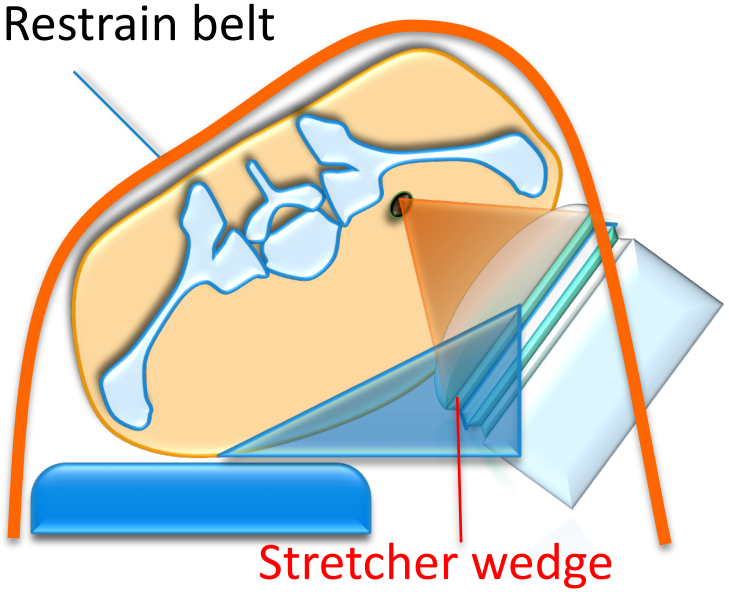
Important items for SWL success

*Restraint belt





*Stretcher wedge



*Air removal (OptiCouple® Images)

Methods

Evaluation items

Regarding the contribution to the success of treatment, the following factors related to treatment were examined using logistic regression analysis;

- Patient factors : Age, Gender, Body mass index (BMI)
- Stone factors : Location, Size, CT value, Stone-skin distance (SSD)
  Grade of hydronephrosis (SFU classification), Stagnation period
- Therapeutic factors : Compliance rate of recommended technique,
  Number of treatments, Stent indwelling, Body position,
  Use of stretcher wedge, Targeting method, Air removal,
  Shock wave number and frequency
- Instrument factor : Lithotripter model, Days after maintenance

Results

Patients' characteristics

*Median (Min – Max)

Age*(y.o.)	59	(18 - 90)
Gender, male n (%)	347	(75.8)
BMI*(kg/m²)	24.1	(14.5 – 38.0)

Backgrounds of the targeted stones (1)

** n (%)

Stone location**	Renal pelvis and calix	180 (39.3)
	UPJ	39 (8.5)
	Proximal Ureter	126 (27.5)
	Middle Ureter	29 (6.3)
	Distal Ureter	81 (17.7)

Results

Backgrounds of the targeted stones (3)

*n (%)

Stone size*	≤4mm	20 (4.4)
	4<≤10mm	305 (66.6)
	10<≤20mm	129 (28.2)
	>20mm	4 (0.9)
Stone composition*	CaOx	186 (40.6)
	CaOx + CaP	107 (23.4)
	CaP/CaHP	8 (1.7)
	UA/UA salt	2 (0.4)
	Cystine	1 (0.2)
	struvite	2 (0.4)
	Unclear	152 (33.2)

Results

Backgrounds of the targeted stones (2)

*n (%) **Median(Min-Max)

Skin-to-stone distance (mm)**	90	(25-180)
CT value (HU)**	817	(107-2250)
Stagnation period (months)**	3	(0-180)
Hydronephrosis grade*(SFU classification)		
Grade 0	266	(58.1)
Grade 1	84	(18.3)
Grade 2	84	(18.3)
Grade 3	17	(3.7)
Grade 4	5	(1.1)
unknown	2	(0.4)
Indwelling of ureteral stent *, YES	28	(5.5)

Results

Backgrounds of the operation

*n (%) **Median(Min-Max)

Shockwave device*	Lithotripter S		232 (50.7)
	Gemini		226 (49.3)
Shockwave number**	Renal stones		3000 (1762-4000)
	Ureter stone		4000 (1256-4102)
Shockwave frequency* (SW numbers/min)			
	≤60		206 (45.0)
	60<≤90		246 (53.7)
	>90		2 (0.4)
	unclear		4 (0.9)
Number of the SWL session		1	415 (90.6)
		2	36 (7.9)
		3	7 (1.5)

Results

Therapeutic information

*n (%) **Median(Min-Max)

■ **Compliance to the recommended techniques in training***

Compliant	380	(83.0)
Non-compliant	78	(17.0)

※The recommended techniques in training ;

1) Combined use of fluoroscopy and ultrasonography for targeting renal and proximal ureter stones
2) Use of stretcher wedges for middle ureter stones
3) semi-supine position with stretcher wedges for distal ureter stones.

■ **Air-removal between cushion and skin***

Removed	349	(76.2)
Unremoved	109	(23.8)

Results

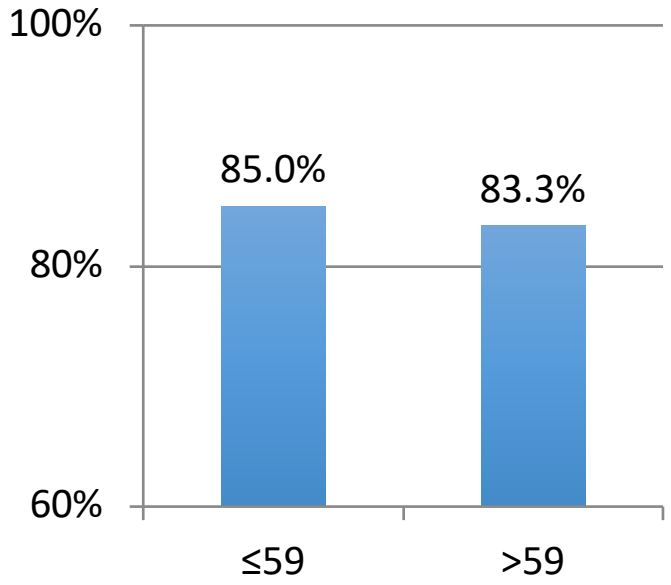
Success rate (stone-free rates after 3 months)

Total* Success 383 (**83.6%**), Failure 72 (16.4%)

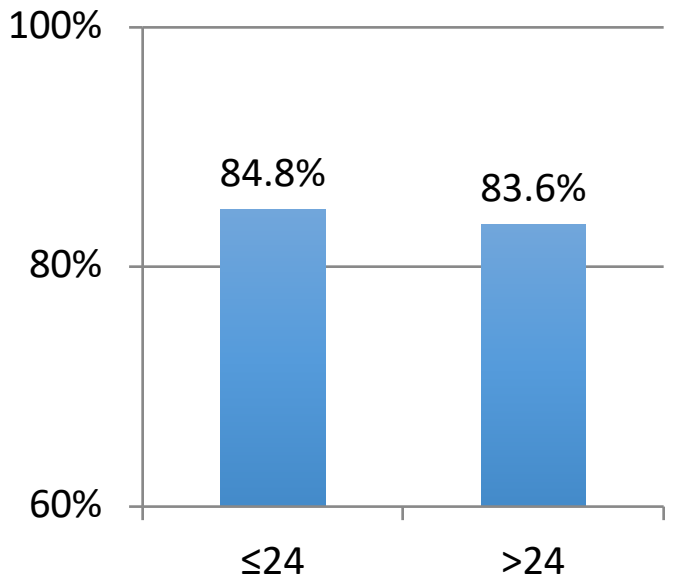
Patient factors

*χ2-test

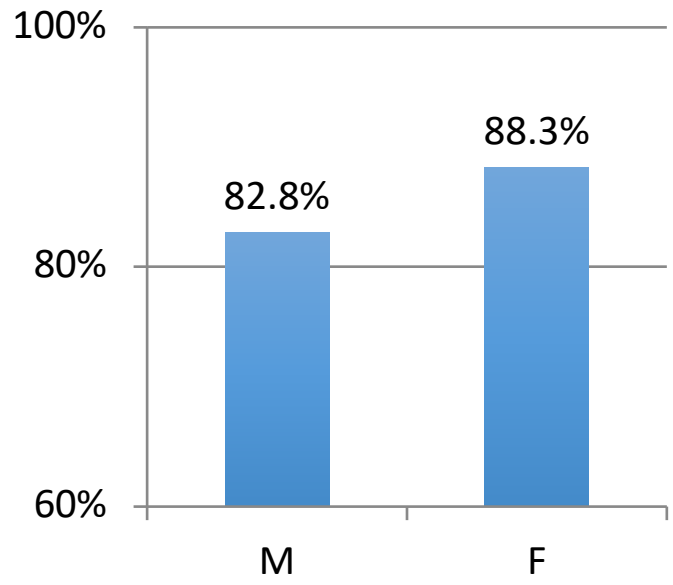
Age* p=0.631



BMI* p=0.631



Gender* p=0.172



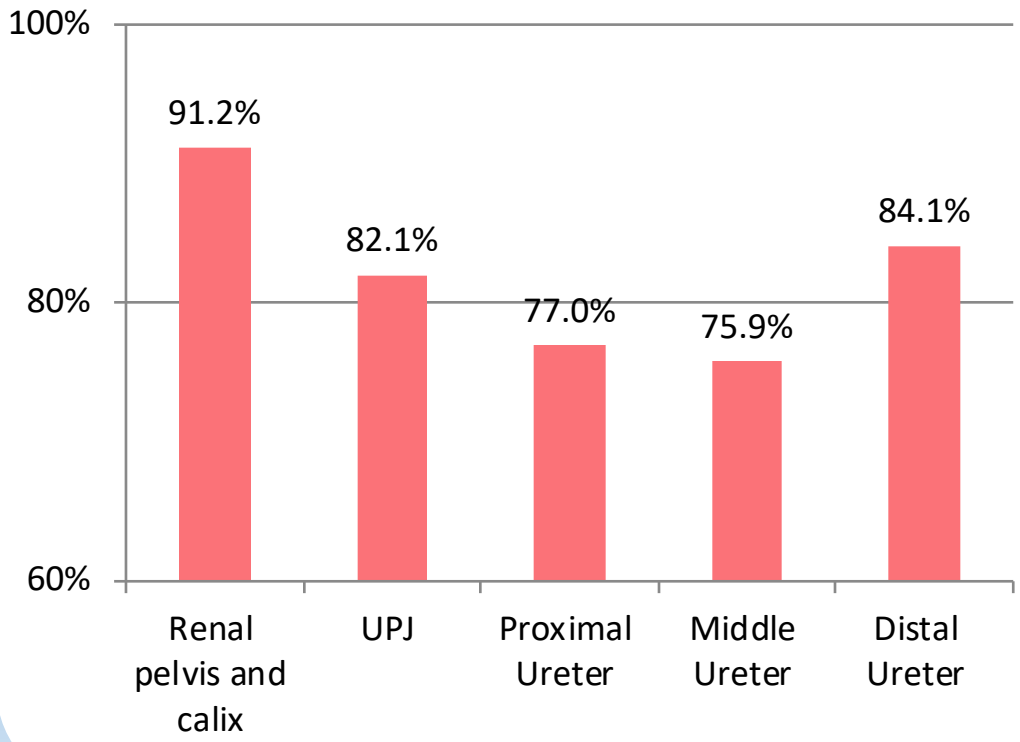
Results

Success rate (stone-free rates after 3 months)

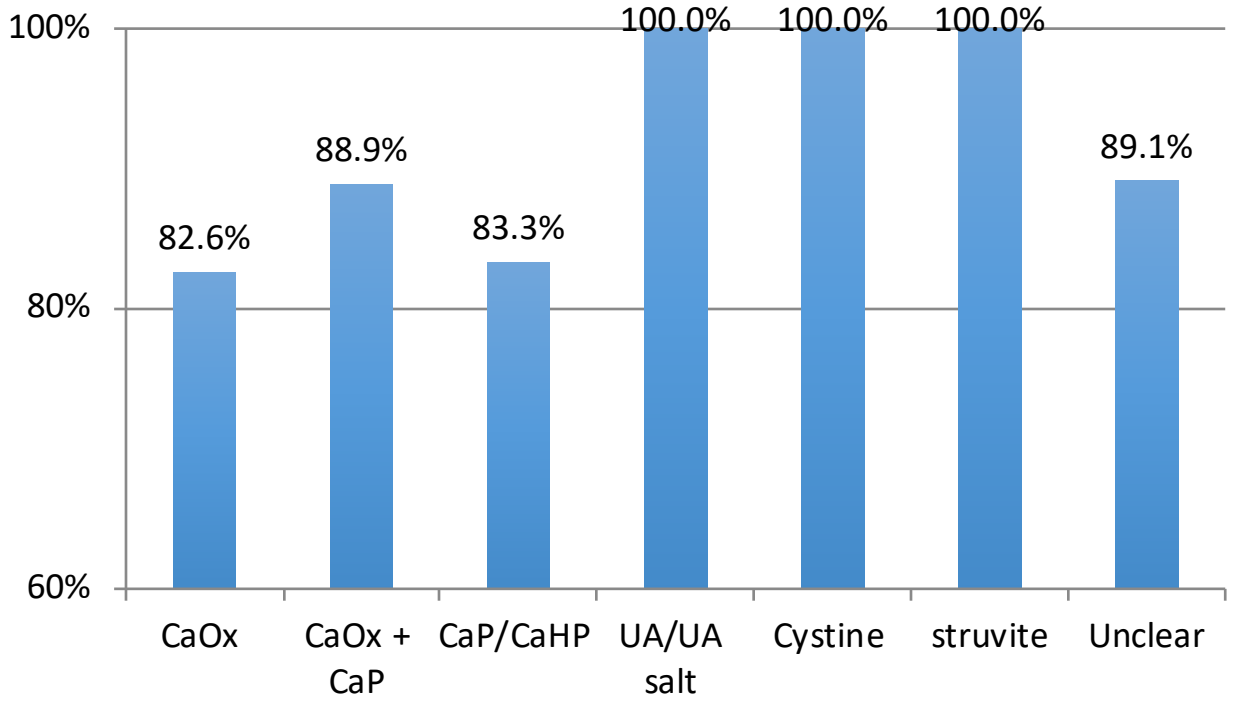
Stone factors (1)

*χ2-test

Stone Location* p=0.010



Stone Component* p=0.314



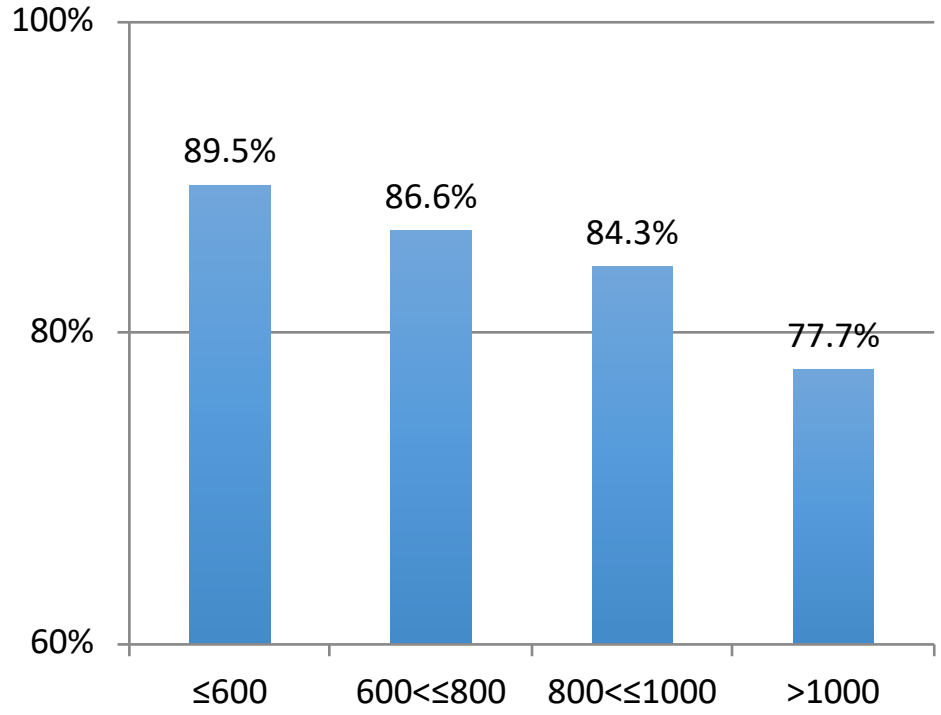
Results

Success rate (stone-free rates after 3 months)

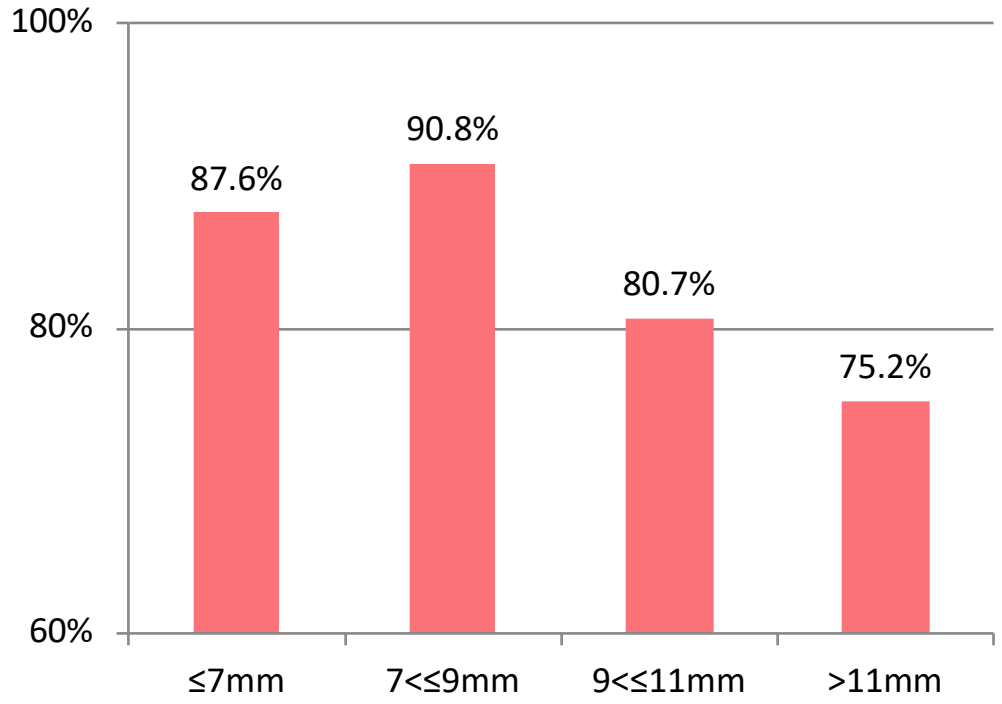
Stone factors (2)

*χ2-test

CT value (HU)* p=0.070



Stone Size* **p=0.0072**



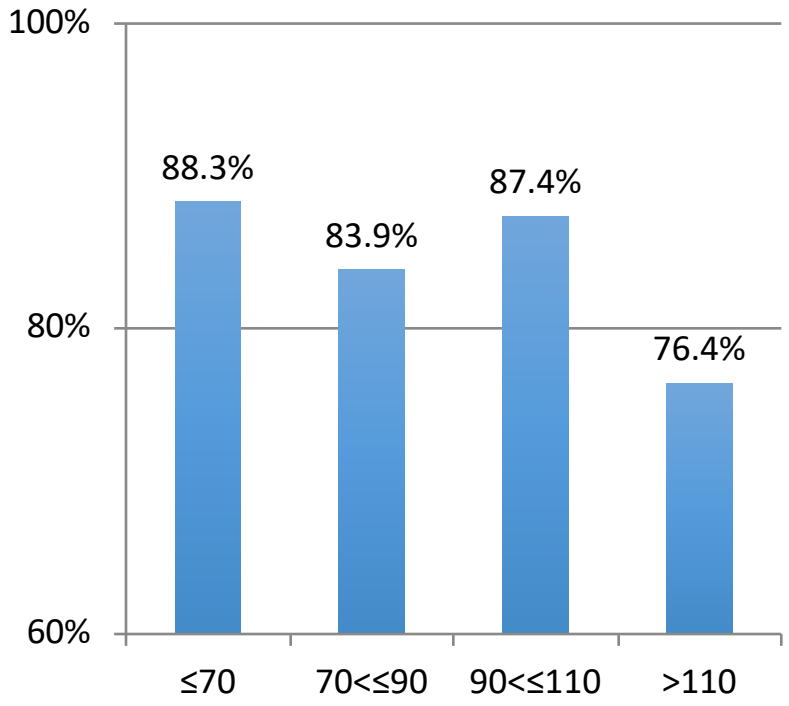
Results

Success rate (stone-free rates after 3 months)

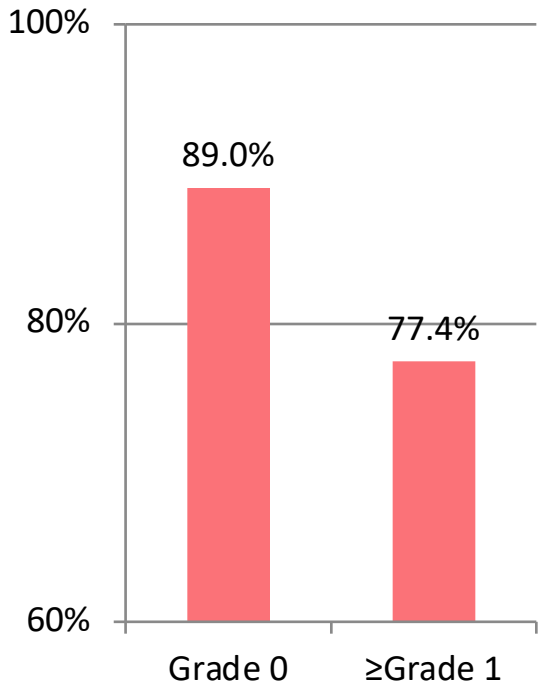
Stone factors (3)

*χ2-test

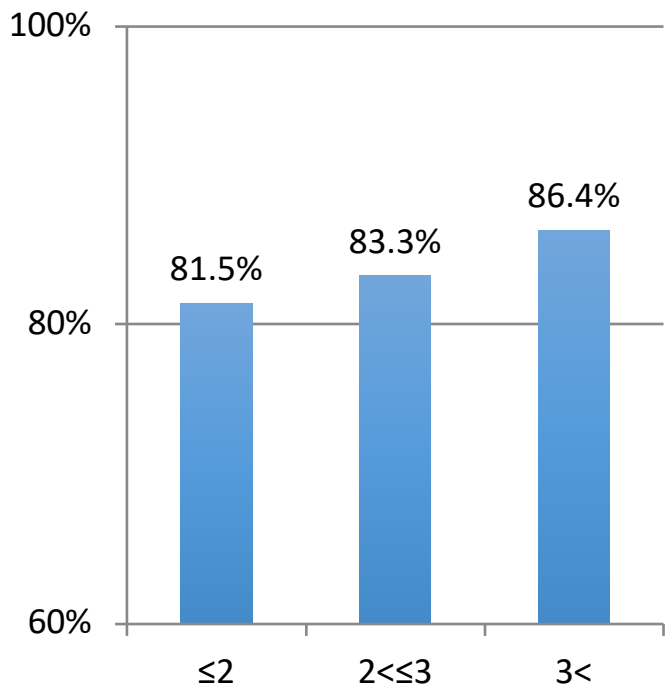
SSD* p=0.073



Hydronephrosis* p=0.001



Stagnation period* p=0.402



Results

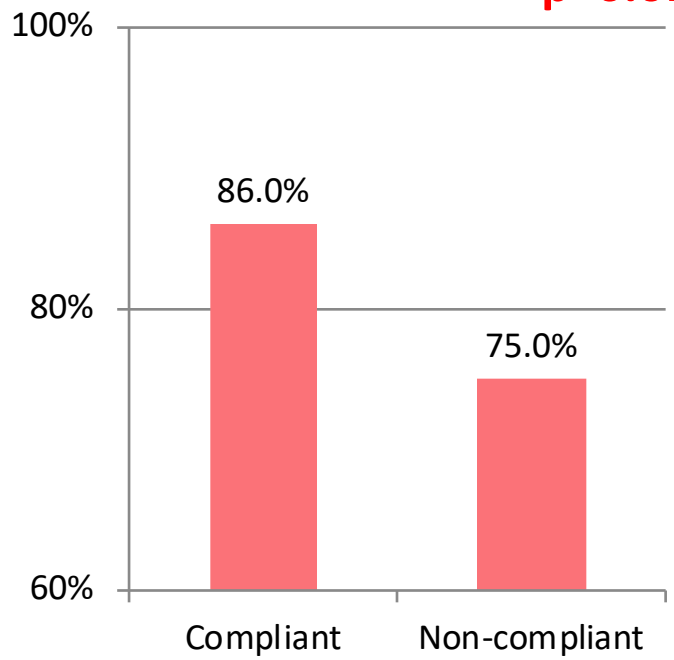
Success rate (stone-free rates after 3 months)

Therapeutic factors (1)

*χ2-test

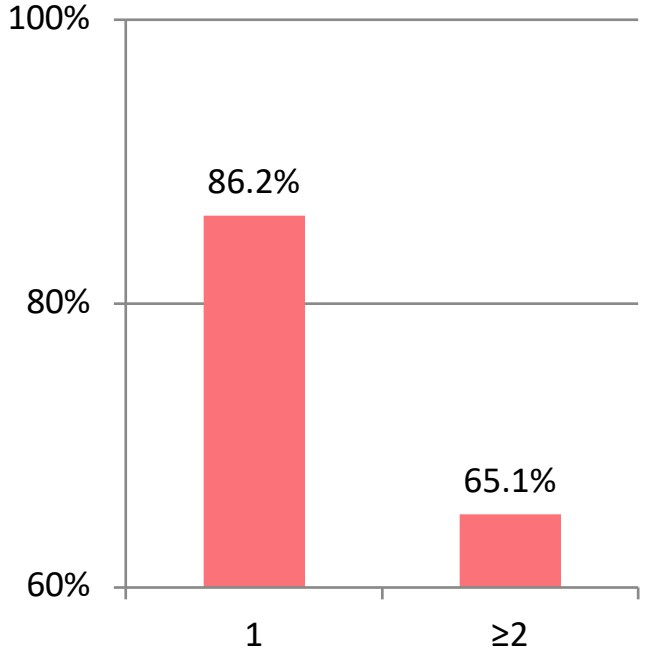
Compliance to recommended technique*

p=0.017



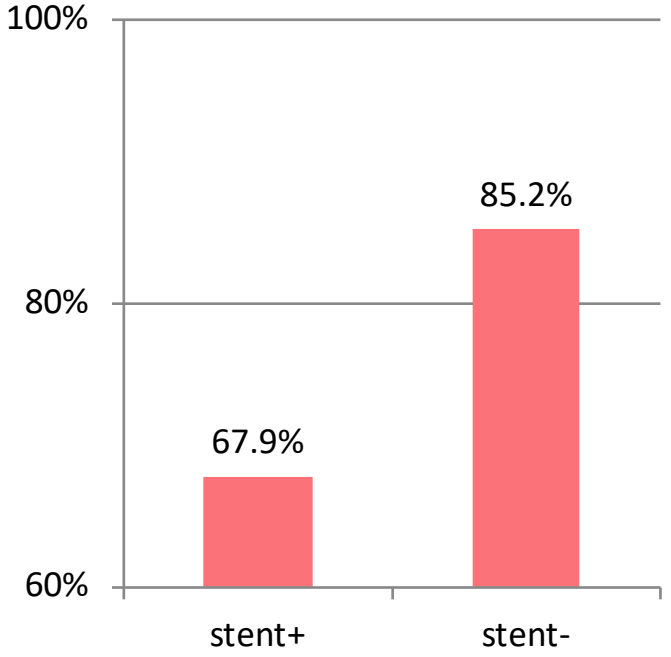
Number of treatments*

p<0.001



Stent indwelling*

p=0.015



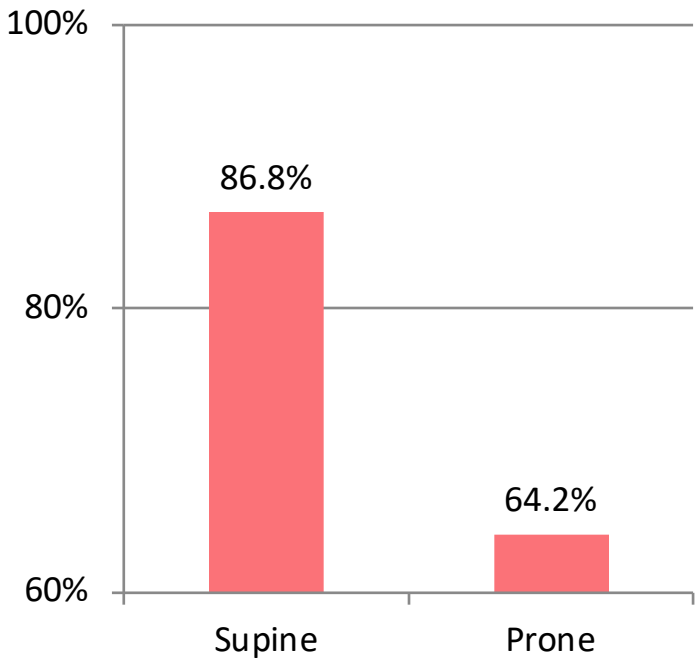
Results

Success rate (stone-free rates after 3 months)

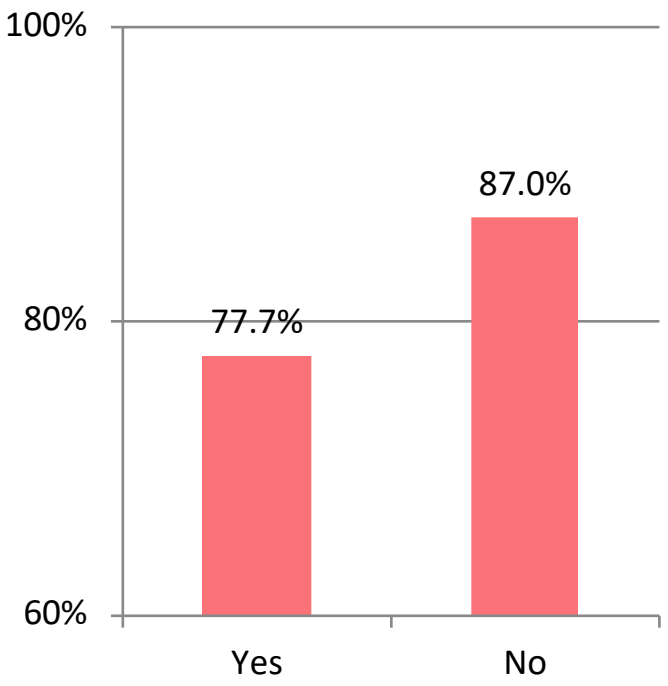
Therapeutic factors (2)

*χ2-test

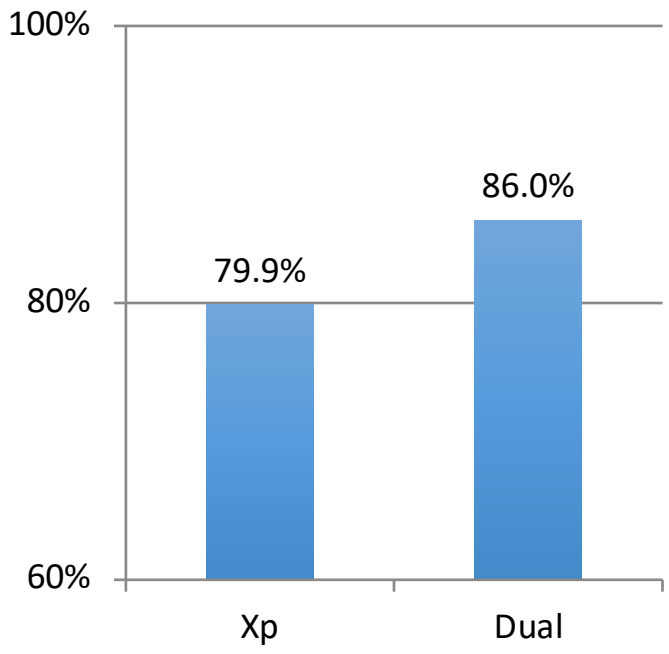
Body position* p<0.001



Use of stretcher wedge* p=0.012



Targeting method* p=0.102



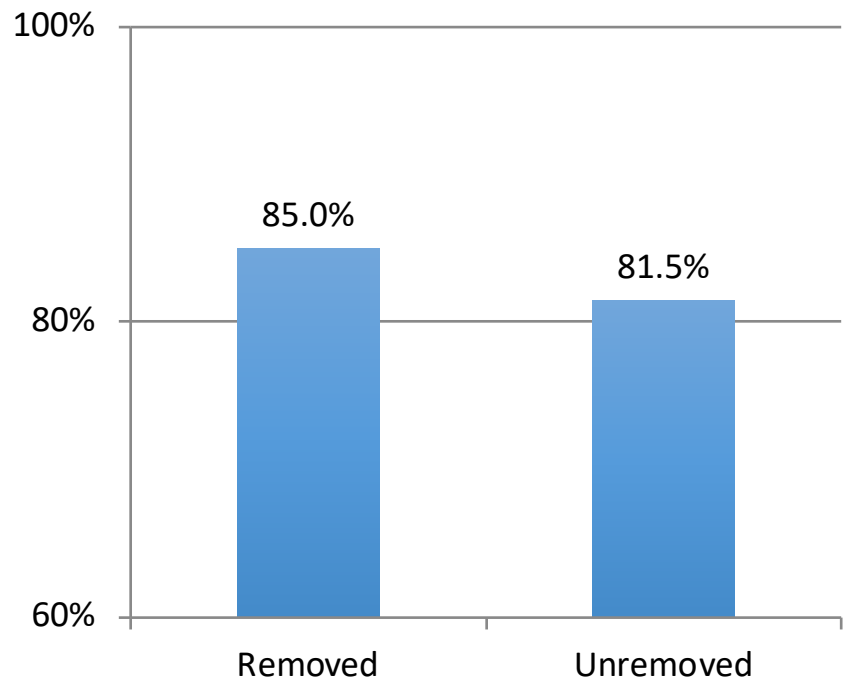
Results

Success rate (stone-free rates after 3 months)

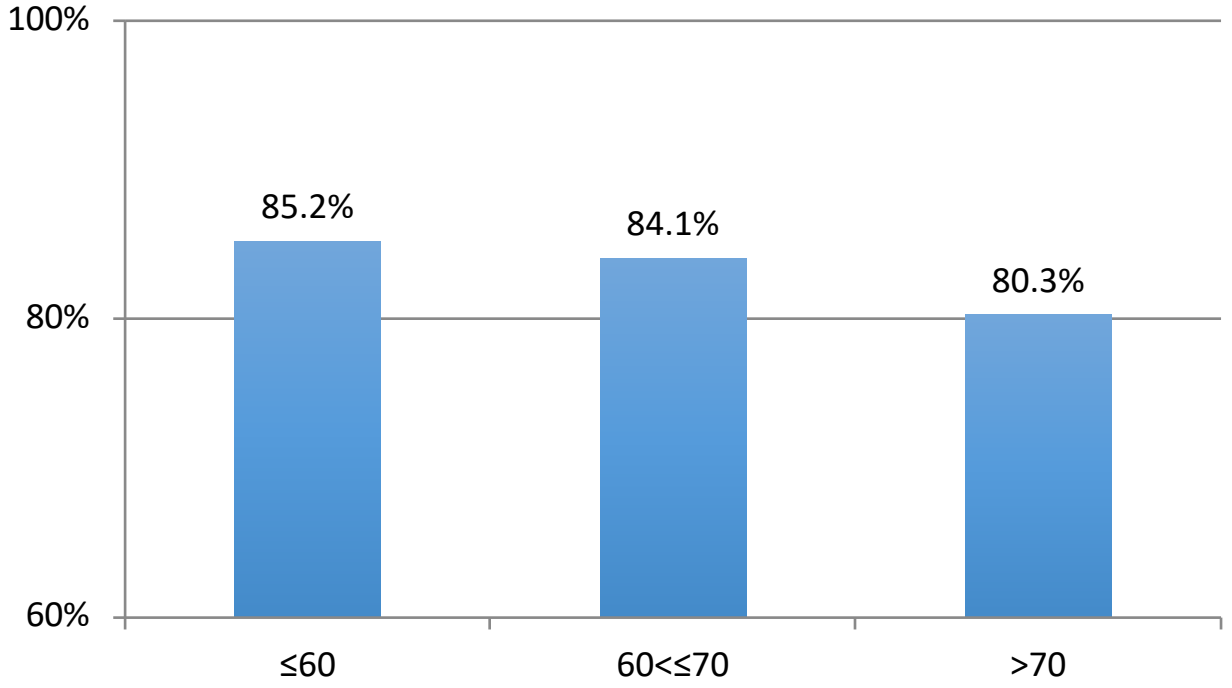
Therapeutic factors (3)

*χ2-test

Air removal* p=0.386



Shock wave frequency* p=0.638



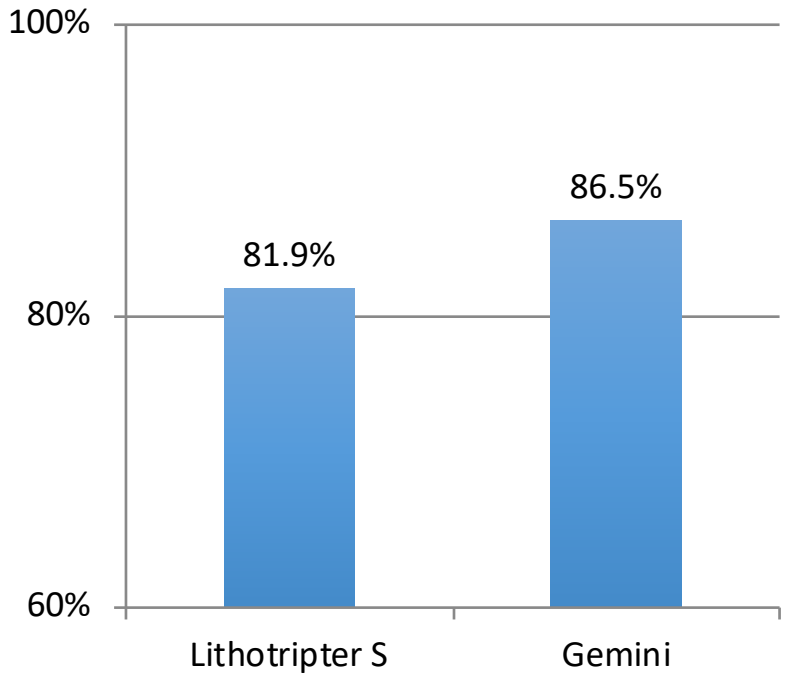
Results

Success rate (stone-free rates after 3 months)

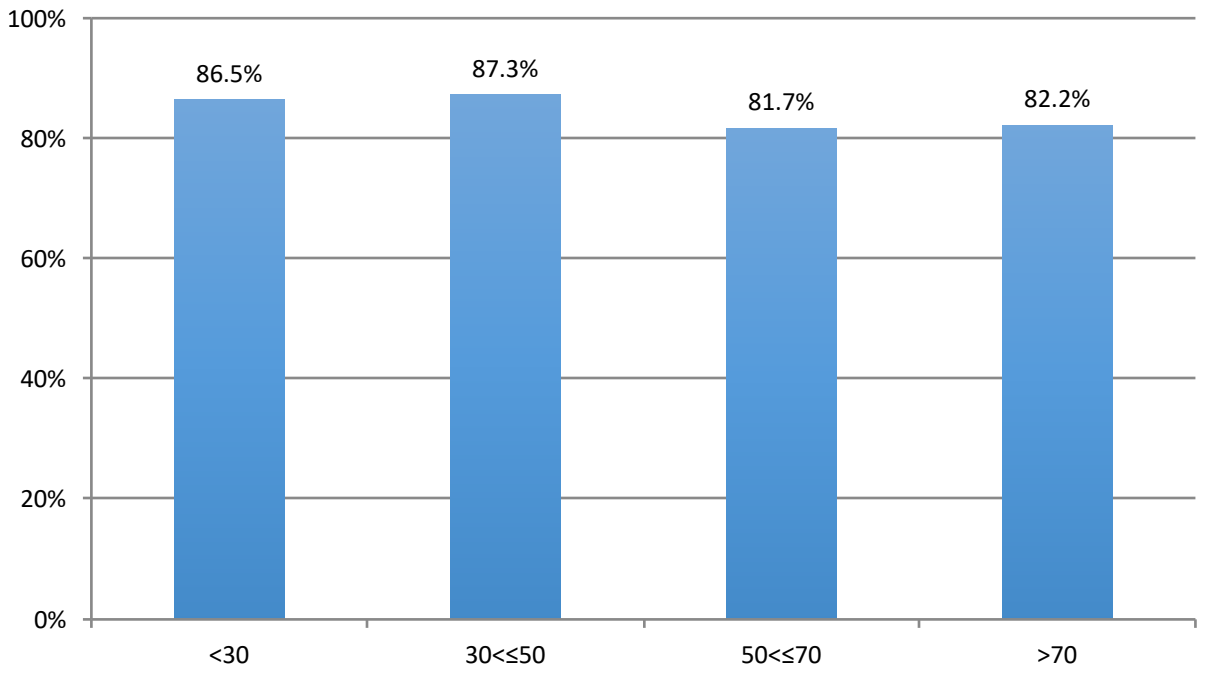
Instrument factors

*χ2-test

Lithotripter model* p=0.174



Days after maintenance* p=0.638



Results

Univariate and Multivariate Analysis for SWL success

		Univariate			Multivariate		
Total		OR	95%CI	p-value	OR	95%CI	p-value
Compliance to HOT	Compliant / Non-compliant	1.99	(1.07 - 3.55)	0.028	1.75	(0.90 - 3.31)	0.098
Number of Treatment	1 / ≥2	2.17	(1.29 - 3.74)	0.003	2.64	(1.22 - 5.52)	0.014
Stone size (mm)	<9 / ≥9	2.59	(1.39 - 5.00)	0.002	2.17	(1.21 - 4.00)	0.010
CT value (HU)	<817 / ≥817	1.74	(1.04 - 2.94)	0.034	1.44	(0.81 - 2.58)	0.216
Hydronephrosis (SFU grades)	G0 / ≥G1	2.32	(1.40- 3.93)	0.001	1.81	(0.98- 3.34)	0.056
Stent indwelling	- / +	2.76	(1.14- 6.22)	0.025	4.21	(1.63- 10.4)	0.004
Body position	Supine / Prone	3.60	(1.89- 6.69)	0.000	2.94	(1.34- 6.41)	0.007
Stretcher Wedge	- / +	1.90	(1.13- 3.17)	0.016	1.27	(0.67- 2.35)	0.466
Renal calyx-pelvis and UPJ							
Stone size (mm)	<10 / ≥10	2.53	(1.03 - 6.84)	0.042	1.98	(0.76 - 5.51)	0.162
Stent indwelling	- / +	7.50	(2.04 - 26.01)	0.004	5.79	(1.52 - 20.98)	0.012
Proximal ureter							
Number of Treatment	1 / ≥2	3.92	(1.39 - 11.01)	0.010	2.14	(0.66 - 6.79)	0.198
Stone size (mm)	<9 / ≥9	3.59	(1.49 - 9.36)	0.004	5.16	(1.77 - 16.22)	0.003
Hydronephrosis (SFU grades)	G0 / ≥G1	4.27	(1.37- 18.82)	0.010	2.69	(0.75- 12.83)	0.133
Body position	Supine / Prone	4.11	(1.52- 11.20)	0.006	2.96	(0.68- 13.27)	0.146
Stretcher Wedge	- / +	3.00	(1.26- 7.20)	0.013	2.25	(0.69- 7.32)	0.177
Middle ureter							
Days after maintenance	<58 / ≥58	8.67	(1.20 - 178.90)	0.031			
Distal ureter							
Stagnation period	<3 / ≥3	3.89	(1.20 - 33.15)	0.025			

Discussion

Based on the results, the model success rate was calculated for the extracted treatments that met the following conditions.

① First treatment ② stone size, <9mm ③ Supine treatment ④ No stent

Success, 160 cases; Fail, 11 cases,
success rate, 93.6%

⑤ Compliance to HOT techniques

Success, 132 cases; Fail, 0 cases,
success rate, 100.0%

Discussion

- **Report on Hands-on-Training for SWL: only 2 reports** (Pubmed Search)

  ① Okada et al. Urolithiasis 2013

  ② Sharma NL et al. Urolithiasis 2017

  Survey on SWL treatment status at 21 UK facilities

  → SWL-HOT is almost unimplemented worldwide

- **Review of SWL safety**

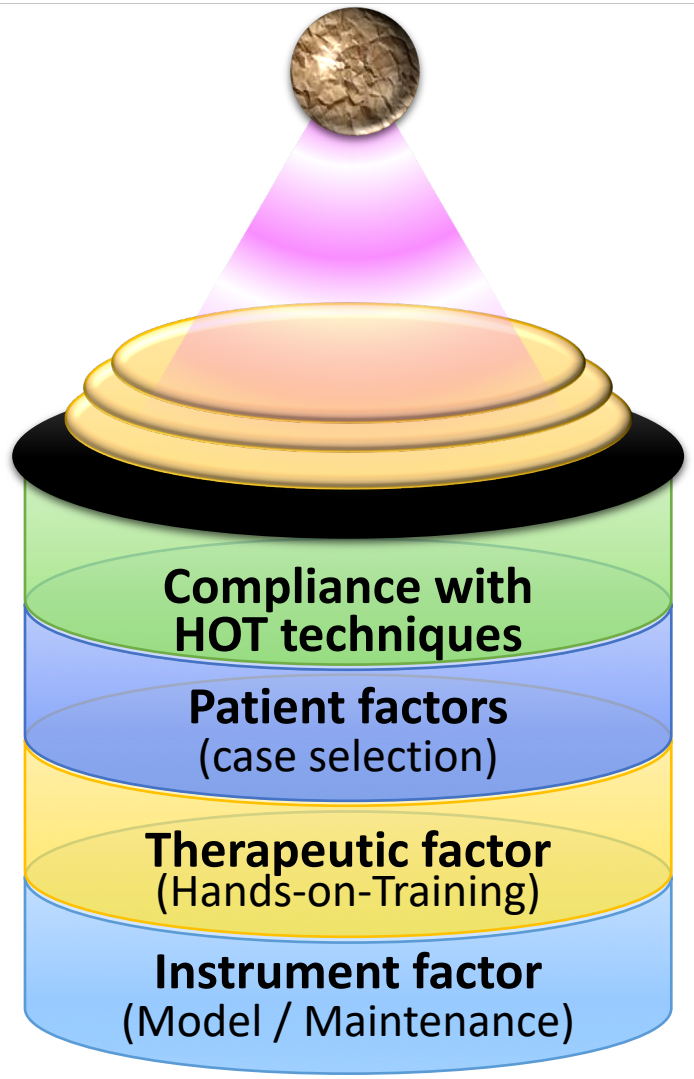
  【 Surgical mortality for urolithiasis 】

  (Japanese guideline for urolithiasis clinical practice, 2nd edition)

  - URS 0.06% (Sugihara T et al. BJU Int. 2013)
  - PNL 0.04% (Seitz C et al. Eur Urol. 2012)
  - SWL 0.0% (Few reports)

  → Now is the time to re-recognize the minimally invasive properties of SWL

Discussion

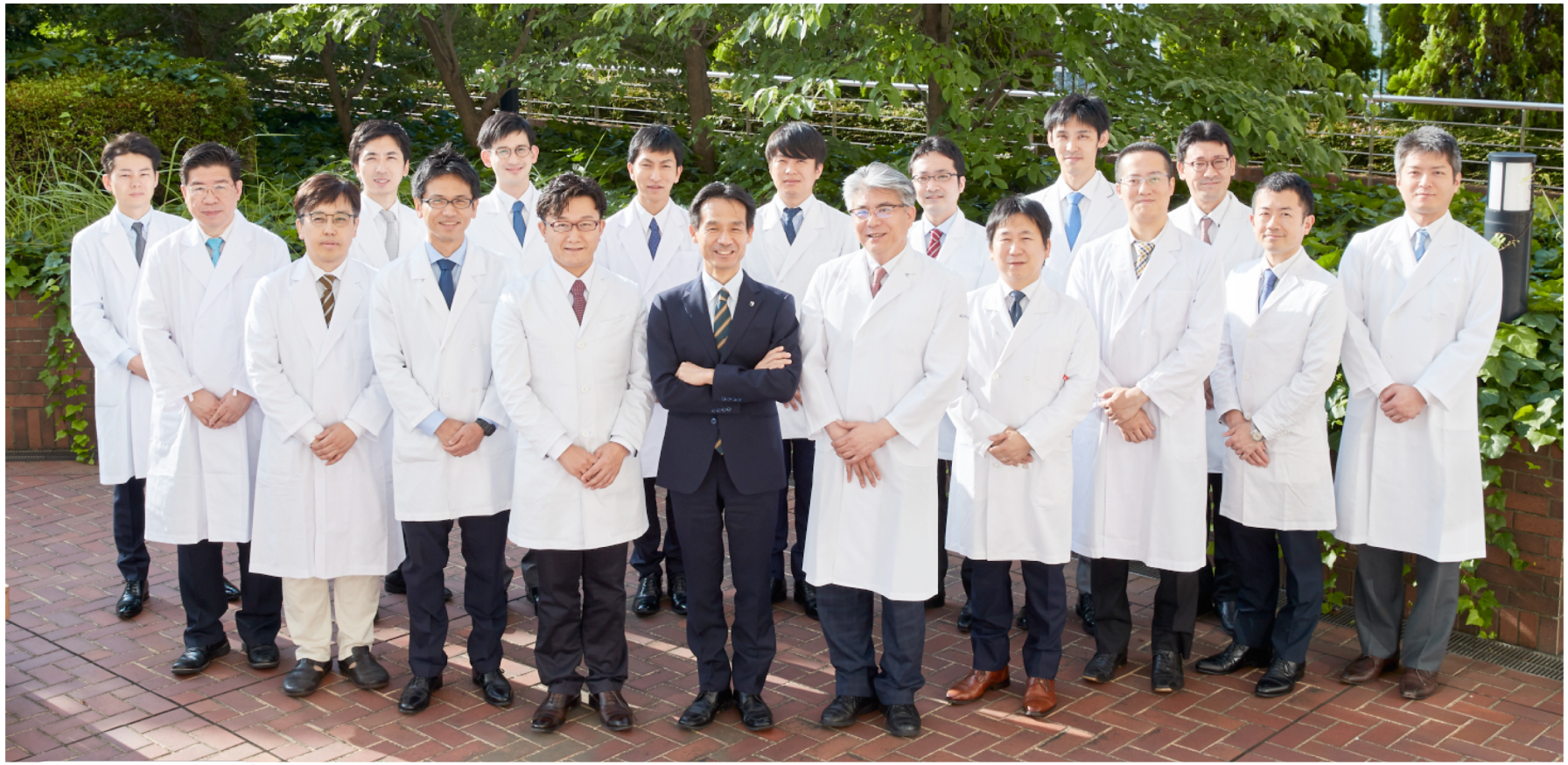


- Rooting SWL-HOT is expected to greatly improve the success rate.
- The implementation of HOT for SWL has not only improved the skills and awareness of surgeons, but has also generated positive interest from manufacturers.
- Since the success rate increases by complying with the HOT technique, it was shown that repeated HOT training could contribute to more effective and safe calculus surgery.

Conclusion

- Continuous hands-on training on SWL technique was found to be able to keep the treatment success rate high.
- Appropriate case selection and compliance with HOT technique can dramatically improve SWL success rate.

Special Thanks



Thank you for your attention.

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