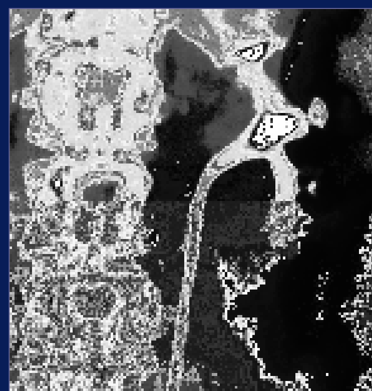
OPTIMAL MANAGEMENT OF LOWER POLE CALCULI



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The University of Texas Southwestern Medical Center
Dallas, Texas

LOWER POLE STONES

- Unique location in terms of stone management
- Differences in outcome of SWL depending on stone location

RESULTS OF SWL BY STONE LOCATION

SWL FOR TREATMENT OF LOWER POLE CALCULI

- Non-invasive
- High patient acceptance
- Low complication rate
- Failures easily salvaged with PCNL or URS

MEASURES TO IMPROVE CLEARANCE

- **Brownlee et al** (J Urol 143, 1990):
  - Controlled inversion tx, percussion, hydration:
  - 88% SF w/ 2 wk IT vs 12.5% w/ single session
- **Kosar et al** (J Endourol 13, 1999):
  - Vibration massage daily x 14 d
  - 80% SF w/ vibration vs 60% w/o
- **Nicely et al** (J Urol 148, 1992):
  - Retrograde irrigation w/ a directed catheter during SWL
  - 71% w/ irrigation vs 54% in controls
- **Graham and Nelson** (J Urol 152, 1994):
  - Continuous saline irrigation via lower pole NT

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MEASURES TO IMPROVE CLEARANCE

Pace et al, J Urol 166, 2001

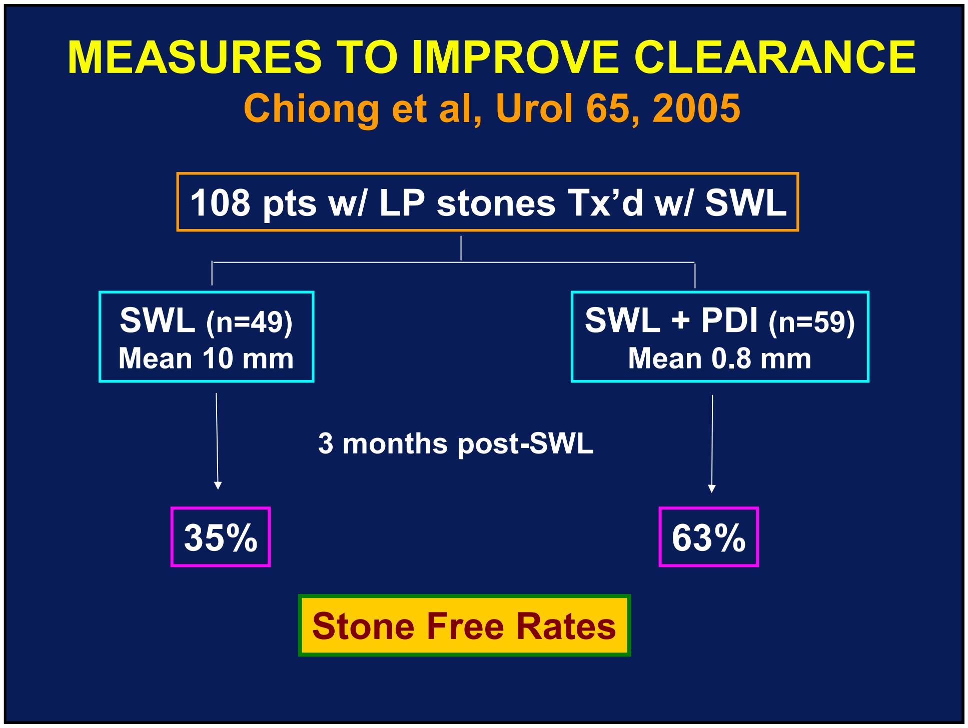
Percussion

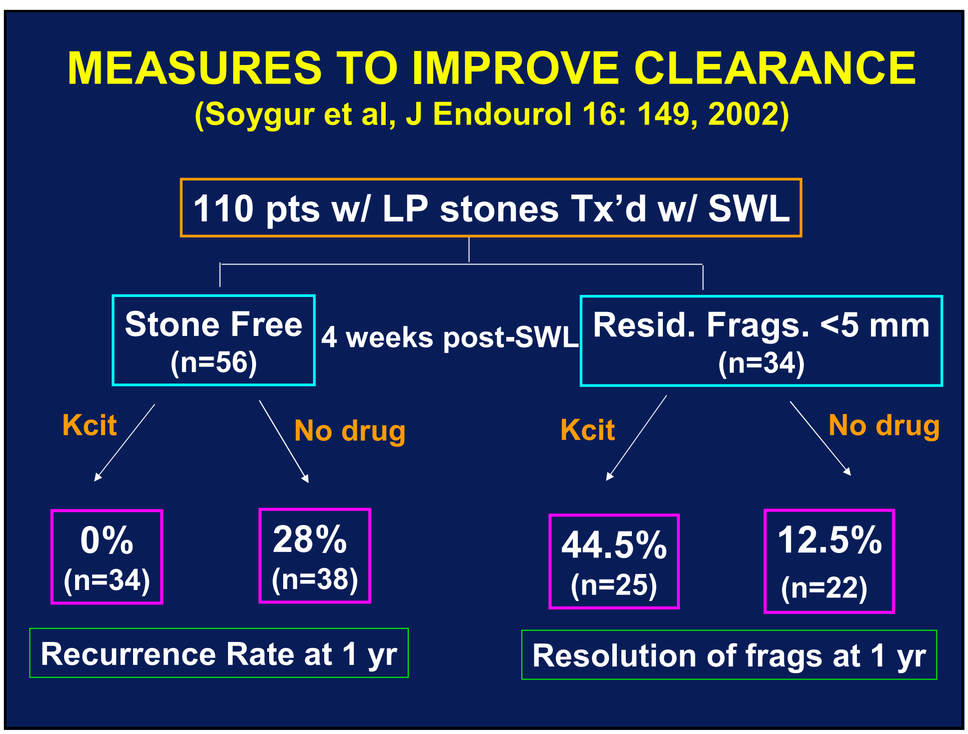
Inversion

Diuresis

69 pts w/ <4 mm residual LP fragments 3 mo post-SWL randomized to MPI vs observation

- SFR 40% vs 3% for control group
- MPI safe and effective tx option for LP fragments

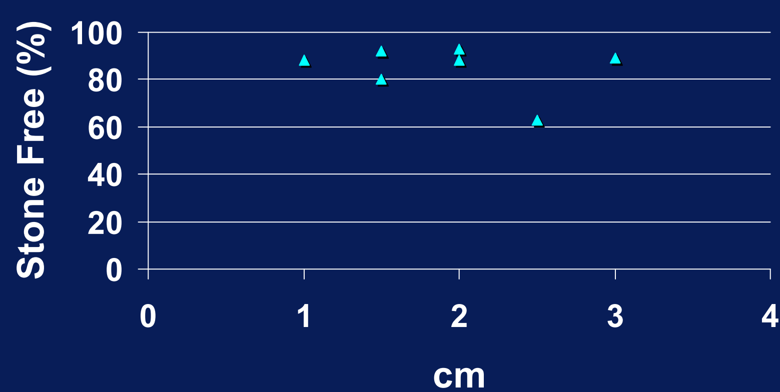

MEASURES TO IMPROVE CLEARANCE
Chiong et al, Urol 65, 2005
108 pts w/ LP stones Tx'd w/ SWL
SWL (n=49)
Mean 10 mm
SWL + PDI (n=59)
Mean 0.8 mm
3 months post-SWL
35%
63%
Stone Free Rates


MEASURES TO IMPROVE CLEARANCE
(Soygur et al, J Endourol 16: 149, 2002)
110 pts w/ LP stones Tx'd w/ SWL
Stone Free
(n=56)
4 weeks post-SWL
Resid. Frags. <5 mm
(n=34)
Kcit
No drug
Kcit
No drug
0%
(n=34)
28%
(n=38)
44.5%
(n=25)
12.5%
(n=22)
Recurrence Rate at 1 yr
Resolution of frags at 1 yr

PCNL FOR TREATMENT OF LOWER POLE CALCULI

- SF rates location-independent
- Generally "easy" percs
- Lower pole access "safe" (below 12th rib)
- Highly effective

PCNL FOR NON-STAGHORN RENAL CALCULI
Influence of Stone Size



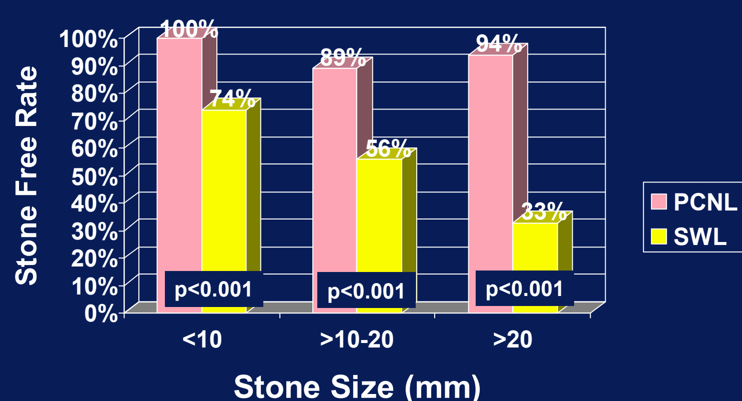
META-ANALYSIS: PCNL VS SWL FOR LOWER POLE STONES

Lingeman et al, J Urol 151, 1994

- 13 SWL studies with stratified lower pole stone data (2927 cases)
- 3 PCNL studies (101 cases)
- Overall stone free rates: 90% PCNL vs 60% SWL ($p<0.0001$)
- Controlling for stone size, pts w/ lower pole stones 6.27x more likely to be rendered SF w/ PCNL than SWL ($p<0.0001$)

META-ANALYSIS OF SWL VS PCNL FOR LOWER POLE STONES

Lingeman et al, J. Urol, 1994



PROSPECTIVE, RANDOMIZED TRIAL: PCNL VS SWL FOR LOWER POLE STONES

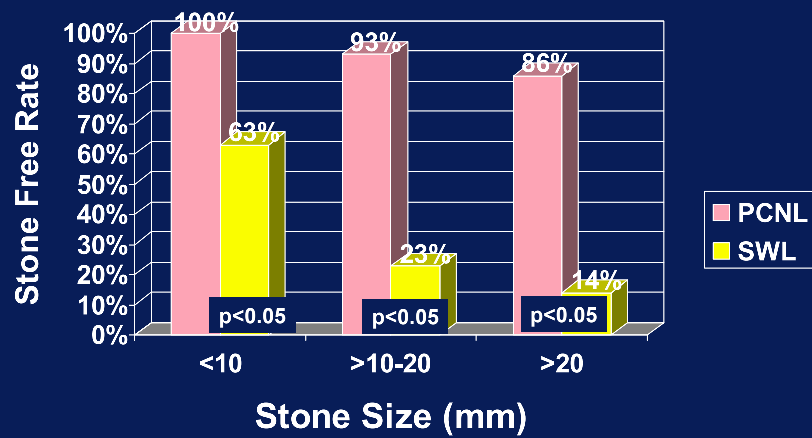
Lingeman and Lower Pole Study Group
(J Urol 166:2072,2001)

- 14 institutions represented
- 160 pts w/ LP stones randomized to SWL vs PCNL, stratified by stone size
- 107 pts (88%) available for 3 mo. F/U
- Patients assessed for:
    - stone free status by nephrotomograms
    - hospital stay
    - complications
    - retreatments
    - Health status survey

PROSPECTIVE, RANDOMIZED STUDY OF PCNL VS SWL FOR LOWER POLE STONES

	Stone Free	LOS (days)	Compl.	ReTx	Auxil. Proc.
SWL	37% (19/52)	0.55	12%	16% (10/64)	16% (10/64)
PCNL	95% (52/55)	2.67	23%	9% (5/58)	2% (1/58)

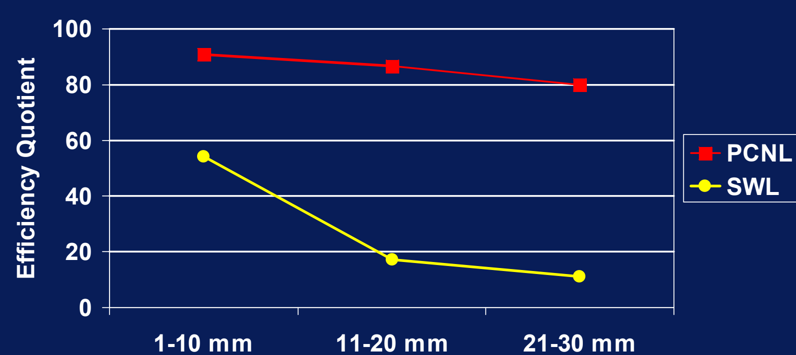
PROSPECTIVE, RANDOMIZED LOWER POLE STONE STUDY: RESULTS OF PCNL VS SWL



EFFICIENCY QUOTIENTS FOR PCNL VS SWL FOR LOWER POLE STONES

Lingeman and Lower Pole Study Group

EQ = %Stone Free/(100 + %Retx + %Auxiliary Proced



LOWER POLE STONES: ANATOMIC CONSIDERATIONS

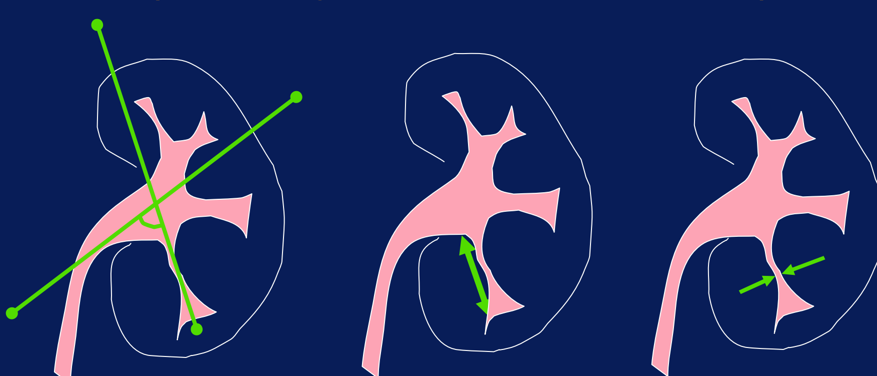
Sampaio and Aragao, J Endourol 8, 1994

Methods

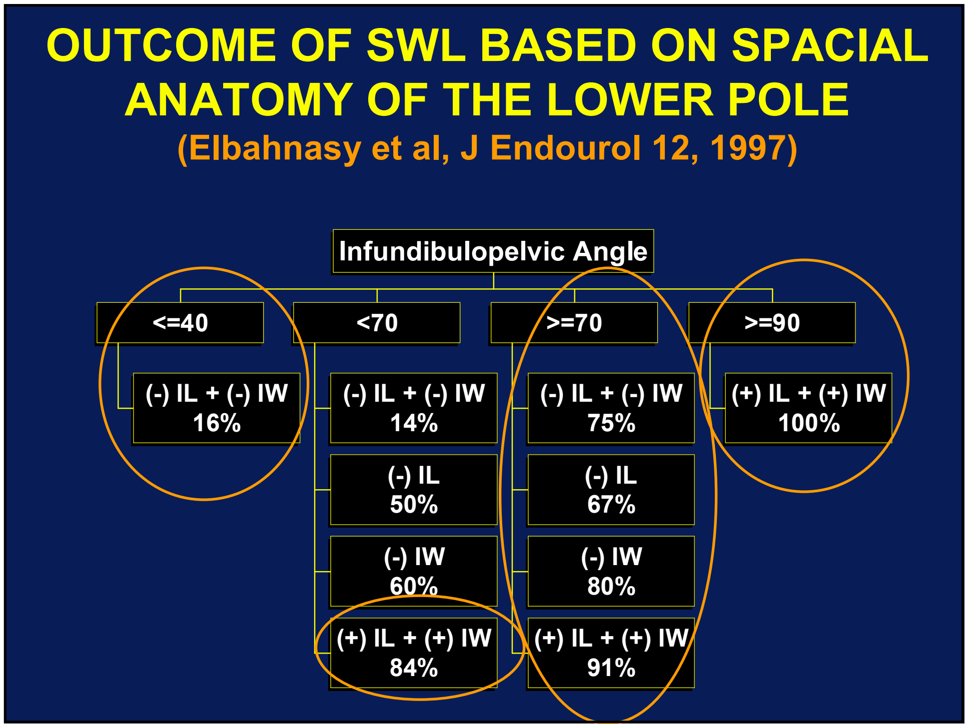
- Analysis of 146 endocasts of kidney collecting systems
- Assessed anatomic configuration of lower pole calyceal system

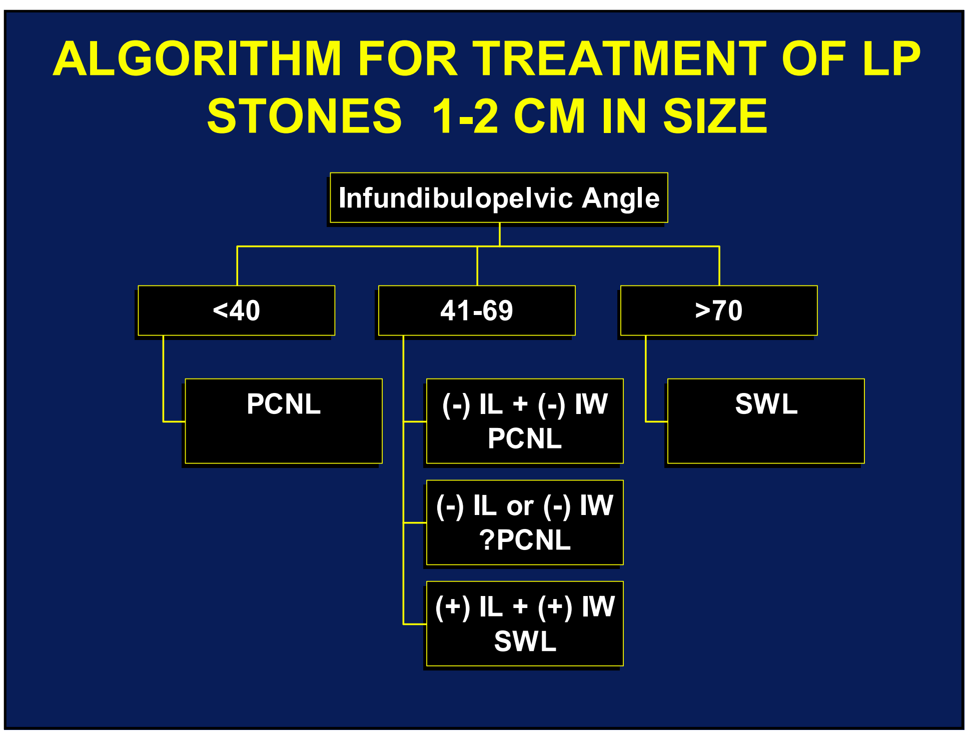
SPACIAL ANATOMY OF THE LP CALYX

(Elbahnasy et al, J Endourol 12, 1997)



Infundibulopelvic angle	Infundibular length	Infundibular width
>90°	<3 cm	>5 mm


OUTCOME OF SWL BASED ON SPACIAL ANATOMY OF THE LOWER POLE
(Elbahnasy et al, J Endourol 12, 1997)
Infundibulopelvic Angle
<=40
<70
>=70
>=90
(-) IL + (-) IW 16%
(-) IL + (-) IW 14%
(-) IL 50%
(-) IW 60%
(+) IL + (+) IW 84%
(-) IL + (-) IW 75%
(-) IL 67%
(-) IW 80%
(+) IL + (+) IW 91%
(+) IL + (+) IW 100%


ALGORITHM FOR TREATMENT OF LP STONES 1-2 CM IN SIZE
Infundibulopelvic Angle
<40
41-69
>70
PCNL
(-) IL + (-) IW PCNL
(-) IL or (-) IW ?PCNL
(+) IL + (+) IW SWL
SWL

EFFECT OF CALYCEAL ANATOMY

- Gupta (JU 163, 2000) LIP angle and IW sig. influence stone clearance after SWL
- Keeley et al (Eur Urol, 36:371, 1999) LIP angle only factor that significantly influences SF rates
- Sumino et al (J Urol 168, 2002) Independent predictors of SF state: infund. length-to-diameter ratio (<7 mm), diameter (>4 mm) and no. of calyces (single)
- Symes et al (Urol Res, 33, 2005) Pelvi-caliceal height significantly lower in stone free group
- Ghoneim et al (Eur Urol, 48: 2005) LIP angle and infundibular length significant factors influencing SF rates

EFFECT OF CALYCEAL ANATOMY

- Madbouly et al (J Urol 165: 1415, 2001) LP anatomy does <u>not</u> affect stone clearance
- Sorensen and Chandhoke (J Urol 168, 2002) Only stone size, not calyceal anatomy, was predictive of stone free state

REPRODUCIBILITY OF MEASURMENTS

Knoll et al, J Endourol 17: 447, 2003

- 40 RU on IVP analyzed by 5 observers, 3x each on different days
  - Interobserver correspondence poor
  - Intraobserver variability better
- Might explain variability among studies

PREDICTION OF LP STONE CLEARANCE USING ARTIFICAL NEURAL NETWORK

Poulakis Et al, JU 169: 1250, 2003

- 680 pts (701 RU) w/ LP stones tx'd w/ SWL: SF rate of 68%
- Assessed impact of variety of pt, stone and anatomic characteristics on SFR
- Neural network created using 101 cases for training, then used 600 cases for testing
- Relative importance of each variable determined

PREDICTION OF LP STONE CLEARANCE USING ARTIFICAL NEURAL NETWORK

Poulakis Et al, JU 169: 1250, 2003

Univariate Analysis

- BMI
- Urine transport type
- Infundibular diameter
- IPA
- Infundulouretero-pelvic angle (IUPA)

ANN-assigned relative wt

- Urinary transport
- IUPA
- Caliceal-pelvic height
- BMI
- Stone size

PREDICTION OF LP STONE CLEARANCE USING ARTIFICAL NEURAL NETWORK

Poulakis Et al, JU 169: 1250, 2003

- ANN 92% accurate in predicting LP stone fragment clearance after SWL
- Dynamic urinary transport most important factor in predicting stone clearance
- Anatomic measurements highly reproducible w/ low intra- and inter-observer variability
- Need for prospective trial

LOWER POLE STONES
Calyceal Anatomy

- Challenge is to predict likelihood of success for individual w/ known anatomic factors
- Need larger data base accumulation and multivariate analysis to construct tables that relate SFR to easily measurable anatomy

URETERORENOSCOPIC APPROACH

Advantages

- Generally performed on outpt basis
- Highly effective
- Minimal morbidity
- Works well for small stones and SWL failures and avoids PCNL

URS FOR INTRARENAL CALCULI

(Grasso, Urol Clinic N Am, 27, 2000)

- Multicenter: Grasso and Bagley
- 1000 procedures using ≤8F flexible ureteroscope
- Access to entire collecting system in 93% of cases; in 7% of cases the lower pole could not be accessed
- Need for secondary deflection to access the lower pole in 57% of cases

URETERORENOSCOPIC APPROACH

Improvements in Ureteroscope Design

2-way deflection and active and passive deflection facilitate access into virtually every calyx

ACCESSING THE LOWER CALYX

Small, nondilated collecting system with shallow infundibular/pelvic angle: Direct access with active deflection

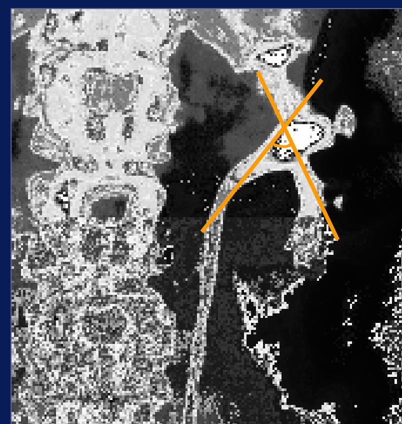
ACCESSING THE LOWER CALYX

Dilated collecting system with sharp infundibular/pelvic angle: Combination active and passive deflection

EFFECT OF PATIENT POSITION

Bercowsky et al, J Endourol 13, 1999

- Based on IVU views in various positions
- Broadest angle of entry into lower pole was w/ pt prone, 20° head down
- Rt side angle increased by 16°, left side by 25°



ACCESSING THE LOWER POLE CALYX

Afane et al, J. Endourol., 1999

- Reviewed 24 pts who underwent prone URS for lower pole stones (17 pts)
- Stone free rate of 88%

ACCESSING THE LOWER CALYX
Improvements in Ureteroscope Design

Duel active 1º and/or 2º deflection

ACMI DUR8 Elite

Storz Flex-X

LOWER POLE STONES
Passage of Instruments

- From 104°- 175° of deflection is required to access lower pole calyces
- Passage of instruments may result in loss of up to 86° of deflection

OPTIMIZING DEFLECTION

- Keep shaft of scope as straight as possible
  - Access sheath prevents buckling in bladder
  - Do not pass ureteroscope thru cystoscope sheath
- Gentle back tension on shaft of scope provides additional angulation of tip
- Placement of superstiff guidewire through working channel provides additional maneuverability
- Straighten scope to <30° deflection to pass instruments

NITINOL RETRIEVING DEVICES

- Tipless Nitinol basket
  - Works best in calyces
  - Causes only 10° loss of deflection w/ 7.5F flex ureteroscope (D'Honey, J. Endourol, 12, 1998)

- Combination grasper/basket
  - Easy to disengage
  - Minimal loss of deflection

RETRIEVAL AND LITHOTRIPSY DEVICES
Effect on Deflection of DUR8-E

Lobik et al, J Endourol 17, 2003

Baseline deflection	Stiff Wire	1.6F EHL	3.0F EHL	2.4/3F basket	200μ laser	365μ laser
Up 170°	5-23°	-6.5°	-20°	<12°	-7-43°	-8-59°
Dwn 185°						

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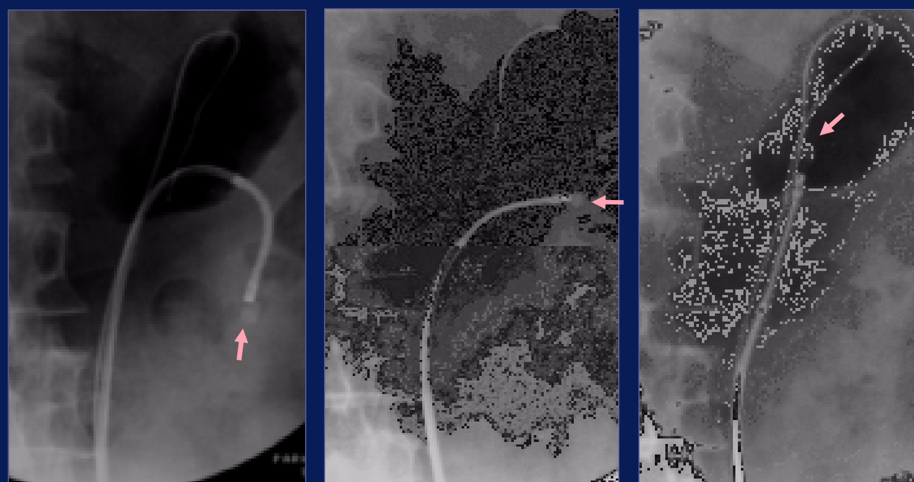
Up 170°	5-23°	-6.5°	-20°	<12°	-7-43°	-8-59°
Dwn 185°						

If 1° deflection initiated first, get maximum 2° deflection compared with 2° first followed by 1°

LOWER POLE STONE REPOSITIONING
Tipless Nitinol Basket



LOWER POLE STONE REPOSITIONING

- **Kourambas et al (Urol 56, 2000):**

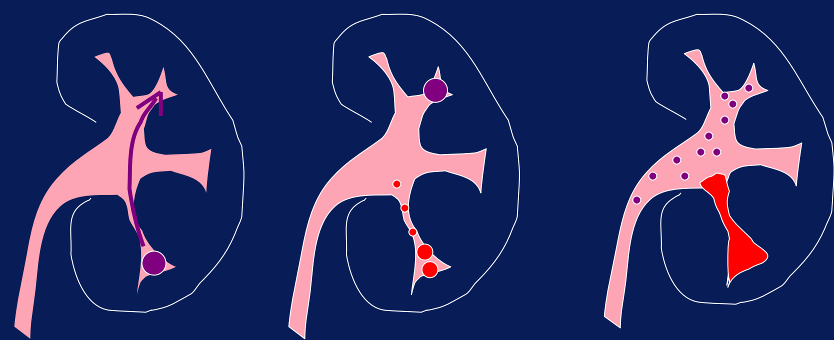
  10 pts w/ LP stones not accessible by URS
  - Stone displaced w/ nitinol basket or grasper
  - 90% SF for displaced
  - 83% for *in situ* stones

- **Schuster et al (J Urol 168, 2002):**

	In Situ N=59	Displaced N=19	P-value
Overall	71%	94%	0.058
≤1 cm	77%	77%	ns
>1 cm	29%	100%	0.005

IMPROVING LOWER POLE STONE CLEARANCE WITH URS

Patel and Fuchs, AUA 2003



Displace stone from lower to upper calyx	Inject autologous blood into lower pole infundibulum	Fragment stone; clot prevents lower pole pooling

LOWER POLE STONE STUDY II

Pearle et al, JU 173, 2005

109 pts enrolled

- **Group 1 (≤1 cm)** (n=67)
  - **SWL** (n=32)
  - **URS** (n=35)
- **Group 2 (>1-2.5 cm)** (n=42)
  - **URS** (n=20)
  - **PCNL** (n=22)

1º outcome parameter: SFR using CT criteria

LOWER POLE STONE STUDY II

	≤1 cm N=72		>1-2.5 cm N=42	
	SWL (n=32)	URS (n=35)	URS (n=20)	PCNL (n=22)
OR time (min)	66	90	91	79
Stone Free	35%	52%	37%	71%
2° proc	24%	7%	25%	5%
Intraop Complications	3%	20%	10%	9%
Postop Complications	23%	21%	0%	9.5%
LOS (days)	0	0.06	0	2.5
100% recovery time (d)	8	16	15	18

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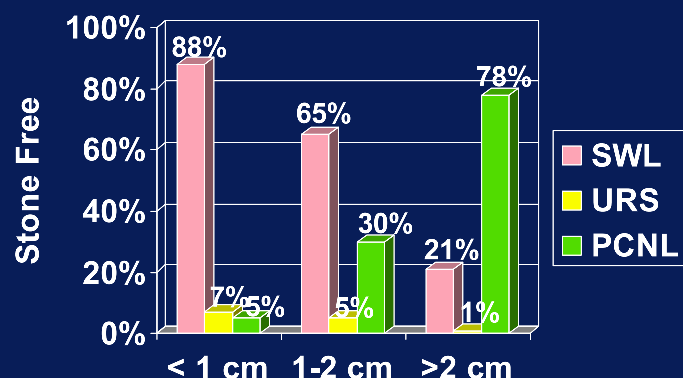
LOWER POLE STONE STUDIES I AND II

- For stones <1 cm, SWL and URS have <u>poor SFRs</u>
  - 2º outcome parameters favor SWL
- For stones >2 cm PCNL superior
- For stones b/w 1 and 2 cm, URS associated w/ relatively poor SFRs
  - PCNL has best outcomes

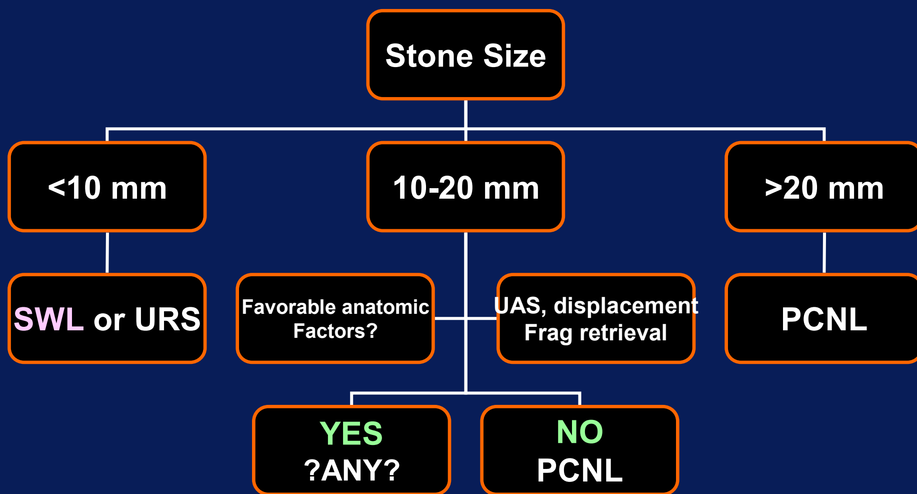
HOW ARE LP STONES TX'D IN PRACTICE?

Gerber, J Endourol 17: 501, 2003

- Internet and postal survey of American urologists regarding management of LP stones <1 cm, 1-2 cm, >2 cm (205 respondents)



ALGORITHM FOR MANAGEMENT OF LOWER POLE STONES



CONCLUSIONS

- For LP stones < 1 cm, SWL and URS stone free rates are low
  - SWL favored for secondary outcomes
- For LP stones >2 cm, PCNL is best
- For LP stones b/w 1 and 2 cm, SWL and URS stone free rates are poor
  - ? favorable anatomic subgroups for SWL
  - Measures to improve fragment clearance after URS (access sheaths, stone displacement, fragment retrieval)