Simulation Lab: Laparoscopic Suturing: Practical Applications for Tissue Re-approximation, Knot Tying and Suturing Technologies

PROGRAM CHAIRS
Jin Hee (Jeannie) Kim, MD & Nash S. Moawad, MD

Uchenna C. Acholonu, MD
Erica Dun, MD, MPH
Grace Y. Liu, MD, MSc
Kimberly A. Swan, MD

Krisztina I. Bajzak, MD
Lydia E. Garcia, MD
Emad M. Mikhail, MD
Tarek Toubia, MD
Johnny Yi, MD

Dina J. Chamsy, MD
Jamie Kroft, MD, MSc
Khara M. Simpson, MD
Mireille Truong, MD

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3-Dmed, Aesculap, Applied Medical, CooperSurgical, Ethicon US, LLC, Medtronic, Karl Storz Endoscopy-America, Inc.
Professional Education Information

Target Audience
This educational activity is developed to meet the needs of residents, fellows and new minimally invasive specialists in the field of gynecology.

Accreditation
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SUTR-702
Simulation Lab: Laparoscopic Suturing: Practical Applications for Tissue Re-approximation, Knot Tying and Suturing Technologies
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This course will provide an introduction to basic and advanced laparoscopic suturing techniques in a dry lab setting and is designed for participants wanting to expand their laparoscopic suturing skills. This course will present a variety of techniques for needle loading and tissue re-approximation from different port configurations in laparoscopic box trainers. Techniques and clinical applications for extra-corporeal, intra-corporeal knot tying, and running suturing techniques relevant to vaginal cuff closure, myomectomy, and cystotomy repair will be presented. In addition, various applications of different suture materials and alternative suturing devices and technologies utilized in gynecologic laparoscopy will be reviewed. This course will aim to present the material in a systematic fashion with concrete and focused objectives throughout the session. Faculty will provide an interactive environment to meet the needs of the individual, critical to effective learning. This course is designed for the practical gynecologist to help determine which suturing techniques will work best in his or her surgical practice.

Learning Objectives: At the conclusion of this course, the clinician will be able to: 1) Explain how to overcome the obstacles to laparoscopic suturing and knot tying in relation to depth perception and port placement; 2) reproduce efficient techniques for laparoscopic tissue re-approximation, suture management, and running closures; 3) recognize and perform efficient intra-corporeal and extra-corporeal knot tying, the common mistakes encountered, and how to correct them; and 4) compare and distinguish potential benefits of suturing technologies and devices used in laparoscopy.

Course Outline

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<td>7:00</td>
<td>Welcome, Introductions and Course Overview</td>
<td>J.H. Kim</td>
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<td>7:05</td>
<td>Pre-Test (3 minutes)</td>
<td>All Faculty</td>
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<tr>
<td>7:20</td>
<td>Handling Suture and Needle, Intra-Corporeal Knot Tying</td>
<td>N.S. Moawad</td>
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<tr>
<td>7:35</td>
<td><strong>LAB I:</strong> Drills, Needle Loading, Intra-Corporeal Knot Tying</td>
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<tr>
<td>8:05</td>
<td>Improve Efficiency and Avoid Errors</td>
<td>N.S. Moawad</td>
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<tr>
<td>8:20</td>
<td><strong>LAB II:</strong> Continuous Suturing, Advanced Skills</td>
<td>All Faculty</td>
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<tr>
<td>8:50</td>
<td>Questions &amp; Answers</td>
<td>All Faculty</td>
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<tr>
<td>9:00</td>
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<tr>
<td>9:15</td>
<td>Extra-Corporeal Knot Tying</td>
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<tr>
<td>9:50</td>
<td>Suture Types and Characteristics; Suturing Devices</td>
<td>J.H. Kim</td>
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<td>10:05</td>
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<tr>
<td>10:20</td>
<td><strong>LAB IV:</strong> Troubleshooting, Supra-Pubic Approach, Barbed Suture and Suturing Devices</td>
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<tr>
<td>10:50</td>
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<td>11:00</td>
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SUTR-703  
Simulation Lab: Laparoscopic Suturing: Practical Applications for Tissue Re-approximation, Knot Tying and Suturing Technologies  
Nash S. Moawad, Chair  
Faculty: Uchenna C. Acholonu, Kristztina I. Bajzak, Dina J. Chamsy, Erica Dun, Lydia E. Garcia, Jin Hee (Jeannie) Kim, Jamie Kroft, Grace Y. Liu, Emad M. Mikhail, Khara M. Simpson, Kimberly A. Swan, Tarek Toubia, Mireille Trioung, Johnny Yi

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</table>
PLANNER DISCLOSURE
The following members of AAGL have been involved in the educational planning of this workshop and have no conflict of interest to disclose (in alphabetical order by last name).
Art Arellano, Professional Education Manager, AAGL*
Amber Bradshaw
Speakers Bureau: Myriad Genetics Lab
Other: Proctor: Intuitive Surgical
Erica Dun*
Frank D. Loffer, Medical Director, AAGL*
Linda Michels, Executive Director, AAGL*
Johnny Yi*

SCIENTIFIC PROGRAM COMMITTEE
Arnold P. Advincula
Consultant: Intuitive
Royalty: CooperSurgical
Sarah L. Cohen*
Jon I. Einarsson*
Stuart Hart
Consultant: Covidien
Speakers Bureau: Boston Scientific, Covidien
Kimberly A. Kho
Contracted/Research: Applied Medical
Other: Pivotal Protocol Advisor: Actamax
Matthew T. Siedhoff
Other: Payment for Training Sales Representatives: Teleflex
M. Jonathon Solnik
Consultant: Z Microsystems
Other: Faculty for PACE Surgical Courses: Covidien

FACULTY DISCLOSURE
The following have agreed to provide verbal disclosure of their relationships prior to their presentations. They have also agreed to support their presentations and clinical recommendations with the “best available evidence” from medical literature (in alphabetical order by last name).
Uchenna C. Acholonu*
Krisztina I. Bajzak*
Dina J. Chamsy*
Erica Dun*
Lydia E. Garcia*
Jin Hee (Jeannie) Kim*
Jamie Kroft
Speakers Bureau: AbbVie
Grace Y. Liu
Other: National Advisory Board: Actavis
Emad M. Mikhail*
Nash S. Moawad*
Khara M. Simpson*
Kimberly A. Swan*
Tarek Toubia*
Mireille Truong*
Johnny Yi*

Asterisk (*) denotes no financial relationships to disclose.
Laparoscopic suturing
SUTR-703
Handling Suture and Needle, Intra-Corporeal Knot Tying
Nash S. Moawad, MD, MS
University of Florida MIGS

Disclosure
• I have no financial relationships to disclose

Objectives
• 1) Explain how to overcome the obstacles to laparoscopic suturing and knot tying in relation to depth perception and port placement
• 2) Recognize the benefits and applications of laparoscopic suturing
• 3) Reproduce efficient techniques for laparoscopic tissue re-approximation and suture management
• 4) Recognize and perform efficient ipsilateral intra-corporeal knot tying

Why suture laparoscopically?
• Enabler - allows you to do more
  • e.g., TLH, Myomectomy, Sacro-colpopexy, USLS, etc.
• Decrease complications
  • e.g., bleeding, vaginal cuff dehiscence, granulation tissue, dyspareunia, uterine rupture, avoid thermal damage, etc.

Vaginal Cuff Closure -TLH

Laparoscopic Myomectomy
**Sacro-Colpopexy**

**Why suture laparoscopically?**

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  - e.g., TLH, Myomectomy, Sacro-colpopexy, USLS, etc.
- **Decrease complications**
  - e.g., bleeding, vaginal cuff dehiscence, granulation tissue, dyspareunia, uterine rupture, avoid thermal damage, etc.
- **Repair complications** - decrease need for conversion.
  - Bowel, bladder and ureter repair.

**Bladder Repair - Excision of Endometriosis**

**Why suture laparoscopically?**

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**Bowel Repair**

**Hemostasis - Ovarian Cystectomy**

**Why suture laparoscopically?**

- **Enabler** - allows you to do more
  - e.g., TLH, Myomectomy, Sacro-colpopexy, USLS, etc.
- **Decrease complications**
  - e.g., bleeding, vaginal cuff dehiscence, granulation tissue, dyspareunia, uterine rupture, avoid thermal damage, etc.
- **Repair complications** - decrease need for conversion.
  - Bowel, bladder and ureter repair.
- **Refine your surgery** - e.g., ovarian cystectomy, oophoropexy, bowel suspension, ventrosuspension, etc.
Oophoropexy

Schools
- Ipsilateral approach
- Supra-pubic approach
- Contra-lateral approach
- Intra-corporeal knot-tying
- Extra-corporeal knot-tying

Plan your approach ...
- Strategy: Port setup
- Trocars (12 mm or backload through 5 or 3 mm trocar)

Intra-corporeal
- Ipsilateral approach
  - Where do you stand?
  - Ideal for suturing
  - Limitations?

Your Tools ...
- Needle Holder
- Needle Grasper “Helper”
- +/- Knot Pusher
- EndoShears
Fundamentals

- Needle introduction (properly load outside)
- Needle handling (Swivel)
- Needle loading
- Throwing a stitch
- Knot-tying

Anatomy of the needle
Tips to remember

• Use the tip of the needle holder and grasper
• A - B - C (Remember 1/3)
• Instrument shaft perpendicular to needle plain
• Utilize your “other” hand to present/stabilize the tissue
• Pierce perpendicular to the tissue
• Follow the curve of the needle (wrist rotation)

References

• Einarsson, et al. Minimally Invasive Hysterectomies, A Survey on Attitudes and Barriers among Practicing Gynecologists. JMIG, Vol 17, No 2, March/April 2010


• Parker et al. Risk Factors for Uterine Rupture after Laparoscopic Myomectomy. JMIG, Vol 17, No 5, September/October 2010

References


LAB I

Practice each drill:
1. Needle introduction - make sure you load the needle appropriately outside the trainer.
2. Practice swiveling
3. Air drive needle, then drive needle through suture pad
4. Tie an intra-corporeal knot - surgeon’s first, then single knot three additional times.
**OBJECTIVES**

- 1) Recognize and perform efficient supra-pubic intra-corporeal knot tying
- 2) Recognize techniques and applications of advanced laparoscopic suturing
- 3) Recognize common errors in laparoscopic suturing and how to overcome them

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**DISCLOSURE**

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**SUPRA-PUBIC SUTURING**

- Versatile for all pelvic procedures
- Equal access
- Ergonomics...
**EXPERT KNOT TYING**
- Required skill for continuous running sutures
- Efficiency: can use same long suture for multiple interrupted sutures
- Decrease needle-in & -out exchanges
- Cost
- Safety (number of needles to account for)

**CONTINUOUS SUTURING**
- 2-layer closure - Efficient closure of vaginal cuff, hysterotomy, cystotomy & enterotomy repair.
- Suture length is critical
- Assistant role

**CINCH KNOT**
- For large bites on tension e.g. Myomectomy
- Hemostatic e.g. Uterine artery ligation
- Lift! e.g. Burch, USLS, Ventrosuspension, Ovarian Transposition, etc
COMMON ERRORS
- Predict them
- Avoid them
- Recognize them
- Correct them
- Eliminate them!

= Proficiency

TROUBLESHOOTING
- Anticipate potential problems
- Avoid errors
- Maximize efficiency
- Maximize safety
- Teach effectively

REFERENCES
- Parker et al. Risk Factors for Uterine Rupture after Laparoscopic Myomectomy. JMG, Vol 17, No 5, September/October 2010
Objectives:
1. Expert knot tying - tying while holding suture
2. Continuous suturing
3. Cinch knot - bonus task once efficient with 1 & 2
Extra-Corporeal Suturing

Jin Hee (Jeannie) Kim, MD
Assistant Professor, Gynecologic Specialty Surgery
Co-Fellowship Director, Minimally Invasive Surgery
Columbia University Medical Center / NYPH
SUTR-700/701 Postgraduate Course
AAGL 2015

Objectives
- Recognize the benefits and applications of extra-corporeal suturing
- Reproduce efficient techniques of extra-corporeal suturing using the closed and open knot pusher
- Discuss alternative methods such as the multi-knot technique and Roeder’s knot
- Discuss extracorporeal suture assist devices including endoloop and endoknot

Benefits of Extracorporeal Suturing
- An alternative to intracorporeal suturing
- May be easier to perform and teach
  - More feasible and reproducible
  - Less need for needle management
  - Actual knot is made outside the body
  - Depending on operator, may be a faster method

Downside of extracorporeal suturing
- Requires long sutures
- There is still a learning curve
- Limited to interrupteds
- Potential for excessive tissue tension

Knot pushers
- Closed
- Open

Disclosures
I have no financial relationships to disclose
Steps for CLOSED knot pusher

- Bring out needle through SAME trocar
- Perform single (or surgeon’s knot)
- Feed exit strand through knot pusher and place a hemostat at tip
- Use knot pusher to drive knot ‘past point’
- Alternate suture tension
- Gravity is your friend!
- Perform one handed knot in opposite direction and drive knot down

Steps for OPEN knot pusher

- Bring out needle through SAME trocar
- Place hemostat on one end
- Perform single surgical knot
- Place open knot pusher next to the knot on the exit strand
- Use knot pusher to drive knot ‘past point’
- Perform one handed knot in opposite direction and drive knot down

Tips and tricks for the ACTIVE hand

- Untwist suture by twirling knot pusher around suture
- The tip of the knot pusher should be 1cm away from the knot on the exit strand
- Not on the knot
- Knot pusher at an angle to the suture
- Never parallel
- Push knot down ‘past point’ into the posterior cul-de-sac

Keep suture length on each side equal
- Shine some indirect light to feed suture
- Keep suture edge unfrayed; use sharp scissors
  - Especially if multifilament
- Snap the tip and drop the hemostat
- Gravity is your friend!
- No tension in trocar
- Tension past the trocar
Tips and Tricks for the PASSIVE hand

- Hold two ends of suture separately in the same hand
- Alternating equal tension on each end of suture as you push down
  - Index and middle finger
- Let the hemostat hang; gravity is your friend

The Actual Knot

- Can do single alternating
- Can start with surgeon’s knot
  - Slightly harder to push down knot but can be faster
- Then one-handed tie with non-dominant hand
- And alternate
- Remember to maintain tension on suture but don’t strangulate

Multi Knot Technique Video

Roeder’s knot

Endoloop

- Ethicon
- Single use
- 0 18” Vicryl and PDS

Steps for Endoloop

- Introduce into trocar
- Break end at assigned area
- Introduce loop around tissue to be removed; assistant pulls tissue thru loop
- Cinch loop tight by pulling end of suture and pushing introducer down
- If needed, place second endoloop distal to the first knot
Endoknot

- Ethicon
- 42" Vicryl, PDS, Ethibond

- Introduce endoknot, suture, bring out through same trocar
- Snap off top of plastic endoknot
- Perform extracorporeal knot tying
- Use built-in knot pusher to drive knot home

References


Thank You

Questions?
Alternative Suturing Technologies and Devices

Jin Hee (Jeannie) Kim, MD
Assistant Professor, Gynecologic Specialty Surgery
Co-Fellowship Director, Minimally Invasive Surgery
Columbia University Medical Center / NYPH
SUTR-700/701 Postgraduate Course
AAGL 2015

Objectives

- Discuss alternative suture material and devices utilized in gynecologic laparoscopic surgery
- Demonstrate utility of these alternatives to facilitate laparoscopic suturing

Laparoscopic suturing

- Technically challenging
- Diminished tactile feedback
- Lack of depth perception
- Tremor amplification
- Limited instrument mobility

Is there a solution?

- Barbed suture
- Automated suturing devices
  - Lapro-Ty
  - Endoloop
  - 3-D vision
  - Robot

Barbed Suture

- Quill™*
  - FDA approved 2004
  - Initially used by Plastics
- V Loc™*
  - FDA approved 2009
- Stratafix™
  - FDA approved 2012

*Greenberg et al. 2008 JMG

Disclosures

I have no financial relationships to disclose
**Quill™**

- Angiotech
- Traditionally bidirectional; unidirectional
- Helical pattern
- Anchors every 1mm

**Bidirectional**
- Monoderm
- PDO
- Nylon
- Polypropylene
- 3.5, 7, 10, 14, 24, 30, 40, 45cm
  
**Unidirectional**
- Monoderm
- PDO
- 20, 30, 45, 60, 70cm

Suture size is determined by its OUTER diameter.
When using barbed suture, upsize by one size.
3-0 traditional suture = 2-0 barbed suture.

---

**V Loc™ 90 and 180**

- Covidien
- Unidirectional barbed suture
  
- 20 barbs/cm
- Spiral configuration of barbs

**V Loc™ 90**
- Similar to Monocryl
- Absorbs in 90-110 days

**V Loc™ 180**
- Similar to PDS, Maxon
- Absorbs in 180 days

- Suture lengths: 6, 9, 12, and 18 inches
- Suture size: 4-0, 3-0, 2-0, 0

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**V-Loc and Quill**

- V-Loc 90 4-0, 18”
  - Dual angle cut
  - 900 anchoring barbs

- Quill 3-0, 18”
  - Single angle cut
  - 360 anchoring barbs

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**Stratafix™**

- Ethicon
- Unidirectional and bidirectional
  
- Suture size 4-0 to 1 (unidirectional); 5-0 to 1 (bidirectional)
  
- Length 20-60cm (unidirectional); 7cm x 7cm to 36cm x 36cm (bidirectional)

- PGA (short-term), PDO (long-term), polypropylene (nonabsorbable)
Quill™ Suturing Video: Myomectomy Closure

Advantages of Barbed Suture

- No knot tying required
- Two throws in the opposite direction to hold
- Equally distributed tension throughout suture
- Enables continuous suturing without backsliding

Advantages of Barbed Suture

- Barbed suture associated with significantly shorter suturing times for laparoscopic myomectomy compared to traditional sutures

V-Loc™ vs continuous suture in lsc myomectomy

<table>
<thead>
<tr>
<th></th>
<th>V-loc 90</th>
<th>Conventional</th>
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<tr>
<td>EBL</td>
<td>113.7 ± 74.1 ml</td>
<td>168.6 ± 76.1 ml</td>
<td>0.0076</td>
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<tr>
<td>Operative time (total)</td>
<td>51 ± 18.1 min</td>
<td>58 ± 17.8 min</td>
<td>0.0016</td>
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<tr>
<td>Suturing time</td>
<td>9.9 ± 4.3 min</td>
<td>15.8 ± 4.7 min</td>
<td>0.0004</td>
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</table>

Advantages of Barbed Suture

- Does barbed suture reduce the risk of vaginal cuff dehiscence?
- Retrospective study N = 387, Jan 2007 - Jan 2010
  - 149 Barbed suture vs. 229 with Vicryl or Endostitch
  - Mean time dehiscence 45 days
  - Two layer closure 0-PDO Quill 14 x 14 cm

<table>
<thead>
<tr>
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<th>Quill (n=149)</th>
<th>Vicryl or Endostitch or Monofilament suture (n=229)</th>
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<tbody>
<tr>
<td>No. Dehiscence</td>
<td>0</td>
<td>10 (4.2%)</td>
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<tr>
<td>Length of follow-up (days)</td>
<td>96</td>
<td>281</td>
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Advantages of Barbed Suture

- Does barbed suture increase the risk of adhesion formation?
  - Unidirectional barbed suture
    - 13 canine enterotomy model
    - No significant difference in adhesion scores at 21 days
  - Bidirectional barbed suture
    - 23 non-pregnant ewes
    - Necropsy at 3 months
    - 12 horns (52.2%) with barbed suture-adhesions
    - 10 horns (43.5%) with Vicryl closure-adhesions

Downside of Barbed Suture

- Does barbed suture increase the risk of adhesion formation?
“His” pareunia

Limited data

117 TLH, 82 completed questionnaires

5 reported persistent dyspareunia (6.8%) at 6 months post-op

6 reported “his”pareunia (8.2%)

Einarsson et al. 2010 JSLS

Case report

Bowel obstruction after TLH

0-PDO 14 x 14 cm Quill with Lapra Ty

Presented POD #30

On laparoscopy-tail of left end of barbed suture (4cm) found as cause of point of volvulus

Donnellan et al. 2011, JMIG

V-Loc™ Suturing Video:
Vaginal Cuff Closure

Automated Suture Devices

RD 180™ and TK®
- LSI Solutions
- Single use
- First used for heart valve surgery

Endostitch™
- Covidien
- Single use
- SILSTM stitch
- Endo360°
- Endo Evolution
- Reusable

RD 180™ and TK®

“Running Device”
- 5 or 10 mm
- Straight or angled shaft

“Titanium Knot”
- Trims suture
- Secures suture
- Permanent clips

Endostitch™

10 mm
- Shuttle needle
- Option articulating tip
- SILS Stitch Articulating Suturing Device

Intracorporeal knot tying 18 cm
- Extracorporeal knot tying 120 cm
Benefits of the Endostitch™

- Needle is preloaded
- Needle is protected from surrounding tissue (in neutral position)
- No needle management issues with loading or unloading
- Simplifies suturing and knot tying

To be successful with the Endostitch™

- You or your scrub (preferably both) needs to know how to load and unload the needle
- Do not twist to free needle from tissue; move the handle in the direction of the needle

Endostitch™

- Comparative study of pyeloplasties and bladder neck suspension
  - Automated intracorporeal suturing versus conventional suturing

<table>
<thead>
<tr>
<th></th>
<th>Endostitch</th>
<th>Conventional</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stitch placement</td>
<td>43 ± 27 sec</td>
<td>151 ± 24 sec</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Knot tying</td>
<td>74 ± 50 sec</td>
<td>197 ± 70 sec</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

Adams et al. 1995. Urology

Endostitch™ with Barbed Suture

- 0, 2-0, 3-0 V-Loc
- 10, 15, 20 cm lengths

Endo360°

- Reusable
- Curved needle
- Articulating
- Roticulating
- 3 lengths
  - Bariatric/single incision
  - Standard
  - Urogyn/natural orifice
- Suturing into a flat plane
## Suture Comparison

<table>
<thead>
<tr>
<th>Suture</th>
<th>Name, Size</th>
<th>Type</th>
<th>Absorption Rate</th>
<th>Tensile Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quill</td>
<td>Polydioxanone Monofilament</td>
<td></td>
<td>Complete by 180 days</td>
<td>80% at 24 days 80% at 28 days</td>
</tr>
<tr>
<td>V-Loc</td>
<td>V-Loc™ 90 V-Loc™ 180</td>
<td>Monofilament</td>
<td>Complete 90-110 days Complete by 180 days</td>
<td>75% at 14 days 65% at 21 days</td>
</tr>
<tr>
<td>Stratafix</td>
<td>PGA PDO</td>
<td>Multifilament</td>
<td>Complete 90-110 days Complete 120-180 days</td>
<td>49% at 21 days 77% at 21 days</td>
</tr>
<tr>
<td>RD 180</td>
<td>StrongSorb 2-0 Monoglide 2-0, 0</td>
<td>Multifilament</td>
<td>Complete 90-110 days Complete &lt; 110 days</td>
<td>30% at 21 days</td>
</tr>
<tr>
<td>Endostitch</td>
<td>Polysorb 3-0, 2-0, 0</td>
<td>Multifilament</td>
<td>Complete 56-70 days</td>
<td></td>
</tr>
<tr>
<td>Endo360</td>
<td>Polydioxanone PGA Monoswift</td>
<td>Multifilament Monofilament</td>
<td>Complete by 180 days Complete 90-120 days Complete &lt; 110 days</td>
<td>50% at 28 days 30% at 21 days 77% at 21 days</td>
</tr>
</tbody>
</table>

## Cost

| Quill | $20-60 |
| V-Loc | V-Loc 90 $20 V-Loc 190 $23 |
| Stratafix | $1720 |
| RD 180 + TK | RD 180 $175 each TK Device $150 each 53” suture $32 each Ti Knot clips $35 pack of 12 |
| Endostitch | Device $140-150 Suture $20-28 V-Loc Suture $57 |

## References


CULTURAL AND LINGUISTIC COMPETENCY

Governor Arnold Schwarzenegger signed into law AB 1195 (eff. 7/1/06) requiring local CME providers, such as the AAGL, to assist in enhancing the cultural and linguistic competency of California's physicians (researchers and doctors without patient contact are exempt). This mandate follows the federal Civil Rights Act of 1964, Executive Order 13166 (2000) and the Dymally-Alatorre Bilingual Services Act (1973), all of which recognize, as confirmed by the US Census Bureau, that substantial numbers of patients possess limited English proficiency (LEP).

California Business & Professions Code §2190.1(c)(3) requires a review and explanation of the laws identified above so as to fulfill AAGL’s obligations pursuant to California law. Additional guidance is provided by the Institute for Medical Quality at http://www.imq.org.

Title VI of the Civil Rights Act of 1964 prohibits recipients of federal financial assistance from discriminating against or otherwise excluding individuals on the basis of race, color, or national origin in any of their activities. In 1974, the US Supreme Court recognized LEP individuals as potential victims of national origin discrimination. In all situations, federal agencies are required to assess the number or proportion of LEP individuals in the eligible service population, the frequency with which they come into contact with the program, the importance of the services, and the resources available to the recipient, including the mix of oral and written language services. Additional details may be found in the Department of Justice Policy Guidance Document: Enforcement of Title VI of the Civil Rights Act of 1964 http://www.usdoj.gov/crt/cor/pubs.htm.

Executive Order 13166, “Improving Access to Services for Persons with Limited English Proficiency”, signed by the President on August 11, 2000 http://www.usdoj.gov/crt/cor/13166.htm was the genesis of the Guidance Document mentioned above. The Executive Order requires all federal agencies, including those which provide federal financial assistance, to examine the services they provide, identify any need for services to LEP individuals, and develop and implement a system to provide those services so LEP persons can have meaningful access.

Dymally-Alatorre Bilingual Services Act (California Government Code §7290 et seq.) requires every California state agency which either provides information to, or has contact with, the public to provide bilingual interpreters as well as translated materials explaining those services whenever the local agency serves LEP members of a group whose numbers exceed 5% of the general population.

If you add staff to assist with LEP patients, confirm their translation skills, not just their language skills. A 2007 Northern California study from Sutter Health confirmed that being bilingual does not guarantee competence as a medical interpreter. http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2078538.