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Hamsling: A Minimally Invasive Hamstring-based Autologous Midurethral Sling

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Abstract

To present, in the supplemental video, a single-patient technical report of an autologous semitendinosus tendon-based midurethral sling (Hamsling) as a minimally invasive alternative to mesh and traditional fascial harvest for stress urinary incontinence (SUI). Case report of a 54-year-old woman with stage II uterovaginal prolapse, SUI, and significant tobacco use. The semitendinosus tendon was harvested through a small medial oblique incision near the tibial tubercle using a tendon stripper, yielding a 1.3- cm by 25- cm graft. A retropubic approach was used, with suprapubic punctures tunneling the tagged non-absorbable sutures so that they exited the same site and were tied without tension. The patient demonstrated complete bladder emptying during her active void trial on postoperative day three. At 6 and 12 weeks, the patient denied SUI and demonstrated normal voiding without retention. This single-patient technical report demonstrates the feasibility of a semitendinosus tendon-based autologous midurethral sling. Further studies with larger cohorts and longer follow-up are required to establish its safety and efficacy.

Keywords: Stress urinary incontinence, autologous sling, semitendinosus tendon, midurethral sling, minimally invasive surgery

Introduction

The lifetime risk of surgery for stress urinary incontinence (SUI) in women is 13.6% (1). Current surgical treatment options include Burch colposuspension, autologous fascial slings, synthetic midurethral slings, and bulking agents. While synthetic polypropylene mesh slings have demonstrated excellent efficacy, concerns regarding mesh complications have led some patients and surgeons to seek alternative approaches. Traditional autologous fascial slings using rectus abdominis fascia or fascia lata can require larger incisions and carry risks of herniation and wound complications (2). For patients who are mesh-averse or at high-risk for healing complications, such as heavy tobacco users, these traditional approaches may not be optimal.

The semitendinosus tendon, a graft harvested from the semitendinosus muscle (one of three muscles comprising the hamstring group), has been successfully utilized in orthopedic surgery for anterior cruciate ligament (ACL) reconstruction for decades. Recent European literature has reported the use of semitendinosus tendon for midurethral slings and sacrocolpopexy procedures (3,4). Hornemann et al. (3) reported the first case of a midurethral autologous semitendinosus tendon sling using a traditional tension-free vaginal tape (TVT) retropubic approach.

To our knowledge, this video represents the first reported use of the semitendinosus tendon for midurethral sling placement in the United States. We present this novel technique, which we have termed the "Hamsling," as a promising alternative for patients with SUI who desire autologous tissue repair with minimal morbidity.

Materials and Methods

A 54-year-old woman presented with SUI and stage II uterovaginal prolapse. Her medical history was significant for heavy tobacco use, including smoking up to two packs of cigarettes per day. The patient voided 15 times during the day and twice at night. She had stress-predominant mixed incontinence. Small-volume occurred multiple times a day; however, she did not use pads. She denied voiding symptoms, and her preoperative office postvoid residual was zero. She had a positive office cough stress test with 300 mL in her bladder, and prolapse reduction was performed using a

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speculum. Pelvic Organ Prolapse Quantification measurements were: Aa +1, Ba +1, Ap -1, Bp -1, C -2, D -4, Gh 3.5 cm, Pb 2 cm, TVL 9 cm. She had a negative urinalysis. No previous surgical treatment for SUI had been attempted.

It is not our practice to perform multichannel urodynamics on patients with stress-predominant incontinence who demonstrate a positive full-bladder cough-stress test during office evaluation. The patient had failed conservative options and was counseled regarding urethral bulking and a fascial sling. Her smoking history put her at risk for a mesh complication; therefore, a synthetic mesh sling was not offered. We discussed the possibility of an interval procedure to defer the anti-incontinence procedure until after her prolapse repair; however, the patient was extremely bothered by SUI and wanted a concomitant sling surgery. She was offered an autologous rectus fascia alternative, but she did not want an abdominal incision.

Written informed consent was obtained from the patient for publication of this video article. This study was deemed not to constitute human subjects research by the Institutional Review Board of Wake Forest University School of Medicine (IRB00129342), as it involved the analysis of existing, de-identified data (Exemption Category 4).

As shown in the Video 1, the procedure started by positioning the patient in the supine position, with the preferred (right) leg prepped and draped. General anesthesia was administered, and preoperative antibiotics (cefazolin and metronidazole) were also given. The procedure was performed with assistance from a colleague in orthopedic surgery.

The harvest began by marking the medial region of the right hamstring. An oblique incision, approximately 3 cm medial to the tibial tubercle, was made in line with the medial tibial joint line. We worked in the most posterior aspect of the pes anserinus. Electrocautery was used through the subcutaneous layer to achieve hemostasis. The sartorius fascia was identified by gently tugging the tissue with forceps and noting its immobile, stiff quality. The sartorius fascia was then incised with electrocautery. The gracilis tendon can be confused with the semitendinosus tendon as it rests behind it, so we distinguished them by aiming for the posterior and medial tendon and retracting the gracilis laterally. The distal end of the tendon was incised and threaded into a closed tendon-stripping device. While maintaining traction on the tendon, the surgeon gently advanced the tendon stripper proximally, with the goal of stripping the tendon to its attachment on the ischial tuberosity.

A tendon harvest measuring 25 cm by 1.3 cm was obtained. Given adequate width, the tendon was not doubled over, but this technique could be employed for narrower harvests to maximize surface area. The tendon was tagged with polypropylene sutures at both ends and soaked in normal saline. The harvest site was closed with absorbable sutures in both the subcutaneous layer and the skin. Postoperatively, the patient wrapped her leg in an elastic compression wrap for a week and had a heavy lifting restriction of no greater than 6 kg for six weeks.

Next, we prepared the patient vaginally and abdominally and redraped the patient in the dorsal lithotomy position for vaginal surgery. Prior to sling placement, the patient underwent a vaginal hysterectomy, uterosacral ligament suspension, and anterior repair to correct prolapse. The anterior colporrhaphy was performed prior to the midurethral sling placement. We made a separate incision at the midurethra to place the sling. We paid close attention not to over-suspend during our anterior repair, so this did not make our subsequent midurethral dissection more difficult.

Next, the sling portion of the procedure was performed. We must acknowledge that the concomitant prolapse surgery could have affected postoperative voiding outcomes.

The midurethral dissection was completely mobilized out to the inferior pubic rami to ensure that the sling lay flat against the urethra. Two skin punctures were created and Stamey needles were passed from top to bottom through the retropubic space into the paraurethral space. A cystoscopy performed immediately after Stamey placement confirmed the absence of bladder perforation. The polypropylene sutures attached to the graft were passed through the Stamey needles and brought up through each suprapubic incision. One Stamey needle was then tunneled subcutaneously from one suprapubic incision to the other, allowing both sutures to exit from the same incision.

The sutures were elevated until the graft was in apposition to the urethra, ensuring that no tight banding was noted against the midurethra. With Mayo scissors providing counter-tension and acting as a spacer, the polypropylene sutures were tied together anterior to the rectus fascia, with a finger placed between the fascia and the knot to avoid over-tensioning. A Credé maneuver with 300 mL instilled in the bladder demonstrated no leakage. The graft was secured at the midurethra with polyglactin suture to prevent curling. The vaginal epithelium was closed with polyglactin suture. The suprapubic incisions were closed with poliglecaprone sutures and covered with skin glue.

The estimated blood loss was less than 25 mL for both the harvest and the sling portions of the case. The harvest was estimated to take 30 minutes. The Foley catheter was maintained for three days, and an active void trial was performed in the clinic, so that intermittent catheterization could be taught if incomplete bladder emptying was noted. There were no perioperative complications. There was no specific rehabilitation program, but activity restrictions included 24-hour-per-day leg wrapping with an elastic compression wrap for a week postop, and heavy lifting restrictions of no greater than 6 kg for six weeks.

Results

An active void trial performed on postoperative day 3 demonstrated complete bladder emptying with continuous flow on uroflowmetry and a normal post-void residual. She had a negative cough stress test despite having over 250 mL in her bladder. At this 3-day postop visit, her Q_{max} was 10.8 mL/s, her average flow was 6.6 mL/s, her voided volume was 240.1 mL, and her voiding time was 42.2 seconds, with a post-void residual of 40 mL. This represents a prolonged, low-flow voiding pattern immediately after catheter removal.

At the 6-week postoperative visit, the patient reported no urinary complaints or SUI. She had a negative cough stress test with over 250 mL in her bladder. Uroflowmetry measurement showed a Q_{max} of 17.9 mL/s, an average flow of 7.6 mL/s, a voided volume of 277 mL, a voiding time of 38 seconds, and a post-void residual of 3 mL. Her uroflow remained slightly prolonged, but her maximum flow rate increased, and she continued to void without Valsalva maneuver. At 12 weeks postoperatively, she continued to report no SUI or other urinary symptoms and showed no evidence of incomplete bladder emptying. She had a negative CST at this visit.

The harvest site healed without complications. At the 6- and 12-week marks, she noted numbness on the lateral aspect of her right leg, extending a few centimeters around the incision site. Otherwise, no focal deficits were noted, including leg pain, hematoma, infection, wound problems, gait limitation, reduced knee range of motion or flexion strength, or delayed return to normal activity at 6 and 12 weeks.

Discussion

This case represents the first reported use of the semitendinosus tendon for midurethral sling placement in the United States. The Hamsling offers several theoretical and practical advantages over traditional autologous sling materials. The primary advantage lies in the minimally invasive harvest technique. Unlike the rectus fascial harvest, which requires a transverse abdominal incision with associated risks of herniation, infection, and prolonged recovery, the semitendinosus harvest requires only a small oblique incision near the tibial tubercle. As shown in the supplementary video, the semitendinosus tendon provides adequate tensile strength, as evidenced by its successful use in ACL reconstruction. The tendon's length (typically 20-30 cm) and width (1-1.5 cm) make it suitable for midurethral sling applications, either as a single strand or doubled over to increase surface area. In a cadaver study comparing the gracilis and semitendinosus muscles, the semitendinosus muscle had greater length and thickness, making it a better candidate for a midurethral sling procedure (5).

Hornemann et al. (3) reported the first case in Germany of midurethral semitendinosus tendon sling placement, performed using a TVT approach under spinal anesthesia. Although the treatment was initially successful, their patient developed urinary retention 10 weeks postoperatively, which was attributed to potential tendon shrinkage. In contrast, our patient has demonstrated continence and normal voiding function at 12 weeks postoperatively. The difference in outcomes may be attributed to several factors. First, our technique involved careful tension adjustment during placement, with attention to the potential for tendon shrinkage reported in the German case. Second, we secured the graft at the mid-urethra with an absorbable suture to prevent curling while maintaining appropriate tension. Our patient's robust tissue quality, despite heavy tobacco use, may have contributed to optimal healing.

We utilized a permanent polypropylene knot; however, Baumelou-Naudi et al. (6) have used absorbable sutures in a bottom-up approach without any adverse outcomes. Because permanent sutures could plausibly cause future knot-related pain, sinus formation, infection, or suture erosion, an absorbable suture could be used if a patient is at high-risk for subsequent healing issues.

Our novel suprapubic tunneling technique avoids the low transverse incision commonly associated with autologous slings and may lead to decreased morbidity and postoperative pain.

Several technical aspects deserve emphasis. The use of appropriate tendon strippers and the careful handling of the harvested tissue are essential to maintain graft integrity. Tension adjustment during sling placement requires avoiding over-tensioning to prevent retention associated with tendon shrinkage. Our approach of tying without tension (over a finger used as a spacer) to provide adequate support to the midurethra (rather than tight banding) appeared successful in achieving continence without causing obstruction.

Study Limitations

This case report has limitations. We do not yet have long-term durability data. Validated questionnaire scores were not obtained, limiting the objective assessment of symptom improvement and quality-of-life measures.

D ownsides of using the semitendinosus tendon include possible hamstring weakness, pain or cramping, hematoma, saphenous nerve symptoms, variable tendon regeneration, and a possible need for orthopedic expertise. Generally, the semitendinosus can pose a problem, as the width of the tendon is not optimal for a midurethral sling, requiring it to be doubled over in narrower harvests to maximize its surface area. Finally, as with all autologous slings, graft contraction or remodeling remains an unresolved safety concern that requires longer follow-up.

Future studies using this approach should include longer follow-up periods, validated outcome measures, and larger patient series to establish the efficacy and safety profile of this technique.

Conclusion

The Hamsling technique offers a minimally invasive autologous alternative for SUI.

Video 1. https://youtu.be/BiuJrSpS2vM?si=lGnMccjMfLJ4fH9J

Ethics

Ethics Committee Approval: This study was deemed not to constitute human subjects research by the Institutional Review Board of Wake Forest University School of Medicine (IRB00129342), as it involved the analysis of existing, de-identified data (Exemption Category 4).

Informed Consent: Written informed consent was obtained from the patient for publication of this video article.

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Footnotes

Authorship Contributions

Surgical and Medical Practices: M.E.S., A.E.H., M.N.D., Concept: M.E.S., A.E.H., Design: M.E.S., A.E.H., M.N.D., Data Collection or Processing: M.E.S., A.E.H., M.N.D., Analysis or Interpretation: M.E.S., A.E.H., Literature Search: M.E.S., A.E.H., Writing: M.E.S., A.E.H., M.N.D.

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