Universitat Autònoma de Barcelona

IMPACTO CLÍNICO DE LOS ÚLTIMOS AVANCES EN CIRUGÍA DE SUELO PÉLVICO SOBRE LA CONTINENCIA URINARIA

Jordi Sabadell García

Universitat Autònoma de Barcelona

TESIS DOCTORAL POR COMPENDIO DE PUBLICACIONES

IMPACTO CLÍNICO DE LOS ÚLTIMOS AVANCES EN CIRUGÍA DE SUELO PÉLVICO SOBRE LA CONTINENCIA URINARIA

Autor: **Jordi Sabadell García**

Director y tutor: **Prof. Antonio Gil Moreno**

DEPARTAMENT DE PEDIATRIA, OBSTETRÍCIA I GINECOLOGIA I DE MEDICINA PREVENTIVA I SALUT PÚBLICA

Facultat de Medicina. Universitat Autònoma de Barcelona.

Barcelona, 2022

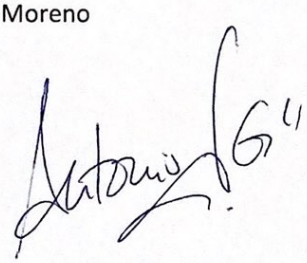
AUTORIZACIÓN DEL TUTOR Y DIRECTOR DE TESIS

El Dr. Antonio Gil Moreno, Profesor titular del Departament de Pediatria, Obstetrícia i Ginecologia de la Universitat Autònoma de Barcelona y Jefe de Servicio de Ginecología de l'Hospital Universitari Vall d'Hebron.

CERTIFICA

Que Jordi Sabadell García, licenciado en Medicina, ha realizado bajo su dirección el trabajo de investigación para la elaboración de su Tesis Doctoral titulada **"Impacto clínico de los últimos avances en cirugía de suelo pélvico sobre la continencia urinaria"**, la considera finalizada y es apta para su defensa ante el tribunal evaluador para optar al Grado de Doctor en Medicina.

Prof. Antonio Gil Moreno



En Barcelona, 19 de septiembre de 2022.

AGRADECIMIENTOS

En esta tesis se plasma el trabajo de investigación realizado en los últimos años en la unidad de Suelo Pélvico del servicio de Ginecología del hospital Vall d'Hebron. Muchas personas han contribuido en mi desarrollo personal y profesional y por ende, en la culminación del presente trabajo. Por todo quiero dar las gracias:

En primer lugar y de forma muy especial a toda mi familia. A mi pareja, Anna, y a mis hijos Martí y Bernat. Sois la razón de todo. Sois el motivo de querer seguir creciendo, aprendiendo y mejorando y la inspiración para avanzar día a día. Os quiero.

A mis padres cuando aún pudieron estar allí y a mis abuelos que realizaron un gran esfuerzo ayudándome a crecer. A mi hermana, "Tati", con quien crecí y me apoyó en los momentos más difíciles y de quien sigo aprendiendo. A toda mi familia política con quien me he sentido totalmente acogido y querido y son un apoyo diario insustituible.

A mi director de tesis, el profesor Antonio Gil y a mis compañeros de la Unidad de Suelo Pélvico: José Luis Poza, Anabel Montero, Sabina Salicrú, Nuria Rodríguez y Marina Catalán. Todos han contribuido de forma importantísima en mi formación clínica, tanto como residente y adjunto "joven", en investigación y en mi desarrollo personal. Sin su apoyo constante y sus consejos muy probablemente no estaría donde estoy ahora. Con todos ellos hemos pasado muchos años juntos y espero que puedan ser muchísimos más. Quiero dar las gracias de forma muy especial al Dr. Poza por transmitirme su paciencia y estar siempre cuando lo necesité.

A todos mis compañeros de Ginecología y Obstetricia con los que he compartido tantas horas y hemos ido aprendiendo juntos.

A las "jefas" y compañeras del grupo de investigación del VHIR, Mª Antònia y Maite, por vuestra generosidad y paciencia para ayudarme a ampliar mi visión en el terreno de la investigación básica.

A mis compañeros y amigos de facultad "las 5 Jotas" con quienes compartí tantas horas de estudio nocturno y me ayudaron a estar aquí. Dres. Sánchez, Ferreiro, Cortés, Vilaseca, (José Luis, José Luis, Jesús y Joan) siempre os tendré presentes y seguiremos juntos.

A todos los compañeros de club de judo Condal y en especial a los *mestres* Talens (D.E.P) y José María García. Me habéis enseñado una disciplina que no solo es un deporte si no una forma de entender la vida. ¡*Al techu*!

A mi profesor de saxo José María Aparicio y mis compañeros del cuarteto *Swingags*: Bernat, Marc y Víctor. Pasamos muchos años juntos ayundándome a crecer como persona y a ser en parte quien soy ahora. También a los compañeros del grupo *Lúkumalunch*: Tato, Yoyi, Joan, Cristian, Peña, Julio con quienes compartí una etapa difícil pero gracias a ellos divertida.

A todos, gracias por haber compartido conmigo, ayudarme a ser la persona que soy ahora y por tanto haber contribuido de alguna forma en la realización de esta tesis doctoral.

ÍNDICE

ABSTRACT

Introducción: En las últimas décadas se han producido diferentes avances en los tratamientos de las disfunciones de suelo pélvico fruto del desarrollo de nuevas técnicas quirúrgicas, nuevos materiales y la profundización en el conocimiento fisiopatológico de esta patología. Desafortunadamente, la implantación clínica de dichos avances no siempre ha ido acompañada de la evidencia necesaria previa que avale su efectividad y seguridad. Es necesario, sin embargo, que cualquier innovación técnica y/o metodológica en el ámbito médico y quirúrgico sea validada clínicamente antes de su aplicación de forma generalizada en la práctica clínica habitual.

Métodos: La presente tesis doctoral se ha realizado conforme a normativa académica de la Universitat Autònoma de Barcelona para la presentación de tesis por compendio de artículos y aprobada para su presentación en fecha 27 de junio de 2022.

Los artículos que conforman el presente trabajo de tesis pertenecen a una misma línea de investigación dirigida a validar clínicamente diferentes avances en el área de la cirugía de suelo pélvico. En concreto los trabajos realizados evalúan clínicamente los siguientes aspectos: 1) El uso de las bandas suburetrales de incisión única (SIMS) Ajust® respecto a las bandas transobturadoras estándar (TOT) para el tratamiento de la incontinencia urinaria femenina. 2) El uso de las TOT de fluoruro de polivinilideno (PVDF) respecto a las de polipropileno (PP) para el tratamiento de la incontinencia urinaria femenina. 3) La validación externa de un modelo predictivo para la incontinencia urinaria de esfuerzo *de novo* tras la cirugía vaginal de prolapso genital. Los resultados obtenidos en estos

trabajos aportan datos robustos y de importante relevancia clínica sobre la trascendencia para la práctica clínica habitual de los avances analizados.

Resultados: En la sección 3 “Publicaciones” puede encontrarse la descripción detallada de los métodos, resultados y discusión de cada trabajo.

Conclusiones: De los trabajos realizados podemos concluir que: 1) Las SIMS Ajust® tienen una eficacia no-inferior a un año respecto a las TOT estándar, pero con un mayor número de casos de dolor posoperatorio. 2) Las TOT de PVDF presentan una eficacia similar a las de PP a un año, con una menor incidencia de incontinencia urinaria de urgencia *de novo*. 3) El modelo predictivo analizado no presenta un buen rendimiento clínico en nuestra población con baja incidencia de incontinencia de esfuerzo *de novo* tras cirugía de prolapso.

ENGLISH ABSTRACT

Introduction: In the last decades, several steps-forward in the field of pelvic floor dysfunction have been described related to new surgical treatments, materials and knowledge on its physiopathology. However, sometimes these advances lack of evidence that endorse their application in clinical practice. It is necessary, however, that any technical or methodological innovation in the medical and surgical field be clinically validated before its general application in daily practice.

Methods: This doctoral thesis has been carried out in accordance with the academic regulations of the Universitat Autònoma de Barcelona for the presentation by compendium of articles and was approved for its presentation on June 27, 2022.

The articles included in this thesis belong to the same line of research aimed at clinically validating different advances in the area of pelvic floor surgery. Specifically, the work carried out clinically evaluates the following aspects: 1) The use of Ajust® single-incision suburethral slings (SIMS) compared to standard transobturator slings (TOT) for the treatment of female urinary incontinence. 2) The use of polyvinylidene fluoride (PVDF) TOTs compared to polypropylene (PP) ones for the treatment of female urinary incontinence. 3) External validation of a predictive model for *de novo* stress urinary incontinence after vaginal surgery for pelvic organ prolapse. The results obtained in these works provide robust data of clinical relevance on the importance of the advances analysed for routine clinical practice.

Results: See section 3 “Publicaciones” for a detailed description of methods, results and discussion of each study.

Conclusions: From the studies carried out, we can conclude that: 1) The SIMS Ajust® have a non-inferior effectiveness at one year compared to the standard TOT, but with a greater number of cases of postoperative pain. 2) PVDF TOTs have similar effectiveness at one year to PP ones, with a lower incidence of *de novo* urge urinary incontinence. 3) The analysed predictive model has not shown a good clinical performance in our population with low incidence of *de novo* stress incontinence after prolapse surgery.

LISTADO DE ABREVIATURAS

AUC	Área bajo la curva (*Area Under the Curve*)
ECA	Ensayo clínico aleatorizado
IC 95%	Intervalo de confianza del 95%
ICIQ-SF	International Consultation on Incontinence Questionnaire-Short Form
IU	Incontinencia urinaria
IUE	Incontinencia urinaria de esfuerzo
IUM	Incontinencia urinaria mixta
IUU	Incontinencia urinaria de urgencia
LHR	Likelihood ratio
OR	Odds ratio
PGI-I	Patient Global Impression of Improvement
POP	Prolapso de órganos pélvicos
PP	Polipropileno
PVDF	Fluoruro de Polivinilideno
SIMS	Bandas suburetrales de incisión única (*Single Incision Midurethral Slings*)
TOT	Bandas suburetrales libres de tensión transobturadoras
TVT	Bandas suburetrales libres de tensión retropúbicas

LISTADO DE FIGURAS

Cada principio es el momento ideal para cuidar atentamente que los equilibrios queden establecidos de la manera más exacta.

De *Manual de Muad'Dib*.

DUNE, Frank Herbert.

1. INTRODUCCIÓN

1.1 Anatomía y función del suelo pélvico femenino

El suelo pélvico se define como el conjunto de huesos, músculos y ligamentos que, desde el peritoneo pélvico hasta el periné superficial, cierran la cavidad abdominal por su parte inferior. Éstos dan soporte a los órganos que se encuentran en la pelvis permitiendo a su vez el paso hacia el exterior de las porciones terminales de los aparatos urinario, reproductor y digestivo (vejiga y uretra, útero y vagina y recto en la mujer).

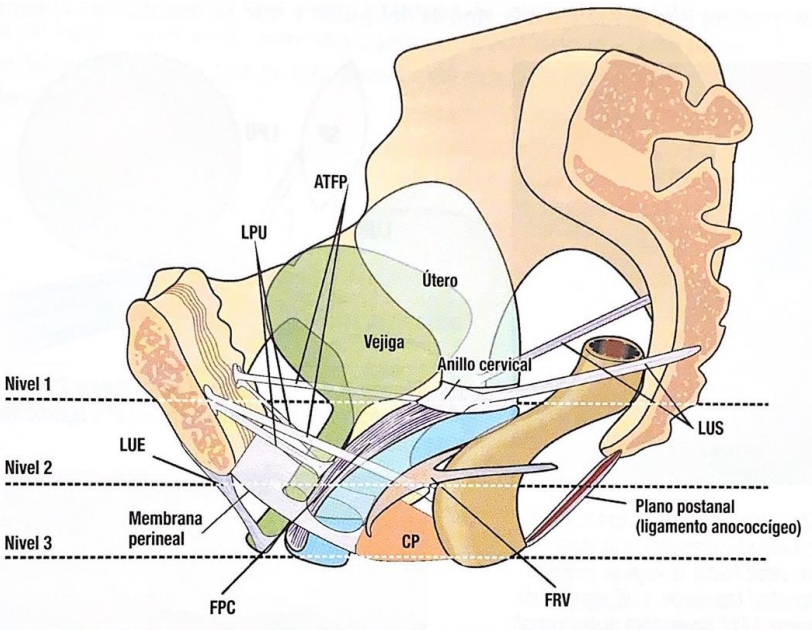
El suelo pélvico es, por tanto, un complejo sistema dinámico e interrelacionado capaz de adaptarse a diferentes situaciones de estrés y que precisa de la integridad de todas sus estructuras para el normal funcionalismo de sus órganos(1–3). El conocimiento preciso de la anatomía será la base fundamental para el desarrollo de nuevas técnicas y aplicaciones quirúrgicas, tal y como defendía el urólogo y anatomista Salvador Gil-Vernet (1892-1987)(4) hecho que resulta de especial relevancia en la patología de suelo pélvico.

1.1.1 Estructuras de tejido conjuntivo

El tejido conjuntivo está constituido por ligamentos y fascias que dan sostén a los diferentes órganos de la pelvis y son clave en la estructura del suelo pélvico. Éstos pueden dividirse en tres niveles (Figura 1)(2):

- Nivel 1: ligamentos uterosacros y fascia pubocervical
- Nivel 2: ligamentos pubouretrales y fascia rectovaginal.
- Nivel 3: ligamento uretral externo, membrana perineal y cuerpo perineal.

Figura 1. Estructuras de tejido conjuntivo del suelo pélvico.



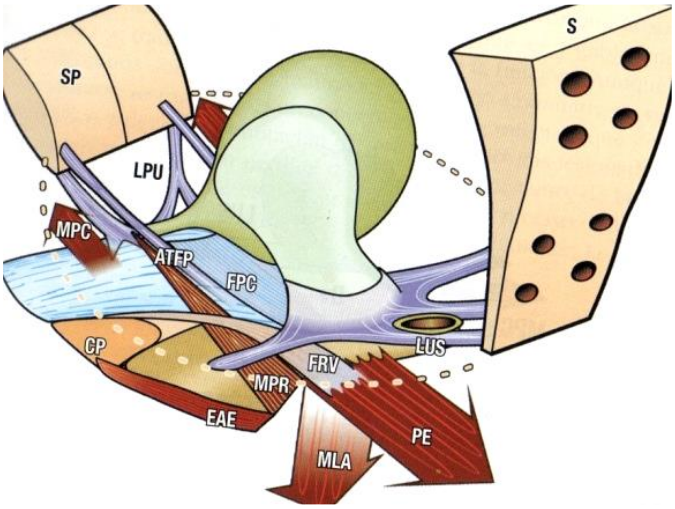
LPU: ligamentos pubouretrales; ATFP: arco tendíneo de la fascia pélvica; LUS: ligamentos uterosacros; CP: cuerpo perineal; EAE: esfínter anal externo; FPC: fascia pubocervical; FRV: fascia rectovaginal; LUE: ligamento uretral externo. *Petros, PE. Suelo pélvico en la mujer. Función, disfunción y tratamiento según la teoría integral. Ed. Mayo; 2006.*

1.1.2 Músculos del suelo pélvico

Diferentes músculos estriados conforman la parte muscular del suelo pélvico. El músculo elevador del ano o diafragma pélvico se subdivide en cuatro músculos: los músculos puboccígeo, ileococcígeo, coccígeo y puborrectal. Éstos se encuentran anclados periféricamente al cuerpo del pubis, a las espinas ciáticas, al arco tendíneo (que es una condensación de la fascia obturadora) y al sacro. Diferentes porciones de los músculos puboccígeo, coccígeo e ilioccocígeo se introducen detrás del recto

conformando el plano elevador. Finalmente existe otro músculo estriado corto que conecta diferentes capas musculares entre sí: el músculo longitudinal del ano. Estos músculos estriados conforman 4 vectores de dirección diferentes (Figura 2) interaccionando con las estructuras óseas y de tejido conjuntivo de la pelvis: el músculo pubococcígeo produce una fuerza hacia adelante contra el ligamento pubouretral y el puborrectal que produce una fuerza contra la sínfisis del pubis. A su vez se describen dos vectores posteriores producidos por el plano elevador conjuntamente con el músculo longitudinal del ano(2,3,5).

Figura 2. Interacción dinámica de los componentes de tejido conjuntivo y muscular del suelo pélvico.



LPU: ligamentos pubouretrales; ATFP: arco tendíneo de la fascia pélvica; LUS: ligamentos uterosacros; CP: cuerpo perineal; EAE: esfínter anal externo; FPC: fascia pubocervical; FRV: fascia rectovaginal; MPC: músculo puboccocígeo; PE: plano elevador; MLA: músculo longitudinal del ano; SP: sínfisis púbica; MPR: músculo puborrectal; S: sacro. *Petros, PE. Suelo pélvico en la mujer. Función, disfunción y tratamiento según la teoría integral. Ed. Mayo; 2006.*

Como se ha descrito, las diferentes estructuras del suelo pélvico actúan de forma integrada e interconectada para su correcta funcionalidad (figura 2). Las lesiones estructurales del suelo pélvico podrán dar lugar a alteraciones funcionales que podemos clasificar en cinco grandes esferas: disfunción miccional, disfunción ano-rectal, prolapso genital, disfunción sexual y dolor pélvico(3,6–10).

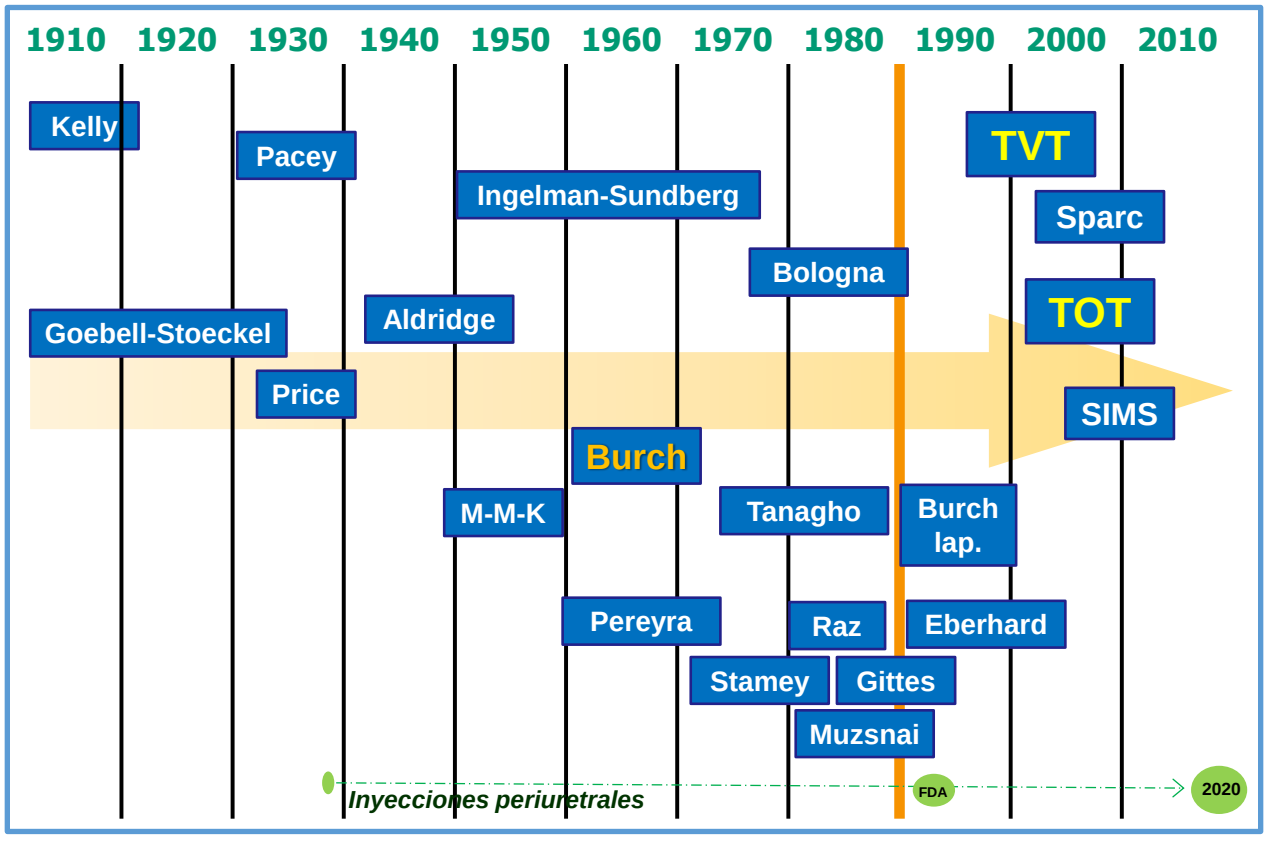
1.2 Disfunción del suelo pélvico femenino

Las disfunciones de suelo pélvico son un conjunto de alteraciones funcionales que afectan a gran proporción de la población femenina adulta. Esta patología está presente a nivel mundial, pudiendo afectar hasta un 25% - 37% de las mujeres y con una importante repercusión sobre su calidad de vida(11–15). Estas disfunciones incluyen un amplio espectro de síntomas como son la incontinencia urinaria (IU), la incontinencia fecal, el prolapso de órganos pélvicos (POP), alteraciones del vaciado vesical, defecación obstructiva, disfunciones sexuales y diversos síndromes dolorosos centrados en el área pelvi-perineal. Es frecuente que se puedan presentar diversas alteraciones funcionales en una misma persona, con la consiguiente mayor repercusión sobre su vida diaria(11,13,16). De entre todas las disfunciones anteriormente citadas, la incontinencia urinaria de esfuerzo (IUE) y el POP son las que requerirán un tratamiento quirúrgico con mayor frecuencia(15,17,18). El análisis algunos de los últimos avances quirúrgicos en estos dos campos centrarán el foco del presente trabajo de tesis.

1.2.1 Incontinencia urinaria de esfuerzo: avances quirúrgicos.

La IUE es aquella pérdida involuntaria de orina que se produce durante el ejercicio, un esfuerzo físico, toser o reír(10,15). Se estima que puede afectar entre el 10% - 39% de la población femenina adulta. La gran variación en las cifras estimadas de prevalencia se debe a las diferentes poblaciones estudiadas, factores culturales en su reporte y a la disparidad entre las definiciones y métodos para evaluar su presencia utilizados(15,19–21).

Figura 3. Evolución de las técnicas quirúrgicas para la IUE.



TVT: bandas suburetrales libres de tensión retropúbicas. TOT: bandas suburetrales libres de tensión transobturadoras. SIMS: bandas suburetrales de incisión única.

Existen más de 200 técnicas quirúrgicas descritas para el tratamiento de la IUE, hecho que refleja la continua modificación de técnicas establecidas previamente, así como la introducción de nuevos materiales y técnicas y la adaptación a las diferentes teorías fisiopatológicas del problema. Entre estas técnicas destacan las técnicas asociadas a reparaciones de defectos anteriores vaginales, las asociadas a defectos paravaginales, los cabestrillos pubouretrales, las técnicas de agujas transvaginales y las técnicas de uretropexia retropúbica (figura 3)(22).

Fue a partir de la Teoría integral del suelo pélvico desarrollada por Petros y Ulmsten(7) que se desarrolló la técnica de bandas suburetrales libres de tensión, que de forma original se insertaban por vía retropúbica (TVT). Éstas desplazaron a la hasta entonces técnica de referencia que era la uretropexia retropúbica de Burch, debido a unos resultados de curación muy elevados asociados a una menor morbilidad y bajo el concepto de cirugía mínimamente invasiva(23–25). Posteriormente y con el fin de minimizar las posibles complicaciones inherentes a la técnica retropúbica al atravesar a ciegas el espacio de Retzius (lesiones vesicales, hematomas retropúbicos, lesiones intestinales o de grandes vasos), Delorme en 2001 y De Leval en 2003 desarrollaron la colocación de bandas suburetrales libres de tensión por acceso transobturador (TOT) por las rutas de fuera-dentro y dentro-fuera respectivamente(26,27). Tanto las bandas TVT como TOT han demostrado una alta efectividad incluso a largo plazo aunque con diferentes perfiles de complicaciones(23,24,28–39), por lo que se han convertido en la técnica quirúrgica de elección para el tratamiento de la IUE femenina en una amplia mayoría de unidades uroginecológicas. Específicamente, la tasa de complicaciones de las TOT se estima entre el 11% y 31%(38–40). Por este motivo, algunos de los avances

en el tratamiento quirúrgico de la IUE se han centrado en disminuir las complicaciones de la técnica de bandas libes de tensión.

Una primera línea de avance fue el desarrollo de las bandas suburetrales de tercera generación o de incisión única (*Single Incision Midurethral Slings*, SIMS), de las que se publicaron las primeras series descriptivas a partir de 2008(41,42). Se han comercializado diferentes SIMS que difieren en la longitud de la banda, sistema de anclaje y posibilidad de ajuste. Sin embargo, los datos en cuanto a resultados de las SIMS en comparación con las bandas estándar son contradictorios(31,43–45). Debido a las diferentes técnicas entre las diferentes SIMS sus resultados no deben ser agrupados. En concreto, la SIMS Ajust® es una banda ajustable con un sistema de anclaje mediante arpones de polipropileno (PP) a la membrana obturatriz (figura 4) y de la que los datos de calidad en cuanto a la efectividad y seguridad procedentes de ensayos clínicos aleatorizados (ECA) eran escasos en el momento del desarrollo del presente trabajo de tesis(46–49).

Figura 4. Banda de incisión única Ajust®.

Una segunda aproximación para intentar mejorar los resultados quirúrgicos de las bandas suburetrales se basaría en modificar el material utilizado en la malla para disminuir las complicaciones que puedan atribuirse directamente éste como son el dolor por retracción, erosión, disfunción de vaciado o urgencia urinaria *de novo*. Aunque existen diversas marcas que comercializan bandas suburetrales, la gran mayoría están compuestas de PP. Sin embargo en Europa está también autorizado el uso del fluoruro de polivinilideno (PVDF) en las mallas quirúrgicas y su aplicación en uroginecología(50). Se trata de un material ampliamente extendido en el campo de la cirugía general con muy buena biocompatibilidad(51,52). Las características biomecánicas diferenciales de las bandas suburetrales de PVDF son poseer un poro aún mayor respecto a las mallas de polipropileno y una muy baja capacidad de elongación, significativamente menor que el polipropileno(52,53), lo que asienta la hipótesis que pueda generar menor tasa de erosiones y urgencia miccional *de novo* debidas a la retracción de la malla a medio y largo plazo. A pesar de todo, en el momento del desarrollo de la presente tesis únicamente existía un estudio descriptivo retrospectivo, publicado por nuestro grupo, que comparara ambos materiales usados en mallas suburetrales para el tratamiento de la IUE femenina(15,54).

En la última década ha habido otros avances técnicos en el campo del tratamiento quirúrgico de la IUE, como son el balón intravesical para la atenuación de los incrementos de presión intravesical, con resultados poco prometedores hasta la fecha(55,56), o el desarrollo de nuevos materiales para las inyecciones periuretrales(57,58). Sin embargo, estos otros avances quedan fuera del foco del presente trabajo de tesis.

1.2.2 Prolapso de órganos pélvicos e incontinencia urinaria *de novo*.

El POP se define como el descenso de uno o más órganos entre los que se incluye el útero, vagina, vejiga, recto, colon sigmoide o intestino delgado, desde su posición anatómica natural debido a un fallo en las estructuras de soporte. Supone una patología muy frecuente, estimándose que sobre el 12% de las mujeres en España preciarán ser intervenidas por POP a lo largo de su vida(59).

El POP puede coexistir con otras patologías del suelo pélvico de forma frecuente. Concretamente la coexistencia de POP e IU está presente hasta en el 30% - 80% de los casos de POP(60,61). Por otro lado, la corrección quirúrgica de un POP puede desencadenar la aparición de IU entre un 22% y un 61% de los casos, según la serie, que no la presentaban previamente(62–68). Este hecho resulta de especial relevancia ya que provocará un resultado insatisfactorio y frustrante tanto para la paciente como el médico tras un procedimiento dirigido a mejorar la calidad de vida.

Ante una cirugía por POP y la posibilidad de aparición de IUE posterior existen dos aproximaciones posibles: la realización de cirugía de POP e IUE de forma concomitante o realizar la cirugía en dos etapas corrigiendo en primer lugar el POP y re-evaluando posteriormente la necesidad de un nuevo tratamiento por IUE. Y aunque la asociación de una técnica anti-incontinencia a la cirugía del POP ha demostrado reducir el riesgo de IU, se ha calculado que el número de pacientes necesarias a tratar para evitar una nueva cirugía por IUE *de novo* es de 6 a 20(62,64,69–71). Sin embargo, las bandas suburetrales concomitantes a una cirugía vaginal de POP también ha demostrado aumentar el riesgo de complicaciones severas de la cirugía, como la lesión

vesical o ureteral, sangrado, dolor o disfunción de vaciado(64,71,72). Por este motivo, no parece apropiado asociar esta técnica de manera sistemática a todas las pacientes que se intervengan por POP. Sin embargo, podría ser una opción para considerar en pacientes con factores de riesgo para la aparición de IU tras la cirugía correctora de POP. Es por ello que identificar aquellas pacientes con un riesgo más elevado de desarrollar IU *de novo* permitiría realizar una medicina más personalizada y un importante avance en este campo. Con este propósito Jelovsek y cols. publicaron un modelo predictivo de IUE *de novo* tras cirugía vaginal de POP basado en 7 variables clínicas y desarrollado a partir de los datos del OPUS trial (figura 5)(73,74). En dicho estudio, mujeres previamente continentes y a las que se realizaba cirugía vaginal por POP fueron randomizadas a la colocación o no de un sling suburetral. En éstas se analizó la incidencia acumulada de IUE *de novo* evaluándolas a los 3 y 12 meses de la intervención.

Figura 5. Modelo predictivo de IUE de novo tras cirugía vaginal de POP.

Variable	Estimate	*P*
Intercept	−2.98883	.208
Age at surgery	−0.02527	.037
Parity*	0.39411	.098
Body mass index†	0.94942	.158
Preoperative stress test positive	0.46057	.063
Continence procedure	−1.83254	<.001
Leakage associated with a feeling of urgency	0.37543	.137
Diabetes	0.56223	.094

* Square root transformation.
† Natural log transformation.

Ecuación de regresión logística:

-2.9888276 - 0.025271306xAGE_SURGERY + 0.39411295xPARITY + 0.94942361xBMI + 0.4605713x(LEAK="Positive") - 1.8324541x(Continence procedure performed="Yes") + 0.37542553x(Leaking associated with a feeling of urgency="Yes") + 0.56222837x(DIABETES="Yes")

Jelovsek et al. Obstet Gynecol 2014;123:279–87.DOI:10.1097/AOG.0000000000000094

Sin embargo, y a pesar de estar disponible para la práctica clínica una calculadora para la estimación del riesgo de IUE *de novo* basada en este modelo predictivo (https://riskcalc.org/FemalePelvicMedicineandReconstructiveSurgery/), éste no había sido validado clínicamente en ninguna población diferente. Es por ello por lo que se decidió realizar una validación externa en nuestra población de este modelo predictivo.

1.3 Justificación del proyecto

En las últimas décadas se han desarrollado diversos avances en diferentes aspectos de la cirugía de disfunciones de suelo pélvico fruto del desarrollo de nuevas técnicas quirúrgicas, nuevos materiales y la profundización en el conocimiento fisiopatológico de esta patología. Sin embargo, la aparición e implantación clínica de dichos avances no siempre ha sido respaldada por suficientes estudios clínicos previos que avalen su efectividad y seguridad. Un claro ejemplo de esta situación fue el uso de mallas para la corrección vaginal del POP, las cuales han sido retiradas del mercado de Estados Unidos tras la prohibición de su comercialización por la FDA en 2019 debido a las complicaciones aparecidas(75). Es por tanto necesario evaluar los avances en cualquier ámbito de la medicina antes de poder establecer con seguridad su aplicación clínica.

2. HIPÓTESIS Y OBJETIVOS

2.1 Hipótesis

La hipótesis de la presente tesis doctoral es que cualquier avance técnico y/o metodológico en el ámbito médico y quirúrgico debe ser validado clínicamente antes de su aplicación de forma generalizada en la práctica clínica habitual, con el fin de evaluar su efectividad, seguridad y relevancia clínica.

2.2 Objetivos

El objetivo general de esta tesis doctoral es evaluar el impacto clínico real de algunos de los últimos avances en la cirugía de suelo pélvico.

Para la consecución de este objetivo general se han llevado a cabo los estudios incluidos en esta tesis con los siguientes objetivos específicos:

1. Evaluar la efectividad a un año de las SIMS Ajust® respecto a las TOT de longitud estándar.
2. Evaluar la seguridad de las SIMS Ajust® respecto a las TOT de longitud estándar.
3. Evaluar la efectividad a un año de las TOT de PVDF respecto a las de PP.
4. Evaluar la seguridad de las TOT de PVDF respecto a las de PP.
5. Evaluar el rendimiento clínico del modelo predictivo desarrollado por Jelovsec y colaboradores para IUE *de novo* después de una cirugía vaginal de POP.

3. PUBLICACIONES

3.1 Multicentre randomized trial of the Ajust™ single-incision sling compared to the Align™ transobturator tape sling.

Sabadell J, Palau-Gené M, Huguet E, Montero-Armengol A, Salicrú S, Poza JL.

Int Urogynecol J. 2017;28(7):1041-1047. doi: 10.1007/s00192-016-3221-3.

Int Urogynecol J (2017) 28:1041–1047
DOI 10.1007/s00192-016-3221-3

ORIGINAL ARTICLE

Multicentre randomized trial of the Ajust™ single-incision sling compared to the Align™ transobturator tape sling

Jordi Sabadell[1] · **Marta Palau-Gené**[2] · **Eva Huguet**[2] · **Anabel Montero-Armengol**[1] · **Sabina Salicrú**[1] · **Jose L. Poza**[1]

Received: 26 September 2016 / Accepted: 21 November 2016 / Published online: 5 December 2016

Abstract
Introduction and hypothesis Tension-free suburethral tapes have become the first-line surgical treatment for female stress urinary incontinence. Single-incision midurethral slings (SIMS) were introduced with the aim of offering similar efficacy with reduced morbidity, particularly postoperative pain. The objective of this study was to compare the effectiveness and complications of the Ajust™ SIMS and the Align™ transobturator tape sling.
Methods We performed a randomized controlled trial with a noninferiority design. Women with pure stress urinary incontinence or stress-predominant mixed urinary incontinence were eligible. The primary outcome was the cure/improvement rate at 1 year, defined according to combined objective and subjective criteria. Rate differences for cure/improvement with the two procedures were calculated along with their 95% confidence intervals. The Sandvik incontinence severity index and the International Consultation on Incontinence Questionnaire-Short Form (ICIQ-SF) were completed before surgery and at 1 year. Complications were also reported.
Results We randomized 30 women to the Ajust™ group and 28 to the Align™ group. At 1 year the cure/improvement rates were 93.3% in the Ajust™ group and 96.4% in the Align™ group. The rate difference for cure/improvement was of −3.1% (95% CI −14.4 % to 8.2%). The study was sufficiently powered to conclude the noninferiority of Ajust™ SIMS under the pre-established criteria. Three women in the Ajust™ group reported persistent thigh pain 1 year after surgery, but none in the Align™ group reported pain.
Conclusions At 1 year, the Ajust™ SIMS showed non-inferior effectiveness compared with the Align™ transobturator sling. Although not statistically significant, unexpectedly, more women reported persistent thigh pain in the Ajust™ group.

Keywords Ajust™ · Midurethral sling · Single incision sling · Suburethral tape complications · Stress urinary incontinence · Transobturator tape

Introduction

Currently, the first line surgical treatment for female stress urinary incontinence (SUI) is the use of tension-free suburethral tapes. Both retropubic and transobturator routes have shown a similarly high effectiveness but with different complication profiles [1–5]. The complication rate with those procedures is low, but complications do occur. Many of them are related to the blind passage of the needles through the retropubic or obturator spaces which can result in vascular and visceral injuries and thigh pain. Specifically, groin and thigh pain can occur in up to 12% of women treated with a transobturator tape (TOT) sling [1, 2, 5]. Furthermore, studies have failed to show differences in the incidence of postoperative groin and thigh pain among the different TOT brands, or with regard to their route of insertion [1, 3]. Thus, single-incision midurethral slings (SIMS) were developed to reduce these complications, particularly postoperative pain.

Different SIMS are commercially available. However, the outcomes following the use of SIMS in comparison with

✉ Jordi Sabadell
jsabadell@vhebron.net

[1] Urogynecology and Pelvic Floor Unit, Department of Obstetrics and Gynecology, Hospital Universitari Vall d'Hebron, Universitat Autònoma de Barcelona, Passeig Vall d'Hebron 119-129, 08035 Barcelona, Spain

[2] Department of Gynecology, Hospital de Viladecans, Universitat de Barcelona, Barcelona, Spain

standard suburethral tapes are still a matter of discussion [5–8]. The properties of different SIMS vary greatly, especially with regard to the type of fixation, and the sling length and adjustability. The Ajust™ SIMS has been available since 2009. It has propylene anchors on the tips that provide a robust fixation to the obturator internus muscle/membrane. In addition, its adjustable mechanism enables the tape length to be adjusted in each patient.

The results of the first prospective series evaluating the Ajust™ SIMS were promising with high cure rates close to 90% [9–15]. The same observational studies showed a very low incidence of postoperative thigh pain (0 – 2%). The effectiveness and security of the Ajust™ SIMS should nevertheless be better evaluated in the context of randomized controlled trials (RCT). Therefore, the Ajust™ SIMS would be expected to show a cure rate similar to that of standard TOTs together with a lower rate of adverse events, particularly the incidence of postoperative pain, and would also allow the procedure to be performed under local anaesthesia. The present study was therefore designed as a noninferiority study to compare the effectiveness of a standard TOT sling (Align™-TO) and the Ajust™ SIMS for the treatment of SUI in women.

Materials and methods

This study was conceived as a multicentre prospective RCT with a noninferiority design to compare the Ajust™ SIMS with the standard Align™ TOT for the treatment of SUI in women. Five Spanish hospitals were initially included in the trial. The research protocol was approved by the Ethics Committees of the participating centres and registered at the public registry ClinicalTrials.gov (NCT01699425).

All patients attending the participating hospitals between March 2013 and March 2015 with planned surgical correction of SUI were considered for participation in the study. The exclusion criteria were previous continence surgery, the presence of mixed urinary incontinence with predominant urge incontinence, detrusor overactivity, intrinsic sphincter deficiency defined as maximal urethral closure pressure of 20 cmH_2O or less, the presence of a low mobile urethra defined as a Q-tip test angle of <30°, the existence of neurogenic bladder and age <18 years. Women were considered eligible if they met the inclusion criteria and were not excluded. All women received a detailed explanation about the different procedures and written informed consent was obtained.

The preoperative evaluation included a detailed physical examination, an interview following a questionnaire concerning signs and symptoms of lower urinary tract dysfunction based on the terminology recommended by the International Continence Society [16], a urinalysis and urine culture. Pelvic organ prolapse (POP) was staged using the POP-Q system. All women underwent a multichannel urodynamic study before surgery that included free uroflowmetry and postvoid residual urine volume calculation, urethral pressure profile measurement, filling cystometry and pressure–flow studies of voiding. Study participants also completed the Sandvik incontinence severity index validated for the Spanish language that categorizes incontinence into four groups (a fifth group with a score of zero was added indicating no incontinence) [17] and the International Consultation on Incontinence Questionnaire-Short Form (ICIQ-SF).

A block randomization procedure stratified by centre was carried out by an external institution using a random number generator program. Allocation was performed with a 1:1 ratio. The randomization sequence was concealed with the use of consecutively numbered, opaque and sealed envelopes. Women were assigned to a group by opening the sealed envelopes consecutively just before surgery. The suburethral devices used were the transobturator sling Align™-TO and the Ajust™ SIMS (both Bard, Covington, GA). All procedures were performed by one of three experienced surgeons each with experience of more than ten procedures with the Ajust™ SIMS. Patients were not blinded to the procedure. The tapes were placed in a tension-free manner without the aid of a cough test. Surgery for POP correction was performed concomitantly when needed.

Postoperative follow-up visits were scheduled at 1, 6 and 12 months. These included physical examination with a cough stress test (patients were invited to attend follow-up visits at least 2 h after micturating) and an interview about signs and symptoms, use of urinary protection, micturition difficulties, pain in the groin or thighs, dyspareunia, and satisfaction with the procedure. Patient satisfaction was assessed with the question "How satisfied are you with the result of surgery?" (completely satisfied, moderately satisfied, or dissatisfied). Postoperative outcome was classified according to mixed objective and subjective criteria. Patients were considered cured if they had a negative cough stress test and were fully satisfied with the operation (no leaks, no voiding dysfunction, and no use of urinary protection). Patients were considered improved if they had a negative cough test and were moderately satisfied with the result of surgery because they still experienced urinary frequency and/or sporadic urgency episodes. The surgery was considered to have failed if the patient had a positive cough test and/or dissatisfaction with the surgery, including de novo urge incontinence and/or voiding dysfunction associated with frequent urinary infections and the use of the same urinary protection during daily activities as before the surgery. Women also completed the Sandvik and ICIQ-SF questionnaires 1 year after surgery. De novo urgency was diagnosed clinically by the presence of bothersome overactive bladder symptoms that were not present before the procedure. Elevated postvoid residual volume was defined as a urine residual of >100 ml.

Sample size calculation was based on a cure rate of 90% for the reference procedure (standard TOT). A noninferiority limit

of −15% was established based on previous literature and clinical relevance. It was calculated that 126 patients (63 per arm) would be needed to identify a difference, with an 85% power and a one-sided α error of 0.025. Analysis was performed on an intention-to-treat basis. Data were analysed using SPSS version 18.0 for Windows. For continuous variables, the normality of distributions was assessed using the Shapiro–Wilk test. Quantitative variables were compared using the unpaired Student's *t* test and with the Mann–Whitney *U* test for those variables that were not normally distributed. Categorical variables were analysed using the chi-squared test or Fisher's exact test as indicated. Logistic regression was used for multivariate analysis to evaluate the relationship between failure rates and the surgical procedure, adjusting for clinically relevant variables such as the presence of urge incontinence symptoms, maximal urethral closure pressure, incontinence severity (according to the Sandvik classification) and associated surgery. Changes in quantitative variables within procedures were analysed using Student's paired *t* test and differences in the changes between procedures were compared using the unpaired *t* test . A two-tailed *p* value <0.05 was considered to indicate statistical significance and 95% confidence intervals were calculated.

Results

Three of the five collaborating centres withdrew from the study before including any participants. Patient recruitment was therefore stopped before reaching the calculated sample size due to difficulty with enrolment and lack of continued funding to extend the insurance of the study. A total of 58 women were randomized during the study period, 30 to the Ajust™ group and 28 to the Align™ group (Fig. 1). The preoperative characteristics of the two groups were similar and are detailed in Table 1. Two women had a history of gynaecological surgery in the Ajust™ group (one vaginal hysterectomy and one abdominal hysterectomy) and two women in the Align™ group (one bilateral salpingo-oophorectomy and one abdominal hysterectomy). At the time of the surgery, 16 women (27.6%) underwent concomitant surgery for POP. The associated procedures are detailed in Table 1. No intraoperative complications were observed.

During the 1-year follow-up period, no losses of patients occurred. As shown in Table 2, there were no differences between the groups in outcomes at different follow-up timepoints. The cure/improvement rate at 1 year was of 96.4% with the Align™ TO and of 93.3% with the Ajust™ SIMS. The rate difference in effectiveness was −3.1% (95% confidence interval −14.4% to 8.2%), a difference that did not reach the established limit of inferiority (Fig. 2). A new power calculation was performed in the light of the obtained data, and the power of the study to find the established difference indicating inferiority was 85.7%. The sling type was also not associated with the odds of failure in the multivariate analysis ($p = 0.38$). The only failure observed in the Align™ group was due to persistent SUI. Two failures were observed in the Ajust™ group: one because of persistent SUI and one because

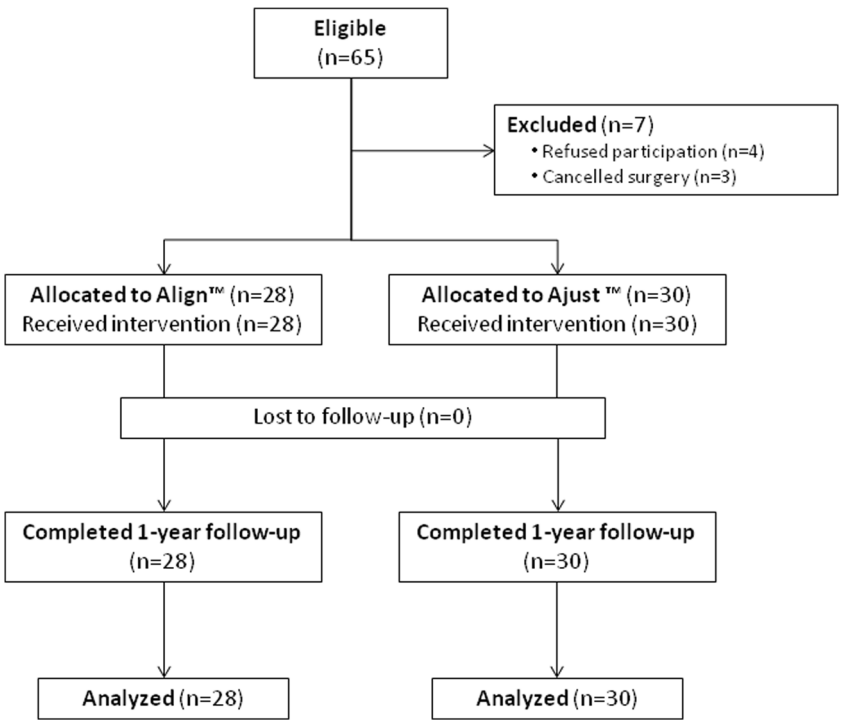


Fig. 1 Study flow chart

Table 1 Baseline characteristics

	Align™ group	Ajust™ group	*p* value
Age (years), median (range)	59.1 (45.9 – 78.9)	60.8 (43.2 – 73.7)	0.790
BMI (kg/m^2), median (range)	29.6 (18.9 – 40.9)	29.1 (22.6 – 44.0)	0.789
Vaginal deliveries, median (range)	2 (1 – 4)	2 (1 – 6)	0.938
Menopause, *n* (%)	20 (71.4)	25 (83.3)	0.277
Smoking habit, *n* (%)	5 (17.9)	2 (6.7)	0.246
Previous surgery, *n* (%)	2 (7.1)	2 (6.7)	1.0
Associated POP, *n* (%)	7 (25.0)	7 (23.3)	0.882
Previous UUI, *n* (%)	16 (57.1)	14 (46.7)	0.425
Severity of incontinence, *n* (%)			0.847
Moderate	4 (14.3)	6 (20.0)	
Severe	12 (42.9)	12 (40.0)	
Very severe	12 (42.9)	12 (40.0)	
ICIQ-SF, median (range)	16.5 (8 – 21)	16 (10 – 21)	0.234
Urodynamic study, median (range)			
MUCP (cmH_2O)	44.5 (25 – 79)	38.0 (22 – 99)	0.669
*Q*max (ml/s)	17 (4 – 40)	24 (7 – 36)	0.271
*P*det*Q*max (cmH_2O)	43.5 (5 – 85)	40.7 (15 – 78)	0.677
PVR (ml)	0 (0 – 200)	0 (0 – 10)	0.263
Associated surgery, *n* (%)	8 (28.6)	8 (26.7)	0.871
Vaginal hysterectomy + anterior repair	2	3	
Manchester procedure	1	0	
Anterior repair	3	1	
Posterior repair	1	1	
Anterior and posterior repair	0	1	
Hysteroscopy	1	2	

BMI Body mass index, *POP* Pelvic organ prolapse, *UUI* Urge urinary incontinence, *MUCP* Maximal urethral closure pressure, *Qmax* maximum flow rate, P*detQmax* Detrusor pressure at maximum flow, *PVR* Postvoid residual urine volume

of severe urge incontinence. No patients required reoperation for persistent SUI in either group during the study period. The rates of de novo urge incontinence in the two groups were also comparable (Table 3).

Both the ICIQ-SF and Sandvik scores improved after surgery with the Align™ TOT and the Ajust™ SIMS. The subjective improvement assessed with these questionnaires was similar in the two groups (Table 4). In three patients, severe incontinence after surgery according to the Sandvik severity index (two patients in the Ajust™ group and one in the Align™ group) was regarded as improvement because this incontinence was due only to nocturia that was also reported to be less than before surgery.

Postoperative complications are summarized in Table 5. There were no differences between the two groups. There were no urinary tract injuries in either group. During the follow-up period, six women experienced hypogastric or thigh pain in the Ajust™ group, but none in the Align™ group, but in some of these women the pain was self-limiting. At 1 year three women complained of persistent thigh pain in the Ajust™ group (10%), but none in the Align™ group; however, the difference was not statistically significant ($p = 0.238$). None of the women reported de novo dyspareunia during the first year after the surgery. None of the women had vaginal exposure of the sling during the follow-up period.

Discussion

SIMS were developed to reduce the complication rate of TOT surgery without significantly reducing the success rate. However, high-quality data comparing the effectiveness of SIMS and TOT are scarce and conflicting [5–8]. Furthermore, commercially available SIMS have many technical differences, making their comparison as a whole with standard TOTs not appropriate. Our study is one on the few RCTs comparing TOT and the Ajust™ SIMS. The number of participants included in the study was below the number expected owing to the withdrawal of some collaborator centres due, in part, to the particular economic circumstances of the country during the study period. Nevertheless, the study had sufficient power to conclude the noninferiority of the Ajust™

Table 2 Outcomes at different follow-up time-points

Outcome	1 month				6 months				12 months			
	Align™ group		Ajust™ group		Align™ group		Ajust™ group		Align™ group		Ajust™ group	
	No. (%) of patients	95% confidence interval	No. (%) of patients	95% confidence interval	No. (%) of patients	95% confidence interval	No. (%) of patients	95% confidence interval	No. (%) of patients	95% confidence interval	No. (%) of patients	95% confidence interval
Cured	24 (85.7)	68.5 – 94.3	21 (70.0)	52.1 – 83.3	22 (78.5)	60.5 – 89.8	21 (70.0)	52.1 – 83.3	20 (71.4)	52.9 – 84.7	19 (63.3)	45.5 – 78.1
Improved	4 (14.3)	5.7 – 31.5	8 (26.7)	14.2 – 44.4	5 (17.9)	7.9 – 35.6	7 (23.3)	11.8 – 40.9	7 (25.0)	12.7 – 43.4	9 (30.0)	16.7 – 47.9
Failure	0 (0)	0 – 12.1	1 (3.3)	0.6 – 16.7	1 (3.6)	0.6 – 17.7	2 (6.7)	1.8 – 21.3	1 (3.6)	0.6 – 17.7	2 (6.7)	1.8 – 21.3
p value[a]	0.99				0.60				0.60			

[a] Comparing Cured/Improved vs. Failure

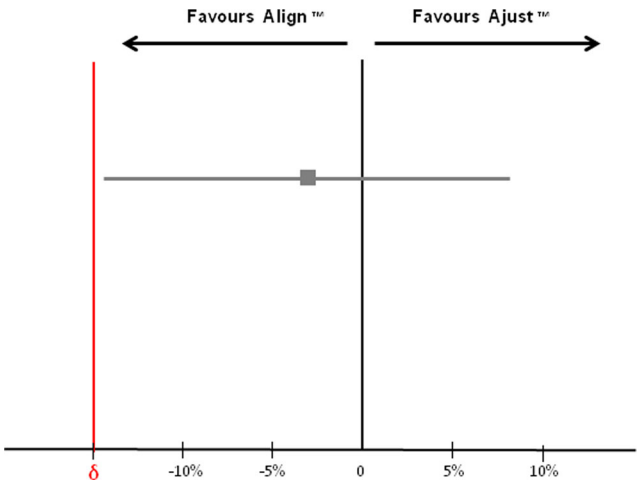


Fig. 2 Difference in cure/improvement rates. δ Noninferiority threshold (−15%)

SIMS compared with the Align™ TOT, according to the defined inferiority threshold. Our findings are in accordance with the results of other RCTs [18–21] and one prospective cohort study [22] which also found no difference in the outcomes with the Ajust™ SIMS and standard TOTs. In addition, owing to the of the block randomization design stratifying by centre, the loss of participating centres did not affect the randomization process. Furthermore, the effectiveness of the Ajust™ SIMS has been proved under more standard conditions in which associated prolapse surgery does not affect the outcome of the procedure.

Complications are another important point to consider since SIMS were developed to reduce them, particularly postoperative pain. As in previous studies [18–21], we found no differences in the complications observed with the two procedures. Notwithstanding, owing to the final small sample size, our study could not allow firm conclusions to be drawn regarding complications. The rates of de novo urge incontinence was also found to be similar in both groups and are also consistent with those reported previously [10–14, 18, 19]. However, as described by others [18, 19], there is a trend towards a higher incidence of de novo urge incontinence in patients treated with the Ajust™ SIMS. This trend has also been observed with other SIMS [6, 8]. Moreover, more patients showed persistent thigh pain in the

Table 3 Rates of urinary incontinence after surgery according to the Sandvik classification.

	Align™ group	Ajust™ group
None	15 (53.3)	16 (53.4)
Slight	3 (10.7)	4 (13.3)
Moderate	8 (28.6)	6 (20.0)
Severe	2 (7.1)	4 (13.3)
Very severe	0	0

The data presented are number (%) of patients

Table 4 Change in questionnaires scores

Questionnaire	Score after surgery		Mean difference		*p* values		
	Align™ group	Ajust™ group	Align™ group	Ajust™ group	Within-group		Between groups
					Align™ group	Ajust™ group	
ICIQ-SF	0 (0 to 6.5)	0 (0 to 6)	−14 (−18 to −8)	−13 (−16 to −10)	0.000	0.000	0.350
Sandvik	0 (0 to 3)	0 (0 to 3)	−8 (−10 to −5)	−7 (−10 to −4)	0.000	0.000	0.459

The data presented are medians (Interquartile range)

Ajust™ group which was unexpected, although the difference was not statistically significant. Nevertheless, no patient had de novo dyspareunia.

Despite the fact that some trials have analysed in detail postoperative pain profiles, few have addressed the problem of long-term pain. Pain at the site of the anchors and dyspareunia have also been reported previously, requiring surgical removal of the anchors in some patients [10, 12, 15, 18]. These observations are, however, in disagreement with those in previous studies that showed lower rates of long-term pain than with standard TOTs and improved sexual quality of life [19, 20]. Furthermore, a higher incidence of dyspareunia has also been observed with other SIMS than with TOT [5]. The pain in these patients could be explained in part by the robustness of the anchors. The difference in the insertion route of the Ajust™ SIMS (inside-out) and the Align™ TOT (outside-in) may also be associated with the trend for the higher rate of persistent thigh pain in the Ajust™ group. The inside-out route has been hypothesized to be related to more thigh pain events, but this has not been confirmed with standard TOTs [1, 3]. The learning curve may also have played a role. It is suspected to be more than ten procedures for the Ajust™ SIMS [12, 20] and, therefore, complication rates could decrease with further procedures. Our study was not designed to compare complication rates and was therefore probably underpowered to find differences in the incidence of long-term pain. This is a point that deserves special attention in future studies because a reduction in pain is one of the main objectives of SIMS.

The present study had some limitations including the small size of the cohort. However, after a power analysis the study showed sufficient power to conclude the noninferiority that was its primary objective. The objective assessment based on the cough stress test was limited because it was not performed with a specified bladder volume, but the effect of this limitation was reduced by using a compound outcome based on both objective and subjective criteria. Even so, the conclusions of this RCT should be viewed with caution due the small sample size, particularly regarding the complication rates, for which the study could have been underpowered. On the other hand, the study had several strengths. The randomization and concealment processes provided high-quality data that increases the amount of evidence available on this new

Table 5 Complications

	Align™ group	Ajust™ group	*p* value
Intraoperative	0 (0)	0 (0)	1
Early postoperative	5 (17.9)	8 (26.7)	0.534
Temporary elevated PVR	1	2	
Voiding difficulty requiring ISC	0	1	
Cystitis[a]	2	0	
Groin/obturator pain	2	4	
Suburethral haematoma	0	1	
Late postoperative	2 (7.1)	6 (20)	0.256
Recurrent cystitis	2	0	
Groin/hypogastric pain[b]	0	6	
Tape erosion	0	0	
De novo urgency	1 (3.6)	3 (10.0)	0.333

The data presented are number (%) of patients

PVR Post-void residual urine volume, *ISC* Intermittent self-catheterization

[a] Positive urinary culture

[b] Pain reported during follow-up, also including the women with self-limited thigh pain (persisting in only three women at 1 year in the Ajust™ group)

technique and that could be useful for further meta-analysis. In addition, the trial was done under more standard conditions than previous studies with more restrictive inclusion criteria (e.g. the inclusion of women with associated POP surgery), making the results more generalizable.

In conclusion, the Ajust™ SIMS showed a noninferior effectiveness compared with the full-length TOT at 1-year. Nevertheless, data on long-term outcomes are still needed. In the light of our results, the question of long-term pain in particular should be addressed in future studies.

Compliance with ethical standards

Funding This work was supported by a grant from Palex Medical (Sant Cugat del Vallès, Barcelona, Spain) to cover exclusively the cost of the insurance of the study for civil liability. Palex Medical is the local distributor of Bard slings in Spain.

Conflicts of interest None.

References

1. Ford AA, Rogerson L, Cody JD, Ogah J. Mid-urethral sling operations for stress urinary incontinence in women. Cochrane Database Syst Rev. 2015;7, CD006375. doi:10.1002/14651858.CD006375.pub3.
2. Latthe PM, Foon R, Toozs-Hobson P. Transobturator and retropubic tape procedures in stress urinary incontinence: a systematic review and meta-analysis of effectiveness and complications. Br J Obstet Gynaecol. 2007;114:522–531. doi:10.1111/j.1471-0528.2007.01268.x.
3. Novara G, Artibani W, Barber MD, et al. Updated systematic review and meta-analysis of the comparative data on colposuspensions, pubovaginal slings, and midurethral tapes in the surgical treatment of female stress urinary incontinence. Eur Urol. 2010;58:218–238. doi:10.1016/j.eururo.2010.04.022.
4. Richter HE, Albo ME, Zyczynski HM, et al. Retropubic versus transobturator midurethral slings for stress incontinence. N Engl J Med. 2010;362:2066–2076. doi:10.1056/NEJMoa0912658.
5. Schimpf MO, Rahn DD, Wheeler TL, et al. Sling surgery for stress urinary incontinence in women: a systematic review and metaanalysis. Am J Obstet Gynecol. 2014;211:71.e1–71.e27. doi:10.1016/j.ajog.2014.01.030.
6. Abdel-Fattah M, Ford JA, Lim CP, Madhuvrata P. Single-incision mini-slings versus standard midurethral slings in surgical management of female stress urinary incontinence: a meta-analysis of effectiveness and complications. Eur Urol. 2011;60:468–480. doi:10.1016/j.eururo.2011.05.003.
7. Mostafa A, Lim CP, Hopper L, Madhuvrata P, Abdel-Fattah M. Single-incision mini-slings versus standard midurethral slings in surgical management of female stress urinary incontinence: an updated systematic review and meta-analysis of effectiveness and complications. Eur Urol. 2014;65:402–427. doi:10.1016/j.eururo.2013.08.032.
8. Nambiar A, Cody JD, Jeffery ST. Single-incision sling operations for urinary incontinence in women. Cochrane Database Syst Rev. 2014;6, CD008709. doi:10.1002/14651858.CD008709.pub2.
9. Abdel-Fattah M, Agur W, Abdel-All M, et al. Prospective multicentre study of adjustable single-incision mini-sling (Ajust(®)) in the management of stress urinary incontinence in women: 1-year follow-up study. BJU Int. 2012;109:880–886. doi:10.1111/j.1464-410X.2011.10471.x.
10. Cornu JN, Peyrat L, Skurnik A, Ciofu C, Lucente VR, Haab F. Ajust single incision transobturator sling procedure for stress urinary incontinence: results after 1-year follow-up. Int Urogynecol J. 2012;23:1265–1270. doi:10.1007/s00192-012-1740-0.
11. Jiang T, Xia Z, Cheng D, et al. Short-term outcomes of adjustable single-incision sling (Ajust™) procedure for stress urinary incontinence: a prospective single-center study. Eur J Obstet Gynecol Reprod Biol. 2015;186:59–62. doi:10.1016/j.ejogrb.2015.01.002.
12. Meschia M, Barbacini P, Baccichet R, et al. Short-term outcomes with the Ajust system: a new single incision sling for the treatment of stress urinary incontinence. Int Urogynecol J. 2011;22:177–182. doi:10.1007/s00192-010-1254-6.
13. Natale F, Dati S, La Penna C, Rombolà P, Cappello S, Piccione E. Single incision sling (Ajust™) for the treatment of female stress urinary incontinence: 2-year follow-up. Eur J Obstet Gynecol Reprod Biol. 2014;182:48–52. doi:10.1016/j.ejogrb.2014.08.011.
14. Naumann G, Hagemeier T, Zachmann S, et al. Long-term outcomes of the Ajust adjustable single-incision sling for the treatment of stress urinary incontinence. Int Urogynecol J. 2013;24:231–239. doi:10.1007/s00192-012-1843-7.
15. Vandendriessche D, Engrand JB, Debodinance P. Ajust(®): prospective study and 1-year follow-up – a series of 60 female patients. Prog Urol. 2013;23:994–999. doi:10.1016/j.purol.2013.04.001.
16. Haylen BT, Ridder D, Freeman RM, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic floor dysfunction. Int Urogynecol J. 2010;21:5–26. doi:10.1007/s00192-009-0976-9.
17. Sandvik H, Espuna M, Hunskaar S. Validity of the incontinence severity index: comparison with pad-weighing tests. Int Urogynecol J. 2006;17:520–524. doi:10.1007/s00192-005-0060-z.
18. Masata J, Svabik K, Zvara K, Hubka P, Toman A, Martan A. Comparison of the efficacy of tension-free vaginal tape obturator (TVT-O) and single-incision tension-free vaginal tape (Ajust™) in the treatment of female stress urinary incontinence: a 1-year follow-up randomized trial. Int Urogynecol J. 2016;27:1497–1505. doi:10.1007/s00192-016-3012-x.
19. Mostafa A, Agur W, Abdel-All M, et al. Multicenter prospective randomized study of single-incision mini-sling vs tension-free vaginal tape-obturator in management of female stress urinary incontinence: a minimum of 1-year follow-up. Urology. 2013;82:552–559. doi:10.1016/j.urology.2013.02.080.
20. Schweitzer KJ, Milani AL, van Eijndhoven HW, et al. Postoperative pain after adjustable single-incision or transobturator sling for incontinence: a randomized controlled trial. Obstet Gynecol. 2015;125:27–34. doi:10.1097/AOG.0000000000000604.
21. Xin X, Song Y, Xia Z. A comparison between adjustable single-incision sling and tension-free vaginal tape-obturator in treating stress urinary incontinence. Arch Gynecol Obstet. 2016;293:457–463. doi:10.1007/s00404-015-3949-x.
22. Grigoriadis C, Bakas P, Derpapas A, Creatsa M, Liapis A. Tension-free vaginal tape obturator versus Ajust adjustable single incision sling procedure in women with urodynamic stress urinary incontinence. Eur J Obstet Gynecol Reprod Biol. 2013;170:563–566. doi:10.1016/j.ejogrb.2013.07.041.

3.2 Polypropylene and polyvinylidene fluoride transobturator slings for the treatment of female stress urinary incontinence: 1-Year outcomes from a multicentre randomized trial.

Sabadell J, Pereda-Núñez A, Ojeda-de-Los-Santos F, Urbaneja M, González-García C, Camps-Lloveras N, Pérez-Plantado À, Canet-Rodríguez J, Pérez-Espejo MP, Rodríguez-Mias N, Sarasa-Castelló N, Palau M, Montero-Armengol A, Salicrú S, Gil-Moreno A, Poza JL.

Neurourol Urodyn. 2021;40(1):475-482. doi: 10.1002/nau.24586.

Received: 23 September 2020 | Revised: 2 November 2020 | Accepted: 15 November 2020

DOI: 10.1002/nau.24586

ORIGINAL CLINICAL ARTICLE

Polypropylene and polyvinylidene fluoride transobturator slings for the treatment of female stress urinary incontinence: 1-Year outcomes from a multicentre randomized trial

Jordi Sabadell MD[1,2] | Anna Pereda-Núñez MD[3] | Fernando Ojeda-de-los-Santos MD[4] | Manuel Urbaneja MD[5] | Carmen González-García MD[6] | Narcís Camps-Lloveras MD[7] | Àngela Pérez-Plantado MD[8] | Judit Canet-Rodríguez MD[9] | Maria Paz Pérez-Espejo MD[10] | Nuria Rodríguez-Mias MD, PhD[1] | Núria Sarasa-Castelló MD[3] | Marta Palau MD[5] | Anabel Montero-Armengol MD[1] | Sabina Salicrú MD[1] | Antonio Gil-Moreno MD, PhD[11,12,13] | Jose L. Poza MD, PhD[1]

[1]Urogynecology and Pelvic Floor Unit, Department of Gynecology, Hospital Universitari Vall d'Hebron, Vall d'Hebron Barcelona Hospital Campus, Universitat Autònoma de Barcelona, Barcelona, Spain

[2]General Surgery Research Group, Vall d'Hebron Institut de Recerca, Vall d'Hebron Barcelona Hospital Campus, Universitat Autònoma de Barcelona, Barcelona, Spain

[3]Pelvic Floor Unit, Department of Obstetrics and Gynecology, Hospital General de Granollers, Barcelona, Spain

[4]Department of Gynecology, Hospital Quirón Sagrado Corazón, Sevilla, Spain

[5]Department of Gynecology, Hospital Virgen del Rocío, Sevilla, Spain

[6]Department of Gynecology, Hospital de Viladecans, Barcelona, Spain

[7]Functional Urology and Urodynamics Unit, Department of Urology, Hospital Universitari de Bellvitge, Universitat de Barcelona, Barcelona, Spain

[8]Department of Gynecology, Hospital de Mataró, Consorci Sanitari del Maresme, Barcelona, Spain

[9]Department of Gynecology, Hospital Santa Caterina de Salt, Girona, Spain

[10]Department of Urology, Hospital General de Riotinto, Huelva, Spain

[11]Department of Gynecology, Hospital Universitari Vall d'Hebron, Vall d'Hebron Barcelona Hospital Campus., Barcelona, Spain

[12]Biomedical Research Group in Gynecology, Vall d'Hebron Institut de Recerca, Vall d'Hebron Barcelona Hospital Campus, Universitat Autònoma de Barcelona, Barcelona, Spain

[13]Centro de Investigación Biomédica en Red (CIBERONC), Instituto de Salud Carlos III, Madrid, Spain

Correspondence
Jordi Sabadell, MD, Urogynecology and Pelvic Floor Unit, Department of Gynecology. Hospital Universitari Vall d'Hebron, Vall d'Hebron Barcelona Hospital Campus. Universitat Autònoma

Abstract

Aims: To compare the effectiveness and safety of polypropylene (PP) and polyvinylidene fluoride (PVDF) transobturator tapes (TOT) for the treatment of female stress urinary incontinence (SUI).

de Barcelona, Passeig Vall d'Hebron 119-129. E-08035 Barcelona, Spain.
Email: jsabadell@vhebron.net

Funding information
Fundación Dexeus Salud de la Mujer; Cardiolink

Methods: This is a multicentre randomized trial. Women with SUI or stress-predominant mixed urinary incontinence and scheduled for a TOT procedure were randomized to PP or PVDF slings. The primary outcome was 1-year cure or improvement rate using composite criteria. Complications were also compared. Relationships with outcomes were analyzed using multivariable logistic regressions models.

Results: From April 2016 to January 2018 285 participants were randomized. PP and PVDF slings showed similar high cure or improvement rate (91.0% vs. 95.6%, $p = .138$). Improvement in validated questionnaires was also similar. PVDF slings were associated with a lower rate of de novo urgency incontinence (adjusted odds ratio = 0.35; 95% confidence interval = 0.15–0.80). We found no statistical differences in complications rates, although a higher incidence of long-term pain events were observed in the PP group. The study is underpowered to find differences in specific complications owing to the low number of events.

Conclusion: PP and PVDF TOTs are equally effective, although PVDF is associated with fewer cases of de novo urgency incontinence. Further studies are needed to give robust conclusions on safety profiles.

KEYWORDS
de novo urgency incontinence, midurethral sling, polypropylene, polyvinylidene fluoride, PVDF, sling complications, stress urinary incontinence, suburethral sling, suburethral tape, transobturator

1 | INTRODUCTION

One of the most common first line surgical treatments for female stress urinary incontinence (SUI) is currently the use of tension-free suburethral tapes. Both retropubic and transobturator routes have shown a similarly high effectiveness but with different complication profiles.[1–5] Specifically, complication rates for transobturator tapes (TOT) ranged from 11% to 31%.[6] It is well known that biomechanical and biocompatibility properties of the materials used in the slings are related to their success and complication rates.[7–10] Therefore, some of the complications that could be related to the sling's material, such as de novo urgency incontinence (UUI), pain, sling extrusion and voiding dysfunction may be further decreased by improving this material.

Although many brands have developed their own slings, the synthetic material utilized in these tapes is mainly polypropylene (PP). However, the use of polyvinylidene fluoride (PVDF) in suburethral tapes is also approved in Europe. PVDF is a nonabsorbable fluoropolymer introduced in 2002 for surgical meshes [11] with improved biocompatibility in animal studies.[12,13] Some of its biomechanical properties are lower elongation and deformation capacities compared with PP.[14] These characteristics are the basis to hypothesize that PVDF slings may be associated with less mesh-related complications.

In a previous descriptive clinical study we found similar effectiveness and complications with PP and PVDF slings, although more obstructive events were observed in the PP group.[15] However, to date there are no clinical trials comparing those materials in suburethral slings. For that reason we designed this randomized controlled trial (RCT) to establish whether PP and PVDF TOTs are equally effective for treating female SUI. Secondarily, safety profiles will be compared.

2 | MATERIALS AND METHODS

The present study was designed as a pragmatic, multicentre RCT to compare the effectiveness of PP and PVDF TOTs for the treatment of female SUI. Eleven Spanish hospitals were initially included in the trial. The research protocol was approved by the Ethics Committee of the participating centers or explicitly accepted the approval of the coordinating center in the absence of an own ethics committee. The protocol was registered at the public registry ClinicalTrials. gov (NCT02886520).

Patients attending at the participant hospitals because of SUI or stress-predominant mixed urinary incontinence (MUI) were considered for participation in the study. Exclusion criteria were previous continence surgery with midurethral slings, the presence of MUI with predominant

urgency incontinence, intrinsic sphincter deficiency (defined as maximal urethral closure pressure of 20 cmH_2O or less or as Valsalva leak point pressure of 60 cmH_2O or less) when it was evaluable, the existence of neurogenic bladder, the incapacity to understand the information or to give their consent, and age less than 18 years. Women were regarded eligible if they met the inclusion and exclusion criteria. All women received a detailed explanation about the surgical procedure and the study, and written informed consent was obtained.

Preoperative evaluation included a detailed physical examination including a cough stress test (patients were invited to attend follow-up visits at least 2 h after the last micturition), an interview following a questionnaire with signs and symptoms of lower urinary tract dysfunction based on the terminology recommended by the International Continence Society,[16] a urinalysis and urine culture. SUI was diagnosed clinically by the cough stress test in all cases. Pelvic organ prolapse (POP) was staged using the POP-Q system. Preoperative urodynamic study before surgery was optional according to each center's protocol. Participants also completed preoperatively the Sandvik's incontinence severity index validated for Spanish language and that categorizes incontinence into four groups (a fifth group was defined for zero punctuation that means no-incontinence)[17] and the International Consultation on Incontinence Questionnaire-Short Form (ICIQ-SF).

A block-randomization procedure, stratified by center, was carried out using a random number generator program. Allocation was performed in a 1:1 ratio. Randomization sequence was concealed in a centralized electronic website designed specifically for this study (http://www.ribk.com/C3PO/). Group assignment was performed before surgeries once participants agreed with the study. Commercial kits of Amid Type-I PP-TOTs used were those that each center used in their daily practice. The second material studied in TOTs was PVDF (DynaMesh-SIS direct soft; FEG Textiltechnik). All the procedures were performed by experienced surgeons with experience of both types of sling material. Patients were not blinded for the procedure. TOT procedures were done following the standard technique[18] and according to the instructions of the different brands, including the insertion routes. The tapes were placed tension-free without the aid of a cough test. PP and PVDF slings were left under the midurethra in the same manner, leaving a small distance between tape and urethra by placing a scissor or a forceps between them. Surgery for POP correction was associated when needed.

Postoperative follow-up visits were scheduled at 1, 6 (optional), and 12 months. These included physical examination with a cough stress test in the same conditions than in the preoperative evaluation and an interview about symptoms of incontinence, use of urinary protection, micturition difficulties, pain in groins or thighs and dyspareunia. Patient satisfaction was assessed with the patient global impression of improvement (PGI-I) questionnaire[19] one year after surgery. Women also completed the Sandvik and ICIQ-SF questionnaires at this follow-up point.

The primary outcome was the cure or improvement rate one year after surgery, classified following a composite objective and subjective criteria. Patients were regarded as cured if they had no stress leaks, the stress test was negative and they were fully satisfied with the operation (Sandvik and ICIQ-SF scores = 0, PGI-I = 1–2). To be regarded as improved, the cough stress test had to be negative and the patient moderately satisfied with the result of surgery due to sporadic stress leaks or to an increase in urinary frequency with or without sporadic UUI episodes (Sandvik and ICIQ-SF > 0, PGI = 2–3). Patients were classified as failures in the presence of a positive cough test and/or dissatisfaction with the surgery, including de novo UUI and/or voiding dysfunction associated with frequent urinary infections and the use of the same urinary protection during daily activities as before the surgery (PGI-I ≥ 4). Intraoperative and postoperative complications were also recorded. Early postoperative complications were defined as those that occurred within the first month after surgery; late postoperative complications were those that were present greater than 1 month after surgery. De novo urgency was diagnosed clinically by the presence of new onset bothersome overactive bladder symptoms or by worsening of previous ones. Elevated post-void residual volume was defined as a urine residual of greater than 100 ml measured by introital ultrasound or by urethral catheterization.

Sample size calculation was based on the results of our preliminary study with both materials[15] and also according to clinical relevance criterion. It was estimated that 282 patients were needed to provide 80% power to detect a 10% difference in success rate with an assumed cure rate of 95% for the reference procedure and a two-sided α-error of 0.05.

Statistical analysis was conducted by a third party not involved in the study. Normal distribution for continuous variables was assessed using the Shapiro–Wilk test. Quantitative variables were compared using the unpaired Student's t test and with the Mann–Whitney U test for those variables that did not follow a normal distribution. Categorical variables were analyzed using the χ^2 test or Fisher's exact test when indicated. Outcomes analyses were performed on an intention-to-treat basis. A second per-protocol analysis for the primary outcome was projected. Univariate analyses were performed with each

baseline variable by means of logistic regression. Multivariate logistic regression models were constructed forcing them to keep the sling material and using a forward process based on the improvement of the likelihood and the Akaike's criterion of the model with a $p < .10$ to decide to include a new variable. Sensitivity for the primary outcome was evaluated using a shrinkage coefficient to calibrate the model. One prespecified subgroup analysis was planned on women with detrussor underactivity. Changes in quantitative variables within-procedures were analyzed by means of the Student's paired t test and differences in the changes between-procedures were compared with the unpaired t test. A two-tailed $p < .05$ was considered to indicate statistical significance for the analyses cited hereinbefore and 95% confidence intervals (CIs) were calculated. Analyses were conducted with the software Stata version 15.1 (StataCorp) and SPSS version 18.0 (IBM).

3 | RESULTS

Between April 2016 and January 2018 a total of 307 patients were assessed for eligibility. One of the 11 participating centers withdrew from the study before including any participant. Patients' recruitment was stopped once the estimated sample size was reached. Of them, 285 patients underwent randomization during the study period, but one withdrew her consent to the study after having been randomized. Finally, 284 women were suitable for the analysis, 140 in the PP group and 144 in the PVDF one (Figure 1). Preoperative characteristics of both groups were similar and are detailed in Table 1. In the PP group the TOT was inserted via the outside-in route in 123 women, whereas in the remaining 16 patients the inside-out route was used. All women in the PVDF group underwent the TOT through the outside-in approach. At the time of the surgery 73 women (25.4%)

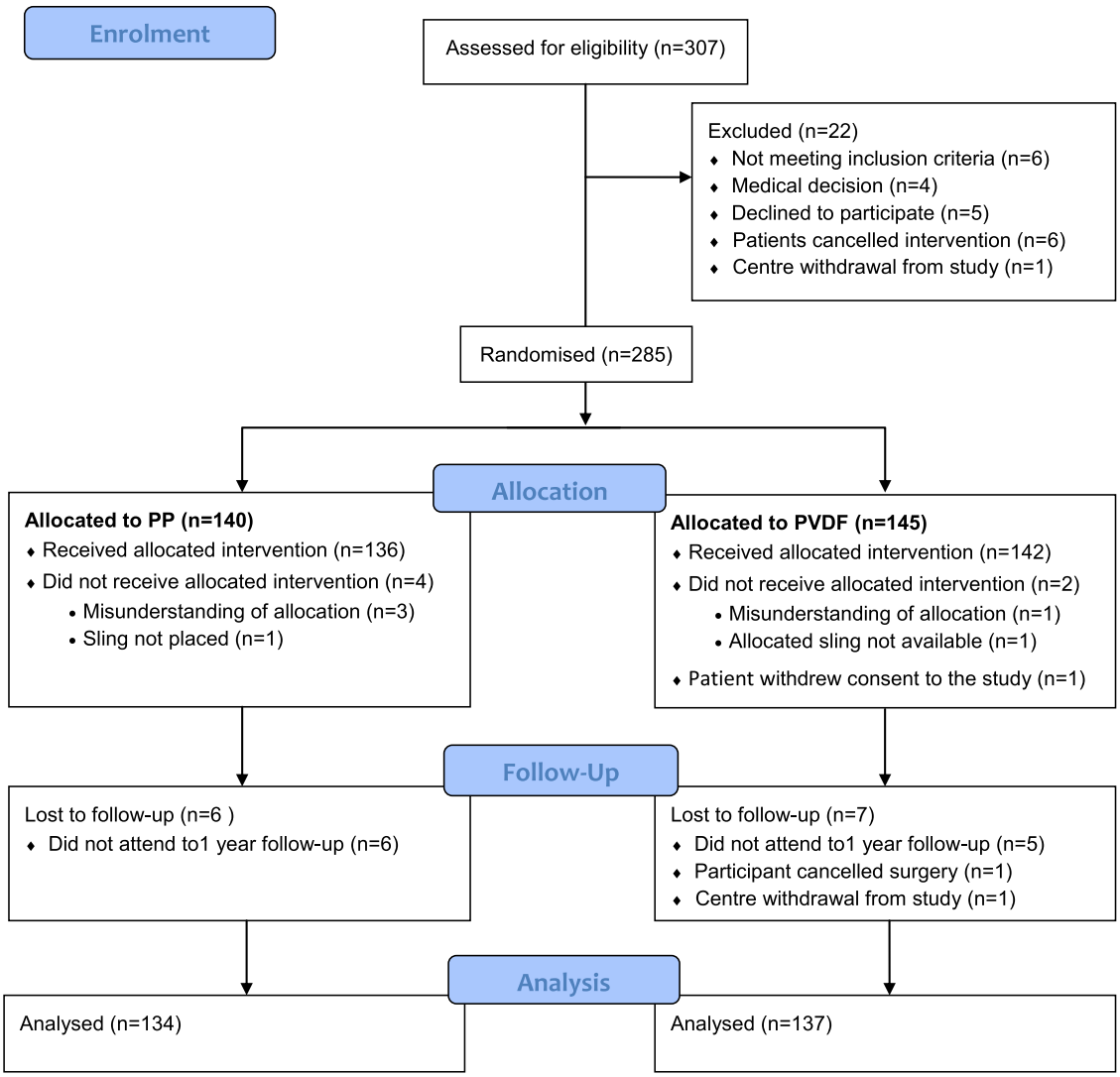


FIGURE 1 CONSORT flow diagram of the study. PP, polypropylene; PVDF, polyvinylidene fluoride

TABLE 1 Baseline characteristics

	PP	PVDF	p[a]
Age (years)[b]	55.3 (48.2–67.0)	58.9 (50.1–68.1)	.133
BMI[b]	28.3 (25.6–31.9)	27.8 (24.9–32.1)	.683
Parity[b]	2 (2–3)	2 (2–3)	.607
Vaginal deliveries[b]	2 (2–3)	2 (2–3)	.548
Menopause[c]	88 (62.9)	94 (65.3)	.671
Smoking habit[c]			.417
Nonsmoker	98 (71.5)	92 (65.3)	
Former smoker	18 (13.1)	19 (13.5)	
Current smoker	21 (15.3)	30 (21.3)	
Urethral hypermobility[c]	112 (80.6)	107 (77.0)	.463
Sandvik score[b]	8 (8–12)	8 (8–12)	.399
ICIQ-SF[b]	16 (14–18)	16 (14–18)	.332
Previous UUI[c]	61 (44.2)	51 (36.9)	.430
Associated POP[c]	55 (39.3)	52 (36.4)	.612
Associated surgery[c]	34 (24.5)	39 (27.3)	.590
Anterior repair	12	12	
Manchester procedure	0	1	
Vaginal hysterectomy	5	8	
Vaginal hysterectomy + anterior and/or posterior repair	13	13	
Posterior repair	0	3	
Colpocleisis	1	2	
Other surgeries	3	0	

Abbreviations: BMI, body mass index; ICIQ-SF, International Consultation on Incontinence Questionnaire-Short Form; PP, polypropylene; POP, pelvic organ prolapse; PVDF, polyvinylidene fluoride; UUI, urinary urge-incontinence.

[a]p Value comparing groups characteristic.

[b]Data expressed in median (interquartile range).

[c]Data expressed in n (%).

underwent concomitant surgery for POP. During the 1-year follow-up period, 13 women (4.58%) were lost to follow-up.

3.1 | Primary outcome

On the intention-to-treat analysis the cure/improvement rate was similar with both sling materials: PP 91% (122/134) versus PVDF 95.6% (131/137, $p = .138$). In the univariate analysis the presence of urge-incontinence before surgery was the only variable associated with a failure of the procedure (odds ratio [OR] = 3.21, 95% CI = 1.10–9.32). Concomitant POP surgery was not associated to failure ($p = .785$). Among failures (n = 18), 5 women (27.8%) underwent concomitant POP surgery while 13 (72.2%) did not. However, in the final multivariate analysis the sling material was the only variable included in the final model obtaining the same results (PVDF OR = 0.47, 95% CI = 0.17–1.28). The failures observed in the PP group were because of persistent SUI in three cases, MUI in four cases, severe de novo urge incontinence in four cases and voiding dysfunction in one case. In the PVDF group 2 cases failed because of persistent SUI and four cases because of MUI. Both the ICIQ-SF and Sandvik scores improved after surgery with PP and PVDF slings. Subjective improvement, assessed with these questionnaires and the PGI-I, was similar in both groups (Table 2). Calibrated model leads to a shrinkage coefficient of 0.098 and therefore no correction of the coefficients has been finally performed.

We conducted a per-protocol analysis including 130 women in the PP group and 135 in the PVDF group. Results were materially unchanged, with an OR of failure in the PVDF group of 0.46 (95% CI = 0.17–1.26).

The subgroup analyses on patients with suspected detrussor underactivity included only 33 women. The observed results were similar to those on the whole study population, with an OR of failure in the PVDF group of 0.25 (95% CI = 0.02–3.10).

3.2 | Complications

Complications are detailed in Table 3. Seven women (5.1%) experienced an intraoperative complication in the PP group and four (2.8%) in the PVDF group. The sling material was not associated with intraoperative complications on the multivariate model (PVDF OR = 1.10, 95% CI = 0.97–1.25) as any other variable either.

Early postoperative complications were observed in 25 women in the PP group (18.1%) and 22 in the PVDF one (15.5%). In the multivariate analysis only the associated surgery to the TOT procedure was related to these complications (OR = 2.58, 95% CI = 1.26–5.28). Eight women (5.71%) in the PP group experienced voiding dysfunction with elevated post-void residual volumes, one of them requiring sling loosening in the first days after surgery. In the PVDF group elevated post-void residual volumes were present in 10 women (6.94%). One case of very early sling vaginal exposure was present in each group.

Late postoperative complications were recorded in 14 women (10.4%) in the PP group and 10 in the PVDF

TABLE 2 Questionnaires scores

	Preoperative		Postoperative		*p* Within group		
	PP	PVDF	PP	PVDF	PP	PVDF	*p* Between groups
ICIQ-SF[a]	16 (14–18)	16 (14–18)	0 (0–6)	0 (0–5)	.000	.000	.149
Sandvik[a]	8 (8–12)	8 (8–12)	0 (0–3.75)	0 (0–3)	.000	.000	.173
No UI	4 (2.9%)	4 (2.8%)	72 (54.5%)	76 (55.9%)			
Slight	3 (2.2%)	1 (0.7%)	20 (15.2%)	24 (17.6%)			
Moderate	26 (19.0%)	23 (16.3%)	32 (24.2%)	32 (23.5%)			
Severe	64 (46.7%)	66 (46.8%)	7 (5.3%)	3 (2.2%)			
Very severe	40 (29.2%)	47 (33.3%)	1 (0.8%)	1 (0.8%)			
PGI-I[a]			1 (1–2)	1 (1–2)			.757
Very much/much better			115 (89.1%)	122 (91.7%)			
Little better			7 (5.4%)	6 (4.5%)			
No change or worse			7 (5.4%)	5 (3.8%)			

Abbreviations: ICIQ-SF, International Consultation on Incontinence Questionnaire-Short Form; PGI-I, patient global impression of improvement; PP, polypropylene; PVDF, polyvinylidene fluoride; UI, urinary incontinence.

[a]Data expressed in median (interquartile range).

TABLE 3 Complications

	PP	PVDF	*p*[a]
Intraoperative	7 (5.1%)	4 (2.8%)	.356
Bleeding	1 (0.7%)	1 (0.7%)	
Vaginal perforation	4 (2.9%)	2 (1.4%)	
Other	2 (1.4%)	1 (0.7%)	
Early postoperative	25 (18.1%)	22 (15.5%)	.452
Temporary elevated PVR	8 (5.8%)	10 (7.0%)	
Cystitis[b]	2 (1.4%)	3 (2.1%)	
Suburethral hematoma	2 (1.4%)	1 (0.7%)	
Obturator/hypogastric pain	6 (4.3%)	4 (2.8%)	
Vaginal exposition	1 (0.7%)	1 (0.7%)	
Other	8 (5.8%)	4 (2.8%)	
Late postoperative	14 (10.4%)	10 (7.2%)	.313
Repeated cystitis[b]	2 (1.5%)	5 (3.6%)	
Voiding dysfunction	1 (0.7%)	1 (0.7%)	
Tape extrusion	3 (2.2%)	2 (1.5%)	
Obturator/hypogastric pain	7 (5.2%)	2 (1.5%)	
Dyspareunia	4 (3.0%)	1 (0.7%)	
Sling division	3 (2.2%)	0 (0%)	.121
De novo urgency	22 (16.4%)	10 (7.3%)	.012

Abbreviations: PP, polypropylene; PVDF, polyvinylidene fluoride; PVR, post-void residual urine volume.

[a]Adjusted *p* value according to final multivariable models.

[b]Positive urinary culture.

group (7.2%). Neither overall late complication rate (PVDF OR = 0.64, 95% CI = 0.27–1.52) nor any specific late complication was associated with sling material. Finally, we find a lower rate of de novo UUI in the PVDF group with an adjusted OR = 0.35 (95% CI = 0.15–0.80; Table 3). Associated POP was not related to de novo UUI ($p = .456$). Among women who suffered de novo UUI, 6 (27.3%) underwent associated POP surgery whereas 16 women (72.7%) did not in the PP group ($p = .753$). In the PVDF group four women (40.0%) underwent associated POP surgery and six (60.0%) did not ($p = .458$). Sling division was needed in three patients in the PP group (in 2 because of voiding dysfunction and in 1 because of vaginal extrusion) while none in the PVDF group, however this difference was not significant ($p = .121$).

4 | DISCUSSION

There are no previous clinical trials comparing the effectiveness of PP and PVDF in midurethral slings for treating female SUI. The present study finds similar effectiveness of both materials under the specified criteria. The observed overall high success rates at 1 year are in accordance with the results obtained in a previous observational study.[15] However, no data are available on long-term outcomes comparing these materials.

Safety however, is also a major issue for surgical procedures. Safety of PVDF meshes in urogynecology has been reported previously.[15,20,21] In the present trial, we

observed a higher incidence of de novo UUI in the PP group. This finding was also observed in our previous descriptive study,[15] and could be explained in part by the lower elongation and better biocompatibility of PVDF than PP described in experimental studies.[12–14] The amount of foreign body reaction and the consequent mesh contraction [13,22] could explain some cases of de novo UUI. In addition, the overall rates of de novo UUI are similar to those described previously.[15,23] On the contrary, we have not found the differences in obstructive events observed previously,[15] nor in other complications. However, a higher number of adverse events that could be associated with the material used were observed in the PP group, such as long-term pain, dyspareunia and the need for sling division. Although the present study was designed to compare the effectiveness of the techniques, it is underpowered to find differences in specific complications due to the low number of events.

This clinical trial compares these materials obtaining robust data on their effectiveness as TOT slings. The objective assessment based on the cough stress test was limited because it was not performed with a specified bladder volume, but the effect of this limitation was reduced by using a composite outcome based on both objective and subjective criteria. Another limitation of the present study is that as it was designed to compare the effectiveness of the slings, it has not shown enough power to find differences in complications with low incidence. In addition, some complications may appear over time and would require a longer follow-up to be observed. Therefore, we could not give conclusive results on the differences in the adverse events. We wish to highlight that improving the properties of materials used in urogynecology to enhance their safety while maintaining their efficacy is an important area of research. In this regard, PVDF seems to be a good alternative to PP obtaining similar high cure rates with fewer adverse events, such as de novo UUI. Despite the fact that PVDF has shown promising results in this study, there is a larger experience worldwide with PP slings and therefore the present results should be taken with caution. Other studies by different groups are desirable to corroborate or to refute our clinical findings.

5 | CONCLUSION

We observed a similar high effectiveness with PP and PVDF TOTs for the treatment of female SUI. PVDF slings seem to be related with less mesh related adverse events, such as de novo UUI and pain symptoms, however these observations should be confirmed in future studies and on long-term follow-up.

ACKNOWLEDGMENTS

The authors would like to thank the Statistics and Bioinformatics Unit (UEB) from the Vall d'Hebron Institut de Recerca (VHIR) for their support in statistical analysis. This study was supported by a grant from Cardiolink restricted to the development of the centralized database for the study and by an unrestricted grant from Fundación Dexeus Salud de la Mujer that was destined to the maintenance of the specific study's website.

CONFLICT OF INTERESTS

JL Poza has received a speaker honorarium from Astellas Pharma outside the submitted work. The remaining authors declare that they have no conflict of interests.

ORCID

Jordi Sabadell http://orcid.org/0000-0001-9380-0338

REFERENCES

1. Ford AA, Rogerson L, Cody JD, Aluko P, Ogah JA. Mid-urethral sling operations for stress urinary incontinence in women. *Cochrane Database Syst Rev*. 2017;7:CD006375. https://doi.org/10.1002/14651858.CD006375.pub4
2. Latthe PM, Foon R, Toozs-Hobson P. Transobturator and retropubic tape procedures in stress urinary incontinence: a systematic review and meta-analysis of effectiveness and complications. *BJOG*. 2007;114(5):522-531. https://doi.org/10.1111/j.1471-0528.2007.01268.x
3. Novara G, Artibani W, Barber MD, et al. Updated systematic review and meta-analysis of the comparative data on colposuspensions, pubovaginal slings, and midurethral tapes in the surgical treatment of female stress urinary incontinence. *Eur Urol*. 2010;58(2):218-238. https://doi.org/10.1016/j.eururo.2010.04.022
4. Richter HE, Albo ME, Zyczynski HM, et al. Retropubic versus transobturator midurethral slings for stress incontinence. *N Engl J Med*. 2010;362(22):2066-2076. https://doi.org/10.1056/NEJMoa0912658
5. Schimpf MO, Rahn DD, Wheeler TL, et al. Sling surgery for stress urinary incontinence in women: a systematic review and metaanalysis. *Am J Obstet Gynecol*. 2014;211(1):71.e1-71.e27. https://doi.org/10.1016/j.ajog.2014.01.030
6. Daneshgari F, Kong W, Swartz M. Complications of mid urethral slings: important outcomes for future clinical trials. *J Urol*. 2008;180(5):1890-1897. https://doi.org/10.1016/j.juro.2008.07.029
7. Yamada BS, Govier FE, Stefanovic KB, Kobashi KC. High rate of vaginal erosions associated with the mentor ObTape. *J Urol*. 2006;176(2):651-654. https://doi.org/10.1016/j.juro.2006.03.064
8. Prien-Larsen JC, Prien-Larsen T, Cieslak L, Dessau RB. Influence of TVT properties on outcomes of midurethral sling procedures: high-stiffness versus low-stiffness tape. *Int Urogynecol J*. 2016;27(7):1039-1045. https://doi.org/10.1007/s00192-015-2921-4
9. Mangera A, Bullock AJ, Chapple CR, Macneil S. Are biomechanical properties predictive of the success of prostheses used in stress urinary incontinence and pelvic organ

prolapse? A systematic review. *Neurourol Urodyn*. 2012;31(1):13-21. https://doi.org/10.1002/nau.21156
10. Okulu E, Kayigil O, Aldemir M, Onen E. Use of three types of synthetic mesh material in sling surgery: a prospective randomized clinical trial evaluating effectiveness and complications. *Scand J Urol*. 2013;47(3):217-224. https://doi.org/10.3109/00365599.2012.733962
11. Klinge U, Klosterhalfen B, Ottinger AP, Junge K, Schumpelick V. PVDF as a new polymer for the construction of surgical meshes. *Biomaterials*. 2002;23(16):3487-3493.
12. Gerullis H, Georgas E, Borós M, et al. Inflammatory reaction as determinant of foreign body reaction is an early and susceptible event after mesh implantation. *BioMed Res Int*. 2014;2014:1-6 e510807. https://doi.org/10.1155/2014/510807
13. Klink CD, Junge K, Binnebösel M, et al. Comparison of long-term biocompability of PVDF and PP meshes. *J Invest Surg*. 2011;24(6):292-299. https://doi.org/10.3109/08941939.2011.589883
14. Otto J, Kaldenhoff E, Kirschner-Hermanns R, Mühl T, Klinge U. Elongation of textile pelvic floor implants under load is related to complete loss of effective porosity, thereby favoring incorporation in scar plates. *J Biomed Mater Res A*. 2014;102(4):1079-1084. https://doi.org/10.1002/jbm.a.34767
15. Sabadell J, Larrain F, Gracia-Perez-Bonfils A, et al. Comparative study of polyvinylidene fluoride and polypropylene suburethral slings in the treatment of female stress urinary incontinence. *J Obstet Gynaecol Res*. 2016;42(3):291-296. https://doi.org/10.1111/jog.12899
16. Haylen BT, de Ridder D, Freeman RM, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic floor dysfunction. *Neurourol Urodyn*. 2010;29(1):4-20. https://doi.org/10.1002/nau.20798
17. Sandvik H, Espuna M, Hunskaar S. Validity of the incontinence severity index: comparison with pad-weighing tests. *Int Urogynecol J*. 2006;17(5):520-524. https://doi.org/10.1007/s00192-005-0060-z
18. Collins SA, Swift S, Jha S, Rosamilia A, Tayrac R, Joint Writing Group of the American Urogynecologic Society and the International Urogynecological Association. Joint report on the terminology for surgical procedures to treat stress urinary incontinence in women. *Int Urogynecol J*. 2020;31(3):465-478. https://doi.org/10.1007/s00192-020-04237-0
19. Srikrishna S, Robinson D, Cardozo L. Validation of the patient global impression of improvement (PGI-I) for urogenital prolapse. *Int Urogynecol J*. 2010;21(5):523-528. https://doi.org/10.1007/s00192-009-1069-5
20. Rexhepi S, Rexhepi E, Stumm M, Mallmann P, Ludwig S. Laparoscopic bilateral cervicosacropexy and vaginosacropexy: new surgical treatment option in women with pelvic organ prolapse and urinary incontinence. *J Endourol*. 2018;32(11):1058-1064. https://doi.org/10.1089/end.2018.0474
21. Balsamo R, Illiano E, Zucchi A, et al. Sacrocolpopexy with polyvinylidene fluoride mesh for pelvic organ prolapse: Mid term comparative outcomes with polypropylene mesh. *Eur J Obstet Gynecol Reprod Biol*. 2018;220:74-78. https://doi.org/10.1016/j.ejogrb.2017.11.018
22. Endo M, Feola A, Sindhwani N, et al. Mesh contraction: in vivo documentation of changes in apparent surface area utilizing meshes visible on magnetic resonance imaging in the rabbit abdominal wall model. *Int Urogynecol J*. 2014;25(6):737-743. https://doi.org/10.1007/s00192-013-2293-6
23. Pergialiotis V, Mudiaga Z, Perrea DN, Doumouchtsis SK. De novo overactive bladder following midurethral sling procedures: a systematic review of the literature and meta-analysis. *Int Urogynecol J*. 2017;28(11):1631-1638. https://doi.org/10.1007/s00192-017-3417-1

How to cite this article: Sabadell J, Pereda-Núñez A, Ojeda-de-los-Santos F, et al. Polypropylene and polyvinylidene fluoride transobturator slings for the treatment of female stress urinary incontinence: 1-Year outcomes from a multicentre randomised trial. *Neurourology and Urodynamics*. 2021;40:475–482. https://doi.org/10.1002/nau.24586

3.3 External validation of de novo stress urinary incontinence prediction model after vaginal prolapse surgery.

Sabadell J, Salicrú S, Montero-Armengol A, Rodriguez-Mias N, Gil-Moreno A, Poza JL.

Int Urogynecol J. 2019;30(10):1719-1723. doi: 10.1007/s00192-018-3805-1.

International Urogynecology Journal (2019) 30:1719–1723
https://doi.org/10.1007/s00192-018-3805-1

ORIGINAL ARTICLE

External validation of de novo stress urinary incontinence prediction model after vaginal prolapse surgery

Jordi Sabadell[1] · Sabina Salicrú[1] · Anabel Montero-Armengol[1] · Núria Rodriguez-Mias[1] · Antonio Gil-Moreno[1] · Jose L. Poza[1]

Received: 4 June 2018 / Accepted: 19 October 2018 / Published online: 15 November 2018

Abstract

Introduction and hypothesis Stress urinary incontinence (SUI) may appear after the correction of pelvic organ prolapse (POP). The aim of this study was to externally validate a described predictive model for de novo SUI and to assess its clinical performance when used as a diagnostic test.

Methods This was a retrospective descriptive study on a cohort of consecutive women treated in our institution. The main outcome used to validate the model was the presence of objective or subjective SUI 1 year after surgery. A receiver operating characteristic curve was generated from our population to evaluate the predictive accuracy and to compare it with the original model. A cutoff point of ≥50% was used to evaluate its clinical performance as a diagnostic test.

Results Of the full cohort, 169 women were suitable for analysis. The rate of de novo SUI was 11.8%. The predictive accuracy of the model in our population was similar to the original [area under the curve (AUC) = 0.69; 95% confidence interval (CI) = 0.58–0.80). However, its performance measures when evaluated as a diagnostic test were low: positive likelihood ratio = 2.71 and negative likelihood ratio = 0.86. Only 15 women presented a positive test result.

Conclusions External validation of the model found a global predictive accuracy similar to that of the original model. Despite the study being underpowered to give firm conclusions, the test did not show a good clinical performance when applied to our population with low de novo SUI prevalence. A larger sample size is needed to validate the model conclusively.

Keywords Pelvic organ prolapse · Stress urinary incontinence · De novo incontinence · Predictive model · External validation · Model performance

Introduction

Pelvic organ prolapse (POP) is a common condition affecting up to 50% of parous women. Of them, between 6 and 20% will require surgical correction [1]. Continent women may develop stress urinary incontinence (SUI) after POP surgery. The prevalence of de novo SUI is estimated to be 22–61% [2–4]. Although the association of an incontinence procedure with POP surgery can reduce the risk of postoperative SUI, it has been calculated that the number of women needed to treat to avoid subsequent SUI surgery is 6–20 [2, 3, 5–7]. Moreover, the combination of POP vaginal surgery with a midurethral sling (MUS) procedure is associated with an increased risk of adverse events such as bladder and urethral perforations, bleeding, sling erosion, pain, and long-term voiding dysfunction [3, 7, 8]. For those reasons, a one-step approach to all women who will undergo surgery for vaginal prolapse seems inappropriate.

Identifying women at higher risk of developing de novo SUI would allow surgeons to tailor the surgical approach to each individual. With this purpose in mind, a model for predicting the risk of de novo SUI after POP surgery was developed based on data from the Outcomes Following Vaginal Prolapse Repair and Mid Urethral Sling (OPUS) trial [9]. In that trial, previously continent women who underwent

Preliminary data of this study was presented at the 10th Annual Congress of the European Urogynaecological Association, Barcelona, Spain, 19–21 October 2017.

✉ Jordi Sabadell
jsabadell@vhebron.net

[1] Urogynecology and Pelvic Floor Unit, Department of Obstetrics and Gynecology, Hospital Universitari Vall d'Hebron, Vall d'Hebron Barcelona Hospital Campus, Universitat Autònoma de Barcelona, Passeig Vall d'Hebron 119-129, E-08035 Barcelona, Spain

vaginal prolapse surgery were randomized to a concomitant MUS placement. The incidence of urinary incontinence (UI) at 3 and 12 months after surgery was evaluated. This study involved women being considered for an apical and/or anterior vaginal prolapse repair (POP stage ≥2), allowing native tissue repairs, use of synthetic or biological grafts, and occlusive techniques [2].

The aim of our study was to externally validate this predictive model and assess its clinical performance when used as a diagnostic test in our population.

Materials and methods

The research protocol was approved by the Ethics Committee of the Vall d'Hebron University Hospital. This retrospective descriptive study was performed by reviewing the medical charts of all consecutive women who underwent POP surgical correction in our center between January 2013 and December 2014. Women with a vaginal surgical correction for prolapse of the anterior and/or apical compartment and a minimum follow-up of 10 months were suitable for the analysis. Both native tissue surgery and vaginal mesh repair were included, analogously to the OPUS trial design [2]. Exclusion criteria were clinical SUI prior to surgery, previous incontinence surgery with MUS, and diagnosis of a neoplasm in the surgical specimen that required an additional surgical procedure and/or radiotherapy.

Preoperative evaluation included detailed history, interview following a questionnaire signs and symptoms of lower urinary tract dysfunction based on the terminology recommended by the International Continence Society (ICS) [10], physical examination including cough test (with and without prolapse reduction), and urinalysis and urine culture if indicated. Staging was done using the POP Quantification (POP-Q) system. Women with occult SUI underwent a concomitant MUS procedure according to surgeon and patient consensual decision.

Postoperative follow-up visits were performed at 1 and 12 months. Annual follow-up was done at the hospital or a specialized primary care setting and included physical examination with a cough stress test, interview about symptoms of UI and POP, use of urinary protection, and micturition difficulties. The primary outcome for validating the predictive model was presence of SUI 12 months (± 2 months) after surgery or the need of SUI surgical correction before (this 12 months after surgery). The presence of postoperative SUI was defined as an affirmative response to the direct question: "Do you usually experience urine leakage related to sneezing, coughing, laughing, or any other physical effort?" or by objectifying it during physical examination. Severity of SUI was defined according to the Sandvik score validated for the Spanish language that categorizes incontinence into four groups [11].

Data were analyzed using the software SPSS® version 18.0 for Windows. The probability of SUI at 1 year was calculated using the logistic regression equation provided with the original model [9]. Variables needed to calculate the risk of de novo SUI were age at surgery, parity, body mass index (BMI), preoperative stress test, presence of urge UI (UUI), and association with an MUS procedure. Women without any of these variables or their primary outcome explicitly recorded in charts were excluded. In the descriptive analysis, the prevalence of SUI in different subgroups was compared using Fisher's exact test. A receiver operating characteristic (ROC) curve was generated to calculate predictive accuracy using the area under the curve (AUC) and compared with the original model; 95% CIs were calculated. To clinically evaluate the model as a predictive test, a probability cutoff point of ≥50% was established, as previously suggested [9]. The predictive accuracy of the test was evaluated using sensitivity (Se), specificity (Sp), and likelihood ratios (LHR). As predictive values depend greatly on disease prevalence, potential predictive values in hypothetical populations with different prevalence of de novo SUI were calculated applying the Bayes' theorem. For this purpose, we used Se and Sp values obtained in our population, as this information was not provided in the original study.

Results

A total of 338 women underwent surgery for POP during the above-mentioned period. Of them, 169 were suitable for the final analysis (Fig. 1). Patient characteristics and surgery type are detailed in Table 1. The rate of de novo SUI 1 year after surgery was 11.8% ($n = 20$; 95% CI = 7.8–17.6) in the whole cohort and 12.8% in women who did not receive a MUS. In the first months after surgery, seven additional women complained of SUI, which resolved spontaneously in less than 1 year. When SUI was present, severity at 1 year was mainly slight to moderate, with a median Sandvik score 3.5 [interquartile range (IQR) = 2–4]; one woman (5%) required a second surgery for SUI.

The descriptive analysis of subgroups showed that, on the one hand, the rate of de novo SUI in women with occult incontinence was 0% if they underwent a concomitant MUS and 23.7% if not ($p = 0.09$). On the other hand, women who had their prolapse corrected using a vaginal mesh experienced de novo SUI more frequently than those operated with native tissue repair (41.7% vs. 9.5%; $p = 0.006$).

The global predictive accuracy of the model in our population was similar to the original (AUC = 0.69; 95% CI = 0.58–0.80), with shrinkage of only 4% (Fig. 2). However, when assessed as a diagnostic test using the cutoff point of ≥50%, it showed a low capacity to identify adequately women who would develop SUI. Only 15 women obtained a positive test result under the defined criterion. Performance measures were as follows: Se = 20.0% (95% CI = 8.1–41.6), Sp =

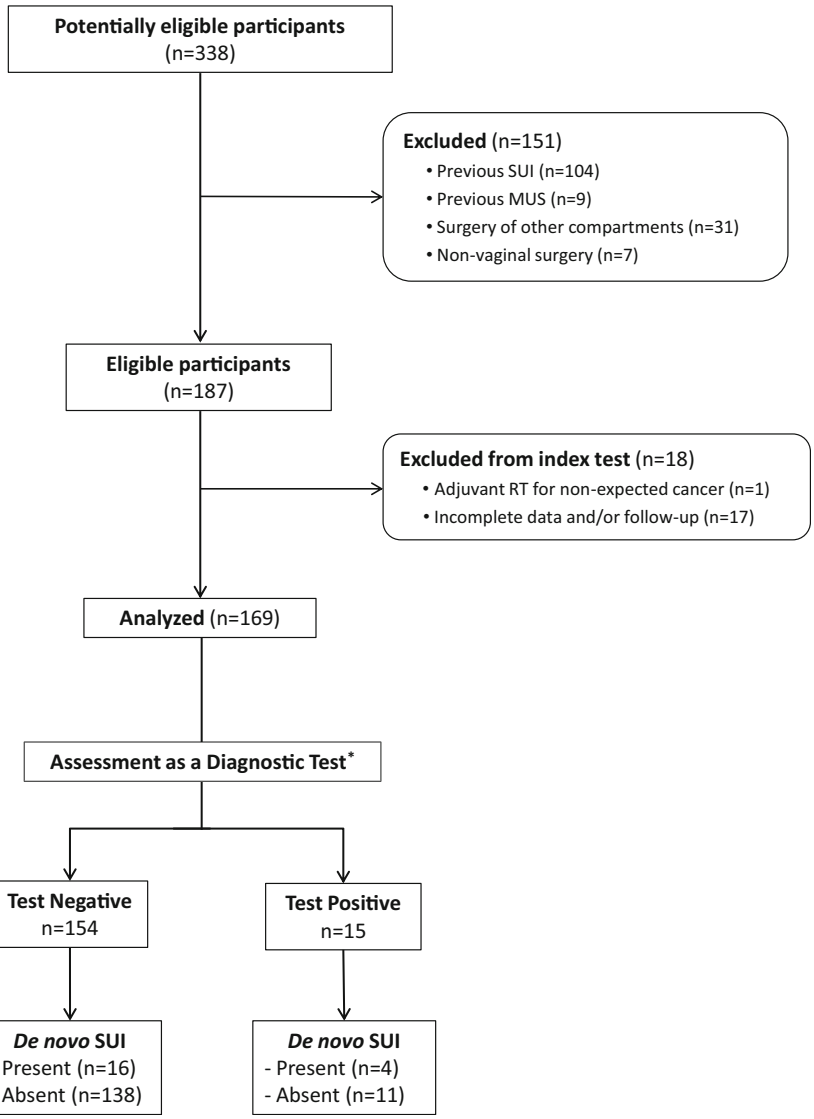


Fig. 1 Study design: *cutoff point, ≥50% probability. *SUI* stress urinary incontinence

92.6% (95% CI = 87.3%–95.8%), positive LHR = 2.71 (95% CI = 0.95–7.70) and negative LHR =0.86 (0.69–1.08).

When it was clinically evaluated in our specific cohort with low prevalence of de novo SUI, using the above-mentioned threshold, the test did not predict appropriately those women who actually developed SUI after a positive result (Fig. 1): Positive predictive value (PPV) = 26.7% (95% CI = 10.9%–51.9%), Negative predictive value = 89.6% (95% CI = 83.8–93.5). After having evaluated the test in different hypothetical scenarios, we calculated that the PPV would be clinically relevant in populations with de novo SUI prevalence close to 50% (see Table 2).

Discussion

SUI may appear after vaginal surgery for POP. Its development decreases patient satisfaction with the procedure and their quality of life. The prevalence of de novo SUI varies substantially depending on the study [2–4]. In addition, MUS surgery is not free from potential serious adverse events [7, 8]. Therefore, their systematic association seems inappropriate. In this context, it would be useful to have a tool to identify women who will benefit from combined surgery.

A predictive model for de novo SUI after vaginal POP surgery was developed based on the OPUS trial [9]. We externally validated that model in a consecutive cohort and found the global predictive accuracy was similar to the original model. Differently from the original model, and due to its clinical relevance, we chose the presence of SUI at 1 year as the primary outcome point rather than the presence of SUI symptoms at any follow-up point during the first year. In fact, we observed that some women developed self-limiting SUI soon after surgery. That could be one reason the prevalence of de novo SUI at 1 year in our population differs greatly from that reported in the study by Jelovsek et al. [9], which used a

Table 1 Preoperative characteristics and surgery type

Patient characteristics	
Age at surgery (years)	67 [61–72]
Body mass index (kg/m^2)	27.5 [25.2–30.4]
Parity	2 [2–3]
Vaginal deliveries	2 [2–3]
Postmenopausal	157 (92.9)
Smoking status	
Nonsmoker	154 (92.8)
Former smoker	9 (5.4)
Current smoker	3 (1.8)
Prior pelvic surgery	27 (16.1)
Diabetes	24 (14.2)
Preoperative urge urinary incontinence	49 (29.0)
Positive stress test[a]	52 (30.8)
Type of surgery	
Anterior repair	53 (31.4)
Anterior repair with mesh	5 (3.0)
Manchester procedure	25 (14.8)
Vaginal hysterectomy	5 (3.0)
Vaginal hysterectomy + anterior repair	64 (37.9)
Vaginal hysterectomy + anterior and posterior repair	9 (5.3)
Anterior and posterior repair	3 (1.8)
Colpocleisis	5 (3.0)
Associated midurethral sling	14 (8.3)

Data expressed in median [interquartile range] or *n* (%)

[a] After having the prolapse reduced

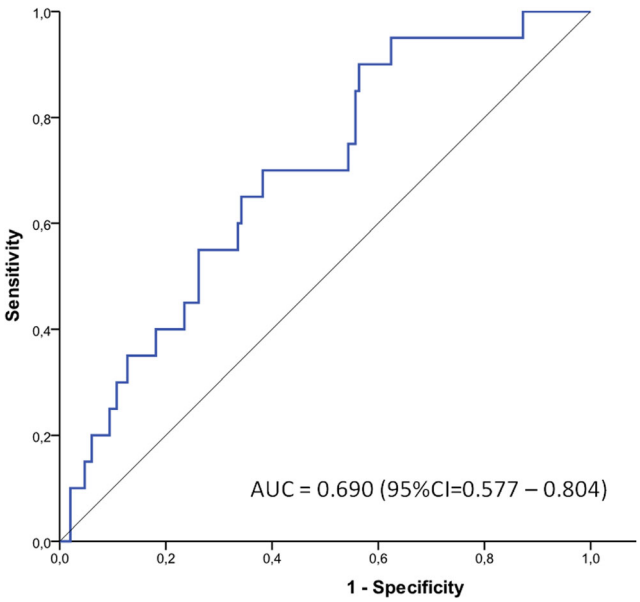


Fig. 2 Receiver operating characteristic curve of the model in our population. AUC: area under the curve

cumulative definition. Although women with posterior prolapse corrections alone could also develop de novo SUI, we chose not to include them in the analysis in order to validate the model in a cohort similar to the derivation one.

Accuracy of a predictive model and a concrete value predictive of an event are, however, difficult to translate into clinical practice. For that reason, we evaluated its clinical performance as a diagnostic test. Although the authors of the

Table 2 Potential predictive values according to the prevalence of de novo stress urinary incontinence (SUI)

SUI prevalence (%)	Bayes' theorem	
	PPV (%)	NPV (%)
10	23.1	91.2
20	40.3	82.3
30	53.7	73.0
40	64.3	63.5
50	73.0	53.7
60	80.3	43.6

PPV positive predictive value, *NPV* negative predictive value

original model did not report a formal analysis of an ideal cutoff point, they suggested a probability value ≥50% at which most clinicians will likely offer a prophylactic continence procedure [9]. Using that threshold, the test does not seem to show satisfactory predictive accuracy measures. Both the LHR+ and LHR− seem to indicate that the test would not change any clinical decision after applying it. However, our study is clearly underpowered to give firm conclusions; there were only 20 cases of de novo SUI. Nonetheless, a recent simulation study found that >100 cases were necessary to perform a conclusive validation of a prognostic model [12]. The lack of power in our study could also be seen when analyzing the CI for accuracy measures.

In our scenario, with a low prevalence of de novo SUI, we found the diagnostic test has a poor ability to identify women who will actually develop SUI. It is important to emphasize that predictive values are directly related to disease prevalence. For that reason, we performed an exploratory analysis and found that PPV would be of clinical interest in populations with a high prevalence of de novo SUI close to 50%. This may be one reason another study found no differences regarding patient satisfaction when using the predictive model [13].

A possible criticism of the model is that both native-tissue and vaginal-mesh surgeries were included, with no distinction made between them. Although no conclusions could be drawn from our study in this regard due to the small number of patients in the subgroups, it seems that native-tissue repair and vaginal-mesh surgery behave as two different populations regarding the development of de novo SUI. This hypothesis is plausible owing to differences between procedures: while native-tissue repair attempts to fix anatomical defects, vaginal mesh does not restore the anatomy but creates a fibrotic layer that decreases vaginal elasticity, thus impairing the dynamic continence mechanisms.

The main limitation of our study is the sample size, which limits its statistical power. In light of our results, a larger cohort with more cases of de novo SUI is needed to attain strong results on the model's validation. Another limitation is its retrospective design. In this respect, the database used is subject to a potential source of information bias that may slightly underestimate the outcome. This potential bias was also limited by calculating probabilities of the model automatically once all clinical data and outcomes were collected. These potential variations would surely not affect the clinical interpretation of results.

In summary, clinical validation of a predictive model is desirable to evaluate the clinical relevance of its prognostic information. In our specific population with very low prevalence of de novo SUI, the described model does not seem to have a good clinical performance. However, the study was underpowered to reach conclusive results. Although results of the estimated predictive values may vary when analyzed using Se and Sp values from the original data, it seems the model could be of clinical interest in populations with high prevalence of de novo SUI. We therefore believe this predictive model should first be evaluated in each population before its clinical application and that a validation study with a larger cohort is needed to provide a more precise evaluation.

References

1. Maher C, Baessler K, Barber M, et al (2017) Pelvic organ prolapse surgery. In: Abrams P, Cardozo L, Wagg A, Wein A (eds) Incontinence, 6th ed. Tokyo, pp 1859–1992.
2. Wei JT, Nygaard I, Richter HE, et al. A midurethral sling to reduce incontinence after vaginal prolapse repair. N Engl J Med. 2012;366:2358–67. https://doi.org/10.1056/NEJMoa1111967.
3. van der Ploeg JM, Oude Rengerink K, van der Steen A, et al. Transvaginal prolapse repair with or without the addition of a midurethral sling in women with genital prolapse and stress urinary incontinence: a randomised trial. BJOG. 2015;122:1022–30. https://doi.org/10.1111/1471-0528.13325.
4. Lensen EJM, Withagen MIJ, Kluivers KB, Milani AL, Vierhout ME. Urinary incontinence after surgery for pelvic organ prolapse. Neurourol Urodyn. 2013;32:455–9. https://doi.org/10.1002/nau.22327.
5. Schierlitz L, Dwyer PL, Rosamilia A, et al. Pelvic organ prolapse surgery with and without tension-free vaginal tape in women with occult or asymptomatic urodynamic stress incontinence: a randomised controlled trial. Int Urogynecol J. 2014;25:33–40. https://doi.org/10.1007/s00192-013-2150-7.
6. van der Ploeg JM, van der Steen A, Oude Rengerink K, et al. Prolapse surgery with or without stress incontinence surgery for pelvic organ prolapse: a systematic review and meta-analysis of randomised trials. BJOG. 2014;121:537–47. https://doi.org/10.1111/1471-0528.12509.
7. van der Ploeg JM, van der Steen A, Zwolsman S, et al. Prolapse surgery with or without incontinence procedure; a systematic review and meta-analysis. BJOG. 2018;125:289–97. https://doi.org/10.1111/1471-0528.14943.
8. Matsuoka PK, Pacetta AM, Baracat EC, Haddad JM. Should prophylactic anti-incontinence procedures be performed at the time of prolapse repair? Systematic review. Int Urogynecol J. 2015;26:187–93. https://doi.org/10.1007/s00192-014-2537-0.
9. Jelovsek JE, Chagin K, Brubaker L, et al. A model for predicting the risk of de novo stress urinary incontinence in women undergoing pelvic organ prolapse surgery. Obstet Gynecol. 2014;123:279–87. https://doi.org/10.1097/AOG.0000000000000094.
10. Haylen BT, Ridder D, Freeman RM, et al. An international Urogynecological association (IUGA)/international continence society (ICS) joint report on the terminology for female pelvic floor dysfunction. Int Urogynecol J. 2010;21:5–26. https://doi.org/10.1007/s00192-009-0976-9.
11. Sandvik H, Espuna M, Hunskaar S. Validity of the incontinence severity index: comparison with pad-weighing tests. Int Urogynecol J. 2006;17:520–4. https://doi.org/10.1007/s00192-005-0060-z.
12. Collins GS, Ogundimu EO, Altman DG. Sample size considerations for the external validation of a multivariable prognostic model: a resampling study. Stat Med. 2016;35:214–26. https://doi.org/10.1002/sim.6787.
13. Miranne JM, Gutman RE, Sokol AI, Park AJ, Iglesia CB. Effect of a new risk calculator on patient satisfaction with the decision for concomitant Midurethral sling during prolapse surgery: a randomized controlled trial. Female Pelvic Med Reconstr Surg. 2017;23:17–22. https://doi.org/10.1097/SPV.0000000000000339.

4. RESUMEN DE LOS RESULTADOS

4.1 Estudio I

Multicentre randomized trial of the Ajust™ single-incision sling compared to the Align™ transobturator tape sling.

Sabadell J, Palau-Gené M, Huguet E, Montero-Armengol A, Salicrú S, Poza JL.

Int Urogynecol J. 2017;28(7):1041-1047. doi: 10.1007/s00192-016-3221-3.

Ensayo clínico aleatorizado multicéntrico con diseño de no-inferioridad para comparar la efectividad a un año de la SIMS Ajust® y las TOT estándar Align® en el tratamiento de la IUE femenina. Inicialmente se incluyeron 5 hospitales españoles y el protocolo del estudio se publicó en el registro público ClinicalTrials.gov (NCT01699425). Se ofreció el estudio a todas las mujeres programadas para tratamiento quirúrgico de la IUE entre marzo'2013 y marzo'2015 con los siguientes criterios de exclusión: cirugía previa por IUE, IUM con predominio de IUU, hiperactividad del detrusor, debilidad esfinteriana y/o ausencia de hipermovilidad uretral. Se realizó una randomización por bloques, estratificada por centro. Se calculó que se necesitaban 123 pacientes (63 por rama de tratamiento, Ajust® o Align®) para encontrar diferencias basados en un límite de no-inferioridad del -15% con una potencia estadística del 85% y un error-α unilateral de 0,025.

De los cinco centros colaboradores, tres se retiraron antes de incluir ningún participante. El reclutamiento de pacientes se paró antes de completar el tamaño muestral calculado debido a la dificultad de reclutar participantes y al cese de soporte para prolongar el seguro de responsabilidad civil del estudio. Finalmente, se

randomizaron 58 mujeres, 30 a Ajust® y 28 a Align®. La secuencia de randomización no se vio afectada por la retirada de centros debido a la estratificación por bloques.

Se realizó un análisis por intención de tratar. Observamos que las tasas de curación/mejoría a un año fueron del 96,4% con la TOT Align® y del 93,3% con la SIMS Ajust®. La diferencia de efectividad fue del -3,1% (intervalo de confianza (IC) del 95% -14,4% a 8,2%) lo que no alcanzó el límite de inferioridad establecido. Se calculó la potencia estadística del análisis basada en los datos y tamaño muestral reales, obteniendo una potencia del 85,7%, suficiente para establecer la no-inferioridad de la SIMS Ajust®. La tasa de IUU *de novo* fue similar entre ambas bandas suburetrales. Las puntuaciones en los cuestionarios ICIQ-SF (International Consultation on Incontinence Questionnaire-Short Form) y Sandvik mejoraron de forma significativa tras el tratamiento con ambas bandas suburetrales y de forma similar entre ellas.

Las tasas de complicaciones intra y posoperatorias fueron similares entre ambos grupos. De forma no esperada, se notificaron más casos de dolor inguinal persistente en el grupo Ajust®, aunque estas diferencias no fueron estadísticamente significativas (p=0,238).

4.2 Estudio II

Polypropylene and polyvinylidene fluoride transobturator slings for the treatment of female stress urinary incontinence: 1-Year outcomes from a multicentre randomized trial.

Sabadell J, Pereda-Núñez A, Ojeda-de-Los-Santos F, Urbaneja M, González-García C, Camps-Lloveras N, Pérez-Plantado À, Canet-Rodríguez J, Pérez-Espejo MP, Rodríguez-Mias N, Sarasa-Castelló N, Palau M, Montero-Armengol A, Salicrú S, Gil-Moreno A, Poza JL.

Neurourol Urodyn. 2021;40(1):475-482. doi: 10.1002/nau.24586.

Ensayo clínico aleatorizado multicéntrico, pragmático, con diseño paralelo para comparar la efectividad a un año de las TOT de PVDF y PP en el tratamiento de la IUE femenina. Se incluyeron 11 hospitales españoles y el protocolo del estudio se publicó en el registro público ClinicalTrials.gov (NCT02886520). Se ofreció el estudio a todas las mujeres programadas para tratamiento quirúrgico de la IUE con los siguientes criterios de exclusión: cirugía previa por IUE mediante bandas suburetrales, IUM con predominio de IUU, hiperactividad del detrusor, debilidad esfinteriana (cuando era evaluable), presencia de vejiga neurógena y/o incapacidad para otorgar el consentimiento informado. Se realizó una randomización por bloques, estratificada por centro. Se estimó que se necesitaban 282 pacientes para encontrar una diferencia del 10% en la tasa de éxito entre ambos materiales, asumiendo una efectividad del 95% para la técnica de referencia (PP), una potencia estadística del 80% y un error-α bilateral del 0,05.

Entre abril'2016 y enero'2018 se randomizaron 285 pacientes, aunque una retiró su consentimiento al estudio. De las 284 pacientes apropiadas para el análisis, 140

correspondieron al grupo PP y 144 al PVDF. En el análisis por intención de tratar las tasas de curación/mejoría fueron similares con ambos materiales: 91% con PP y 95,6% con PVDF (odds ratio [OR] = 0,47, IC95%=0,17-1,28). Los resultados en los cuestionarios ICIQ-SF, Sandvik mejoraron de forma significativa y similar con ambos materiales. Los resultados subjetivos analizados mediante el cuestionario PGI-I (Patient Global Impression of Improvement) fueron también similares, mostrando un grado de satisfacción muy elevado tras la cirugía con ambos materiales en aproximadamente el 90% de mujeres operadas. En el análisis por protocolo se incluyeron 265 pacientes obteniendo unos resultados análogos, con una OR de fallo para PVDF de 0,46 (IC95%=0,17-1,26).

No se encontraron tampoco diferencias en cuanto a la tasa de complicaciones globales ni específicas, intra ni posoperatorias. Finalmente, las bandas de PVDF se asociaron a una menor tasa de IUU *de novo* (16,4% en el grupo PP frente a un 7,3% en el grupo PVDF; PVDF-OR=0,35 [IC95%=0,15-0,80]).

4.3 Estudio III

External validation of de novo stress urinary incontinence prediction model after vaginal prolapse surgery.

Sabadell J, Salicrú S, Montero-Armengol A, Rodriguez-Mias N, Gil-Moreno A, Poza JL.

Int Urogynecol J. 2019;30(10):1719-1723. doi: 10.1007/s00192-018-3805-1.

Estudio descriptivo retrospective en el que se revisaron las historias clínicas de todas las pacientes operadas por POP en nuestro centro entre enero'2013 y diciembre'2014. Fueron elegibles para el análisis todas aquellas mujeres con una cirugía vaginal por POP del compartimento anterior y/o medio y con un seguimiento posoperatorio mínimo de 10 meses. Se incluyeron tanto cirugías con tejido nativo como con uso de mallas vaginales, de forma análoga la muestra de derivación del estudio OPUS. Los criterios de exclusión fueron la cirugía previa de POP, cirugía previa de IUE con bandas suburetrales o el diagnóstico de una neoplasia no esperada en el análisis de la pieza operatoria que requiriera un tratamiento quirúrgico complementario o radioterapia. El resultado principal utilizado para validar el modelo predictivo fue la presencia de IUE 12 meses tras la cirugía (± 2 meses) o la necesidad de corrección quirúrgica de la IUE antes de ese punto. LA presencia de IUE se evaluó con la respuesta afirmativa a la pregunta: "¿Presenta usted habitualmente pérdidas de orina relacionadas con toser, reír, estornudar o cualquier otro esfuerzo físico?". La probabilidad de IUE al año se calculó mediante la ecuación de regresión logística proporcionada en el modelo original, utilizando las variables basales necesarias: edad, paridad, índice de masa

corporal, estrés test preoperatorio, presencia de IUU y la asociación de MUS a la cirugía del POP. Se utilizó un punto de corte de probabilidad de IUE ≥50%, sugerida por los autores del modelo original, para evaluar clínicamente el modelo como un test diagnóstico.

Durante el periodo del estudio se operaron 338 mujeres por POP, de las cuales 169 fueron adecuadas para el análisis final. La prevalencia de IUE *de novo* al año de la cirugía en nuestra cohorte completa fue del 11,8% (IC95%=7,8-17,6%) y del 12,8% en aquellas mujeres a las que no se les realizó técnica anti-incontinencia concomitante. Otras 7 mujeres presentaron IUE tras la cirugía que se resolvió de forma autolimitada antes del año. Cuando se presentó IUE *de novo*, ésta fue leve-moderada en la mayoría de casos, con una puntuación mediana en el test de Sandvik de 3,5 (rango intercuartil=2-4). Sólo una mujer precisó una nueva cirugía para corregir su IUE. En el análisis descriptivo destacó que las mujeres con IUE oculta presentaron IUE *de novo* en un 0% cuando se les asoció una MUS mientras que fue del 23,7% cuando no se les asoció técnica anti-incontinencia (p=0,09). Por otro lado, las mujeres operadas con una malla vaginal experimentaron IUE *de novo* con más frecuencia que aquellas operadas mediante corrección de tejido nativo (41,7% vs. 9,5%; p=0,006).

La precisión predictiva global del modelo en nuestra población fue similar a la del modelo original (AUC=0,69; IC95%=0,58-0,80) con una pérdida de capacidad predictiva del 4%. Sin embargo, cuando se evaluó el modelo como un test diagnóstico éste mostró una baja capacidad de identificar adecuadamente aquellas mujeres que desarrollarán efectivamente IUE. Una likelihood ratio (LHR) positiva de 2,71 (IC95%=0,95-7,70) indica

que la prueba no hará cambiar la decisión clínica pretest. Por último, dado que los valores predictivos dependen en gran medida de la prevalencia de la enfermedad en la población, aplicamos el teorema de Bayes para analizar los valores predictivos en diferentes escenarios y calculamos que el modelo predictivo podría tener una aplicación clínica relevante en poblaciones con una alta incidencia de IUE *de novo,* cercana al 50%.

5. DISCUSIÓN CONJUNTA

En las últimas décadas se han producido importantes avances en el campo de la cirugía correctora en las disfunciones de suelo pélvico. Por contra, es frecuente que la evolución técnica sea más rápida que la obtención de evidencia clínica para su aplicación. Por tanto, en ocasiones estos pretendidos avances no han sido acompañados de suficiente validación clínica para asegurar su efectividad y seguridad antes de su uso generalizado en la práctica clínica habitual. Existen ejemplos en los que finalmente los riesgos de su uso superaban a los potenciales beneficios de la nueva técnica, como fue el caso del uso extendido de las mallas vaginales para corrección del POP y que fueron finalmente retiradas del mercado por la FDA en 2019(75). Es, por tanto, necesaria una apropiada validación clínica de los avances en el ámbito quirúrgico, al igual que en el resto de campos de la medicina, para poder valorar su seguridad y efectividad y así establecer cuál es el lugar de estos avances dentro del arsenal terapéutico del que disponemos.

La presente tesis doctoral se ha centrado en dos campos concretos dentro de los diferentes avances en cirugía de suelo pélvico: en primer lugar evalúa el impacto en los avances en la técnica de bandas libres de tensión transobturadoras para el tratamiento de la IUE femenina. Concretamente analiza el desarrollo de las bandas de tercera generación o SIMS, específicamente la SIMS-Ajust®, así como el uso de nuevos materiales como es el PVDF en las bandas suburetrales. En segundo lugar, evalúa la relevancia clínica que pueda tener un modelo predictivo desarrollado para calcular el riesgo de IUE *de novo* tras cirugía de POP y que se encuentra disponible de forma abierta para su uso en la práctica clínica.

5.1 Avances en la técnica TOT para el tratamiento de la IUE femenina

5.1.1 Impacto clínico de la banda de incisión única Ajust®

Las bandas suburetrales de incisión única (SIMS) o de tercera generación fueron desarrolladas para evitar algunas de las complicaciones asociadas al uso de las bandas de longitud estándar, en especial el dolor posoperatorio que puede darse hasta en el 12% de las mujeres tratadas mediante una TOT(23,31). Cabe destacar que las características de las diferentes SIMS difieren de forma importante en cuanto a la longitud de la banda, sistema de anclaje y ajustabilidad. Por tanto, evaluar todas las SIMS como un único procedimiento no parece adecuado. En concreto, la SIMS Ajust® tiene un sistema de anclaje a la membrana obturadora mediante arpones de polipropileno y su longitud efectiva puede ajustarse a cada paciente. A pesar de que se habían publicado diferentes series prospectivas con resultados prometedores(46,76–81), la efectividad y seguridad de estas bandas debe establecerse mediante estudios clínicos aleatorizados con el fin de obtener datos de máxima calidad.

Dado que con las SIMS se espera obtener una efectividad similar con una menor tasa de complicaciones el presente ensayo clínico se desarrolló como un estudio de no-inferioridad con el fin de maximizar la potencia de éste. Los resultados obtenidos permitieron establecer la no-inferioridad de la SIMS Ajust®, a un año tras la cirugía, respecto a las TOT estándar conforme al umbral de no-inferioridad definido del -15%. Nuestros resultados concuerdan con los obtenidos en otros ensayos clínicos aleatorizados (ECAs)(44,48,49,82). Cabe destacar la mayor generabilidad de nuestros resultados puesto que nuestra muestra de estudio representa mejor a la población

general en la práctica habitual al estar menos hiperseleccionada respecto a los otros ECAs, incorporando pacientes con POP asociado y/o con IUM.

Pese a que nuestro estudio fue diseñado para evaluar la efectividad de la SIMS Ajust®, la seguridad también es un factor de gran relevancia al evaluar nuevas técnicas quirúrgicas. De forma similar a estudios previos(44,48,49,82), no encontramos diferencias en las complicaciones observadas entre ambas técnicas. Aún así, cabe destacar que de forma no esperada encontramos una tendencia hacia una mayor proporción de casos de IUU *de novo* con la SIMS Ajust®, así como un mayor número de dolor inguinal persistente. Este dolor podría verse motivado por el robusto sistema de anclaje de la banda Ajust®, aunque este evento también podría verse afectado por la curva de aprendizaje de la técnica y con vía de inserción dentro-fuera de la misma, la cual se ha relacionado también a un aumento del dolor posoperatorio(23,28). Además, los resultados respecto al dolor persistente tras el procedimiento son contradictorios en los diferentes estudios con la banda Ajust® (48,76,78,81–83), mientras que este problema no se ha descrito con otras SIMS aunque sí en el caso de la dispareunia(31). Son, por tanto, necesarios obtener resultados a largo plazo en cuanto a la efectividad y seguridad de la SIMS Ajust®, aportando datos especialmente en cuanto al dolor mantenido en el tiempo. A día de hoy, y a la luz de los resultados obtenidos, no podemos recomendar el uso generalizado de la SIMS Ajust® para el tratamiento de la IUE femenina.

Aunque han pasado ya más de 10 años desde que se iniciara su aplicación clínica, en la actualidad el papel de las SIMS para el tratamiento de la IUE femenina aun no queda bien establecido, recomendándose su uso en el contexto de registros

prospectivos, ensayos clínicos y casos seleccionados con una justificación concreta(84–86). Como se ha comentado anteriormente, la evaluación conjunta de las diferentes SIMS no parece un proceso adecuado dado que las diferentes bandas incluidas en el grupo de SIMS difieren de forma marcada en cuanto a sus características físicas, debiéndose analizar por separado cada una de ellas. Y a pesar de que la empresa Bard® retiró en 2019 todos sus productos para uroginecología, incluída la SIMS Ajust®, obtener información sobre los resultados a muy largo plazo de estos productos sigue siendo altamente relevante con el fin de poder mejorar el desarrollo de futuras técnicas.

5.1.2 Impacto clínico del uso de PVDF en las bandas TOT.

El PVDF es un fluoro-polímero irreabsorbible introducido en Europa en 2002 para su uso en mallas quirúrgicas y que se encuentra a su vez autorizado para su aplicación en uroginecología(50). Este material ha demostrado una menor capacidad de elongación y deformación, así como una mayor biocompatibilidad que el PP en estudios experimentales(51–53). Sin embargo, aunque el PVDF ya era un producto de uso clínico habitual por otros grupos (pósteres nº 311, 395, 525, 548 y oral póster nº 111 en el 40th Annual IUGA Meeting 2015, Nice, http://2015.iuga.org / pósteres nº 82, 85, 153, 196 en el 44th ICS Annual Meeting 2014, Rio de Janeiro, http://www.ics.org/2014), a fecha del desarrollo del presente estudio los datos clínicos sobre el uso de PVDF en uroginecología publicados en la literatura estándar eran muy escasos(87,88).

En el presente estudio PVDF y PP mostraron una efectividad similar entre ambos materiales a un año de seguimiento. Y aunque hasta el momento no existen otros ECAs

que comparen ambos materiales en uroginecología, esta elevada efectividad a un año corrobora los resultados obtenidos en el estudio piloto descriptivo publicado previamente por nuestro grupo(54).

Por otro lado, en cuanto a los eventos adversos relacionados con ambos materiales, observamos un mayor número de dolor a largo plazo, dispareunia y necesidad de sección de la banda en los casos tratados con bandas de PP, aunque estas diferencias no fueron estadísticamente significativas. Cabe señalar que debido a que el estudio fue diseñado para comparar la efectividad de ambos materiales, tiene una baja potencia para poder encontrar diferencias entre complicaciones específicas con un bajo número de eventos. Por el contrario, sí fue significativa la mayor incidencia de casos con IUU *de novo* tras la cirugía en el grupo PP. Estas diferencias, que también describimos en nuestro estudio observacional(54), pueden justificarse, en parte, por el mejor perfil de biocompatibilidad de PVDF respecto a PP descrito en estudios experimentales mencionados anteriormente(51–53), dado que la cantidad de reacción a cuerpo extraño y la consiguiente retracción del sling explicarían el incremento de casos de IUU *de novo*(52,89). Además, cabe mencionar que ciertas complicaciones aparecen y/o aumenta su incidencia con el paso del tiempo, por lo que un seguimiento a mayor plazo será necesario para poder compararlas de forma más concluyente.

Por tanto, con la realización de este estudio aportamos datos robustos sobre la alta efectividad de las TOT de PVDF, similar a las realizadas con PP. A su vez, parece que las bandas de PVDF pueden asociarse con una disminución de determinadas complicaciones directamente relacionadas con el material de las mallas. Sin embargo,

aunque podemos establecer la efectividad y seguridad de las TOT de PVDF y por tanto recomendar la incorporación de las bandas de este material en el arsenal terapéutico de la IUE femenina en la práctica clínica habitual, debemos ser cautos con esta recomendación dado que el tiempo de experiencia con su uso es mucho mayor con las TOT de PP, que se encuentran más extendidas a nivel mundial.

En conjunto, en cuanto a los avances de la técnica TOT para el tratamiento de la IUE femenina objetivamos que las SIMS deben valorarse de forma separada para cada una de ellas, con el fin de poder establecer cuál es su papel, si lo tienen, en la práctica clínica. En concreto, no puede recomendarse el uso de la SIMS Ajust® para uso habitual al no quedar claro su perfil de seguridad. Por otro lado, cabe destacar que la investigación y mejora de las propiedades de los biomateriales es un potencial campo de avance en el terreno de la uroginecología, con el fin de mantener la eficacia del material sintético utilizado y mejorando su seguridad. En este aspecto, el PVDF parece ser una buena alternativa al PP en las bandas suburetrales, por lo que ampliar la investigación en este terreno sería deseable.

5.2 Predicción de la IUE de novo tras la cirugía vaginal de POP

La cirugía vaginal para la corrección de POP puede desencadenar una IUE que no existía previamente en un porcentaje variable de casos(62–64). Este hecho condicionará una pérdida en la calidad de vida de estas pacientes y por tanto un resultado no satisfactorio con la cirugía. La asociación de una técnica anti-incontinencia a la cirugía

del POP reduce la aparición de esta IUE de novo a expensas de un incremento de las complicaciones, algunas potencialmente graves(71,72). Por tanto sería de gran relevancia poder disponer de una herramienta para poder predecir la aparición de esta IU y por tanto individualizar el tratamiento quirúrgico ideal a cada paciente. Con este fin Jelovsek y colaboradores(73) desarrollaron un modelo predictivo basado en modelos de regresión logística y que pusieron a disposición general para su uso clínico rutinario.

Sin embargo, la repercusión clínica de la información proporcionada por un modelo predictivo debe ser validada antes de su uso en la práctica habitual. Este fue el objetivo de nuestro estudio, mediante una validación externa del modelo basada en una cohorte de nuestra población. Encontramos que la precisión predictiva global en nuestro estudio fue similar a la de la muestra de derivación. Sin embargo, la precisión predictiva de un modelo y el valor concreto de una predicción tienen una difícil traducción clínica. Por este motivo decidimos también evaluar el modelo como una prueba diagnóstica. Utilizamos el punto de corte propuesto por los propios autores de una probabilidad ≥50% (a pesar de no haber realizado un análisis formal del punto de corte ideal) a partir de la cual especulan que la mayoría de cirujanos optarían por realizar una cirugía anti-IU profiláctica(73). Partiendo de este umbral de probabilidad el modelo no mostró unas medidas predictivas satisfactorias. Concretamente las razones de verosimilitud, tanto la positiva como la negativa, indicaron que la prueba diagnóstica difícilmente cambiaría una decisión clínica. Cabe destacar que los valores predictivos de una prueba están directamente relacionados con la prevalencia de la condición a estudio; en nuestro caso observamos la aparición de IUE en un 11,8% de las mujeres operadas vaginalmente por POP, valor muy diferente al observado por los autores que desarrollaron el modelo

predictivo cercano al 25% en toda su muestra, y del 39% en las mujeres a las que no se asoció técnica anti-IU. Una posible explicación para esta importante diferencia es que al desarrollar el modelo predictivo los autores utilizan una definición acumulativa de aparición de IUE durante el primer año. Sin embargo, en nuestro trabajo tenemos en cuenta únicamente la prevalencia de IUE al año de la cirugía dada la mayor relevancia clínica de este evento. De hecho, observamos como algunas mujeres desarrollan IUE de forma temprana tras la cirugía que se autolimitó en el seguimiento y no requirió tratamiento. Otra posible explicación es que para construir el modelo original se incluyeron tanto cirugías con tejido nativo como el uso de mallas vaginales para la corrección del POP. Y aunque no podemos obtener resultados concluyentes a este respecto debido al pequeño tamaño de subgrupos en nuestra muestra, parece lógico pensar que estos dos subgrupos se comportan como dos poblaciones diferentes en cuanto a la aparición de IUE *de novo*. Estos es así ya que mientras la cirugía con tejido nativo pretende reparar los defectos anatómicos, el uso de materiales sintéticos con las mallas vaginales crea una capa fibrótica que disminuirá la elasticidad del tejido vaginal y por tanto entorpecerá en los mecanismos dinámicos de continencia. Como ejemplo de esta posibilidad podemos constatar que en nuestra población, las paciente tratadas mediante colposacropexia laparoscópica desarrollaron IUE *de novo* en un 19% de los casos(90), porcentaje superior a lo observado con cirugía vaginal. Esta discrepancia en la prevalencia de IUE posterior podría también justificar el que otro grupo no encontrara diferencias en la satisfacción de las mujeres tras la cirugía aplicando o no el modelo predictivo(91). Tras un análisis exploratorio objetivamos que las predicciones del modelo

podrían tener algún interés clínico en poblaciones con una incidencia de IUE *de novo* cercana al 50%.

Una limitación a nuestro estudio es no poseer una potencia estadística suficiente para establecer conclusiones firmes sobre el modelo. Estudios de simulación reciente han establecido que se necesita la ocurrencia de unos 100 eventos para poder realizar una validación robusta de un modelo predictivo(92). Aún así, otro estudio más reciente ha replicado nuestro trabajo obteniendo unos resultados muy similares(93). Sería por tanto necesario validar el modelo predictivo propuesto con una muestra mucho más amplia y que sea representativa de nuestra población, así como crear uno a partir de nuestros datos y valorando la inclusión de otras variables potencialmente relevantes.

Finalmente, tras la valoración clínica conjunta de estos avances en la cirugía de suelo pélvico vemos que uno de ellos puede suponer una importante mejora en el tratamiento de la incontinencia urinaria como es el uso de nuevos materiales, específicamente el PVDF, en bandas transobturadoras. De éste podemos recomendar su uso clínico aunque se debe profundizar más aún en su investigación. Otro avance, como fue el desarrollo del modelo predictivo de IUE, vemos que no nos aporta un beneficio claro en nuestra población y que, por el contrario, su aplicación puede añadir confusión en el momento de la toma de decisiones clínicas. Por último, la SIMS Ajust®, pese a ser no-inferior en cuanto a efectividad a un año respecto a las TOT estándar para el tratamiento de la IUE puede suponer un aumento en los casos del dolor postoperatorio

al contrario de lo pretendido con el desarrollo de este tipo de bandas de tercera generación y por tanto no puede recomendarse su uso en la práctica clínica habitual.

6. CONCLUSIONES

- La banda suburetral de incisión única Ajust® ha demostrado una efectividad no-inferior a las TOT estándar a un año de seguimiento tras la cirugía, estableciendo el límite de no-inferioridad del –15%.
- Se han observado unas tasas de complicaciones intra y posoperatorias similares entra la banda de incisión única Ajust® y las TOT estándar. A pesar de ello se han producido un mayor número de casos de IUU *de novo* y dolor inguinal persistente con el uso de la SIMS Ajust®.
- Las bandas suburetrales transobturadoras de PVDF han demostrado una efectividad similar a las bandas de polipropileno a un año de seguimiento.
- No se han encontrado diferencias entre las tasas de complicaciones intra y posoperatorias según el material del que estaban compuestas las bandas TOT. Aún así, se ha observado una mayor incidencia de dolor posoperatorio con las TOT de PP aunque las diferencias no fueron estadísticamente significativas.
- Encontramos una menor incidencia de IUU *de novo* con el uso de TOT de PVDF respecto a las de PP.
- La validación externa del modelo predictivo de IUE *de novo* tras cirugía de POP demuestra una exactitud predictiva global similar a la del modelo original.
- El rendimiento clínico del modelo, evaluado como una prueba diagnóstica, fue bajo en nuestra población con baja incidencia de IUE *de novo*. El modelo evaluado podría tener interés clínico en aquellas poblaciones con incidencias de IUE *de novo* cercanas al 50%.

7. REFERENCIAS BIBLIOGRÁFICAS

1. Sekiguchi Y, Inoue H, Nakamura R. A practical update on functional and dysfunctional anatomy of the female pelvic floor - Part 1 Function. Pelviperineology Multidiscip Pelvic Floor J. 2019;38(1):16–20.

2. Petros, PE. Suelo pélvico en la mujer. Función, disfunción y tratamiento según la teoría integral. Mayo; 2006.

3. Quaghebeur J, Petros P, Wyndaele JJ, De Wachter S. Pelvic-floor function, dysfunction, and treatment. Eur J Obstet Gynecol Reprod Biol. 2021 Oct;265:143–9.

4. Gil-Vernet JM. Salvador Gil-Vernet, a pioneer in Urological Anatomy. In: Van Kerrebroecke P, Schultheiss D, editors. De Historia Urologiae Europeae. 2017. p. 48–77.

5. Bharucha AE. Pelvic floor: anatomy and function. Neurogastroenterol Motil Off J Eur Gastrointest Motil Soc. 2006 Jul;18(7):507–19.

6. Sekiguchi Y, Inoue H, Nakamura R. A practical update on functional and dysfunctional anatomy of the female pelvic floor - Part 2 Dysfunction. Pelviperineology Multidiscip Pelvic Floor J. 2019;38(1):21–6.

7. Petros PE, Ulmsten UI. An integral theory of female urinary incontinence. Experimental and clinical considerations. Acta Obstet Gynecol Scand Suppl. 1990;153:7–31.

8. Papa Petros PE. Cure of urinary and fecal incontinence by pelvic ligament reconstruction suggests a connective tissue etiology for both. Int Urogynecol J Pelvic Floor Dysfunct. 1999;10(6):356–60.

9. Petros PP, Sc DM. Severe chronic pelvic pain in women may be caused by ligamentous laxity in the posterior fornix of the vagina. Pelviperineology Multidiscip Pelvic Floor J. 2017;36(3):71–3.

10. Haylen BT, de Ridder D, Freeman RM, Swift SE, Berghmans B, Lee J, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic floor dysfunction. Neurourol Urodyn. 2010;29(1):4–20.

11. Wu JM, Vaughan CP, Goode PS, Redden DT, Burgio KL, Richter HE, et al. Prevalence and Trends of Symptomatic Pelvic Floor Disorders in U.S. Women. Obstet Gynecol. 2014 Jan;123(1):141–8.

12. Nygaard I, Barber MD, Burgio KL, Kenton K, Meikle S, Schaffer J, et al. Prevalence of symptomatic pelvic floor disorders in US women. JAMA. 2008 Sep 17;300(11):1311–6.

13. Lawrence JM, Lukacz ES, Nager CW, Hsu JWY, Luber KM. Prevalence and co-occurrence of pelvic floor disorders in community-dwelling women. Obstet Gynecol. 2008 Mar;111(3):678–85.

14. Al-Badr A, Saleem Z, Kaddour O, Almosaieed B, Dawood A, Al-Tannir M, et al. Prevalence of pelvic floor dysfunction: a Saudi national survey. BMC Womens Health. 2022 Feb 4;22(1):27.

15. Abrams P, Cardozo L, Wagg A, Wein A, editors. Incontinence 6th Edition. 6th ed. Bristol UK: ICI-ICS. International Continence Society; 2017.

16. Dieter AA, Wilkins MF, Wu JM. Epidemiological trends and future care needs for pelvic floor disorders. Curr Opin Obstet Gynecol. 2015 Oct;27(5):380–4.

17. Wilkins MF, Wu JM. Lifetime risk of surgery for stress urinary incontinence or pelvic organ prolapse. Minerva Ginecol. 2017 Apr;69(2):171–7.

18. Wu JM, Matthews CA, Conover MM, Pate V, Jonsson Funk M. Lifetime risk of stress urinary incontinence or pelvic organ prolapse surgery. Obstet Gynecol. 2014 Jun;123(6):1201–6.

19. Hunskaar S, Lose G, Sykes D, Voss S. The prevalence of urinary incontinence in women in four European countries. BJU Int. 2004 Feb;93(3):324–30.

20. Irwin DE, Milsom I, Hunskaar S, Reilly K, Kopp Z, Herschorn S, et al. Population-based survey of urinary incontinence, overactive bladder, and other lower urinary tract symptoms in five countries: results of the EPIC study. Eur Urol. 2006 Dec;50(6):1306–14; discussion 1314-1315.

21. Baena V, Blasco Hernández P, Cózar-Olmo JM, Díez-Itza I, Espuña Pons M, Hidalgo Á, et al. Libro Blanco de la Carga Socioeconómica de la Incontinencia

Urinaria en España [Internet]. Fundación Weber; 2017 [cited 2022 Feb 28]. Available from: http://weber.org.es/wp-content/uploads/2017/10/Libro-Blanco-de-la-Carga-Socioecono%CC%81mica-de-la-Incontinencia-Urinaria-en-Espan%CC%83a.pdf

22. Rock JA, Jones HW. Te Linde's Operative Gynecology. 10th ed. Lippincott Williams & Wilkins; 2008.

23. Ford AA, Rogerson L, Cody JD, Aluko P, Ogah JA. Mid-urethral sling operations for stress urinary incontinence in women. Cochrane Database Syst Rev. 2017 Jul 31;7:CD006375.

24. Fusco F, Abdel-Fattah M, Chapple CR, Creta M, La Falce S, Waltregny D, et al. Updated Systematic Review and Meta-analysis of the Comparative Data on Colposuspensions, Pubovaginal Slings, and Midurethral Tapes in the Surgical Treatment of Female Stress Urinary Incontinence. Eur Urol. 2017 Oct;72(4):567–91.

25. Saraswat L, Rehman H, Omar MI, Cody JD, Aluko P, Glazener CM. Traditional suburethral sling operations for urinary incontinence in women. Cochrane Database Syst Rev [Internet]. 2020 [cited 2022 Feb 25];(1). Available from: https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD001754.pub5/full?highlightAbstract=slings%7Cmidurethr%7Cmidurethral%7Csling

26. Delorme E. [Transobturator urethral suspension: mini-invasive procedure in the treatment of stress urinary incontinence in women]. Progres En Urol J Assoc Francaise Urol Soc Francaise Urol. 2001 Dec;11(6):1306–13.

27. de Leval J. Novel surgical technique for the treatment of female stress urinary incontinence: transobturator vaginal tape inside-out. Eur Urol. 2003 Dec;44(6):724–30.

28. Novara G, Artibani W, Barber MD, Chapple CR, Costantini E, Ficarra V, et al. Updated systematic review and meta-analysis of the comparative data on colposuspensions, pubovaginal slings, and midurethral tapes in the surgical treatment of female stress urinary incontinence. Eur Urol. 2010 Aug;58(2):218–38.

29. Latthe PM, Foon R, Toozs-Hobson P. Transobturator and retropubic tape procedures in stress urinary incontinence: a systematic review and meta-analysis of effectiveness and complications. BJOG Int J Obstet Gynaecol. 2007 May;114(5):522–31.

30. Richter HE, Albo ME, Zyczynski HM, Kenton K, Norton PA, Sirls LT, et al. Retropubic versus transobturator midurethral slings for stress incontinence. N Engl J Med. 2010 Jun 3;362(22):2066–76.

31. Schimpf MO, Rahn DD, Wheeler TL, Patel M, White AB, Orejuela FJ, et al. Sling surgery for stress urinary incontinence in women: a systematic review and metaanalysis. Am J Obstet Gynecol. 2014 Jul;211(1):71.e1-71.e27.

32. Bakas P, Papadakis E, Karachalios C, Liapis I, Panagopoulos N, Liapis A. Assessment of the long-term outcome of TVT procedure for stress urinary incontinence in a female population: results at 17 years' follow-up. Int Urogynecology J. 2019 Feb;30(2):265–9.

33. Nilsson CG, Palva K, Aarnio R, Morcos E, Falconer C. Seventeen years' follow-up of the tension-free vaginal tape procedure for female stress urinary incontinence. Int Urogynecology J. 2013 Aug;24(8):1265–9.

34. Braga A, Caccia G, Sorice P, Cantaluppi S, Coluccia AC, Di Dedda MC, et al. Tension-free vaginal tape for treatment of pure urodynamic stress urinary incontinence: efficacy and adverse effects at 17-year follow-up. BJU Int. 2018 Jul;122(1):113–7.

35. Zhang Y, Song X, Zhang Z, Mao M, Ai F, Kang J, et al. Tension-free vaginal tape-obturator for the treatment of stress urinary incontinence: a 12-year prospective follow-up. BJU Int. 2019 May;123(5A):E57–62.

36. Serati M, Braga A, Caccia G, Torella M, Ghezzi F, Salvatore S, et al. TVT-O for treatment of pure urodynamic stress urinary incontinence: Efficacy and adverse effects at 13-years follow-up. Neurourol Urodyn. 2020 Jun;39(5):1423–9.

37. Natale F, Illiano E, Marchesi A, La Penna C, Costantini E. Transobturator Tape: Over 10 Years Follow-up. Urology. 2019 Jul;129:48–53.

38. Valadez L, Frilot CF, Gomelsky A. Long-term outcomes of transobturator midurethral slings: A critical evaluation of a real-world population. Neurourol Urodyn. 2020 Nov;39(8):2463–70.

39. Sabadell J, Montero-Armengol A, Salicrú S, Catalán-Martínez M, Gil-Moreno A, Poza JL. Long-term outcomes of transobturator suburethral tapes for female stress urinary incontinence. Neurourol Urodyn. 2022 Jan;41(1):391–8.

40. Daneshgari F, Kong W, Swartz M. Complications of mid urethral slings: important outcomes for future clinical trials. J Urol. 2008 Nov;180(5):1890–7.

41. Molden SM, Lucente VR. New minimally invasive slings: TVT Secur. Curr Urol Rep. 2008 Sep;9(5):358–61.

42. Debodinance P, Delporte P. [MiniArc: preliminary prospective study on 72 cases]. J Gynecol Obstet Biol Reprod (Paris). 2009 Apr;38(2):144–8.

43. Abdel-Fattah M, Ford JA, Lim CP, Madhuvrata P. Single-incision mini-slings versus standard midurethral slings in surgical management of female stress urinary incontinence: a meta-analysis of effectiveness and complications. Eur Urol. 2011 Sep;60(3):468–80.

44. Mostafa A, Lim CP, Hopper L, Madhuvrata P, Abdel-Fattah M. Single-incision mini-slings versus standard midurethral slings in surgical management of female stress urinary incontinence: an updated systematic review and meta-analysis of effectiveness and complications. Eur Urol. 2014 Feb;65(2):402–27.

45. Nambiar A, Cody JD, Jeffery ST, Aluko P. Single-incision sling operations for urinary incontinence in women. Cochrane Database Syst Rev. 2017 26;7:CD008709.

46. Mostafa A, Agur W, Abdel-All M, Guerrero K, Lim C, Allam M, et al. A multicentre prospective randomised study of single-incision mini-sling (Ajust) versus tension-free vaginal tape-obturator (TVT-O) in the management of female stress urinary incontinence: pain profile and short-term outcomes. Eur J Obstet Gynecol Reprod Biol. 2012;165(1):115–21.

47. Masata J, Svabik K, Zvara K, Drahoradova P, El Haddad R, Hubka P, et al. Randomized trial of a comparison of the efficacy of TVT-O and single-incision tape TVT SECUR systems in the treatment of stress urinary incontinent women--2-year follow-up. Int Urogynecology J. 2012 Oct;23(10):1403–12.

48. Schweitzer KJ, Milani AL, van Eijndhoven HWF, Gietelink DA, Hallensleben E, Cromheecke GJ, et al. Postoperative pain after adjustable single-incision or transobturator sling for incontinence: a randomized controlled trial. Obstet Gynecol. 2015 Jan;125(1):27–34.

49. Xin X, Song Y, Xia Z. A comparison between adjustable single-incision sling and tension-free vaginal tape-obturator in treating stress urinary incontinence. Arch Gynecol Obstet. 2016 Feb;293(2):457–63.

50. Klinge U, Klosterhalfen B, Ottinger AP, Junge K, Schumpelick V. PVDF as a new polymer for the construction of surgical meshes. Biomaterials. 2002 Aug;23(16):3487–93.

51. Gerullis H, Georgas E, Borós M, Klosterhalfen B, Eimer C, Arndt C, et al. Inflammatory Reaction as Determinant of Foreign Body Reaction Is an Early and Susceptible Event after Mesh Implantation. BioMed Res Int. 2014 Mar 26;2014:e510807.

52. Klink CD, Junge K, Binnebösel M, Alizai HP, Otto J, Neumann UP, et al. Comparison of long-term biocompability of PVDF and PP meshes. J Investig Surg Off J Acad Surg Res. 2011;24(6):292–9.

53. Otto J, Kaldenhoff E, Kirschner-Hermanns R, Mühl T, Klinge U. Elongation of textile pelvic floor implants under load is related to complete loss of effective porosity, thereby favoring incorporation in scar plates. J Biomed Mater Res A. 2014 Apr 1;102(4):1079–84.

54. Sabadell J, Larrain F, Gracia-Perez-Bonfils A, Montero-Armengol A, Salicrú S, Gil-Moreno A, et al. Comparative study of polyvinylidene fluoride and polypropylene suburethral slings in the treatment of female stress urinary incontinence. J Obstet Gynaecol Res. 2016 Mar;42(3):291–6.

55. Rovner ES, Dmochowski RR, Leach GE, Jayne C, Snyder JA. A randomized, controlled clinical trial of a novel intravesical pressure attenuation device for the treatment of stress urinary incontinence. J Urol. 2013 Dec;190(6):2243–50.

56. Winkler H, Jacoby K, Kalota S, Snyder J, Cline K, Robertson K, et al. Twelve-Month Efficacy and Safety Data for the 'Stress Incontinence Control, Efficacy and Safety Study': A Phase III, Multicenter, Prospective, Randomized, Controlled Study Treating Female Stress Urinary Incontinence Using the Vesair Intravesical Balloon. Female Pelvic Med Reconstr Surg. 2018 Jun;24(3):222–31.

57. Itkonen Freitas AM, Mentula M, Rahkola-Soisalo P, Tulokas S, Mikkola TS. Tension-Free Vaginal Tape Surgery versus Polyacrylamide Hydrogel Injection for Primary Stress Urinary Incontinence: A Randomized Clinical Trial. J Urol. 2020 Feb;203(2):372–8.

58. Itkonen Freitas AM, Mikkola TS, Rahkola-Soisalo P, Tulokas S, Mentula M. Quality of life and sexual function after TVT surgery versus Bulkamid injection for primary stress urinary incontinence: 1 year results from a randomized clinical trial. Int Urogynecology J. 2021 Mar;32(3):595–601.

59. Díez I, Cassadó J, Martín A, Muñoz E, Bauset C, López-Herrero E. Prolapso de órganos pélvicos 2019. Guía de Asistencia Práctica. [Internet]. 2019 [cited 2021 Dec 21]. Available from: https://sego.es/Guias_de_Asistencia_Practica#suelopelvico

60. Bai SW, Jeon MJ, Kim JY, Chung KA, Kim SK, Park KH. Relationship between stress urinary incontinence and pelvic organ prolapse. Int Urogynecol J Pelvic Floor Dysfunct. 2002;13(4):256–60; discussion 260.

61. Khayyami Y, Elmelund M, Klarskov N. Urinary incontinence before and after pelvic organ prolapse surgery-A national database study. Int Urogynecology J. 2021 Aug;32(8):2119–23.

62. Wei JT, Nygaard I, Richter HE, Nager CW, Barber MD, Kenton K, et al. A midurethral sling to reduce incontinence after vaginal prolapse repair. N Engl J Med. 2012 Jun 21;366(25):2358–67.

63. Lensen EJM, Withagen MIJ, Kluivers KB, Milani AL, Vierhout ME. Urinary incontinence after surgery for pelvic organ prolapse. Neurourol Urodyn. 2013 Jun;32(5):455–9.

64. van der Ploeg JM, Oude Rengerink K, van der Steen A, van Leeuwen JHS, Stekelenburg J, Bongers MY, et al. Transvaginal prolapse repair with or without the addition of a midurethral sling in women with genital prolapse and stress urinary incontinence: a randomised trial. BJOG Int J Obstet Gynaecol. 2015 Jun;122(7):1022–30.

65. Brubaker L, Cundiff GW, Fine P, Nygaard I, Richter HE, Visco AG, et al. Abdominal sacrocolpopexy with Burch colposuspension to reduce urinary stress incontinence. N Engl J Med. 2006 Apr 13;354(15):1557–66.

66. Ellström Engh AM, Ekeryd A, Magnusson A, Olsson I, Otterlind L, Tobiasson G. Can de novo stress incontinence after anterior wall repair be predicted? Acta Obstet Gynecol Scand. 2011 May;90(5):488–93.

67. Alas AN, Chinthakanan O, Espaillat L, Plowright L, Davila GW, Aguilar VC. De novo stress urinary incontinence after pelvic organ prolapse surgery in women without occult incontinence. Int Urogynecology J. 2017 Apr;28(4):583–90.

68. Ennemoser S, Schönfeld M, von Bodungen V, Dian D, Friese K, Jundt K. Clinical relevance of occult stress urinary incontinence (OSUI) following vaginal prolapse surgery: long-term follow-up. Int Urogynecology J. 2012 Jul;23(7):851–5.

69. Schierlitz L, Dwyer PL, Rosamilia A, De Souza A, Murray C, Thomas E, et al. Pelvic organ prolapse surgery with and without tension-free vaginal tape in women with occult or asymptomatic urodynamic stress incontinence: a randomised controlled trial. Int Urogynecology J. 2014 Jan;25(1):33–40.

70. van der Ploeg JM, van der Steen A, Oude Rengerink K, van der Vaart CH, Roovers JP. Prolapse surgery with or without stress incontinence surgery for pelvic organ prolapse: a systematic review and meta-analysis of randomised trials. BJOG Int J Obstet Gynaecol. 2014 Apr;121(5):537–47.

71. van der Ploeg JM, van der Steen A, Zwolsman S, van der Vaart CH, Roovers J. Prolapse surgery with or without incontinence procedure: a systematic review and meta-analysis. BJOG Int J Obstet Gynaecol. 2018 Feb;125(3):289–97.

72. Matsuoka PK, Pacetta AM, Baracat EC, Haddad JM. Should prophylactic anti-incontinence procedures be performed at the time of prolapse repair? Systematic review. Int Urogynecology J. 2015 Feb;26(2):187–93.

73. Jelovsek JE, Chagin K, Brubaker L, Rogers RG, Richter HE, Arya L, et al. A model for predicting the risk of de novo stress urinary incontinence in women undergoing pelvic organ prolapse surgery. Obstet Gynecol. 2014 Feb;123(2 Pt 1):279–87.

74. Wei J, Nygaard I, Richter H, Brown M, Barber M, Xiao Xu null, et al. Outcomes following vaginal prolapse repair and mid urethral sling (OPUS) trial--design and methods. Clin Trials Lond Engl. 2009 Apr;6(2):162–71.

75. Commissioner O of the. FDA takes action to protect women's health, orders manufacturers of surgical mesh intended for transvaginal repair of pelvic organ prolapse to stop selling all devices [Internet]. FDA. FDA; 2020 [cited 2022 Mar 1]. Available from: https://www.fda.gov/news-events/press-announcements/fda-takes-action-protect-womens-health-orders-manufacturers-surgical-mesh-intended-transvaginal

76. Cornu JN, Peyrat L, Skurnik A, Ciofu C, Lucente VR, Haab F. Ajust single incision transobturator sling procedure for stress urinary incontinence: results after 1-year follow-up. Int Urogynecology J. 2012;23(9):1265–70.

77. Jiang T, Xia Z, Cheng D, Song Y, Guo Z, Hu Q, et al. Short-term outcomes of adjustable single-incision sling (Ajust™) procedure for stress urinary incontinence: a prospective single-center study. Eur J Obstet Gynecol Reprod Biol. 2015 Mar;186:59–62.

78. Meschia M, Barbacini P, Baccichet R, Buonaguidi A, Maffiolini M, Ricci L, et al. Short-term outcomes with the Ajust system: a new single incision sling for the treatment of stress urinary incontinence. Int Urogynecology J. 2011;22(2):177–82.

79. Natale F, Dati S, La Penna C, Rombolà P, Cappello S, Piccione E. Single incision sling (Ajust™) for the treatment of female stress urinary incontinence: 2-year follow-up. Eur J Obstet Gynecol Reprod Biol. 2014 Nov;182:48–52.

80. Naumann G, Hagemeier T, Zachmann S, Al-Ani A, Albrich S, Skala C, et al. Long-term outcomes of the Ajust Adjustable Single-Incision Sling for the treatment of stress urinary incontinence. Int Urogynecology J. 2013 Feb;24(2):231–9.

81. Vandendriessche D, Engrand JB, Debodinance P. [Ajust(®): prospective study and 1-year follow-up - a series of 60 female patients]. Prog En Urol J Assoc Fr Urol Société Fr Urol. 2013 Oct;23(12):994–9.

82. Masata J, Svabik K, Zvara K, Hubka P, Toman A, Martan A. Comparison of the efficacy of tension-free vaginal tape obturator (TVT-O) and single-incision tension-free vaginal tape (Ajust™) in the treatment of female stress urinary incontinence: a 1-year follow-up randomized trial. Int Urogynecology J. 2016 Oct;27(10):1497–505.

83. Mostafa A, Agur W, Abdel-All M, Guerrero K, Lim C, Allam M, et al. Multicenter prospective randomized study of single-incision mini-sling vs tension-free vaginal tape-obturator in management of female stress urinary incontinence: a minimum of 1-year follow-up. Urology. 2013 Sep;82(3):552–9.

84. EAU Guidelines on Non-neurogenic Female LUTS - DISEASE MANAGEMENT - Uroweb [Internet]. Uroweb - European Association of Urology. [cited 2022 May 16]. Available from: https://uroweb.org/guidelines/non-neurogenic-female-luts/chapter/disease-management

85. Recommendations | Urinary incontinence and pelvic organ prolapse in women: management | Guidance | NICE [Internet]. NICE; [cited 2022 May 16]. Available from: https://www.nice.org.uk/guidance/ng123/chapter/Recommendations#surgical-management-of-stress-urinary-incontinence

86. Tratamiento de la incontinencia urinaria de esfuerzo. Guía de Asistencia Práctica actualizada en septirmbre 2017. [Internet]. [cited 2022 May 16]. Available from: https://sego.es/Guias_de_Asistencia_Practica#suelopelvico

87. Jäger W, Mirenska O, Brügge S. Surgical treatment of mixed and urge urinary incontinence in women. Gynecol Obstet Invest. 2012;74(2):157–64.

88. Najjari L, Hennemann J, Kirschner-Hermanns R, Maass N, Papathemelis T. Visualization of polypropylene and polyvinylidene fluoride slings in perineal ultrasound and correlation with clinical outcome. BioMed Res Int. 2014;2014:181035.

89. Endo M, Feola A, Sindhwani N, Manodoro S, Vlacil J, Engels AC, et al. Mesh contraction: in vivo documentation of changes in apparent surface area utilizing meshes visible on magnetic resonance imaging in the rabbit abdominal wall model. Int Urogynecology J. 2014 Jan 22;

90. Rodríguez-Mias NL, Sabadell-García J, Suárez-Salvador E, Gil-Moreno A, Poza-Barrasus JL. Behaviour of urinary incontinence in the face of sacrocolpopexy. Urogynaecologia. 2017 Aug 30;30(1):185.

91. Miranne JM, Gutman RE, Sokol AI, Park AJ, Iglesia CB. Effect of a New Risk Calculator on Patient Satisfaction With the Decision for Concomitant Midurethral Sling During Prolapse Surgery: A Randomized Controlled Trial. Female Pelvic Med Reconstr Surg. 2017 Feb;23(1):17–22.

92. Collins GS, Ogundimu EO, Altman DG. Sample size considerations for the external validation of a multivariable prognostic model: a resampling study. Stat Med. 2016 Jan 30;35(2):214–26.

93. Yasa C, Gungor Ugurlucan F, Dural O, Yalcın O. External validation of a model predicting de novo stress urinary incontinence after pelvic organ prolapse surgery. Neurourol Urodyn. 2021 Feb;40(2):688–94.

8. ANEXOS

8.1 Publicaciones preliminares en la línea de investigación

Comparative study of polyvinylidene fluoride and polypropylene suburethral slings in the treatment of female stress urinary incontinence.

Sabadell J, Larrain F, Gracia-Perez-Bonfils A, Montero-Armengol A, Salicrú S, Gil-Moreno A, Poza JL.

J Obstet Gynaecol Res. 2016 Mar;42(3):291–6.

Comparative study of polyvinylidene fluoride and polypropylene suburethral slings in the treatment of female stress urinary incontinence.

Jordi Sabadell, MD (✉)[1,2] · Francisco Larrain, MD[1,3,4] · Ana Gracia-Perez-Bonfils, MD[1] · Anabel Montero-Armengol, MD[1] · Sabina Salicrú, MD[1] · Antonio Gil-Moreno, MD, PhD[1] · Jose L. Poza, MD[1].

1. Urogynecology and Pelvic Floor Unit, Department of Obstetrics and Gynecology. Hospital Universitari Vall d'Hebron, Universitat Autònoma de Barcelona.
Passeig Vall d'Hebron 119-129. E-08035 Barcelona, Spain
Telephone and fax: +34-93-4893066
E-mail: jsabadell@vhebron.net

2. General Surgery Research Group. Gynecology, Pediatric Diseases and Experimental Surgery Area. Vall d'Hebron Research Institute. Hospital Universitari Vall d'Hebron. Universitat Autònoma de Barcelona, Barcelona, Spain.

3. Department of Gynecology. Hospital San José, Santiago, Chile.

4. Department of Gynecology. Clínica Alemana, Santiago, Chile.

RUNNING TITLE: PVDF/polypropylene in suburethral slings

Word count: Abstract: 198 words. Main text: 2163 words.

Number of tables: 2 **Number of figures:** 1

Comparative study of polyvinylidene fluoride and polypropylene suburethral slings in the treatment of female stress urinary incontinence.

ABSTRACT

Aims: Evaluate the effectiveness and safety of polyvinylidene fluoride (PVDF) transobturator suburethral slings (TOT) in the treatment of stress urinary incontinence, and compare them to polypropylene (PP) slings.

Methods: A retrospective cohort study was performed on women treated with a TOT procedure at Vall d'Hebron Hospital between February 2010 and May 2013. Twenty-three women were operated on with a PVDF sling. A comparison group was randomly selected among all women treated with a PP sling in a 1:4 ratio (n=92). The failure incidence was analyzed by the Kaplan-Meier survival functions and by a multivariate Cox regression model.

Results: Both groups were similar in their initial characteristics. The median follow-up was 24.6 months in the PP group and 21.3 months in the PVDF group. The survival functions showed a higher incidence of failures in the PP group, mostly because obstructive symptoms. However the differences were not statistically significant (hazard ratio of failure of PP vs. PVDF = 4.31; 95% CI=0.56 – 33.05). Complication rates do not differ either between the two groups. More cases of voiding dysfunction were observed in the PP group.

Conclusions: PVDF suburethral tapes have been found to have an effectiveness and safety comparable to PP tapes.

KEYWORDS: Midurethral sling; Polypropylene; Polyvinylidene fluoride; PVDF; Suburethral sling; Stress urinary incontinence.

INTRODUCTION:

Nowadays, the first line surgical treatment for female stress urinary incontinence (SUI) is the use of tension-free suburethral tapes. Among them, transobturator slings (TOT) are the treatment of choice in many urogynecology units. Owing to the high effectiveness of TOT, with a cure rate close to 85%[1], many investigation and development efforts are aimed at decreasing the complications of the technique. One line of development in this field during the last few years is single-incision slings, which obtained controversial results[2,3].

Another approach to improve the outcomes of suburethral slings could be based on modifying the material used in the sling in order to decrease the complications directly related to the tape. Although many brands have developed their own slings, the synthetic material utilized in these tapes is mainly polypropylene (PP). However, the use of polyvinylidene fluoride (PVDF) in suburethral tapes was also approved in Europe. PVDF is a nonabsorbable fluoropolymer introduced in 2002 for surgical meshes[4] with an excellent biocompatibility[5,6]. Some of its biomechanical properties are: lower elongation and deformation capacities compared to PP[7]. These characteristics are the basis to hypothesize that PVDF slings could be associated with less mesh-related complications such as erosions and urinary obstruction. Nonetheless, to the best of our knowledge, there are no studies comparing clinical outcomes of both materials in suburethral slings.

The aim of the present study is to describe and compare the effectiveness and complication rates of PVDF and PP transobturator suburethral tapes in the treatment of female SUI.

MATERIALS AND METHODS

A retrospective cohort study was performed to compare the outcomes of PP and PVDF suburethral slings for the treatment of SUI. Participants were selected among all women treated for SUI with a TOT sling procedure at Vall d'Hebron University Hospital between February 2010 and May 2013. Data was obtained by reviewing medical records and also during prospective follow-up. This study was approved by the hospital's Ethics Committee.

Patients and definitions:

Twenty-three women were treated with a PVDF suburethral sling during the above-mentioned period. The comparison group was randomly selected in a 1:4 ratio (n=92) using the macro !RNDI for SPSS[8], among all women treated with a TOT made of PP during the same period of time (n=457). Patients with stress-predominant mixed urinary incontinence were also included. Provided that this is an exploratory study there was not a previous sample size calculation and the number of patients included was limited by the number of women operated with a PVDF sling. However the power of the study was estimated with the results.

The preoperative evaluation included a detailed physical examination, an interview following a questionnaire with signs and symptoms of lower urinary tract dysfunction based on the terminology recommended by the International Continence Society[9], a urinalysis and urine culture. Urethral hypermobility was defined as a Q-tip test >30º. All women underwent a multichannel urodynamic study before surgery.

Procedure and follow-up:

All the slings used in the study are approved by our center and used in the daily practice. The synthetic materials included in the study were Amid type-I

polypropylene[10], with low elongation capacity, and PVDF (DynaMesh-SIS™; FEG Textiltechnik, Aachen, Germany), which is a macroporous mesh with a lower elongation capacity than PP[7]. All the procedures were performed by four experienced **urogynecological** surgeons under spinal anesthesia, **being the use of PVDF-slings limited to two surgeons (JLP and SS) because the general experience with the use of PVDF-slings is lesser than with PP.** The tape used was chosen under the surgeon's preference. The tape was placed in a tension-free manner without the aid of a cough test. Surgery for pelvic organ prolapse (POP) correction was associated when needed.

Postoperative follow-up visits were scheduled at 1, 6, and 12 months and yearly thereafter. These included physical examination with a cough stress test (patients were invited to attend follow-up visits at least 2 hours after the last micturition), and an interview about signs and symptoms, use of urinary protections, micturition difficulties, pain in groins or thighs, dyspareunia and satisfaction with the procedure. Patient satisfaction was assessed with the question "How satisfied are you with the result of surgery? Completely satisfied, moderately satisfied or dissatisfied". Postoperatively, the patients were regarded as cured if they had a negative cough stress test and were fully satisfied with the operation (no leaks, no voiding dysfunction, and no use of urinary protection). To be regarded as improved, the cough stress test had to be negative and the patient moderately satisfied with the result of surgery due to an increase in urinary frequency and/or sporadic urgency episodes. Patients were classified as failures in the presence of a positive cough test and/or dissatisfaction with surgery, including de novo or worsened urge-incontinence and/or voiding dysfunction associated with frequent urinary infections, and the use of the same urinary protections during daily activities as before surgery. Early-postoperative obstruction was defined as a post-void residual

urine volume higher than 100ml measured by transvaginal ultrasound or by urethral catheterization. De novo urgency was diagnosed clinically by the presence of bothersome overactive bladder symptoms that were not present before the procedure.

Statistical analysis:

Data analysis was performed using the software SPSS® version 18.0 for Windows (SPSS Inc., Chicago, Illinois). Categorical variables were analyzed using the χ^2 test or Fisher's exact test when indicated. Quantitative variables were compared with the Mann-Whitney U test because they did not follow a normal distribution. The failure incidence was analyzed by the Kaplan-Meier survival functions, which were compared with the log-rank test. Multivariate Cox regression was used to calculate the hazard ratio (HR) of failure according to the sling type, adjusting for potential confounding factors such as the presence of mixed urinary incontinence, the presence of urethral hypermobility and associated POP surgery. A two-tailed p value <0.05 was considered to indicate statistical significance and 95% confidence intervals (CI) were calculated.

RESULTS

The preoperative characteristics of the patients are detailed in table 1. No differences were found between the two groups with the exception of lower urethral closure pressures in the PVDF group.

At the time of the surgery 72 women (63.2%) underwent concomitant surgery for pelvic organ prolapse (Table 1). During the surgery 3 intraoperative complications were recorded: one bladder puncture and two vaginal perforations. All these complications were identified during the needle passage, corrected at this time, and the suburethral sling was placed in all cases without further complications.

The median follow-up was 24.6 months in the PP group (interquartile range 12.6-39.5 months) and 21.3 in the PVDF group (interquartile range 12.3-31.0 months). In the survival analysis (figure 1) a higher proportion of failures in the PP group could be observed. The survival estimates showed that the likelihood to be cured or improved is of 92.4%, 87.7% and 83.6% in the PP group and of 95.7%, 95.7% and 95.7% in the PVDF group at 6, 12 and 24 months of follow-up respectively, although these differences were not statistically significant (p=0.179). Nor were any differences found in the incidence of failure (adjusted HR of failure of PP vs. PVDF=4.31; 95%CI=0.56-33.05). The power of the study to find differences in the incidence of failure described is of 73.5%. Two of the 15 failures observed in the PP group were because of obstructive micturition, 9 because of severe urge-incontinence, 3 because of mixed incontinence and one because of persistent stress-only incontinence, whilst the failure described in the PVDF group was due to persistent SUI.

Postoperative complications are summarized in table 2. We found no differences between the two groups. However, it is remarkable that a higher number of transient

episodes of elevated post-void residuals occurred in the PP group during the early postoperative period. Those cases occurred more frequently in women with associated surgery for POP (75% of the cases), the episodes were self-limited and lasted between one and five days. Only four cases of urinary obstruction were more prolonged, lasting 10, 14, 17 and 28 days respectively. These patients were all observed in the PP group and required intermittent clean self-catheterization temporarily.

Sling division was needed in seven women. The median time from the TOT surgery to the tape division was 17.1 months (range 6.9 to 47.1 months). In six cases it was performed because of severe urge-incontinence along with an obstructive pattern in a postsurgical urodynamic study that did not improve with anticholinergic treatment. In the remaining case it was performed because of persistent incomplete bladder emptying associated with recurrent urinary infections. All these cases occurred in the PP group, four of them (57.1%) in women who underwent concomitant POP surgery.

DISCUSSION:

Although the complication rate of the TOT procedure is low[1,11], it would be further decreased by improving the material used in the slings. PVDF is a synthetic material with a wide experience in their use in meshes for abdominal wall hernias and in sutures for cardiovascular and orthopedic surgery that has showed its safety and biocompatibility. It exists in four different isomorphs (α, β, γ and δ) where the β-phase PVDF has the most significant piezoelectric properties. The relative proportion of the different isomorphs in a mesh could evoke different cellular responses. Nowadays, there is a good understanding of the parameters that influence the proportional rates of α- and β-phase PVDF during its manufacturing, making it possible to tailor the PVDF product to specific biomedical applications[12,13]. Because of its mechanical properties and enhanced biocompatibility, PVDF has been presumed to be an excellent candidate for its use in urogynecology[14]. The effectiveness and safety of PVDF for urogynecological indications has been showed, however, the reports regarding its use in the treatment of SUI are scarce[15,16]. The present study finds that the effectiveness and safety of PVDF is similar to that of PP in the short and medium terms. However, the study is underpowered to find differences in the incidence of failures observed, and its power would be even lower in case that the real difference was smaller: the power would be of 57.5% to find a HR of 2, a difference that would be considered clinically relevant. In fact, the survival analysis showed a trend to obtain better outcomes with PVDF slings, despite the fact that some characteristics that would confer a worse surgical prognosis, **such as a lower MUCP or a higher prevalence of women with mixed urinary incontinence and detrusor overactivity, were slightly more frequent in the PVDF group**.

The complication rates observed in the study did not differ. However, a higher number of obstructive events was observed in the PP group, although those differences were not statistically significant. This observation could be justified for different reasons and among them the sling material would play a role. On the one hand, the elastic properties of the tapes would be responsible for some early urinary obstructions because of the restoration to their initial shape[17] after an elongation during their insertion. PVDF has been found to have a lower elongation[7] and this could intervene in the lower number of immediate postoperative transient obstructions observed herein. On the other hand, PVDF has shown excellent biocompatibility in different animal studies resulting in lower inflammatory and foreign body reaction (FBR) than PP[5,6]. The amount of FBR is directly associated with wound contraction and mesh shrinkage, therefore PVDF would be associated with less mesh-related complications in the medium and long term, such as urinary obstructive symptoms, de novo urinary urge-incontinence and sling erosions[6,14,17]. Our findings seem to fit in with those hypotheses, although the present study could not confirm them.

In the present series a relatively high number of women requiring sling revision is observed in the PP group. However, in our experience, a high proportion of women dramatically improve after the sling incision in those cases with severe and refractory urge-incontinence and urinary obstruction[18]. In fact, in the present series, six women (85.7%) were regarded as cured or improved one year after the sling division.

In the present series, PVDF has shown a similar effectiveness and safety than PP. However, the results of the study should be interpreted with caution. There are potential sources of bias, such as the retrospective nature of part of the data, the lack of randomization in the sling selection, and that the comparative group could not be

representative of all the women treated with a TOT in our center. As the procedures with PVDF mas limited to two surgeons it could be also a potential source of bias, although this fact is unlikely because all the surgeons are experienced urogynecologists with a wide experience in the TOT technique. As stated above, PVDF seems to be a good alternative to PP because, theoretically, PVDF would be associated with less mesh-related side effects. However, because of its design and the results, the present study could not reach this conclusion. It is important to highlight that there is a potential field of improvement with the TOT procedure by finding the best material for the slings. The potential benefits of PDVF over PP used in suburethral slings should be further evaluated through randomized controlled trials with a long follow-up.

DISCLOSURE

No author has any potential conflict of interest.

REFERENCES

1. Ogah J, Cody JD, Rogerson L. Minimally invasive synthetic suburethral sling operations for stress urinary incontinence in women. Cochrane Database Syst Rev 2009;(4):CD006375.

2. Mostafa A, Lim CP, Hopper L, Madhuvrata P, Abdel-Fattah M. Single-incision mini-slings versus standard midurethral slings in surgical management of female stress urinary incontinence: an updated systematic review and meta-analysis of effectiveness and complications. Eur Urol 2014;65(2):402–27.

3. Nambiar A, Cody JD, Jeffery ST. Single-incision sling operations for urinary incontinence in women. Cochrane Database Syst Rev 2014;6:CD008709.

4. Klinge U, Klosterhalfen B, Ottinger AP, Junge K, Schumpelick V. PVDF as a new polymer for the construction of surgical meshes. Biomaterials 2002;23(16):3487–93.

5. Gerullis H, Georgas E, Borós M, et al. Inflammatory Reaction as Determinant of Foreign Body Reaction Is an Early and Susceptible Event after Mesh Implantation. Biomed Res Int 2014;2014:e510807.

6. Klink CD, Junge K, Binnebösel M, et al. Comparison of long-term biocompability of PVDF and PP meshes. J Investig Surg 2011;24(6):292–9.

7. Otto J, Kaldenhoff E, Kirschner-Hermanns R, Mühl T, Klinge U. Elongation of textile pelvic floor implants under load is related to complete loss of effective

porosity, thereby favoring incorporation in scar plates. J Biomed Mater Res A 2014;102(4):1079–84.

8. Domenech JM, Granero R. Macro !RNDI for SPSS Statistics. Extraction of N Random Integers from LN to HN (Exhaustive sampling). [Computer program]. V2001.09.09. Bellaterra: Universitat Autònoma de Barcelona; 2011.; [accessed Novembre 14, 2013]. Available from: http://www.metodo.uab.cat/macros.htm

9. Haylen BT, Ridder D, Freeman RM, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic floor dysfunction. Int Urogynecol J 2010;21(1):5–26.

10. Amid PK. Classification of biomaterials and their related complications in abdominal wall hernia surgery. Hernia 1997;1(1):15–21.

11. Novara G, Artibani W, Barber MD, et al. Updated systematic review and meta-analysis of the comparative data on colposuspensions, pubovaginal slings, and midurethral tapes in the surgical treatment of female stress urinary incontinence. Eur Urol 2010;58(2):218–38.

12. Damaraju SM, Wu S, Jaffe M, Arinzeh TL. Structural changes in PVDF fibers due to electrospinning and its effect on biological function. Biomed Mater 2013;8(4):045007.

13. Low YKA, Meenubharathi N, Niphadkar ND, Boey FYC, Ng KW. α- and β-poly(vinylidene fluoride) evoke different cellular behaviours. J Biomater Sci Polym Ed 2011;22(12):1651–67.

14. Klinge U, Binneboesel M, Kuschel S, Schuessler B. Demands and properties of alloplastic implants for the treatment of stress urinary incontinence. Expert Rev Med Devices 2007;4(3):349–59.

15. Jäger W, Mirenska O, Brügge S. Surgical treatment of mixed and urge urinary incontinence in women. Gynecol Obstet Invest 2012;74(2):157–64.

16. Najjari L, Hennemann J, Kirschner-Hermanns R, Maass N, Papathemelis T. Visualization of polypropylene and polyvinylidene fluoride slings in perineal ultrasound and correlation with clinical outcome. Biomed Res Int 2014;2014:181035.

17. Petros P, Papadimitriou J. Evolution of midurethral and other mesh slings--a critical analysis. Neurourol Urodyn 2013;32(4):399–406.

18. Montero A, Sabadell J, Salicrú S, Poza JL, Gil A. Transvaginal release for prolonged voiding dysfunction after tension-free vaginal tape placement: Long-Term results [Internet]. 43rd ICS Annual Meeting, Barcelona 2013. Available from: http://www.ics.org/Abstracts/Publish/180/000634.pdf

Fig. 1 Kaplan-Meier survival functions for the effectiveness of the slings. The steps indicate failures.

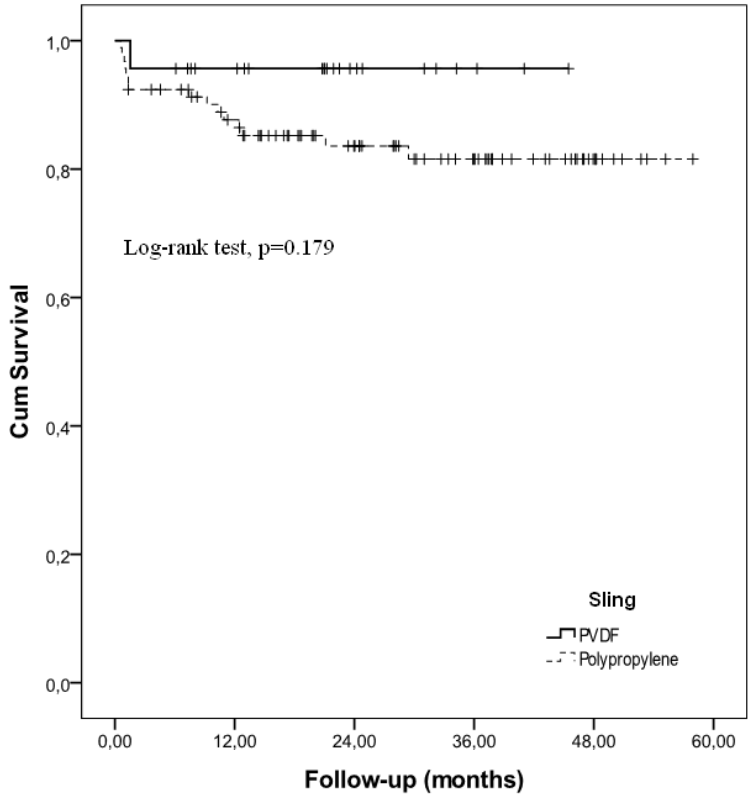


Table 1. Initial characteristics

	Polypropylene	**PVDF**	***p***
Age (years)†	63.8 [39.3 – 80.5]	65.8 [41.1 – 85.0]	0.394
BMI†	29.7 [20.8 – 42.9]	30.1 [26.0 – 43.2]	0.507
Previous surgery‡	23 (25.3)	4 (17.4)	0.427
Associated POP‡	63 (68.5)	13 (56.5)	0.279
Previous UUI‡	32 (34.8)	10 (43.5)	0.439
Presence of DOA‡,§	5 (15.6)	4 (40)	
Urethral hypermobility‡	72 (79.1)	15 (65.2)	0.267
MUCP†	49.0 [8 – 74]	45.0 [16 – 60]	0.018
Associated surgery‡	60 (65.9)	12 (52.2)	0.222

BMI: Body mass index. *POP:* Pelvic organ prolapse. *UUI:* Urinary urge-incontinence. DOA*:* Detrusor overactivity. MUCP*:* Maximal urethral closure pressure.

†Data expressed in median [range]. ‡Data expressed in n(%). §Percentage in relation to cases with UUI.

Table 2. Complications

	Polypropylene	PVFD	*p*
Intraoperative	3 (3.3%)	0 (0%)	1
Bladder puncture	1	0	
Vaginal perforation	2	0	
Early postoperative	22 (23.9%)	3 (13.0%)	0.258
Cystitis†	2	0	
Temporary elevated PVRV	22	3	
Voiding difficulty requiring ISC	4	0	
Late postoperative	6 (6.5%)	0 (0%)	0.598
Repeated cystitis	1	0	
Urinary obstruction	4	0	
Transient groin pain	1	0	
Tape erosion	0	0	
De novo urgency	13 (14.1%)	1 (4.3%)	0.295
Urethrolysis	7 (7.6%)	0 (0%)	0.342

PVRV: Post-void residual urine volume. *ISC:* Intermittent self-catheterization.

†Positive urinary culture.

Behaviour of urinary incontinence in the face of sacrocolpopexy.

Rodríguez-Mias NL, Sabadell-García J, Suárez-Salvador E, Gil-Moreno A, Poza-Barrasus JL.

Urogynaecologia. 2017 Aug 30;30(1):185.

Behaviour of urinary incontinence in the face of sacrocolpopexy

Nuria L. Rodríguez-Mias, Jordi Sabadell-García, Elena Suárez-Salvador, Antonio Gil-Moreno, Jose Luis Poza-Barrasus

Department of Obstetrics and Gynecology, Vall d'Hebrón University-Hospital, Autonomous University of Barcelona, Spain

Abstract

The aim of this study was to determine whether an association exists between the performance of a sacrocolpopexy for genital prolapse and the bladder function. A case series study was performed that includes all patients who received sacrocolpopexy in a tertiary Spanish hospital. An analysis was performed to study the association of some variables and the occurrence or persistence of urinary incontinence after the surgery. Forty patients with indication of sacrocolpopexy were included. A year after sacrocolpopexy, the outcomes showed 97.3% of prolapse healing. 19.3% complained about *de novo* stress urinary incontinence, 33.3% recovered from it and another 66.7% remained the same. Only 10.8% asked for an anti-incontinence surgery after the sacrocolpopexy. The urethral hypermobility shows an increased risk of stress urinary incontinence after the sacrocolpopexy. Based on our results, we do not consider it necessary to perform a systematic anti-incontinence procedure simultaneously with sacrocolpopexy unless a woman without urethral anti-incontinence surgical background shows a urethral hypermobility.

Introduction

Pelvic floor dysfunction (PFD) is a highly prevalent health problem that has an impact on the patient's quality of life and the economy of the health system. It includes urinary incontinence (UI), pelvic organ prolapse (POP), fecal incontinence, sexual dysfunction and pelvic pain.

POP is a common condition, and it occurs in half of parous women when they lose pelvic floor support, thus resulting in some degree of prolapse.[1] It is estimated that at the age of eighty, 11% of women will require some type of surgical treatment for this affection and 30% of these will require another operation.[2] It has also been said that an association might exist between POP symptoms and lower urinary tract dysfunction, which are two of the most common PFD.[3,4]

Focussing on the specific genital prolapse of the vaginal vault, an estimated incidence between 0.2% and 45% has been reported. It appears to be attributed to a weakening of the first level of uterovaginal support described by De Lancey,[5] or as a lack of a proper apical correction during a vaginal hysterectomy.

The correction of the vaginal vault prolapse has always been a challenge for all gynecologists. Sacrocolpopexy (SCP) is considered one of the most effective surgical treatments for repairing stage II-IV vault prolapse[6] [based on pelvic organ prolapse quantification system (POP-Q)]. It is considered as the *gold standard* for the correction of vaginal vault prolapse, as it offers the best success rates with fewer relapses, and it enables adequate sexual functionality compared to other techniques. Originally, it was performed by laparotomy, but the endoscopic approach achieved a reduction in morbidity while maintaining the same high rate of success.[7,8] The reported cure rate increases to 78-100% by laparotomy and 90-100% by laparoscopy.[7,9]

This study aimed to describe what kind of effect this type of genital prolapse surgery could have on the bladder function as it had been published that SCP over time could lead to the appearance of *de novo* UI over time. In connection with that, this investigation attempted to consider the need for an anti-incontinence procedure combined with the prolapse surgery in women who planned to undergo SCP. Furthermore, it also strived to assess the surgical results of our group with this technique as well as to demonstrate our prolapse success rate to the ones described in the literature.

Materials and Methods

We conducted a case series study, based on STROBE guidelines, including all patients who underwent SCP because of a vault prolapse. Two specialised surgeons from our PFD unit in our Spanish University tertiary Hospital Vall d'Hebrón operated them all. This study was registered and received institutional review board approval by the Institutional Review Board at our centre.

The women enrolled were those who underwent SCP because of stage II to IV vault prolapse from 2002 to 2015. All of them signed an informed consent for the elective surgery, where they agreed with the prolapse correction and accepted the risk of UI among other possible complications. As the exclusion criteria were accepted, the women who visited our unit were not candidates for SCP or had refused this approach.

All epidemiological data was acquired all at once during the first visit to the unit. Trained urogynecologists interviewed and examined all women and all the information was collected in a Microsoft Excel® database.

Based on the examination, the interview and the International Continence Society (ICS) definitions,[10] we define the POP as the presence of vaginal bulge; the stress UI (SUI) as the involuntary leakage on effort or exertion, or on sneezing or coughing; the occult or latent SUI when it appears after reducing of co-existent prolapse; the urge UI (UUI) is the leakage immediately preceded by or associated with a sudden desire to void and mixed incontinence as that SUI associated to UUI; and the mixed urinary incontinence (MUI) as the complaint of involuntary leakage associated with

Correspondence: Nuria L. Rodríguez-Mias, Department of Gynecology, Vall d'Hebrón University-Hospital, Autonomous University of Barcelona, Passeig de la Vall d'Hebrón, 119-129, 08035 Barcelona, Spain.
Tel.: 93.489.30.00 - Fax: 93.489.30.39.
E-mail: nuromi@gmail.com

Key words: Sacrocolpopexy; pelvic floor dysfunction; pelvic organ rolapsed; urinary incontinence; vault prolapse.

Contributions: NLR-M, conception and design, data analysis and interpretation, article drafting and revising, final approval; JS-G, data analysis and interpretation, article drafting and final approval; ES-S, AG-M, conception and design, article revising and final approval; JLP-B, conception and design, data interpretation, article revising and final approval.

Conflict of interest: the authors declare that they have no conflict of interest.

Received for publication: 18 August 2016.
Revision received: 13 December 2016.
Accepted for publication: 24 August 2017.

Urogynaecologia 2017; 30:185
doi:10.4081/uij.2017.185

urgency and also with exertion, effort sneezing or coughing. *De novo* stress or urgency was defined as the appearance of SUI or UUI after prolapse surgery, accepting that this term could only be used when the patient did not have any stress or urgent preoperative symptoms.

The information collected for the study included epidemiological data, obstetric and gynecologic history and gynecologic surgery history. Also included the assessment of SUI and/or UUI along with the grade of prolapse based on, the POP-Q examination for the prolapse evaluation, the Q-tip test for the urethral mobility appraisal (defining the urethral hypermobility as a straining angle of 30 degrees or greater relative to the horizontal) and finally the multichannel urodynamic test[10] for the continence status exploration. Data about the surgery was also recorded. All patients underwent a laparoscopic, robotic or laparotomy SCP using a Y-shaped piece of polypropylene mesh. The two skilled specialists on this technique performed all surgeries. Outcomes were classified into prolapse restoration or the worsening of POP besides urinary tract symptoms or complications with the prolapse surgery.

A descriptive analysis was performed for the information detailed before. The SPSS 18 programme for Windows (SPSS, Chicago, IL, USA) was used for the statistical analysis of the association between variables and the occurrence of incontinence after SCP. To identify the risk factors associated with UI onset after the surgical procedure, we performed a univariate analysis. Variables with a P-value <0.1 in the univariate analysis were included in a multivariate logistic regression model. The level of significance was set at P<0.05.

Results

A total of 40 women with vaginal apex prolapse were included in this study. They were evaluated for UI symptoms and monitored over a year for UI resolution, remaining UI or onset UI after SCP performed in our centre from 2002 to the first quarter of 2015.

From the epidemiologic descriptive data collected and analysed, the mean age of the entire group at the surgery was 58 years old (range 39-72 years), the mean BMI was 27.2 (range 20.31-35.70) and 2.5% (n=1) were smokers. Regarding the obstetric and gynecologic variables reviewed, it was seen that the median parity was 2.2 children per woman, 97.5% (n=39) were post-menopausal and two were under hormone replacement therapy. Table 1 shows the outcome of gynecologic surgery history, emphasising that 27.5% (n=11) had been operated on before because of UI.

Focussing on the physical examination, it was outlined that the majority of them showed a high-grade POP: 55% (n=22) had a third degree and 35% (n=14) had a fourth degree. The classification by type of prolapse showed that 77.5% (n=31) had a vaginal vault prolapse, 55% (n=22) a rectocele, 32.5% (n=13) a cystocele, 27.5% (n=11) an enterocele and 2.5% (n=1) a uterine prolapse. 35% (n=14) of the women complained about a single affected vaginal compartment. And finally, a urethral hypermobility was seen in 45.2% (n=14) of them.

On the other hand, the presence of UI before surgery showed that 15% (n=6) were affected by SUI, 17.5% (n=7) UUI and 7.5 % (n=3) mixed UI. It was noticed that 11 patients had a previous history of an anti-incontinence surgery prior to the SCP, 18.2% (n=2) complained about SUI, 36.4% (n=4) complained about UUI and 45.5% (n=5) did not complain about UI.

Looking closely at the urodynamic outcome and taking into account that only 77.5% (n = 31) had performed the study, where 32.3% (n=10) had an overactive detrusor muscle.

Concerning the surgical intervention, the same two skilled surgeons operated all patients. The selection process for approach to SCP was mainly based in the endoscopic approach, laparoscopically either robotically depending on the BMI resulting in that the main surgical approach was done in 77.5% (n=31) laparoscopically and 20% (n=8) robotically. While the other 2.5% (n=1) was performed by laparotomy due to a medical contraindication of a general anesthesia. 97.5% (n=39) of them underwent SCP, except for one woman (2.5%) who underwent a supracervical hysterectomy plus a cervicosacropexy. The overall surgical time was 285.12 minutes (from 150 to 390 minutes), and the average hospital stay was 3.02 days with no readmissions for any complication.

10% (n=4) of patients presented complications during surgery: two urinary bladder injuries, one vagina perforation and one rectum laceration with an immediate repair during the same surgical procedure among all of them. During the hospitalisation, 7.5% (n=3) showed minor complications such as two urinary tract infections and a vaginal vault hematoma that were resolved with antibiotic therapy.

Table 2 shows the follow-up during the first year after SCP, where it must be emphasised that 100% (n=40) of patients showed a full recovery from genital prolapse after one month of the intervention, which remained cured in 97.3% (n=36) one year later. Concerning the appearance of SUI after the surgery, it is demonstrated that at the first month, 15% (n=6) of women were affected by the appearance, and 12 months later, this increased to 27% (n=10). During the first year of the surgical procedure, it was observed that 10.8% (n=4) required an anti-incontinence surgery (between the 3rd and 12th month after SCP),

Table 1. Gynecologic surgery history patients who underwent a SCP.

	n	%
Presence of gynecologic surgery history	39	97.5
Hysterectomy	39	97.5
Anterior colporrhaphy	16	40
Posterior colporrhaphy	10	25
Anterior compartment Mesh surgery	9	22.5
Posterior compartment Mesh surgery	3	7.5
Richter technique	3	7.5
Anti incontinence surgery*	11	27.5

*Type of anti incontinence surgery: 3 Burch technique, 1 Marshall-Marchetti-Kantz, 2 TVT, 4 TOT and 1 unknown surgery.

Table 2. Outcomes and complications after the SCP (at 1, 6 and 12 months).

Outcomes post-SCP	1st month (n=40)	6th month (n=38)	12th month (n=37)
Pelvic floor recovery	100% (n= 40)	97.4% (n= 37)	97.3% (n= 36)
SUI	15.0% (n=6)	26.3% (n=10)	27.0% (n=10)
UUI	7.5% (n=3)	5.2% (n=2)	5.4% (n=2)
MUI	5.0% (n=2)	10.5% (n=4)	10.8% (n=4)
Dyspareunia	5.0% (n=2)	13.1% (n=5)	5.4% (n=2)
Constipation	32.5% (n=13)	28.9% (n=11)	27.0% (n=10)
Mesh extrusion	0% (n=0)	2.6% (n=1)	2.7% (n=1)

of which 75% (n=3) required a transobturator tape and 25% (n=1) required a suburethral mini-sling. After the first 12 months, the postoperative follow-up continued annually. Focussing on the appearance of SUI and UUI after surgery, Table 3 summarises what happened before and after the SCP and during the first year that the patients were followed up at our unit. It has been reported that during the first month after surgery, 9.1% (n=3) developed *de novo* SUI, 57.1% (n=4) healed from the previous SUI and another 42.9% (n=3) remained with the same SUI; whereas, one year later, the *de novo* SUI increased to 19.3% (n=6), recovered SUI decreased to 33.3% (n=2) and persistent SUI rose to 66.7% (n=4). On the other hand, regarding UUI, it can be seen that during the first 30 days after SCP, 8.8% (n=3) of women showed *de novo* UUI, 100% (n=6) restored and 0% (n=0) persisted with urge symptoms after surgery. Twelve months later, 3.2% (n=1) developed *de novo* UUI, 83.3% (n=5) restored it and 16.7% (n=1) continued with the same UUI. Finally, regarding MUI, one month after the prolapse repair, 2.7% (n=1) complained about *de novo* MUI, 66.7% (n=2) recovered from the previous MUI and 33.3% (n=1) continued with the same MUI; whereas, one year later, 8.8% (n=3) developed *de novo* MUI, 66.7% (n=2) recovered from it and 33.3% (n=1) persisted with MUI. Figure 1 shows the behaviour of the different types of UI before and after SCP. It can be seen that there was only a slight increase of the UI group one year after. It must be said that the women with SUI who asked for an anti-incontinence surgery after they had already repaired the prolapse were included in the one-year follow-up as incontinent regardless of the surgical outcome. Some variables (such as age, BMI, history of previous SUI, UUI or MUI, history of previous anti-incontinence surgery and urethral hypermobility) were studied to analyse the association between them and the onset of SUI or UUI after surgery. It has only been statistically demonstrated (if a multivariate analysis is performed) that the presence of urethral hypermobility could increase the risk of SUI after SCP (OR = 35.29 95%, CI = 1.2 to 1036.0), mainly in patients without previous anti-incontinence surgery. No other variables have shown statistically significant results with SUI or UUI.

Discussion

The main goal of the reconstructive surgery for genital prolapse should be the restoration of the normal pelvic floor anatomy in order to maintain and repair a normal urinary, defecatory and sexual function.[11]

SUI and POP, both conditions considered as a PFD, can often occur simultaneously, especially in extreme forms of prolapse, as it seems that they could share similar pathophysiological mechanisms.[12] However, when POP masks or reduces the severity of SUI symptoms, this is referred to as occult SUI.[13]

It has been described that 8-60% of women who undergo SCP may develop SUI after surgery.[14] Even asymptomatic women for SUI before surgery may experience it after surgery (up to 44%),[15] suggesting that it might be due to the tortuous anatomical urethra or to a compression of it in the advanced condition that is corrected during surgery.[13]

About 40-50% of women who undergo a surgery for POP might have SUI symptoms before surgery, and the urinary symptoms will not disappear after the correction of the prolapse.[16] Some studies demonstrate that up to 80% of women affected by occult SUI prior to the surgical correction of POP

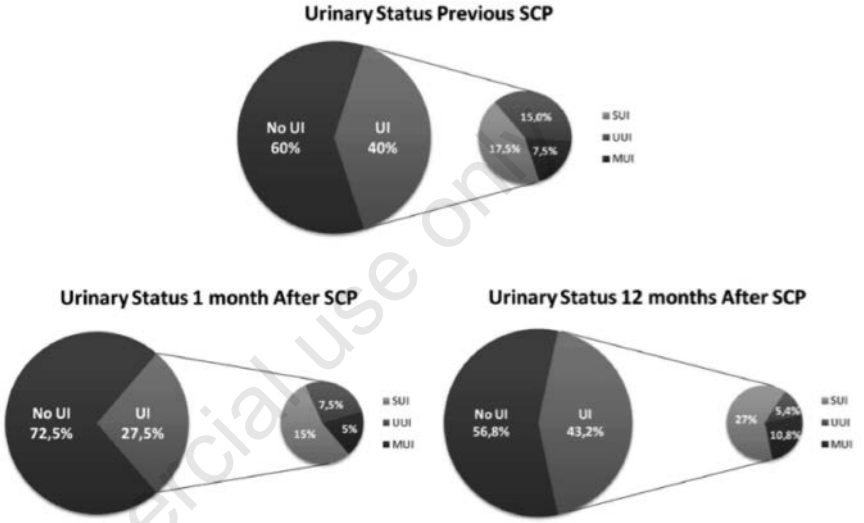


Figure 1. Behaviour of the different types of UI before and after SCP.

Table 3. Urinary incontinence status before and after SCP.

		SUI 12 months post SCP No	SUI 12 months post SCP Yes	Total
SUI before SCP	No	25 81%	6 19%	31 100%
	Yes	2 33%	4 67%	6 100%
Total		27 73%	10 27 %	37 100%
		UUI 12 month post SCP No	**UUI 12 month post SCP Yes**	**Total**
UUI before SCP	No	30 97%	1 3%	31 100%
	Yes	5 83%	1 17%	6 100%
Total		35 95%	2 5%	37 100%
		MUI 12 month post SCP No	**MUI 12 month post SCP Yes**	**Total**
MUI before SCP	No	31 91%	3 9%	34 100%
	Yes	2 67%	1 33%	3 100%
Total		33 89%	4 11%	37 100%

will develop SUI after prolapse surgery.[16]

Currently, one of the most discussed and controversial issues in urogynaecology is whether to perform a systematic prophylactic anti-incontinence procedure during POP repair in women without UI symptoms in order to prevent the onset of SUI after the prolapse correction.

In the literature, regarding this topic, two different points of view can be found. Some authors recommend a two-stage anti-incontinence surgery after the POP correction.[17] Yet others suggest an all-in-one surgical repair in order to reduce the costs and risks of a new hospitalisation and procedure.[18-20]

An interesting meta-analysis published in 2014 by Van der Ploeg *et al*.[16] compares the effectiveness and safeness of prolapse surgery alone and its correction combined with anti-incontinence in women with POP plus SUI, occult SUI or asymptomatic SUI. There is some risk of developing SUI after a POP surgical repair, so patients should be informed that the UI onset would be less frequent if a combined surgery is performed. In contrast, accepting that the rate of side effects from combined surgery is high and knowing that only 7% of asymptomatic patients will require a second surgery because of a postoperative SUI. Combined surgery should only be considered in women with prolapse and occult SUI, where the benefits of an all-in-one procedure outweigh the risks.

Matsukoda[21] has recently published another meta-analysis where they conclude that performing any prophylactic anti-incontinence procedure at the same time as the reparative prolapse surgery reduces the incidence of SUI after surgery in patients who present occult SUI. However, the assessment of occult SUI still remains controversial. Only the patients who underwent retropubic TVT express a benefit.[20,22,23] They estimate that 36-80% of women with severe POP have a occult SUI preoperatively. It is at that point when patients should be offered a combined surgery in order to prevent the occurrence of SUI postoperatively.

Focussing solely on the relationship between UI and SCP, the literature is quite scarce, and only a couple of interesting studies have been published. Jeon *et al*.[24] presents a prospective observational study where they conclude that a preoperative prolapse-reduction stress test alone is not sufficient to determine the need of anti-incontinence surgery at the time of SCP. However, women with SUI symptoms, despite a negative prolapse-reduction stress test, are more likely to experience postoperative SUI or the need for an additional anti-incontinence surgery.

The second article executed by LeClaire *et al*.[25] concludes in a retrospective cohort study that greater anatomic reduction and the laparotomy approach are risk factors for the appearance of SUI after SCP.

It is therefore crucial to carefully weigh the pros and cons of performing an anti-incontinence operation together with the prolapse repair. Preventing SUI in the same surgical procedure has some drawbacks, and recent literature provides increasing evidence that more serious complications may arise (such as increased risk of bladder perforation, bleeding or vessel laceration, intestinal perforation or even nerve injury, aside from other uncomfortable urinary symptoms that could arise later on).

The main strength of our descriptive study is, aside from the large sample size of SCP, that as a case series, it has been used to describe outcomes of novel treatments and it might be useful to lead focused studies of a stronger design afterwards. This article should be considered unique, as no other specific articles analysing the behaviour of UI in the face of SCP have been published before. Certain limitations must be also considered as it is a clinical series and it may suffer from the shortcomings of this type of study. The selection bias, an inherent bias in case series, could be detected apart from other limitations such as, the full follow-up duration after SCP of all the patients recruited and that tendencies for a vault prolapse repair changed since the FDA warn in 2011 implying a bias for the interpretation of results.

Conclusions

Considering our data, we conclude that a year after the SCP, our prolapse cure rate and our complication rate were similar to the standard described in the literature. Concerning the behaviour of UI after SCP, our study demonstrates that a month after prolapse surgery, more than the half of them recovered from their previous SUI and more than one third remained unchanged their SUI condition. Focussing on UUI and MUI disorders other less relevant data was obtained.

In general, this study shows that there was a slight increase in the overall UI rate in the first year after surgery. But this was at the expense of an increase in the SUI percentage, mainly in women who maintained the previous SUI status with a lower percentage of *de novo* condition, and a decrease in the UUI group. It is highlighted that 10% of the patients who complained about SUI after SCP required a two-stage anti-incontinence surgery. A urethral hypermobility in the physical examination prior to the prolapse repair seems to be the only potential risk factor of SUI onset after SCP for those without any previous anti-incontinence surgery.

Based on our work, we consider that SCP reaches a high cure rate for vault prolapse and observes similar percentages to those described in the literature. Besides, since the approach is minimally invasive, it enables achieving lower incidence of minimal complications with the same results. Focusing on the behaviour of bladder dysfunction in the face of SCP, our data shows that, almost 50% of them recover spontaneously from SUI a year after the SCP without associating any anti-incontinence surgery. The need of a two-stage anti-incontinence surgery should only be considered when a SUI appears after the SCP, as the likelihood ratio shown is low. The only statistically significant predictor of SUI onset that is postoperatively demonstrated is the presence of urethral hypermobility in women who had never undergone an anti-incontinence surgery before.

Considering all these results, we might not consider the need for a systematic anti-incontinence surgery in those asymptomatic women who would undergo SCP unless a urethral hypermobility is shown in the clinical examination and the patient has never undergone any anti-incontinence surgery. Nevertheless, the risks and benefits of combined surgery should be explained in detail, and although the risk of *de novo* SUI appearance is reduced, some other adverse effects could appear after it. Further prospective randomised studies with larger sample sizes are needed in order to ensure the effect of SCP in the pelvic structures and the lower urinary tract.

References

1. Beck RP, McCormick S, Nordstrom L. A 25-year experience with 519 anterior colporrhaphy procedures. Obstetr Gynecol 1991;78:1011-8.
2. Olsen AL, Smith VJ, Bergstrom JO, et al. Epidemiology of surgically managed pelvic organ prolapse and urinary incontinence. Obstetr Gynecol 1997;89: 501-6.
3. Nygaard I, Barber MD, Burgio KL, et al. Prevalence of symptomatic pelvic floor disorders in US women. JAMA 2008;300:1311-6.
4. Hannestad YS, Rortveit G, Sandvik H, Hunskaar S. Norwegian EPINCONT study. Epidemiology of Incontinence in the County of Nord-Trøndelag. A community-based epidemiological survey

of female urinary incontinence: the Norwegian EPINCONT study. Epidemiology of Incontinence in the County of Nord-Trøndelag. J Clin Epidemiol 2009;53:1150-7.
5. DeLancey JO. Structural support of the urethra as it relates to stress urinary incontinence: the hammock hypothesis. YMOB 1994;170:1713-23.
6. Agarwala N, Hasiak N, Shade M. Laparoscopic sacral colpopexy with Gynemesh as graft material--experience and results. J Minim Invasive Gynecol 2007;14:577-83.
7. Nezhat CH, Nezhat F, Nezhat C. Laparoscopic sacral colpopexy for vaginal vault prolapse. Obstet Gynecol 1994;84:885-8.
8. Dorsey JH, Cundiff G. Laparoscopic procedures for incontinence and prolapse. Curr Opin Obstet Gynecol 1994;6:223-30.
9. Rozet F, Mandron E, Arroyo C, et al. Laparoscopic sacral colpopexy approach for genito-urinary prolapse: experience with 363 cases. Eur Urol 2005;47:230-6.
10. Abrams P, Cardozo L, Fall M, et al. The standardisation of terminology of lower urinary tract function: report from the Standardisation Sub-committee of the International Continence Society. YMOB 2002;18:116-26.
11. Jelovsek JE, Maher C, Barber MD. Pelvic organ prolapse. Lancet 2007;369:1027-38.
12. Nygaard I, Barber MD, Burgio KL, et al. Prevalence of symptomatic pelvic floor disorders in US women. JAMA 2008;300:1311-6.
13. Smith AL, Karp DR, Lefevre R, et al. LeFort colpocleisis and stress incontinence: weighing the risk of voiding dysfunction with sling placement. Int Urogynecol J 2011;22:1357-62.
14. Nygaard IE, McCreery R, Brubaker L, et al. Abdominal sacrocolpoepexy: a comprehensive review. Obstet Gynecol 2004;104:805-23.
15. Brubaker L, Cundiff GW, Fine P, et al. Abdominal sacrocolpopexy with Burch colposuspension to reduce urinary stress incontinence. N Engl J Med 2006;354:1557-66.
16. Van der Ploeg JM, van der Steen A, Oude Rengerink K, et al. Prolapse surgery with or without stress incontinence surgery for pelvic organ prolapse: a systematic review and meta-analysis of randomised trials. BJOG 2014;121:537-47.
17. Goldman HB. SUI surgery at the time of vaginal POP repair: is a surgical algorithm possible or desirable? Neurourol Urodyn 2011;30:758-61.
18. Maher C, Feiner B, Baessler K, Schmid C. Surgical management of pelvic organ prolapse in women. Cochrane Database Syst Rev 2013.
19. Brubaker L, Nygaard I, Richter HE, et al. Two-year outcomes after sacrocolpopexy with and without burch to prevent stress urinary incontinence. Obstet Gynecol 2008;112:49-55.
20. Wei JT, Nygaard I, Richter HE, et al. A midurethral sling to reduce incontinence after vaginal prolapse repair. N Engl J Med 2012;366:2358-67.
21. Matsuoka PK, Pacetta AM, Baracat EC, Haddad JM. Should prophylactic anti-incontinence procedures be performed at the time of prolapse repair? Systematic review. Int Urogynecol J 2015;26:187-93.
22. Schierlitz L, Dwyer PL, Rosamilia A, et al. Pelvic organ prolapse surgery with and without tension-free vaginal tape in women with occult or asymptomatic urodynamic stress incontinence: a randomised controlled trial. Int Urogynecol J 2014;25:33-40.
23. Brubaker L, Cundiff G, Fine P, et al. A randomized trial of colpopexy and urinary reduction efforts (CARE): design and methods. Control Clin Trials 2003;24:629-42.
24. Jeon MJ, Kim JY, Moon YJ, et al. Two-year urinary outcomes of sacrocolpopexy with or without transobturator tape: results of a prolapse-reduction stress test-based approach. Int Urogynecol J 2014;25:1517-22.
25. LeClaire EL, Mukati MS, Juarez D, et al. Is de novo stress incontinence after sacrocolpopexy related to anatomical changes and surgical approach? Int Urogynecol J 2014;25:1201-6.

8.2 Cuestionarios utilizados en los estudios

Test de severidad de Sandvik

Cuestionario validado en Español

Fecha : ___ - ___ - _____

Multiplicar la frecuencia de las pérdidas de orina por el volumen de las pérdidas.

Con cuanta frecuencia tiene pérdidas de orina?		**Cuanta orina pierde con cada pérdida?**	
0 = Nunca **1** = Menos de una vez al mes **2** = Una o más veces al mes **3** = Una o más veces por semana **4** = Cada día y/o noche	X	**1** = Gotas **2** = Chorro pequeño (cantidad moderada) 3 = Mucha cantidad	=

International Consultation on Incontinence Questionnaire-Short Form (ICIQ-SF)

Cuestionario validado en español

ICIQ-IU-SF

FECHA: DÍA ☐☐ MES ☐☐ AÑO ☐☐

1. Por favor, escriba la fecha de su nacimiento: DÍA ☐☐ MES ☐☐ AÑO ☐☐

2. Nº ID: ☐☐☐☐☐

3. **¿Con qué frecuencia pierde orina?** (Marque una)

Nunca	☐ 0
Una vez a la semana o menos	☐ 1
Dos o tres veces a la semana	☐ 2
Una vez al día	☐ 3
Varias veces al día	☐ 4
Continuamente	☐ 5

4. **Nos gustaría saber su impresión acerca de la cantidad de orina que usted cree que se le escapa. Cantidad de orina que pierde habitualmente (tanto si lleva protección como si no).** (Marque una)

No se me escapa nada	☐ 0
Muy poca cantidad	☐ 2
Una cantidad moderada	☐ 4
Mucha cantidad	☐ 6

5. **Estos escapes de orina que tiene, ¿cuánto afectan a su vida diaria?**

Por favor, marque un círculo en un número entre 0 (no me afectan nada) y 10 (me afectan mucho)

0	1	2	3	4	5	6	7	8	9	10
nada										mucho

Puntuación de ICI-Q: sume las puntuaciones de las preguntas 3 + 4 + 5 = ☐☐

6. **¿Cuándo pierde orina?** (Señale tolo lo que le pasa a usted)

Nunca pierde orina	☐
Pierde orina antes de llegar al WC	☐
Pierde orina cuando tose o estornuda	☐
Pierde orina cuando duerme	☐
Pierde orina cuando hace esfuerzos físicos/ejercicio	☐
Pierde orina al acabar de orinar y ya se ha vestido	☐
Pierde orina sin un motivo evidente	☐
Pierde orina de forma continua	☐

Muchas gracias por contestar a estas preguntas

Patient Global Impression of Improvement (PGI-I)

Cuestionario en inglés, traducido al español.

Elija el número que describa mejor su situación postoperatoria actual en comparación con su situación previa a la cirugía.

1- Mucho mejor

2- Bastante mejor

3- Algo mejor

4- Igual

5- Algo peor

6- Bastante peor

7- Mucho peor