Cureus
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Open Access Technical Report

TAPP5: Technical Modification of Transabdominal Preperitoneal (TAPP) Inguinal Hernia Repair Using Three 5-mm Ports

Review began 10/01/2026
Review ended 10/27/2026
Published 11/03/2026

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DOI: 10.7759/cureus.119071

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Abstract

The laparoscopic transabdominal preperitoneal (TAPP) technique is an established method for inguinal hernia repair, conventionally performed using one 10-mm and two 5-mm ports. We describe TAPP5, a three-port technique using 5-mm ports throughout, including a method for introducing appropriately sized mesh through a 5-mm incision. The procedure follows the standard principles of TAPP repair, including development of the preperitoneal space, identification of the relevant anatomical landmarks, reduction of the hernia sac, and placement of the mesh over the myopectineal orifice. The mesh is introduced through a lateral 5-mm operating port after being rolled into a narrow cylindrical configuration, grasped with a laparoscopic rat-tooth grasper, lubricated, and advanced through the port incision using gentle traction and rotational movement. The port is then reinserted and the mesh positioned using standard laparoscopic instruments. TAPP5 allows inguinal hernia repair to be performed using three 5-mm ports while permitting introduction of standard medium- and large-sized meshes. The technique maintains the established principles of TAPP repair and may provide an alternative port configuration for laparoscopic inguinal hernia repair. Further studies are required to evaluate operative and clinical outcomes and to compare this approach directly with conventional TAPP repair.

Categories: General Surgery
Keywords: 5mm ports, groin hernia, laparoscopic techniques, minimal invasive surgery, tapp hernia repair

Introduction

Inguinal hernia repair is one of the most commonly performed surgical procedures worldwide [1], with more than 20 million operations undertaken annually [2]. Mesh-based repair is the standard treatment for most adult groin hernias. The International HerniaSurge Guidelines recommend either an open or a laparo-endoscopic approach as first-line treatment, taking into account patient characteristics, surgeon expertise, and local resources [3].

Evidence suggests that minimally invasive inguinal hernia repair is associated with reduced postoperative pain, earlier return to normal activities and work, and lower rates of wound complications and chronic postoperative pain compared with open repair [3,4]. In addition, laparoscopic techniques allow bilateral groin hernias to be repaired through the same access and are recommended as the preferred approach for bilateral inguinal hernias when appropriate expertise is available [3]. However, laparo-endoscopic repair remains technically demanding and is associated with a recognised learning curve [5].

Both the totally extraperitoneal (TEP) and transabdominal preperitoneal (TAPP) approaches are established minimally invasive techniques for inguinal hernia repair, with systematic reviews demonstrating comparable outcomes when performed by experienced surgeons [6-8]. At our institution, TAPP repair is the preferred approach because of local surgical expertise. This technical report describes TAPP5, a modification of conventional TAPP repair that uses three 5-mm ports and enables standard medium and large meshes to be introduced through a 5-mm port-site incision, without requiring a dedicated 10-mm mesh-introduction port.

Consent was obtained, and no identifiable patient information is included in this report. The work was undertaken as a technical report; the applicable local research governance determination regarding the requirement for formal ethics approval is described in the manuscript.

Technical Report

Surgical technique: TAPP5 approach

The general principles of TAPP repair using this technique follow the principles of other methods published elsewhere in the literature. In our centre, appropriately sized Bard 3D mesh (BD/Davol Inc., Warwick, RI, USA) or Dextile mesh (Medtronic, Minneapolis, MN, USA) are currently the preferred mesh for TAPP groin

hernia repairs. Full equipment preferences are included in Table 1.

Item	Specification/Brand
Insufflation access	Veress needle
Laparoscope	5-mm, 30°
Ports	Three 5-mm Versa ports or similar
Graspers	5-mm atraumatic grasper, curved dissector, rat-tooth grasper/gallbladder extractor on a ratchet
Dissection tool	Monopolar hook
Mesh	Bard 3DMax or Medtronic Dextile
Lubrication	Standard surgical lubricating gel
Fixation device	Capsure or ReliaTack system

TABLE 1: Equipment Preference Card for TAPP5 Repair.

Note: No prophylactic antibiotics or hair shaving were routinely used. TAPP: transabdominal preperitoneal. Bard 3DMax and CapSure system from BD/Davol Inc. (Warwick, RI, USA); Versa ports, Dextile and ReliaTack system from Medtronic (Minneapolis, MN, USA).

The TAPP5 technique has been performed by a single consultant surgeon at the Royal Free NHS Foundation Trust since 2012. This report describes an established surgical technique undertaken as a service evaluation. Formal ethical approval was not required, in accordance with the applicable local research governance determination.

Anaesthesia, positioning and port placement

All procedures were performed under general anaesthesia. Patients underwent preoperative assessment and preparation according to the applicable local hospital protocols. Antibiotic prophylaxis was not routinely administered. Mechanical and pharmacological thromboprophylaxis was provided in accordance with the perioperative practice followed for these procedures.

Patients were positioned supine, with the surgeon standing on the contralateral side of the hernia. The assistant stood opposite the surgeon and controlled the laparoscope.

The abdominal cavity was usually accessed using a closed technique with a Veress needle inserted at the superior umbilical margin, followed by insufflation to 12-mmHg. In selected cases, pneumoperitoneum was established through Palmer's point. Three 5-mm Versa ports (Medtronic) were used: one optical port inserted at the superior umbilical margin and two operating ports. The two 5-mm operating ports were placed bilaterally, each approximately 3 cm lateral to the lateral border of the corresponding rectus abdominis muscle, along an imaginary horizontal line passing through the umbilicus. This configuration provided access both for laparoscopic instrumentation during the procedure and mesh insertion as described and was maintained for both unilateral and bilateral hernia repair.

After establishment of pneumoperitoneum, a 15°-20° Trendelenburg position was adopted. A 30° 5-mm laparoscope was used throughout the procedure, initially with the scope directed upwards.

Dissection and hernia reduction

The peritoneum was incised approximately 4 cm superior to the hernia defect, and the preperitoneal space was entered laterally near the anterior superior iliac spine. A combination of blunt dissection and pneumodissection was used to develop the preperitoneal plane. The peritoneal incision was extended in a lateral-to-medial direction to create the peritoneal flap.

Dissection was continued medially into the retropubic space until Cooper's ligament and/or the pubic symphysis were identified. The hernia sac was subsequently mobilised and reduced.

Novel mesh introduction technique

The principal modification of the TAPP5 technique is the method used to introduce the mesh into the abdominal cavity. In conventional TAPP repair, the mesh is generally introduced through a 10-mm port. In the TAPP5 technique, the mesh is introduced through one of the lateral 5-mm port-site incisions without

enlarging the port incision.

After completion of the preperitoneal dissection and reduction of the hernia sac, the lateral operating port contralateral to the side of the hernia is removed. A laparoscopic rat-tooth grasper is then passed through the port incision and exteriorised through the abdominal wall (Figure *1*). The jaws of the grasper are opened after removal of the port, allowing the mesh to be positioned for grasping (Figure *2*).

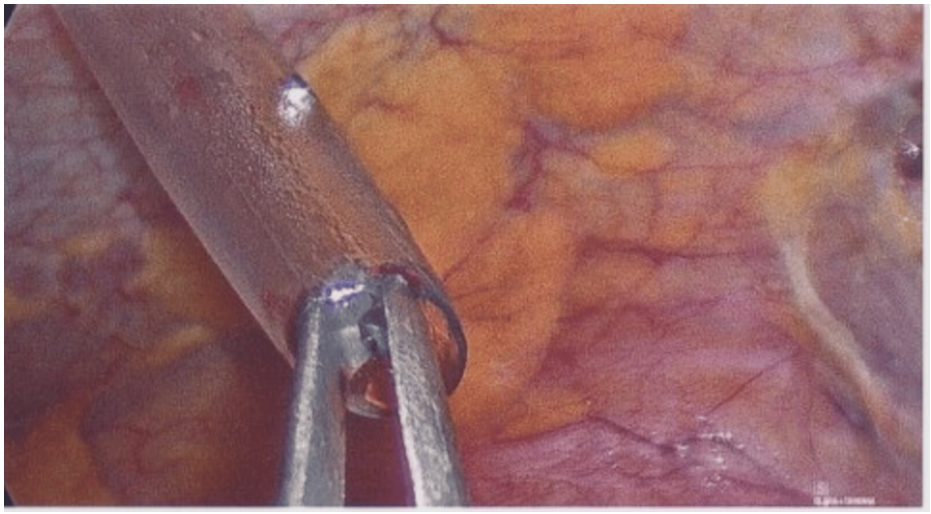


FIGURE 1: Exteriorisation of the laparoscopic rat-tooth grasper through the contralateral 5-mm operating port.

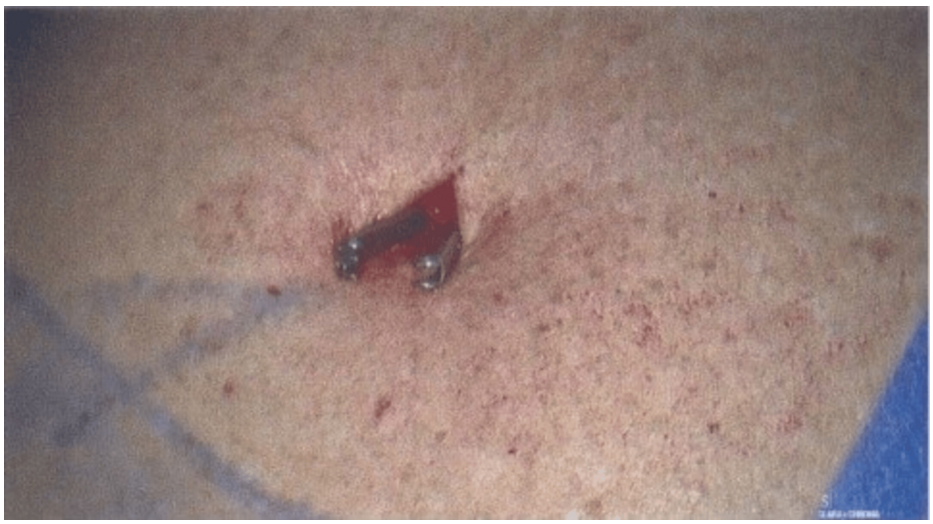


FIGURE 2: Removal of the operating port and opening of the grasper jaws.

The mesh is then manually rolled from its medial corner towards the lateral edge into a cylindrical ("cigarette") configuration (Figure *3*). This configuration reduces the transverse dimensions of the mesh sufficiently to facilitate passage through the 5-mm port incision while maintaining the orientation of the three-dimensional mesh.

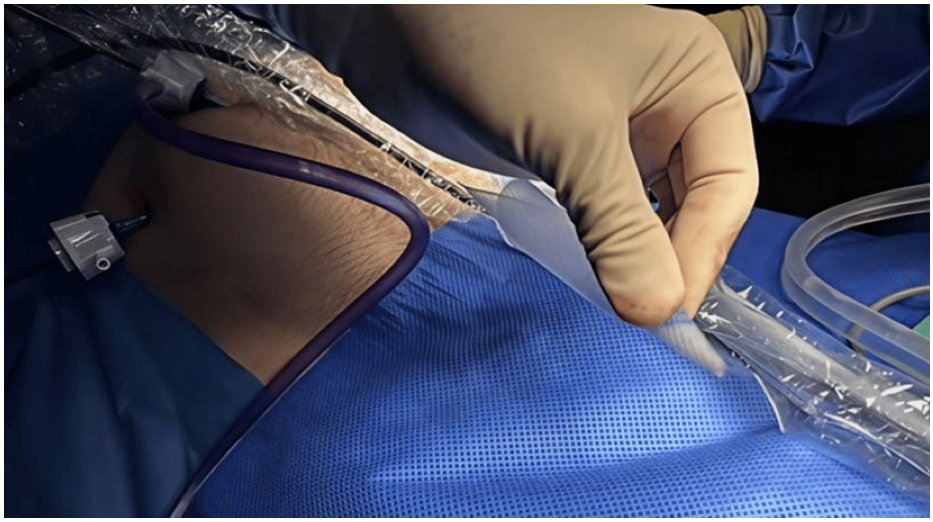


FIGURE 3: The mesh is rolled manually from the medial corner towards the lateral edge, creating a narrow cylindrical shape that facilitates grasping and passage through the 5-mm port incision while maintaining the original orientation of the mesh.

The rolled mesh is then grasped firmly with the rat-tooth grasper (Figure *4*). The ratchet mechanism is engaged to maintain a secure grip on the mesh during introduction. The external surface of the rolled mesh is subsequently lubricated with sterile surgical gel, usually Instillagel (CliniMed Limited, High Wycombe, UK) to facilitate passage through the port incision (Figure *5*).



FIGURE 4: The rolled mesh is grasped securely with the rat-tooth grasper, which is then locked using the ratchet mechanism.



FIGURE 5: Once grasped the rolled mesh is lubricated with gel to facilitate passage.

The mesh is then introduced into the abdominal cavity by applying gentle traction to the grasper while simultaneously using a clockwise rotational movement (Figure *6*). This combined traction and rotational manoeuvre allows the rolled mesh to pass gently and progressively through the 5-mm incision without requiring enlargement of the port site incision. Once completely introduced, the mesh is released from the grasper and allowed to expand within the abdominal cavity (Figure *7*).

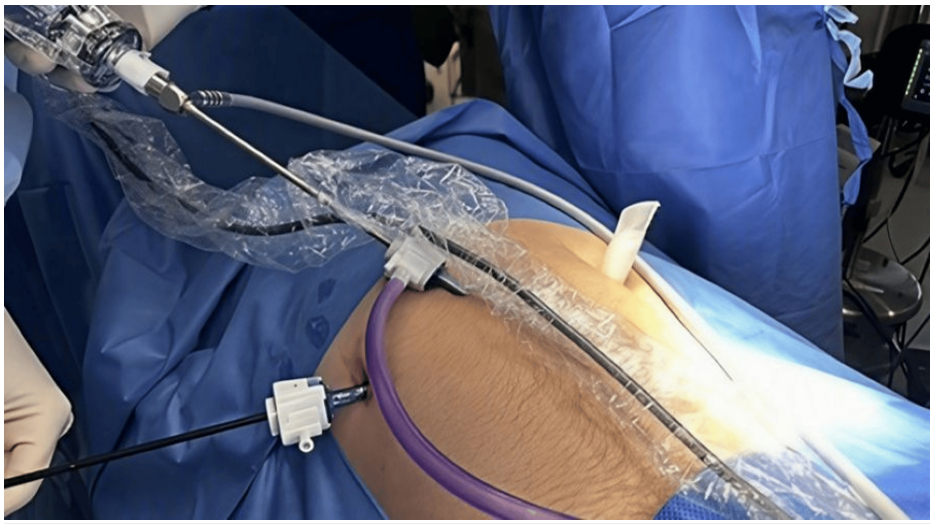


FIGURE 6: The mesh (e.g., Bard 3DMax (BD, Warwick, RI, USA); or Dextile (Medtronic, Minneapolis, MN, USA)) can then be pulled through the 5-mm incision using gentle traction combined with clockwise rotational movements.

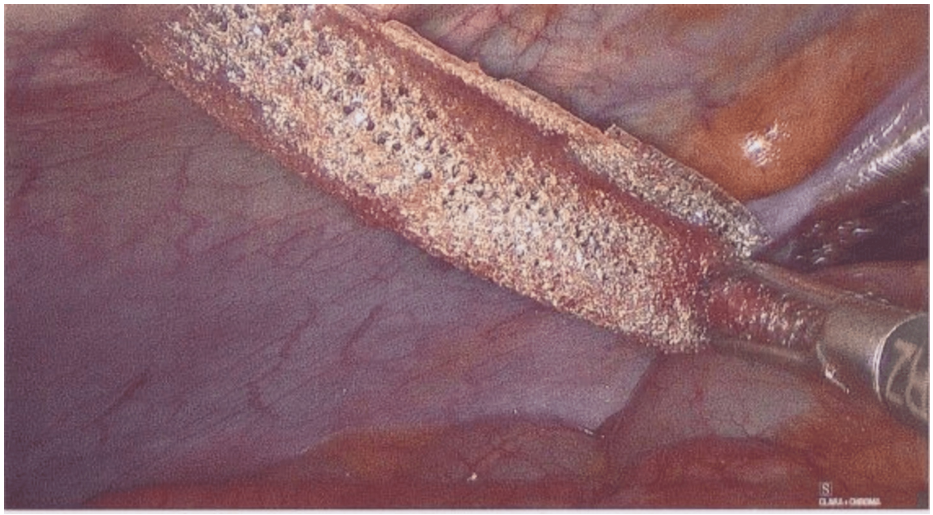


FIGURE 7: The mesh is inserted gently and with a clockwise rotation within the abdominal cavity.

The 5-mm operating port is subsequently reinserted through the same incision (Figure *8*). Standard laparoscopic instruments can then be used to unfold and position the mesh appropriately over the myopectineal orifice.



FIGURE 8: Reinsertion of the 5-mm port followed by positioning of the mesh over the myopectineal orifice.

For bilateral hernias, the same sequence can be repeated to introduce a second mesh through the same port site. To facilitate introduction of the second mesh, the surgeon briefly moves to the opposite side of the patient to face the port being used for mesh introduction. The technique permits introduction of medium-sized meshes (10 × 15 cm) as well as larger meshes (12 × 16 cm), including three-dimensional meshes such as 3DMax and Dextile. After introduction, the mesh is unfolded and manipulated using standard laparoscopic instruments before being positioned over the myopectineal orifice.

In the reported experience, mesh introduction was successful with both medium and large meshes, with no observed deformation following introduction through the 5-mm port-site incision.

Mesh fixation and closure

The procedure is completed by securing the mesh in the appropriate position and closure of the peritoneal

flap with a tacking device, either a CapSure tacker (BD/Davol Inc.) or a ReliaTack tacker (Medtronic) or, more rarely, with a continuous suture. As only 5-mm ports are used, the aponeurosis is not routinely closed at the port sites. The two operating ports are removed under direct vision. The skin is closed using rapidly absorbable sutures.

Technical experience

The technique has been performed by a single consultant surgeon at the Royal Free since 2012, with 547 patients undergoing TAPP5 during this period. In our experience, mesh introduction takes approximately two to three minutes. No cases required conversion to a conventional 10-mm port for mesh introduction.

These observations describe the technical experience with TAPP5. Total operative duration and comparative clinical outcomes were not formally evaluated in this technical report, which focuses on the operative technique rather than a systematic assessment of clinical outcomes. No systematic clinical outcome data are presented, and the report does not permit conclusions regarding comparative safety, postoperative recovery, complications, or hernia recurrence.

Discussion

Laparoscopic inguinal hernia repair has become an integral part of contemporary hernia surgery, with both TAPP and TEP approaches widely accepted as effective minimally invasive techniques. The choice between these approaches is frequently influenced by surgeon experience, training background, and local expertise, with evidence suggesting comparable outcomes when performed by experienced surgeons [6-8].

Although the principles of laparoscopic groin hernia repair are well established, technical refinements continue to evolve to simplify procedures and potentially reduce access-related morbidity [5,7]. This report describes TAPP5, a modification of conventional TAPP repair that uses three 5-mm ports and introduces the mesh through a lateral 5-mm operating port-site incision rather than a dedicated 10-mm mesh-introduction port.

Adequate mesh coverage of the myopectineal orifice is a fundamental principle of laparoscopic inguinal hernia repair, including in large and bilateral hernias [3,7,8]. Conventional TAPP configurations frequently use a 10-mm port for mesh introduction, although port configurations vary between surgeons and institutions [5,7]. TAPP5 enables medium (10 × 15 cm) and large (12 × 16 cm) meshes to be introduced through a 5-mm port incision using the described rolling and grasping technique. The modification does not alter the fundamental operative steps of conventional TAPP, including development of the preperitoneal space, identification of anatomical landmarks, reduction of the hernia sac, and adequate mesh placement over the myopectineal orifice [7,9].

The technique has been performed by a single consultant surgeon at the Royal Free since 2012, with 547 patients undergoing the procedure during this period. In our experience, mesh introduction takes approximately two to three minutes, and no cases required conversion to a conventional 10-mm port for mesh introduction. These observations describe our experience with the technique; total operative duration was not formally analysed, and no comparative evaluation against conventional TAPP was undertaken. For bilateral repair, both meshes can be introduced through the same 5-mm port-site incision [3,6].

In our experience, both medium (10 × 15 cm) and large (12 × 16 cm) meshes could be introduced through the 5-mm port-site incision using the described technique. Successful introduction depends on rolling the mesh into a narrow cylindrical configuration and securing it with a laparoscopic rat-tooth grasper equipped with a ratchet mechanism. Gentle traction, controlled rotation, and lubrication facilitate passage through the incision. If controlled introduction cannot be achieved, the surgeon should avoid excessive force and consider enlarging the incision to accommodate a conventional 10-mm port or using an alternative mesh-introduction method. Although no such conversions were required in our reported experience, these alternatives remain appropriate practical considerations.

Using three 5-mm ports may offer practical advantages by avoiding a dedicated larger port for mesh introduction. Smaller trocar sites may also reduce access-related morbidity; however, trocar-site hernias have been reported following the use of 5-mm ports, and smaller port size does not eliminate this complication [10-12]. Avoiding a dedicated 10-mm port may reduce expenditure on disposable surgical equipment, although this potential cost advantage has not been formally evaluated. Similarly, the effects of TAPP5 on operative duration, instrument ergonomics, and other aspects of surgical efficiency remain undetermined.

Laparo-endoscopic inguinal hernia repair has a recognised learning curve, requiring familiarity with preperitoneal anatomy, laparoscopic dissection, and accurate mesh positioning [5,7]. TAPP5 retains the fundamental operative steps of conventional TAPP, with the principal modification being the introduction of mesh through a 5-mm operating port. Although this modification avoids the need for a dedicated 10-mm mesh-introduction port, the technique requires familiarity with rolling, grasping, and manipulating the mesh through the smaller skin incision. The effect of this modification on the learning curve, technical

difficulty, and training requirements has not been formally evaluated. Surgeons adopting the technique should therefore have appropriate training and experience in conventional TAPP repair before attempting the modified mesh-introduction method.

Several potential risks should be considered when introducing mesh through a 5-mm incision. Grasping the mesh with rat-tooth forceps may cause local damage if excessive pressure is applied, while excessive traction or rotation may compromise controlled introduction or potentially damage the mesh. These risks may be minimised by careful handling, gentle and controlled movements, and inspection of the mesh after introduction. In our technique, the mesh is handled exclusively with sterile gloves, and sterile Instillagel is used to facilitate passage through the incision. Its suitability for direct contact with the specific mesh materials should be confirmed against the relevant manufacturers' instructions. These potential risks and precautions have not been systematically evaluated in this report.

In our experience, TAPP5 has been used for the range of inguinal hernias treated using conventional TAPP repair. The ability to introduce both medium and large meshes suggests that the modified introduction technique does not inherently restrict the mesh sizes used in conventional TAPP. However, its applicability to large scrotal hernias, patients with obesity, recurrent hernias, and femoral hernias must be considered in the context of individual patient characteristics, hernia complexity, and surgical judgement. The present report does not provide subgroup-specific data to establish the feasibility or outcomes of the technique in these particular patient groups.

This report has several limitations. The technique has been developed and performed by a single experienced surgeon, and its reproducibility among surgeons with different levels of laparoscopic expertise remains to be established. The learning curve specific to TAPP5 has not been formally evaluated. Furthermore, this report focuses on the technical aspects of the procedure and does not present a systematic analysis of clinical outcomes or a comparative evaluation against conventional TAPP repair. The potential effects on operative duration, postoperative pain, recovery, port-site complications, long-term recurrence, and cost-effectiveness therefore remain uncertain. Future prospective comparative studies are warranted to determine whether TAPP5 offers measurable clinical or economic advantages over conventional TAPP repair.

Conclusions

TAPP5 is a technical modification of conventional TAPP inguinal hernia repair that enables standard medium and large three-dimensional meshes to be introduced through a 5-mm port site incision using a controlled sequence of mesh rolling, grasping, lubrication, and rotational traction. In our experience, mesh introduction takes approximately two to three minutes, and no cases required conversion to a conventional 10-mm port for this purpose.

This technique permits TAPP repair using three 5-mm ports and allows both meshes in bilateral repairs to be introduced through the same port-site incision. These observations describe the technical experience with this approach but do not establish comparative clinical benefit. Further studies are required to evaluate clinical outcomes and determine whether TAPP5 offers measurable clinical or economic advantages over conventional TAPP repair.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Luis M. Couceiro Soares, Ana Luisa Couceiro, William Atkins, Jaime Daniel Martinho Vilaça

Acquisition, analysis, or interpretation of data: Luis M. Couceiro Soares, Ana Luisa Couceiro, William Atkins, Jaime Daniel Martinho Vilaça

Drafting of the manuscript: Luis M. Couceiro Soares, Ana Luisa Couceiro, William Atkins, Jaime Daniel Martinho Vilaça

Critical review of the manuscript for important intellectual content: Luis M. Couceiro Soares, Ana Luisa Couceiro, William Atkins, Jaime Daniel Martinho Vilaça

Supervision: Luis M. Couceiro Soares, Ana Luisa Couceiro, William Atkins, Jaime Daniel Martinho Vilaça

Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all

participants in this study. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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