



Editorial: Mesh Complications in Hernia Surgery

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Keywords: hernia repair, GRIP concept, cyclic loading hernia, mesh materials, bench test hernia, incisional abdominal ventral hernia, CT abdomen with Valsalva, unstable abdominal wall

Editorial on the Research Topic

Mesh Complications in Hernia Surgery

Hernia repair aims at restoring the integrity of the abdominal wall and its load-bearing capacity. These aims are sought after with textile meshes augmenting the herniated abdominal wall. The results are plagued by seroma formation, infections, pain and recurrences. Surgeons, patients, hospital systems, and health policy makers throughout the world are eagerly seeking better solutions.

Basic science in hernia research points toward genetic changes generating weak collagen (1). Weak collagens are unable to sufficiently bear load (2). An unstable abdominal wall can result. Advanced suture techniques can prevent most but not all burst abdomen and hernia (3). During the wound healing, skin and subcutaneous tissue will cover the weak fascia-forming collagen. The fascial dehiscence will be invisible from the outside. The repaired abdominal wall is thus open to hernia formation (4). In due course, the dehiscence creates an instability with the biological consequence of a seroma formation (5). A seroma easily gets infected with the wound infection further facilitating hernia recurrence. The aggressiveness of bacteria is an important influence on the infectious load (6). Pain is caused by small nerve fibers within the wound being inflicted by microbial products such as lactic acid and by the stretching of the lax collagen beyond a fraction of a millimeter. A recurrence is the obvious end of a mechanical overload.

We cannot change our genetic fittings or the aggressiveness of the microbiome surrounding us. But we can create stronger defect closures. Material science advises us that pulse loads act as the destructive force for compounds made from polymers such as tissues and textiles. In this sense, strong defect closures can be defined as those which withstand pulse loads. In mankind, pulse loads are caused by coughing, jumping, sharply bending and other motions. In order to get a strong defect closure, a load limit needed to be defined (7). An overload by daily activities should be prevented as long as the incised abdominal wall heals. For this sake, an analysis of daily activities and the benefits of abdominal binders are desperately needed (8).

Not all people are equal. Tissue quality needs to be assessed in the individual patient prior to hernia repair. Frail people and athletes might be two cornerstones marking the continuum of ordinary people, workers or hernia patients. The analysis of the individual tissue quality has

OPEN ACCESS

Edited and reviewed by:

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Specialty section:

This article was submitted to
Visceral Surgery,
a section of the journal
Frontiers in Surgery

Received: 22 December 2021

Accepted: 25 January 2022

Published: 07 March 2022

Citation:

Kallinowski F, Fortelny RH,
Köckerling F, Mayer F,
Morales-Conde S and Sandblom G
(2022) Editorial: Mesh Complications
in Hernia Surgery.
Front. Surg. 9:841672.
doi: 10.3389/fsurg.2022.841672

become possible with the use of a bench test for cyclic loading and advanced imaging techniques (9). The concept of an unstable abdominal wall repaired by an individualized biomechanical approach was condensed in the GRIP concept [gained resistance toward impact related to pressure; (10)]. This approach is based on the milestone consideration that not the mesh or an overlap *per se*, but the mesh-defect-area ratio (MDAR) provide the fundamental base for a durable repair (11).

Not all meshes or fixation elements are equal (12). Advanced mesh material with well-known biomechanical properties combined with sophisticated techniques can give excellent clinical results (9, 13, 14). Material science works with coefficients permitting engineers to build skyscrapers, supersonic airplanes or just fitting a balcony to a house in an earthquake area. Surgeons need such coefficients for the materials they use. At this point in time, the first data are available. In the future, most materials will be tested since regulatory agencies, patients and health policy makers seek more durable repairs. Surgeons can fulfill this wish once the required data are available (14).

Mesh-related complications are costly and can appear years after hernia repair (15). Long-term follow up requires registries such as Herniamed[®] (16, 17). Such a registry can be extended for research purposes following patients for years (14). Patient-reported outcomes should be included (18). Patient's wishes

and expectations matter and should be considered for good outcomes (19).

The hernia size has to be considered in abdominal wall reconstructions (20). Mesh material properties are critically underreported, depriving surgeons and patients alike from the benefits of optimal surgical techniques (21). Nobody would repair an airplane wing with sticky tape, some glue off the shelf and prayers. In contrast, well-tested materials are used in aviation industries by highly trained professionals according to standard procedures. Such a strategy will be a future road to avoid complications falsely attributed to the mesh. Preventing instability of both the abdominal wall and the mesh repair is an obvious path to more durable reconstructions in incisional hernia. The findings detailed above may be generalized to other types of hernia after future research. Instead of blaming the meshes, the reconstructions as compound structures must safely bear load during the healing process. With a Research Topic on "Mesh-related complications," Frontiers in Surgery contributed to an ongoing discussion how make hernia repair better in the future.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

REFERENCES

- Franz MG. The biology of hernias and the abdominal wall. *Hernia*. (2006) 10:462–71. doi: 10.1007/s10029-006-0144-9
- Münster S, Jawerth LM, Leslie BA, Weitz JI, Fabry B, Weitz DA. Strain history dependence of the nonlinear stress response of fibrin and collagen networks. *Proc Natl Acad Sci U S A*. (2013) 110:12197–202. doi: 10.1073/pnas.1222787110
- Albertsmeier M, Hofmann A, Baumann P, Riedl S, Reisensohn C, Kewer JL, et al. Effects of the short-stitch technique for midline abdominal closure: short-term results from the randomised-controlled ESTOIH trial. *Hernia*. (2021). doi: 10.1007/s10029-021-02410-y. [Epub ahead of print].
- Pollock AV, Evans M. Early prediction of late incisional hernias. *Br J Surg*. (1989) 76:953–4. doi: 10.1002/bjs.1800760926
- Morales-Conde S, Gómez-Menchero J, Alarcón I, Balla A. Retroprosthetic seroma after laparoscopic ventral hernia repair is related to mesh used? *J Laparoendosc Adv Surg Tech A*. (2020) 30:241–5. doi: 10.1089/lap.2019.0646
- Xu X, Zhan M, Li X, Chen T, Yang L. In vivo analysis of the resistance of the meshes to escherichia coli infection. *Front Surg*. (2021) 8:644227. doi: 10.3389/fsurg.2021.644227
- Kallinowski F, Ludwig Y, Löffler T, Vollmer M, Lösel PD, Voß S, et al. Biomechanics applied to incisional hernia repair – Considering the critical and the gained resistance towards impacts related to pressure. *Clin Biomech* (Bristol, Avon). (2021) 82:105253. doi: 10.1016/j.clinbiomech.2020.105253
- Schaaf S, Schwab R, Gūsgen C, Vilz TO, Willms A. Recommendations on postoperative activities after abdominal operations and incisional hernia repair—a national and international survey. *Front Surg*. (2021) 8:713138. doi: 10.3389/fsurg.2021.713138
- Kallinowski F, Ludwig Y, Gutjahr D, Gerhard C, Schulte-Hörmann H, Krimmel L, et al. Biomechanical influences on mesh-related complications in incisional hernia repair. *Front Surg*. (2021) 8:763957. doi: 10.3389/fsurg.2021.763957
- Kallinowski F, Gutjahr D, Harder F, Sabagh M, Ludwig Y, Lozanovski VJ, et al. The grip concept of incisional hernia repair—dynamic bench test, ct abdomen with valsalva and 1-year clinical results. *Front Surg*. (2021) 8:602181. doi: 10.3389/fsurg.2021.602181
- Tulloch B, de Beaux A. Defects and donuts: the importance of the mesh: defect area ratio. *Hernia*. (2016) 20:893–5. doi: 10.1007/s10029-016-1524-4
- Olsson A, Kiwanuka O, Sandblom G, Stackelberg O. Evaluation of functional outcomes following rectus diastasis repair—an up-to-date literature review. *Hernia*. (2021) 25:905–14. doi: 10.1007/s10029-021-02462-0
- Zhang W, Zhao Y, Shao X, Cheng T, Ji Z, Li J. Long-term follow-up of lichtenstein repair of inguinal hernia in the morbid patients with self-gripping mesh (ProgridTM). *Front Surg*. (2021) 8:748880. doi: 10.3389/fsurg.2021.748880
- Nessel R, Löffler T, Rinn J, Lösel P, Voss S, Heuveline V, et al. Primary and recurrent repair of incisional hernia based on biomechanical considerations to avoid mesh-related complications. *Front Surg*. (2021) 8:764470. doi: 10.3389/fsurg.2021.764470
- Zhang J, Hu Z, Lin X, Chen B. Late-onset ileocutaneous fistula eight years after plug repair with polypropylene mesh: a case report. *Front Surg*. (2021) 8:785087. doi: 10.3389/fsurg.2021.785087
- Köckerling F, Sheen AJ, Berrevoet F, Campanelli G, Cuccurullo D, Fortelny R, et al. The reality of general surgery training and increased complexity of abdominal wall hernia surgery. *Hernia*. (2019) 23:1081–91. doi: 10.1007/s10029-019-02062-z
- Köckerling F, Brunner W, Fortelny R, Mayer F, Adolf D, Niebuhr H, et al. Treatment of small (<2 cm) umbilical hernias: guidelines and current trends from the Herniamed Registry. *Hernia*. (2021) 25:605–17. doi: 10.1007/s10029-020-02345-w
- East B, Hill S, Dames N, Blackwell S, Laidlaw L, Gök H, et al. patient views around their hernia surgery: a worldwide online survey promoted through social media. *Front Surg*. (2021) 8:769938. doi: 10.3389/fsurg.2021.769938
- Fadaee N, Huynh D, Towfigh S. #Mesh: Social media and its influence on perceptions in hernia repair. *Am Surg*. (2020) 86:1351–7. doi: 10.1177/0003134820964459
- Parker SG, Halligan S, Erotocritou M, Wood CPJ, Boulton RW, Plumb AAO, et al. A systematic methodological review of non-randomised interventional studies of elective ventral hernia repair: clear definitions and a standardised minimum dataset are needed. *Hernia*. (2019) 23:859–72. doi: 10.1007/s10029-019-01979-9

21. Kahan LG, Blatnik JA. Critical under-reporting of hernia mesh properties and development of a novel package label. *J Am Coll Surg.* (2018) 226:117–25. doi: 10.1016/j.jamcollsurg.2017.10.020

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