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Review article

Avoiding migration at open mesh plug inguinal hernioplasty

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HIGHLIGHTS

- Open Mesh plug inguinal hernia repair needs to be performed methodically.

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ABSTRACT

The open repair of groin hernias is often augmented with prosthetic biomaterials (mesh) as this favours a lower recurrence rate. The use of such prostheses may be associated with various complications including migration the frequency of which is unclear. A 29-year review of this complication after mesh plug hernioplasty is undertaken and technical advice described to avoid this.

1. Introduction

Great strides have been accomplished in the open repair of inguinal hernias following the use of prosthetic mesh as pioneered by Lichtenstein over 40 years ago [1]. Open hernioplasty can be performed with various prostheses often described as 'flat', 3-dimensional 'mesh plugs ' or 'bi-layered'. The use of mesh plugs (MP), originally popularized for cases of recurrence [1], remains well-liked possibly because of its simplicity, but may be associated with various complications including mesh migration and/or organ fistulation. Over the last 25 years we have used a MP (Perfix ™, BD, New Jersey) in over 3000 open repairs and have not witnessed this complication. Why is this?

2. Surgical technique

As all hernia surgeons will confirm the most important step in hernioplasty is accurate characterization of the anatomical defect. It is important to remember that a MP repair is essentially an open approach to the preperitoneal space. After carefully opening the inguinal canal in direct (medial) hernias the overlying thinned transversalis fascia needs to be excised and this space widened by blunt finger or swab dissection. Before dividing the fascia we infiltrate this area (with a mixture of 0.5% bupivacaine and 1% lignocaine with 1:200,000 adrenaline) to aid this dissection and lessen the annoying bleeding that can be encountered. With indirect (lateral) hernias it is important to reach the glistening darker yellow preperitoneal fat, which is a good indicator that the correct plane has been achieved. Any 'lipomas' can be excised and again we place a moist sponge into the defect (Figure 1) before choosing the correct size of the MP. One of the criticisms of the original open tension-free MP hernioplasty is that the 3-D cone shaped mesh was 'semi-rigid' and only supported part of the posterior wall at the defect in the preperitoneal plane. Indeed this may well play a role in the later development of migration and/or visceral fistulation if the sac has been inadvertently breached or there is poor mesh overlap of the defect. As a consequence of this fair derision, and that the inguinal canal is a multi-laminar arrangement, as opposed to a three dimensional one, we always gently stretch the inner 'sublay' component of the MP to make it flatter (Figure 2). This renders the MP less rigid and also allows a greater part of the posterior wall to be augmented by the prosthesis (Figure 3). When correctly positioned in this plane intra-abdominal pressure maintains this location [2]. The inner petals of the MP (Figure 4) are then carefully sutured circumferentially to the edges of the well-defined defect so as to firmly anchor the MP. With the repair complete, and tested on-table if under local anaesthesia, the accompanying patch is placed and anchored (but not sutured as in a Lichtenstein repair) behind the cord and the canal closed.

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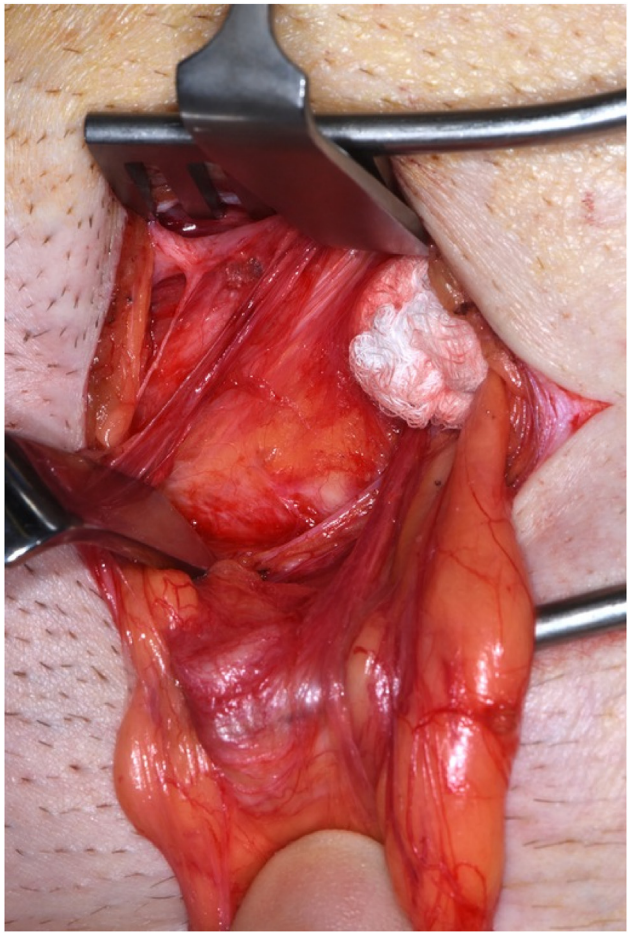

Figure 1. A moist sponge is pressed into the perperitoneal plane of the hernial defect (left indirect). The key point is recognition of the glistening darker yellow preperitoneal fat. The 'cavity' for the MP may be enlarged, if necessary, by further blunt dissection to accommodate the flattened prosthesis.

2.1. Incidence of mesh plug migration

With this approach, and in over 3000 open MP (primary and recurrent) repairs over 25 years, we have not observed a single case of migration. Is that because our patients have had their complications managed elsewhere? This is most unlikely given the litigious society that we are all in but we concur that patients are indeed likely to seek the help of another surgeon as is apparent from the published literature. Indeed this might be considered a limitation here, as we do not have complete long-term follow-up for all our MP repairs [2]. Nevertheless it is clear that such cases do occur although most infrequently given that since 1993 over 5 million Perfix MPs have been implanted worldwide (BD; New Jersey, USA. http://www.bd.com). Indeed when we critically scrutinised the literature we identified only 26 well-documented published cases during the last 29 years (Table 1). No doubt there have been other such cases, probably unreported for various reasons, but the incidence of such a problem is undoubtedly low. Furthermore, it is worthy of note that many of these cases occurred many years after the original MP hernioplasty where fistulation was probably of a response to a later near-by intra-abdominal inflammatory process. With respect to those cases of bladder fistulation it would be of interest to know whether the primary MP repair was for a direct (medial) hernia that is later repeatedly compressed by an obstructed bladder in elderly men. Furthermore it would be of interest to know if the original 3D MP had been gently flattened as we advise. Similarly it is noteworthy that reports where there was small bowel obstruction the elapsed interval is relatively short further strengthening the case for modifying or 'flattening' the rigidity of the MP with reliable anchoring at the deep inguinal ring. Unfortunately we will never know these answers as that the original procedures were performed at "St Elsewhere"! Finally and possibly as a consequence of these conjectures, a lighter-weight 'softer' version of the MP is marketed to reduce the quantity of the polypropylene prosthesis. We tend to reserve the use of this prosthesis for patients with lean groins. Whilst this MP is more malleable the operative steps required for a sound repair remain unaltered.

2.2. Alternatives

The MP approach is only one of many open techniques for repairing groin hernias and trainees should be shown and carefully taught how to perform all types of repair. Indeed residents may need a little more supervision [3] and intra-operative tutoring with regard to the correct placement (and fixation) of the MP prosthesis, which is indeed the motivation for this piece of writing. Furthermore we believe trainees should be encouraged to perform all types of open repair under local anaesthesia albeit initially at general anaesthesia [4, 5].

Mesh migration and organ fistulation is not unique to MP repairs as documented by Gossetti *et al* [6] and is even documented after traditional open flat-mesh repairs. Indeed this complication is also acknowledged after laparoscopic (preperitoneal) procedures, especially in TAPP as opposed to TEP repairs [6]. Nevertheless, given the number of inguinal hernia repairs carried out annually this complication is however rare. Nevertheless it should be noted that the HerniaSurge Group [7] has been vigilant in their recommendations regarding MP because of these issues. Clearly teaching and careful surgical technique (as outlined here) is essential even if the operative time for a MP repair is shorter when compared with other open techniques. Finally it is important to note that meta-analyses have suggested that there is no appreciative differences in risks/outcomes such as chronic pain or recurrence when MP repairs are compared to more traditional flat mesh repairs [8, 9].

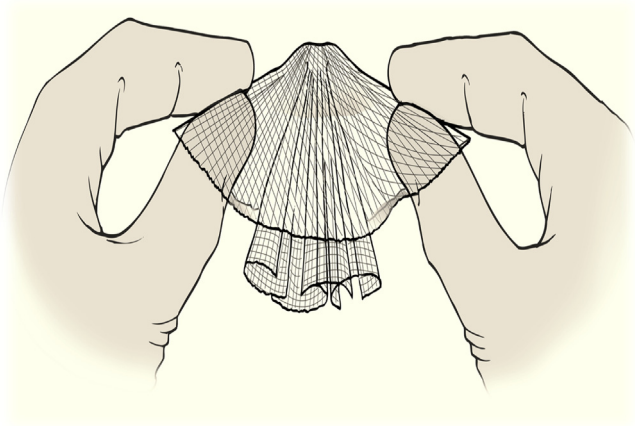

Figure 2. Gentle stretching flattens the outer petals of the MP to increase the cross-sectional area of the sublay component before placement in the 'cavity' in the perperitoneal plane. [Reprinted with permission from SpringerNature: Hernia. Groin symptoms 5-7 years after a 'modified' plug and patch inguinal hernioplasty. Bhattacharjee A, Jayamanne H, Evans MD, Stephenson BM. 2010].

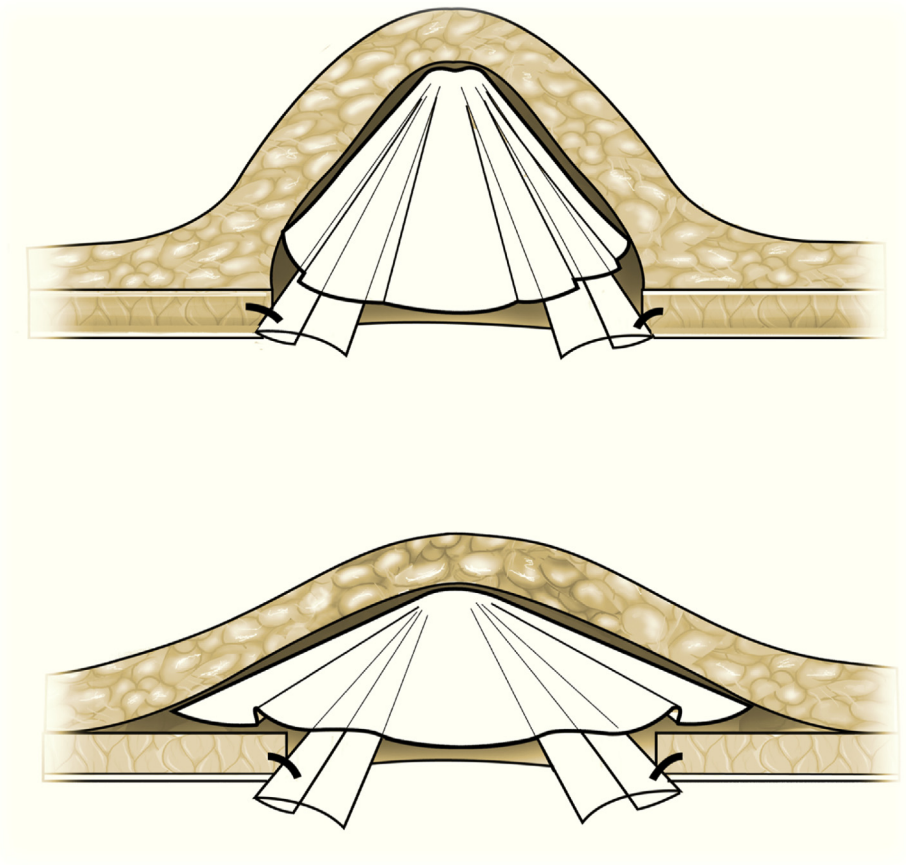

Figure 3. The stretched and flattened sublay component now augments a greater area of the defect (lower panel). [Reprinted with permission from SpringerNature: Hernia. Groin symptoms 5-7 years after a 'modified' plug and patch inguinal hernioplasty. Bhattacharjee A, Jayamanne H, Evans MD, Stephenson BM. 2010].

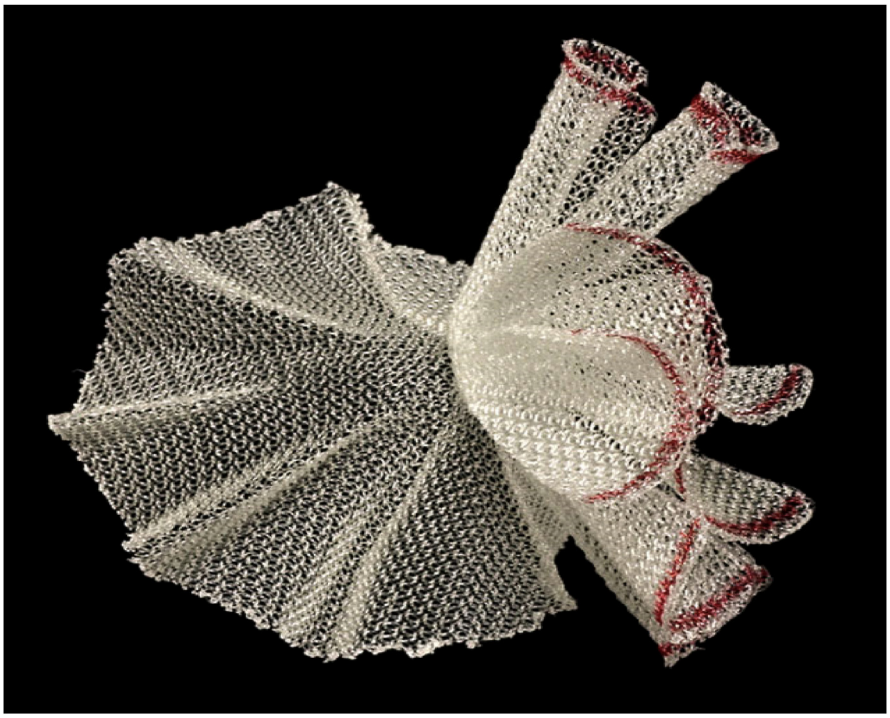

Figure 4. The inner petals (coloured here) are anchored circumferentially to the well defined defect.

Table 1. Reports of MP migration/fistulation.

Author	Time to setback	Presentation	Comment
Dieter	15 months	Hernia Recurrence	Poor initial operation
Chuback	2 years	Small Bowel Obstruction	Poor anchoring of MP
Tokunaga	7 years	Bleeding/stricture	Not true migration
Moorman	1.5 years	Abdominal pain	Poor anchoring of MP
Benedetti	2 years	Rectal bleeding	MP migration 'possible'
Ojo	8 years	Caecal mass	'Not true migration'
Murphy	3 years	Recurrent diverticulitis	MP migration 'possible'
Zubaidi	3 years	Cutaneous fistula	MP migration 'possible'
Stout	uncertain	Small bowel obstruction	Poor anchoring of MP
Liang	4 years	Small bowel obstruction	Poor anchoring of MP
Ishiguro	3 years	Cutaneous fistula	MP migration confirmed
Rettermaier	3 years	Adnexal mass on CT	MP migration confirmed
Chen	2 years	Small bowel perforation	MP migration confirmed
Ratajczak	2 years	Sigmoid mass	MP migration confirmed
Yilmaz	3 years	Sigmoid obstruction	MP migration confirmed
Ishikawa	5 years	Urinary fistula	MP migration confirmed
Sekiguchi	13 years	Cutaneous fistula	MP migration confirmed
Yamamoto	2 years	Small bowel obstruction	MP migration confirmed
Scaringi	26 years	Cutaneous fistula	Diverticulitis as pathology
Sevilla	15 years	Haematuria	MP migration confirmed
Okada	11 years	Haematuria	MP not anchored
Hamada	7 years	Anaemia	MP migration confirmed
Liu	10 years	Cutaneous fistula	MP migration confirmed
Zwaans	10 years	RIF pain	MP migration confirmed
Gosetti	5 years	Cutaneous fistula	MP migration confirmed
Zhang	8 years	Cutaneous fistula	MP migration confirmed

After careful scrutiny by all authors a comment was added to the table to summarise the correctness of the publication.

3. Conclusions

The MP approach remains our choice in the repair of primary and recurrent inguinal hernias. In nearly 25 years we have not had a case of migration and at this point it seems pertinent to recall the words of Sir Cecil Wakely [10], who in 1948 said " A surgeon can do more for the community by operating on hernia cases, and seeing that his recurrence rate is lower, than by operating on cases of malignant disease". The same applies to a careful surgical technique to obtain a sound result and avoid this most unusual complication. Maybe we could do with remembering the aphorism "A good surgeon must not blame his tools".

Declarations

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Declaration of interests statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

References

[1] I.L. Lichtenstein, J.M. Shore, Simplified repair of femoral and recurrent inguinal hernias by a "plug" technique, Am. J. Surg. 128 (1974) 439–444.
[2] A. Bhattacharjee, H. Jayamanne, M.D. Evans, B.M. Stephenson, Groin symptoms 5-7 years after a 'modified' plug and patch inguinal hernioplasty, Hernia 14 (2010) 171–174.
[3] T. Takahashi, Y. Kaneoka, A. Maeda, Y. Takayama, Y. Fukami, M. Uji, Feasibility study of open inguinal hernia repair using mesh plug by residents, Asian J. Surg. 43 (2020) 304–310.
[4] R.W. Radwan, A. Gardner, H. Jayamanne, B.M. Stephenson, Benefits of pre-emptive analgesia by local infiltration at day-case general anaesthetic open inguinal hernioplasty, Ann. R. Coll. Surg. Engl. 100 (2018) 450–453.
[5] R. Singh, J. Byam, R.W. Radwan, B.M. Stephenson, Local or general anesthesia when repairing inguinal hernias? Am. J. Surg. 222 (2021) 52.
[6] F. Gossetti, L. D'Amore, E. Annesi, P. Bruzzone, L. Bambi, M.R. Grimaldi, F. Ceci, P. Negro, Mesh-related visceral complications following inguinal hernia repair: an emerging topic, Hernia 23 (2019) 699–708.
[7] HerniaSurge Group, International guidelines for groin hernia management, Hernia 22 (2018) 1–165.
[8] J. Li, Z. Ji, Y. Li, Comparison of mesh-plug and Lichtenstein for inguinal hernia repair: a meta-analysis of randomized controlled trials, Hernia 16 (2012) 541–548.
[9] K. Ran, X. Wang, Y. Zhao, Open tensionless repair techniques for inguinal hernia: a meta-analysis of randomized controlled trials, Hernia 24 (2020) 733–745.
[10] F. Glassow, Inguinal hernia repair using local Anaesthesia, Ann. R. Coll. Surg. Engl. 66 (1984) 382–387.

Supplementary file

M. Benedetti, S. Albertario, T. Niebel, C. Bianchi, F.P. Tinozzi, P. Moglia, M. Arcidiaco, S. Tinozzi, Intestinal perforation as a long-term complication of plug and mesh inguinal hernioplasty: case report, Hernia 9 (2005) 93–95.
M.J. Chen, Y.F. Tian, Intraperitoneal migration of a mesh plug with a small intestinal perforation: report of a case, Surg. Today 40 (2010) 566–568.
J.A. Chuback, R.S. Singh, C. Sills, L.S. DiVck, Small bowel obstruction resulting from mesh plug migration after open inguinal hernia repair, Surgery 127 (2000) 475–476.
R.A. Dieter, Mesh plug migration into scrotum: a new complication of hernia repair, Int Surg 84 (1999) 57–59.
F. Gossetti, L. D'Amore, E. Annesi, P. Bruzzone, L. Bambi, M.R. Grimaldi, F. Ceci, P. Negro, Mesh-related visceral complications following inguinal hernia repair: an emerging topic, Hernia 23 (2019) 699–708.
Y. Hamada, K. Tanaka, M. Katsurahara, M. Nakamura, Mesh plug migration into the small intestine: an unusual cause of chronic anemia, Dig. Liver Dis. 51 (2019) 1062.
Y. Ishiguro, H. Horie, H. Satoh, Y. Miyakura, Y. Yasuda, A.T. Lefor, Colocutaneous fistula after left inguinal hernia repair using the mesh plug technique, Surgery 145 (2009) 120–121.
S. Ishikawa, T. Kawano, R. Karashima, T. Arita, Y. Yagi, M. Hirota, A case of mesh plug migration into the bladder 5 years after hernia repair, Surg. Case Rep 1 (2015) 4.
Koichi Okada K, Nakayama J, Adachi S, Miyake O. Unfixed mesh plug migration from inguinal ring to urinary bladder. Acta Urol. Jpn.2018; 64: 63–66
X. Liang, X.J. Cai, H. Yu, Y.F. Wang, Strangulated bowel obstruction resulting from mesh plug migration after open inguinal hernioplasty: case report, Chin. Med. J. 121 (2008) 183–184.
H. Liu, X. Liu, G. Zheng, B. Ye, W. Chen, H. Xie, Y. Liu, Y. Guo, Chronic mesh infection complicated by an enterocutaneous fistula successfully treated by infected mesh removal and negative pressure wound therapy: a case report, Medicine (Baltim.) 98 (2019) e18192.
M.L. Moorman, P.D. Price, Migrating mesh plug: complication of a well- established hernia repair technique, Am. Surg. 70 (2004) 298–299.
J.W. Murphy, D.C. Misra, B. Silverglide, Sigmoid colonic fistula secondary to Perfix-plug, left inguinal hernia repair, Hernia 10 (2006) 436–438.
P. Ojo, A. Abenthroth, P. Fiedler, G. Yavorek, Migrating mesh mimicking colonic malignancy, Am. Surg. 73 (2006) 1210–1211.
A. Ratajczak, T. Kościński, T. Banasiewicz, M. Lange-Ratajczak, J. Hermann, A. Bobkiewicz, M. Drews, Migration of biomaterials used in gastroenterological surgery, Pol. Przegl. Chir. 85 (2013) 377–380.
M.A. Rettenmaier, S. Heinemann, H. Truong, J.P. Micha, J.V. Brown 3rd, B.H. Goldstein, Marlex mesh mimicking an adnexal malignancy, Hernia 13 (2009) 221–223.
S. Scaringi, M. Ardu, D. Zambonin, F. Giudici, P. Bechi, Sigmoidocutaneous fistula 26 Years after left inguinal hernia repair with mesh-plug technique, Am. Surg. 82 (2016) E52–E53.
K. Sekiguchi, Y. Mizuguchi, Y. Mamada, M. Koizumi, E. Uchida, Intraperitoneal migration of a mesh plug from a hernioplasty forming a colocutaneous fistula with the cecum: report of a case, J. Nippon Med. Sch 82 (2015) 246–249.

C. Sevilla, D. Dajani, M. Aron, Migrated mesh plug masquerading as a bladder tumor, J. Endourol. Case Rep. 3 (2017) 1–3.
C.L. Stout, A. Foret, D.B. Christie, E. Mullis, Small bowel volvulus caused by migrating mesh plug, Am. Surg. 73 (2007) 796–797.
Y. Tokunaga, A. Tokuka, K. Ohsumi, Sigmoid colon diverticulosis adherent to mesh plug migration after open inguinal hernia repair, Curr. Surg. 58 (2001) 493–494.
S. Yamamoto, T. Kubota, T. Abe, A rare case of mechanical bowel obstruction caused by mesh plug migration, Hernia 19 (2015) 983–985.
I. Yilmaz, D.O. Karakaş, I. Sucullu, Y. Ozdemir, E. Yucel, A rare cause of mechanical bowel obstruction: mesh migration, Hernia 17 (2013) 267–269.
J. Zhang, Z. Hu, X. Lin, B. Chen, Late-onset ileocutaneous fistula eight years after plug repair with polypropylene mesh: a case report, Front.Surg. 8 (2021) 785087.
A.M. Zubaidi, M. Al Saghier, M. Kabbani, A. Abdo, Colocutaneous fistula after mesh plug inguinal hernia repair- a delayed complication, Ann. Saudi Med. 26 (2006) 385–387.
W.A. Zwaans, M.R. Scheltinga, R.M. Roumen, Symptomatic attachment of appendix vermiformis following a plug inguinal hernia repair, BMJ Case Rep. 12 (2019) e220408.