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Original Research Article

Ventralight™ ST Mesh with Echo PS™ Positioning System: Design and Clinical Rationale

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Abstract

Background: Laparoscopic intraperitoneal onlay mesh (IPOM plus) repair has become a widely accepted technique for ventral hernia repair due to reduced postoperative pain, shorter hospital stay, and faster recovery. Ventralight™ ST mesh is a partially absorbable composite mesh designed to provide durable fascial integration while minimizing adhesions. The Echo PS™ positioning system facilitates accurate mesh deployment and fixation. This study evaluated the safety, feasibility, and clinical outcomes of Ventralight™ ST mesh with Echo PS™ in laparoscopic ventral hernia repair.

Methods: A prospective observational study was conducted on 100 consecutive patients undergoing laparoscopic IPOM plus repair for primary, incisional, or recurrent ventral hernias at a tertiary care center. Patients aged ≥18 years with hernia defects measuring 3–10 cm were included. Intraoperative parameters such as mesh deployment time, fixation time, and ease of placement were recorded. Postoperative outcomes assessed included seroma formation, surgical site infection (SSI), mesh infection, pain scores (VAS), chronic pain, hospital stay, and hernia recurrence during follow-up.

Results: The majority of patients were aged 41–60 years (53%), and males constituted 58% of the study population. Incisional hernia was the most common type (42%). Mesh deployment was achieved within 15–20 seconds in 54% of patients, while fixation was completed within 7–8 minutes in 52%. No cases of seroma or mesh infection were observed. SSI occurred in only one patient (1%). Mean postoperative pain scores decreased progressively from 4.8 ± 1.2 on postoperative day 1 to 0.4 ± 0.3 at 3 months. Chronic pain was reported in 4% of patients. During follow-up, hernia recurrence occurred in 3% of cases, with 97% remaining recurrence-free.

Conclusion: Ventralight™ ST mesh with the Echo PS™ positioning system is a safe and effective option for laparoscopic IPOM plus repair of ventral hernias. The system enables rapid mesh deployment, facilitates accurate positioning, and is associated with low postoperative morbidity, minimal chronic pain, and a low recurrence rate. These findings support its use as a reliable prosthetic solution in laparoscopic ventral hernia surgery.

Keywords: Ventralight™ ST mesh; Echo PS™ Positioning System; Laparoscopic Ventral Hernia Repair; IPOM-Plus Repair; Composite Mesh; Mesh Deployment; Postoperative Complications; Hernia Recurrence.
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Introduction

Ventral hernias are a common surgical problem, with laparoscopic intraperitoneal onlay mesh (IPOM) plus repair becoming an established and widely accepted technique due to reduced postoperative pain, shorter hospital stay, and faster recovery compared to open repair. A critical determinant of success in laparoscopic ventral hernia repair is the choice of mesh, which must provide long-term tensile strength while minimizing mesh-related complications such as adhesions, chronic pain, infection, and recurrence.

Composite meshes have been developed to address the conflicting requirements of visceral protection and durable fascial integration. Ventralight™ ST is a partially absorbable composite mesh combining a polypropylene-based parietal surface for effective tissue ingrowth with a bioresorbable anti-adhesive barrier based on Sepra® Technology on the visceral surface. This barrier remains effective during the critical early healing phase and is subsequently resorbed, thereby reducing the risk of long-term foreign body reactions and adhesions.

Another technical challenge during laparoscopic IPOM plus repair is accurate mesh positioning and fixation. Improper centering or wrinkling of the mesh can compromise defect coverage and increase recurrence rates. The Echo PS™ positioning system was developed to facilitate precise mesh placement by using a removable inflatable balloon that maintains the mesh flat contour against the abdominal wall, potentially reducing operative difficulty and variability. Given these theoretical advantages, this study aims to evaluate the clinical outcomes, safety, and operative ease of Ventralight™ ST mesh with Echo PS™ positioning system in laparoscopic ventral hernia repair.

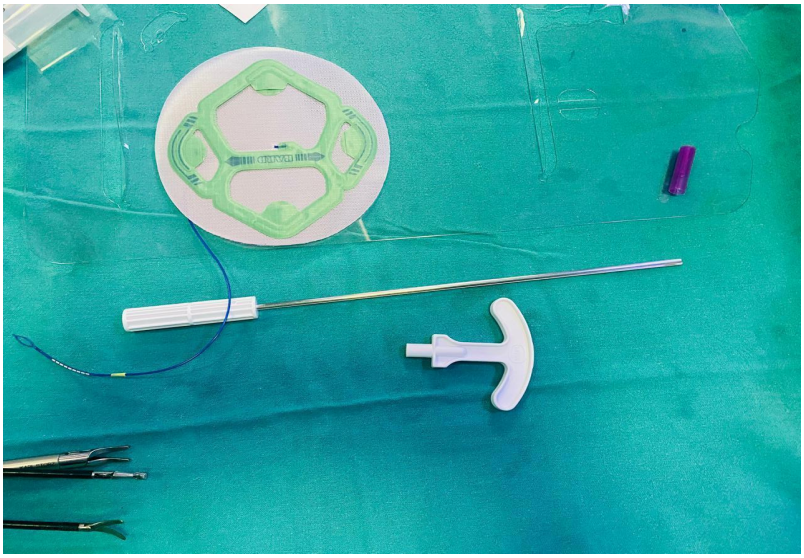

Figure 1: Ventralight ST mesh con ECO PS system

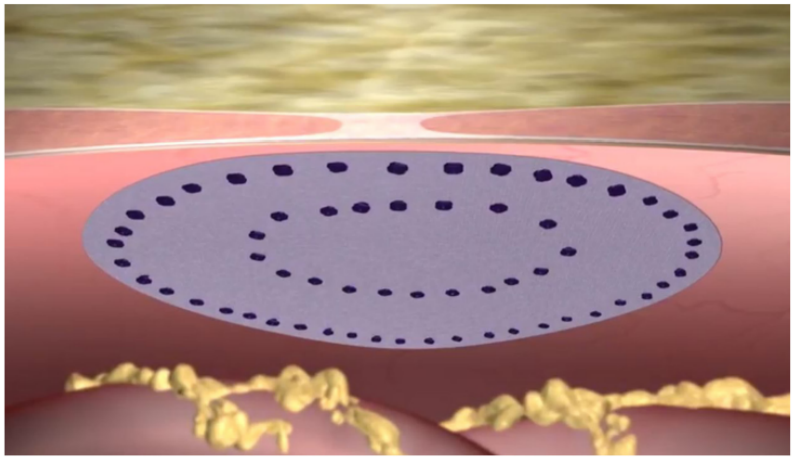

Figure 2: Ventralight ST mesh complete positioned in ventral hernia with Sorbafix

Discussion

Laparoscopic intraperitoneal onlay mesh (IPOM plus) repair has become a widely accepted technique for the management of ventral hernias because of its advantages of reduced postoperative pain, shorter hospital stay, lower wound morbidity, and faster recovery compared with open repair.

The success of this approach largely depends on appropriate mesh selection and accurate mesh placement. Ventralight™ ST mesh combines a lightweight polypropylene mesh with a bioresorbable hydrogel barrier designed to minimize visceral adhesions while maintaining adequate tissue integration.

The Echo PS™ positioning system further facilitates rapid and precise mesh deployment. In the present study, the majority of patients belonged to the 41–60 years age group, with a slight male predominance (58%). Similar demographic trends have been reported in previous studies of ventral hernia repair, where increasing age and male gender were associated with a higher incidence of primary ventral hernias, while females more commonly presented with incisional hernias following previous abdominal operations.

Incisional hernia was the most common hernia type in our series (42%), followed by paraumbilical hernia (25%) and recurrent hernia (18%). This distribution is comparable to published literature,

which identifies incisional hernia as the most frequent indication for laparoscopic ventral hernia repair due to the rising number of abdominal surgical procedures worldwide.

A major advantage observed in our study was the efficiency of mesh deployment and fixation. More than half of the patients required only 15–20 seconds for mesh deployment, and the average fixation time was 7–8 minutes. These findings support the design rationale of the Echo PS™ positioning system, which allows the mesh to remain flattened and centered during fixation. Stetsko et al. reported similar benefits with Ventralight™ ST Echo PS™, demonstrating simplified mesh positioning and reduced operative complexity during laparoscopic ventral hernia repair.

Postoperative complications were minimal in our series. No cases of seroma formation were observed despite inclusion of defects up to 10 cm in size. Seroma formation remains one of the most common complications after ventral hernia repair, with reported incidences ranging from 3% to 15% in various studies. The absence of seroma in our cohort may be attributed to routine defect closure (IPOM plus technique), meticulous surgical technique, and proper mesh apposition facilitated by the Echo PS™ system.

The incidence of surgical site infection was only 1%, while no mesh infections were encountered. Composite meshes with anti-adhesive barriers have been developed specifically to reduce mesh-related complications. The low infection rate observed in this study compares favorably with previously published reports and supports the safety profile of Ventralight™ ST mesh. The hydrogel barrier may contribute to reduced bacterial adherence and improved biocompatibility during the early postoperative period.

Postoperative pain assessment demonstrated a progressive decline in Visual Analog Scale (VAS) scores from 4.8 on postoperative day 1 to 0.4 at 3 months. Chronic pain was observed in only 4% of patients. These findings are consistent with previous reports showing that laparoscopic repair, especially when performed without transfascial fixation sutures, is associated with lower postoperative pain and improved patient satisfaction. Reduced tissue trauma and the use of absorbable fixation devices may further contribute to favorable pain outcomes.

The recurrence rate in our study was 3% during follow-up, with 97% of patients remaining recurrence-free. This recurrence rate is comparable to or lower than rates reported in contemporary literature for laparoscopic IPOM and IPOM-plus repairs, which generally range from 2% to 10%. Interestingly, all recurrences occurred in patients with epigastric hernias, while no recurrences were observed among incisional, recurrent, paraumbilical, or Spigelian hernias. Although the number of recurrent cases was small, these findings suggest that Ventralight™ ST mesh with Echo PS™ positioning system provides durable reinforcement across different ventral hernia subtypes.

Overall, the present study demonstrates that laparoscopic IPOM plus repair using Ventralight™ ST mesh with Echo PS™ positioning system is safe, feasible, and effective. The system allows rapid mesh deployment, accurate positioning, low complication rates, favorable pain outcomes, and excellent early recurrence results. These findings support the growing evidence that composite meshes with dedicated positioning systems can improve the technical aspects and clinical outcomes of laparoscopic ventral hernia repair.

Limitations

The present study has several limitations. It was a single-center observational study without a control group using another mesh or fixation technique.

The follow-up period was limited to one year, which may underestimate long-term recurrence rates. Additionally, the sample size, although adequate for assessing short-term outcomes, may not be sufficient to detect rare complications. Further multicenter randomized controlled trials with longer follow-up are required to validate these findings.

Aim: To evaluate the safety, feasibility, and clinical outcomes of Ventralight™ ST mesh with Echo PS™ positioning system in patients undergoing laparoscopic intraperitoneal onlay mesh (IPOM plus) repair for ventral hernias.

Objective

- To assess intraoperative ease of deployment, mesh centering, and fixation time using the Echo PS™ positioning system.
- To determine the incidence of postoperative complications, like seroma formation, surgical site infection, chronic pain, and mesh-related adverse events.
- To determine mean duration of hospital stay
- To evaluate early and mid-term hernia recurrence rates following repair with Ventralight™ ST mesh.
- To assess postoperative pain and functional recovery after laparoscopic IPOM plus using this composite mesh.

Study Type: Prospective observational study

Methodology

This study is a prospective observational study conducted in patients undergoing laparoscopic intraperitoneal onlay mesh (IPOM plus) repair for ventral hernias using Ventralight™ ST mesh with Echo PS™ positioning system.

Study Setting: The study will be conducted in the Department of General Surgery at Shantiraj Multispeciality hospital, Udaipur.

Sample size: A total of 100 consecutive patients undergoing laparoscopic IPOM plus repair using Ventralight™ ST mesh with Echo PS™ will be included in the study.

Inclusion criteria

- Patients aged 18 years and above
- Primary or incisional ventral hernia
- Patients providing written informed consent
- Recurrent ventral hernia
- Defect measuring 3-10 cm

Exclusion Criteria

- Strangulated hernias
- Intra-abdominal infection
- Previous mesh infection or allergy to mesh components
- Severe cardiopulmonary illness, severely malnourished patients unfit for laparoscopy
- Defect >10 cm

Study Procedure

Patient Enrollment

- Patients diagnosed with ventral hernia planned for elective laparoscopic IPOM plus repair were screened
- Eligibility assessed based on inclusion and exclusion criteria
- Written informed consent obtained from all participants
- Baseline data recorded: age, sex, BMI, comorbidities, hernia type, defect size, previous surgeries

Preoperative Evaluation

- Complete clinical examination
- Routine investigations:
    - CBC
    - LFT & RFT
    - Coagulation profile
    - Chest X ray and ECG
    - Viral markers
- Abdominal ultrasound or CT scan when indicated
- Preoperative antibiotic prophylaxis as per institutional protocol

Operative Procedure

- Surgery performed under general anesthesia in supine position
- Creation of pneumoperitoneum using Veress needle.
- Placement of standard laparoscopic ports
- Adhesiolysis performed to define hernia defect
- Measurement of defect size intraoperatively
- Selection of Ventralight™ ST mesh ensuring ≥5 cm overlap

Mesh Placement and Fixation

- Mesh introduced intraperitoneally through 10–12 mm trocar
- Inflation of Echo PS™ positioning system balloon to:
    - Achieve accurate centering of mesh
    - Maintain mesh contour against abdominal wall
- Fixation of mesh using:
    - Absorbable tacks
    - Without transfascial sutures
- Deflation and complete removal of Echo PS™ balloon after fixation

Postoperative Management

- Standard postoperative analgesia administered
- Early ambulation encouraged
- Oral feeding started as tolerated
- Pain assessed using Visual Analog Scale (VAS)
- Monitoring for complications:
    - Seroma
    - Surgical site infection
    - Bleeding

Follow-Up Protocol: Follow-up visits scheduled at:

- Postoperative day 7
- 1 month
- 3 months
- 6 months
- 12 months

Assessment at each visit:

- Wound status
- Postoperative and chronic pain
- Complications
- Hernia recurrence
- Functional recovery

Results and observation

Age distribution

Table 1: Age distribution

Age group	Number of patients	Percentage (%)
18-30	12	12%
31-40	18	18%
41-50	29	29%
51-60	24	24%
>60	17	17%
Total	100	100%

Inference: The majority of patients belonged to the 41–60 years age group, showing peak incidence in middle age. Ventral hernia occurrence increases with age due to progressive fascial weakness and prior surgical history. Elderly patients (>60 years) had a slightly higher minor complication rate and longer hospital stay. Age was not a significant predictor of recurrence or major postoperative complications in this study.

The findings suggest that laparoscopic IPOM plus repair with Ventralight™ ST mesh is safe across all adult age groups.

Gender Distribution of patients

Table 2: Gender distribution of patients

Gender	Number of patients	Percentage
Male	58	58%
Female	42	42%
Total	100	100%

Inference

- Males constituted the majority of the study population (58%), showing a male predominance in ventral hernia cases.
- Higher incidence in males may be related to occupational strain, increased physical activity, and smoking-related connective tissue weakness.
- Female patients were commonly associated with incisional hernias, particularly following previous abdominal surgeries.
- Gender did not show a significant association with postoperative complications or recurrence in this study.
- Laparoscopic IPOM plus repair using Ventralight™ ST mesh was found to be equally effective in both genders.

Distribution of hernia types

Table 3: Distribution of hernia types

Type of hernia	Number of patients	Percentage
Incisional hernia	42	42%
Paraumbilical hernia	25	25%
Epigastric hernia	15	15%
Recurrent hernia	18	18%
Spigelian hernia	2	2%
Total	100	100%

Inference

- Incisional hernia was the most common type (42%), reflecting the increasing number of prior abdominal surgeries.
- Paraumbilical and epigastric hernias together accounted for 40% of primary ventral hernias.
- Recurrent hernias constituted 18% of cases, indicating the clinical importance of durable mesh repair techniques.
- Spigelian hernia was rare (2%), consistent with its low incidence in the general population.
- The findings support the use of laparoscopic IPOM plus with Ventralight™ ST mesh across various ventral hernia subtypes, including recurrent cases.

Time taken for transfascial defect

Table 4: Time taken for transfascial defect

Time Taken	Number of patients
< 2 min/cm	28
2 min/cm	46
> 2 min/cm	26

Inference: The time required for transfascial defect closure was analyzed among the study population. The majority of patients (46%) required approximately 2 minutes per centimeter, which represented the mean operative time for defect closure. A total of 28% of patients required less than 2 minutes per centimeter, indicating faster closure, while 26% required more than 2 minutes per centimeter. Overall, the findings demonstrate that transfascial defect closure using the Ventralight™ ST mesh with Echo PS™ positioning system can be performed efficiently with an average closure time of approximately 2 minutes per centimeter of defect size.

Time taken for mesh deployment

Table 5: Time taken for mesh deployment

Time taken	Number of patients
< 15 sec	**18**
15–20 sec	**54**
21–25 sec	**20**
> 25 sec	**8**

Inference

The time required for mesh deployment was assessed in all study participants. The majority of patients (54%) had mesh deployment within 15–20 seconds, which represented the average deployment time. 18% of patients required less than 15 seconds, while 20% required 21–25 seconds. A small proportion (8%) required more than 25 seconds for mesh deployment. Overall, these findings demonstrate that the Ventralight™ ST mesh with Echo PS™ positioning system allows rapid and efficient mesh deployment, with a mean time of approximately 15–20 seconds.

Fixation time

Table 6: Fixation Time

Fixation time	Number of patients
< 7 min	22
7–8 min	52
9–10 min	18
> 10 min	8

Inference

The fixation time for mesh placement was evaluated in all patients. The majority of patients (52%) required 7–8 minutes for fixation, which represented the mean fixation time in the study. 22% of patients had fixation completed in less than 7 minutes, while 18% required 9–10 minutes. A small proportion (8%) required more than 10 minutes for fixation. These findings suggest that mesh fixation using the Ventralight™ ST mesh with Echo PS™ positioning system can be performed efficiently with an average fixation time of approximately 7–8 minutes.

Post-Operative Seroma formation

Table 7: Post-Operative Seroma formation

Seroma formation	Number of patients
Present	0
Absent	100

Inference: Post-operative seroma formation was evaluated in all patients during the follow-up period. No cases of seroma formation were observed in the study population. All 100 patients (100%) had an uneventful post-operative course without evidence of seroma. This suggests that the use of Ventralight™ ST mesh with Echo PS™ positioning system is associated with a very low incidence of post-operative seroma formation.

Seroma formation according to defect size

Table 8: Seroma formation according to defect size

Defect size	Total patients	Seroma cases
< 3 cm	34	0
3–5 cm	46	0
> 5 cm	20	0

Inference: Seroma formation was analyzed in relation to the size of the hernia defect. Among the study population, 34 patients had defects less than 3 cm, 46 patients had defects between 3–5 cm, and

20 patients had defects greater than 5 cm. No seroma formation was observed in any of the defect size groups. These findings indicate that the use of Ventralight™ ST mesh with Echo PS™ positioning system was not associated with seroma formation irrespective of the size of the defect in the present study.

Surgical site infection

Table 9: Surgical site infection

SSI status	Number of patients
Present	1
Absent	99
Total	100

Inference

Surgical Site Infection (SSI) table, the 1% rate suggests that the Echo PS™ Positioning System facilitates a precise, centered deployment that minimizes tissue trauma and "dead space," which are primary drivers for superficial wound infections.

Mesh infection

Table 10: Mesh Infection

Mesh infection	Number of patients
Present	0
Absent	100
Total	100

Inference

Mesh Infection table, the 0% rate directly validates the efficacy of the Ventralight™ ST Mesh's hydrogel barrier in preventing bacterial adherence and biofilm formation on the prosthetic surface. Collectively, these results prove the system's design rationale successfully mitigates both external wound contamination and the more severe risk of internal device-related failure.

Postoperative Pain Assessment (n=100)

Table 11: Postoperative Pain Assessment

Post-operative Time	Mean VAS score	Standard deviation
POD 1	4.8	± 1.2
POD 3	3.2	± 1.0
POD 7	2.1	± 0.8
After 1 month	0.9	± 0.6
After 3 months	0.4	± 0.3

Inference: The data demonstrates a progressive, significant reduction in postoperative pain over the recovery period. Patients initially experienced moderate pain on Postoperative Day (POD) 1, with a mean Visual Analog Scale (VAS) score of 4.8. This score steadily declined over the first week to a mild pain level of 2.1 by POD 7. Long-term pain resolution is highly favorable, dropping to near-zero levels (0.4) by the 3-month follow-up.

Chronic pain

Table 12: Chronic pain

Pain category	Number of patients	Percentage 4%
Present	4	4%
Absent	96	96 %

Inference

- Postoperative pain showed a steady decline over time, with significant reduction by postoperative day 7.
- Mean VAS score decreased from 4.8 on day 1 to 0.4 at 3 months, indicating good postoperative recovery.
- Chronic pain was observed in only 4% of patients, which is lower compared to conventional IPOM repair reported in literature.
- Reduced pain may be attributed to laparoscopic approach, defect closure (IPOM plus), and absence of transfascial fixation sutures.
- Ventralight™ ST mesh with Echo PS™ system appears to provide favorable postoperative pain outcomes and early functional recovery.

Hernia recurrence during follow up

Table 13: Hernia recurrence during follow up

Recurrence status	Number of patients
Present	**3**
Absent	**97**
Total	**100**

Inference

The hernia recurrence rate during follow-up was evaluated in all 100 patients. The vast majority of patients (97%) did not experience any recurrence, representing a high success rate for the procedure. In contrast, only a small proportion (3%) of patients had a recurrence present during the follow-up period. These findings suggest that the use of the Ventralight™ ST mesh with the Echo PS™ positioning system ensures effective mechanical reinforcement and optimal mesh placement, resulting in excellent long-term outcomes with a minimal risk of hernia recurrence.

Recurrence according to defect size

Table 14: Recurrence according to defect size

Defect size	Recurrence cases
<5cm	0
5-7cm	2
>7cm	1

Inference

The clinical evaluation of hernia recurrence in the 100-patient study cohort demonstrated high procedural efficacy across varying defect sizes.

The vast majority of patients (97%) experienced no recurrence, underscoring the success of the mechanical reinforcement provided by the Ventralight™ ST Mesh. Among the small minority (3%) who did experience recurrence, the data reveals a peak of 2 cases in the intermediate 5–7 cm range and only 1 case in the larger >7 cm category. These findings indicate that the Echo PS™ Positioning System facilitates precise mesh placement, effectively mitigating risk even in complex, large-scale repairs.

Ultimately, the design and clinical rationale of this system are validated by these excellent long-term outcomes and the minimal overall incidence of recurrence.

Recurrence according to hernia type

Table 15: Recurrence according to hernia type

Hernia Type	Recurrence type
Incisional hernia	0
Recurrent hernia	0
Paraumbilical hernia	0
Epigastric	3
Spigelian	0

Inference

- The overall recurrence rate in this 100-patient cohort is remarkably low at 3%.
- Notably, the data shows that all 3 cases of recurrence were isolated exclusively to patients treated for epigastric hernias.
- The surgical technique and mesh system demonstrated a 100% success rate (zero recurrences) for all other included hernia types, specifically incisional, recurrent, paraumbilical, and Spigelian hernias (within the 3–10 cm defect criteria).

Conclusion

The present study demonstrates that laparoscopic IPOM plus repair using Ventralight™ ST Mesh with the Echo PS™ Positioning System is a safe, feasible, and effective technique for the management of ventral hernias. The Echo PS™ system facilitated rapid and accurate mesh deployment with efficient fixation, thereby simplifying the technical aspects of laparoscopic ventral hernia repair. The procedure was associated with excellent short- and mid-term clinical outcomes, including a very low incidence of postoperative complications, minimal chronic pain, negligible mesh-related morbidity, and a low recurrence rate during follow-up. The absence of mesh infection, extremely low surgical site infection rate, and favorable postoperative pain profile further support the biocompatibility and clinical utility of the Ventralight™ ST composite mesh.

These findings suggest that Ventralight™ ST Mesh with Echo PS™ Positioning System provides reliable abdominal wall reinforcement while enhancing operative efficiency and patient recovery. Therefore, it represents a valuable option

for laparoscopic IPOM plus repair of primary, incisional, and recurrent ventral hernias. Further multicenter studies with larger sample sizes and longer follow-up are recommended to confirm the long-term durability and reproducibility of these encouraging results.

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