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Authors

Stramiello, Joshua

Nuyen, Brian

Saraswathula, Anirudh

et al.

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ORIGINAL RESEARCH

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Timing of postoperative oral feeding after head and neck mucosal free flap reconstruction

Joshua Stramiello MD[1] | Brian Nuyen MD[2] | Anirudh Saraswathula MD, MS[2] | Liza Blumenfeld MA, CCC-SLP, BCS-S[1] | Vasu Divi MD[2] | Eben Rosenthal MD[2] | Ryan Orosco MD[1] | Heather M. Starmer MA, CCC-SLP, BCS-S[2]

[1]Division of Otolaryngology-Head and Neck Surgery, Department of Surgery, University of California San Diego School of Medicine, San Diego, California, USA

[2]Department of Otolaryngology-Head and Neck Surgery, Stanford University School of Medicine, Stanford, California, USA

Correspondence
Heather M. Starmer, MA CCC-SLP, BCS-S, Clinical Associate Professor, Department of Otolaryngology, Head and Neck Surgery, Director, Head and Neck Cancer Speech and Swallowing Rehabilitation, Stanford Cancer Center, 900 Blake Wilbur Drive, Suite 3073, Stanford, CA 94305, USA.
Email: hstarmer@stanford.edu

Abstract

Objective: Fistula remains a common complication of upper aerodigestive tract reconstruction. Optimal timing of oral feeding is unknown and the impact of early feeding on swallow function and fistula rates remains controversial. The purpose of this study is to better understand the effects of "early feeding" on fistula rate and swallow in patients with free flap reconstruction of upper aerodigestive tract defects.

Methods: Retrospective cohort study. One hundred and four patients undergoing free flap reconstruction of mucosalized head and neck defects. Two groups, early feeding (oral intake on or before postoperative day 5) and late-feeding (oral intake after postoperative day 5). Primary outcome was incidence of salivary fistula. Secondary outcomes included Functional Oral Intake Scale scores.

Results: Fistula rate was 16.5% in late-feeding group and 0% in early-feeding group ($P = .035$). Patients who were fed early had an association with progression to a full oral diet by 30 days ($P = .027$).

Discussion: This cohort analysis suggests that in properly selected patients with free flap reconstruction for mucosal defects, early feeding may not increase risk of salivary fistula and may improve swallow functional outcomes earlier.

Level of Evidence: 3

KEYWORDS
early feeding, fistula, FOIS, free flap reconstruction, swallow outcomes

1 | INTRODUCTION

Following from the excellent success rates for head and neck free flap viability, contemporary head and neck reconstruction now focuses on key functional outcomes. This priority is particularly challenging in the context of defects involving head and neck mucosa because reconstruction must support and withstand complex speaking, swallowing, and

Joshua Stramiello and Brian Nuyen should be considered as first authors.

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respiratory mechanics.[1,2] Postoperative complications impair wound healing and rehabilitation efforts, and delay adjuvant treatment.

Salivary fistula is a risk that carries negative effects on length of stay, cost, other wound sequelae, time to adjuvant treatment, time to oral nutritive intake, and quality of life.[1,3,4] It is thought that the risks of fistula increase when oral (PO) feeds are introduced prematurely due to tension on suture lines, mechanical stress imposed by the use of oral and pharyngeal musculature, and increased wound contamination by food and secretions. There is a challenge to balance the risks of development of fistula through early feeding (EF) and the risks of delayed oral intake which may negatively impact swallowing function, a major contributor to an improved quality of life, nutrition, and return to function, due to avoidance of disuse atrophy.[5,6]

The timing of intake after free flap reconstruction remains controversial and can vary significantly between surgeons, but limited data are often cited as a reason. Studies of functional outcomes after microvascular reconstruction for mucosal defects, have found that timing is often tailored to the patient, but generally ranges between 10 and 20 days to initiate feeding.[7,8] Such studies typically consider conservative postoperative management as a justification for their timeline of oral feeds. Others have found no difference in complications, including fistula, between patients who were fed within 5 days postoperatively and those fed after postoperative day (POD) 6.[9,10] The functional implications of the timing of initiation of oral intake after free flap reconstruction is even more poorly understood. Accordingly, more evidence is needed to help guide the timing of postoperative initiation of oral intake after head and neck free flap reconstruction involving mucosal subsites.[11-13]

To better understand the impact of EF on the swallowing function, we compared fistula rates and functional swallowing outcomes in patients who were fed before and after the fifth POD.

2 | MATERIALS AND METHODS

A retrospective chart review was performed on patients requiring free-flap reconstruction of head and neck mucosal surgical defects for any indication at Stanford University Hospital between March 1, 2016 and March 1, 2017 and at the University of California, San Diego Medical Center between September 1, 2017 and April 1, 2019. Defects requiring free-flap reconstruction in all subsites of oral cavity, pharynx, and larynx were included. We included all subsites to provide a broad perspective of how we have been practicing EF at our two institutions. Of these, patients who already presented with fistulas or required free flap reconstruction for fistula ($n = 6$) were excluded to study fistula as a de novo complication and not as an indication of preoperative comorbidity. The reconstruction was performed by two head and neck surgeons at Stanford (E. L. R. and V. D.) and one head and neck surgeon at UCSD (R. K. O.), and all employed the same closure technique. Horizontal mattress sutures using 2-0 Vicryl (SH needle) was the preferred technique. For areas with confined exposure and impaired maneuverability, simple interrupted 4-0 Vicryl (RB1 needle) technique was used.

Cases were divided into two groups: EF patients fed on or before POD 5 and "late-feeding" (LF) patients fed after POD 5. An exact definition for "EF" has not been recognized, however, this study follows the convention established by Guidera et al.[9] Timing of PO initiation depended on the practicing surgeons' experience and encompassed a host of factors, including prior radiation and/or other treatments, comorbidities, baseline swallow function, and reconstructive characteristics.

The primary outcome investigated was postoperative fistula. Fistula was identified by physical examination characteristics such as the appearance of output in a surgical drain and neck examination (edema, abscess, wound breakdown, etc.). The null hypothesis is no increased incidence of fistula in EF. The number of postoperative fistulas developed within 90 days from reconstructive surgery for the EF group was compared to those recorded in the LF group using the Fisher's exact test. Additionally, statistically significant variance in demographic and independent variables was investigated between the two groups, including FOIS scores ≤3 vs >3. The Pearson's chi-square and Mann-Whitney *U* tests were used to compare categorical baseline characteristics between the two feeding groups; the Levene's test and independent samples *t* test were used to compare the continuous characteristics. A *P*-value <.05 was considered statistically significant. Statistical analysis was performed with SPSS software (Version 26.0. IBM Corp., Armonk, New York) and confirmed with R software (R Foundation for Statistical Computing, Vienna, Austria).

Functional Oral Intake Scale (FOIS) scores were generated for patients with available data. The FOIS was initially developed and validated for the estimation and documentation of change in functional eating abilities of stroke patients over time.[14] However, the FOIS has been documented and published in a variety of research settings for other patient populations experiencing dysphagia, including head and neck cancer patients.[15,16] The FOIS is a seven-point scale of oral dietary tolerance. Scores range from complete dependence on enteral tube feeds (1), to tolerance of an oral diet without restriction (7). A score greater than 3 signifies no feeding tube presence/use. FOIS data for postoperative time points: POD30, POD60, and POD90 were collected and analyzed.

This study was approved by the Stanford Cancer Center institutional review board and the UC San Diego Human Research Protections Program institutional review board.

3 | RESULTS

Of 104 patients who underwent free flap reconstruction and met inclusion criteria, 24 were in the EF group and 80 were in the LF group. There were no significant differences in age, sex, race, indication for surgery, or preoperative chemotherapy between the two groups (Table 1). There was a difference between the EF and LF groups in ablated anatomy ($P = .004$), with the EF group consisting almost exclusively (95.8%) of oral cavity and mandible reconstruction. Consistent with concerns over wound healing issues, EF patients were less likely to have had prior radiotherapy ($P = .004$).

TABLE 1 Demographic data and independent variables

	Early	Late	*P* value
N	24	80	
Age (mean [SD])	62.81 [14.18]	62.14 [13.59]	.927
Institution (%)			.002
UCSD	16 (66.7)	25 (31.3)	
STANFORD	8 (33.3)	55 (68.7)	
Female sex (%)	10 (41.7)	26 (32.5)	.408
Race (%)			.728
White	18 (75.0)	59 (76.6)	
Black	1 (4.2)	1 (1.3)	
Asian/Pacific Islander	5 (20.8)	14 (17.5)	
Other	0 (0.0)	6 (7.5)	
Cancer indication for surgery (%)	21 (87.5)	65 (81.3)	.478
Preoperative chemotherapy (%)			.107
Yes	3 (12.5)	23 (28.7)	
No	21 (87.5)	57 (71.3)	
Preoperative radiotherapy (%)			.004
Yes	1 (4.2)	27 (33.8)	
No	23 (95.8)	53 (66.3)	
Ablated anatomy (N, %)			.004
Isolated oral cavity, mandible	23 (95.8)	55 (68.8)	
Oropharynx/hypopharynx	0 (0.0)	18 (22.5)	
Mixed aerodigestive	0 (0.0)	5 (6.3)	
Maxilla	1 (4.2)	2 (2.5)	

In this series, the surgeons did not practice EF on patients with pharyngeal defects. Of EF patients, 95.8% had an oral cavity defect. One patient had a maxillary sinus defect with a nearly intact superior alveolar ridge. Of the LF patients, 68.8% had oral cavity defects and 22.5% had pharyngeal defects (Table 1).

Within the first 3 months following surgery, fistula occurred in no patients from the EF group and 13 patients (16.5%) from the LF group (Table 2, Figure 1) ($P = .035$). Characteristics of these patients are presented in Table 3. Nine of the thirteen patients who developed a fistula had preoperative radiation, seven of which also had preoperative chemotherapy. Fistula diagnosis ranged from POD 1 to 43 in previously radiated patients, and POD 5 to 21 in those without prior radiation. The patient who developed a fistula on POD 1 was treated for mandibular osteoradionecrosis with a fibula free flap and had very poor surrounding tissue integrity.

FOIS data were available for 101 patients (97.1%). Of the EF patients, 13 (54%) were on full oral diets (FOIS > 3) by POD 30 (Figure 2). In the LF group, 22 (29%) were on an oral diet by POD 30 and this increased to 28 (42%) by POD 90. Figure 3 demonstrates the distribution of FOIS scores of early- and late-fed patients at POD 30, 60, and 90. EF patients were more likely to have an FOIS score >3 at POD 30 only ($P = .027$). There was no statistically significant difference between the EF and LF groups on POD 60 ($P = .205$) and POD 90 ($P = .181$). POD 30, POD 60, and POD 90 FOIS average (SD; range) for the EF group was 3.4 (1.5; 1-5), 3.8 (1.5; 1-6), and 3.8 (1.8; 1-7), respectively. POD 30, POD 60, and POD 90 FOIS average (SD; range) for the LF group was 2.6 (1.6; 1-6), 3.3 (1.7; 1-7), and 3.3 (1.8; 1-7), respectively. Parametric testing showed statistical significance between the EF and LF groups at POD 30 ($P = .028$), but not POD 60 ($P = .19$), and POD 90 ($P = .27$).

TABLE 2 Fistula frequency—tabulated

Fistula	EF	LF	*P* value
Yes	0 (0%)	13 (16.5%)	
No	24 (100%)	66 (83.5%)	.035

Abbreviations: EF, early feeding; LF, late feeding.

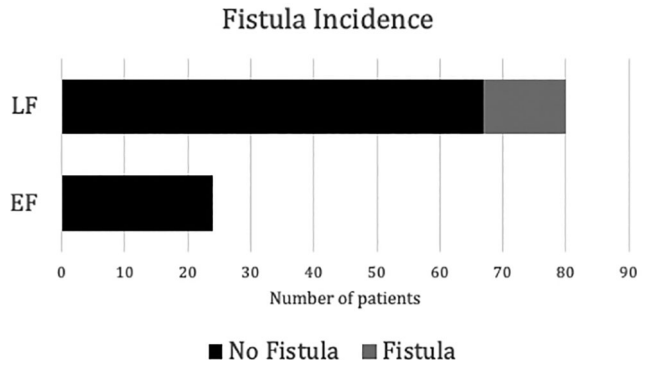

FIGURE 1 Fistula incidence, stacked bar graph

Subanalysis of patients with oral cavity and mandible reconstruction alone (n = 78) identified 23 patients in the EF and 55 patients in the LF group. Fistula rates were 0 and 5 (9.1%), respectively ($P = .314$). FOIS data were available for 76 (97.4%) of patients with oral cavity and mandible reconstruction only. Eight (38%) EF patients and nineteen (35%) LF patients were on full oral diets (FOIS > 3) by POD 30. There was no statistically significant difference between the EF and LF groups on POD 30 ($P = .814$), POD 60 ($P = .538$), and POD 90 ($P = .229$).

4 | DISCUSSION

This report demonstrates the potential for early PO initiation after head and neck mucosal free flap reconstruction with favorable swallow function, without compromising fistula risk. In these well-selected patients, there were no fistulas in the 24 patients managed with PO diet prior to or on POD 5. There was a statistically significant difference in fistula incidence between the EF and LF groups. Then, 45% of those in the EF group required tube feeding 30 days postoperatively, vs 57% in the LF group. Fistula occurred in 16.5% of the LF group overall. Subanalysis of the LF group (n = 54) showed improvement in functional outcomes over time with an FOIS score >3 increasing from 29% on POD 30 to 37%, by POD 60, and 42% at POD 90. Ten of these patients developed a fistula. Of the patients who did develop fistula, a disproportionate number had preoperative radiation therapy with/without chemotherapy (Table 3). The subgroup analysis of patients with oral cavity and mandible reconstruction did trend toward a decreased likelihood of fistula in EF patients, however, was not statistically significant, and again likely points to the need for appropriate patient selection.

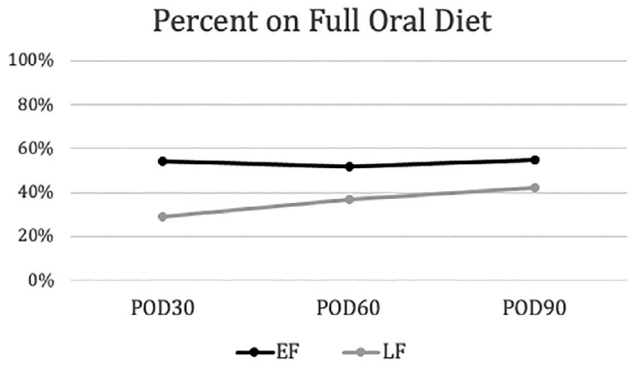

FIGURE 2 Frequency of head and neck free flap patients fed early (on or before postoperative day [POD] 5) vs late (after POD 5) on a full oral diet (Functional Oral Intake Scale [FOIS] >3) at POD 30, 60, and 90

The timing of PO initiation following mucosal defect head and neck free flap reconstruction remains controversial and this work does not support that delayed feeding will prevent a fistula. It is traditionally thought that fistula and wound healing complications are caused by early initiation of swallow rehabilitation to work toward resumption of oral diet. Although it is clear that postoperative fistula increases morbidity, treatment cost, and in certain cases can delay radiation and complicating overall survival, it has not been shown that delay of oral intake will prevent a fistula.[17] While there is a theoretical concern that early swallowing will loosen mucosal sutures or increase contamination of the wound, increasing evidence is demonstrating that early and continued swallow rehabilitation in head and neck cancer treatment is associated with improved swallowing outcomes and quality of life.[6,17,18] Our data suggest that in properly selected patients, EF may not increase fistula risk and is associated with

TABLE 3 Characteristics of patients with fistulas

Pre-op XRT	Feeding group	Age	Sex	Pre-op Chemo	T category	Ablated anatomy	Reconstruction tissue	Fistula diagnosis (POD)
Yes	LF	68	M	Yes	NA	OC, SM	Fibula	1
	LF	58	M	Yes	T3	OP, larynx	ALT	4
	LF	70	M	Yes	T4a	OC	OCRFFF	5
	LF	81	M	No	T3	OC, SM	ALT	6
	LF	61	F	Yes	T4a	OC	ALT	11
	LF	58	M	Yes	T4a	Larynx	RFFF	21
	LF	73	F	No	T4a	OC, MM, OP	ALT	28
	LF	56	M	Yes	T1	OC	RFFF	29
	LF	56	M	Yes	T4a	Larynx	ALT	43
No	LF	70	F	No	T3	OC	RFFF	5
	LF	47	M	No	T4a	OC, SM	Fibula	16
	LF	59	F	No	T4a	OC, MM, OP	ALT	19
	LF	69	F	No	T4a	Hypopharynx	Rectus	21

Abbreviations: ALT, anterolateral thigh free flap; Chemo, chemotherapy; F, female; LF, late-feeding group; M, male; MM, marginal mandibulectomy; OC, oral cavity; OCRFFF, osteocutaneous radial forearm free flap; OP, oropharynx; POD, postoperative day; RFFF, fasciocutaneous radial forearm free flap; SM, segmental mandibulectomy; XRT, radiation therapy.

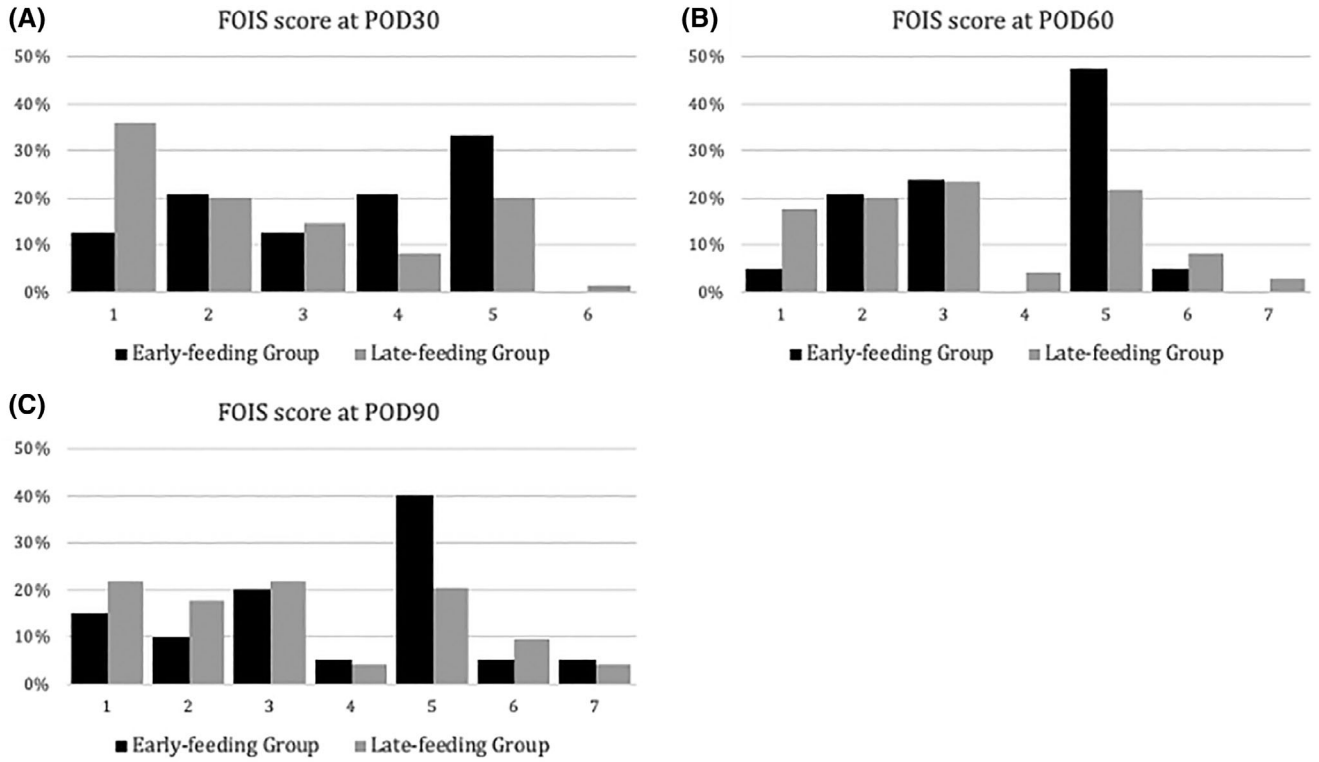

FIGURE 3 Frequency of Functional Oral Intake Scale (FOIS) scores in early (on or before postoperative day [POD] 5) vs late (after POD 5) feeding at (A) POD 30, (B) POD 60, and (C) POD 90

expedited diet advancement thus contributing to better patient quality of life.

It is important to consider that not all patients may be well-suited for an aggressive postoperative feeding pathway. The patients in this study were not randomized, and as evident by Table 1, an intentional selection bias impacted their PO management pathway (eg, preoperative radiotherapy, defect subsite), emphasizing the need for proper patient selection for EF after head and neck free flap reconstruction. Factors that may push toward a later-feeding pathway include prior radiation, poor baseline swallow function, and comorbidities such as hypothyroidism and diabetes which have well-documented associations with poor wound healing.[19] In contrast, factors that may support candidacy for EF include surgery as initial oncologic treatment, oral cavity primary, and smaller primary tumors. The decision for EF was not strictly constrained in our cohorts. A variety of factors came into play for each case when determining the timing of PO initiation. History of prior radiation was an important consideration but did not obviate EF. The tissue quality and the surgeon's confidence with attaining a watertight flap inset were other paramount factors. Age was a minor consideration. We did take into account whether a patient had a preexisting gastrostomy tube. If EF was felt to potentially speed up a patient's recovery and functional rehabilitation, it was strongly considered. Defect size was not a critical factor, nor was the proximity of a suture line to pooled saliva.

Postoperative swallow function will gradually improve over a weeks or months depending on the extent of the operation and previous treatments. It is unrealistic to assume that patients who begin taking PO early after surgery will be able to take adequate nutrition solely by mouth. Gradual reduction in nasogastric feeding or gastrostomy tube feeding should adjust as oral intake and swallow rehabilitation improves (or declines with adjuvant therapy). Once a patient is able to maintain nutrition on oral feedings alone the enteral feeding tube can be withdrawn. In our study, patients who were fed early had feeding tubes for a median postoperative duration of 24 days (range of POD5-POD270). Of the EF patients with FOIS score <4 at POD30, only six progressed to an oral diet by POD90. LF patients had steady progression in their FOIS score from POD 30 to 90 suggesting the majority of LF patients require more time to reach their penultimate FOIS score compared to EF patients. Both nonparametric and parametric statistical analysis identified a statistically significant increased likelihood for full oral diet at POD 30. However, this may only be due to the inclusion of patients with oropharyngeal and/or laryngeal reconstruction needs as subanalysis of patients with oral cavity and mandible reconstruction only did not portend statistically significant associations. Furthermore, when a fistula occurred, the patient was kept NPO until the salivary fistula resolved. This delay in further PO intake and swallowing therapies may have been a major contributor to delays in attaining favorable FOIS scores.

There are no randomized trials of postoperative feeding pathways for aerodigestive tract reconstruction. Other, single-institution studies found that EF was not associated with increased risk of fistula for oral cavity patients undergoing free flap reconstruction.[9,10] Our report

supports the lack of adverse outcomes with early oral feeding in patients with oral cavity primaries. In the future, larger studies are needed to further explore this question. There are numerous patient-, provider-, and system-level factors that interplay with surgical recovery and functional outcomes. Multi-institutional, prospective studies would bring greater clarity to the understanding of optimal timing of postoperative oral feeding. It would be challenging to design and carry out a randomized controlled trial to address this question about fistula and swallow function prospectively. A key consideration is that EF as an intervention may not alter an individual patient's risk of developing a fistula. A more important question may be, how to identify patients that would be optimally managed with an EF approach. Another question that remains is whether patients who are fed early have better swallow function outcomes, at least in part because of the EF. Perhaps, they would have equivalent swallow outcomes if their PO intake was held for a week or two. The most important primary outcome for a prospective trial would be swallow function, and inclusion criteria may include nonradiated patients undergoing oral cavity resection and reconstruction.

The retrospective data collection method and relatively small patient populations are significant limitations to our study. There is likely significant selection bias related to patients chosen for EF, confirmed by the lack of cancer primary site diversity in the EF group. However, this also suggests that properly selected patients will have no increased risk of fistula and improved FOIS scores earlier.

5 | CONCLUSION

Early postoperative intake is demonstrated to yield satisfactory postoperative and swallowing outcomes in select patients. More research is needed to define patients best suited to pursue early PO pathways.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ORCID

Brian Nuyen https://orcid.org/0000-0002-3184-7488
Eben Rosenthal https://orcid.org/0000-0003-0294-5203
Ryan Orosco https://orcid.org/0000-0002-7885-4327
Heather M. Starmer https://orcid.org/0000-0002-1716-9852

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