

Development of an Acute Care Plastic Surgery Service in the Saskatoon Health Region: Effects on flexor tendon management

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BACKGROUND: The acute care surgery model has gained favour in general surgery, but has yet to be widely adopted in other specialties. An Acute Care Plastic Surgery (ACS) Service was recently implemented in the Saskatoon Health Region in an effort to improve trauma care.

OBJECTIVE: To evaluate the impact of ACS on the management of flexor tendon lacerations. The authors hypothesize that ACS has resulted in more timely intervention, improved outcomes and decreased 'after hours' surgery.

METHODS: A retrospective review of patients treated for flexor tendon lacerations from 2007 to 2013 was performed. Patients were stratified into two groups based on whether they received treatment before (group A) or after (group B) ACS implementation. Variables included dates and times of patient referral, consultation and tendon repair; postoperative complications; and admissions. A surgeon survey was administered on the perceived impact of ACS.

RESULTS: Group A was more likely to have surgery performed after hours ($P=0.0019$) and be admitted to hospital ($P=0.0211$) compared with group B. Time from referral to consultation and injury-to-surgery interval were slightly increased post-ACS (Group B). Surgeons were highly satisfied with the new system, citing benefits to patients and surgeons.

CONCLUSION: ACS was designed to improve trauma care, while favourably impacting surgeon workload. Surprisingly, the injury-to-surgery interval was slightly increased. However, this was not clinically significant and did not lead to increased postoperative complications. This finding was likely due to a favourable change in practice patterns observed after ACS implementation. ACS has resulted in fewer hospital admissions, decreased after-hours surgeries and improved surgeon satisfaction.

Key Words: Acute care surgery; Flexor tendon injury; Health care delivery; Surgeon satisfaction; Trauma care

The Acute Care Plastic Surgery (ACS) service is a new and innovative practice model implemented in the Saskatoon Health Region (SHR), Saskatoon, Saskatchewan, in 2011. In this model, two surgeons are 'on call' weekly, each with distinct and complementary responsibilities in the care of patients with traumatic plastic surgery injuries (Table 1). The first surgeon (ACS surgeon) serves as the 'quarterback' of the team, and is on call for all urgent plastic surgery referrals received through the Region's Acute Care Access Line from 06:00 to 17:00 Monday through Thursday, and from 06:00 Friday until 06:00 Saturday. The ACS surgeon is stationed at a hospital-based ambulatory care clinic with two dedicated minor procedure rooms, allowing them to see urgent referrals as well as perform minor procedures that can be accomplished under local anesthesia. Patients seen in referral who require operative care are prepared for the second member of the team, the plastic surgery trauma surgeon, designated the 'E3' surgeon. The E3 surgeon has dedicated trauma time in the operating room

La création d'un service de chirurgie plastique de courte durée au sein de la région sanitaire de Saskatoon : ses effets sur le traitement du tendon fléchisseur

HISTORIQUE : Le modèle de chirurgie de courte durée est devenu populaire en chirurgie générale, mais ne s'est pas étendu aux autres spécialités. La région sanitaire de Saskatoon a récemment créé un service de chirurgie plastique de courte durée (CPCD) afin d'améliorer les soins des traumatismes.

OBJECTIF : Évaluer les répercussions de la CPCD sur la prise en charge des lacerations du tendon fléchisseur. Les auteurs postulent que la CPCD favorise des interventions plus rapides, améliore les résultats cliniques et réduit les interventions après les heures ouvrables.

MÉTHODOLOGIE : Les chercheurs ont procédé à une analyse rétrospective des patients traités en raison de lacerations du tendon fléchisseur entre 2007 et 2013. Les patients ont été répartis en deux groupes selon qu'ils avaient été traités avant (groupe A) ou après (groupe B) l'adoption de la CPCD. Les variables incluaient la date et l'heure de l'aiguillage des patients, de la consultation et de la réparation du tendon, les complications postopératoires et les hospitalisations. Les chirurgiens ont reçu un sondage pour faire connaître leur perception des répercussions de la CPCD.

RÉSULTATS : Le groupe A était plus susceptible d'avoir subi la chirurgie après les heures ouvrables ($P=0,0019$) et d'avoir été hospitalisé ($P=0,0211$) que le groupe B. Le délai entre l'aiguillage et la consultation et entre la blessure et l'opération était légèrement plus long après l'adoption de la CPCD (groupe B). Les chirurgiens étaient très satisfaits du nouveau système et en citaient les avantages pour eux et pour les patients.

CONCLUSION : La CPCD visait à améliorer les soins des traumatismes, tout en réduisant la charge de travail des chirurgiens. Fait surprenant, le délai entre la blessure et l'opération était légèrement plus long. Cette variable n'était toutefois pas significative sur le plan clinique et n'accroissait pas le nombre de complications postopératoires. Ces observations découlaient probablement de l'évolution positive des profils d'exercice après l'adoption de la CPCD. La CPCD a réduit le nombre d'hospitalisations et d'opérations après les heures ouvrables et accru la satisfaction des chirurgiens.

Monday, Wednesday and Friday (on Tuesday and Thursday, the E3 surgeon may pursue their elective practice). A more standard call arrangement remains for evening call (Monday to Thursday) as well as weekend call, in which there is single on-call surgeon to complete consultations and emergent operative cases as required.

Despite Saskatoon's relatively small population, its place as the province's tertiary referral centre for plastic surgery make it a very busy trauma centre. Before implementation of ACS, surgeons struggled while on call to balance the responsibility of caring for patients in their elective practice while attending to urgent referrals, many of whom required timely operative intervention. This could result in delays in tending to urgent referrals, the cancelling of elective cases and/or the completion of trauma cases after hours. This system was believed to compromise safe and timely care for patients with urgent needs, as well as lead to decreased physician satisfaction and increased surgeon fatigue.

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TABLE 1
Acute Care Plastic Surgery (ACS) roles

Surgeon role	Duties
ACS surgeon	On-call 06:00–17:00 Monday to Thursday, and 06:00 Friday to 06:00 Saturday
E3 surgeon	Dedicated trauma (E3) operating room Monday, Wednesday and Friday

TABLE 2
Patient demographics

	Group A	Group B	P
Age, years, mean	32.6	32.2	0.6615
Male sex, n (%)	51 (82.3)	50 (70.4)	0.1112

This new practice model was adapted from the acute care surgery model that has gained popularity in general surgery and is quickly becoming the standard model for delivering emergency general surgery care across Canada (1). Results from the general surgery literature have shown this practice model to be effective in reducing time spent in the emergency department, decreasing time to consultation, reducing wait times for surgery and decreasing the length of hospital stay (2-4). In addition, a majority of general surgeons reported an improved balance between time spent on call and time available for their elective practices (5). In the SHR, the acute care model in general surgery has decreased surgical wait times, led to fewer after-hours surgeries and improved surgeon satisfaction (6). American studies have demonstrated similar findings (7,8).

The goal of the present study was to evaluate the effects of ACS implementation on health care delivery for plastic surgery trauma patients. For the present article, we chose to focus on patients with acute flexor tendon lacerations. The rationale for this was as follows: these injuries are one of the most commonly encountered traumatic injuries seen in plastic surgery; it would allow us to analyze a fairly homogenous group of patients, thereby improving the validity of our outcomes data; and it is generally accepted that prompt surgical management of these injuries leads to improved outcomes (9-11).

Our hypothesis was that the implementation of ACS has resulted in decreased time from referral to surgical consultation, prompt operative repair, fewer after-hours surgeries and improved surgical outcomes in patients with acute flexor tendon injuries. We also sought to evaluate surgeon perception of and satisfaction with the new ACS practice model.

METHODS

The present study was approved by the University of Saskatchewan Biomedical Ethics Board (Bio REB# 13-141). A retrospective chart review was performed of all patients who had undergone a flexor tendon repair surgery (zones 1 to 5) from September 2007 to June 2013. Only those patients with isolated flexor tendon injuries with or without a digital nerve injury that were repaired in the operating room were included. All patients included in the present study had flexor tendon repair performed in the operating room under general anesthesia or intravenous regional anesthesia. Any patient with concurrent fractures, arterial damage or extensor tendon injury were excluded, as were patients who underwent flexor tendon repair in the emergency department under local anesthesia.

Patients were stratified into two groups based on whether they received treatment before (group A) or after (group B) the implementation of ACS in September 2011. Because the numbers of plastic surgery faculty performing flexor tendon repair changed over time, there were three surgeons in the pre-ACS time frame and an additional two surgeons (for a total of five) operating after ACS implementation.

Data were obtained from surgeon charts and hospital records after assignment of a study identification number to protect patient privacy. Data included patient age, sex, and the dates and times of initial referral,

TABLE 3
Wait times before and after Acute Care Plastic Surgery implementation

	Group A	Group B	P
Assessment wait time, days	0.9±1.4	1.1±1.1	0.0302*
Surgery wait time, days	0.7±1.3	1.1±1.4	0.1022
Injury-to-surgery interval, days	2.0±2.2	2.5±1.8	0.0203*

Data presented as mean ± SD unless otherwise specified. *Significant at $P < 0.05$

TABLE 4
Postoperative complications, after-hours surgery and hospital admissions

	Group A	Group B	P
Postoperative complications	7 (11.3)	4 (5.6)	0.4430
After-hours surgery	12 (19.4)	2 (2.8)	0.0019*
Admission to hospital	10 (16.1)	3 (4.2)	0.0211*

Data presented as n (%) unless otherwise specified. *Significant at $P < 0.05$

assessment by surgeon and flexor tendon repair. Data regarding hospital admissions and major postoperative complications were also recorded. Major postoperative complications were defined as those requiring additional or prolonged care or a return to the operating room.

A questionnaire, adapted from Helewa et al (5), was e-mailed to all plastic surgeons. Surgeon satisfaction was determined by responses to a series of questions relating to patient flow and system improvement, elective practice and workload, work environment and personal satisfaction. The surgeons were asked to indicate their level of agreement on a scale of 1 to 5 (where 1 is strongly disagree, 2 is disagree, 3 is neutral, 4 is agree and 5 is strongly agree) to 13 statements. The statements were designed to assess work satisfaction and personal satisfaction following ACS implementation.

Statistical analysis

χ^2 tests were performed to assess differences in groups A and B with regard to sex, number of after-hours (after 17:00) surgeries performed, rate of postoperative complications and number of admissions to hospital. The Wilcoxon two-sample test for nonparametric data was performed to compare between-groups wait time for surgical assessment (defined as time between referral and consultation), surgery wait time (defined as time between consultation and operative repair) and the injury-to-surgery interval. This test was also used to examine the relationship between injury-to-surgery interval and postoperative complications. $P < 0.05$ was considered to be statistically significant.

RESULTS

In total, 404 patients were identified as having undergone a flexor tendon repair between September 2007 and June 2013. Of these patients, 133 met the criteria for inclusion in the present study. Demographics were similar among the 62 patients receiving surgery before ACS implementation and the 71 treated after ACS implementation (Table 2).

Wait times for consultation and surgical repair generally increased following ACS implementation (Table 3). The time to surgical assessment increased from 0.9 days to 1.1 days ($P = 0.0302$) and the injury-to-surgery interval also increased, from 2.0 days to 2.5 days ($P = 0.0203$) in the new model. The wait time for flexor tendon repair surgery was also slightly increased, although this was not statistically significant ($P = 0.1022$). The rate of postoperative complications did not differ between groups ($P = 0.4430$) (Table 4). The number of flexor tendon repairs performed after hours was greatly decreased after ACS implementation, from 12 (19.4%) to two (2.8%) ($P = 0.0019$) and the number of patients admitted to hospital for isolated flexor tendon injury was also significantly decreased, from 10 (16.1%) to three (4.25%) ($P = 0.0211$) (Table 4). There was no association found between the

TABLE 5
Association between mean injury-to-surgery interval and rate of postoperative complications

	Postoperative complications		P
	Yes	No	
Mean injury-to-surgery interval, days	2.3	2.1	0.8516

TABLE 6
Association between after-hours surgery and rate of postoperative complications

	Postoperative complications		P
	Yes	No	
Surgery performed after hours	2 (18.2)	10 (9.8)	0.3915
Surgery not performed after hours	9 (81.8)	92 (90.2)	

Data presented as n (%) unless otherwise specified

mean injury-to-surgery interval and the rate of postoperative complications (Table 5). Similarly, there was no association between after-hours surgery and postoperative complications (Table 6).

Results from the surgeon survey are summarized in Table 7. The survey response rate was 100%. All surgeons perceived that patients were being seen and operated on in a more timely fashion since ACS implementation. Surgeons were greatly satisfied with the work environment under the ACS model. All agreed that ACS allowed for greater operating room accessibility and fewer cases being operated on after hours. Surgeons also generally found the ACS workload to be manageable, and that ACS had a positive impact on time available for their elective practices.

DISCUSSION

The goal of implementing the ACS plastic surgery model in the SHR was to improve timeliness and quality of care for plastic surgery trauma patients, while positively impacting physician's time management and reducing surgeon fatigue. Results from the general surgery literature supported our hypotheses that ACS would improve efficiencies in patient flow, decreasing time from referral to surgery, while having a positive effect on surgeon lifestyle. Therefore, it came as a surprise that our study indicated that there was a statistically significant increase in mean assessment time (from 0.9 to 1.1 days) and mean injury-to-surgery interval (from 2.0 to 2.5 days) following the introduction of ACS. Interestingly, these findings sharply contrasted the unanimous surgeon perception that ACS resulted in more timely patient care. However, it is worth noting that although wait times for assessment and surgery had a small but statistically significant increase following ACS implementation, these mean differences (<12 h) are not clinically significant in the treatment of flexor tendon injuries. There was also no associated increase in postoperative complications. In fact, these results highlight the efficiency of surgeons' trauma care before ACS, and are likely explained by a fundamental difference in health care delivery brought about by this new system. Before ACS, the on-call surgeon had no dedicated time for urgent patient consultations, nor reserved 'trauma time' in which operative patients could be managed. Patients were seen between office consultations or elective surgery cases, with surgeons often having to drive to different locations around the city for evaluation of urgent referrals at one of three sites within the health region. In many cases, these patients would be seen at the end of the work day, and put on the operative slate to be completed that evening or overnight. Study results corroborate this, showing that there was indeed a statistically significant decrease in the number of surgeries being performed after hours (from 19.4% to 2.8%) following ACS implementation. In our study, after-hours surgery was not associated with

TABLE 7
Surgeon survey

Statements regarding surgeon satisfaction	Mean score*
Patient flow and system improvement	
1. I feel that since ACS implementation, patient consults are performed in a more timely fashion	5
2. I feel that trauma (E3) patients are operated on in a more timely fashion since implementation of ACS	5
3. I feel that trauma (E3) patient outcomes have improved since implementation of ACS	3.3
Elective practice and workload	
4. The ACS schedule allows me to focus on my elective surgical practice when not on call	4
5. I find the volume of ACS consults seen monthly to be manageable	3.3
6. I find the workload while on ACS to be manageable	3.3
7. I feel adequately equipped to deal with the cases I encounter while on ACS	4.7
Work environment	
8. While on ACS, I find that there is time during the day to teach residents and medical students	3.3
9. The organization of the ACS/E3 service provides for improved operating room accessibility	5
10. I feel that I am performing fewer cases after hours (after 17:00) since implementation of ACS	5
Personal satisfaction	
11. I feel adequately remunerated for my work while on call	2.7
12. I am satisfied with the variety of clinical cases seen while on ACS	4.7
13. I feel that introduction of ACS has had a favourable impact on my quality of life	5

*Scoring system: 1 – strongly disagree; 2 – disagree; 3 – neutral; 4 – agree; 5 – strongly agree. ACS Acute Care Plastic Surgery

an increase in postoperative complications, but there is an association in the literature between after-hours surgeries and increased morbidity and mortality (12,13).

In the new system, the ACS surgeon would see daytime consults as they were received, Monday through Friday. They would complete simple cases that could be performed under local anesthesia in the ambulatory care setting, while preparing operative patients for a slot in the Monday, Wednesday or Friday trauma operating time. It is precisely this difference in patient flow that likely led to the findings of slightly increased mean assessment times and injury to surgery intervals. For example, in ACS system, the on-call surgeon getting a flexor tendon injury consult Monday evening would likely have the patient come to the ambulatory care clinic Tuesday for assessment. The ACS surgeon would assess the patient and schedule the patient for the next available E3 (trauma) operating room time on Wednesday. A similar situation would exist for a weekend consult, in which case the patient may be instructed to come in fasting Monday morning for a consultation and possible operative repair that day. In contrast, in the pre-ACS system, the on-call surgeon in many cases would have the patient come to the emergency room the day of the consultation (Monday night or the weekend in the above examples) and then add them on to the operating room slate for later that evening or overnight. Of course, before ACS implementation, the surgeon would have otherwise had to juggle or cancel elective patient care to find time to complete these trauma cases. Therefore, it can be argued that despite small increases in wait times after ACS, patient flow and system efficiencies improved.

In addition to a reduction in after-hours surgery, our study also showed a significant reduction in hospital admissions following the implementation of ACS, from 16.1% to 4.2%. This is an important finding considering that medically necessary hospital admissions for

patients with isolated flexor tendon injuries are rare. A majority of patients in the pre-ACS group were admitted solely to await surgery after being placed onto the operating room slate as an 'add-on'. This was rarely necessary after ACS introduction because there was dedicated E3 operating room time readily available. This suggests that ACS implementation has had a positive impact on the utilization of health care resources.

The surgeon survey also yielded valuable information about the effects of ACS implementation. Overall, surgeons found the changes to be favourable, citing improved access to operating room resources, improved balance between on-call and elective practice, and an overall improvement in surgeon satisfaction and quality of life. Interesting, their beliefs that consultations and surgeries were performed in a more timely manner after ACS were contrary to the findings in this study. It is likely that the improvements in patient flow discussed above contributed to these false perceptions, but it highlights the fact that surgeon perceptions regarding the efficiencies of health care delivery are not always accurate.

In our study, all flexor tendon repairs were performed under general or intravenous regional anesthesia in the operating room. Some Canadian centres have moved to a model of wide-awake surgery for flexor tendon repair. While there are many potential benefits to this approach, it has not been adopted in Saskatoon for two main reasons. Firstly, few of the attending surgeons in our group have experience with this technique, and some believe that the current best practice remains repair in a well-lit operating theatre under general or regional anesthesia. Second, we currently do not have the necessary resources with respect to personnel or equipment to undertake these procedures in an ambulatory care setting. However, from a standpoint of resource allocation and surgeon/patient satisfaction, it certainly is something worth investigating in the future.

CONCLUSION

Introduction of an ACS service in the SHR has resulted in a statistically significant reduction in after-hours surgery and hospital admissions for patients with acute flexor tendon injuries. Although overall patient wait times for assessment and injury to surgery interval were slightly increased, these differences were not clinically significant and did not result in increased postoperative complications. Overall, surgeons were highly satisfied with the new health care delivery system, citing benefits to both patients and surgeons. Future studies will examine the impact of ACS implementation on the treatment of other common plastic surgery injuries.

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