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A retrospective cohort study evaluating the efficacy and safety of an orthopaedic consultant-led virtual fracture clinic in an Australian Level 1 trauma centre

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Abstract

Background: In Australian healthcare the consistent rise in demand for orthopaedic outpatient clinic services is creating marked challenges in the provision of quality care. This study investigates the efficacy and safety of a Virtual Fracture Clinic (VFC) as an alternative model of care for the management of acute injuries and musculoskeletal conditions in the Australian public hospital setting.

Methods: A retrospective cohort study of consecutive Emergency Department (ED) referrals to the Department of Orthopaedic Surgery was conducted comparing outcomes prior to (November 2015 to February 2017) and after (March 2017 to June 2018) implementation of a VFC. The primary outcome measures assessed were the proportion of referrals virtually discharged and unplanned 30 day ED re-attendance rates.

Results: A total of 737 (36.4%) referrals managed by the VFC were discharged without requiring orthopaedic outpatient clinic attendance. The rate of unplanned ED re-attendances was 5.2% post VFC implementation compared to 6.5% at baseline ($p=0.01$). VFC implementation was also associated with reductions in the average number of orthopaedic outpatient clinic attendances per referral (1.1 versus 1.7, $p<0.01$) and the number of referrals lost to follow-up (7.2% versus 14.7%, $p<0.01$). Additionally, patients wait times for first contact by the orthopaedic team were significantly reduced from a median of 7 (IQR 5,9) days to 2 (IQR 1,3) days post intervention ($p<0.01$). No complications or adverse events were reported.

Conclusion: This study demonstrates that a VFC is applicable to the Australian healthcare system, and can lead to effective and safe provision of orthopaedic outpatient care.

Introduction

Outpatient clinic activity in Australian public hospitals continues to rise with orthopaedic clinics ranked second amongst specialties for the number of attendances during 2016/17.[1, 2] A select group of orthopaedic conditions can be effectively and safely managed in primary care with excellent outcomes.[3-5] The traditional model of care necessitating in-person orthopaedic outpatient clinic review of all acute referrals potentially results in inefficient use of limited hospital resources and places unnecessary demand on services already operating at capacity.

Virtual Fracture Clinics (VFC) have been widely implemented in the United Kingdom (UK) and Republic of Ireland as an alternative to traditional fracture clinic attendance.[6] The original model published by the Glasgow Royal Infirmary consisted of direct ED discharge of simple stable injuries including 5th metacarpal, radial head, metatarsal and stable ankle fractures, and VFC review of remaining conditions not requiring admission.[7, 8] In the first year post VFC implementation they directly discharged 33% of patients presenting to their ED and an additional 23% following remote review via the VFC.[9] Similar findings have been reported by other institutions for a range of orthopaedic conditions with VFC direct discharge rates as high as 75%.[10-16] Concomitant findings of improvement in outpatient clinic access and utilisation, cost savings, and enhanced patient satisfaction have also been described.[17-21]

At the time of publication, we were not aware of published evidence pertaining to outcomes of consultant-led VFC outside of the UK National Health Service (NHS) and Republic of Ireland. The primary aim of this study was to investigate the efficacy and safety of a VFC in an Australian Level 1 adult trauma centre.

Approval to conduct this study was granted by the Melbourne Health Human Research Ethics Committee (2017.049, QA2018082). RMH received a Better Care Victoria Innovation Fund Grant to pilot a VFC (IF16118).

Methods

Study design

We undertook a retrospective cohort study of consecutive ED referrals to the Department of Orthopaedic Surgery comparing the outcomes prior to (November 2015 to February 2017) and after (March 2017 to June 2018) implementation of a VFC in our institution. The Royal Melbourne Hospital is a Level 1 adult trauma centre with an annual census of more than 70,000 emergency attendances over the study period. Our orthopaedic outpatient clinics are consultant-led with significant registrar assistance.

Participants

This study included all ambulatory ED referrals to the Department of Orthopaedic Surgery other than spine conditions. Patients were ineligible from virtual management if any of the following criteria applied: radiological imaging unavailable, high energy injury (road accident >30km/hr, fall from >1.5m), open fracture, neurovascular concern, pregnancy, complex multiple injuries, and non-English speaking patients without an English speaking next of kin (Fig. 1). In our institution, conditions distal to the carpus are managed by the Department of Plastic and Reconstructive Surgery and were therefore deemed beyond the scope of this study.

Virtual Fracture Clinic

Prior to implementation of the VFC the Department of Orthopaedic Surgery developed consensus management guidelines[22] for 28 commonly presenting conditions (Table 1). Guidelines were developed using a template to achieve consistency. Each identified condition was assigned to a lead orthopaedic consultant who drafted the guideline which was then revised by the multidisciplinary team until uniformity and consensus was reached. Consultants could diverge from these guidelines at their discretion. The VFC team presented the guidelines and instructions for use at relevant multidisciplinary meetings and electronic versions were made available. The team directly contacted

referring clinicians where significant divergence from the guidelines was identified discussing the management plan and providing support with interpretation of the guidelines.

ED management remained unchanged with initial fracture reduction, manipulation and immobilisation performed as per usual practice. ED clinicians were provided with the orthopaedic management guidelines to reduce variation in management and reduce use of rigid immobilisation. Patients were provided with written information advising to expect a telephone call from the VFC within two business days of discharge, and the VFC telephone number to contact in the event of complications or communication delay.

Our VFC team consisted of five orthopaedic consultants and two senior physiotherapists (VFC co-ordinators). The VFC were conducted four days per week with a consultant and physiotherapist rostered for each session. The consultant reviewed all referrals and provided a diagnosis and management plan allocating referrals to one of four options: 1. in-person orthopaedic outpatient clinic review, 2. virtual management, 3. referral to another specialty or hospital, or 4. emergency surgery. Referrals ineligible for virtual management defaulted to an in-person clinic appointment. Following the VFC session, the physiotherapist contacted all patients via telephone to advise them of their diagnosis and consultant recommendations. Patients allocated to virtual management were provided additional advice regarding their condition and rehabilitation which was reinforced by an email or letter including an information brochure where available. Correspondence was sent to general practitioners. Occupational certificates and other required documentation were also supplied to patients at request.

In addition to the VFC telephone number, patients were provided with a VFC email address, monitored by the physiotherapists to address any questions or concerns. Patients were advised the email and telephone were only monitored during business hours and in case of an emergency or after hours, to present to their local medical clinic or ED.

Additional funding was required for 1.0 full time equivalent senior physiotherapist. Consultants were able to staff the VFC in their contracted time and existing resources were used for all other requirements. A comprehensive Virtual Fracture Clinic implementation Guide has been published on our institution's website.[23]

Outcomes

The primary measure of VFC efficacy was defined as the proportion of ED presentations discharged without requiring in-person orthopaedic outpatient clinic review. Secondary measures of efficacy were average number of orthopaedic outpatient clinic encounters per referral, clinic non-attendance rate, and patient wait time (days) from ED discharge to first orthopaedic team contact. Patients who did not attend any scheduled outpatient clinic appointments were deemed lost to follow up.

Safety was assessed with the following four variables: 1. unplanned 30 day ED re-attendance rate for the index condition, 2. complications identified by or reported to the Department of Orthopaedic Surgery, 3.misdiagnosed or missed injury, and 4. unplanned surgery.

Data collection

Patient electronic medical records and hospital databases were reviewed retrospectively to obtain patient demographics, outpatient clinic attendances, and complications and adverse events in the pre-intervention cohort. Prospective data was recorded in a VFC database. ED data was extracted from the ED information system (Symphony Version 2.29).

Data analysis

Numerical data were summarised as mean (min, max) or median (Q1, Q3). Categorical variables were summarized as n (%). Chi-squared or Fisher's exact tests were used to compare categorical data between pre and post-VFC implementation groups. A Wilcoxon-Mann-Whitney test was applied for numerical comparisons. Statistical analysis was performed using SAS® 9.4 and R 3.6.

Results

Patient demographic characteristics are summarised in Table 2. The pre-post implementation analysis showed no significant difference in patient characteristics between groups. Figure 1 describes the patient flow. In the traditional model 1,899 ED referrals were made to the Department of Orthopaedic Surgery and 1,837 patients were directly booked into the orthopaedic outpatient clinic. In the post-VFC period 2,023 ED referrals were received by the Department of Orthopaedic Surgery and reviewed by a consultant within a median of 1 (IQR 1, 2) day of referral. Consultants directed 1,136 referrals to clinic (inclusive of the 263 referrals ineligible for virtual management), 853 for virtual management, 33 to another specialty/hospital and 1 patient with an unstable ankle fracture was directly booked for surgery.

Following VFC patient telephone contact 170 referrals initially allocated to virtual management were referred for in-person assessment in the clinic, 7 patients elected to proceed with management in the private sector, and 2 patients with unstable distal radius fractures were booked for surgery. The main reasons for cross over from virtual to in-person management were: VFC unable to contact patient by telephone (n=60); disclosure of new information during the telephone call including uncontrolled pain, new injury, or neurovascular symptoms (n=40), and patient preference for an in-person assessment (n=17). Of the patients initially allocated to clinic, 3 declined further management and 17 elected for private care.

Efficacy outcomes

During the post implementation period 737 (36.4%) ED referrals were virtually discharged without outpatient clinic attendance (Fig. 1). Radial head/neck fractures, acromioclavicular joint dislocations, ankle sprains and 5th metatarsal fractures had the highest proportion of virtual discharge (Table 1). The physiotherapist made telephone contact with 92% (n=1,744) of patients within a median of 2 days (IQR 1,3) of ED referral. This was a significantly shorter wait compared to 7 days (IQR 5,9) for the first outpatient clinic appointment in the traditional model ($p<0.01$). The average number of clinic

appointments attended per ED referral was lower in the post-VFC period with 1.06 attendances per referral versus 1.67 at baseline (p<0.01). Fewer referrals were lost to clinic follow up in the post-VFC period (7.4%) compared to baseline (11.4%). Of the 853 referrals allocated to virtual management at triage, 192 (22.5%) had multiple virtual encounters (177 patients had two virtual encounters, 15 patients had three).

Safety outcomes

The ED re-attendance rate in the post-VFC period was 5.2% (n=105) compared to 6.5% (n=123) at baseline (p=0.12). 16 patients reviewed by the VFC re-attended ED a median of 6 days (IQR 3, 13) post telephone contact with the VFC; 4 of these patients were scheduled for an in-person outpatient clinic review which did not result in surgical intervention. No complications or adverse events were observed by or reported to our institution.

Of the patients redirected from virtual to in-person clinic attendance (n=170) 11 required surgical intervention: 8 distal radius fracture fixations, 1 5th metatarsal fixation, 1 knee arthroscopy and 1 ankle arthroscopy.

Discussion

An orthopaedic consultant-led VFC model of care is predicated on the concept that a proportion of ambulatory musculoskeletal injuries that present to an ED can achieve good outcomes without direct orthopaedic involvement. Successful management of these conditions requires accurate diagnosis, consensus treatment guidelines and effective patient communication and education regarding their condition and expected recovery. Subsequent monitoring of progress is well suited to primary care. This study demonstrated that the implementation of a VFC outside of the NHS was efficacious and safe, with a one third reduction in the number of patients requiring an in-person clinic attendance, no negative impact on ED re-attendance rates and no reported complications or adverse events. Compared to the traditional model of care, the VFC was associated with timelier orthopaedic decision making, early direct communication with patients, and reductions in outpatient clinic encounters. These results may provide incentive for other Australian hospitals to consider implementing a VFC as an oversubscribed orthopaedic outpatient service is not unique to our institution.

Several elements contributed to the success of this VFC implementation. Inclusion of consensus evidence-based condition-specific guidelines reduced variation in clinical care and streamlined management. In our model, as recommended by current BOA guidelines[24], an orthopaedic consultant reviewed all ED referrals, confirmed the diagnosis, and recommended a management plan. Early consultant involvement is intended to provide more timely decision making and planning of care thereby eliminating unnecessary clinic appointments and investigations. The efficiency gain is evidenced by the reduction in in-person clinic attendances post-VFC implementation. Our findings indicate the efficiency gains achieved post implementation of the VFC did not compromise patient safety, with no reported complications or adverse events. Strict application of exclusion criteria and protocoled questioning of patients during the telephone calls assessing for red flags and undiagnosed injuries enabled us to identify and predict those not appropriate for virtual management.

Our findings are consistent with current literature investigating the effects of virtual management on health service activity. A recent systematic review analysing outcomes of VFC implementation in the UK indicated VFC discharge rates of 33-60%.[6] Smaller series have demonstrated that certain conditions are more suited to a VFC than others. Diagnoses such as mallet fingers, 5th metatarsal fractures, and radial head fractures have shown higher success rates than the average.[10, 12] We made a similar finding with radial head fractures and 5th metatarsal fractures achieving over 60% successful with virtual management. It is worthy of mention the VFC model was useful during the COVID pandemic as we had a structure and resources in place to undertake telehealth consultations conducted by consultants and registrars in place of in-person orthopaedic clinic attendances.

This study has several strengths. It is the first study comparing a VFC with the traditional model of care in a consecutive cohort of ED referrals to the Department of Orthopaedic Surgery inclusive of all conditions excluding spinal injuries. Therefore, the results are indicative of the outcomes of 'real world' implementation of a VFC in a large trauma hospital. Our model also identifies the broadest number of conditions deemed suitable for virtual discharge. This study is the first to investigate the outcomes of VFC implementation outside the British Isles. Despite our large number of subjects, our loss to follow-up rate was very low, minimising any associated selection bias.

We acknowledge several limitations**.** This was a retrospective cohort study with an unmatched pre VFC cohort. Despite the demographics being similar and the numbers large, we cannot be certain that the two cohorts were adequately matched. Our safety data was limited to unplanned ED re-attendance and adverse events and complications reported to our department. We did not capture patient attendances with their primary health care provider or other health care networks, representing a potential underestimation of adverse outcomes. Additionally, late complications such as arthritis and mal-union may not be captured in the time period of our study.

Considering the strong support for the clinical efficacy and safety of the VFC we suggest future research should evaluate the economic implications of this model including any primary care

implications. It will also be relevant to undertake a more sensitive estimation of the patient experience, and joint and limb specific patient reported outcome scores. In addition, it will be helpful to extend the timeframe for evaluation for adverse outcomes to detect late complications such as malunion and post-traumatic sequelae.

Conclusion

This study demonstrates that a consultant-led VFC model is an effective and safe intervention applicable to the Australian healthcare system, reducing in-person outpatient clinic activity with no adverse effect on safety.

Disclosures

We confirm that each author meets the criteria for authorship and that this manuscript has not been submitted elsewhere. We do not have any author specific conflicts of interest to declare.

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Table 1

Conditions with consensus management guideline

	Condition	Virtually discharged n (%)
Direct discharge after virtual consult	Radial head/neck #	125 (69.8)
	Ankle sprain	18 (64.3)
	Acromioclavicular joint dislocation (grade I/II)	10 (62.5)
	5th metatarsal #	60 (61.2)
	Foot phalanx #	22 (57.9)
	Carpal # (dorsal hamate/triquetral)	7 (53.8)
	Glenohumeral dislocation (primary, age 20-35)	14 (48.3)
	Ankle #	45 (44.6)
	Foot # (tarsal, other foot)	35 (35.7)
	Elbow dislocation	8 (33.3)
	Clavicle # (no skin tenting)	26 (28.3)
	Scapula # (no rib involvement)	2 (25.0)
	Patella vertical #	1 (16.7)
	Tibial plateau #	1 (7.1)
VFC (single virtual review with x-ray)	Distal radius #	130 (48.7)
	Humerus # (proximal/surgical neck/greater tuberosity)	39 (36.4)
	Patella horizontal #	3 (33.3)
Orthopaedic outpatient clinic	Glenohumeral dislocation (recurrent, age ≤19 & ≥36)	-
	Humerus shaft #	-
	Knee soft tissue injury	-
	Patellofemoral dislocation	-
	Scaphoid #	-
	Tendo Achilles rupture	-
	Ulna #	-

#=fracture

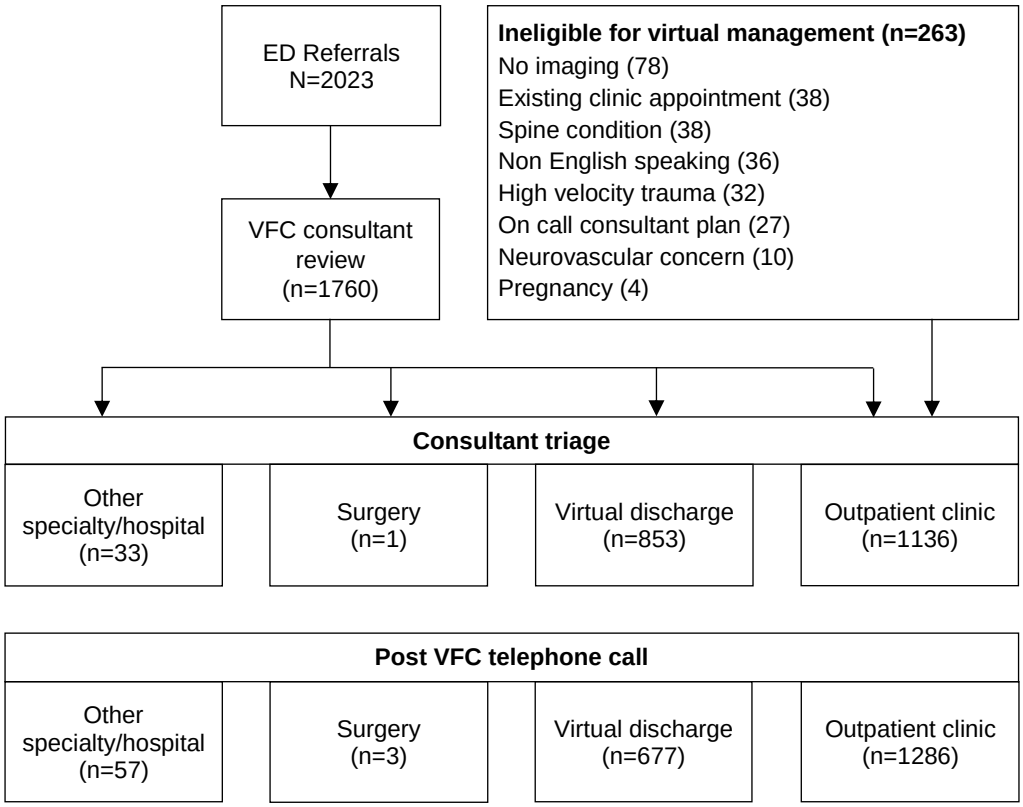
Table 2

Participant characteristics

	Pre-VFC	Post-VFC	p value
Orthopaedic referrals (n)	1,899	2,023	
Gender (Male/Female)	1,086 / 813	1,127 / 896	0.35
Age, median (IQR)	36 (26, 55)	37 (26, 56)	0.69
Females	48 (30, 66)	46 (29, 64)	0.27
Males	32 (25, 45)	32 (24, 46)	0.96
Classification of injury, n (%)			0.56
Upper Limb	1,107 (58)	1,166 (58)	
Lower limb	740 (39)	797 (39)	
Spine	39 (2)	38 (2)	
Axial	5 (0)	5 (0)	
Multiple areas	8 (0)	17 (1)	

Figure 1

VFC participant flow



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