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Wait times at the MUHC

No: 3 FRACTURE MANAGEMENT

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This report was prepared for the Technology Assessment Unit (TAU)

of the McGill University Health Centre (MUHC)
by

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and approved and adopted by the committee of the TAU:

Invitation.

This document was developed to assist decision-making in the McGill University Health Centre. All are welcome to make use of it. However, to help us estimate its impact, it would be deeply appreciated if potential users could inform us whether it has influenced policy decisions in any way.

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Contexte
Le présent rapport sur les délais subits par les patients du CUSM avant une correction chirurgicale de fractures, s'inscrit dans une série d'études sur les délais d'attente demandées par le président-directeur général, le D[r] Arthur Porter. Il traite uniquement de la gestion des fractures aiguës, non émergentes, non pathologiques et primaires.

Roulement au CUSM
Au cours de l'année 2005-2006, à l'exclusion des fractures pathologiques et des chirurgies de reprise, 830 patients adultes ont subi une réduction chirurgicale de fractures aiguës au CUSM. Ce nombre augmente d'environ 4,3 % par année. Les taux d'admission sont environ 40 % plus élevés en hiver qu'en été.

Points de repères
Une revue systématique de la littérature met en lumière les conclusions suivantes :

Hanche. Les conclusions des études sur les conséquences d'un délai dans la correction chirurgicale des fractures de la hanche sont contradictoires. Il est probable, mais non prouvé, que les délais dans la correction chirurgicale des fractures de la hanche entraînent une mortalité et une morbidité accrues ainsi qu'une prolongation du séjour postopératoire à l'hôpital.

Cheville. Tibia. Le peu de données dont nous disposons indiquent qu'un délai de plus de 24 heures dans la correction chirurgicale des fractures fermées de la cheville et du tibia est associé à des complications accrues et à la prolongation du séjour à l'hôpital.

Cibles et lignes directrices
Tous les rapports d'experts et lignes directrices confirment que la correction d'une fracture de la hanche doit se faire dans les 24 heures, en l'absence de contre-indications médicales.

Aucune donnée n'indique de complications résultant d'une correction rapide de ces fractures. Au contraire, une correction rapide permet une diminution de la douleur et de l'invalidité, une correction chirurgicale plus facile, la réduction du temps opératoire ainsi que la diminution du séjour postopératoire à l'hôpital.

Délais d'attente actuels au CUSM

Toutes les fractures. À l'exclusion des délais imputables à des raisons médicales, 6 % des patients du CUSM souffrant de fractures ont subi une

correction chirurgicale dans les délais cibles de moins de 24 heures au cours de la dernière année.

La distribution des délais d'attente était la suivante :

Patients ayant attendu plus de 1 jour après l'admission à l'urgence : 542 (94 %)
Patients ayant attendu plus de 4 jours après l'admission à l'urgence : 295 (51 %)
Patients ayant attendu plus de 7 jours après l'admission à l'urgence : 155 (27 %)
Patients ayant attendu plus de 14 jours après l'admission à l'urgence : 36 (6 %)

Fractures de la hanche. Au cours de l'année 2005-2006, 136 patients adultes sur 163 (83%) souffrant d'une fracture de la hanche ont attendu plus de 48 heures avant une chirurgie. Les données nous suggèrent fortement que ces patients ont été exposés à des risques accrus de mortalité et de morbidité.

Avantages de l'élimination des délais de plus de 24 heures.

Réduction de la douleur, de l'invalidité et des inconvénients. Les délais opératoires accroissent la douleur et l'invalidité des patients souffrant de fractures.

Planification facilité des chirurgies. En moyenne, 10 patients souffrant de fractures attendent de subir une chirurgie dans les salles d'orthopédie et autres salles de chirurgie. L'ouverture de ces lits faciliterait la planification de l'admission des cas électifs.

Amélioration du moral. Les membres du personnel médical, des soins infirmiers et de soutien partagent le même désir d'offrir les meilleurs soins dans un environnement efficace et fonctionnel. L'élimination des délais d'attente inutiles aurait un effet positif sur leur moral et sur la capacité à recruter du personnel.

Utilisation plus efficace des lits. Au cours de la dernière année, environ 1 407 lits ont été occupés inutilement à cause de délais d'attente de plus de 24 heures. Au cours de la prochaine année, si tous les patients étaient opérés dans les 24 heures, environ 2 974 jours-lits pourraient être récupérés. Ceci représente environ 838 668 $ par année. Cette somme ne serait pas réalisée en économie budgétaire, mais plutôt en productivité accrue.

Mesures correctives

Actuellement, les délais d'attente subits par de nombreux patients souffrant de fractures au CUSM sont incompatibles avec une saine pratique médicale et sont une source d'inefficacité et de gaspillage de ressources.

Les raisons principales des délais dans le traitement des fractures au CUSM à l'heure actuelle sont une hausse de la demande (en moyenne 4,3 % par année) qui dépasse maintenant la capacité pendant les mois d'hiver, et une capacité limitée due surtout à la diminution de l'accès aux salles d'opération mais aussi à la pénurie de lits. Il y a cinq solutions théoriques à ce problème.

1). Le débit des patients au CUSM pourrait être réduit. Certaines interventions pourraient, en théorie, être assumées par des établissements de soins de niveau secondaires. Les raisons pour lesquelles elles ne le sont pas ainsi que toute intervention visant à rediriger le débit des patients, échappent à l'autorité du CUSM.

2). Une proportion accrue des heures consacrées à la chirurgie orthopédique pourrait être transférées de la chirurgie élective à la chirurgie des traumatismes. Cette solution ne pourrait être permanente car les délais d'attente pour les interventions orthopédiques sont déjà inacceptables (24 à 36 mois).

3). Transfert d'heures opératoires de la chirurgie générale à la chirurgie des fractures. Cette solution n'est pas pratique parce que les délais d'attente pour les chirurgies non-urgentes sont déjà trop longs. Ils excèdent de beaucoup les délais moyens notés au Québec.

4). Accroître le nombre de corrections de fractures pendant les heures opératoires disponibles le soir. Ce pourrait être une mesure temporaire pratique pour rattraper les retards, mais elle ne peut être considérée comme une solution permanente. Les cas de fracture admis le soir ou la nuit devraient toujours être traités rapidement, mais il serait déraisonnable d'attendre d'une discipline, quelle qu'elle soit, que ses membres travaillent régulièrement le soir pour pallier au manque de temps opératoire pendant le jour.

5). Ouvrir une salle d'opération additionnelle. Cette mesure est la seule solution locale que l'on peut envisager de façon permanente. En plus de l'augmentation du budget, du personnel et de certains éléments d'équipement, elle exigerait l'allocation d'une PREM additionnelle en anesthésie et d'une PREM additionnelle en orthopédie.

Recommandations.

Il est recommandé :

1). Que le CUSM informe de façon urgente l'Agence et le MSSS de la gravité de la situation et demande à recevoir l'autorité nécessaires pour ouvrir une salle d'opération additionnelle.

2). Qu'une demande urgente soit présentée pour l'octroi immédiat d'une PREM additionnelle en anesthésie et d'une PREM en orthopédie.

3). Que, comme solution intérimaire à court terme, l'hôpital garde la salle des fractures ouverte après 15 h et demande au département d'orthopédie de tout mettre en œuvre pour éliminer les délais d'attente excessifs en planifiant des cas pendant les heures disponibles en salle d'opération, le soir. Cette mesure devrait être revue après quatre semaines et la demande retirée si aucun progrès réel n'a été réalisé pour l'ouverture d'une salle d'opération additionnelle.

EXECUTIVE SUMMARY

Background.
This report on the delays experienced by patients before surgical correction of fractures in the MUHC is one of a series of studies on wait times requested by the Director General and CEO, Dr. Arthur Porter. It concerns only the management of acute, non-emergent, non-pathological, primary fractures.

Turnover at the MUHC
In the year 2005-06, excluding pathological fractures and re-operations, 830 adult patients underwent surgical reduction of acute fractures in the MUHC. This number is increasing by approximately 4.3% per year. Admission rates in winter are approximately 40% higher than in summer.

Benchmarks.
A systematic review of the literature leads to the following conclusions:

Hip. Results of studies on the consequences of delayed surgical correction of hip fractures is conflicting. It is probable, but cannot be considered proven, that delayed surgical correction of *hip fractures* results in increased mortality and morbidity, and prolongation of postoperative hospital stay.

Ankle. Tibia. The limited evidence available indicates that delay of > 24 hours in surgical correction of closed *ankle and tibial fractures* is associated with increased complications and with prolongation of hospital stay.

Targets/Guidelines.
Expert opinion and guidelines are unanimous that hip fracture correction should be undertaken within 24 hours, in the absence of medical contraindications.

There is no evidence of any adverse consequences resulting from prompt fixation of any of these fractures. On the contrary, early fixation results in reduced pain and disability, easier surgical fixation, reduced OR time, and reduced postoperative hospital stay.

Current wait times in the MUHC.
All limb fractures. In 2005-06 there were 830 cases who underwent surgical reduction of acute fractures. After exclusion of open fractures, delays due to medical causes, and problems with exact identification of wait times, the delays experienced by 574 patients were as follows:
Patients waiting more than 1 day after admission to ER…………..542 (94%)
Patients waiting more than 4 days after admission to ER………..…295 (51%)
Patients waiting more than 7 days after admission to ER…………..155 (27%)
Patients waiting more than 14 days after admission to ER…………….36 (6%)

Thus, in this sample 6% of fracture patients in the MUHC underwent surgical correction within the target of less than 24 hours,

Hip fractures. In 2005-06, of 163 adult patients with fractured hip, 136 (83%) waited > 48 hours before surgery. These patients were probably exposed to increased risk of mortality and morbidity.

Benefits of eliminating delays of >24 hours.

Reduction of Pain, Disability, Inconvenience. The pain and disability experienced by patients with fractures are all increased by operative delay.

Facilitation of surgical planning. On average there are 10 fracture patients awaiting surgery on the orthopaedic and other surgical wards. The opening of these beds would then facilitate the planned admission of elective cases.

Improved Morale. Medical, nursing, and support staff share a strong desire to render the best care in an efficiently functioning environment. Eliminating unnecessary wait times would have a positive effect on their morale and their ability to recruit.

More efficient bed usage. In the past year approximately 1,407 bed days were occupied unnecessarily as a result of wait times >24 hours. In the coming year, if all patients could be operated on within 24 hours there could be a saving of approximately 2,974 bed days. The dollar equivalent of this figure is approximately $838,668 per year. This sum would not be realized as budgetary saving, but would represent increased productivity.

Remedial measures

The wait time experienced by many fracture patients in the MUHC at this time is inconsistent with good medical practice and is a source of inefficiency and wastage of resources.

The principal reasons for delay in fracture management in the MUHC at this time are an increase in demand (average 4.3% per year), which now exceeds capacity during the winter months, and a limitation of capacity due principally to limitation of access to the OR but also to bed shortage. There are five theoretical solutions to this problem.

1). The patient flow to the MUHC could be reduced. A proportion of these surgical interventions could theoretically be managed in secondary level institutions. The reason that they are not, and any intervention to redirect patient flow are matters beyond the authority of the MUHC.

2). An increased proportion of orthopedic OR time could be diverted from elective to trauma surgery. As a permanent solution this is not feasible because wait times for elective orthopedic procedures are already unacceptable, ranging from 24 to 36 months.

3). Increased OR time could be diverted from General Surgery to fracture surgery. This is also not feasible because waiting times for other than urgent cases in general surgery are already unacceptably long. They are well in excess of the reported Québec average.

4). Increase the number of fracture corrections undertaken in available evening OR time. While this might be a feasible temporary measure to correct a backlog of cases, it cannot be considered a permanent solution. Fracture cases admitted in the evenings or at night should always receive prompt treatment, but it would be unreasonable to expect any discipline to routinely work at night to compensate for the unavailability of OR time in daylight hours.

5). Open an additional OR. This is the only feasible permanent local solution. In addition to the increase in budget, personnel, and some equipment, this would require the allocation of one additional anesthesia PREM, and one additional orthopedic PREM.

Recommendations.

It is recommended:

1). That the MUHC urgently inform the Agence and the MSSS of the present egregious state of affairs and request urgent authority to open an additional operating room.

2). That an urgent request be made for the immediate award of one additional anaesthetist PREM, and one orthopedic PREM.

3). That as an interim short term solution, the hospital should hold the fracture room open after 3 p.m. and request the Department of Orthopedics to make every effort to eliminate excessive wait times by scheduling cases in the available evening operating room space. This step should be reviewed after four weeks, and the request withdrawn if there has been no real progress in the opening of an additional operating room.

Wait times at the MUHC.
Fracture management.

CONTEXT

This document is one of a series of reports developed by the Technology Assessment Unit (TAU) in response to the request of Dr. Arthur Porter, Director General and CEO of the McGill University Health Centre (MUHC) that the Technology Assessment Unit (TAU) should conduct an investigation into wait times with the following objectives:

1. To determine wait times at the MUHC in the five priority areas identified by the Provincial First Ministers (diagnostic imaging, joint replacement, cancer care, sight restoration, and cardiac care).
2. To study patient internal wait times at the MUHC (appointments, tests, procedures) with the object of identifying bottlenecks in patient flow.
3. To identify the measures necessary to reduce excessive wait times.

The first two reports in this series[1;2] were directed to the first and second of the above objectives. In general these studies showed that in the MUHC patients requiring *emergency* and *urgent* care were generally being treated within an acceptably short waiting time. However, an exception was the delay experienced by adult patients awaiting surgical fixation of fractures. The present report is directed to this finding.

In reviewing the management of fractures, we consider the following questions:

1. What *targets and benchmarks* for fracture management should be used in the MUHC?
2. What are the wait times *experienced by patients* with fractures in the MUHC?
3. What *remedial steps* are necessary to ensure that the waiting times experienced by fracture patients in the MUHC are consistent with acceptable target values?

This report will consider only primary, non-emergent fractures of the limbs.

Thus, the following categories of fractures are not considered in this report:

- <u>Open fractures, and fractures of the pelvic ring</u>*. These are considered to be emergencies or urgent, and as such already receive prompt attention*.
- <u>Fractures of the head and neck, spine, pelvis, or rib</u>*. These also are mostly treated as emergency or urgent cases.*
- <u>Pathological fractures resulting from tumors;</u>
- <u>Secondary interventions involving re-operation for failed or imperfect union</u>

- Emergency Room (ER) Admissions. *Direct admissions to the orthopedic ward or transfers from other hospitals are excluded because of difficulty in determining the wait times.*
- Primary limb fractures treated by closed reduction. *Fractures that do not require use of the operating room and a general anesthetic are generally treated promptly.*

DEFINITIONS

Wait times

The wait time is generally considered to be the time elapsed between the initiation of a request for a service by the appropriate physician and the time that elapses before the service is received. In the case of fracture management we will consider the wait time to be the time elapsed between admission of a fracture patient to the emergency room (ER) of the MUHC, and transfer to the operating room (OR) for surgical fixation. Though there are other causes of delay, such as the time elapsed before coming to the MUHC, or the time spent in another institution before transfer, our concern in this report is to quantify delays *within the MUHC* and to suggest measures for their correction.

Benchmarks

Benchmarks are intended to be *evidence-based* intervals that express the longest time that it is appropriate to wait for a particular procedure or diagnostic test. Theoretically, because they are based on evidence, they are applicable across different jurisdictions[3]. In practice the "evidence" is often weak, and published benchmarks are variably dependent on expert opinion.

Targets

Targets are performance goals set by health authorities. They may be influenced by numerous factors including the pain and distress experienced by waiting patients, and are thus partly determined subjectively.

Priority

Unless otherwise specified the definition of priority is that used by the Canadian Wait Time Alliance[4]:

1 Emergency	Immediate danger to life, limb or organ.
2 Urgent	A situation that is unstable and has the potential to deteriorate quickly and result in an emergency situation.
3 Scheduled	A situation involving minimal pain, dysfunction or disability (also called "routine" or "elective").

METHOD

Information required for this study has been accessed as follows:

A search for evidence relating the length of wait times to mortality, morbidity, and length of hospital stay was carried out as described in Appendix 1. Reference lists of papers identified as relevant were searched further. This strategy was repeated to find guidelines and authoritative reviews that identified wait time targets and guidelines.

Data reflecting turnover rates and wait times within the MUHC were provided by the Department of Quality Management (Mme Doris Dubé).

Dr. G. Berry, Department of Orthopedics, MUHC was extensively consulted on the technical aspects of fracture management.

RESULTS

Turnover.

In Québec, the number of limb fractures requiring surgical fixation has shown a modest increase over recent years. Thus, in the two years for which data are available, 2002/3 to 2004/5, the total number of fractures (adult) corrected by open fixation in Québec rose from 16,322, to 17,558, or 3.5% per year [Explorateur 2004-05. MSSS].

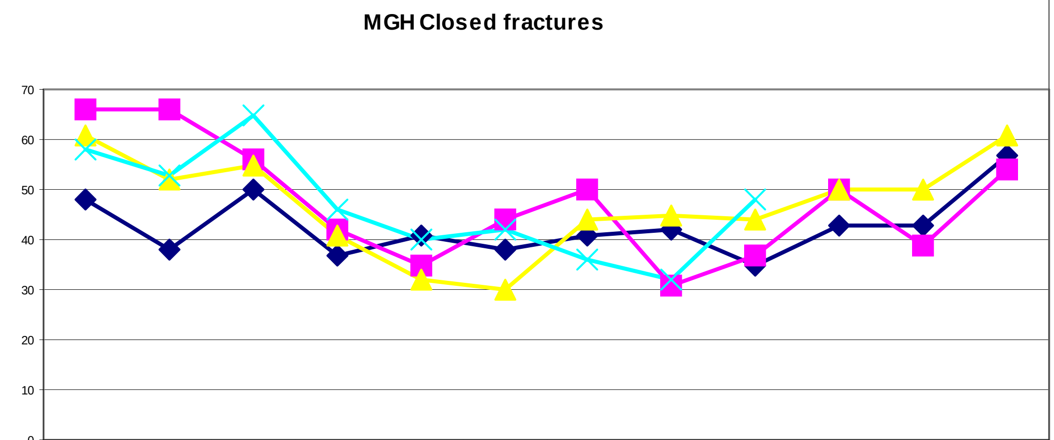
At the MUHC the turnover has increased more steeply. Thus, over the past four years, 2002-03 to 2005-06, the number of these procedures increased by 17%, (from 652 to 764), or approximately 4.3% per year [Explorateur 2002-06. MSSS].

It is anticipated that there will be a further increase in the coming months as a consequence of the discontinuation of fracture management in the Santa Cabrini hospital, an institution that has previously treated approximately 260 acute fractures per year.

Seasonal Variation.

As can be seen from figure 1, there is a seasonal variation in fracture admission rates, with approximately 40% fewer cases in the summer than in winter.

Figure 1



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2002	48	38	50	37	41	38	41	42	35	43	43	57
2003	66	66	56	42	35	44	50	31	37	50	39	54
2004	61	52	55	41	32	30	44	45	44	50	50	61
2005	58	53	65	46	40	42	36	32	48			

<u>Summary.</u> *The number of acute fractures (adult) undergoing surgical treatment in the MUHC has been increasing by approximately 4.3% per year. Admission rates in winter are approximately 40% higher than in summer*

Benchmarks. Evidence based.

Almost all of the identified studies that document the effect of wait times on clinical outcomes have been based on fixation of *hip fractures.* The outcomes most commonly considered have been mortality, morbidity, and length of hospital stay. These studies are considered below.

<u>Effect of delay of surgical correction of *hip fractures* on *mortality*.</u>

For ethical reasons there are no randomized controlled studies comparing the effect of different wait times on clinical outcomes. Thus, all studies are observational and suffer from the possibility of error due to confounding.

Since surgical techniques and devices have been evolving we have arbitrarily decided to review only those studies published since January 1, 1990. We also have excluded studies involving < 100 cases. After these exclusions we identified 23 studies of the relationship between surgical delay and mortality, 11 studies of the relationship between delay and morbidity, and 6 of the relationship between delay and hospital stay. In these studies, “delay” most frequently means >24 hrs, but can mean >12, >48hrs, or >72 hrs, from hospital admission to surgery. Occasionally the delay referred to is the time from injury to surgery. Mortality can mean deaths within 1, 3, 6, or 12 months. These studies also involve different age groups and different types of fracture, or use different methodologies and different statistical approaches. Accordingly, their results cannot be subjected to meta-analysis. Their more comparable features are summarized in Table 1(pp 28-34).

Surgical correction of a fracture may be delayed for medical reasons such as the need to stabilize the patient or because of the existence of serious comorbidities, or for administrative reasons such as unavailability of an OR or an anaesthetist. We are concerned here only with administrative delays that are at least theoretically avoidable.

Of 8 studies in which all delays were presumed to be administrative (non-medical) (table 1A), 4 studies found a statistically significant relationship between delay and mortality[5-8], while 4 did not[9-12]. The event rates are not reflected in all these studies. However the cohort size tended to be lower in the latter group compared to the former (278, 381, 468, 2148, vs 182, 778, 3625, 57315), suggesting that the absence of mortality effect may, at least in part, be due to lack of statistical power.

Nineteen studies include delays due to both medical and administrative causes, and in most the proportions are unstated (table 1B and 1C). In 16 studies in which adjustment for comorbidities was attempted, 9 found a significant relationship between delay and mortality[13-21] and 7 did not[9;22-27].

Quite apart from methodological problems that are found in most of these studies, the statistical adjustment of mortality according to the presence of pre-existing comorbidities is problematic. It is unlikely that comorbidity adjustments can be made for all clinical determinants of risk. Different studies use different indices of morbidity and not all can be correct. Thus, residual confounding is likely.

Theoretically, this problem should not arise in those studies in which attempts have been made to eliminate all medical causes of operative delay (table 1A). However, no such assumption can be made. For example, in the prospective observational study of Siegmeth *et al.*[8], even after elimination of all cases in which delay was for medical reasons, there must still have been an unequal distribution of comorbidities between delayed and not delayed patients since univariate analysis shows a highly significant relationship between delay and mortality at one year, but this is no longer statistically significant after adjustment for three different morbidity indices (American Society of Anesthesiology (ASA) grade, a mental score, and a pre-fracture mobility score).

The problems relating to adjustment are well illustrated in the study of Zuckerman *et al.*[21]. Here, outcomes were adjusted first according to the *number* of pre-existing co-morbidities as judged by the attending physicians, and second according to the *severity* of pre-existing co-morbidities using the ASA scale. The former analysis found a significant association between operative delay and one-year mortality while the second did not. Which should be considered "correct" remains completely uncertain.

Thus, it is difficult to know in such studies whether the preoperative delay was the *cause* of the outcomes observed, or whether it was the existence of the co-morbidities that caused surgery to be delayed. Hamilton and colleagues after comparing wait times and outcomes of hip fracture patients in Québec and Massachusetts concluded that "the strong statistical relationship between delay and outcomes…. appears to reflect unmeasured patient frailty at the time of admission[28]."

What can be concluded from these studies? A comprehensive systematic review concluded in 2005 that in four cohort studies in which "appropriate risk adjustment" was employed; surgical delay was associated with increased adverse outcomes. "However, determining the effect of time to surgery on patient outcomes is difficult because RCT's have not been considered feasible or ethical"[29]. There is no obvious difference between the quality of those studies that find a relationship between delay and mortality, and those that do not. Nor is there a difference between those that compare mortality in-hospital or at the end of the first, third, sixth, or twelfth month.

However, studies such as those of Dorotka et al. may provide some explanation. Defining delay by a series of progressively longer cut-offs (+/- 6 hours, 12 hours, 18 hours, 24 hours, and 36 hours), they found that mortality rose progressively with each increase in surgical delay up to 36 hours[7]. There are similar findings in other studies[13;18]. If it were true that most of the increase in mortality occurs with delays of up to 36 hours, series that examine the influence of longer delays on mortality may fail to detect an effect.

Summary*. On the basis of the available evidence it is probable, but cannot be considered completely proven, that delayed surgical correction of hip fractures results in increased mortality.*

Effect of delay of surgical correction of *hip fractures* on *morbidity* and *hospital stay*.

Morbidity. Studies of the effect of surgical delay on postoperative morbidity suffer from the same problems. The results of these studies are also shown in table 1 (pp 23-29). Surgical delay has been found to be associated with; pressure sores[11;24;30;31], post-operative complications[17], deep vein thrombosis[11;30;32], anemia[25], confusional state[11], pneumonia[30], urinary infection[30;33], and with pooled complications (infection, deep vein thrombosis, urinary infection, MI, confusion, and pneumonia) [5]. However, as can be seen from the table, not all investigators have found these associations. This may be due in part to a lack of statistical power for secondary outcomes in these studies.

Hospital stay. The evidence for an association between operative delay and increased postoperative hospital stay is more consistent. Of 7 studies that examined this, a statistically significant relationship was found in 4[8;26;34;35], and a marginally significant (P=0.06) relationship in the other three[9;11;24]. This strongly supports the probability that increased delay is in fact associated with increased postoperative morbidity, since there is no other obvious reason why postoperative stay should be prolonged.

Summary. *The evidence suggests that delayed correction of hip fractures is associated with increased postoperative hospital stay, and is very probably associated with increased postoperative morbidity, (in particular, pressure sores, deep vein thrombosis, urinary infection, and possibly myocardial infarction, pneumonia, and confusional states).*

Effect of delay of surgical correction of *ankle fractures* on *morbidity* and *hospital stay*.

Morbidity. Two papers examined the effect of delayed surgery for *closed* ankle fractures that require open reduction and internal fixation (ORIF). One found that the rate of major complications associated with delays over 24 hours was more than 8 times higher (44% vs. 5.3%, p not given) than in patients who were operated on <24 hours [36], and the other found that in a closed ankle fracture population in which all surgical delay was due to non-availability of OR, there were no infections in patients operated on <24 hours compared to 6 infections in patients who had surgery more than 24 hours after injury (p = not given)[37]. In a third study in which patients operated on within 8 hours were compared to those whose surgery was delayed by five or more days, the infection rates were 3% and 17.6% in the early and delayed groups respectively (p=0.054)[59].

Hospital stay. In the previously mentioned study [59] the total hospital stay for patients whose intervention was delayed by five or more days was longer by 12.4 days (p<0.001), and two studies found that operative delays of > 24 hours were associated with increased post operative hospital stay by 4.4 and 1.2 days respectively [37;38]. Other studies have found delays of >48 hours to be associated with an increase of 1.5 post operative days[39], and of 5-8 days to be associated with “a considerably longer” hospital stay[40]. One study, in which comparison was made between patients undergoing surgery on average 1.5 days and 13.6 days after admission found no significant difference in complication rates or length of stay[41].

The fairly consistent finding of a relationship between delayed intervention and prolongation of post-operative hospitalization increases the credibility of a relationship between surgical delay and increased postoperative complications since there is presumably no other reason than increased complications for postoperative hospitalization to be prolonged.

Surgical delay of more than 24 hours may also allow sufficient time for the development of “fracture blisters”, which may form 24-48 hours after injury in approximately 4% of ankle fractures. When these develop operative intervention has to be avoided until they resolve, which may take several days[42].

Finally, hospitalization may be prolonged when patients are unable to mobilize and assume self-care after surgery due to muscle loss and weakness, a result of the muscle wasting that occurs when patients are kept immobile for long periods while awaiting surgery. Muscle wasting can also occur as a result of a patient being repeatedly prepared for surgery, with appropriate fasting, and then displaced from the operating list by a more urgent case. It is reported that in the MUHC this series of events may recur on several occasions, and can involve many patients during the most overloaded months [Dr G Berry, Trauma Service, MUHC].

<u>Summary</u>. *The limited available evidence is consistent in finding that delays in the surgical correction of closed ankle and tibial fractures of more than 24 hours are associated with increased complications and with prolongation of post-hospital stay.*

<u>Effect of delay of surgical correction of *closed tibial fractures* on *morbidity* and *hospital stay*.</u>

Two studies report on the effect of delay of operative treatment of closed fractures of the tibial shaft of >12 hours. Both were associated with prolongation of postoperative hospital stay (4.5 days, $p < 0.01$)[43], and 3.1 days, $p < 0.05$)[44]. These studies are published by the same group and there may be overlap of data. The second study also found an association between delayed surgery and delayed fracture union (28.2 weeks and 44.2 weeks, $p < 0.01$).

Targets. Guidelines.

Reviewers of hip fracture management have generally advocated early fixation[31;45-49]. Because only observational studies with their inherent biases and conflicting results are available an Australian reviewer concluded more cautiously that “longer time to surgery is likely to increase the risk of complications…and early surgery on patients who are medically stable has not been shown to cause any harm”[50].

In 2003 a systematic review of “Evidenced-based guidelines for fixing broken hips: an update”, concluded that “early surgery (within 24-36 hours) is recommended for most patients once a medical assessment has been made and the patient’s condition has been stabilized appropriately. Undue delay to surgery inevitably increases length of stay and may lead to more complications, including pressure sores, pneumonia and confusion”[51].

A meta-analysis published in 2005, designed to establish “Best practices for elderly hip fracture patients” concluded that fixation of hip fractures should be undertaken “once patients are medically stable, within 24 hours if possible”[29].

In June 2003 the New Zealand Guidelines Group concluded that “Early operation (within 24 hours) for people age 65 and over with hip fracture is associated with shorter hospital stay and decreased mortality/morbidity”[52].

Scottish guidelines produced in 2002 recommend that “Patients should be operated on as soon as possible (within 24 hours), if their medical condition allows”[53].

On December 12, 2005 the Canadian ministers of health defined the benchmark for hip fracture repair (for all jurisdictions except Québec) to be < 24 hours[54].

In October 2006 the Executive Committee of the Québec Orthopedic Association recommended that a “ reasonable delay ” for access to orthopedic surgical care was <12 hours for lower limb fractures or long bone fractures and < 24 hours for hip fractures and ankle fractures[55].

<u>Summary</u>. *Expert opinion and guidelines are unanimous that hip fractures should be corrected within 24 hours in the absence of medical contraindications.*

Other reasons to avoid delay in surgical correction.

There is virtually no justification for any delay of fracture fixation, other than those determined by the patient’s condition. Though temporary splinting and appropriate analgesia can successfully diminish the pain associated with acute fractures, any delay in fixation will obviously prolong disability, and disadvantage patients through impairing their ability to work and to carry out common tasks

In addition, operative delay for more than a few days can make corrective alignment more difficult and require longer operative time. It may also necessitate the use of more expensive fixation devices. Delay for 10 days or more may require that temporary union be forcefully disrupted before alignment and fixation can proceed.[G Berry, Orthopedic Surgeon, Trauma, MUHC]

Summary. *There is no evidence of any adverse consequences resulting from early fixation of these fractures. On the contrary, early fixation results in reduced pain and disability, easier surgical fixation, reduced OR time, and shorter postoperative stay.*

Wait times in the MUHC.

Wait times. All acute fractures.

In previous years the proportion of adult patients waiting for fixation of acute fractures (pathological fractures excluded) for more than three days is as follows [Trauma Registry MUHC]:

2002… 40%
2003….52%
2004….56%
2005….65%

More information is available for the year 2005-06, in which 830 cases underwent open reduction of acute closed fractures. The hospital database was studied to establish the time of fracture, the time of admission to the ER, the time of surgery, the source of each patient, the precise site of fracture, and the presence of co-morbidities.(see Appendix 2). It was necessary to exclude 256 cases for the following reasons:

Exclusions

- Day surgeries without previous visit to ER ………………………….…45
- Patients either lacking the date of first visit to ER, or patients previously admitted for fracture (ie.not acute fractures).………...…...40
- Transfers from other hospitals, rehabilitation centres, or clinics, with no date of the first ER visit…………………………………..……….67

- Compound (open) fractures…………………………………………….……….80
- Medical reasons for delaying surgery……..…………………...……..…24

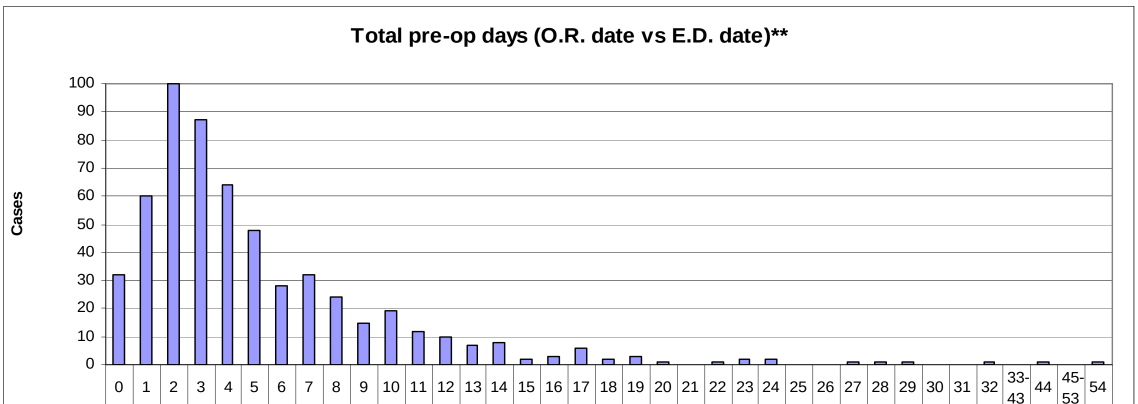
Total…………………………………………………………………………..256

Thus, this analysis includes: 830 – 256 patients =………………….…….574

The histogram describing the distribution of wait times in these 574 patients is shown in figure 1 .

<u>Figure 1</u>

McGill University Health Centre, 2005-06.
Inpatients & Day Surgeries for Reduction of closed fractures or dislocations & hip hemiarthroplasties



Pre-op days	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
# of cases	32	60	100	87	64	48	28	32	24	15	19	12	10	7	8	2	3	6	2

Pre-op days	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33-43	44	45-53	54
# of cases	3	1		1	2	2			1	1	1			1		1		1

Note: These data indicate the difference in the *dates* of admission to the ER and OR. They therefore are not identical with, but closely reflect the time lapse between these two events.
** Includes pre-op days in ER in-hospital, or at home.

n = 574, Pre-op delay (days) Average(range)= 5(0-54), Total pre-op days = 3,004

<u>NOTE</u> With few exceptions these data are not based on chart review, but on the hospital databank. It is thus possible that in some instances a medical reason for delay of surgery has been overlooked. These data, nevertheless, reflect closely the waiting times experienced for administrative, non-medical reasons.

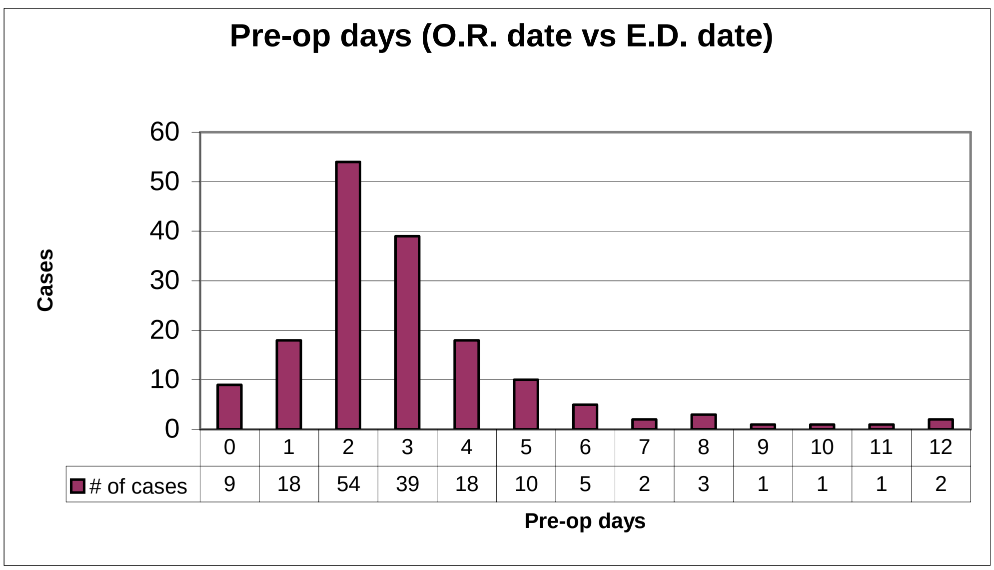
<u>Summary</u>. *Considering only administrative wait times, in the past year 6% of fracture patients at the MUHC underwent surgical correction within the generally accepted target of < 24 hours. The distribution of wait times was as follows :*

Patients waiting more than 1 day   after admission to ER……………..542 (94%)
Patients waiting more than 2 days after admission to ER……………..482 (84%)
Patients waiting more than 4 days after admission to ER……………..295 (51%)
Patients waiting more than 1 week after admission to ER……………..155 (27%)
Patients waiting more than 14 days after admission to ER……………….36   (6%)
Patients waiting more than 21 days after admission to ER………………..6   (1%)

Wait times. Hip fractures.

Because the evidence supports the probability of increased mortality as well as morbidity associated with delayed correction of hip fractures, the distribution of delays for patients with *hip* fracture awaiting surgery for non-medical reasons in 2005 – 06 is shown in Figure 2, below.

Figure 2



	0	1	2	3	4	5	6	7	8	9	10	11	12
# of cases	9	18	54	39	18	10	5	2	3	1	1	1	2

** Includes pre-op days in ER, in-hospital or at home

n = 163. Pre-op days Average = 3, Pre-op days Median = 3, Pre-op days Min =0
Pre-op days Max =12, Total pre-op days = 487

From this it can be seen that in the year 2005-06, 163-(9+18) = 136 patients waited >48 hours for surgical correction of hip fractures for non-medical reasons.

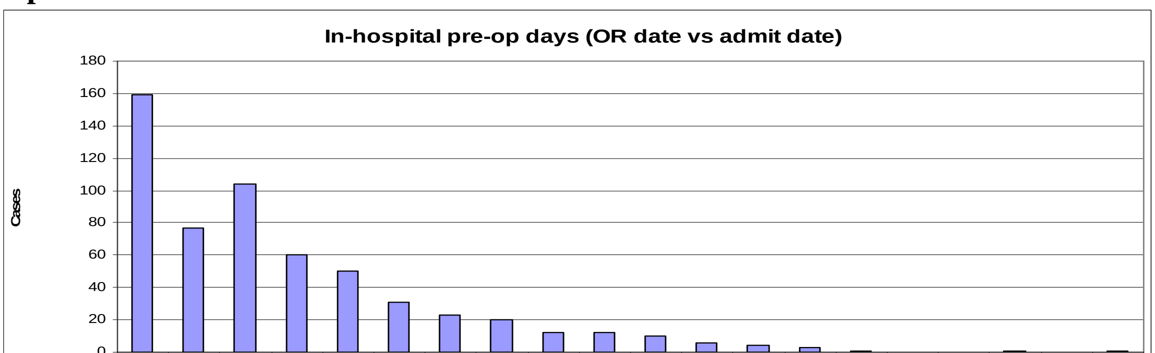
Summary. *In 2005-06 approximately 136 adult patients with fractured hip waited >48 hours before correction and were thus presumably exposed to increased risk of mortality and morbidity.*

Bed days wasted.

In addition to patient related ill effects of surgical delay, prolonged wait times also cause an unnecessary wastage of beds while patients wait for their surgery. To estimate the number of hospital bed days used by patients awaiting surgery for administrative reasons we will consider time spent in the ER and that on the ward as equivalent. The numbers are shown in figure 3 below.

Figure 3

Inpatient bed Utilization



	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
# of cases	159	77	104	60	50	31	23	20	12	12	10	6	4	3	1			1		1

In-hospital pre-op days

n = 574 Total in-hospital pre-op days (ER + Ward) = 1,605

From the above it can be seen that a total of 1,605 bed days were used by patients waiting in the hospital for their surgery, for non-medical reasons. If all these patients had been operated on <24 hours from admission to the ER there would have been a saving of 1605-(159+ 39) = 1, 407 bed days. (We assume that half of the patients operated on day 1, i.e. 39, were admitted on day 0, with a wait time of < 24 hours).

As can be seen above (pp.20-21), 152 cases were excluded from this analysis because of inability to be sure of admission date. If it were assumed that the distribution of wait times in these patients was the same as in the 574 cases included, then surgery within 24 hours of admission would have resulted in a saving of (1,407 X 726/574) = 1,780 bed days.

The above estimates are based on data from the year 2005-06. However, in the coming year the bed wastage will be greater. Because of the difficulty of obtaining a bed for the planned admission of a fracture patient awaiting surgery, the decision has been taken that instead of being sent home, all fracture patients will be kept in hospital until surgery can be undertaken. If this policy had been in effect in 2005-06, the total number of days in-hospital (ER + Ward) used by fracture patients awaiting surgery would have been 3004 (Figure 1) while a policy that resulted in all cases (other than medical delays) being operated on <24 hours would have resulted in a saving of 3004-30 = or 2974 bed days for patients awaiting surgery. We again assume that half of the patients operated on day one were admitted on day 0 with a wait time of <24 hours.

Costs.

Of the total time spent waiting for surgery, most is spent on the orthopedic ward where the direct cost is estimated to be $282 per day. For present purposes we will attribute this cost to all time spent in the hospital. With this assumption, the dollar equivalent of bed days wasted due to delays in excess of 24 hours in the year 2005-06 are approximately 1,780 x 282 = $501,960. Furthermore, if the policy of not discharging patients to await surgery in their homes were to be maintained, correcting all fractures within 24 hours would produce a saving of approximately 2974 X 282 = $838,668.These sums would not, of course, be realized as budget savings, but would reflect increased productivity.

Efficiency.

There are at present on average 10 fracture patients on the orthopaedic or other surgical wards awaiting surgery for administrative reasons, and a variable number blocking spaces in emergency rooms. Freeing these beds would facilitate the planning of elective cases, and bring some relief to the deplorable ER overcrowding.

Morale.

The demoralizing effect on all staff of having to work in an environment in which delivery of less than optimal health care has become the norm cannot be exaggerated. Elimination of unnecessary delay of fracture management would have a very positive effect on morale of all and would obviously facilitate recruiting.

Summary. *In the past year approximately 1,780 unnecessary bed days were used as a result of wait times >24 hours. Reduction of wait times to <24 hours in the coming year might save 2,974 bed days (equivalent $838,668) and make on average 10 additional surgical beds available*.

REMEDIAL MEASURES.

There are no benefits associated with delays. All patients must eventually be treated. At present only 6% of surgical corrections are undertaken within the target time of <24 hours from admission to the hospital. **This is inconsistent with good medical practice and a source of inefficiency and wastage of resources.**

The principal causes of delay in the MUHC at this time are: a greater volume of patients than can be managed during the winter months; and the difficulty of accessing the operating room. Lack of bed availability is often a contributing factor.

There are five ways in which excessive surgical delay could theoretically be eliminated.

1. Reduce the flow of fracture patients coming to the MUHC.
2. Transfer more orthopaedic OR time from elective to fracture surgery.
3. Transfer OR time from other surgical disciplines to fracture surgery.
4. Undertake fracture surgery at night when OR time becomes available.
5. Open an additional operating room.

We will consider each of these briefly below.

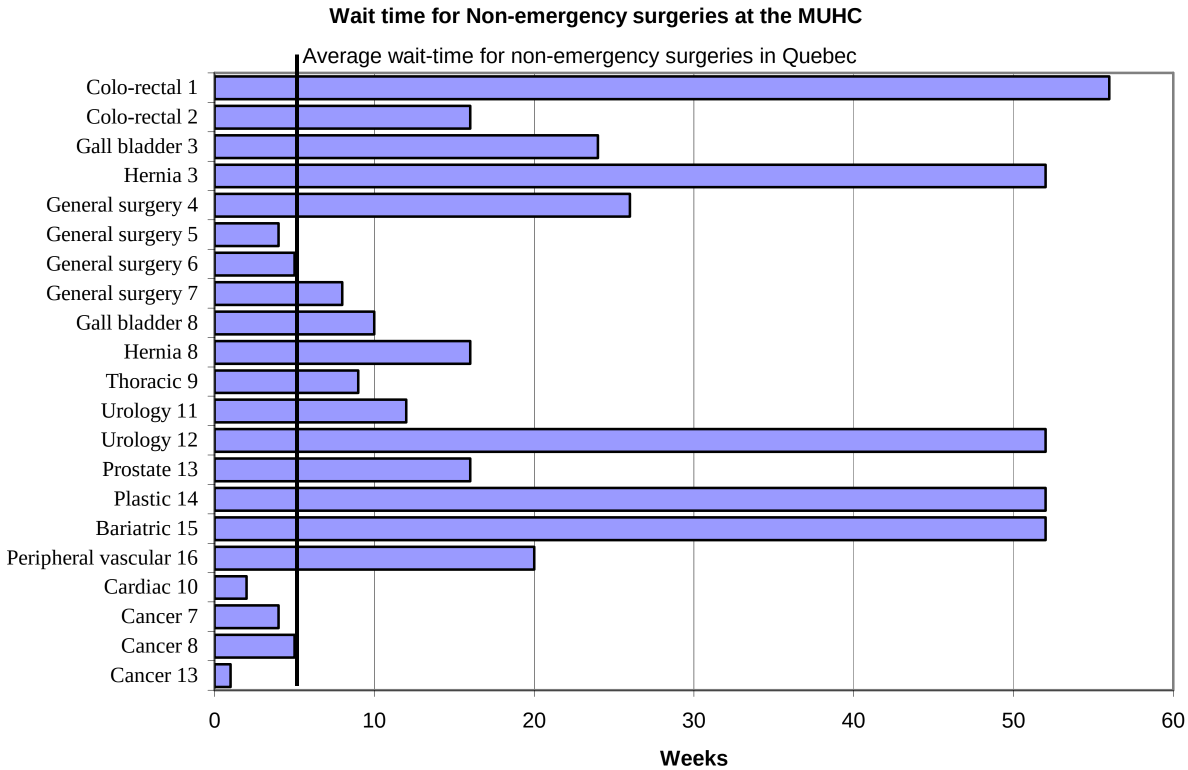
<u>1). Reduce patient flow</u>.
As outlined above there has been an average 4.3 % pa. increase in fracture work at the MUHC totaling 17% over the past four years alone. There is no way in which this increase in demand can be corrected by the MUHC, and any such action must be taken at the level of the Agence.

<u>2). Transfer more orthopedic OR time from elective to fracture surgery.</u>
As reported in TAU Report Number 26, wait times for elective orthopedic procedures are already completely unacceptable (E.g. Hip replacement, 24 months; Knee replacement, 36 months; Hip arthroscopy, 27 months; Knee arthroscopy, 24 months). The principal reason for these long wait times is a lack of OR access. To diminish this access even further is clearly not a permanent option.

<u>3). Transfer OR time from other surgical disciplines to fracture surgery.</u>
The ORs are used by various surgical disciplines all of which require an increased allocation of time. The graph shown below reflects the waiting time for non-emergency, non-urgent cases reported by a convenience sample of surgical disciplines at the MUHC in January 2007.

The vertical line in this graph indicates, not the target or benchmark wait time, but the average wait time reported for “non-urgent surgery” in Québec in 2005 [56]. As can be seen, with very few exceptions wait times, even for cancer surgery, exceed the Québec average. Such wait times are unacceptable.

Figure 4:



Note: The delay for Bariatric surgery is between one and three years, according to severity. However, much of the delay is due to bed shortage rather than lack of OR time

4). Undertake fracture surgery in the evenings when OR time becomes available
This cannot be considered other than a very temporary solution. Normal practice requires that cases admitted in the evening or overnight should undergo surgery as soon as they are medically prepared. But it would be unreasonable to expect orthopaedic or any other discipline to routinely operate at night in order to compensate for the unavailability of operating room space during the daytime.

5). Open an additional operating room.
The opening of an additional OR is the only local acceptable permanent solution. It cannot be undertaken without the allocation of one additional anesthesia PREM, and cannot be sustained without one additional orthopedic PREM. Fracture cases, which should always be considered Emergency or Urgent, should receive priority treatment in this facility. The remaining time should be used for elective procedures of all disciplines, according to need.

RECOMMENDATIONS.

It is recommended:

1). That the MUHC urgently inform the Agence and the MSSS of the present egregious state of affairs and request urgent authority to open an additional operating room.

2). That an urgent request be made for the immediate award of one additional anaesthetist PREM, and one orthopedic PREM.

2). That as an interim short term solution, the hospital should hold the fracture room open after 3 p.m. and request the Department of orthopedics to make every effort to eliminate excessive wait times by scheduling cases in the available evening operating room space. This step should be reviewed after eight weeks, and the request withdrawn if there has been no real progress in the opening of an additional operating room.

TABLE 1
Hip Fractures. Relationship between time to surgery and clinical outcome.

1 A
Only delays for administrative reasons included.

ADJUSTED OUTCOMES

Bergeron. 2006[9]. Fracture of proximal femur. Age, mean, 80yr.
Retrospective medical record review. n=278. Logistic regression.
Medical Delays, 0%.* . Groups tested (days) <2 vs. >2

Relationship		Risk	
? In Hospital Mortality**	No	3.9% vs. 0%	P= 0.2
Severe Complications	No	5.9% vs. 0%	P= 0.04
Hospital Stay (days)	No	16 vs. 20	P= 0.07

* This is a subgroup of a larger study. For results of patients in whom all delays were for medical reasons, see table 1A
** Not explicitly stated.

Siegmeth. 2005[8]. Fractured hip. Age, mean, 81yr (60-103).
Prospective observational study. n=3628. Regression analysis.
Medical Delays 0%. Groups tested (days) <2 vs. >2

Relationship		Risk	
1 year Mortality*	Yes	6.9% vs. 13.8%	CI 2.9-10.8.
1 year Mortality**	No		
Hospital Stay (days)*	Yes	22 vs. 37	P=<0.0001

* Univariate analysis .
**Adjusted for American Society of Anesthesiology grade, mental score, and pre-fracture mobility score.

Weller. 2005[5]. "Fractured hip." Age, mean, Men= 78yr, Women= 81yr
Retrospective database study. n= 57,315. Multiple regression
Medical Delays, assumed 0% * Groups tested (days) <1 vs. 3-7

Relationship		Risk	
In Hospital Mortality **	Yes	OR 1.60	CI 1.42-1.80
3 month Mortality	Yes	OR 1.40	CI 1.27-1.53
1 year Mortality	Yes	OR 1.58	CI 1.26-1.99
Complications	Yes	OR 1.38	CI 1.25-1.52

* Delays <7 days assumed to be administrative. Delays >7days excluded.
** Risk of in hospital mortality greater for younger, healthier patients.

Moran. 2005[10]. "Fractured hip". Age, mean(range)= 80 (17-103)yr.
Prospective observational cohort. n=2,148. Multivariate Cox regression.

Medical delays = 0% . Groups tested (days)<2 vs. >3

Relationship		Risk	
30 day Mortality	No	7.3% vs. 8.7%	P= 0.19

Williams. 2005[12]. "Fractured hip". Age mean(range)= 81 (53-100)yr.
Retrospective cohort. n=381.
Medical delays =0% . Delay a continuous variable.

Relationship		Risk
1 year Mortality	No	P= 0.32

Dorotka. 2003[7]. Proximal fracture of femur . Age Approx78 yr.
Prospective cohort. n=182.
Medical delays=0%. Groups tested (days) <1 vs. >1

Relationship		Risk	
6 months Mortality	Yes	13.9 vs. 33.3	P<0.05

Parker. 1992[11]. "Proximal femoral fractures", receiving hemiarthroplasty or internal fixation with dynamic hip screw. Age not stated.
Prospective study. Consecutive cases. n=468
Medical Delays= 0% Groups tested(days) <1 vs. >2

Relationship.		Risk	
30 day Mortality	No	10% vs. 9%	n.s.
Bedsores	Yes	18% vs. 28%	P = 0.01
Infections	No	8% vs. 11%	P = 0.3
Thrombo-Embolism	Marginal	1% vs. 3%	P = 0.06
Confusional State	Yes	21% vs. 13%	P = 0.05
Hospital Stay (days).	Marginal	37% vs. 46%	P = 0.06

Bredahl. 1992[6]. ".Fracture neck or trochanter". Age, median,(range).79(16-102)yr.
Retrospective chart review. n =778
Medical Delays = 0% Groups tested (hours) <12h vs.>12 hr

Relationship			Risk
1 yr Mortality	(All Fractures)	Yes	P > 0.05
	(Fem neck)	Yes	P < 0.05
	(Trochanter)	No	P > 0.05

1B

Delays for both medical and administrative reasons included.

ADJUSTED OUTCOMES

Bergeron. 2006[9]. Fractions of proximal femur. Age, mean, +/- 80.
Retrospective chart review. n= 699.
Medical Delays 0%.*Logistic regression. Groups tested (days) <2 vs.>2

Relationship		Risk	
? In-hospital Mortality**	No	15% vs. 22%	P=0.2
Severe complications	No	22% vs. 32%	P=0.06
Hospital stay (days)	No	20 vs. 30	P=0.06

* This is a subgroup of a larger study. All delays for medical reasons are excluded. For patients with 100% medical delays see table 1B
** Not explicitly stated.

Petersen. 2006[20]. Intracapsular displaced femoral neck fracture. Age, mean +/- 82 yr.
Retrospective. Consecutive medical records. State population Registry. N=1186.
Medical Delays ?%. Multivariate analysis, delay a continuous variable..

Relationship		Risk	
3 month Mortality	Yes	6%increase/day delayed.	P<0.0001
1 year Mortality	Yes	4% increase/day delayed	P=0.005

Majumdar. 2006[25]. "Fractured hip". Age, median(range) 82(60-104)yr.
Prospective cohort study. n=3864
Medical Delays ? % Groups tested (days) <1 vs. >2

Relationship		Risk	
In-Hospital Mortality	No	OR 1.3	CI 0.86-2.0
MI	No	1% vs. 3%	ns
Pneumonia	No	1% vs. 2%	P = 0.14
Urinary infection	No	2% vs. 3%	P = 0.34
Anemia	Yes	17% vs. 8%	P >0.001

Bottle. 2006[14]. "Fractured neck of femur". Age, median 83yr.
NHS database study. Population based cohort. . n= 114,942
Medical Delays ?% Groups tested (days)<2 vs. >2

Relationship		Risk	
In-Hospital Mortality	Yes	OR 1.43	CI 1.37 – 1.49

Franzo. 2005[57]. "Hip Fracture". Age Average(range) +/- 81(65-101)yr
Prospective cohort study. n=6629
Medical Delays =?% Groups tested (days)<2 vs. >2

Relationship		Risk
In-Hospital Mortality	No	OR 0.9 CI 0.58 – 1.4
1 month Mortality	No	OR 1.08 CI 0.80 – 1.47
6 month Mortality	No	OR 0.99 CI 0.86 – 1.15
12 month Mortality	No	OR 1.07 CI 1.07 – 1.21

McGuire. 2004[19]**.** "Hip Fracture". Age. Mean (range) 82.4(65-118)yr.
Historic cohort study. Medicare database. n=18,209
Medical Delays ?% Groups tested (days)<2 vs. >2

Relationship		Risk
30 day Mortality	Yes	OR 1.17 P = 0.02

Orosz. 2004[26]."Hip Fracture"". Age. Mean, 82 yr
Prospective, 4 hospitals. n =1178.
Medical Delays ?%. Groups tested (days) <1 vs. >1

Relationship		Risk
6 month Mortality	No	HR 0.98 CI 0.63-1.50
Hospital stay	Yes	OR-1.94 CI –2.82 to -1.06

Gdalevich. 2004[17]**.** "Hip Fracture". Age. All > 60. Half > 80yr.
Retrospective cohort. n=651.
Medical Delays ?%. Groups tested (days) <2 vs>2

Relationship		Risk
1 year Mortality	Yes	HR 1.63 CI 1.11 – 2.40
General Complications	No	HR 1.13 CI 0.78 –1.63

Baumgarten. 2003[31]. "Hip Fracture". Age >60yr.
Retrospective cohort study. Chart review. n=9400
Medical Delays ? % Groups tested (days) <1 vs. >3

Relationship		Risk
Pressure Sores	Yes	OR 2.3 CI 1.6-3.1

Elliott. 2003[15]**.** "Fractured Neck of femur".
Prospective cohort study. n= 1,780
Medical delays ? %. Logistic regression model.

Relationship		Risk
1 Yr Mortality	Yes	OR 7.98 CI 2.17 – 29.7

<u>Grimes. 2002</u>[24]. “Fractured hip”. Age > 60 yr.
Retrospective cohort study. Hospital records. n=8,303
Medical Delays =65% Groups tested(days) 1-2 vs. >4

<u>Relationship</u>		<u>Risk</u>
30 day Mortality	No	OR 1and.05. CI 0.68-1.63
Bedsores	Yes	OR 2.2 CI 1.6-3.1
Infections	No	OR 1.1 CI 0.7-1.8
M. I	No	OR 0.8 CI 0.4-1.7
Thrombo Embolism	No	OR 1.3 CI 0.7-2.8
Hospital Stay (days)	Marginal	31 vs. 46 P = 0.06

<u>Stoddart. 2002</u>[27]. “Fractured neck of femur”. Age = 60 yr.
With prospective cohort study. Hospital records. n=138.
Medical delays= ? %. Groups tested (days) <1 vs. >1

<u>Relationship</u>		<u>Risk</u>
1 year Mortality	No	P= 0.43

<u>Clague. 2002</u>[22]. “Fractured Hip”. Age mean 80 yrs.
Prospective cohort study. n=622.
Medical delays ? %. Groups tested (days) <1 vs>1

<u>Relationship</u>		<u>Risk</u>
90 day Mortality	No	
Pressure sores	No	

<u>Hamlet. 1997</u>[18]. “Intertrochanteric or neck fracture”. Age. Av(range). 77(44-100)yr.
Retrospective chart review of consecutive cases. n=168.
Medical Delays = ?% Groups tested (days) <1vs1-2 vs. >2

<u>Relationship</u>			<u>Risk</u>	
1 Yr Mortality	<1 vs. 1-2	Yes	8% vs. 15%	P ,0.001
	1-2 vs. >2	Yes	15% vs. 29%	P<0.001

<u>Zuckerman. 1995</u>[21]. “Hip Fracture”. Age >65yr.
Prospective cohort study. <u>n</u>=367. Groups tested(days)<3vs>3
Medical Delays = ?%.Two analyses: a) Number of co-morbidities.(physicians estimates).
b) Severity of comorbidities (Am.Soc.Anes. classification).

<u>Relationship</u>			<u>Risk</u>
1 year Mortality.	a)	Yes	OR 1.76 CI 1.00-3.10
	b)	No	OR 1.60 CI 0.90-2.85
Complications*		No	6% vs. 5% ns

* = MI, decubitus ulcer, pneumonia, pulm.embolus, urinary tract infection, allergy, arrhythmia, deep wound infection

Beringer. 1996[13]. "Proximal Femoral Fracture". Age Approx 83 yr
Prospective cohort. n=280
Medical Delays ?%. Groups tested (days) <1 vs. >1, <1 vs. >3

Relationship			Risk	
1 yr Mortality	<1vs. >1	Yes	RR 1.7	CI 1.0-2.9
	<1vs. >3	Yes	RR 2.7	CI 1.5-4.8

Fox. 1994[16]. "Proximal femoral fractures". Age not stated.
Prospective 1 Yr cohort. n= 142
Medical Delays 45%. Groups tested(days)<1 vs. 1-3 vs. >3

Relationship			Risk
In-patient Mortality.	<1 vs. >1	Yes	0 vs. 16% p= 0.04

1 C

Delays for both medical and administrative reasons included.

UNADJUSTED OUTCOMES

Elder. 2005[30]. "Fractured neck of femur". Age>64yr.
Retrospective review of outcomes in two hospitals. n=680
Medical Delays =?%. Groups tested(hrs)Hosp A=56(4.3-520.1) vs.
Hosp B=29.3(0.6-574.1)

Relationship		Risk	
30 day Mortality	No	7.5% vs. 10.2%	P= 0.21
Pneumonia	Yes	11.8% vs. 5.5%	P=0.0017
P. embolism	No	1.8% vs. 1.6%	P=0.9
Deep V. thrombosis	Yes	2.4% vs. 5.7%	P= 0.0246
Urinary infection	Yes	10.0% vs. 36.3%	P=0.0017
Pressure sores	Yes	2.0% vs. 6.1%	P=0.002
Wound infection	Yes	0.7% vs. 2.5%	P=0.0192
Combined cardiac	Yes	10.0% vs. 24 %	P= 0.0001

(Note: This was not a study designed to determine influence of delay on outcome, but a study of two hospitals, in one of which (A) mean preoperative delay was 56 hours compared to 29.3 hours in hospital (B). However, in (A) operative time 17min longer, there was significantly more blood loss, and more general than spinal anesthesia.)

Casaletto. 2004[58]. "Fractured hip" Age, Average(range). Approx 78(28-99)yr
Retrospective comparison of 2 cohorts. Different times. Different anaesthetists. n=363
Medical Delays=?%. Two cohorts, average wait 0.47& 1.01 days, respectively.

Relationship .		Risk.	
30 day Mortality	No	4.2% vs. 5.5%	ns
1 yr Mortality	Yes	16.8% vs. 26.9%	P =<0.025.

Thomas. 2001[35]. "Fractured Hip" Age "Elderly"
Retrospective cohort. n= 306
Medical delays ?%. Groups tested av 9 hr vs. av 16 hr

Relationship		Risk	
Post-op stay (days)	Yes	12days vs. 15 days	P< 0.01

Hefley.1996[32]. "Intertrochanteric or neck fracture". Age Mean(SD) +/- 70(13)yr.
Prospective bilateral venography of 133 fractures. n = 133.
Medical Delays % ? Groups tested (days)<2 vs. >2(8 +/- 5)

Relationship.		Risk.	
Deep-Vein Thrombosis	Yes	6% vs. 55%	P < 0.001

Hoerer. 1993[34]. Fractures of femoral neck**.** Age . Mean +/-78yr.
Retrospective review of consecutive patients. n= 254
Medical Delays %? .11 Groups tested (days) <2 vs. 2-7

Relationship		Risk
"Immediate Mortality".	No	ns
Prolonged Hospital stay	Yes	P<0.001

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APPENDIX 1: Search Strategy.

Medline (1990-2007, week 1) and Embase (1990-2007, week 2) databases were searched, for articles on ***surgical treatment delays affecting the prognosis of fractures***.

Medline database:

We first searched for articles on *surgical fractures treatment* beginning with the controlled vocabulary "Fracture Fixation" or "Fracture, Bone/surgery". We next searched for articles on *treatment delays* using the controlled vocabulary "Time Factors" combined with a search of the title and abstract fields using "delay$".* The *surgical fractures treatment* and *treatment delays* searches were combined with the Boolean operator 'and'. We restricted our results to humans and adults, aged 19 or over.

Embase database:

We first searched for articles on *surgical fractures treatment* beginning with the controlled vocabulary "Fracture Fixation" or "Fracture/surgery". We next searched for articles on *treatment delays* using the controlled vocabulary "Therapy Delay" or "Time", combined with a search of the title and abstract fields using the terms "delay$, or time [within 3 words of] surgery". The *surgical fractures treatment* and *treatment delays* searches were combined with the Boolean operator 'and'. We restricted our results to humans and adults, aged 18 years and over.

* $ includes variations such as delays, delaying.

APPENDIX 2: Methodology notes

From the MGH medical records database- Medecho local- (all inpatients and day surgeries are coded in Medecho local): All cases discharged in fiscal year 2005-06, (inpatients or day surgeries) with a **principal procedure** of:
Reduction of fracture and dislocation (CCP code 911 to 9199) or Hip hemiarthroplasty (CCP code 9361 to 9369):

Does not include the closed reduction without internal fixation
Does not include cranial, facial and spinal fractures

Does not include cases where a more invasive procedure was done during the same admission eg: craniotomy…
Does not include cases where a medical reason for delay was identified eg: polytrauma…

Principal procedure fracture reduction:
764 cases qualified (90% operated by orthopaedic surgeons)

498 admitted from ED
139 day surgeries
60 admitted from home
67 transfers-in from other acute hospital, rehab or chronic...

45 day surgeries excluded as no previous visit (ED nor DS nor inpt) at the MGH in 2004 nor 2005;
40 inpatients from home excluded as no previous data or admitted previously
67 transfers-in from other acute hospital, from rehab or chronic..
80 open fractures excluded
24 polytrauma & other medical reason excluded
256 excluded
66 hip hemiarthroplasties added Total : 574 included in analysis

Reduction of closed fractures or dislocations & hip hemiarthroplasties

Diff OR vs. ED date

Pre-op days	# of cases	Total Pre-op days
0	32	0
1	60	60
2	100	200
3	87	261
4	64	256
5	48	240
6	28	168
7	32	224
8	24	192
9	15	135
10	19	190
11	12	132
12	10	120
13	7	91
14	8	112
15	2	30
16	3	48
17	6	102
18	2	36
19	3	57
20	1	20
21		0
22	1	22
23	2	46
24	2	48
25		0
26		0
27	1	27
28	1	28
29	1	29
30		0
31		0
32	1	32
33-43		
44	1	44
45-53		
54	1	54
	574	3004

Diff OR date vs. Admit date

Inpatient pre-op days	# of cases	Total inpatient Pre-op days
0	159	0
1	77	77
2	104	208
3	60	180
4	50	200
5	31	155
6	23	138
7	20	140
8	12	96
9	12	108
10	10	100
11	6	66
12	4	48
13	3	39
14	1	14
15		
16		
17	1	17
18		
19	1	19
	574	1605

Hip fracture reductions & hemiarthroplasties only

Diff OR date vs. ED date

Pre-op days	# of cases	Total Pre-op days
0	9	0
1	18	18
2	54	108
3	39	117
4	18	72
5	10	50
6	5	30
7	2	14
8	3	24
9	1	9
10	1	10
11	1	11
12	2	24
Grand Total	163	487