

# Venting during prophylactic nailing for femoral metastases: current orthopedic practice

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**Introduction:** Reamed intramedullary nailing, recommended for impending fracture of a femur weakened by bone metastases, causes a rise in intramedullary pressure and increases the risk of a fat embolism syndrome. The pressure can be equalized by the technique of venting — drilling a hole into the distal cortex of the femur. Our objective was to study the current practice of orthopedic surgeons in Ontario with respect to venting during prophylactic intramedullary nailing for an impending femoral fracture due to bone metastases. **Methods:** We mailed a questionnaire to all orthopedic surgeons from the Province of Ontario listed in the 1999 *Canadian Medical Directory* or on the Canadian Orthopaedic Association membership list, asking if they vent when prophylactically nailing an impending pathologic femoral fracture. The responses were modelled as a function of surgeon volume and year of graduation. **Results:** Of the 415 surveys mailed, 223 (54%) surgeons responded. Of these, 81% reported having prophylactically treated a femoral metastatic lesion during the previous year; 67% treated 1 to 3 metastatic lesions and 14% treated more than 3; 19% did not treat a metastatic femoral lesion prophylactically. Over two-thirds of surgeons had never considered venting, whereas one-third always or sometimes vented the femoral canal. More recent graduates were 3 times more likely to vent than earlier (before 1980) graduates (odds ratio [OR] = 3.2, 95% confidence interval [CI] 1.6–6.5) as were those who treat a greater number of impending fractures (OR = 1.4, 95% CI 1.1–1.7). **Conclusions:** Although there is a theoretical rationale for routine venting, there is disagreement among Ontario orthopedic surgeons regarding the use of this technique during prophylactic nailing for femoral metastatic lesions. Prospective evidence will be required to warrant a change in the standard of care.

**Introduction :** L'enclouage centromédullaire avec alésage, recommandé contre la fracture imminente d'un fémur affaibli par des métastases osseuses, entraîne une augmentation de la pression centromédullaire et accroît le risque de syndrome d'embolie graisseuse. Il est possible de régulariser la pression au moyen de la technique de décharge, qui consiste à forer un trou transcortical dans la portion distale du fémur. L'étude visait à examiner, auprès des chirurgiens orthopédistes de l'Ontario, la pratique courante relativement au trou de décharge au cours des interventions prophylactiques d'enclouage centromédullaire contre une fracture imminente du fémur attribuable à des métastases osseuses. **Méthodes :** Nous avons fait parvenir à tous les chirurgiens orthopédistes de l'Ontario inscrits au *Canadian Medical Directory* de 1999 ou sur la liste des membres de l'Association canadienne d'orthopédie un questionnaire pour leur demander s'ils pratiquent un trou de décharge lors des interventions prophylactiques d'enclouage contre une fracture pathologique imminente du fémur. Les réponses ont été modélisées en fonction du volume de chirurgies des chirurgiens et de l'année de leur diplôme. **Résultats :** Parmi les 415 chirurgiens auxquels un questionnaire a été envoyé, 223 (54 %) ont répondu. Parmi les répondants, 81 % ont signalé avoir pratiqué une intervention prophylactique contre une lésion métastatique au fémur au cours de l'année précédente, 67 % ont dit avoir traité d'une à trois lésions métastatiques et 14 %, plus de trois, tandis que 19 % n'avaient pas pratiqué d'intervention prophylactique contre une lésion métastatique au fémur. Plus des deux tiers des chirurgiens n'avaient jamais envisagé de pratiquer un trou de décharge, tandis qu'un tiers d'entre eux recouraient toujours ou parfois à la technique de décharge du canal fémoral. Les chirurgiens ayant reçu leur diplôme plus récemment étaient trois fois plus susceptibles de pratiquer un trou de décharge que les chirurgiens ayant obtenu leur diplôme plus tôt (avant 1980) (coefficient de probabilité [CP] = 3,2, intervalle de confiance [IC] à 95 %, 1,6–6,5), tout comme

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Accepted for publication May 22, 2003.

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ceux qui traitent un plus grand nombre de fractures imminentes (CP = 1,4, IC à 95 %, 1,1-1,7). **Conclusions :** Même si la théorie justifie le trou de décharge de routine, les chirurgiens orthopédistes de l'Ontario ne s'entendent pas quant à l'utilisation de cette technique au cours des interventions prophylactiques d'enclouage contre les lésions métastatiques au fémur. Il faudra des données prospectives pour entraîner un changement au niveau de la norme de soin.

**R**eamed intramedullary (IM) nailing, now an established method of fracture stabilization in long bones, was introduced by Küntscher in 1940. This technique provides limited or no fracture site exposure, early mobilization, patient comfort and early weight-bearing.<sup>1,2</sup> The femur is one of the commonest sites of bone metastasis. As the bone lesion enlarges in the femur, the bone is weakened and may fracture spontaneously. It is generally recommended that a femur in danger of fracturing spontaneously be surgically stabilized to prevent the pain and suffering associated with a completed fracture.<sup>3</sup> However, as is the case with fracture fixation, the practice of prophylactic stabilization with an IM nail is associated with potential surgical morbidity and mortality due to fat and tumour embolization. The insertion of an implant into an unbroken long bone is of major concern because it causes compression of the medullary cavity, resulting in a rise in the IM pressure.<sup>4</sup> Numerous findings indicate that an increase in IM pressure causes the intravasation of marrow, fat and bone debris into the venous circulation leading to fat emboli.<sup>1,5-11</sup> The only way in which a pressure build-up from an implant insertion can be equalized is if the medullary contents are released from the cavity at the fracture or the insertion site.<sup>4</sup> The amount of pressure that is generated depends on the amount of marrow contents that can escape.<sup>4</sup> When a fracture of the femur is present, the fracture acts as an exhaust vent<sup>12</sup> as it decompresses the pressure in the medullary cavity.<sup>2</sup> Nailing an unbroken femur for an impending pathologic fracture causes a rise in IM pressure and increases the risk of the patient of being exposed to a fat embolism syndrome.<sup>2,12,13</sup> There is also evidence that embolization of marrow contents can occur during the insertion of the femoral prosthesis

in total hip arthroplasty,<sup>5,7,10,14,15</sup> and this can lead to hypotension, hypoxemia, cardiac arrest and sudden death.<sup>16,17</sup> It has been suggested that these symptoms may even occur during cemented total knee arthroplasty.<sup>8,18</sup>

In the 1970s, Parsons<sup>18</sup> and others<sup>19</sup> first suggested a venting technique when having difficulty packing cement into a femur during total hip replacements. Venting, drilling a hole approximately 4.5 mm in diameter into the distal cortex of the femur, has been examined in both clinical<sup>1,20,21</sup> and laboratory<sup>5,7,22,23</sup> studies, all of which reported favourable results in reducing IM pressure. Some investigators have suggested that venting may be impractical because the vent hole may become blocked with bone debris, fat, marrow and blood clots,<sup>11</sup> may be too small,<sup>22</sup> or may put the patient at risk of subsequent fracture from stress concentrated about the vent hole.<sup>5</sup> Nevertheless, venting the femur during IM nailing reduces the IM pressure,<sup>5,7,11,20-23</sup> and may minimize the risk of embolism associated with this increased pressure. The purpose of this study was to examine current practice patterns of orthopedic surgeons with respect to venting during prophylactic femoral IM nailing for an impending pathologic fracture.

## Methods

### Sample

The target population was Ontario orthopedic surgeons. Questionnaires were sent to a total of 415 orthopedic surgeons identified from the 1999 *Canadian Medical Directory* and the Canadian Orthopaedic Association membership list. As a tracking mechanism, each survey was numbered. Surgeons who did not respond received only one follow-up phone call.

## Survey

The questionnaire was developed to examine the practice patterns among orthopedic surgeons in treating a femoral diaphyseal metastatic lesion. Surgeons were asked if they vent when prophylactically treating an impending pathologic fracture of the femur. Surgeons who never vent could further indicate if they had not previously considered venting as an option or if they considered venting unimportant. Surgeons who do not treat femoral metastatic lesions were hypothetically asked whether they would vent if they had the opportunity. Demographic information regarding the number of impending and completed fractures treated in a year, preferred type of implant and year of graduation from medical school was also collected.

## Analysis

A desktop PC running SAS version 6.12 for Windows NT was used for the analysis. Frequency distributions were calculated for the responses to each question. To examine the influence of the numbers of years in practice on responses, surgeons were divided into 2 groups: surgeons who graduated from medical school in 1979 or earlier (earlier graduates) and those who graduated from medical school in 1980 or later (more recent graduates). The cutoff was based on the median year of graduation from medical school of the respondents and that the more recent graduates would represent surgeons in practice for fewer than 20 years.

The dependent variable, vent (1 = always or sometimes and 0 = never), was analyzed using a logistic regression to examine the effects of graduate group and number of impending fractures treated per year. Compar-

isons of continuous variables (e.g., number of impending fractures treated per year) between the 2 groups were made using 2-sample *t*-tests. Comparisons of proportions (e.g., vent, 1 = always or sometimes and 0 = never) between the 2 graduate groups were made using  $\chi^2$  tests; *p* values less than 0.05 were considered significant.

## Results

### Characteristics of responding surgeons

Overall, 223 (54%) of the 415 orthopedic surgeons responded to the questionnaire (Table 1). The year of graduation from medical school of the respondents ranged from 1945 to 1994 (median 1979). Of the 223 respondents, 181 (81%) had an occasion to treat a femoral metastatic lesion prophylactically. The range and median year of graduation for these was no different from the entire set

of respondents. There was no significant difference between earlier and more recent graduates to have prophylactically treated a femoral metastatic lesion.

Of the 181 surgeons who prophylactically treated an impending fracture during the previous year: 19% treated no fractures; 67% treated 1 to 3; and 14% treated more than 3. These surgeons also treated completed fractures during the previous year as follows: 19% treated less than 1; 63% treated 1 to 3; and 18% treated more than 3. The greatest reported number of impending fractures and completed fractures treated per year was 15. There was no significant difference between earlier and more recent graduates in the number of impending or completed fractures treated per year.

When treating pathologic fractures of the femoral diaphysis, 85% of the surgeons preferred the IM nail implant, 7% preferred to use a plate and 8% had no preference.

### Venting practice

Of the 181 respondents who had prophylactically treated a femoral metastatic lesion, 32% said that they always or sometimes vented, whereas 67% said that they had never vented (Table 2). Most surgeons not venting had not previously considered venting as an option, still others said that they had never vented because they did not consider venting to be important.

Of the 42 respondents who had not prophylactically treated a femoral metastatic lesion, 19% said they would vent if they had the opportunity, but the majority (74%) said that they had not previously considered venting as an option (Table 2). For these 42 surgeons, the median year of graduation from medical school was 1977 (range from 1947–1994), with 26 considered to be earlier graduates and 16 to be more recent graduates. There was a trend among these 42 respondents for earlier grad-

**Table 1**

### Characteristics of Responding Ontario Orthopedic Surgeons Regarding Prophylactic Intramedullary Nailing

Characteristic	Earlier graduates ≤ 1979, no. (and %)	Recent graduates ≥ 1980, no. (and %)	Total, no. (and %)
Ever had an occasion to prophylactically treat a femoral metastatic lesion?			
No	115	108	223 (100)
Yes	26 (23)	16 (15)	42 (19)
No. of impending fractures treated per year	86	91	177 (100)*
None	20 (23)	14 (16)	34 (19)
1–3	55 (64)	63 (68)	118 (67)
> 3	11 (13)	14 (16)	25 (14)
No. of completed fractures treated per year	86	89	175 (100)*
None	16 (19)	18 (20)	34 (19)
1–3	56 (65)	54 (61)	110 (63)
> 3	14 (16)	17 (19)	31 (18)
Total no. of pathologic femoral fractures treated per year	86	89	175 (100)*
None	2 (2)	2 (2)	4 (2)
1–3	45 (52)	44 (50)	89 (51)
> 3	39 (46)	43 (48)	82 (47)
Preferred implant	87	91	178 (100)*
Intramedullary nail	64 (73)	87 (96)	151 (85)
Plate	12 (14)	1 (1)	13 (7)
No preference	11 (13)	3 (3)	14 (8)

\*No. responding to this section.

uates to be less aware of venting than more recent graduates, but this difference was not significant.

### Factors influencing venting practice

More recent graduates vent significantly ( $p < 0.001$ ) more often than earlier graduates. Among the more recent graduates, 43% vent and 57% never vent, whereas, among the earlier graduates 20% vent and 80% never vent. Also, we found that surgeons who treat more impending fractures vent more often ( $p = 0.004$ ). Sixty percent of surgeons who prophylactically treated more than 3 impending fractures during the previous year regularly vent compared with 29% and 24% of surgeons who treated 1 to 3 fractures and no fractures during the previous year. The results from the logistic regression analysis suggest that more recent graduates are 3 times more likely to vent than earlier graduates (odds ratio [OR] = 3.1, 95% confidence interval [CI] 1.5–6.2) and those who treat a greater number of impending fractures per year are more likely to vent (OR = 1.4, 95% CI 1.2–1.7).

### Discussion

When prophylactically stabilizing a femoral metastatic lesion, venting does not appear to be common practice among orthopedic surgeons in Ontario. About one-third of surgeons who prophylactically treated pathologic femoral fractures always or sometimes vented, but over two-thirds of them never did. These results are mirrored even in surgeons who do not prophylactically treat femoral metastatic lesions. Surgeons who do vent are more likely to have graduated from medical school in 1980 or later and likely treat a greater number of impending fractures. This suggests that more recent clinical teaching promotes the use of venting.

Venting the femur during IM nailing is thought to decrease the risk of fat and tumour embolization associated with an increase in IM pressure. Although several studies have suggested that venting reduces the IM pressure,<sup>5,7,11,20–23</sup> the pressure in the IM canal may not be reduced below the critical pressure point that will not result in the intravasation of fat globules into the venous circulation.<sup>5,22</sup> In the animal studies it was

found that above the 150 mm Hg pressure point, the risk of cardiopulmonary dysfunction and pulmonary microemboli increases 10-fold.<sup>5,22</sup> Although this critical point has not yet been established in humans, venting may reduce the IM pressure enough to act as a safeguard.

There are limitations to our study. First, members of the Canadian Orthopaedic Association constitute only about 70% of practising orthopedic surgeons in Canada, and the 1999 *Canadian Medical Directory* may not have captured all Ontario surgeons. On the other hand, we have no way of removing those surgeons who are retired and would be considered “nonclinical” from the sample surveyed. Thus, our response rate of only 54% is likely to be an underestimate. In addition, the orthopedic surgeons who responded may have been more likely to consider venting an important consideration when prophylactically nailing for femoral metastases, so our results may overestimate the practice of venting. However, it is also likely that many of the nonrespondents do not prophylactically stabilize femoral metastatic lesions.

Asking surgeons who do not treat femoral metastatic lesions to respond hypothetically was meant to elicit a response from all surgeons mailed a questionnaire.

### Conclusions

There is disagreement among Ontario orthopedic surgeons regarding the use of venting during prophylactic nailing for femoral metastatic lesions. Although there is a theoretical rationale for routine venting, prospective evidence will be required to warrant a change in the standard of care.

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**Table 2**

#### Venting Practices of Ontario Orthopedic Surgeons With Respect to Prophylactic Intramedullary Nailing

Characteristic	Earlier graduates ≤ 1979, % of respondents	Recent graduates ≥ 1980, % of respondents	Total, % of respondents
Previously treated a femoral metastatic lesion			
Do you vent?			
Always	9	26	18
Sometimes	11	17	14
Never considered this as an option	65	46	55
Never because it is not important	14	11	12
No response	1	0	1
Not previously treated a femoral metastatic lesion			
Would you vent?			
Yes	8	38	19
No	4	0	2
Never considered this as an option	84	56	74
No response	4	6	5

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