追跡率が低いため確かではないが、わずか1年の間に、3骨折とも、骨折を契機としてADLと共に認知能力が低下する症例が多い。しかし、生活場所の変更はなかった。

E. 結　論

脊椎圧迫骨折、橈骨遠位端骨折、上腕骨近位部骨折は骨粗鬆症性骨折という共通点がある反面、それぞれ特徴がある。これらの特徴を把握することによって、これらの骨折への治療、予防が必要に思われる。

「定点観察による脊椎骨折・橈骨遠位部骨折・上腕骨近位部骨折予後調査」
研究者用マニュアル

研究の概要

- 先生方の施設を受診された該当するすべての患者さんを登録します。
- 調査対象期間は19年6月から１９年１２月末日までとします（ただしこの調査対象期間内に多数の症例が見込まれる場合には、登録症例数あるいは登録期間をあらかじめ任意に限定していただくことが可能です。詳細は下記「研究の詳細」をご覧下さい）。
- 調査は初診時、４－８週経過時、および１２ヶ月経過時の３時点です。
- 患者さんのプライバシーを保護するため、調査シートの二枚目の切り取り線から下の部を郵送、またはFaxいただきます。
- Fax先は日本整形外科学会事務局（03-3816-2337）です。

研究の詳細

◇ 貴院の病院コードは「０１」です。
◇ 平成１９年６月１日以降平成１９年１２月３１日までの7ヶ月間を調査対象期間とし、その期間内に受傷した脊椎骨折・橈骨遠位部骨折・上腕骨近位部骨折のすべての患者さんについて同封の調査用紙にご記入下さい。
◇ 「すべての患者さん」というのを強調させていただきますが、これは入院した症例だけとか手術症例だけとかに限定すると、選択バイアスが生じるため、一定期間内に貴院を受診したすべての症例を登録頂きたいのです。
◇ 調査期間は「平成１９年６月１日以降平成１９年１２月３１日まで」としましたが、その間の症例数が多くなる場合には先生方の御負担が増えますので、10症例を超えるような場合には登録期間を限定していただいても、あるいは、登録症例数を10症例とか20症例に限定していただいてもかまいません。例えば、（1）脊椎骨折は7月1日から２０症例に達するまで登録する、（2）橈骨遠位部骨折は7月1日から１１月３０日までの5ヶ月間の症例を登録する、（3）上腕骨近位部骨折は１０症例に達するまで登録する、などです。繰り返しになりますが、症例登録は、連続する症例の登録をお願いいたします。
◇ 期間内の再骨折例は対象となりますが、偽関節等による再手術例は除外して下さい。
◇ 腫瘍による病的骨折は含めないで下さい。
◇ 各調査シートの一枚目に誤って切り取り線を記入してしまいましたが、ここで切り取ると患者さんが同定できなくなりますので、切り取らないでください。
◇ 調査研究用コードは患者さんのプライバシーを保護するため、また後日再調査を可能とするため先生方に任意の番号をつけていただくものです。（例：玉－００１など）つまり、本調査シートあるいは病院内ＩＤと調査研究用コードの対応表を先生方に保管していただく必要があります。

◇ 入院期間： 現在入院中の患者に関しては退院日を空白のままで結構です。また術後リハビリ目的などで転院して入院された場合も、貴院での入院期間をご記入下さい。
急性期（一般）病棟から回復期リハ病棟や療養型へ移った場合には、全ての病棟での入院期間を含め、貴院を退院（転院）した日までの、入院期間をご記入下さい。
受傷以前から入院していて、入院中に骨折した場合は、入院日を骨折発生日としてください。
◇ 患者さんへの調査研究の説明文、同意書、患者登録リスト（調査施設保管用）の用紙は誠に恐れ入りますが、コピーしてご使用ください。
◇ １２ヶ月経過時の調査シートは後日郵送いたします。

※ご不明な点がございましたら下記までご連絡下さい（FAXまたはe-mailでのお問い合わせをお願いします）

連絡先：日整会骨粗鬆症委員会 骨折調査事務局
〒865-0064 熊本県玉名市中 1950 公立玉名中央病院 整形外科 中野哲雄
Fax 0968 73 2867 Mail nakano@tamana-chp.jp

図1. 研究者用マニュアル

脊椎圧迫骨折調査シート1(初診時用)

名前		
病院内ID		

切取線

病院名		
病院コード		
研究調査用コード(登録ID)		＊各施設で患者様にコードをつけ、必ずご記入ください。
性別	1. 男　2. 女	
生年月日	(明治,大正,昭和,平成)___年__月__日	
初診日	平成___年__月__日	
主な診断方法	1. X線単純像　2. 臨床所見　3. MRI　4. 骨シンチ　5. その他	
骨折年月日の特定	1. 全く不明　2. おおよそ特定可　3. 特定可	
骨折年月日	平成___年__月__日(おおよそ特定可なら○月上旬などと記入)	
受傷場所	1. 不明　2. 一般住宅屋内　3. 施設・病院などの屋内 4. 屋外　5. その他	
受傷前の主な生活場所	1. 自宅などの一般住宅　2. 病院　3. 介護施設など	
受傷の原因	1. 不明　2. 原因なし　3. 重い物を持ったなど 4. 転倒　5. 転落　6. 交通事故　7. その他	
受傷前の日常生活自立度	1. 交通機関を利用して外出する　2. 隣近所へなら外出する 3. 介助により外出し、日中はほとんどベッドから離れて生活する 4. 外出の頻度は少なく、日中も寝たり起きたりの生活をしている 5. 車いすに移乗し、食事排泄はベッドから離れて行う 6. 介助により車いすに移乗する　7. 自力で寝返りをうつ 8. 自力では寝返りもうたない　9. 不明	
受傷前の認知能力	1. 正常 2. 何らかの痴呆を有するが、日常生活は家庭内及び社会的にほぼ自立している 3. 日常生活に支障を来たすような症状・行動や意思疎通の困難さが多少見られても、誰かが注意していれば自立できる 4. 日常生活に支障を来たすような症状・行動や意思疎通の困難さが見られ、介護を必要とする 5. 日常生活に支障を来たすような症状・行動や意思疎通の困難さが頻繁に見られ、常に介護を必要とする 6. 著しい精神症状や問題行動あるいは重篤な身体疾患が見られ、専門医療を必要とする	
受傷前の腰背痛	1. 全く痛くなかった　2. 時々労作時などに軽い痛みがあった 3. 中等度の痛みがあった　4. 強い痛みが常時または、頻繁にあった	

脊椎圧迫骨折調査シート1(初診時用)

＜連絡先＞公立玉名中央病院整形外科内
日本整形外科学会骨粗鬆症委員会事務局
E-mail:nakano@tamana-chp.jp

図2. 脊椎圧迫骨折調査シート1(初診時用)

脊椎圧迫骨折調査シート2(退院時あるいは4-8週経過時用)

名前		
病院内ID		

切取線

病院名		
病院コード		
研究調査用コード(登録ID)		＊患者様を特定するのに必要ですので必ずご記入ください。
性別	1. 男　2. 女	
生年月日	(明治,大正,昭和,平成)＿＿年＿月＿日	
入院の有無	1. あり　2. なし	
入院日	平成＿＿年＿月＿日	
手術日	平成＿＿年＿月＿日	
退院日	平成＿＿年＿月＿日	
主な診断方法(※1)	1. X線単純像　2. 臨床所見　3. MRI　4. 骨シンチ　5. その他	
骨折型	1. 単純圧迫骨折　2. 後壁損傷あり　3. posterior columnに及ぶ不安定骨折	
主な治療法	1. ギプス　2. コルセット　3. 椎体形成術　4. その他の手術	
骨粗鬆症薬の服用状況	1. 骨折前から服用　2. 骨折後に新たに投与　3. 骨折後も投与なし	

※1:初診時にご記入いただいていない場合のみご記入ください。

脊椎圧迫骨折調査シート2(退院時あるいは4-8週経過時用)

<連絡先>公立玉名中央病院整形外科内
日本整形外科学会骨粗鬆症委員会事務局
E-mail:nakano@tamana-chp.jp

図3. 脊椎圧迫骨折調査シート2(退院時あるいは 4-8 週経過時用)

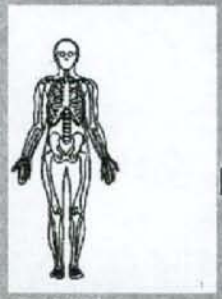
＿＿＿＿＿＿＿＿様

<病院記入欄>	
病院コード	
登録ID	

アンケート記入日　平成＿＿年＿＿月＿＿日

アンケート記入者
1. ご本人　2. ご家族　3. スタッフ　4. その他

※下記の質問にお答えください。



問1 骨折したその背骨はその後手術を受けましたか？
1. はい　2. いいえ

問2 その後にどこかの骨折をしましたか？
1. はい　2. いいえ
＊「はい」の場合はどこですか？　上の図の該当する所に○をお付け下さい。

問3 その後に入院治療した、あるいは寝込んだ病気・ケガはありますか？
1. ある　2. ない　＊「ある」の場合 → (＿＿＿＿＿＿＿＿)

問4 現在の腰背痛、下肢へひびく痛みは？
1. 全く痛くない
2. 立ったり座ったりした時に少し痛いことがある
3. 中等度の痛みがある
4. 強い痛みが常時または、頻繁にある

問5 現在の状態についてお尋ねします。(該当するもの一つに○をお付け下さい)
1. 自力では寝返りもうてない
2. 寝たきりだが、自力で寝返りをうつことができる
3. 助けてもらって車いすに乗る
4. 自分で車いすに乗ることができて、食事排泄はベッドから離れて行う
5. 外出の頻度は少なく、日中も寝たり起きたりの生活をしている
6. 誰かに付き添ってもらって外出し、日中はほとんどベッドから離れて生活する
7. 隣近所へなら一人で外出する
8. 交通機関を利用して一人で外出する

問6 現在の状態についてお尋ねします。(該当するもの一つに○をお付け下さい)
1. 食事をしたことも忘れてしまうほどもの忘れがひどく、体も不自由で、専門的な治療を必要としている
2. もの忘れや勘違いが非常に多く、日常生活に支障を来たすような症状が頻繁に見られ、常に介護を必要とする
3. もの忘れや勘違いが非常に多く、日常生活に支障があり、介護を必要とする
4. もの忘れや勘違いは多いが、誰かが注意していれば一人でできる
5. もの忘れは多いが、日常生活は何でも一人でできる
6. 何でも一人でできる

問7 現在お住まいはどちらですか？
1. 自宅などの一般住宅　2. 介護施設　3. 病院

問8 もしお亡くなりになっている場合はその年月日を教えて下さい。
→　平成＿＿年＿＿月＿＿日

ご協力ありがとうございました。

脊椎圧迫骨折調査シート3(12ヶ月経過時用)

図4. 脊椎圧迫骨折調査シート3(12カ月経過時用)

橈骨遠位部骨折調査シート1(初診時用)

名前		
病院内ID		

切取線

病院名		
病院コード		
研究調査用コード(登録ID)		＊各施設で患者様にコードをつけ、必ずご記入ください。
性別	1. 男　2. 女	
生年月日	(明治,大正,昭和,平成)___年__月__日	
骨折年月日	平成___年__月__日	
初診日	平成___年__月__日	
受傷側	1. 右　2. 左	
利き手	1. 右　2. 左	
骨折型	1. 関節外　2. 関節内	
受傷場所	1. 不明　2. 一般住宅屋内　3. 施設・病院などの屋内 4. 屋外　5. 交通機関内	
受傷前の主な生活場所	1. 自宅などの一般住宅　2. 病院　3. 介護施設など	
受傷の原因	1. 転倒　2. 転落　3. 交通事故　4. その他	
受傷前の日常生活自立度	1. 交通機関を利用して外出する　2. 隣近所へなら外出する 3. 介助により外出し、日中はほとんどベッドから離れて生活する 4. 外出の頻度は少なく、日中も寝たり起きたりの生活をしている 5. 車いすに移乗し、食事排泄はベッドから離れて行う 6. 介助により車いすに移乗する　7. 自力で寝返りをうつ 8. 自力では寝返りもうたない　9. 不明	
受傷前の認知能力	1. 正常 2. 何らかの痴呆を有するが、日常生活は家庭内及び社会的にほぼ自立している 3. 日常生活に支障を来たすような症状・行動や意思疎通の困難さが多少見られても、誰かが注意していれば自立できる 4. 日常生活に支障を来たすような症状・行動や意思疎通の困難さが見られ、介護を必要とする 5. 日常生活に支障を来たすような症状・行動や意思疎通の困難さが頻繁に見られ、常に介護を必要とする 6. 著しい精神症状や問題行動あるいは重篤な身体疾患が見られ、専門医療を必要とする	

橈骨遠位部骨折調査シート1(初診時用)

<連絡先>公立玉名中央病院整形外科内
日本整形外科学会骨粗鬆症委員会事務局
E-mail:nakano@tamana-chp.jp

図5. 橈骨遠位部骨折調査シート1(初診時用)

橈骨遠位部骨折調査シート2(退院時あるいは4-8週経過時用)

名前		
病院内ID		

切取線

病院名		
病院コード		
研究調査用コード(登録ID)		＊患者様を特定するのに必要ですので必ずご記入ください。
性別	1. 男　2. 女	
生年月日	(明治,大正,昭和,平成)___年__月__日	
入院の有無	1. あり　2. なし	
入院日	平成___年__月__日	
手術	1. あり　2. なし	
手術日	平成___年__月__日	
退院日	平成___年__月__日	
主な治療法	1. 保存　2. ピンニング　3. 創外固定　4. 内固定	
骨粗鬆症薬の服用状況	1. 骨折前から服用　2. 骨折後に新たに投与　3. 骨折後も投与なし	

橈骨遠位部骨折調査シート2(退院時あるいは4-8週経過時用)

<連絡先>公立玉名中央病院整形外科内
日本整形外科学会骨粗鬆症委員会事務局
E-mail:nakano@tamana-chp.jp

図6. 橈骨遠位部骨折調査シート2(退院時あるいは 4-8 週経過時用)

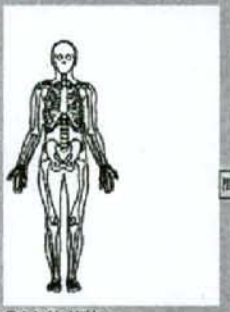
_____様

<病院記入欄>	
病院コード	
登録ID	

アンケート記入日　平成___年___月___日

アンケート記入者
1. ご本人　2. ご家族　3. スタッフ　4. その他

※下記の質問にお答えください。



問1 骨折した手首はその後手術を受けましたか?
1. はい　2. いいえ

問2 その後にどこかの骨折をしましたか?
1. はい　2. いいえ
＊「はい」の場合はどこですか?　上の図の該当する所に○をお付け下さい。

問3 その後に入院治療した、あるいは寝込んだ病気・ケガはありますか?
1. ある　2. ない　＊「ある」の場合 → (_____)

問4 骨折した手は骨折する前と同じように使えますか?
1. 同じように使える　2. 少し不自由になった
3. 不自由になってあまり使わなくなった

問5 痛みはどうですか?
1. 全く痛くない　2. 重い物を持ったりした時に少し痛いことがある
3. 中程度の痛みがある　4. 安静時も痛みがある

問6 現在の状態についてお尋ねします。(該当するもの一つに○をお付け下さい)
1. 自力では寝返りもうてない
2. 寝たきりだが、自力で寝返りをうつことができる
3. 助けてもらって車いすに乗る
4. 自分で車いすに乗ることができて、食事排泄はベッドから離れて行う
5. 外出の頻度は少なく、日中も寝たり起きたりの生活をしている
6. 誰かに付き添ってもらって外出し、日中はほとんどベッドから離れて生活する
7. 隣近所へなら一人で外出する
8. 交通機関を利用して一人で外出する

問7 現在の状態についてお尋ねします。(該当するもの一つに○をお付け下さい)
1. 食事をしたことも忘れてしまうほどもの忘れがひどく、体も不自由で、
専門的な治療を必要としている
2. もの忘れや勘違いが非常に多く、日常生活に支障を来たすような症状が
頻繁に見られ、常に介護を必要とする
3. もの忘れや勘違いが非常に多く、日常生活に支障があり、介護を必要とする
4. もの忘れや勘違いは多いが、誰かが注意していれば一人でできる
5. もの忘れは多いが、日常生活は何でも一人でできる
6. 何でも一人でできる

問8 現在お住まいはどちらですか?
1. 自宅などの一般住宅　2. 介護施設　3. 病院

問9 もしお亡くなりになっている場合はその年月日を教えて下さい。
→ 平成___年___月___日

ご協力ありがとうございました。

図7. 橈骨遠位部骨折調査シート3(12カ月経過時用)

上腕骨近位部骨折調査シート1(初診時用)

名前		
病院内ID		

切取線

病院名		
病院コード		
研究調査用コード(登録ID)		＊各施設で患者様にコードをつけ、必ずご記入ください。
性別	1. 男　2. 女	
生年月日	(明治,大正,昭和,平成)＿＿年＿＿月＿＿日	
骨折年月日	平成＿＿年＿＿月＿＿日	
初診日	平成＿＿年＿＿月＿＿日	
受傷前の主な生活場所	1. 自宅などの一般住宅　2. 病院　3. 介護施設など	
受傷場所	1. 不明　2. 一般住宅屋内　3. 施設・病院などの屋内 4. 屋外　5. 交通機関内	
受傷の原因	1. 転倒　2. 転落　3. 交通事故　4. その他	
受傷前の日常生活自立度	1. 交通機関を利用して外出する　2. 隣近所へなら外出する 3. 介助により外出し、日中はほとんどベッドから離れて生活する 4. 外出の頻度は少なく、日中も寝たり起きたりの生活をしている 5. 車いすに移乗し、食事排泄はベッドから離れて行う 6. 介助により車いすに移乗する　7. 自力で寝返りをうつ 8. 自力では寝返りもうたない　9. 不明	
受傷前の認知能力	1. 正常 2. 何らかの痴呆を有するが、日常生活は家庭内及び社会的にほぼ自立している 3. 日常生活に支障を来たすような症状・行動や意思疎通の困難さが多少見られても、誰かが注意していれば自立できる 4. 日常生活に支障を来たすような症状・行動や意思疎通の困難さが見られ、介護を必要とする 5. 日常生活に支障を来たすような症状・行動や意思疎通の困難さが頻繁に見られ、常に介護を必要とする 6. 著しい精神症状や問題行動あるいは重篤な身体疾患が見られ、専門医療を必要とする	

上腕骨近位部骨折調査シート1(初診時用)

<連絡先>公立玉名中央病院整形外科内
日本整形外科学会骨粗鬆症委員会事務局
E-mail:nakano@tamana-chp.jp

図8. 上腕骨近位部骨折調査シート1(初診時用)

上腕骨近位部骨折調査シート2(退院時あるいは4-8週経過時用)

名前		
病院内ID		

切取線

病院名		
病院コード		
研究調査用コード(登録ID)		＊患者様を特定するのに必要ですので必ずご記入ください。
性別	1. 男　2. 女	
生年月日	(明治,大正,昭和,平成)___年__月__日	
入院の有無	1. あり　2. なし	
入院日	平成___年__月__日	
手術	1. あり　2. なし	
手術日	平成___年__月__日	
退院日	平成___年__月__日	
骨折型		＊可能ならご記入ください。
主な治療法	1. 保存　2. ピンニング　3. 創外固定　4. 内固定　5. 人口骨頭置換	
骨粗鬆症薬の服用状況	1. 骨折前から服用　2. 骨折後に新たに投与　3. 骨折後も投与なし	

上腕骨近位部骨折調査シート2(退院時あるいは4-8週経過時用)

＜連絡先＞公立玉名中央病院整形外科内
日本整形外科学会骨粗鬆症委員会事務局
E-mail:nakano@tamana-chp.jp

図9. 上腕骨近位部骨折調査シート2(退院時あるいは 4-8 週経過時用)

図 10. 上腕骨遠位部骨折調査シート3（12カ月経過時用）

_____様

上腕骨遠位部骨折調査シート3（12ヶ月経過時用）

〈病院記入欄〉	
病院コード	
登録ID	

アンケート記入日　平成___年___月___日

アンケート記入者
1. ご本人　2. ご家族　3. スタッフ　4. その他

※下記の質問にお答えください。

問1 骨折した肩はその後手術を受けましたか？
1. はい　2. いいえ

問2 その後にどこかの骨折をしましたか？
1. はい　2. いいえ
＊「はい」の場合はどこですか？　上の図の該当する所に○をお付け下さい。

問3 その後に入院治療した、あるいは寝込んだ病気・ケガはありますか？
1. ある　2. ない　＊「ある」の場合 →（_____）

問4 骨折した手は骨折する前と同じように使えますか？
1. 同じように使える　2. 少し不自由になった
3. 不自由になってあまり使わなくなった

問5 痛みはどうですか？
1. 全く痛くない　2. 重い物を持ったりした時に少し痛いことがある
3. 中程度の痛みがある　4. 安静時も痛みがある

問6 現在の状態についてお尋ねします。（該当するもの一つに○をお付け下さい）
1. 自力では寝返りもうてない
2. 寝たきりだが、自力で寝返りをうつことができる
3. 助けてもらって車いすに乗る
4. 自分で車いすに乗ることができて、食事排泄はベッドから離れて行う
5. 外出の頻度は少なく、日中も寝たり起きたりの生活をしている
6. 誰かに付き添ってもらって外出し、日中はほとんどベッドから離れて生活する
7. 隣近所へなら一人で外出する
8. 交通機関を利用して一人で外出する

問7 現在の状態についてお尋ねします。（該当するもの一つに○をお付け下さい）
1. 食事をしたことも忘れてしまうほどもの忘れがひどく、体も不自由で、専門的な治療を必要としている
2. もの忘れや勘違いが非常に多く、日常生活に支障を来たすような症状が頻繁に見られ、常に介護を必要とする
3. もの忘れや勘違いが非常に多く、日常生活に支障があり、介護を必要とする
4. もの忘れや勘違いは多いが、誰かが注意していれば一人でできる
5. もの忘れは多いが、日常生活は何でも一人でできる
6. 何でも一人でできる

問8 現在お住まいはどちらですか？
1. 自宅などの一般住宅　2. 介護施設　3. 病院

問9 もしお亡くなりになっている場合はその年月日を教えて下さい。
→ 平成___年___月___日

ご協力ありがとうございました。

研究成果の刊行に関する一覧表

雑誌

発表者氏名	論文タイトル名	発表誌名	巻号	ページ	出版年
Hagino H, et al	Recent Trend in the Incidence and Lifetime Risk of Hip Fracture in Tottori, Japan	Osteoporos Int	20(4)	543-548	2009
Sakuma M, et al	Incidence and outcome of osteoporotic fractures in 2004 in Sado City, Niigata Prefecture, Japan	Bone Miner Metab	26	373-378	2008
遠藤直人,他	ﾋﾞﾀﾐﾝD製剤の適応と治療の注意点	Geriatric Medicine(老年医学)	46	851-854	2008
遠藤直人	上皮小体(副甲状腺)ﾎﾙﾓﾝの骨量増加作用と機序	日本医事新報	4328	94-95	2008
萩野 浩	大腿骨近位部骨折発生率はなお上昇傾向にある	Osteoporosis Jpn	16	28-31	2008
萩野 浩	大腿骨近位部骨折患者の予後	Journal of Integrated Medicine	18	350-352	2008

Osteoporos Int (2009) 20:543–548
DOI 10.1007/s00198-008-0685-0

ORIGINAL ARTICLE

Recent trends in the incidence and lifetime risk of hip fracture in Tottori, Japan

H. Hagino · K. Furukawa · S. Fujiwara · T. Okano · H. Katagiri · K. Yamamoto · R. Teshima

Received: 3 February 2008 / Accepted: 29 May 2008 / Published online: 17 July 2008
© International Osteoporosis Foundation and National Osteoporosis Foundation 2008

Abstract
Summary Hip fracture incidence from 2004 to 2006 in the Tottori prefecture of Japan was investigated and compared with previously reported rates. The age- and gender-specific incidence of hip fracture in the Tottori prefecture has not plateaued, as has been reported for populations in Northern Europe or North America.
Introduction Recent data from Northern Europe and North America indicate that the incidence of hip fracture has plateaued, whereas most reports from Asia indicate that the incidence is increasing. The aims of this study were to investigate the recent incidence of hip fracture in the Tottori prefecture, Japan, and to compare it with previous reports.
Methods All hip fractures in patients aged 35 years and older occurring between 2004 and 2006 were surveyed in all of the hospitals from the Tottori prefecture. The age- and gender-specific incidence rates were then calculated. Using these and previously reported data, the estimated number of hip fracture patients was determined using the age- and gender-specific incidence rates in each year from 1986 to 2006.
Results The survey identified 851, 906, and 1,059 patients aged 35 years and older, in 2004, 2005, and 2006 respectively. The residual lifetime risk of hip fracture for individuals at 50 years of age was estimated to be 5.6% for men and 20.0% for women. The estimated number of patients from 1986 to 2006 showed a significant increase over time for both genders.
Conclusions The age- and gender-specific incidence of hip fracture in the Tottori prefecture, Japan has not plateaued for either gender.

Keywords Epidemiology · Hip fracture · Incidence · Lifetime risk · Osteoporosis

H. Hagino · H. Katagiri
Rehabilitation Division, Tottori University Hospital, Yonago, Japan

K. Furukawa
Department of Statistics, Radiation Effects Research Foundation, Hiroshima, Japan

S. Fujiwara
Department of Clinical Studies, Radiation Effects Research Foundation, Hiroshima, Japan

T. Okano · R. Teshima
Department of Orthopedic Surgery, School of Medicine, Faculty of Medicine, Tottori University, Tottori, Japan

K. Yamamoto
Department of Orthopedic Surgery, Hakuai Hospital, Tottori, Japan

H. Hagino (✉)
School of Health Science, Faculty of Medicine, Tottori University, Yonago, Tottori 683–8503, Japan
e-mail: hagino@med.tottori-u.ac.jp

Introduction

Hip fracture is the most significant osteoporotic fracture in terms of health outcomes, quality of life, and cost. As a result of the aging population, the burden of these fractures on our health care systems is increasing and the absolute number of hip fractures is expected to increase significantly during the next few decades. It has been estimated that the total number of hip fractures worldwide will increase from 1.3 million in 1990 to 2.6 million by the year 2025 and to 4.5 million by the year 2050 [1]. To predict the number of

patients requiring treatment for hip fractures during the coming decades, however, it is necessary to determine whether the number of fractures is rising more rapidly than can be accounted for by demographic changes alone.

A growing number of epidemiological surveys show an exponential increase in the incidence of hip fracture with age among different ethnic groups. In addition, data obtained beginning in the 1990s from Northern Europe [2, 3], North America [4], and Australia [5] indicate that previously observed age-specific increases in the incidence of hip fracture have plateaued. We previously performed a hip fracture survey in the Tottori prefecture and found that the incidence of hip fracture increased from 1986 to 2001; this agreed with most other studies from Asia, which indicated an increase in the incidence of hip fracture over time [6].

To estimate the real burden of this problem, a long-term prospective population-based study specifically examining the age distribution and changes in the incidence rates of hip fracture is essential. There is, however, a paucity of long-term data on the changes in these rates in men and women within defined communities. The aims of this study were to investigate hip fracture incidence rates in the Tottori prefecture from 2004 to 2006 and to compare them with previously reported rates.

Patients and methods

Data sources

In 2006, the Tottori prefecture, which is located in midwestern Japan, had a population of 603,987, including 176,255 men and 208,582 women aged 35 years and older. The percentages of the population aged 65 years and older, 75 years and older, 85 years and older, and 90 years and older in 2006 were 24.6% (20.4% of men; 28.4% of women), 12.9% (9.4% of men; 16.1% of women), 3.5% (1.8% of men; 5.0% of women), and 1.4% (0.6% of men; 2.0% of women) respectively.

As previously stated [6], all hip fractures in patients 35 years and older that occurred between 2004 and 2006 were surveyed in all of the hospitals in the Tottori prefecture. This included 30 hospitals with orthopedic or general surgery departments; according to the hospital records, survey registration was performed by the doctors or medical staff in each of these hospitals. Registration information included gender, age, area of residence, date of fracture, type of fracture (neck or trochanteric), and treatment. Patients residing in other prefectures were excluded. Duplication of cases was determined using the patients' ages, dates of fracture, types of fracture, and areas of residence. As previously reported [6], we investigated the data collection methods at the three hospitals with the most hip fracture patients in each year, which covered one-third of the total number of patients in this prefecture. This confirmed that the methods used to register the patients with hip fractures were consistent with those used in previous observational periods.

The study was approved by the local ethics research committee at the Faculty of Medicine, Tottori University.

Statistical analysis

The patients were divided into groups according to their age (subdivided into 5-year increments), gender, and fracture type (neck or trochanteric fracture). The age- and gender-specific incidence rates (per 100,000 person years) were calculated based on the population of the Tottori prefecture during each year. Every 5 years in Japan, a national census is performed on 1 October, including in 2005 during the observation period. The age- and gender-specific populations for each survey year were estimated by the Bureau of Statistics of the Tottori prefecture government office according to resident registration records.

To determine recent trends in the hip fracture incidence, a test of trends of proportions in quantitatively ordered samples was used [7]. The age- and gender-specific incidence (per 100,000 person years) from 1986–1988, 1992–1994, and 1998–2001, which we have previously reported [6, 8], were used for this analysis. The expected number of patients, age-adjusted to the population structure from 1986 in the Tottori prefecture (35 years and older), was calculated from the age- and gender-specific incidence rates in each observation year. The overall and slope Chi-squared values were examined. Additionally, we elucidated the influence of the expansion in the elderly population using the age-adjusted incidence in two age groups: 85–89 years old and 90 years and older.

Lifetime risks of hip fracture for 50-year-old men and women in the population were estimated by simple approximation using the incidence data and the age- and gender-specific incidence and life tables for the Japanese population in 2006 released by the Ministry of Health, Labour and Welfare of Japan (http://www.mhlw.go.jp/english/database/index.html).

To compute the lifetime risks, Pr was defined as the probability of having no hip fracture until death for a 50-year-old man or woman. This probability may be discretely approximated using the following formula:

$$\begin{aligned}\Pr = {} & d50(1-I50) + (1-d50)(1-I50)d51(1-I51) \\ & + (1-d50)(1-I50)(1-d51) \\ & \times (1-I51)d52(1-I52) + \cdots\end{aligned}$$

where $d50$ is the probability of dying between the ages of 50 and 51 years, $I50$ is the probability of having a fracture between the ages of 50 and 51 years, and so on. These

values were replaced with the corresponding incidence or mortality rates in this study. The residual lifetime risk of an individual aged 50 years experiencing a hip fracture is then estimated by 1 − Pr.

The significance of the difference in proportions of patients with left or right fractures was examined using Chi-squared testing. The monthly variation in the number of patients was tested using the Friedman test. $P<0.05$ was regarded as significant.

Results

Characteristics of patients aged 35 years and older with hip fracture

Registration was performed in all hospitals during the entire observation period. As a result, this survey covered all patients with hip fractures. The survey identified 851 (161 men and 690 women), 906 (170 men and 736 women), 1,059 (191 men and 868 women) patients aged 35 years and older in 2004, 2005, and 2006 respectively. Categorizing the patients by fracture type, there were 360 neck fractures (63 men and 297 women) and 487 trochanteric fractures (97 men and 390 women) in 2004 (4 fractures were undetermined); 338 neck fractures (61 men and 277 women) and 547 trochanteric fractures (103 men and 444 women) in 2005 (21 fractures were undetermined); and 424 neck fractures (84 men and 340 women) and 617 trochanteric fractures (102 men and 515 women) in 2006 (18 fractures were undetermined).

Right hips were fractured in 1,421 patients and left hips were fractured in 1,395 patients, with no significant difference between the numbers of right and left fractures. The maximum number of fractures occurred in January (267), whereas the smallest number occurred in August (189). There was no statistically significant difference among months during the 3-year period from 2004 to 2006. Including the data from the previous observational periods (1986–1988, 1992–1994, 1998–2001, and 2004–2006), a significant seasonal change in the incidence was noted, with a higher incidence observed in the winter and a lower incidence identified in the summer months ($p<0.006$, by Friedman test).

Incidence of hip fracture between 2004 and 2006

In the population aged 35 years and older, the crude incidence of hip fractures was 244.8 per 100,000 person years from 2004 to 2006, and the gender-specific incidence was 99.1 per 100,000 person years for men and 368.0 per 100,000 person years for women. Although the incidence rate of hip fractures increased with age (Table 1), the absolute number of hip fractures peaked in the 80- to 84-year-old population of men and in the 85- to 89-year-old population of women.

After categorizing the fracture types, the incidence of neck fractures averaged during the 3-year period (from 2004 to 2006) in men and women was 58.6 and 143.7 (70- to 74-year-old group), 101.1 and 309.0 (75- to 79-year-old group), 160.9 and 477.9 (80- to 84-year-old group), 301.6 and 634.7 (85- to 89-year-old group), and 391.5 and 820.1 (≥90-year-old group) respectively. The incidence of trochanteric fractures was 62.9 and 105.5 (70- to 74-year-old group), 128.8 and 244.7 (75- to 79-year-old group), 289.7 and 730.2 (80- to 84-year-old group), 575.4 and 1,470.5 (85- to 89-year-old group), and 619.6 and 2,070.0 (≥90-year-old group) respectively.

Table 1 Age- and gender-specific incidence of hip fracture in Tottori Prefecture, Japan

Age group	Men						Women						Average	
(years)	2004	*n*	2005	*n*	2006	*n*	2004	*n*	2005	*n*	2006	*n*	Men	Women
35–39	0.0	0	6.0	1	11.5	2	5.9	1	5.9	1	5.7	1	5.8	5.8
40–44	5.8	1	5.8	1	12.2	2	0.0	0	0.0	0	5.8	1	7.9	1.9
44–49	24.9	5	26.0	5	26.8	5	5.0	1	0.0	0	26.5	5	25.9	10.5
50–54	8.5	2	17.6	4	13.7	3	39.2	9	22.6	5	4.7	1	13.3	22.1
55–59	13.4	3	24.8	6	34.6	9	31.6	7	33.5	8	50.7	13	24.3	38.6
60–64	61.3	11	16.6	3	47.1	8	71.6	14	31.0	6	88.3	16	41.7	63.7
65–69	110.7	18	106.4	17	81.7	13	163.7	32	78.8	15	164.4	31	99.6	135.7
70–74	150.8	24	88.6	14	131.5	21	270.3	53	192.9	39	299.2	60	123.6	254.1
75–79	185.5	24	249.0	33	270.6	36	508.0	96	568.7	109	620.8	120	235.0	565.8
80–84	441.8	31	554.9	43	391.7	33	1,163.7	163	1,301.9	196	1,258.3	196	462.8	1,241.3
85–89	665.3	22	915.0	31	1,107.3	39	2,035.8	166	1,953.7	174	2,437.5	230	895.9	2,142.3
90+	1,246.9	20	730.8	12	1,116.7	20	2,605.6	146	3,089.1	183	3,024.6	191	1,031.5	2,906.5

Incidence data are per 100,000 person years

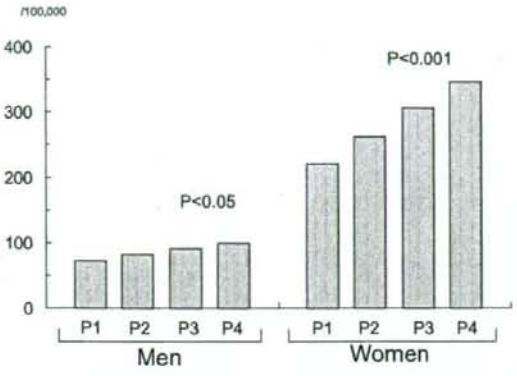


Fig. 1 Trends in the incidence of hip fracture per annum (patients aged 35 years and older). Data are the expected number of patients adjusted for the age- and gender-specific incidence in each year standardized using the 1986 population structure in the Tottori prefecture. In the population aged 35 and older, 154,774 individuals were men and 183,157 were women in 1986. P1: 1986–1988; P2: 1992–1994; P3: 1998–2001; P4: 2004–2006. The incidence in the periods 1986–1988, 1992–1994, and 1998–2001, which we have previously reported [6, 8], was used. χ^2 (overall) was 24.7 ($p<0.05$) for men and 110.0 ($p<0.001$) for women. χ^2 (slope) was 16.4 ($p<0.01$) for men and 97.7 ($p<0.001$) for women

The residual lifetime risk of hip fracture for individuals aged 50 years was estimated to be 5.6% for men and 20.0% for women.

Changes in incidence during the 20-year period

During the 20-year observational period, the total population aged 35 years and older in this area grew 1.14-fold, whereas that aged 85 years and older grew 3.18-fold (from 6,662 to 21,163). From 1986 to 1988, 916 hip fractures were reported in patients 35 years and older, whereas 2,816 hip fractures were identified in this patient population in the period from 2004 to 2006. The number of hip fractures among women increased 3.3-fold, from 692 to 2,294, and that among men increased 2.3-fold, from 224 to 522.

The expected number of patients adjusted for the age- and gender-specific incidence in each year and standardized using the population structure of 1986 showed significant increases from 1986 to 2006 for both genders (Fig. 1). The mean age- and female-specific incidence in the 85- to 89- and ≥90-year-old age groups was 1,179.2 and 1,506.9 per 100,000 person years from 1986 to 1988, 1,632.8 and 1,838.0 per 100,000 person years from 1992 to 1994, 1,810.9 and 2,407.5 per 100,000 person years from 1998 to 2001, and 2,142.3 and 2,906.5 per 100,000 person years from 2004 to 2006 respectively. Those for men in the 85- to 89- and ≥90-year-old age groups were 551.5 and 871.9 per 100,000 person years from 1986 to 1988, 572.6 and 887.3 per 100,000 person years from 1992 to 1994, 632.9 and 1,059.3 per 100,000 person years from 1998 to 2001, and 895.9 and 1,031.5 per 100,000 person years from 2004 to 2006 respectively.

Figure 2 shows the average age- and gender-specific incidence for neck and trochanteric fractures from the periods 1986–1988, 1992–1994, 1998–2001, and 2004–2006. For both genders, the incidence of both types of fracture was significantly higher in 2004–2006 than in all other survey periods. The expected numbers of patients with neck fracture adjusted for the age- and gender-specific incidence in each year and standardized by the population structure of 1986 was 22.0 for men and 87.0 for women in 1986, and 47.2 for men and 175.0 for women in 2006. The expected numbers of trochanteric fractures in men and

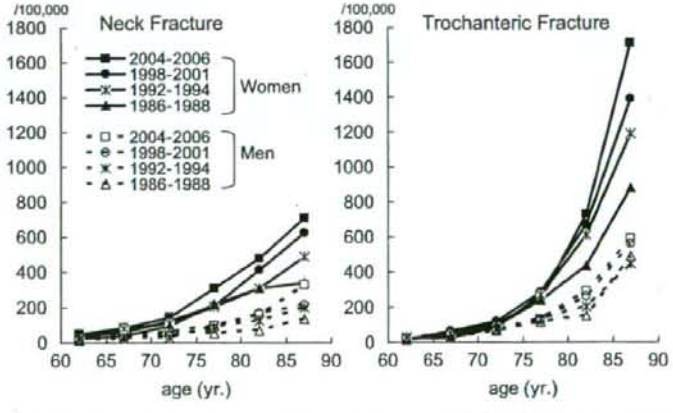


Fig. 2 Age- and gender-specific incidence of neck and trochanteric fractures between 1986 and 2006. Incidence data are per 100,000 person years. Incidence from the periods 1986–1988, 1992–1994, and 1998–2001, which we have previously reported [6, 8], were used for comparison

women were 39.0 and 119.0 in 1986 and 57.0 and 202.2 in 2006 respectively. These increases were statistically significant, with the exception of trochanteric fractures in men.

Discussion

In this study, we have demonstrated that the age-specific incidence of hip fracture in the Tottori prefecture has not stabilized, but rather has slightly increased during the past two decades. This observational study began in 1986 and has been carried out using 3-year intervals, except for the 4-year survey from 1998 to 2001. The catchment area, the methods of identifying hip fracture patients, and the definitions of fracture were identical to those used in previous studies [6, 8]. The proportion of the population aged 65 years and older in the whole of Japan was 20.8% in 2006, whereas it was 24.6% in Tottori. In the Tottori prefecture, there are 6.6 general hospitals per 100,000 persons (6.2/100,000 persons for the whole of Japan) and the average monthly income is ¥504,729 (US$4,799) per family unit (¥525,716 [US $4,997] for the whole of Japan) in 2006. Based on these data, the Tottori prefecture has a higher percentage of seniors, but is representative of Japan based on the medical resources and family economics. Because the Tottori prefecture is on the coast and is surrounded by mountains, all patients with fractures must be treated at a hospital within the prefecture. Japanese citizens are legally obliged to belong to one of several government-subsidized health insurance programs, and thus every patient with hip fracture is treated in a hospital. These circumstances contribute to the validity of this longitudinal survey. The incidence observed during the 20-year period in the Tottori prefecture was in the middle of the range observed within Japan as a whole over the same period [9, 10], suggesting that the data from this study are representative of the Japanese population.

Several studies have suggested a wide geographic variation in hip fracture incidence between countries, with the highest rates reported for northern European countries [2, 3] and the United States [11], and the lowest rates reported in Africa and some Asian populations [6, 12, 13]. The Japanese incidence presented in the current study is slightly higher than that reported recently in Korea [14] or Taiwan [15]. In general, people who live in latitudes farther from the equator seem to have a higher incidence of fracture [16].

The lifetime risk of hip fractures for individuals aged 50 years is estimated to be 22.9% for women and 10.7% for men in Sweden, and 11.4% and 3.1% respectively in the UK [17, 18]. The average life expectancy at birth for Japanese individuals has steadily increased, reaching 78.56 years for men and 85.52 years for women in 2005. The life expectancy for 50-year-old men was 29.26 years and that for women was 35.94 years in 2005. Although the incidence of hip fracture in Japan is lower than that in Sweden, longer lifespans have elevated the residual lifetime fracture risk for individuals 50 years of age.

This type of increase has been observed in longitudinal data from several areas within Japan [19] and in nationwide surveys [10], in which the incidence was increased in both men and women, particularly among individuals at least 80 years old; the present study demonstrated the same tendency. In the Tottori prefecture, the total population decreased by 2.1% from 1986 to 2006, whereas the population aged 85 years and older more than tripled. This expansion in the elderly population may have affected our findings. To address this possibility, we compared the age-adjusted incidence with previous observations in the population aged between 85 and 89 years and in that aged 90 years and older. We found a substantial increase in women in the incidence in these age groups and in men 85 to 89 years old. This age-specific increase in these older populations indicates that the increase in hip fracture incidence is not completely due to a proportional change in the population structure.

Decreases in the incidence of hip and wrist fractures have been observed in Ontario, Canada; the authors suggested that the higher diagnosis rates for osteoporosis and the shift from specialist to primary care observed in the late 1990s resulted in a greater number of women with osteoporosis receiving appropriate diagnosis and treatment, which coincided with the reduction in fracture rates [20]. A nationwide decline in the incidence of hip fracture has been also been reported in Finland; potential reasons proposed by the authors included a cohort effect toward a healthier elderly population, increased body mass index, improved functional ability in the elderly, specific actions to prevent and treat osteoporosis, and effective programs and interventions for fall prevention [21]. Bone mineral density in older Japanese individuals has been increasing recently. The Miyama study conducted in 1990 and in 2000 showed significant improvements in the bone density of the femoral neck in men in their 60s and in women in their 50s, suggesting that bone fragility may be generally less severe than before in Japan [22]. This is probably a result of increased body weight among Japanese individuals; increases in obesity, however, may result in decreases in hip fracture similar to the data described from Northern Europe. Therefore, risks of fracture other than bone fragility should be assessed to help explain the increase in the incidence in Japan. We reported that one significant preventive factor for distal radius fractures among Japanese individuals was the use of a futon (as opposed to a bed) [23]. We speculated that futon use helps to maintain some level of physical activity, resulting in a reduced risk of falls. Moreover, the overall decrease in physical activity of a Westernized lifestyle may explain the increase in fracture incidence among Japanese patients. Another explanation may

be that more seniors with poor health due to other conditions are being treated, which results in people living longer at a time when their risk of falling is considerably high.

The incidence of neck fracture is higher than that of trochanteric fracture in Northern European and African populations, whereas neck fracture is less common in Japanese populations [3, 13, 24, 25]. This study showed that an increasing number of patients in the Tottori prefecture are suffering neck fracture relative to trochanteric fracture; the increases in age-standardized incidence during the two decades for neck fracture was 115% in men and 101% in women, and those for trochanteric fracture were 46% and 70% respectively. On the other hand, a recent survey in Sweden showed that the neck-to-trochanteric fracture incidence ratio had leveled off [2]. Although the reason for these trends is uncertain, the neck-to-trochanteric fracture ratio in Japan is approaching values observed in Northern European populations.

Our study has some limitations, particularly with regard to the data collection. The method of data collection was consistent, and, as mentioned before, we checked patient enrollment in three monitoring hospitals [6]. Second hip fractures in the same patient during the observational period were not specifically identified in the present survey, which may have affected the result. Moreover, hip fracture patients living in the Tottori prefecture and treated outside the prefecture may have been missed during the registration. The number of such patients, however, is likely to be very small.

We conclude that the age- and gender-specific incidence of hip fracture in the Tottori prefecture of Japan has not plateaued as it has for populations in Northern Europe and North America. This presents a remarkable challenge to the Japanese health care system. An estimated 12 million patients have osteoporosis in Japan, and only 20–25% are being treated with anti-osteoporotic medication. Appropriate diagnosis and treatment of osteoporosis is essential, and more effective interventions for preventing falls are needed.

Acknowledgements The authors sincerely acknowledge the staff members of the hospitals in the Tottori prefecture that participated in this study. The authors also acknowledge the Japanese Orthopedic Society. The authors would like to express sincere thanks to Motoko Sasaki for her secretarial help. This study was supported by a grant-in-aid from the Ministry of Health, Labour and Welfare of Japan (grant H18–Choujyu Ippann–036).

Conflicts of interest None.

References

1. Gullberg B, Johnell O, Kanis JA (1997) World-wide projections for hip fracture. Osteoporos Int 7:407–413
2. Lofman O, Berglund K, Larsson L et al (2002) Changes in hip fracture epidemiology: redistribution between ages, genders and fracture types. Osteoporos Int 13:18–25
3. Bjorgul K, Reikeras O (2007) Incidence of hip fracture in southeastern Norway: A study of 1,730 cervical and trochanteric fractures. Int Orthop 31:665–669
4. Melton LJ III, Atkinson EJ, Madhok R (1996) Downturn in hip fracture incidence. Pub Health Rep 111:146–150, discussion 151
5. Boufous S, Finch CF, Lord SR (2004) Incidence of hip fracture in New South Wales: are our efforts having an effect? Med J Aust 180:623–626
6. Hagino H, Katagiri H, Okano T et al (2005) Increasing incidence of hip fracture in Tottori Prefecture, Japan: trend from 1986 to 2001. Osteoporos Int 16:1963–1968
7. Fleiss JL (1973) Proportions from independent samples. Statistical methods for rates and proportions. Wiley, New York, pp 96–99
8. Hagino H, Yamamoto K, Ohshiro H et al (1999) Changing incidence of hip, distal radius, and proximal humerus fractures in Tottori Prefecture, Japan. Bone 24:265–270
9. Orimo H, Hashimoto T, Sakata K et al (2000) Trends in the incidence of hip fracture in Japan, 1987–1997: the third nationwide survey. J Bone Miner Metab 18:126–131
10. Yoshimura N, Suzuki T, Hosoi T et al (2005) Epidemiology of hip fracture in Japan: incidence and risk factors. J Bone Miner Metab 23 Suppl:78–80
11. Ross PD, Norimatsu H, Davis JW et al (1991) A comparison of hip fracture incidence among native Japanese, Japanese Americans, and American Caucasians. Am J Epidemiol 133:801–809
12. Abolhassani F, Moayyeri A, Naghavi M et al (2006) Incidence and characteristics of falls leading to hip fracture in Iranian population. Bone 39:408–413
13. El Maghraoui A, Koumba BA, Jroundi I et al (2005) Epidemiology of hip fractures in 2002 in Rabat, Morocco. Osteoporos Int 16:597–602
14. Rowe SM, Song EK, Kim JS et al (2005) Rising incidence of hip fracture in Gwangju City and Chonnam Province, Korea. J Kor Med Sci 20:655–658
15. Chie WC, Yang RS, Liu JP et al (2004) High incidence rate of hip fracture in Taiwan: estimated from a nationwide health insurance database. Osteoporos Int 15:998–1002
16. Lönnroos E, Kautiainen H, Karppi P et al (2006) Increased incidence of hip fractures. A population-based study in Finland. Bone 39:623–627
17. Kanis JA, Johnell O, Oden A et al (2000) Long-term risk of osteoporotic fracture in Malmo. Osteoporos Int 11:669–674
18. Johnell O, Kanis J (2005) Epidemiology of osteoporotic fractures. Osteoporos Int 16 [Suppl 2]:S3–S7
19. Endo E, Endo N, Sakuma M (2005) Complete survey of hip fracture in 2004 in Niigata Prefecture. InL The 23rd Annual Meeting of the Japanese Society for Bone and Mienral Research, Osaka, p 202
20. Jaglal SB, Weller I, Mamdani M et al (2005) Population trends in BMD testing, treatment, and hip and wrist fracture rates: are the hip fracture projections wrong? J Bone Miner Res 20:898–905
21. Kannus P, Niemi S, Parkkari J et al (2006) Nationwide decline in incidence of hip fracture. J Bone Miner Res 21:1836–1838
22. Yoshimura N, Kinoshita H, Danjoh S et al (2002) Bone loss at the lumbar spine and the proximal femur in a rural Japanese community, 1990–2000: the Miyama study. Osteoporos Int 13:803–808
23. Hagino H, Fujiwara S, Nakashima E et al (2004) Case-control study of risk factors for fractures of the distal radius and proximal humerus among the Japanese population. Osteoporos Int 15:226–230
24. Luthje P, Santavirta S, Nurmi I et al (1993) Increasing incidence of hip fractures in Finland. Arch Orthop Trauma Surg 112:280–282
25. Hagino H (2007) Features of limb fractures: a review of epidemiology from a Japanese perspective. J Bone Miner Metab 25:261–265

J Bone Miner Metab (2008) 26:373–378
DOI 10.1007/s00774-007-0841-1

© Springer 2008

ORIGINAL ARTICLE

**Mayumi Sakuma · Naoto Endo · Takeo Oinuma
Einosuke Endo · Takashi Yazawa · Kei Watanabe
Satoshi Watanabe**

Incidence and outcome of osteoporotic fractures in 2004 in Sado City, Niigata Prefecture, Japan

Received: May 10, 2007 / Accepted: December 20, 2007

Abstract Osteoporotic fracture in elderly populations is increasing worldwide, but there are few data on the incidence and outcome of osteoporotic fractures, including upper extremity and vertebral fracture, during a certain period in a defined geographic area. The purpose of this study was to determine the incidence of osteoporotic fractures in a particular area: Sado City, Niigata Prefecture, Japan. From January to December 2004, osteoporotic fractures of the vertebra, hip, distal radius, and proximal humerus in Sado City were recorded. The incidence, age, gender, type of fracture (for hip fracture), right or left side (for distal radius, proximal humerus, and hip fracture), place of injury, cause of injury, outcome, hospitalization period, and patient status regarding taking of drugs for osteoporosis treatment were checked for each fracture. The incidence was calculated based on the whole population of Sado City. The incidence per 100000 population was 232.8, 121.4, 108.6, and 37.1 for fractures of the vertebra, hip, distal radius, and proximal humerus, respectively. The total incidence of these four kinds of fracture was 499.9 per 100000 persons per year. The average age at the time of injury was 81.4, 77.7, 75.7, and 60.2 years old for fractures of the hip, vertebra, proximal humerus, and distal radius, respectively. As the average age increased, the percentage of fractures that occurred indoors also increased; that is, a higher percentage of hip fractures occurred indoors, followed by fractures of the vertebra, proximal humerus, and distal radius. Most patients were not taking anti-osteoporosis drugs before fractures of the hip or vertebra. We determined the incidence of major osteoporotic fractures in 1 year in a defined geographic area. Our data showed that 81% of hip fracture patients also had a vertebral fracture and that the average age at the time of injury was higher for hip fractures than for vertebral fractures. Therefore, these results suggest that vertebral fracture leads to hip fracture, indicating that early fracture prevention and continuous prevention strategies through positive treatment are of importance in osteoporotic elderly people.

Key words vertebral fracture · hip fracture · proximal humerus fracture · distal radius fracture · incidence

M. Sakuma (✉) · T. Oinuma · E. Endo · T. Yazawa · K. Watanabe
Department of Orthopedic Surgery, Sado General Hospital,
113-1 Chigusa, Sado 952-1209, Japan
Tel. +81-259-63-6346; Fax +81-259-63-6347
e-mail: maysakuma7@yahoo.co.jp

M. Sakuma · N. Endo · S. Watanabe
Division of Orthopedic Surgery, Department of Regenerative and Transplant Medicine, Niigata University Graduate School of Medical and Dental Sciences, Niigata, Japan

M. Sakuma · N. Endo
Division of Rehabilitation Medicine, Department of Community Preventive Medicine, Niigata University Graduate School of Medical and Dental Sciences, Niigata, Japan

Introduction

Osteoporotic fractures, and especially vertebral and hip fractures, reduce quality of life (QOL) in elderly people because of associated pain, malposture, movement disability, and mental anxiety [1–4]. Knowledge of the descriptive epidemiology of the incidence and outcome of these fractures is important for prevention or reduction of such fractures. The aim of this study was to identify the incidence of fractures of the vertebra, hip, distal radius, and proximal humerus over a certain period in a population in a defined geographic area: Sado City, Niigata Prefecture, Japan.

Patients and methods

Study site

The study was carried out in Sado City, Japan. Sado City is located on Sado Island, and the population of the city and the island are equivalent. Sado Island is located in Niigata Prefecture on the Sea of Japan, at latitude 37°47′ N to 38°20′ N and longitude 138°12′ E to 138°34 E, situated north of the main Japanese island of Honshu. Sado Island has an area of 855 km^2, and the population of the island was 70011

(33418 males and 36593 females) as of June 30, 2004, of which 23787 (9603 males and 14184 females) (34%) were 65 years old and older. Tourism, fishing, and agriculture are the chief industries, and access to the island is only possible by sea or air. Immigration and emigration among the elderly people of the island are extremely low.

Subjects

We examined the occurrences of osteoporotic fractures of the vertebra, hip, distal radius, and proximal humerus on Sado Island from January to December 2004. Almost all patients with hip fractures visited one general hospital, where all cases of this type are concentrated and surgery for hip fractures is carried out. To obtain information on fractures of the vertebra, distal radius, and proximal humerus, we distributed questionnaires to four hospitals and five doctors' offices on the island, including the main orthopedics facility. Answers were obtained from three hospitals and three doctors' offices, comprising 94% of the number of beds allocated for orthopedics cases. Fractures that occurred in tourists were excluded from the data, and pathological fractures resulting from malignant tumor or other bone metabolic diseases were also excluded.

Methods

All fractures were examined by X-ray. For vertebral fractures, lateral spinal radiographs were examined and the fractures were defined as wedge, biconcave, and compound (Fig. 1) based on the dimensions of the vertebral body and diagnostic criteria issued by the Ministry of Health and Welfare and widely used in Japan [5,6]. It was not necessarily easy to identify a new vertebral fracture, but patients who visited the hospital for symptoms such as back pain for the first time and were judged to have a vertebral fracture by the orthopedic doctor based on X-ray and physical examination were considered to be new fracture cases (an incident of fracture: clinical fracture). Asymptomatic older fractures (prevalent fracture) discovered accidentally by X-ray were excluded from the data. The incidence, age, gender, type of fracture (for hip fracture), right or left side (for distal radius, proximal humerus, and hip fracture), place of injury, cause of injury, outcome, hospitalization period, and patient status regarding taking of anti-osteoporosis drugs were checked for each fracture. The incidence rates were calculated based on the whole population of Sado City. Incidence rates adjusted to the entire population of Japan in 2005 were also calculated.

Statistical analysis

A chi-square test for goodness of fit was used to evaluate the difference in numbers of right and left side fractures (for distal radius and proximal humerus fractures). The analysis was performed using Microsoft Excel for Windows.

Results

Vertebral fracture

There were 163 cases of vertebral fracture (45 males and 118 females), a male-to-female ratio of 1:2.6 (Table 1). The overall incidence was 232.8 per 100000 population per year, which was the highest incidence among the four kinds of fractures. With adjustment for the Japanese population, the incidence was 138.4. The average age at the time of injury was 77.7 years old, with a range of 18 to 97 years old.

Hip fracture

There were 85 cases of hip fracture (20 males and 65 females), a male-to-female ratio of 1:3.3. The overall incidence was 121.4 per 100000 population per year. Adjusted for the Japanese population, the incidence was 69.8. The

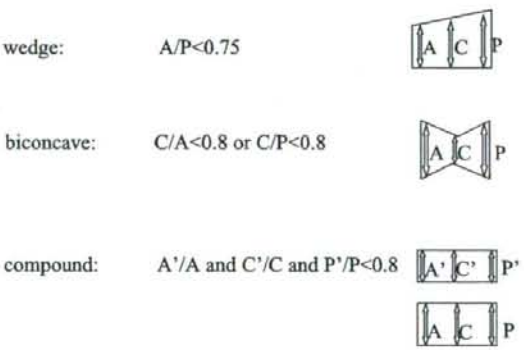


Fig. 1. Diagnostic criteria for vertebral fracture. (From [5, 6])

Table 1. Number and incidence of each fracture in Sado City in 2004

Site	Number of fractures (male, female)	Male-to-female ratio	Mean age (years)	Incidence (per 100000 person-year)	Adjusted for Japanese population (2005)
Vertebra	163 (45, 118)	1:2.6	77.7 ± 11.8 (18–97)	232.8	138.4
Hip	85 (20, 65)	1:3.3	81.4 ± 11.0 (42–104)	121.4	69.8
Distal radius	76* (18, 57)	1:3.2	60.2 ± 24.6 (8–91)	108.6	76.9
Proximal humerus	26 (3, 23)	1:7.7	75.7 ± 16.2 (15–92)	37.1	37.3
Total	350 (86, 263)	1:3.1	—	499.9	322.4

*One patient of unknown gender