Longitudinal Change in BMD in a Population Based Cohort of Patients with Inflammatory Bowel Disease

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ABSTRACT

Background: Persons with inflammatory bowel disease (IBD) are reported to have a high prevalence of osteoporosis and reduced bone mineral density (BMD), and are at higher risk of fracture. The course of BMD loss over time is poorly characterized in persons with IBD

Methods: 86 persons, stratified by age, were enrolled from a population based longitudinal IBD cohort study to undergo BMD testing at baseline, with final BMD testing mean 4.3 years later. The proportion of subjects with significant change in BMD at the lumbar spine, total hip, and femoral neck was assessed, as were clinical, biochemical, and anthropomorphic changes. Vertebral radiographs were also obtained at baseline and at end of follow-up in those age 50 years and older to detect vertebral fractures.

Results: The change in BMD seen in this cohort of IBD patients was similar to the expected rate of BMD loss in the general population. Age >50 years, decreasing BMI and corticosteroid use were most notably correlated with BMD loss. Subjects age <50 years did not have statistically significant declines in BMD. IBD symptom activity scores correlated poorly with BMD loss. Vertebral fractures were uncommon, with only two subjects out of 41 over age 50 years developing a definite radiographic fracture over the course of follow-up. No major nonvertebral fractures were observed.

Conclusion: Patients with IBD do not appear to have significantly accelerated BMD loss. Older age, decreasing BMI and corticosteroid use may identify IBD patients at greater risk for BMD loss.

INTRODUCTION:

Inflammatory bowel disease (IBD), consisting of both Crohn's disease (CD) and ulcerative colitis (UC), is typified by the development of chronic inflammation in the gastrointestinal tract of uncertain etiology. It has long been recognized that persons with IBD have an increased prevalence of reduced bone mineral density (BMD) and osteoporosis[1-4]. Furthermore, IBD is associated with an approximately 40% increased risk of fracture over persons without IBD[5]. However, it is currently unclear whether the intestinal inflammation is directly responsible for this increase in fracture risk and BMD loss[6,7], or whether other factors commonly seen in IBD, including decreased body mass, corticosteroid use, and poor intake of calcium and/or vitamin D, are primarily responsible.

While there are numerous cross-sectional studies which have evaluated BMD and assessed risk factors for low BMD, there are few data on changes in BMD over time among persons with IBD, and which disease related risk factors have the most pronounced effects on BMD loss. While IBD is considered to be a risk factor for accelerated BMD loss, there are little data currently to support this assertion. There are also no guidelines to determine whether subjects with IBD require BMD testing at more frequent intervals. To this end, we have assembled a population based cohort of persons with known IBD to prospectively and longitudinally assess the effects of IBD on BMD and fracture.

METHODS:

Patient Population:

The Manitoba IBD Cohort Study was initiated in 2002 in order to prospectively assess IBD related outcomes and the process of care among persons with IBD[8]. In order to be eligible for inclusion in the IBD cohort study, subjects must have been diagnosed with IBD within 7 years of enrollment, and must have been age 18 years or older. Potential subjects were recruited from a validated population-based research registry that has been previously described[9]. The Registry identifies and recruits participants based on an administrative definition of IBD from the comprehensive population-based health databases of Manitoba Health, the single insurer that provides healthcare to all residents in the province. Approximately one-half of all persons in Manitoba who have met the administrative definition for IBD have agreed to be included in the Registry, allowing us to contact these persons for consideration of participation in a variety of research initiatives. The performance of this study was approved by the University of Manitoba Research Ethics Board, and all patients provided informed consent for their participation in the Cohort and attendant studies.

At the time of the Cohort study recruitment, there were 3192 participants in the University of Manitoba IBD Research Registry, among whom 606 were eligible for this study, given the age and recent disease onset criteria. Overall, 388 subjects agreed to participate in the Manitoba IBD Cohort study. To assess representativeness, Cohort participants were compared to all other IBD

cases diagnosed in the same time period using the University of Manitoba IBD Epidemiology Database, a comprehensive validated dataset that includes all diagnosed IBD cases in the province. There were no significant differences on standard demographic comparisons including age distribution, sex distribution, urban versus rural residence, and mean duration of disease[8].

Subjects in the Cohort study are sent survey material every six months to gather information on core clinical and psychological parameters. Disease activity was assessed semiannually using the Manitoba IBD Index (MIBDI, see supplemental table), which is a single-response question where subjects are asked to rate their symptom burden on a six-level scale. The MIBDI has been demonstrated to correlate well to activity as measured with the Harvey Bradshaw Index and Powell Tuck Activity Index[10].

On an annual basis, all subjects in the Cohort undergo an in-person interview by trained research staff where disease activity is assessed using the Harvey Bradshaw Index for CD and the Powell Tuck Index for UC[11,12]. At these visits, subjects are queried about overall changes in their health status and medication use, and undergo an assessment of dietary composition and of physical activity. Subjects are also weighed, examined, and samples are obtained for laboratory testing.

Description of the Bone Health Substudy:

From the Manitoba IBD Cohort, 101 subjects were randomly selected, stratified by age ($\geq$50 and <50 years at enrolment) to be considered for a substudy of bone health and completed all baseline measurements. The baseline visit for patients in this substudy occurred in 2003. The 86 subjects completing prospective assessments for changes in bone health are the subject of the current report.

In addition to the survey measures and interviews described above, all subjects underwent dual x-ray absorptiometry (DXA) at baseline and follow up with the final measurement approximately 4 years after the initial DXA. Areal BMD was assessed at the first four vertebrae of the lumbar spine (L1-4), the femoral neck, and at the total hip. All subjects underwent BMD testing with dual-energy x-ray absorptiometry (DXA) (Hologic QDR-4500, Waltham, MA). Scans were acquired and analyzed using manufacturer specifications and White reference data to provide standard measures of areal BMD including T-scores and Z-scores. NHANES III reference data were used for the total hip and femoral neck; manufacturer reference data were used for the lumbar spine. T-scores and Z-scores used gender-matched reference data. In accordance with BMD reporting recommendations from the International Society of Clinical Densitometry (ISCD), osteoporotic BMD was defined as a T-score $\leq$ -2.5 for the minimum T-score from the lumbar spine, total hip and femoral neck.[13] The densitometers used showed stable long-term performance (coefficient of variation [CV] < 0.5%), and satisfactory in vivo precision (CV 1.7% for L1-4 and 1.1% for the total hip).

All subjects also underwent morning blood draws at the final visit. Blood was collected for assessment of hemoglobin, calcium, phosphate, alkaline phosphatase, 25-hydroxyvitamin D, C-telopeptide (CTX), C-reactive protein (CRP), and estrogen and free testosterone. In subjects over the age of 50 years at the time of enrollment, lateral radiographs were also obtained of the thoracic and lumbar spine to look for evidence of vertebral fractures.

Assessment of Outcomes:

BMD: The primary outcome was the change in BMD from between the initial and final assessments at the total hip, femoral neck, and lumbar spine. We also assessed for differences in BMD loss between males and females, subjects with CD compared with UC, and also contrasted persons under age 50 years with those ages 50 and older. We then looked for differences in BMD and other measures between subjects with active IBD and those with inactive IBD over the five years of follow-up. Subjects were defined as having active disease if their mean MIBDI score over the 10 measurements was 4.5 or less. We also correlated changes in BMD with disease activity using scores on the Harvey Bradshaw score and Powell Tuck Index for CD and UC respectively, with active disease defined as a mean score on either index of 6 or greater. We then evaluated the effect of prednisone exposure during the follow-up period and compared change in BMD at each of the measurement sites for prednisone users and non-users, with subjects considered to be users of prednisone if the cumulative dose of prednisone over the course of follow-up exceeded 450mg (equivalent to 5mg daily for at least 90 days). Correlations between change in BMD at each site and measured laboratory parameters, anthropomorphic measures at baseline and at the 60 month visit were also assessed.

Fractures: We evaluated all spine X-rays to determine the presence or absence of fractures. Spinal radiographs were initially screened by trained technologists from the Canadian Multicentre Osteoporosis Study (CaMos) core laboratory[14] , and then any flagged vertebrae were reviewed for evidence of fracture by two imaging specialists (a musculoskeletal radiologist and a bone densitometry expert with combined 40 years experience). Spinal fractures were graded using the semi-quantitative Genant classification method. Genant Grade II and III fractures (25-39% and $\geq$40% loss of vertebral height) were considered to be definite fractures, whereas Grade I fracture were classified as possible fractures[15]. The change in BMD, disease activity, and prednisone use in all patients with possible (Grade I) and definite (Grade II/III) was assessed. All subjects were also queried at the final visit about all fractures which had taken place since the initial assessment. We considered a fracture to be osteoporosis-related if the subject reported the fracture took place following a fall from a standing height or lower.

Statistics:

Chi-square and Fisher Exact Test were used to compare differences in proportions, and Student t-test was used to assess for difference in means between groups. Subjects were considered to have a significant increase or decrease from baseline if the 95% confidence interval of the mean

change in BMD did not include zero. Correlations were assessed using the Spearman Rank test. Confidence intervals for incidence rates for fracture were calculated assuming a Poisson distribution. Tests were considered to be statistically significant if p-values were less than 0.05. All statistical testing was performed using Statistica 10 (Statsoft Inc, Tulsa, OK).

RESULTS

86 subjects completed the baseline and final visits, and were included in the analysis. 50 had CD, 32 had UC, and 4 were IBD type unclassified. 45 subjects were less than 50 years old, whereas 41 subjects were 50 or older. Baseline characteristics are displayed in Table 1. Osteoporosis, defined as a T-score <=-2.5 at any of the lumbar spine, total hip, or femoral neck, was detected in 6 of 86 subjects (7.0%). Only 2 individuals had a history of prior low trauma fracture after a fall from standing height or lower.

BMD measurements were separated by a mean of 4.3 +/- 0.3 years. For all participants, mean BMD showed a significant decrease from baseline at all measurement sites except for the lumbar spine where BMD actually increased slightly (change in lumbar spine BMD +0.011, 95% CI -0.002 to 0.024). The mean change in BMD ranged from -0.016 /cm^2 at the femoral neck (95% CI: -0.028 to -0.004, p=0.008) and -0.013 g/cm^2 at the total hip (95% CI: -0.025 to -0.001, p=0.031). Overall, there was no change in the proportion of subjects with osteoporosis from baseline (6/86 subjects, 7.0%). Subgroups in which BMD change differed significantly from zero are displayed in Table 2. Notably, significant decreases in BMD were detected at all nonspine measurement sites for subjects age 50 years and over, but not in those under age 50 years. Subjects whose BMI decreased also manifested significant declines in BMD at all non-spine sites. A significant decline was seen at the femoral neck in with a cumulative prednisone dose exceeding 450mg.

When comparing change in BMD between patient subgroups (Table 2), subjects who had a decrease in BMI had a statistically significantly greater BMD loss at the femoral neck and total hip than those reporting an increase in BMI. However, for all other analyses comparing substrata by age, sex, disease subtype, disease activity and prednisone use there were no significant differences in BMD change.

Correlations of BMD with clinical, biochemical, and anthropometric measures are shown in Table 3. Changes in BMD at the hip and femoral neck between the initial and final visits were most strongly positively associated with changes in BMI and weight (r-values 0.40-0.41). Change in total hip and/or femoral neck BMD was negatively associated with cumulative prednisone dose, final serum CTX, serum phosphate, and serum alkaline phosphatase levels. Loss of BMD was not correlated with serum albumin, creatinine, calcium, 25-hydroxyvitamin D, PTH, estradiol, testosterone or CRP. Disease activity as assessed using the Harvey Bradshaw/Powell Tuck indices or the MIBDI was not associated with change in BMD at any measurement site.

On baseline spine radiographs there were 7 subjects who had possible vertebral fractures (6 subjects with a single Grade I fracture, and 1 with two Grade I fractures), but there were no definite (Grade II/III) fractures. By the final visit, 1 of the 7 subjects with prevalent fractures had 1 additional Grade II fracture detected (Table 4). Two patients with no vertebral fractures at baseline had evidence of incident fractures: one subject developed a possible (Grade I) fracture, whereas another developed fractures involving all 5 lumbar vertebrae (3 Grade II and 2 Grade I). This latter subject was a 61 year old female with CD, normal baseline lumbar spine BMD (T-score -0.47), and a mild reduction in total hip BMD (T-score -1.49). By the final visit, BMD had decreased 9.0% at the lumbar spine (final T-score -1.90) and 25.2% at the total hip (final T-score -3.06). This patient also reported a 14.9 kg weight loss over the course of the study. However, these changes were not related to self-reported IBD activity (average MIBDI score = 4.7 [inactive]), and there was also no reported use of prednisone. It is unclear what other factors may have predisposed this specific subject to this degree of weight loss and BMD loss. The overall crude incidence rate of vertebral fractures was 4.0 per 100 person-years for any possible fractures (95%CI 1.5 – 8.3 per 100 person years), and 2.3 per 100 person-years for definite fractures (Grade 2/3), (95%CI 0.6 – 7.0 per 100 person years). In addition, 2 subjects reported minor fractures (feet) and 1 reported a sports-related fracture (forearm); no hip or other major non-vertebral fractures occurred.

DISCUSSION

In this population based cohort of persons with IBD, there was a small, yet statistically significant, decline in BMD at the total hip and femoral neck in persons with IBD age 50 years and older after a mean interval of 4.3 years. These changes were not different, however, than what is expected with aging in persons over age 50 years[16]. Persons with IBD under age 50 years did not have a significant decline in BMD. A decrease in BMD at the femoral neck and total hip was most strongly correlated with a decrease in BMI and weight, and was moderately correlated with cumulative prednisone use. Change in BMD was not correlated with any of the disease activity indices. Lastly, a low rate of vertebral and non-vertebral fragility fractures was seen over the follow-up period.

Overall, these results indicate that persons with IBD do not appear to be at high risk of rapid BMD loss. In a large prospective study in the Canadian population, postmenopausal women had a mean loss in total hip BMD of approximately 0.004 g/cm^2/year, and men over age 50 lost BMD at the total hip at a mean rate of 0.002 g/cm^2/year. Similar rates of BMD loss over time have been seen in other populations.[17,18] Premenopausal women and young men did not manifest significant losses in BMD[16]. The change in BMD we detected in this cohort of IBD subjects was quite similar, with subjects under the age of 50 having no detectable change in BMD at any site, and the rate of nonspine BMD loss in older men and women being approximately 0.004-0.005 g/cm^2/year. Therefore, it does not appear that IBD patients manifest a greater than average rate of BMD loss when compared to the general population.

There has been substantial interest in the diagnosis and management of metabolic bone disease in IBD, based on prior work demonstrating a high rate of osteoporosis and osteopenia in persons with IBD[3,19]. However, the majority of these studies are retrospective and cross-sectional, which makes it difficult to determine which IBD related factors may be responsible for bone mineral loss; and mostly from referral centers which may reflect persons with a higher burden of disease and/or osteoporosis risk factors. However, there are relatively few studies which have evaluated the natural history of bone metabolism and bone disease over time. The largest published prospective study to date assessed BMD in 120 subjects with IBD (60 CD, 60 UC) of whom 93 underwent BMD testing at baseline and after 2 years of follow up[20]. In this study, the mean change in BMD at the femoral neck and total hip was not statistically significant, and was no different between persons with CD and UC. The results of our study are consistent with these findings, and have the additional advantage of subjects having a longer length of follow up.

The results of this analysis further suggest that changes in BMD and the predictors of change in BMD are not significantly different from the general population. Decreases in BMI[21,22], corticosteroid use[23,24], and age over 50[16] have all been demonstrated to be strong predictors of low BMD in the general population, and appear to also be related to BMD loss in the population with IBD[25], both in this analysis and in other published studies. Furthermore, we did not see any association between self-reported IBD related symptom burden and bone mineral loss. This lends further support to current guidelines which suggest screening and follow-up of patients with IBD should be similar to that in the general population, where screening is focused on individuals at high risk for having osteoporosis (history of previous fragility fracture, postmenopausal women, men over age 50, chronic corticosteroid therapy exceeding 3 months, or hypogonadism), and should not focus on merely carrying a diagnosis of IBD[26].

We also did not detect a large number of vertebral fractures occurring in our cohort. Moreover, two of the three definite fractures occurred in a single subject with dramatic weight and BMD loss who did not have active symptomatic IBD. It has been established that persons with IBD have a higher risk of fracture than persons without IBD, although it is not clear whether IBD itself increases fracture risk, or whether it is due to other factors which may be common in persons with IBD, such as reduced BMI and poor nutrition[5,27]. Although previous studies have demonstrated an increased risk of vertebral fractures among persons with IBD[5,27], the risk of fracture may have been underestimated in previous work due to difficulty in detecting asymptomatic vertebral fractures.

While the correlations between change in BMD and baseline serum phosphate, alkaline phosphatase and C-telopeptide were all statistically significant, none had r-values exceeding 0.31, which is indicative of a weak correlation. This would imply that measures of bone turnover may not be useful for predicting which patients with IBD are likely to develop accelerated bone mineral loss. There was a slightly stronger correlation between change in BMI and change in BMD, in keeping with the known association of BMI with BMD.

The strengths of this study include that it represents findings from the largest population based prospectively followed cohort of IBD patients to date. Subjects were also followed for over four years, which would have been sufficient time to detect rapid changes in BMD. Among the limitations of this study is that although subjects were drawn from a population-based data source, subjects who agreed to participate may not be representative of the IBD population at large. Specifically, as participation in this study requires multiple visits and health assessments, subjects who were more frail, and thus at greater risk for decreasing BMD and fracture, may be underrepresented. Conversely, this may be more representative of persons with IBD in the community as opposed to cohorts drawn from tertiary care settings. Furthermore, relatively few subjects were using osteoprotective medication regimens at baseline, and subjects were not queried as to their continued use of these medications during the follow-up period. Therefore, it is difficult to assess the benefits of osteoprotective medications in this cohort. Also, though we used a validated index to gauge IBD disease activity, these indices are primarily reflective of symptoms burden, which does not necessarily reflect the degree of gut inflammation. As it has been postulated that inflammatory burden may be a driver of BMD loss[6,7], it is possible that using symptom scores as a surrogate for inflammatory activity is imperfect[28]. Unfortunately, assessing inflammatory activity over the course of the study would require frequent colonoscopy for direct visualization of the intestinal mucosa, which would have been excessively burdensome for study participants. Although we did measure CRP as an indirect measure of inflammatory activity, it is well recognized the CRP is relatively insensitive for gut inflammation[29,30]. More sensitive yet non-invasive markers of gut inflammation, such as fecal calprotectin, may be useful in better assessing the relationship between actual inflammation and bone mineral metabolism[29,31]. Last, we did not obtain routine spinal radiographs on subjects who were under the age of 50 years at enrollment for the detection of asymptomatic vertebral fractures, as was the case with the enrolled subjects over age 50. As a result, we may have underestimated the incidence of vertebral fractures, especially for those women under the age of 50 who may already be postmenopausal. However, as only three out of 34 women under the age of 50 years were postmenopausal at the time of enrollment, it is unlikely that the number of missed spinal fracture is large.

In conclusion, in a population-based cohort of IBD patients followed for a mean of 4.3 years, we could not demonstrate a significant effect of IBD on BMD loss above what would be expected. The incidence of vertebral and nonvertebral fractures was also low. Older age, decreasing BMI and corticosteroid use identified IBD patients at greater risk for BMD loss. Screening for osteoporosis and BMD loss in IBD patients should be most strongly considered for those with these risk factors.

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DISCLOSURES:
Laura Targownik has served on advisory boards for Janssen Canada, Merck Canada, and Astra Zeneca Canada; is on the Speakers' Panel for Pfizer Canada.

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Table 1: Baseline Characteristics of Cohort

	N=86
Age (yrs)	
Median	46 (IQR 35 – 57)
Mean	46.7 +/- 14.9
Age ≥50 yrs	45 (52)
Female	51 (59)
Disease Subtype	
Crohn's Disease	50 (58)
Ulcerative Colitis	32 (37)
Unsure	4 (5)
Disease Activity At Baseline	
Manitoba Inflammatory Bowel Disease Index (MIBDI)	
Mean Score	3.8 +/- 1.1
% With Active Disease (MIBDI < 4.5)	58 (67)
Powell Tuck/Harvey Bradshaw Index	
Mean Score	4.9 +/- 3.1
% With Active disease (Index > 6)	25 (29)
Bone Health	
Prior Low Trauma Fracture	2 (2)
Bisphosphonate Use	4 (5)
Hormone Replacement Therapy (Post Menopausal Females Only, N=21)	9 (42)
Supplemental Calcium Use	27 (31)
Supplemental Vitamin D Use	14 (16)
Any Prior Corticosteroid Use Exceeding 1 Month	49 (57)
Other Medical Comorbidities	
Hypertension	12 (14)
Diabetes	3 (4)
Arthritis (Rheumatoid/Osteoarthritis)	35 (41)
Back Pain	28 (33)
Thyroid Disease	2 (2)
Cardiovascular Disease	4 (5)
Cerebrovascular Disease	1 (1)
Asthma	12 (14)
Other Chronic Respiratory Disease	12 (14)
Mean Baseline Z-scores (+/- SD)	
Lumbar Spine	0.12 (1.27)
Total Hip	0.00 (0.95)
Femoral Neck	0.09 (0.96)

Data are N (%) or Mean ± SD. IQR: interquartile range.

Table 2: Mean Change in BMD (g/cm^2) Between First and Last Visits

	Overall	**Age**			**Sex**			**Disease Subtype**		
		≥50	<50	p-value	Male	Female	p-value	CD	UC	p-value
Lumbar Spine	0.011	0.002	0.019*	0.179	0.022*	0.004	0.168	0.006	0.019	> 0.2
Total Hip	-0.013*	-0.022*	-0.005	0.152	-0.012	-0.014	> 0.2	-0.016	-0.009	> 0.2
Femoral Neck	-0.016**	-0.020*	-0.012	> 0.2	-0.018	-0.014	> 0.2	-0.018*	-0.012	> 0.2

	Disease Activity (MIBDI)			**Disease Activity (HB / PT)**			**Cumulative Prednisone Use**			**BMI**		
	<4.5 (active)	≥4.5 (inactive)	p-value	≥6 (active)	<6 (inactive)	p-value	<450 mg	>450 mg	p-value	BMI Increase	BMI Decrease	p-value
Lumbar Spine	0.012	0.012	> 0.2	0.004	0.014	> 0.2	0.006	0.020	> 0.2	0.015	0.007	> 0.2
Total Hip	-0.014	-0.011	> 0.2	-0.029*	-0.006	0.083	-0.009	-0.020	> 0.2	0.000	-0.027	0.022
Femoral Neck	-0.016*	-0.016	> 0.2	-0.025	-0.012	> 0.2	-0.010	-0.028*	0.148	-0.002	-0.030	0.017

Mean time between testing: 4.3 +/- 0.3 years.

* Denotes significant BMD decrease compared with baseline, $p<0.05$; ** $p<0.01$ via ANOVA

p-values refer to intergroup comparisons

CD: Crohn's Disease, UC: Ulcerative Colitis

MIBDI: Manitoba Inflammatory Bowel Disease Index, HB: Harvey Bradshaw Index (in CD); PT: Powell-Tuck Index (in UC)

Table 3: Spearman Rank Test Correlations Between Change in BMD and Other Variables

	Lumbar Spine	**Total Hip**	**Femoral Neck**
Serum Levels			
Creatinine	0.12	-0.05	-0.04
Calcium	0.07	0.14	0.14
Albumin	0.04	0.03	-0.01
Phosphate	-0.16	-0.22*	-0.14
Alkaline Phosphatase	-0.20	-0.22*	-0.16
Parathyroid Hormone	0.06	-0.04	0.04
25-Hydroxy Vitamin D	-0.06	-0.02	0.02
Testosterone (males only)	-0.02	0.11	0.04
Hemoglobin	-0.21	-0.04	-0.10
Estradiol (females only)	0.18	0.32	0.27
C-Telopeptide	-0.17	-0.31**	-0.27*
C-Reactive Protein	0.00	0.00	0.14
Disease Activity Indices			
Mean HB/PT Score	0.02	-0.18	-0.13
Mean MIBDI Score	-0.02	0.02	0.04
Cumulative Prednisone Use	-0.10	-0.23*	-0.29**
Anthropomorphic Measures			
Change in Height	0.13	0.08	0.08
Change in Weight	0.08	0.41†	0.40†
Change in BMI	0.10	0.41†	0.40†

Abbreviations: HB: Harvey Bradshaw; PT: Powell Tuck; MIBDI: Manitoba Inflammatory Bowel Disease Inventory

* $p<0.05$. ** $p<0.01$ † $p<0.001$

Table 4: Characteristics of IBD subjects with incident vertebral fractures.

Age/Sex, Disease Subtype	Baseline T-score	Change in BMD	Change in Weight	Cumulative Prednisone Dose	Baseline Vertebral Fractures	New Vertebral Fractures
61F, CD	Spine: -0.47 Total Hip: -1.50	Spine : -9.0% Total Hip: -25.2%	-14.1 kg	0	None	2 Grade I 3 Grade II
72F, UC	Spine : +1.43 Total Hip :+1.13	Spine : +4.0% Total Hip : -6.3%	-8.6 kg	0	2 Grade I	1 Grade I
65M, CD	Spine :-2.49 Total Hip : -0.90	Spine : -12.0% Total Hip : 13.3%	+2.8 kg	24.3g	None	1 Grade II

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