PRODUCT INFORMATION

ADRONAT®
(alendronate sodium)

ADRONAT® PLUS
(alendronate sodium/colecalciferol)

ADRONAT PLUS D-Cal ™
(alendronate sodium/colecalciferol/calcium)

Tablets

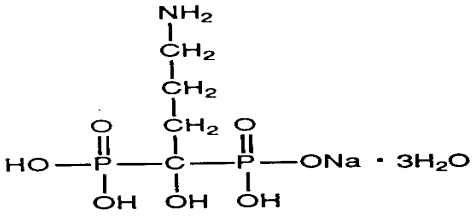
ADRONAT tablets contain alendronate sodium.

ADRONAT PLUS tablets contain alendronate sodium and colecalciferol (vitamin D_3)

ADRONAT PLUS D-Cal is a combination pack containing ADRONAT PLUS (alendronate sodium and colecalciferol [vitamin D3]) in addition to BoneCal® tablets (calcium carbonate)

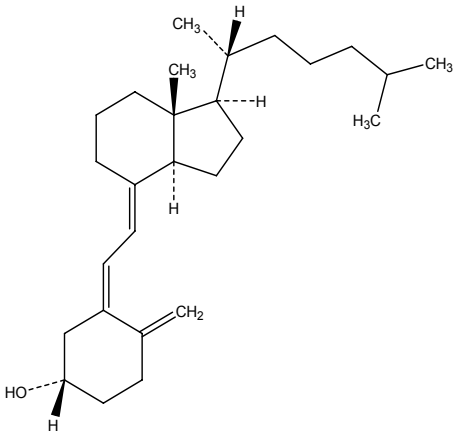
Alendronate sodium is described chemically as: (4-amino-1-hydroxybutylidene) bisphosphonic acid monosodium salt trihydrate.

The empirical formula is $C_4H_{12}NNaO_7P_2 \cdot 3H_2O$. The formula weight is 325.12. The CAS Registry Number is 121268-17-5. The structural formula is:



Colecalciferol

The chemical name of colecalciferol is (3β,5*Z*,7*E*)-9,10-secocholesta-5,7,10(19)-trien-3-ol. The empirical formula of colecalciferol is $C_{27}H_{44}O$ and its molecular weight is 384.6. The CAS Registry Number is 67-97-0. The structural formula is:



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Calcium carbonate
Calcium carbonate is described chemically as carbonic acid calcium salt (1:1). The empirical formula of calcium carbonate is $CaCo_3$ and its molecular weight is 100.09. The CAS Registry Number is 471-34-1.

DESCRIPTION

Alendronate sodium, MSD is a bisphosphonate that acts as a potent, specific inhibitor of osteoclast-mediated bone resorption. Bisphosphonates are synthetic analogs of pyrophosphate that bind to the hydroxyapatite found in bone.

Alendronate is a white, crystalline, nonhygroscopic powder. It is soluble in water, very slightly soluble in alcohol, and practically insoluble in chloroform.

Colecalciferol (vitamin D_3) is a secosterol that is the natural precursor of the calcium-regulating hormone calcitriol (1,25-dihydroxyvitamin D_3).

Colecalciferol is a white, crystalline, odourless powder. Colecalciferol is practically insoluble in water, freely soluble in usual organic solvents, and slightly soluble in vegetable oils.

Each tablet of ADRONAT contains either 6.53, 13.05, or 91.4mg of alendronate sodium, which is the molar equivalent to 5.0, 10.0, and 70 mg respectively of alendronic acid. In addition to the active ingredient alendronate sodium, each ADRONAT tablet contains the following inactive ingredients: cellulose-microcrystalline, lactose anhydrous, croscarmellose sodium and magnesium stearate. ADRONAT 10 mg tablets also contain carnauba wax.

Each tablet of ADRONAT PLUS 70 mg/140 μg) contains 91.4 mg of alendronate sodium, which is the molar equivalent to 70 mg of alendronic acid, and 140 μg of colecalciferol equivalent to 5600 IU vitamin D.
In addition to the active ingredients alendronate sodium and colecalciferol, each ADRONAT PLUS tablet 70 mg/140 μg contains the following inactive ingredients: cellulose-microcrystalline, lactose anhydrous, medium chain triglycerides, gelatin, croscarmellose sodium, sucrose, silica-colloidal anhydrous, magnesium stearate, butylated hydroxytoluene, modified food starch and aluminium sodium silicate.

Each tablet of BoneCal contains 1250 mg calcium carbonate which is equivalent to 500 mg elemental calcium. In addition, each BoneCal tablet contains the following inactive ingredients: cellulose- microcrystalline, maltodextrin, acacia, crospovidone, hypromellose, titanium dioxide, magnesium stearate, macrogol 400, carnauba wax, iron oxide yellow CI77492, chlorophyllin copper complex.

PHARMACOLOGY

PHARMACOKINETIC PROPERTIES

Absorption
Alendronate sodium
Relative to an intravenous (IV) reference dose, the mean oral bioavailability of alendronate in women was 0.64% for doses ranging from 5 to 70 mg when administered after an overnight fast and two hours before a standardised breakfast. There was substantial variability both within and between patients, coefficient of variation 63% and 77%, respectively. Oral bioavailability in men (0.6%) was similar to that in women.

In two two-period cross-over studies, the alendronate in the ADRONAT PLUS (70 mg/140 μg) tablet was shown to be bioequivalent to the alendronate in the alendronate 70 mg tablet.

Bioavailability was decreased similarly (by approximately 40%) whether alendronate was administered one or one-half hour before a standardised breakfast. In osteoporosis studies, ADRONAT was effective when administered at least 30 minutes before the first food or beverage of the day.

Bioavailability was negligible whether alendronate was administered with or up to two hours after a standardised breakfast. Concomitant administration of alendronate with coffee or orange juice reduced bioavailability by approximately 60%.

In normal subjects, oral prednisone (20mg three times daily for five days) did not substantially alter the oral bioavailability of alendronate (alendronate alone, 0.73%; alendronate plus prednisone, 0.87%).

Colecalciferol
Following administration of ADRONAT PLUS 70 mg/140 μg after an overnight fast and two hours before a standard meal, the mean area under the serum-concentration-time curve ($AUC_{0\text{-}80\ hrs}$) (unadjusted for endogenous vitamin D_3 levels) for vitamin D_3 was 490.2 ng-hr/mL (Geometric Mean Ratio [{GMR} ADRONAT PLUS 70 mg/140 μg /vitamin D3 only]: 0.94; 90% CI 0.89, 1.00), . The baseline unadjusted mean maximal serum concentration (C_{max}) of vitamin D_3 was 12.2 ng/mL, [GMR (ADRONAT PLUS 70mg/140 μg /vitamin D_3 only 0.94; 90% CI: 0.88, 1.00] and the median time to maximal serum concentration (T_{max}) was 10.6 hrs. The bioavailability of the 140 μg (5600 IU) vitamin D_3 in ADRONAT PLUS 70 mg/140 μg is similar to 140 μg (5600 IU) vitamin D_3 administered alone (using the $AUC_{0\text{-}80\ hr}$ and C_{max} GMR values).

Calcium Carbonate
Following ingestion of BoneCal, approximately 15 to 40% of ingested calcium is absorbed from the small intestine into the circulation. The amount absorbed is under physiological regulation based on the body's needs.

Distribution
Alendronate sodium
Preclinical studies show that alendronate transiently distributes to soft tissues following administration but is then rapidly redistributed to bone or excreted in the urine. The mean steady state volume of distribution, exclusive of bone, is at least 28 L in humans. Concentrations of alendronate in plasma following therapeutic oral doses are generally below the limits of quantification (less than 5 ng/mL). Protein binding in human plasma is approximately 78%.

Colecalciferol
Following absorption, vitamin D_3 enters the blood as part of chylomicrons. Vitamin D_3 is rapidly distributed mostly to the liver where it undergoes metabolism to 25-hydroxyvitamin D_3, the major storage form. Lesser amounts are distributed to adipose and muscle tissue and stored as vitamin D_3 at these sites for later release into the circulation. Circulating vitamin D_3 is bound to vitamin D-binding protein.

Calcium
Calcium is present throughout the body. Approximately 99% of calcium in the body is concentrated in bones and teeth. The remaining 1% is present in the intra- and extra-cellular fluids. About 50% of the total plasma calcium content is the physiologically active ionized form, 10% is complexed with citrate, phosphate or other anions, and the remaining 40% is bound to proteins, principally albumin.

Metabolism
Alendronate sodium
There is no evidence that alendronate is metabolised in animals or humans.

Colecalciferol
Vitamin D_3 is rapidly metabolised by hydroxylation in the liver to 25-hydroxyvitamin D_3, and subsequently metabolised in the kidney to 1,25-dihydroxyvitamin D_3, which represents the biologically active form. Further hydroxylation occurs prior to elimination. A small percentage of vitamin D_3 undergoes glucuronidation prior to elimination.

Elimination
Alendronate sodium
Following a single 10 mg IV dose of [^{14}C] alendronate, approximately 50% of the radioactivity was excreted in the urine within 72 hours and little or no radioactivity was recovered in the faeces; the renal clearance of alendronate was 71 mL/min. Plasma concentrations fell by more than 95% within 6 hours following IV administration, due to distribution to the bone and excretion in the urine. The terminal half-life in humans is estimated to exceed 10 years, reflecting release of alendronate from the skeleton. Alendronate is not excreted through the acidic or basic transport systems of the kidney in rats, and thus it is not anticipated to interfere with the excretion of other drugs by those systems in humans

Preclinical studies show that the drug that is not deposited in bone is rapidly excreted in the urine. No evidence of saturation of bone uptake was found over three weeks in rats, with a cumulative IV dose of 35 mg/kg. Although no clinical information is available, it is likely that, as in animals, elimination of alendronate via the kidney will be reduced in patients with impaired renal function. Therefore, somewhat greater accumulation of

alendronate in bone might be expected in patients with impaired renal function (see DOSAGE AND ADMINISTRATION).

Colecalciferol
When radioactive vitamin D_3 was administered to healthy subjects, the mean urinary excretion of radioactivity after 48 hours was 2.4%, and the mean faecal excretion of radioactivity after 4 days was 4.9%. In both cases, the excreted radioactivity was almost exclusively as metabolites of the parent. The mean half-life of vitamin D_3 in the serum following an oral dose of alendronate 70 mg/colecalciferol 70 is approximately 24 hours.

Calcium
Calcium is eliminated through renal excretion.

PHARMACODYNAMIC PROPERTIES

Alendronate sodium
Alendronate is a bisphosphonate that, in animal studies, localises preferentially to sites of bone resorption, specifically under osteoclasts, and inhibits osteoclastic bone resorption with no direct effect on bone formation. Since bone formation and bone resorption are coupled, bone formation is also reduced, but less so than resorption, leading to progressive gains in bone mass (see Clinical Trials section for details). Following exposure to alendronate, normal bone is formed that incorporates alendronate into its matrix where it is pharmacologically inactive.

The relative inhibitory activities on bone resorption and mineralisation of alendronate and etidronate were compared in growing rats. The lowest dose of alendronate that interfered with bone mineralisation (leading to osteomalacia) was 6000-fold the antiresorptive dose. The corresponding safety margin for etidronate was one to one. These data indicate that, unlike etidronate, alendronate administered in therapeutic doses is highly unlikely to induce osteomalacia.

Colecalciferol
Vitamin D_3 is produced in the skin by photochemical conversion of 7-dehydrocholesterol to previtamin D_3 by ultraviolet light. This is followed by non-enzymatic isomerisation to vitamin D_3. In the absence of adequate sunlight exposure, vitamin D_3 is an essential dietary nutrient. Vitamin D_3 in skin and dietary vitamin D_3 (absorbed into chylomicrons) is converted to 25-hydroxyvitamin D_3 in the liver. Conversion to the active calcium-mobilising hormone 1,25-dihydroxyvitamin D_3 (calcitriol) in the kidney is stimulated by both parathyroid hormone and hypophosphataemia. The principal action of 1,25-dihydroxyvitamin D_3 is to increase intestinal absorption of both calcium and phosphate as well as regulate serum calcium, renal calcium and phosphate excretion, bone formation and bone resorption.

Vitamin D_3 is required for normal bone formation. Optimal serum levels of 25-hydroxyvitamin D are unknown. Vitamin D insufficiency may be seen with serum levels below 30 – 50 nmol/L. Severe vitamin D deficiency is commonly associated with levels <12.5 nmol/L. Vitamin D insufficiency develops when both sunlight exposure and dietary intake are inadequate. Insufficiency is associated with negative calcium balance, bone loss, and increased risk of skeletal fracture. In severe cases, deficiency results in secondary hyperparathyroidism, hypophosphataemia, proximal muscle weakness and osteomalacia, further increasing the risk of falls and fractures in osteoporotic individuals. Supplemental vitamin D is associated with reduced risk of vitamin D insufficiency as defined by serum hydroxyvitamin D of < 37.5 nmol/L.

OSTEOPOROSIS

WHO utilises the definition of osteoporosis as a disease characterised by low bone mass and microarchitectural deterioration of bone tissue, leading to enhanced bone fragility and a consequent increase in fracture risk. The diagnosis may be confirmed by the finding of low bone mass (for example, at least 2 standard deviations below the gender specific mean for young adults) or by the presence or history of osteoporotic fracture. It occurs in both males and females but is most common among women following the menopause, when bone turnover increases and the rate of bone resorption exceeds that of bone formation, leading to loss of bone mass.

OSTEOPOROSIS IN POSTMENOPAUSAL WOMEN

Daily oral doses of alendronate in postmenopausal women produced biochemical changes indicative of dose-dependent inhibition of bone resorption, including decreases in urinary calcium and urinary markers of bone collagen degradation (such as hydroxyproline, deoxypyridinoline, and cross-linked N-telopeptides of type I

collagen). These biochemical changes returned toward baseline values as early as three weeks following the discontinuation of alendronate despite the long retention of alendronate in the skeleton.

Long-term treatment of osteoporosis with ADRONAT 10 mg/day (for up to five years) reduced urinary excretion of markers of bone resorption, deoxypyridinoline and cross-linked N-telopeptides of type I collagen, by approximately 50% and 70%, respectively, to reach levels similar to those seen in healthy premenopausal women. Similar decreases were seen in patients in osteoporosis prevention studies who received ADRONAT 5mg/day. The decrease in the rate of bone resorption indicated by these markers was evident as early as one month and at three to six months reached a plateau that was maintained for the entire duration of treatment with ADRONAT. In osteoporosis treatment studies ADRONAT 10mg/day decreased the markers of bone formation, osteocalcin and total serum alkaline phosphatase, by approximately 50% and 25-30%, respectively, to reach a plateau after 6 to 12 months. Similar though slightly lower reductions in the rate of bone turnover were observed in postmenopausal women during one-year studies with ADRONAT once weekly 70 mg for the treatment of osteoporosis. In osteoporosis prevention studies ADRONAT 5mg/day decreased these markers by approximately 40% and 15%, respectively.

OSTEOPOROSIS IN MEN

Even though osteoporosis is less prevalent in men than in postmenopausal women, a significant proportion of osteoporotic fractures occur in men. The prevalence of vertebral deformities appears to be similar in men and women. All men with osteoporosis should be investigated for hypogonadism and, if necessary, treated for this condition. Treatment of men with osteoporosis with ADRONAT 10 mg/day for two years reduced urinary excretion of cross-linked N-telopeptides of type I collagen by approximately 60% and bone-specific alkaline phosphatase by approximately 40%. Similar reductions in cross-linked N-telopeptides of type I collagen were seen in men receiving ADRONAT 70 mg once weekly.

CLINICAL TRIALS

TREATMENT OF OSTEOPOROSIS

Alendronate with colecalciferol studies

The effect of alendronate 70 mg/colecalciferol 70 μg on vitamin D status was demonstrated in a 15-week, double-blind, multinational study of 717 osteoporotic postmenopausal women and men (serum 25-hydroxyvitamin D at baseline: mean, 22.2 ng/mL [56 nmol/L]; range, 9-90 ng/mL [22.5-225 nmol/L]). Patients received alendronate 70 mg/colecalciferol 70 μg (2800 IU) (n=350 women, 10 men) or ADRONAT (alendronate 70 mg (n=332 women, 25 men) once a week; additional vitamin D supplements were prohibited. Patients who were vitamin D deficient [defined as serum 25-hydroxyvitamin D < 9 ng/mL (22.5 nmol/L)] at baseline were excluded. Patients with vitamin D insufficiency at baseline were defined as having serum 25-hydroxyvitamin D levels between 9 ng/mL (22.5nmol/L) and 15 ng/mL (37.5 nmol/L).

The percentage of patients with serum 25-hydroxyvitamin D ≥15 ng/mL (37.5 nmol/L) was significantly higher with alendronate 70 mg/colecalciferol 70 μg vs. alendronate only (89% vs. 68%, respectively). The percentage of patients with serum 25-hydroxyvitamin D ≥9 ng/mL (22.5 nmol/L) was significantly higher with alendronate 70 mg/colecalciferol 70 μg vs. alendronate only (99% vs 87%, respectively). There were no differences in mean serum calcium, phosphate, or 24-hour urine calcium between treatment groups. The final levels of 25-hydroxyvitamin D at week 15 are summarised in the table below.

25-hydroxyvitamin D Levels after treatment with alendronate 70mg/colecalciferol 70μg and alendronate 70 mg at Week 15* Number (%) of Patients						
25-hydroxyvitamin D Ranges (nmol/L)	< 22.5	22.5-35	37.5-47.5	50-60	62.5-72.5	75-155
alendronate 70mg/colecalciferol 70 μg (N=357)	4 (1.1)	37 (10.4)	87 (24.4)	84 (23.5)	82 (23.0)	63 (17.7)
Alendronate 70 mg (N=351)	46 (13.1)	66 (18.8)	108 (30.8)	58 (16.5)	37 (10.5)	36 (10.3)

* Patients who were vitamin D deficient (25-hydroxyvitamin D < 22.5 nmol/L) at baseline were excluded.

The effect of alendronate 70 mg/colecalciferol 70 μg with an additional 70 μg colecalciferol (2800 IU vitamin D_3) for a total of 140 μg colecalciferol (5600 IU vitamin D_3) once weekly was compared to 70mg/colecalciferol 70 μg weekly in a 24-week, extension study that enrolled 652 osteoporotic men and post-menopausal women who completed the above 15-week study. Patients in the colecalciferol 70 μg group received alendronate 70 mg/ colecalciferol 70 μg (n=305 women, 21 men) and those in the colecalciferol 140 μg group received alendronate 70 mg /colecalciferol 70 μg with an additional 70 μg colecalciferol (n=314 women, 12 men) once a week; additional vitamin D supplements were allowed. The primary endpoint was incidence of hypercalciuria, defined as an increase of greater than 25% from baseline in 24-hour urine calcium and to a value greater than the upper limit of normal (300 mg in women, 350 mg in men). The rate of hypercalciuria was 13/311 (4.2%) for the colecalciferol 140 μg group and 9/317 (2.8%) for the colecalciferol 70 μg group , relative risk 1.48 (95% CI 0.64, 3.40).

Secondary endpoints included 25 hydroxyvitamin D levels. The proportions of patients with vitamin D insufficiency (< 37.5 nmol/L) after 39 weeks was 10/321 (3.1%) in the colecalciferol 140 μg group and 18/320 (5.6%) in the colecalciferol 70 μg group.

The percentage of patients with serum 25-hydroxyvitamin D ≥15 ng/mL (37.5 nmol/L) was higher with the colecalciferol 140 μg group vs. the colecalciferol 70 μg group (96.9% vs. 94.4%, respectively), although not statistically significant.

There were no differences detected between mean serum calcium, mean serum phosphate, or mean 24-hour urine calcium between groups. The distribution of the final levels of 25-hydroxyvitamin D at week 39 is summarised in the table below.

25-hydroxyvitamin D Levels after treatment with alendronate 70 mg/colecalciferol 70 μg or alendronate 70 mg/colecalciferol 70 μg plus additional colecalciferol 70 μg at week 39 in extension study Number (%) of Patients						
25-hydroxyvitamin D Ranges (nmol/L)	< 22.5	22.5-35	37.5-47.5	50-60	62.5-72.5	75-155
Vitamin D_3 5600 IU group*(N=321)	0	10 (3.1)	29 (9.0)	79 (24.6)	87 (27.1)	116 (36.1)
Vitamin D_3 2800 IU group**(N=320)	1 (0.3)	17 (5.3)	56 (17.5)	80 (25.0)	74 (23.1)	92 (28.7)

* Patients received ADRONAT 70mg or alendronate 70mg/colecalciferol 70 μg for the 15-week base study followed by alendronate 70mg/colecalciferol 70 μg and 70 μg additional colecalciferol for the 24-week extension study.

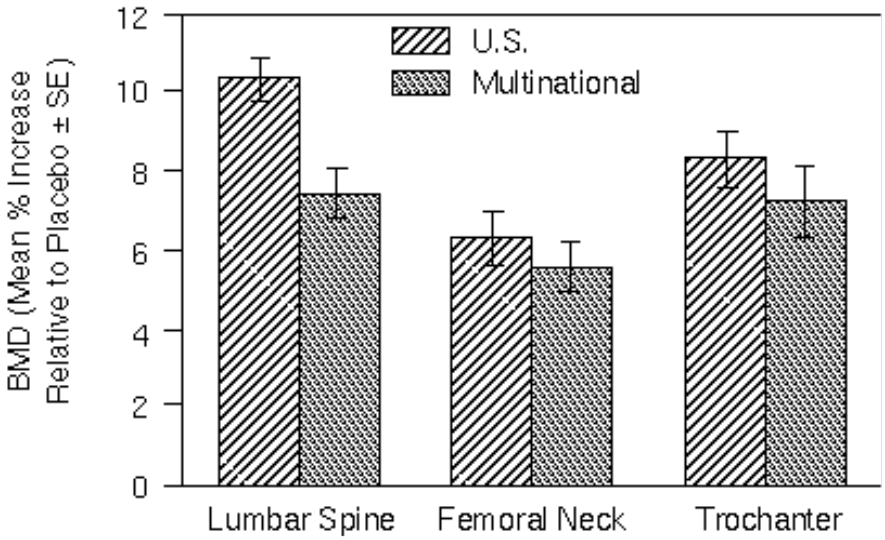
** Patients received ADRONAT 70mg or alendronate 70mg/colecalciferol 70 μg for the 15-week base study followed by alendronate 70mg/colecalciferol 70 μg and placebo for the additional colecalciferol for 24 week extension study.

ADRONAT STUDIES
Postmenopausal women

Effect on bone mineral density

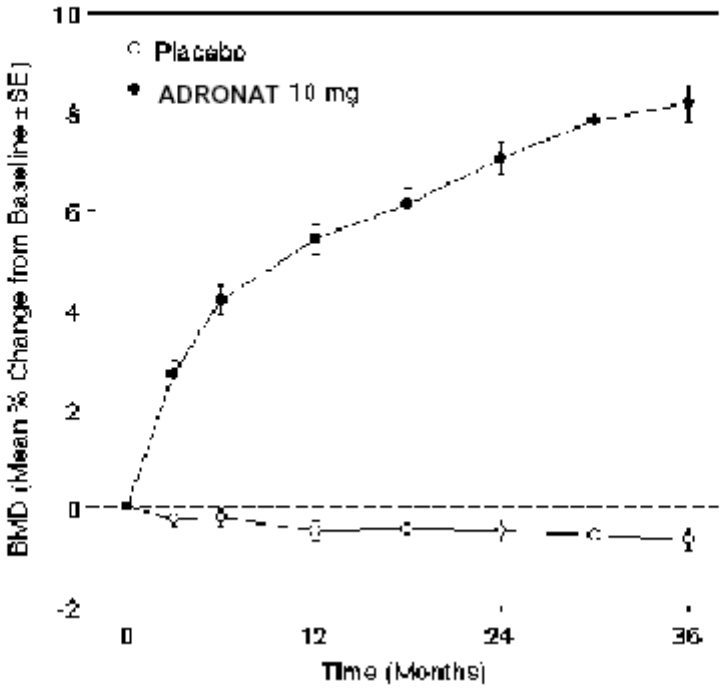
The efficacy of ADRONAT 10mg once daily in postmenopausal women with osteoporosis was demonstrated in two large three year multicentre studies of virtually identical design, one performed in the United States and the other in 15 different countries (Multinational), which enrolled 478 and 516 patients, respectively. The following graph shows the mean increases in bone mineral density (BMD) of the lumbar spine, femoral neck and trochanter in patients receiving ADRONAT 10mg/day relative to placebo-treated patients at three years for each of these studies.

ADRONAT Increase in BMD 10 mg/day in Two Studies at Three Years



These increases were highly significant relative both to baseline and placebo at each measurement site in each study. Increases in BMD were evident as early as three months and continued throughout the entire three years of treatment (see figure below for lumbar spine results). In the two-year extension of these studies, treatment with ADRONAT 10mg/day resulted in continued increases in BMD at the lumbar spine and trochanter (absolute additional increases between years 3 and 5: lumbar spine 0.94%; trochanter 0.88%). BMD at the femoral neck, forearm and total body were maintained. Thus, ADRONAT appears to reverse the progression of osteoporosis as assessed by increased bone mineral density. ADRONAT was similarly effective regardless of age, race, baseline rate of bone turnover, renal function and use of concomitant medications.

Time Course of Effect of ADRONAT 10 mg/day versus Placebo: Lumbar Spine BMD Percent Change from Baseline



In patients with postmenopausal osteoporosis treated with ADRONAT 10 mg/day for one or two years the effects of treatment withdrawal were assessed. Following discontinuation, there were no further increases in bone mass and the rates of bone loss were similar to those in the placebo groups. These data indicate that continuous treatment with ADRONAT is required to produce progressive increases in bone mass.

The therapeutic equivalence of ADRONAT once weekly 70 mg (n = 519) and ADRONAT 10 mg daily (n = 370) was demonstrated in a one-year, double-blind, multicentre study of postmenopausal women with osteoporosis. The mean increases from baseline in lumbar spine BMD at one year were 5.1% (4.8, 5.4%; 95% CI) in the 70 mg once weekly group and 5.4% (5.0, 5.8%; 95% CI) in the 10 mg daily group. The two treatment groups were also similar with regard to BMD increases at other skeletal sites. While there are no placebo-controlled fracture data for the once weekly 70 mg tablet, the increases in bone density support the expectation that ADRONAT once weekly 70 mg will have effects to reduce the incidence of fractures similar to those of the 10 mg daily treatment (see below). The study was not designed to evaluate the relative compliance of ADRONAT once weekly 70 mg and 10 mg daily.

Effect on fracture incidence

Although the US and Multinational studies (see above) were not designed to assess fracture rates as the primary endpoint, preplanned analysis of the data pooled across once daily doses at three years revealed a statistically significant and clinically meaningful 48% reduction in the proportion of patients treated with ADRONAT experiencing one or more vertebral fractures (3.2%) relative to those treated with placebo (6.2 %). Furthermore, of patients who sustained any vertebral fracture, those treated with ADRONAT experienced less height loss (5.9 mm vs 23.3 mm) due to a reduction in both the number and severity of fractures.

The Fracture Intervention Trial (FIT) consisted of two studies in postmenopausal women: the Three-Year Study of patients who had at least one baseline vertebral (compression) fracture and the Four-Year Study of patients with low bone mass but without baseline vertebral fracture.

Fracture Intervention Trial: Three-Year Study (patients with at least one baseline vertebral fracture)

This randomised, double-blind, placebo-controlled 2027-patient study, (ADRONAT n=1022; placebo, n=1005) demonstrated that treatment with ADRONAT resulted in clinically significant reductions in fracture incidence at three years as shown in the table below. Data also showed statistically significant reductions in painful vertebral

fractures and clinical fractures at other sites. Similar reductions of hip and wrist fractures were seen in five pooled osteoporosis treatment studies of two or three years duration.

Effect of ADRONAT on Fracture Incidence in the Three-Year Study of FIT (% of patients with vertebral fracture at baseline)					
	ADRONAT (n=1022)	**Placebo (n=1005)**	**Absolute Reduction in Fracture Incidence**	**Relative Reduction in Fracture Risk %**	**P Value**
Patients with:					
≥ 1 new vertebral fracture	7.9	15.0	7.1	47	<.001*
≥ 2 new vertebral fractures	0.5	4.9	4.4	90	<.001*
≥ 1 painful vertebral fracture	2.3	5.0	2.7	54	<.002**
Any painful (inc. vertebral) fracture	13.8	18.1	4.3	26	0.007**
Hip fractures	1.1	2.2	1.1	51	0.047**
Wrist (forearm) fractures	2.2	4.1	1.9	48	0.013**
* Mantel-Haenzel chi^2 **Log Rank test					

Furthermore, in this population of patients with baseline vertebral fracture, treatment with ADRONAT significantly reduced the incidence of hospitalisations resulting from any cause (25.0%vs. 30.7%, a 20% relative risk reduction). This difference appears to be related, at least in part, to the reduction in fracture incidence.

Fracture Intervention Trial: Four-Year Study (patients with low bone mass but without a baseline vertebral fracture)

This randomised, double-blind, placebo-controlled, 4432-patient study (ADRONAT, n=2214; placebo, n=2218) further demonstrated the reduction in fracture incidence due to ADRONAT. The intent of the study was to recruit women with osteoporosis, i.e. with a baseline femoral neck BMD at least two standard deviations below the mean for young adult women. However, due to subsequent revisions to the normative values for femoral neck BMD, 31% of patients were found not to meet this entry criterion and thus this study included both osteoporotic and non-osteoporotic women. The results are shown in the table below for the patients with osteoporosis.

Effect of ADRONAT on Fracture Incidence in Osteoporotic† Patients in the Four-Year Study of FIT (patients without vertebral fracture at baseline)				
% of Patients				
	ADRONAT (n=1545)	**Placebo (n=1521)**	**Absolute Reduction in Fracture Incidence**	**Relative Reduction in Fracture Risk %**
Patients with:				
≥ 1 painful fracture	12.9	16.2	3.3	22**
≥ 1 vertebral fracture††	2.5	4.8	2.3	48***
≥ 1 painful vertebral fracture	1.0	1.6	0.6	(NS)
Hip fracture	1.0	1.4	0.4	(NS)
Wrist (forearm) fracture	3.9	3.8	-0.1	none

†Baseline femoral neck BMD at least 2 SD below the mean for young adult women
††Number evaluable for vertebral fracture: ADRONAT, n=1426; placebo, n=1428
nsNot significant. This study was not powered to detect differences at these sites.
**p = 0.01, ***p <0.001

Consistency of fracture results

The reductions in the incidence of vertebral fractures (ADRONAT vs. placebo) in the Three and Four-Year Studies of FIT were consistent with that in the combined US and Multinational (US/Mult) treatment studies (see above), in which 80% of the women did not have a vertebral fracture at baseline. During these studies, treatment with ADRONAT reduced the proportion of women experiencing at least one new vertebral fracture by approximately 50% (Three-Year FIT: 47% reduction, $p<0.001$; Four-Year FIT: 44% reduction, $p=0.001$ US/Mult, 48% reduction, $p=0.034$). In addition, ADRONAT reduced the proportion of women experiencing multiple (two or more) new vertebral fractures by approximately 90% in the US/Mult and Three-Year FIT studies ($p<0.001$). Thus, ADRONAT reduced the incidence of vertebral fractures whether or not patients had experienced a previous vertebral fracture.

Overall, these results demonstrate the consistent efficacy of ADRONAT in reducing the incidence of fractures, including those of the spine and hip, which are the sites of osteoporotic fracture associated with greatest morbidity.

Bone histology

Bone histology in 270 postmenopausal patients with osteoporosis treated with ADRONAT at doses ranging from 1 to 20 mg/day for one, two or three years revealed normal mineralisation and structure, as well as the expected decrease in bone turnover relative to placebo. These data, together with the normal bone histology and increased bone strength observed in ovariectomised rats and baboons exposed to long term alendronate treatment, indicate that bone formed during therapy with ADRONAT is of normal quality.

Concomitant Use with Oestrogen/Hormone Replacement Therapy

The effects on BMD of treatment with ADRONAT 10 mg once daily and conjugated oestrogen (0.625 mg/day) either alone or in combination were assessed in a two-year, double-blind, placebo-controlled study of hysterectomised postmenopausal osteoporotic women (n=425). At two years, the increases in lumbar spine BMD from baseline were significantly greater with the combination (8.3%) than with either oestrogen or ADRONAT alone (both 6.0%).

The effects on BMD when ADRONAT was added to stable doses (for at least one year) of HRT (oestrogen $\pm$ progestin) were assessed in a one-year, double-blind, placebo-controlled study in postmenopausal osteoporotic women (n=428). The addition of ADRONAT 10 mg once daily to HRT produced, at one year, significantly greater increases in lumbar spine BMD (3.7%) vs. HRT alone (1.1%).

In these studies, significant increases or favourable trends in BMD for combined therapy compared with HRT alone were seen at the total hip, femoral neck, and trochanter. No significant effect was seen for total body BMD.

Men

The efficacy of ADRONAT 10 mg once daily in men with osteoporosis was demonstrated in a two-year, double-blind, placebo-controlled, multicentre study, which enrolled 241 osteoporotic men between the ages of 31 and 87 years. All patients in the study (97.5% of whom were Caucasian) had either:1) a BMD T-score $\leq$ -2 at the femoral neck and $\leq$ -1 at the lumbar spine or 2) a baseline osteoporotic fracture and a BMD T-score of $\leq$ -1 at the femoral neck. At two years the mean increases relative to placebo in BMD in men receiving ADRONAT 10 mg daily were; lumbar spine 5.3%; femoral neck 2.6%; trochanter 3.1%; and total body 1.6% (all $p \leq 0.001$). ADRONAT was effective regardless of age, gonadal function, baseline rate of bone turnover, or baseline BMD. Consistent with the much larger studies in postmenopausal women, in these men ADRONAT 10 mg daily reduced the incidence of new vertebral fracture (post-hoc analysis; assessment by quantitative radiography) relative to placebo (0.8% vs 7.1%, respectively; $p = 0.017$) and correspondingly, also reduced height loss (-0.6 vs –2.4 mm, respectively; $p = 0.022$).

The effects of discontinuation of ADRONAT treatment have not been studied in this population.

Prevention of osteoporosis

For the prevention of osteoporosis, ADRONAT may be considered in postmenopausal women who are at risk of developing osteoporosis and for whom the desired clinical outcome is to maintain bone mass and to reduce the risk of future fracture.

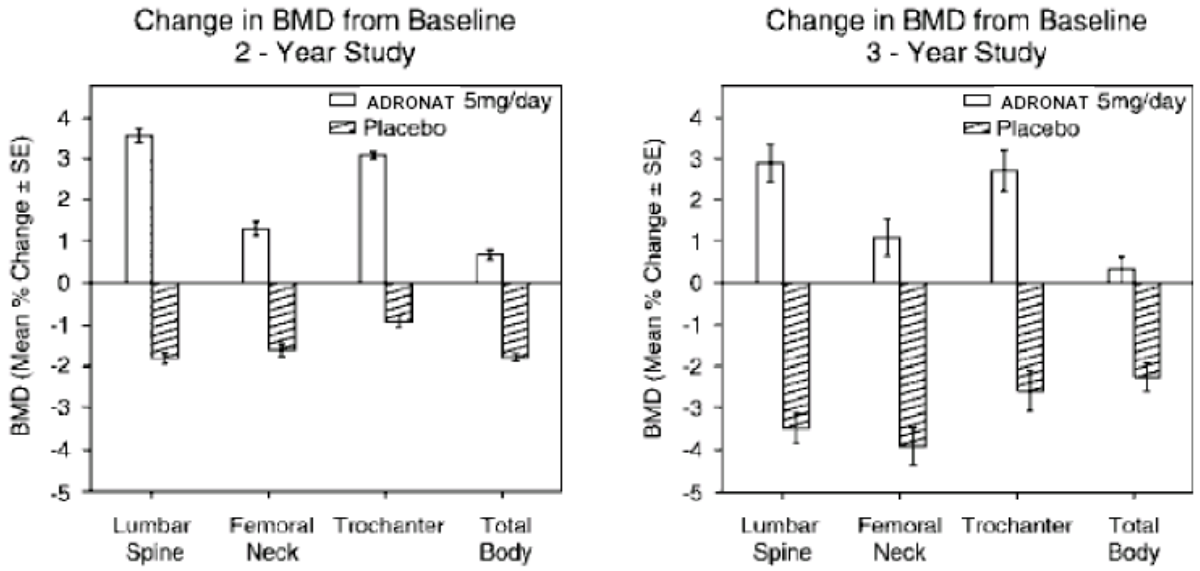
Bone loss is particularly rapid in postmenopausal women younger than age 60. Risk factors often associated with the development of postmenopausal osteoporosis include early menopause; moderately low bone mass (for example, at least 1 standard deviation below the mean for healthy young adult women; thin body build and family history of osteoporosis). The presence of such risk factors may be important when considering the use of ADRONAT for prevention of osteoporosis.

Prevention of bone loss was demonstrated in both a two-year (n=1609) and a three-year (n=447) study of women 40-60 years of age who were at least 6 months postmenopausal. In these studies, ADRONAT or matching placebo was administered once daily to non-osteoporotic women (overall baseline spine BMD approximately one SD lower that the premenopausal mean BMD.)

As expected, in the placebo-treated patients BMD losses of approximately 1% per year were seen at the spine, hip (femoral neck and trochanter) and total body. In contrast, ADRONAT 5mg/day effectively prevented bone loss, and induced highly significant increases in bone mass at each of these sites. The mean percent increase in BMD from baseline at the lumbar spine, femoral neck, trochanter and total body at the end of the two-year study were 3.46%, 1.27%, 2.98% and 0.67%, respectively, and those at the end of the three-year study were 2.89%, 1.10%, 2.71% and 0.32%, respectively. (see figures below)

In addition, ADRONAT 5mg/day reduced the rate of bone loss in the forearm by approximately half relative to placebo. ADRONAT 5mg/day was similarly effective in this population regardless of age, time since menopause, race and baseline rate of bone turnover.

Osteoporosis Prevention Studies in Postmenopausal Women



In the two year study (n=1609), of 435 women willing to be randomised to an open-label oestrogen/progestin therapy subgroup, 55 in the US centres received conjugated equine oestrogens 0.625 mg daily (Premarin ™) in combination with medroxyprogesterone acetate 5 mg daily (Provera™), whilst 55 in the European centres received higher doses of oestrogen given as 17β-oestradiol 2mg daily in combination with norethisterone acetate 1mg daily (10 days per 28 day cycle) (Trisequens™). Only women in the European centres using Trisequens experienced increases in BMD at the spine, hip and total body that were different from those in women using ADRONAT 5mg. At these centres, two-year increases in BMD at the lumbar spine were 5.1% and 3.3%, femoral neck 2.4% and 1.4%, trochanter 4.8% and 2.8%, and total body 2.6% and 0.6% in the Trisequens and ADRONAT 5 mg groups, respectively. Increases with Premarin and Provera in the US centres were not

statistically different to those obtained with ADRONAT 5mg. Both ADRONAT 5 mg and oestrogen/progestin therapy prevented bone loss in these non-osteoporotic women.

Bone histology was normal in the 28 patients biopsied at the end of three years who received ADRONAT doses of up to 10mg/day.

Glucocorticoid - Induced Osteoporosis

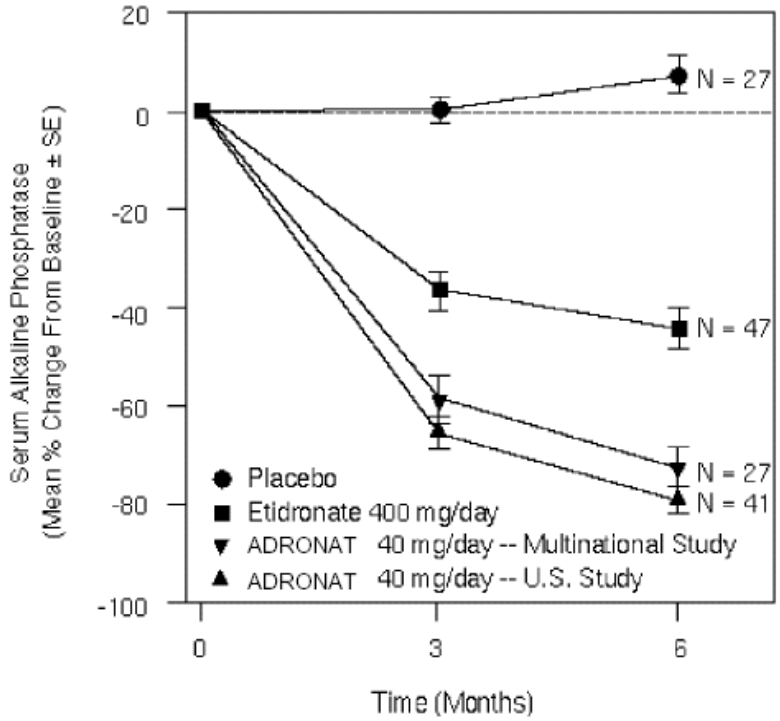
Sustained use of glucocorticoids is commonly associated with development of osteoporosis and resulting fractures (especially vertebral, hip and rib). It occurs both in males and females of all ages. Bone loss occurs as a result of a lower rate of bone formation relative to that of bone resorption. Alendronate decreases bone resorption without directly inhibiting bone formation.

In clinical studies of one year's duration, ADRONAT 5 and 10 mg/day reduced cross-linked N-telopeptides of type 1 collagen (a marker of bone resorption) by approximately 60% and reduced bone-specific alkaline phosphatase and total serum alkaline phosphatase (markers of bone formation) by approximately 25 to 30% and 12 to 15%, respectively. As a result of inhibition of bone resorption, ADRONAT 5 and 10 mg/day induced asymptomatic decreases in serum calcium (approximately 1%) and serum phosphate (approximately 2 to 7%).

The efficacy of ADRONAT 5 and 10 mg once daily in men and women receiving glucocorticoids (at least 7.5 mg/day of prednisone or equivalent) was demonstrated in two, one-year placebo controlled, double-blind, multicentre studies (n: total = 560, males = 176) of virtually identical design. Most of the patients were ambulant, caucasian and non-smokers. The study population included patients with rheumatoid arthritis, polymyalgia rheumatica, systemic lupus erythematosus, pemphigus, asthma, myositis, inflammatory bowel disease, giant cell arteritis, sarcoidosis, myasthenia gravis, chronic obstructive pulmonary disease and nephrotic syndrome. The range and duration of prior corticosteroid use in the studies was 0 to 538 months with a mean of 43.6 months and a median of 12 months. The range of prednisone dose at study commencement was 5 to 135 mg/day with a mean of 18.4 mg and a median of 10 mg daily. Fifty-seven percent of patients had osteopenia/osteoporosis at study commencement. Patients received supplemental calcium and vitamin D. At one year, the mean increases relative to placebo in BMD in patients receiving ADRONAT 5 mg/day from the combined studies were: lumbar spine, 2.41%; femoral neck, 2.19%; and trochanter, 1.65%. These increases were significant at each site. Total body BMD was maintained with ADRONAT 5 mg/day indicating that the increase in bone mass of the spine and hip did not occur at the expense of other sites. The increases in BMD with ADRONAT 10 mg/day were similar to those with ADRONAT 5 mg/day in all patients except for postmenopausal women not receiving oestrogen therapy. In these women, the increases (relative to placebo) with ADRONAT 10 mg/day were greater than those with ADRONAT 5 mg/day at the lumbar spine (4.11% vs. 1.56%) and trochanter (2.84% vs. 1.67%), but not at other sites. ADRONAT was effective regardless of dose or duration of glucocorticoid use. In addition, ADRONAT was similarly effective regardless of age (<65 vs. ≥65 years), race (Caucasian vs. other races), gender, baseline BMD, baseline bone turnover, and use with a variety of common medications.

Bone histology was normal in the 49 patients biopsied at the end of one year who received ADRONAT at doses of up to 10 mg/day.

Effect on Serum Alkaline Phosphatase of ADRONAT 40 mg/day
Versus Placebo or Etidronate 400 mg/day



At six months, the mean percent suppression from baseline in serum alkaline phosphatase in patients treated with ADRONAT (-79% and -73% in the two studies) was significantly greater than that achieved with etidronate disodium 400mg/day (-44%) and contrasted with the complete lack of response in placebo-treated patients (+8.0%). Response (defined as either normalisation of serum alkaline phosphatase or decrease from baseline ≥ 60%) occurred in approximately 85% of patients treated with ADRONAT in the combined studies versus 30% in the etidronate group and 0% in the placebo group. ADRONAT was similarly effective irrespective of age, gender, race, renal function, concomitant medications, prior use of other bisphosphonates, or baseline alkaline phosphatase.

INDICATIONS

ADRONAT is indicated for the treatment of:

- Osteoporosis*, including glucocorticoid-induced osteoporosis

ADRONAT is also indicated for the prevention of:

- Osteoporosis in postmenopausal women with low bone mass (at least 1 standard deviation below the mean for young adults).
- Glucocorticoid-induced osteoporosis in those patients on long term corticosteroid therapy (see Clinical Trials)

ADRONAT PLUS is indicated for the treatment of:

- Osteoporosis* in select patients where vitamin D supplementation is recommended

ADRONAT PLUS D-Cal is indicated for the treatment of:

- Osteoporosis* in select patients where vitamin D and calcium supplementation is recommended

* Prior to treatment, osteoporosis must be confirmed by:

- the finding of low bone mass of at least 2 standard deviations below the gender specific mean for young adults or by
- the presence of osteoporotic fracture.

CONTRAINDICATIONS

ADRONAT/ADRONAT PLUS (including the ADRONAT PLUS component of ADRONAT PLUS D-Cal):

- Abnormalities of the oesophagus which delay oesophageal emptying such as stricture or achalasia
- Inability to stand or sit upright for at least 30 minutes
- Hypersensitivity to any component of this product
- Hypocalcaemia (see PRECAUTIONS)

BONECAL component of ADRONAT PLUS D-Cal

- Hypercalcaemia
- Severe hypercalciuria
- Hypersensitivity to any component of this product

PRECAUTIONS

SEVERE OESOPHAGEAL ULCERATION HAS BEEN REPORTED IN PATIENTS TAKING THIS ALENDRONATE. SEE DOSAGE AND ADMINISTRATION. PHYSICIANS SHOULD THEREFORE BE ALERT TO ANY SIGNS OR SYMPTOMS SIGNALING A POSSIBLE OESOPHAGEAL REACTION. PATIENTS SHOULD BE INSTRUCTED TO DISCONTINUE ADRONAT, ADRONAT PLUS OR THE ADRONAT PLUS COMPONENT OF ADRONAT PLUS D-CAL AND SEEK MEDICAL ATTENTION IF THEY DEVELOP DYSPHAGIA, ODYNOPHAGIA OR RETROSTERNAL PAIN.

GENERAL
Causes of osteoporosis other than hypogonadism, aging and glucocorticoid use should be considered.

If there are clinical reasons to suspect hypocalcaemia and/or vitamin D deficiency, the appropriate diagnostic tests should be performed. Hypocalcaemia must be corrected before initiating therapy with ADRONAT, ADRONAT PLUS or the ADRONAT PLUS component of ADRONAT PLUS D-Cal (See CONTRAINDICATIONS). Other disturbances of mineral metabolism (such as vitamin D deficiency) should also be effectively treated. In patients with these conditions, serum calcium and symptoms of hypocalcemia should be monitored during therapy with ADRONAT,ADRONAT PLUS or the ADRONAT PLUS component of ADRONAT PLUS D-Cal. The content of vitamin D in ADRONAT PLUS is not suitable for correction of vitamin D deficiency

Small, asymptomatic decreases in serum calcium and phosphate may occur, especially in patients receiving glucocorticoids, in whom calcium absorption may be decreased.

Ensuring adequate calcium and vitamin D intake is especially important in patients receiving glucocorticoids.

Alendronate
ADRONAT, like other bisphosphonates, may cause local irritation of the upper gastrointestinal mucosa.

Oesophageal adverse experiences, such as oesophagitis, oesophageal ulcers and oesophageal erosions, rarely followed by oesophageal stricture or perforation, have been reported in patients receiving treatment with alemdronate. In some cases these have been severe and required hospitalisation.

The risk of severe oesophageal adverse experiences appears to be greater in patients who lie down after taking ADRONAT, ADRONAT PLUS or the ADRONAT PLUS component of ADRONAT PLUS D-Cal and/or who fail to swallow it with a full glass of water, and/or who continue to take ADRONAT,ADRONAT PLUS or the ADRONAT PLUS component of ADRONAT PLUS D-Cal after developing symptoms suggestive of oesophageal irritation. Therefore, it is very important that the full dosing instructions are provided to, and understood by, the patient (see DOSAGE AND ADMINISTRATION).

While no increased risk was observed in extensive clinical trials, there have been rare (post-marketing) reports of gastric and duodenal ulcers, some severe and with complications.

Because of possible irritant effects of alendronate on the upper gastrointestinal mucosa and a potential for worsening of the underlying disease, caution should be used when ADRONAT, ADRONAT PLUS or the ADRONAT PLUS component of ADRONAT PLUS D-Cal is given to patients with active upper gastrointestinal problems, such as dysphagia, oesophageal diseases (including known Barrett's oesophagus), gastritis, duodenitis, or ulcers.

Colecalciferol
Vitamin D_3 may increase the magnitude of hypercalcemia and/or hypercalciuria when administered to patients with diseases associated with unregulated overproduction of calcitriol (e.g., leukaemia, lymphoma, sarcoidosis). Urine and serum calcium should be monitored in these patients.

Patients with malabsorption may not adequately absorb vitamin D_3.

DENTAL
Localised osteonecrosis of the jaw (ONJ), generally associated with tooth extraction and/or local infection (including osteomyelitis) with delayed healing, has been reported rarely with oral bisphosphonates including alendronate (see ADVERSE REACTIONS, *Post-Marketing Experience*). As of May 2004, ONJ after bisphosphonate treatment has been described in a total of 99 cases in two large case series, 7 of which were taking oral bisphosphonates. As of 3 Nov 2006, the Australian Adverse Drug Reactions Advisory Committee has received 25 reports of ONJ in patients receiving alendronate. Most reported cases of bisphosphonate-associated ONJ have been in cancer patients treated with intravenous bisphosphonates. Known risk factors for ONJ include a diagnosis of cancer, concomitant therapies (e.g., chemotherapy, radiotherapy, corticosteroids), poor oral hygiene, co-morbid disorders (e.g., periodontal and/or other pre-existing dental disease, anaemia, coagulopathy, infection) and smoking.

Prior to treatment with bisphosphonates, a dental examination with appropriate preventative dentistry should be considered in patients with possible risk factors.

Before commencing invasive dental procedures, patients and their dentist should be advised of the risks and reports of osteonecrosis of the jaw so that dental symptoms, including toothache, developing during treatment can be fully assessed for cause before treatment of the tooth commences.

For patients requiring invasive dental surgery (eg. tooth extraction, dental implants), there are no definitive data available to establish whether discontinuation of bisphosphonate treatment reduces the risk of ONJ. Therefore clinical judgment of the treating physician and/or oral surgeon should guide the management plan, including discontinuation of bisphosphonate treatment, of each patient based on individual benefit/risk assessment.

In patients who develop ONJ while on bisphosphonate therapy, the clinical judgment of the treating physician should guide the management plan to include appropriate care by an oral surgeon and discontinuation of bisphosphonate therapy should be based on individual benefit/risk assessment. Surgery at the affected area may exacerbate the condition.

ATYPICAL STRESS FRACTURES
A small number of long-term (usually longer than three years) alendronate-treated patients developed stress fractures of the proximal femoral shaft (also known as insufficiency fractures), some of which occurred in the absence of apparent trauma. Some patients experienced prodromal pain in the affected area, often associated with imaging features of stress fracture, weeks to months before a complete fracture occurred. Approximately one third of these fractures were bilateral; therefore the contralateral femur should be examined in patients who have sustained a femoral shaft stress fracture. The number of reported cases of this condition is very low (some 40 reported cases world-wide). Patients with suspected stress fractures should be evaluated, including evaluation for known causes and risk factors (e.g., vitamin D deficiency, malabsorption, glucocorticoid use, previous stress fracture, lower extremity arthritis or fracture, extreme or increased exercise, diabetes mellitus,

chronic alcohol abuse), and receive appropriate orthopaedic care. Discontinuation of bisphosphonate therapy in patients with stress fractures is advisable pending evaluation of the patient, based on individual benefit/risk assessment. A cause and effect relationship between bisphosphonate use and stress fractures has not been excluded.

MUSCULOSKELETAL PAIN
Bone, joint, and/or muscle pain has been reported in patients taking bisphosphonates. In post-marketing experience, these symptoms have rarely been severe and/or incapacitating (see ADVERSE REACTIONS, *Post-Marketing Experience*). The time to onset of symptoms varied from one day to several months after starting treatment. Most patients had relief of symptoms after stopping treatment. A subset had recurrence of symptoms when rechallenged with the same drug or another bisphosphonate.

RENAL INSUFFICIENCY
ADRONAT and ADRONAT PLUS (70mg/140 mcg or D-Cal) are not recommended for patients with creatinine clearance < 35mL/min (see DOSAGE AND ADMINISTRATION).

NEPHROLITHIASIS AND HYPERCALCIURIA
Patients with a history of either nephrolithiasis or hypercalciuria may require special diets that limit their calcium intake. The calcium content of BoneCal should be considered when these diets are prescribed.

DOSAGE INSTRUCTIONS FOR PATIENTS

ADRONAT/ADRONAT PLUS tablets (including the ADRONAT PLUS component of ADRONAT PLUS D-Cal)
To facilitate delivery to the stomach and thus reduce the potential for oesophageal irritation patients should be instructed to swallow each tablet of ADRONAT,ADRONAT PLUS or the ADRONAT PLUS component of ADRONAT PLUS D-Cal with a full glass of water.. Patients should be instructed not to lie down for at least 30 minutes and until after their first food of the day. Patients should not chew or suck on the tablet because of a potential for oropharyngeal ulceration. Patients should be specifically instructed not to take ADRONAT,ADRONAT PLUS or ADRONAT PLUS component of ADRONAT PLUS D-Cal at bedtime or before arising for the day. Patients should be informed that failure to follow these instructions may increase their risk of oesophageal problems. Patients should be instructed that if they develop symptoms of oesophageal disease (such as difficulty or pain upon swallowing, retrosternal pain or new or worsening heartburn) they should stop taking ADRONAT,ADRONAT PLUS or the ADRONAT PLUS component of ADRONAT PLUS D-Cal and consult their physician.

Patients should be instructed that if they miss a dose of ADRONAT once weekly , ADRONAT PLUS or the ADRONAT PLUS component of ADRONAT PLUS D-Cal, they should take one tablet on the morning after they remember. They should not take two tablets on the same day but should return to taking one tablet once a week, as originally scheduled on their chosen day.

Additional Instructions for ADRONAT PLUS D-Cal
ADRONAT PLUS D-Cal is a combination pack consisting of 4 once weekly tablets of ADRONAT PLUS 70mg/140μg and 48 tablets of BoneCal. One tablet of ADRONAT PLUS 70 mg/140 μg should be taken on the first day. Beginning on the next day, one or two BoneCal tablets should be taken daily for 6 days. This 7 day cycle should be repeated each week. With this regimen ADRONAT PLUS and BoneCal are not taken on the same day.

The ADRONAT PLUS component should always be taken on the same day each week, in accordance with the directions as described above. Patients should be instructed to commence the BoneCal component on the day after the ADRONAT PLUS tablet is taken. Patients should be instructed to take one or two tablets each day with food for the next 6 days, depending on their need for calcium supplementation.

Patients should be instructed that if they miss a dose of ADRONAT PLUS 70 mg/140 μg, they should take one tablet on the morning after they remember. They should not take two tablets on the same day but should return to taking one tablet once a week, as originally scheduled on their chosen day. On the following day, they should take their next dose of BoneCal.

Patients should be instructed that if they miss a dose of BoneCal, they should omit that dose and continue taking the tablets on the day that they remember.

EFFECTS ON FERTILITY
Alendronate sodium
Alendronate sodium had no effect on fertility in male and female rats at oral doses of up to 9 and 15 mg/kg/day.

No studies on the effects on fertility have been carried out using the alendronate and colecalciferol combination.

USE IN PREGNANCY (Category B3)
Alendronate sodium
ADRONAT has not been studied in pregnant women and should not be given to them. In studies with pregnant rats, oral alendronate doses of 2mg/kg/day and above resulted in dystocia due to maternal hypocalcaemia. Foetal weight was reduced in rats at maternal doses greater than 5mg/kg/day. No teratogenic effects were seen in rats or rabbits at oral doses up to 25 and 35mg/kg/day, respectively.

Colecalciferol
No data are available for colecalciferol (vitamin D_3). Intramuscular administration of high doses (≥ 10,000 IU/every other day) of ergocalciferol (vitamin D_2) to pregnant rabbits resulted in higher incidence of foetal aortic stenosis compared to controls. Administration of vitamin D_2 (40,000 IU/day) to pregnant rats resulted in neonatal death, decreased foetal weight, and impaired osteogenesis of long bones postnatally.

No studies on the reproductive toxicity potential of the alendronate and colecalciferol combination have been carried out in animals.

USE IN LACTATION
ADRONAT,ADRONAT PLUS and the ADRONAT PLUS component of ADRONAT PLUS D-Cal have not been studied in breast-feeding women and should not be given to them. No studies using the combination of alendronate and colecalciferol have been carried out in lactating animals.

PAEDIATRIC USE
ADRONAT, ADRONAT PLUS and the ADRONAT PLUS component of ADRONAT PLUS D-Cal have not been studied in children and should not be given to them.

USE IN THE ELDERLY
In controlled trials, there was no age-related difference in the efficacy or safety profiles of ADRONAT, ADRONAT PLUS or the ADRONAT PLUS component of ADRONAT PLUS D-Cal.

CARCINOGENICITY
Alendronate sodium
No evidence of carcinogenic effect was observed in a 105-week study in rats receiving oral doses up to 3.75 mg/kg/day and in a 92-week study in mice receiving oral doses up to 10 mg/kg/day.

The carcinogenic potential of colecalciferol alone or the alendronate and colecalciferol combination has not been studied.

GENOTOXICITY
Alendronate sodium
Alendronate did not cause gene mutations in bacteria or in mammalian cells *in vitro*, nor did it cause DNA damage in rat hepatocytes *in vitro* (alkaline elution assay). In assays of chromosomal damage, alendronate was weakly positive in an *in vitro* assay using Chinese hamster ovary cells at cytotoxic concentrations (≥5mM), but was negative at IV doses up to 25 mg/kg/day (75 mg/m^2) in an *in vivo* assay (chromosomal aberrations in mouse bone marrow).

Colecalciferol
Calcitriol, the active hormonal metabolite of colecalciferol, was not genotoxic in the microbial mutagenesis assay with or without metabolic activation, or in an *in vivo* micronucleus assay in mice.

No studies on the genotoxic potential have been carried out using the alendronate and colecalciferol combination.

INTERACTIONS WITH OTHER MEDICINES
Alendronate sodium
If taken at the same time it is likely that calcium supplements, antacids and other oral medications will interfere with absorption of alendronate. Therefore, patients must wait at least one-half hour after taking ADRONAT,

ADRONAT PLUS or the ADRONAT PLUS component of ADRONAT PLUS D-Cal before taking any other oral medication.

No other drug interactions of clinical significance are anticipated though the concomitant medication with two or more bisphosphonates cannot be recommended because of the lack of clinical data.

Concomitant use of HRT (oestrogen ± progestin) and ADRONAT was assessed in two clinical studies of one or two years' duration in postmenopausal osteoporotic women. Combined use of ADRONAT and HRT resulted in greater increases in bone mass, together with greater decreases in bone turnover, than seen with either treatment alone. In these studies, the safety and tolerability profile of the combination was consistent with those of the individual treatments (see ADVERSE REACTIONS, Clinical Studies, Concomitant use with oestrogen/hormone replacement therapy).

Specific interaction studies were not performed. ADRONAT (10mg and 5mg/day) was used in studies of treatment and prevention of osteoporosis in postmenopausal women, men and glucocorticoid users, with a wide range of commonly prescribed drugs without evidence of clinical adverse interactions. In clinical studies, the incidence of upper gastrointestinal adverse events was increased in patients receiving daily therapy with dosages of ADRONAT greater than 10 mg and aspirin-containing products. However, this was not observed in studies with ADRONAT once weekly 70 mg.

Since Non Steroidal Anti-inflammatory Drug (NSAID) use is associated with gastrointestinal irritation, caution should be used during concomitant use with alendronate.

Colecalciferol
Olestra, mineral oils, orlistat, and bile acid sequestrants (e.g., cholestyramine, colestipol) may impair the absorption of vitamin D. Anticonvulsants, cimetidine, and thiazides may increase the catabolism of vitamin D.

Calcium carbonate
Calcium carbonate may interfere with the absorption of some concomitantly administered medications (e.g. tetracycline preparations). For this reason, the effect of calcium on the absorption of concomitantly administered medications should be reviewed.

Thiazide diuretics may reduce the urinary excretion of calcium.

Systemic glucocorticoids may reduce calcium absorption. During concomitant use with the BoneCal component of ADRONAT PLUS D-Cal, it may be necessary to increase the amount of calcium supplementation.

EFFECT ON ABILITY TO DRIVE OR USE MACHINERY
No studies on the effects on the ability to drive and use machines have been performed. However, certain adverse reactions that have been reported with ADRONAT or ADRONAT PLUS may affect some patients' ability to drive or operate machinery. Individual responses to ADRONAT or ADRONAT PLUS may vary (see ADVERSE EFFECTS).

EFFECT ON LABORATORY TESTS
In double-blind, multicentre, controlled studies, asymptomatic, mild and transient decreases in serum calcium and phosphate were observed in approximately 18 and 10%, respectively, of patients taking ADRONAT versus approximately 12 and 3% of those taking placebo. However, the incidences of decreases in serum calcium to <8.0 mg/dL (2.0 mM) and serum phosphate to ≤ 2.0 mg P/dL (0.65 mM) were similar in both treatment groups.

ADVERSE EFFECTS

CLINICAL STUDIES

In clinical studies ADRONAT was generally well tolerated. In studies of up to five years in duration, side effects, which usually were mild, generally did not require discontinuation of therapy.

Treatment of osteoporosis

Postmenopausal women

ADRONAT has been evaluated for safety in clinical studies in approximately 5000 postmenopausal patients. In two three-year, placebo controlled, double blind multicentre studies, discontinuation of therapy due to any clinical adverse experience occurred in 4.1% of 196 patients treated with ADRONAT 10mg/day and 6.0% of 397 patients treated with placebo. Adverse experiences reported by the investigators as possibly, probably or definitely drug related in ≥1% of patients treated with either ADRONAT 10mg/day or placebo are presented in the following table:

Drug Related Adverse Experiences Reported in ≥1% of Patients

	ADRONAT 10mg/day % (n=196)	PLACEBO % (n=397)
Gastrointestinal		
abdominal pain	6.6	4.8
nausea	3.6	4.0
dyspepsia	3.6	3.5
diarrhoea	3.1	1.8
constipation	3.1	1.8
flatulence	2.6	0.5
acid regurgitation	2.0	4.3
oesophageal ulcer	1.5	0.0
vomiting	1.0	1.5
dysphagia	1.0	0.0
abdominal distension	1.0	0.8
gastritis	0.5	1.3
Musculoskeletal		
musculoskeletal (bone, muscle or joint) pain	4.1	2.5
muscle cramp	0.0	1.0
Nervous System/Psychiatric		
headache	2.6	1.5
dizziness	0.0	1.0
Special Senses		
taste perversion	0.5	1.0

Rarely, rash and erythema have occurred.

In the two-year extension (treatment years 4 and 5) of the above studies, the overall safety profile of ADRONAT 10 mg/day was similar to that observed during the three-year placebo-controlled period. Additionally, the proportion of patients who discontinued ADRONAT 10 mg/day due to any clinical adverse experience was similar to that during the first three years of the study.

In the Fracture Intervention Trial, discontinuation of therapy due to any clinical adverse experience occurred in 9.1% of 3236 patients treated with ADRONAT 5 mg/day for 2 years and 10 mg/day for either one or two additional years and 10.1% of 3223 patients treated with placebo. Discontinuations due to upper gastrointestinal adverse experiences were: ADRONAT, 3.2%; placebo, 2.7%. The overall adverse experience profile was similar to that seen in other studies with ADRONAT 5 or 10 mg/day.

In a one-year, double-blind, multicentre study, the overall safety and tolerability profiles of ADRONAT once weekly 70 mg (n = 519) and ADRONAT 10 mg daily (n = 370) were similar. Adverse experiences reported by the investigators as possibly, probably or definitely drug related in ≥1% of patients treated with either patient group are presented in the following table:

Drug Related Adverse Experiences Reported in ≥ 1% of Patients

	ADRONAT once weekly 70 mg % (n = 519)	ADRONAT 10 mg/day % (n = 370)
Gastrointestinal		
Abdominal pain	3.7	3.0
Dyspepsia	2.7	2.2
Acid regurgitation	1.9	2.4
Nausea	1.9	2.4
Abdominal distension	1.0	1.4
Constipation	0.8	1.6
Flatulence	0.4	1.6
Gastritis	0.2	1.1
Gastric ulcer	0.0	1.1
Musculoskeletal		
musculoskeletal (bone, muscle or joint) pain	2.9	3.2
muscle cramp	0.2	1.1

Concomitant use with oestrogen/hormone replacement therapy

In two studies (of one and two years' duration) of postmenopausal osteoporotic women (total: n=853), the safety and tolerability profile of combined treatment with ADRONAT 10 mg once daily and oestrogen ± progestin (n=354) was consistent with those of the individual treatments.

Men

In a two year, placebo-controlled, double-blind, multicentre study, the safety profile of ADRONAT 10 mg daily in 146 men was generally similar to that seen in postmenopausal women.

Other studies in men and women

In a ten-week endoscopy study in men and women (n = 277; mean age 55 years) no difference was seen in upper gastrointestinal tract lesions between ADRONAT once weekly 70 mg and placebo.

In an additional one-year study in men and women (n = 335; mean age 50 years) the overall safety and tolerability profiles of ADRONAT once weekly 70 mg were similar to that of placebo and no difference was seen between men and women.

Prevention of osteoporosis

The safety of ADRONAT in postmenopausal women 40-60 years of age has been evaluated in three double-blind, placebo-controlled studies involving over 1,400 patients randomised to receive ADRONAT for either two or three years. In these studies, the safety and tolerability profile of ADRONAT 5mg/day (n=642) was similar to that of placebo (n=648). The only adverse experience reported by the investigators as possibly, probably, or definitely drug related in ≥1% of patients treated with ADRONAT 5mg/day and at a greater incidence than placebo was dyspepsia (ADRONAT, 1.9% vs. placebo, 1.7%)

Treatment and prevention of glucocorticoid - induced osteoporosis.

In two, one-year, placebo-controlled, double-blind, multicentre studies in patients receiving glucocorticoid treatment, the overall safety and tolerability profiles of ADRONAT 5 and 10 mg/day were generally similar to that of placebo. Adverse experiences reported by the investigators as possibly, probably or definitely drug related in

≥1% of patients treated with either ADRONAT 5mg/day, 10mg/day or placebo are presented in the following table:

Drug Related Adverse Experiences Reported in ≥ 1% of Patients

	ADRONAT 10 mg/day %	ADRONAT 5 mg/day %	PLACEBO %
Gastrointestinal			
Abdominal pain	3.2	1.9	0.0
Acid regurgitation	2.5	1.9	1.3
Constipation	1.3	0.6	0.0
Melena	1.3	0.0	0.0
Nausea	0.6	1.2	0.6

Alendronate and colecalciferol

In a 15-week, double-blind, multinational study in osteoporotic postmenopausal women (n=682) and men (n=35), the safety profile of once weekly alendronate 70 mg /colecalciferol 70 µg was similar to that of ADRONAT once weekly 70 mg. In the 24-week double-blind extension study in women (n=619) and men (n=33), the safety profile of alendronate 70 mg/colecalciferol 70 µg (vitamin D_3 2800 IU) administered with an additional colecalciferol 70 µg for a total of 140 µg colecalciferol (5600 IU vitamin D_3) was similar to that of alendronate 70 mg/colecalciferol 70 µg (2800 IU vitamin D_3). The primary endpoint was the proportion of patients who developed hypercalciuria at Week 39, with 4.2% noted in the colecalciferol 140 µg group and 2.8% in the colecalciferol 70 µg group, which was not statistically significant. Overall, the safety profile of alendronate 70 mg/colecalciferol 70 µg administered with 70 µg additional colecalciferol for a total of 140 µg colecaciferol was similar to that of alendronate/colecalciferol 70 µg.

ADRONAT/ADRONAT PLUS (including the ADRONAT PLUS component of ADRONAT PLUS D-Cal) Post-marketing Experience

The following adverse reactions have been reported in post-marketing use with alendronate:

Body as a Whole: hypersensitivity reactions including urticaria and rarely angioedema. Transient symptoms as in an acute-phase response (myalgia, malaise, asthenia and rarely, fever) have been reported with alendronate, typically in association with initiation of treatment. Rarely, symptomatic hypocalcemia has occurred, generally in association with predisposing conditions. Rarely, peripheral oedema.

Gastrointestinal: nausea, vomiting, oesophagitis, oesophageal erosions, oesophageal ulcers, rarely oesophageal stricture or perforation, and oropharyngeal ulceration and/or stomatitis; rarely, gastric or duodenal ulcers, some severe and with complications (see PRECAUTIONS and DOSAGE AND ADMINISTRATION). Localised osteonecrosis of the jaw, generally associated with tooth extraction and/or local infection, (including osteomyelitis) often with delayed healing, has been reported rarely (see PRECAUTIONS).

Musculoskeletal: bone, joint, and/or muscle pain, rarely severe and/or incapacitating (see PRECAUTIONS) joint swelling, atypical stress fracture (see PRECAUTIONS).

Nervous System: dizziness, vertigo, dysgeusia.

Skin: rash (occasionally with photosensitivity), pruritus, alopecia, rarely severe skin reactions, including Stevens-Johnson syndrome and toxic epidermal necrolysis.

Special senses: rarely uveitis, scleritis or episcleritis

BoneCal component of ADRONAT PLUS D-Cal

The following adverse reactions have been described with calcium carbonate:
Constipation, flatulence, nausea, abdominal pain, hypercalcaemia, hypercalciuria, nephrolithiasis.

DOSAGE AND ADMINISTRATION

ADRONAT and ADRONAT PLUS, as well as the ADRONAT PLUS component of ADRONAT PLUS D-Cal must be taken at least 30 minutes before the first food, beverage, or medication of the day with plain water only. Other beverages (including mineral water), food and some medications are likely to reduce the absorption of ADRONAT (see DRUG INTERACTIONS).

ADRONAT and ADRONAT PLUS, as well as the ADRONAT PLUS component of ADRONAT PLUS D-Cal should only be taken upon arising for the day. To facilitate delivery to the stomach and thus reduce the potential for oesophageal irritation, ADRONAT and ADRONAT PLUS tablets should be swallowed with a full glass of water.

Patients should not lie down for at least 30 minutes and until after their first food of the day. ADRONAT and ADRONAT PLUS as well as the ADRONAT PLUS component of ADRONAT PLUS D-Cal should not be taken at bedtime or before arising for the day. Failure to follow these instructions may increase the risk of oesophageal adverse experiences (see PRECAUTIONS).

SEVERE OESOPHAGEAL ULCERATION HAS BEEN REPORTED IN PATIENTS TAKING THIS DRUG. SEE PRECAUTIONS. PATIENTS SHOULD BE INSTRUCTED THAT IF THEY DEVELOP SYMPTOMS OF OESOPHAGEAL DISEASE (SUCH AS DIFFICULTY OR PAIN UPON SWALLOWING, RETROSTERNAL PAIN OR NEW OR WORSENING HEARTBURN) THEY SHOULD STOP TAKING ADRONAT OR ADRONAT PLUS OR THE ADRONAT PLUS COMPONENT OF ADRONAT PLUS D-CAL AND CONSULT THEIR PHYSICIAN.

In clinical trials, ADRONAT was administered with appropriate calcium and vitamin D supplementation. The use of vitamin D as the sole treatment of osteoporosis has not been established.

Patients should receive supplemental calcium and vitamin D, if dietary intake is inadequate (see PRECAUTIONS). Each tablet of BoneCal in ADRONAT PLUS D-Cal provides 500mg elemental calcium.

Physicians should consider the vitamin D intake from vitamins and dietary supplements. ADRONAT PLUS provides 140 µg colecalciferol (5600 IU of vitamin D_3) in a single once weekly dose, which is equivalent to seven daily doses of 20 µg colecalciferol (800 IU vitamin D_3). Additional supplements should not be taken at the same time of day as ADRONAT, ADRONAT PLUS or the ADRONAT PLUS component of ADRONAT PLUS D-Cal (see above).

No dosage adjustment is necessary for the elderly or for patients with mild-to-moderate renal insufficiency (creatinine clearance 35 to 60 mL/min). ADRONAT, ADRONAT PLUS and ADRONAT PLUS D-Cal are not recommended for patients with more severe renal insufficiency (creatinine clearance < 35 mL/min).

Although no specific studies have been conducted on the effects of switching patients on another therapy for osteoporosis to ADRONAT or ADRONAT PLUS, there are no known or theoretical safety concerns related to ADRONAT or ADRONAT PLUS in patients who previously received any other antiosteoporotic therapy.

ADRONAT

Treatment of osteoporosis

The recommended dosage is:

- one 70 mg tablet once weekly

or

- one 10 mg tablet once daily

Prevention of osteoporosis in postmenopausal women

The recommended dosage is 5mg once a day

Treatment and prevention of glucocorticoid - induced osteoporosis

In selected patients, the recommended dosage is 5 mg once a day, except for postmenopausal women not receiving oestrogen, for whom the recommended dosage is 10 mg once a day (see Clinical Trials, Glucocorticoid - Induced Osteoporosis).

ADRONAT PLUS
Treatment of osteoporosis in patients where vitamin D supplementation is recommended

The recommended dose is one tablet of ADRONAT PLUS once weekly.

ADRONAT PLUS D-Cal
Treatment of osteoporosis in patients where vitamin D and calcium supplementation is recommended

The recommended dose is one tablet of ADRONAT PLUS 70 mg/140 μg taken once weekly. For the next six days, patients should take one or two BoneCal tablets daily depending on their need for calcium supplementation . This 7 day cycle should be repeated each week. With this regimen ADRONAT PLUS and BoneCal are not taken on the same day.

The ADRONAT PLUS component should always be taken on the same day each week , in accordance with the directions as described above. The BoneCal component should commence on the day after the ADRONAT PLUS tablet is taken, with one or two tablets taken each day with food for the next 6 days. The ADRONAT PLUS and BoneCal tablets should never be taken at the same time.

OVERDOSAGE

Alendronate sodium
No specific information is available on the treatment of overdosage with ADRONAT. Hypocalcaemia, hypophosphataemia and upper gastrointestinal adverse events, such as upset stomach, heartburn, oesophagitis, gastritis, or ulcer, may result from oral overdosage. Administration of milk or antacids, to bind alendronate, should be considered.

Colecalciferol
Vitamin D toxicity has not been documented during chronic therapy in generally healthy adults at a dose less than 10,000 IU/day. In a clinical study of healthy adults, a 4000 IU daily dose of vitamin D_3 for up to five months was not associated with hypercalciuria or hypercalcemia.

Calcium carbonate
Adverse effects of overdosage with calcium carbonate is unlikely due to limited intestinal absorption. However, chronic excessive dosing can lead to hypercalcaemia or hypercalciuria.

Contact the Poisons Information Centre (telephone 13 11 26) for advice regarding management of overdose.

PRESENTATION AND STORAGE CONDITIONS

***ADRONAT**® 5mg, white round tablet, one side MSD 925 other side outline of a bone image.
Supplied in blister packs of 8** and 30 tablets.

***ADRONAT**®10mg, white to off-white, polished oval tablet (one side plain, the other side engraved 936).
Supplied in blister packs of 8** and 30 tablets.

ADRONAT®Once Weekly 70 mg, white oval tablet with the outline of a bone image on one side and 31 on the other
Supplied in blister packs of 1** and 4 tablets.

***ADRONAT® PLUS** 70 mg/ 140 μg, once weekly tablet, providing 5600 IU vitamin D_3. White to off-white, modified rectangle-shaped tablet with "270" on one side and a bone image on the other.
Supplied in blister packs of 1** and 4 tablets.

***ADRONAT PLUS D-Cal™** a combination pack of ADRONAT PLUS 70mg/140 μg and BoneCal tablets.
ADRONAT PLUS 70 mg/140 μg tablets, providing 5600 IU vitamin D_3, are white to off-white, modified rectangle-shaped tablets with "270" on one side and a bone image on the other.
Supplied in blister packs of 4 tablets.
BoneCal tablets, providing 500mg elemental calcium, are green film coated capsule shaped tablets.
Supplied in a bottle of 48 tablets.

Protect ADRONAT PLUS and ADRONAT PLUS D-Cal tablets from moisture and light, and store tablets in original blister package until use.

Store below 30°C.
** Supplied as starter packs only.
*Not available

NAME AND ADDRESS OF THE SPONSOR

MERCK SHARP & DOHME (AUSTRALIA) PTY LIMITED
54-68 Ferndell Street
SOUTH GRANVILLE NSW 2142

BoneCal is supplied in Australia by
Vitaco Australia Pty Limited
64 Fennell Street
PORT MELBOURNE 3207 VIC

POISON SCHEDULE OF THE MEDICINE

Prescription only medicine (S4)

NAME AND ADDRESS OF SUPPLIER

Alphapharm Pty Ltd,
Chase Building 2, Wentworth Park Rd
GLEBE NSW 2037

DATE OF APPROVAL

This document was approved by the Therapeutic Goods Administration on 15 March 2010.

Date of most recent amendment: August 10, 2010