KRIGING: UNDERSTANDING ALLAYS INTIMIDATION
Ricardo A Olea,
Lawrence, Kansas, USA
Abstracted from Geobyte 7 12-17 1992

In 1938 Daniel Gerhardus “Danie” Krige obtained an undergraduate degree in mining engineering and started a brilliant career centered on analyzing the gold and uranium mines in the Witwatersrand conglomerates of South Africa. He became interested in the disharmony between the poor reliability of reserve estimation reports and the magnitude of the economic decisions that were based on these studies. Back at the University of Witwatersrand, he wrote a master’s thesis that began a revolution in mining evaluation methods.

Krige was not alone in his research. Another mining engineer, Georges Matheron, a Frenchman, thought space data analysis belonged in a separate discipline, just as geophysics is a separate branch from physics. He named the new field geostatistics.

Kriging is the name given in geostatistics to a collection of generalized linear regression techniques for the estimation of spatial phenomena. Pierre Carlier, another Frenchman, coined the term krigeage in the late 1950s to honor Krige’s seminal work. Matheron anglicized the term to kriging when he published a paper for English-speaking readers. France dominated the development and application of geostatistics for several years. However, geostatistics in general, and kriging in particular, are employed by few and are regarded with apprehension by many.

One of the possible applications of kriging is in computer mapping. Computer contouring methods can be grouped into two families: triangulation and gridding. The former is a direct procedure in which the contour lines are computed straight from the data by partitioning the sampling area into triangles with one observation per vertex. Kriging belongs in the gridding family. A grid is a regular arrangement of locations or nodes. In the gridding method the isolines are determined from interpolated values at the nodes.

The difference between kriging and other weighting methods is in the calculation of the weights. Even for the simplest form of kriging, the calculations are more demanding. The kriging system of equations differs from classical regression in that the observations are allowed to be correlated and that neither the estimate nor the observations are necessarily points – they may have a volume, shape, and orientation. The mean square error is the average of the squares of the differences between the true and the estimated values. Simple kriging, the most basic form of kriging in that the system of equations has the fewest terms, requires the phenomena to have a constant and known mean. The next step up, ordinary kriging, does not require knowledge of the population mean. The external drift method, universal kriging, and intrinsic kriging go even further by allowing fluctuations in the mean.

In practice, estimation by kriging is not as difficult to handle as it may look at first glance. In these days of high technology, all the details in the procedure are coded into computer programs.
When properly used, kriging has several appealing attributes, the most important being that it does the work more accurately. By design, kriging provides the weights that result in the minimum mean square error. And yes, there have been people who have tested its superiority with real data. Practice has consistently confirmed theory.

Kriging is also robust. Within reasonable limits, kriging tends to persist in yielding correct estimates even when the user selects the wrong model, misspecifies parameters, or both. This property should be an incentive for the novice to try the method. Gross misuse of kriging, though, can lead to poor results, worse even than those produced by alternative methods.

Kriging has evolved and continues to expand to accommodate the estimation of increasingly demanding realities.

Conclusions

Theory and practice show that computer contour maps generated using kriging have the least mean square estimation error. In addition, the method provides information to assess the reliability of the maps.

Key words: Computer contouring; Geophysics; Kriging; Mapping.
Reprints: R A Olea, Kansas Geological Survey, 1930 Constant Ave, The University of Kansas, Lawrence KS 66047, USA.

Environmental effects:

POTENTIAL ACCUMULATION OF A CFC-REPLACEMENT DEGRADATION PRODUCT IN SEASONAL WETLANDS

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Cambridge, Massachusetts, USA

Abstract from Nature 376 327-330 1995

Because of their refractory nature, chlorofluorocarbons (CFCs) released by industries are eventually transported to the stratosphere, where they are slowly degraded by solar ultraviolet radiation into highly reactive chlorine atoms which can then participate in a catalytic ozone depletion cycle. For this reason, signatories to the Montreal Protocol and subsequent amendments have agreed to phase out the use of CFCs in the next few decades. Hydrofluorocarbons and hydrochlorofluorocarbons have been proposed as CFC replacements; atmospheric degradation of several of these is expected to produce trifluoroacetate (TFA), which is removed from the atmosphere mainly by rain. The global average TFA concentration in rain water for the year 2010 is estimated to be 0.16 \( \mu g \) L\(^{-1}\) - well below the concentrations thought to inhibit plant growth (\( \sim 10^{2} - 10^{6} \mu g \) L\(^{-1}\)). But our modelling analysis, presented here, indicates that in conditions of high evapotranspiration, TFA could attain appreciable concentrations (\( > 10^{2} \mu g \) L\(^{-1}\)) in the local surface waters of seasonal wetlands within a few decades, if removal by degradation and seepage is limited.

Key words: Chlorofluorocarbons (CFCs); Seasonal wetlands; Trifluoroacetate (TFA).
Reprints: Atmospheric and Environmental Research Inc, 840 Memorial Drive, Cambridge, Massachusetts 02139, USA.
BIOMONITORING OF FLUORIDE CONTAMINATION OF WILD RUMINANT HABITATS IN NORTHERN BOHEMIA (CZECH REPUBLIC) [in German]
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Cologne, Germany

Abstract from Zeitschrift für Jagdwissenschaft 42(1) 41-52 1996

Fluoride content and occurrence of dental fluorosis were studied in 39 mandibles of four ruminant species (red deer, roe deer, sika deer and mouflon) from five hunting districts situated in the fluoride contaminated ore mountains and its foreland in Northern Bohemia. Compared to controls from areas in Germany not exposed to increased fluoride deposition, bone fluoride concentrations in the N-Bohemian red and roe deer samples were elevated by factors of 5.5 and 6.6, respectively. All specimens from N-Bohemia exhibited characteristic dental lesions resulting from chronic fluoride intoxication during tooth development. In the three deer species, the degree of dental fluorosis of the permanent cheek teeth was assessed using a scoring scheme. On the basis of these individual tooth scores, dental lesion indices were calculated for the tooth rows. Increase of this index (DLI) was positively associated with an increase in bone fluoride concentration. Recording dental lesion indices thus offers the opportunity for a quick and economic large scale biomonitoring of the level of fluoride contamination of deer habitats. The differences in the degree of fluorotic alteration of the M(1) and M(2) between fluorosed red and roe deer mandibles were related to variation in the timing of mineralization of these teeth in the two species.

Key words: Bone fluoride content; Czech Republic; Dental fluorosis; Deer; Fluoride contamination; Wild ruminants.

Reprints: H Kierdorf, University of Cologne, Gronewaldstr 2, D-50931 Cologne, Germany.

FLUORIDE EXPOSURE IN CERVIDS INHABITING AREAS ADJACENT TO ALUMINUM SMELTERS IN NORWAY 1. RESIDUE LEVELS
T Vikoren, G Stuve and A Froslie
Oslo, Norway

Abstract from Journal of Wildlife Diseases 32 (2) 169-180 1996

Mandibular fluorine concentrations were determined in 1,425 red deer (Cervus elaphus), 240 moose (Alces alces), and 424 roe deer (Capreolus capreolus) collected in Norway from 1990 to 1993 in seven municipalities in which aluminum smelters are located, in eight neighboring municipalities, and in eight reference areas representing background levels. Background fluorine concentration was significantly correlated with age in all three species. Roe deer had the highest mean background fluorine level in each age group, followed by red deer. Due to differences in fluoride exposure, large variations in bone fluorine residues were evident between locations. In Ardal, the district most severely exposed to fluoride contamination, nine of ten cervids had fluorine concentrations exceeding background levels. The proportions of red deer with fluorine residues exceeding background levels also were high in neighboring municipalities to Ardal. We propose that roe deer are a better biomonitor of local fluoride exposure than red deer and moose, due to their more sedentary behavior.

Key words: Alces alces; Bone fluorine; Capreolus capreolus; Cervids; Cervus elaphus; Fluoride emission. (Reprints: see next page)
Reprints (also for following two abstracts): T Vikoren, Central Veterinary Laboratory, Wildlife Diseases Section, PO Box 8156 Dept, N-0033 Oslo, Norway.

FLUORIDE EXPOSURE IN CERVIDS INHABITING AREAS ADJACENT TO ALUMINUM SMELTERS IN NORWAY 2. FLUOROSIS
T Vikoren and G Stuve
Oslo, Norway

Abstract from Journal of Wildlife Diseases 32 (2) 181-189 1996

Mandibles from 1104 red deer (Cervus elaphus), 147 moose (Alces alces), and 453 roe deer (Capreolus capreolus), collected between 1990 and 1993 in the vicinity of seven Norwegian aluminum smelters, were examined for dental fluorotic and osteofluorotic lesions. The metacarpal or metatarsal bones from 214 of these cervids also were evaluated. Dental fluorotic lesions occurred in all three cervid species. Prevalence of dental fluorosis was generally low at the various locations, with the exception of Ardal, where 15% of the cervids examined were affected. Only sporadic cases of severe dental fluorotic lesions were diagnosed. All red deer yearlings (1.5 yr) with mandibular fluorine (F) levels exceeding 2,000 ppm F, had dental fluorosis. However, the lowest skeletal fluorine level found in a fluorotic animal of this age was 1,355 ppm F. Gross osteofluorosis occurred in only three cervids, all with mandibular fluorine residues >8,000 ppm F. Hence, generalized fluorosis was not a prominent feature in the material studied.

Key words: Alces alces; Capreolus capreolus; Cervids; Cervus elaphus; Dental fluorosis; Fluorine; Osteofluorosis. (Reprints: see above)

FLUORIDE EXPOSURE AND SELECTED CHARACTERISTICS OF EGGS AND BONES OF THE HERRING GULL (LARUS ARGENTATUS) AND THE COMMON GULL (LARUS CANUS)
T Vikoren and G Stuve
Oslo, Norway

Abstract from Journal of Wildlife Diseases 32 (2) 190-196 1996

Fluorine concentrations were determined in the shell of 285 herring gull eggs (Larus argentatus) and 120 common gull eggs (Larus canus), collected May 1991 to 1993, from breeding colonies exposed to emissions from two Norwegian primary aluminum smelters located at Karmoy and Sunndal, and from unexposed reference localities in Eigersund, Sola, and Stavanger. Volume-index, shell thickness, thickness-index, and fertilization of the eggs also were monitored. In both species, the shell fluorine concentration was significantly increased in eggs collected at sites exposed to fluoride emissions. No effects on other egg characteristics were observed. In both exposed and unexposed sites, the last-laid egg in a clutch, normally containing three eggs, had the highest shell fluorine residue. Fluorine levels also were analyzed in femurs from 42 herring gulls, collected from Karmoy and Sola in May 1993. The relationship between sex and fluoride accumulation, and the relations between fluorine concentration in femurs of laying herring gulls and in the shell of their eggs, were evaluated. Bone morphology also was studied. Bone fluorine concentrations were raised significantly in emission-exposed female birds. Moreover, females from the exposed site had significantly higher fluorine residues than males. There was a positive correlation between fluorine levels in femurs of
individual laying birds and those in the shells of their eggs. No change in bone morphology due to fluoride exposure was found.

Key words: Birds; Bone; Egg; Fluoride emissions; Fluorine; *Larus argentatus*; *Larus canus*. (Reprints: see top of page 178)

### INFLUENCE OF FLUORIDE ON ALUMINUM TOXICITY TO ATLANTIC SALMON (*SALMO SALAR*)

S J Hamilton and T A Haines

Yankton, South Dakota, USA

Abstract from *Canadian Journal of Fisheries and Aquatic Sciences* 52 (11) 2432-2444 1995

Atlantic salmon (*Salmo salar*) alevins were exposed to various aluminum (0-4700 μg/L) and four fluoride (0-500 μg/L) concentrations at two pH values (5.5 and 6.5) for 4- and 30-d periods. In the 4-d tests, aluminum with fluoride was less toxic at pH 6.5 than at pH 5.5, whereas without fluoride, pH had no effect. In the 30-d test, mortality in all treatments was 17-21% at pH 5.5, but only 3-7% at pH 6.5. Fish length and weight after 30 d were reduced in all fluoride-aluminum treatments at pH 5.5, but only in the 200-μg/L aluminum without fluoride treatment at pH 6.5. At pH 5.5 and 6.5 without aluminum, histomorphological examinations revealed no abnormalities in gill tissue. However, in aluminum exposure with no fluoride, gill filaments and secondary lamellae were swollen and thickened. Addition of fluoride at pH 6.5 alleviated some gill damage. At pH 5.5 and 200 μg/L aluminum, addition of 100 μg/L fluoride reduced swelling of gill lamellae, but 200 μg/L fluoride did not reduce swelling. Low fluoride concentrations (<100 μg/L) may reduce gill morphological damage in fish exposed to aluminum in acidic waters, whereas high fluoride concentrations (>100 μg/L) may not reduce aluminum-induced effects.

Key words: Aluminum toxicity; Fluoride; Salmon.

Reprints: S J Hamilton, National Biological Service, Midwestern Science Center, RR 1 Box 295 Yankton, SD 57078, USA.

### FLUORIDE IMPACT ON NATIVE TREE SPECIES OF THE ATLANTIC FOREST NEAR CUBATÃO, BRAZIL

A Klumpp, G Klumpp, M Domingos and M D Dasilva

São Paulo, Brazil

Abstract from *Water, Air, and Soil Pollution* 87 (1-4) 57-71 1996

Air pollutant emissions from the industrial complex of Cubatão, Brazil, have led to a severe deterioration of the Atlantic Forest ecosystem. In a field study, leaves of the tree species *Tibouchina pulchra*, *Miconia pyrifolia*, and *Cecropia glazioui* were collected at four sites with different pollution characteristics. Leaf fluoride contents of the three species were found to be highly elevated in a valley near to fertilizer factories. In an area further from the emission sources, which in the past had been affected by fluoride pollution, fluoride concentrations in *Tibouchina* and *Miconia* continued to be elevated. Preliminary exposure experiments using *Tibouchina* seedlings as accumulative indicators are reported.

Key words: Air pollution; Brazil; Fluoride; Native trees.

Reprints: A Klumpp, Botanical Institute, C P 4005, BR-01061970 São Paulo, Brazil.
CHANGES IN POLYSACCHARIDES IN BONE AND ARTICULAR CARTILAGE OF RATS EXPOSED TO FLUORIDE

Miklós Bély
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Abstracted from *Environmental Sciences* 3 (4) 193-198 1995

Osteofluorosis was assessed experimentally by studying the changes in the capsular and intercapsular polysaccharides of the bone tissue and articular cartilage of rats exposed to sodium fluoride (0.5 mg and 5 mg administered daily for three months). The exposure markedly decreased the regular linear orientation of the polysaccharides. The disarray was associated with damage to the capsular and intercapsular proteoglycin aggregate matrix and collagen structure. These changes may be considered as manifestations of the toxic effects of fluoride.

Key words: Articular cartilage; Bone tissue; Osteofluorosis; Polysaccharides; Rats.

Reprints: M Bély, National Institute of Rheumatology, 1525 Budapest 114, Hungary.

EFFECTS OF FLUORIDE ON RAT VERTEBRAL BODY BIOMECHANICAL COMPETENCE AND BONE MASS

C H Sogaard, L Mosekilde, W Schwartz, G Leidig, H W Minne and R Ziegler
Aarhus, Denmark

Abstract from *Bone* 16 (1) 163-169 1995

For more than 30 years, sodium fluoride has been a commonly used therapeutic agent for established osteoporosis because of its repeatedly documented anabolic effect on trabecular bone mass. Recent clinical and experimental studies have, however, indicated a possible detrimental effect of fluoride on bone strength. Thus, the efficacy of fluoride therapy remains a controversial issue. The aim of this study was to investigate the effect of fluoride on both vertebral bone mass and quality in rats. Twenty-nine 3-month-old, female rats were randomized into three groups. One group served as a control group, and the other two groups received fluoridated water at different doses (100 ppm and 150 ppm). The rats were followed for 90 days. Three lumbar vertebrae were obtained from each rat, and changes in bone fluoride content, bone mass and biomechanical competence were assessed. The results revealed a significant increase in bone fluoride content, ash density and trabecular bone volume after fluoride treatment. Directly obtained load values and load corrected for cross sectional area were constant. Load corrected for ash content, which is a measure of bone quality, decreased significantly after fluoride therapy. It is concluded that the increase in bone mass during fluoride treatment does not translate into an improved bone strength and that the bone quality declines. This investigation thereby supports the hypothesis of a possible negative effect of fluoride on bone quality.

Key words: Bone fluoride content; Bone mass; Bone quality; Fluoride treatment; Osteoporosis; Rat; Vertebrae.

Reprints: C H Sogaard, Aarhus University, Department of Cell Biology, DK-8000 Aarhus C, Denmark.
SPINAL CORD COMPRESSION AND BONE FLUORIDE INTOXICATION - REPORT OF FOUR CASES [French]
A Mrabet, M Fredj, S Benammmou, H Tounsi and A Haddad
Tunis, Tunisia

Abstract from *Revue de Medecine Interne* 16 (7) 533-535 1995

The authors report four cases of spinal cord compression (three at cervical level and one at dorsal level) due to vertebral osteosclerosis secondary to chronic fluoride intoxication. Roentgenograms showed typical diffuse densification of vertebral bodies, calcifications of bony insertions of many ligaments, discs and interosseous membranes. Urinary fluoride was markedly increased in two cases. In the other two cases the bone biopsy was suggestive of skeletal fluorosis. Spinal computed tomography showed severe cord compression due to posterior osteophytes. Good improvement was observed after surgical decompression in one case. Fluorosis was described as a consequence of endemic exposure to high fluoride content in soil and natural ground water in North Africa. Fluorotic myelopathy was due to bone excrescences mainly affecting the spine.

Key words: Computed tomography; Fluorine osteosclerosis; Spinal cord compression.

Reprints: A Mrabet, Hospital Charles Nicolle, Unite Neurologie, 1006 Tunis, Tunisia.

FLUORIDE SUPPLEMENTATION STATUS, FRACTURES AND OSTEOPENIA IN CHILDREN WITH ACUTE LYMPHOBLASTIC LEUKEMIA
R D Barr, J M Halton, C Webber, S A Atkinson and D J McFarlane
Hamilton, Ontario, Canada

Abstract from *Oncology Reports* 3 (3) 473-475 1996

Children with acute lymphoblastic leukemia (ALL) experience fractures on the basis of osteopenia related to chemotherapy administered for the maintenance of remission. It is likely that corticosteroids are the main cause of bone mineral loss in this circumstance. Because fluoride has been used as a therapeutic intervention in osteoporosis, including that induced by corticosteroid therapy, we explored the prospect that children with ALL who received fluoride supplementation (in drinking water or from other sources) may be relatively protected from iatrogenic skeletal morbidity. Children who completed therapy according to the Dana Farber Cancer Institute protocol 87-01 (n=35) were assessed by skeletal radiology and bone densitometry every 6 months from diagnosis. In addition, their families completed a questionnaire relating to fluoride supplementation. There was no correlation between such fluoride supplementation and either the prevalence of fractures or the severity of osteopenia. This outcome may reflect the mainly appendicular location of the fractures in this group of children. These findings, together with a consideration of the risk benefit ratio of fluoride administration to children at large, suggest that such intervention is unlikely to be beneficial in limiting skeletal morbidity during the treatment of ALL in childhood.

Key words: Fluoride supplementation; Fractures; Leukemia; Osteopenia.

Reprints: R D Barr, McMaster University, Medical Centre, Room 3N27B, 1200 Main St W, Hamilton, ON L8N 3Z5, Canada.
ENHANCED CONTRACTILE RESPONSES OF ARTERIES FROM STREPTOZOTOCIN DIABETIC RATS TO SODIUM FLUORIDE

L P Weber, W L Chow, W Abebe and K M Macleod
Vancouver, British Columbia, Canada

Abstracted from British Journal of Pharmacology 118 (1) 115-122 1996

Previous studies from this laboratory have demonstrated that alpha-1-adrenoceptor-mediated increases in tension and phosphoinositide metabolism are enhanced in the aorta and mesenteric arteries from diabetic rats. The purpose of the present investigation was to determine whether contractile responses to sodium fluoride (NaF), which directly stimulates GTP-binding proteins (G-proteins), are also enhanced in diabetic arteries. These data suggest that there may be increased activation of the same signalling processes that mediate NA-stimulated vasoconstriction, perhaps contraction-associated G-proteins or the effecters coupled to these G-proteins, in response to NaF in mesenteric arteries from diabetic rats. This may also be responsible for the enhanced contractile responses of these arteries to alpha-1-adrenoceptor stimulation.

Key words: Diabetes mellitus; G-proteins; Mesenteric artery; Sodium fluoride; Vasoconstriction.

Reprints: K M Macleod, University of British Columbia, Faculty of Pharmaceutical Science, Vancouver, BC V6T 1Z3, Canada.

EFFECT OF INTRATESTICULAR INJECTION OF SODIUM FLUORIDE ON SPERMATOGENESIS

R L Sprando, T N Black, M J Ames, J I Rorie and T F X Collins
Beltsville, Maryland, USA

Abstract from Food and Chemical Toxicology 34 (4) 377-384 1996

The potential of sodium fluoride to affect spermatogenesis in the rat was assessed by intratesticular injection. Experimental rats' left testis was injected with sodium fluoride (50, 175 and 250 ppm) in vehicle (0.9% physiological saline); control testes were injected with vehicle. The right testis served as a non-injected control. Testicular tissues collected at and distal to the injection site and from the non-injected control testes were evaluated microscopically 24 hr and 1, 2 and 3 wk post-injection. Testicular tissues obtained at and distal to the injection site in all fluoride-injected groups resembled tissues collected from corresponding areas in the controls. Seminiferous tubule damage observed in both the vehicle-injected control testes and the fluoride-injected testes but not in the non-injected testes was attributed to injection trauma. Polymorphonuclear leucocyte infiltration was observed 24 hr post injection only at the injection site in the vehicle- and fluoride-injected groups. Leydig cells were unaffected. Leucocyte infiltration with seminiferous tubule damage was not considered to be a fluoride treatment-related effect because it was observed in both vehicle- and fluoride-injected testes. The results demonstrate that spermatogenesis in the rat is not adversely affected by direct exposure to fluoride at levels 200 times greater than those under normal conditions.

Key words: Sodium fluoride; Rats; Spermatogenesis.

Reprints: R L Sprando, US Food and Drug Administration, Center for Food Safety and Applied Nutrition, 8301 Muirkirk Road, Beltsville, Md 20708, USA.
ABSENCE OF DETRIMENTAL EFFECTS OF FLUORIDE EXPOSURE IN DIABETIC RATS
Indianapolis, Indiana, USA
Abstract from Archives of Oral Biology 41 (2) 191-203 1996
This study is part of a comprehensive programme to investigate fluoride toxicity and the hypothesis that fluoride ingested by 'medically compromised' animals will result in altered physiological function. Its objectives were to monitor fluoride retention, tissue fluoride concentrations and genetic variables in diabetic and control rats chronically exposed to fluoride, and to determine whether or not adverse effects occurred. Male, Zucker fatty diabetic rats and Zucker age-matched lean controls were fed a low-fluoride diet (< 1.2 parts/10^6 F^-) ad libitum and received 0, 5, 15 or 50 parts/10^6 fluoride in their drinking water for 3 or 6 months. Fluoride metabolic balance was determined for 4 days before the end of each study phase. Plasma and urine were analysed for biochemical markers of tissue function, and plasma, urine, faeces and tissues were analysed for fluoride. Bone marrow cells from animals killed after 6 months of treatment were examined for frequency of sister chromatid exchange, a marker of genetic damage. The diabetic rats consumed, excreted and retained significantly greater amounts of fluoride than the controls (p < 0.05). There were dose-related increases in fluoride excretion, retention and tissue concentrations in both classes of animals, which were significantly greater in the diabetic rats. In spite of greater amounts of fluoride in the tissues of diabetic animals, there was no evidence, under these experimental conditions, that any of the fluoride exposures tested caused measurable adverse effects on the physiological, biochemical or genetic variables that were monitored.
Key words: Animals; Diabetes; Fluoride; Rats.
Reprints: A J Dunipace, Indiana University, Oral Health Research Institute, Indianapolis, IN 46202, USA.

PHOTOPERIODIC ELEVATION OF TESTICULAR ZINC PROTECTS SEMINIFEROUS TUBULES AGAINST FLUORIDE TOXICITY IN THE BANK VOLE (CLETHRONOMYS GLAREOLUS)
A Krasowska and T Wlostowski
Bialystok, Poland
Abstract from Comparative Biochemistry and Physiology C: Comparative Pharmacology and Toxicology 113 (1) 81-84 1996
Recent work has shown that a high fluoride (F) intake in rodents leads to histopathologic changes in the germinal epithelium of testes and to zinc deficiency in the testis and several other organs. The purpose of the present study was to determine whether an elevation of testicular zinc concentration during fluoride exposure could protect the testes of bank vole from damage. The elevation of testicular zinc was achieved by exposing the bank voles to a long photoperiod (16 hr light/8 hr dark). The zinc concentration in the testes of bank voles kept under the long photoperiod was 38% higher than that in animals exposed to a moderate photoperiod (12 hr light/12 hr dark). Fluoride exposure (200 μg F/mL drinking water) during 4 months decreased additionally (p < 0.05) zinc concentration in the
Abstracts (Non-skeletal effects)  Fluoride 29 (3)

testes of bank voles kept under the moderate photoperiod. The same animals also exhibited histopathologic changes in the germinal epithelium. By contrast, these disturbances were not observed in animals maintained in the long photoperiod. This experiment suggests that an increase in testicular zinc due to a long photoperiod prevents seminiferous tubules from a damage induced by fluoride in bank voles. The protective effects of zinc (or a long photoperiod) did not appear to be related to a decrease in testicular fluoride accumulation or lipid peroxidation.

Key words: Bank vole; Fluoride; Germinal epithelium; Lipid peroxidation; Liver; Photoperiod; Testes; Zinc.
Reprints:A Krasowska, University of Warsaw Bialystok Branch, Institute of Biology, Swierkowa 20B, PL-15950 Bialystok, Poland.

EVALUATION OF MUTAGENIC AND CYTOTOXIC EFFECTS OF SODIUM FLUORIDE ON MAMMALIAN CELLS INFLUENCED BY AN ACID ENVIRONMENT
D Slamenova, K Ruppova, A Gabelova, and L Wsolova Bratislava, Slovakia

Abstract from Cell Biology and Toxicology 12 (1) 11-17 1996

The mutagenic activity of sodium fluoride at reduced pH was studied in the V79/HGPRT system. Statistical analysis of the results of mutagenicity testing suggests that, despite its high toxicity, sodium fluoride has no mutagenic effects at reduced pH on hamster V79 cells. Short-term treatment of cells with sodium fluoride at reduced pH inhibits growth activity of cells as well as synthesis of pulse-labeled nascent DNA and cumulative RNA synthesis and proteosynthesis. From the results of this study we suggest that an acid environment which supports formation of hydrogen fluoride increases toxic but not mutagenic potencies of sodium fluoride.

Key words: Cytotoxicity; Gene mutations; Macromolecular syntheses; Mammalian cells; Sodium fluoride; Treatment at reduced pH.
Reprints:D Slamenova, Slovakian Academy of Science, Cancer Research Institute, Spitalska 21, Bratislava 81232 Slovakia.

ENHANCEMENT OF ALUMINUM DIGESTIVE ABSORPTION BY FLUORIDE IN RATS
P Allain, F Gauchard and N Krari Angers, France

Abstract from Research Communications in Molecular Pathology and Pharmacology 91 (2) 225-231 1996

Aluminum, responsible of dialysis encephalopathy, is suspected to be involved in other neurological disorders such as Alzheimer disease. Absorption of aluminum from the digestive tract can be enhanced by the concommitant intake of substances such as citrate. We studied in rats and mice the interactions between fluoride and aluminum for their digestive absorption and showed that fluoride increased the levels of aluminum in plasma as much as citrate whereas aluminum decreased the absorption of fluoride. This results could be the consequence of the high affinity between aluminum and fluoride which form complexes able to increase the absorption of aluminum and to decrease the absorption of fluoride.

Key words: Aluminum fluoride interaction; Digestive absorption; Rats.
Reprints:P Allain, Laboratory of Pharmacology and Toxicology, 4 Rue Larrey, F-49033 Angers 01, France.
URINARY FLUORIDE EXCRETION IN CHILDREN LIVING AROUND AN ALUMINIUM SMELTER [French]
C Declercq, P Ponti, D Warembourg, V Tronet and J F Rousselle
La Madeleine, France

Abstract from Revue d'Epidemiologie et de Sante Publique 43 (5) 504-509 1995

Aluminium industry discharges fluoride into the atmosphere and several studies have shown a slight but significant contribution to the intake of fluoride by children living around aluminium smelters. A monitoring system was set up in 1991, just before a new aluminium smelter came into operation in Loon-Plage, on the North Sea coast, to study the evolution of the urinary fluoride excretion in children around the plant. Every year, 250 children under 14 are sampled in infant clinics, nursery schools and a secondary school. Urinary fluoride excretion was assessed by a potentiometric method on a spot morning urine sample and information on exposure factors was obtained by questionnaire. Urinary fluoride levels decreased with age ($r = -0.31$) and were higher in children drinking a local bottled water rich in fluoride (geometric mean in mg per gram of creatinine: 0.69 vs 0.52) or taking fluoride tablets (0.82 vs 0.52). The mean urinary fluoride excretion in children did not vary significantly between 1991, (geometric mean: 0.70 mg per gram of creatinine, 95% CI: [0.64-0.77]), 1992 (0.68 [0.62-0.75]) and 1993 (0.68 [0.61-0.76]), even after adjustment for potential confounding factors and despite a moderate increase in atmospheric fluoride levels.

Key words: Aluminium smelter; Children; Industrial pollution; Urinary fluoride.
Reprints: C Declercq, 4 Rue Jeanne Maillotte, F-59110 La Madeleine, France.

UMBILICAL CORD FLUORIDE SERUM LEVELS MAY NOT REFLECT FETAL FLUORIDE STATUS
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Jerusalem, Israel

Abstract from Journal of Perinatal Medicine 23 (4) 279-282 1995

Objective: To evaluate the reliability of fluoride levels in the umbilical cord as reflecting neonate fluoride status.

Design: Prospective study of fluoride levels of pregnant women at term and their neonates.

Setting: Delivery room and maternity unite of Hadassah Hospital Mount Scopus.

Patients: Fluoride serum levels were determined in the sera of 20 women with normal pregnancies at term, during delivery, in the corresponding mixed cord sera and neonatal sera at 24 hours after delivery.

Results: The mean maternal fluoride serum level was 0.0303 µg/mL (SD 9.015), mean cord fluoride serum level 0.0183 µg/mL (SD 0.012), and mean neonatal fluoride serum 0.0380 µg/mL (SD 0.016).

Conclusion: The significantly ($p < 0.001$) low mixed cord serum levels of fluoride as compared with neonatal and maternal serum levels may be explained by placental sequestration of fluoride. It is suggested that cord serum fluoride levels to not reflect fetal fluoride status.

Key words: Cord serum; Maternal serum; Neonate; Umbilical fluoride level.
Reprints: S Shimonovitz, Hadassah University Hospital, Department of Obstetrics and Gynecology, POB 24035, IL-91240 Jerusalem, Israel.
FLUORIDE CONTENT OF THE ENAMEL AND DENTINE OF HUMAN
PREMOLARS PRIOR TO AND FOLLOWING THE INTRODUCTION
OF FLUORIDATION IN NEW ZEALAND
T W Cutress, G E Coote, M Shu and E I F Pearce
Wellington, New Zealand
Abstract from Caries Research 30 (3) 204-212 1996

The fluoride content of the enamel and dentine of premolars was used as a deter-
minal of the availability of ingested fluoride in New Zealand prior to and following the
introduction of water fluoridation 40 years ago. Premolar teeth, which developed during
the periods (PRE and POST respectively) under study, were selected from teeth extracted
from 12 to 14-year-old children resident in different geographic areas in the country.
The fluoride content, determined by multiple proton microprobe analyses, of surface
enamel, deep enamel, and dentine, were for PRE teeth 440, 65 and 115, respectively.
For POST teeth the mean values were significantly (p <0.001) higher, by 69, 29 and
102% respectively. The relevance of the change in fluoride content was assessed by
comparison with published reports on the fluoride content of teeth developed in
communities exposed to low (< 0.5 ppm), optimal (1-2 ppm) and high (> 3 ppm)
naturally occurring fluoride levels in drinking water. The PRE teeth had a fluoride
content associated with a low fluoride exposure and POST teeth with optimal fluoride
exposure during tooth development. It was concluded that fluoride availability in New
Zealand teeth had increased over the past 30 years but this increase is compatible with
exposure of the community to optimal rather than excessive levels of ingested fluoride.
Key words: Dentine; Enamel; Fluoridation; Fluoride content; Microprobe analysis.
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FLUORIDE DISTRIBUTION IN HUMAN DENTAL CALCULUS OBTAINED
FROM DIFFERENT SITES ON THE TOOTH SURFACE
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We examined the site specificity of fluoride (F) distribution in human dental calculus.
Teeth with supra- and subgingival calculus were obtained from patients who resided in
non-fluoridated areas in Japan and China. Sequential layers of the dental calculus (30 µm
thick) were abraded by an abrasive micro-sampling technique and fluoride and phosphorus
in the powdered samples were analyzed. Fluoride concentrations were highest in the
outer, lowest in the middle and intermediate in the inner layers of dental calculus in
general. In the outermost layers fluoride concentrations were highest in calculus found
near the tooth cervix both in supra- and subgingival calculus. Fluoride concentrations
decreased markedly toward the apical region in subgingival calculus, while it did not
change toward the incisal or occlusal region in supragingival calculus. In the inner layers,
fluoride concentrations in both supra- and subgingival calculus were not affected by
position on the teeth. Fluoride concentrations in subgingival calculus near the apex were
lower than in supragingival calculus near the incisal or occlusal region. It was concluded
that the fluoride concentrations differ in different regions of dental calculus, probably due
to their different mechanisms of formation.
Key words: Dental calculus; Fluoride; Human teeth; Site difference.
Reprints: S Huang, Aichi Gakuin University, Department of Preventive Dentistry and Dental