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Analysis of Mass Averaged Tissue Doses in CAM, CAF, MAX, and FAX

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Symbols

$A_0, A_1, ...A_9$	Real constant coefficients for second order surface.
$D_{T,R}$	Mass averaged absorbed dose in tissue *T* due to radiation of type *R*, Gy or Gy/day.
$D(L, \mathbf{r}, \mathbf{\Omega})$	Spectral distribution of absorbed dose in terms of *L* associated with the ray emanating from the target point $\mathbf{r}$ in the direction of $\mathbf{\Omega}$, Gy or Gy/day.
$\bar{\bar{E}}$	Effective dose computed using equivalent dose, Sv or Sv/day.
E	Effective dose computed using dose equivalent, Sv or Sv/day.
$\tilde{E}$	Effective dose with error due to point distributions included, Sv or Sv/day.
E_{comp}	Computed effective dose using recommended point distributions for VCAM, VCAF, MAX, or FAX, Sv or Sv/day.
E_{error}	Effective dose error using recommended point distributions for VCAM, VCAF, MAX, or FAX, Sv or Sv/day.
$\varepsilon_{T,i}^{(j)}$	Percent difference of the mass averaged tissue dose equivalent computing using the ith point distribution of the jth group from the average group 1 dose for tissue *T*, %.
$\varepsilon_T^{(j)}$	Maximum percent difference (taken over 10 point distributions in a group) of the mass averaged tissue dose equivalent computing using the ith point distribution of the jth group from the average group 1 dose for tissue *T*, %.
ε_T	Error associated with the recommended set of point distributions for VCAM, VCAF, MAX, or FAX for tissue *T*, %.
$\tilde{\varepsilon}_T$	Error associated with the recommended set of point distributions for VCAM, VCAF, MAX, or FAX for tissue *T* divided by 100.
$\bar{H}_T$	Mass averaged equivalent dose for tissue *T*, Sv or Sv/day.
H_T	Mass averaged dose equivalent for tissue *T*, Sv or Sv/day.
$h(\mathbf{r}, \mathbf{\Omega})$	Dose equivalent associated with the ray emanating from the target point $\mathbf{r}$ in the direction of $\mathbf{\Omega}$, Sv or Sv/day.
$H_{T,i}^{(j)}$	Mass averaged tissue dose equivalent for tissue *T* computed using the ith point distribution from the jth group, Sv or Sv/day.
$H_T^{(1)}$	Average group 1 dose for tissue *T*, Sv or Sv/day.
L	Linear energy transfer, keV/μm.
M	Mass of a tissue, g.
$N_{\mathbf{r}}$	Number of tissue target points.
$N_{\mathbf{\Omega}}$	Number of unit direction vectors.
ρ	Volume density of a tissue, g/cm^3.
PD	Percent difference from the average tissue dose between two phantoms for a given effective dose tissue, %.
$Q(L)$	LET dependent quality factor.
T	Tissue type.
R	Radiation type.
$\mathbf{r}$	Tissue target point.
$\mathbf{r}_i$	Set of tissue target points.
w_T	Effective dose weighting factor for tissue *T*.

w_R	Radiation weighting factor for radiation *R*.
$\mathbf{\Omega}$	Unit direction vector.
$\mathbf{\Omega}_j$	Set of unit direction vectors.
V	Volume of a tissue, cm^3.
x, y, z	Cartesian coordinate variables, cm.

Abbreviations

BFO	Blood Forming Organs.
CAF	Computerized Anatomical Female.
CAM	Computerized Anatomical Man.
CAMERA	visualization and ray-tracing software for CAM and CAF.
CT	Computed Tomography.
ET	ExtraThoracic.
FAX	Female Adult voXel model.
GCR	Galactic Cosmic Rays.
HZETRN	High charge (Z) and Energy TRaNsport.
ICRP	International Commission on Radiological Protection.
LEO	Low Earth Orbit.
LET	Linear Energy Transfer.
MAX	Male Adult voXel model.
NCRP	National Council on Radiation Protection & measurements.
OLTARIS	On-Line Tool for the Assessment of Radiation In Space.
SPE	Solar Particle Event.

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Abstract

To estimate astronaut health risk due to space radiation, one must have the ability to calculate various exposure-related quantities that are averaged over specific organs and tissue types. Such calculations require computational models of the ambient space radiation environment, particle transport, nuclear and atomic physics, and the human body. While significant efforts have been made to verify, validate, and quantify the uncertainties associated with many of these models and tools, relatively little work has focused on the uncertainties associated with the representation and utilization of the human phantoms. These models are used to study common biological risks associated with space radiation exposure and ensure that current space operations meet existing guidelines. In this study, we first examine the anatomical properties of the Computerized Anatomical Man (CAM), Computerized Anatomical Female (CAF), Male Adult voXel (MAX), and Female Adult voXel (FAX) models by comparing the masses of various model tissues used to calculate effective dose to the reference values specified by the International Commission on Radiological Protection (ICRP). Since MAX and FAX have been developed specifically to meet the ICRP recommendations, their tissue masses are found to be in good agreement with the reference values. Major discrepancies are found between the CAM and CAF tissue masses and the ICRP reference data for almost all of the effective dose tissues. We next examine the distribution of target points used with the deterministic transport code HZETRN (High charge (Z) and Energy TRaNsport) to compute mass averaged exposure quantities. To our knowledge, only one set of point distributions has been published for CAM and CAF, and no reference point sets have been published for MAX and FAX. Hence, the question of how many points to use and how to distribute them has yet to be studied. A numerical algorithm is presented and used to generate multiple point distributions of varying fidelity for many of the effective dose tissues identified in CAM, CAF, MAX, and FAX. The point distributions are used to compute mass averaged dose equivalent values under both a galactic cosmic ray (GCR) and solar particle event (SPE) environment impinging isotropically on three spherical Aluminum shells with areal densities of 0.4 g/cm^2, 2.0 g/cm^2, and 10.0 g/cm^2. The dose equivalent values are examined to identify a recommended set of target points for each of the tissues and to further assess the differences between CAM, CAF, MAX, and FAX. It is concluded that the previously published CAM and CAF point distributions were significantly under-sampled and that the set of point distributions presented here should be adequate for future studies involving CAM, CAF, MAX, or FAX. It is also found that the errors associated with the mass and location of certain tissues in CAM and CAF have a significant impact on the mass averaged dose equivalent values, and it is concluded that MAX and FAX are more accurate than CAM and CAF for space radiation analyses.

1. Introduction

Mitigating the health risks of astronaut exposure to space radiation is a critical step toward satisfying the goals identified in NASA's 2006 Strategic Plan [NASA Strategic Plan 2006] and the Vision for Space Exploration [The Vision for Space Exploration 2004]. Since exposure guidelines are often expressed in terms of effective dose, mass averaged dose, or mass averaged dose equivalent, a significant need naturally arises for computational tools capable of estimating such quantities in human phantoms protected by various shielding structures. Several tools have been developed to meet this need, including models of the natural space environment, nuclear and atomic physics, particle transport, shielding, and the human body. Despite significant efforts toward verifying, validating, and quantifying the uncertainty associated with each of these models, relatively little work has been done to study the uncertainty associated with the representation and utilization of the human phantoms. These models are necessary to estimate the mass averaged tissue doses used to calculate effective dose and provide the means to estimate health risks such as carcinogenesis, degenerative tissue effects, and vascular diseases.

The CAM (Computerized Anatomical Man) [Billings et al. 1973] and CAF (Computerized Anatomical Female) [Yucker et al. 1990, 1992] human phantoms were developed in 1973 and 1992, respectively, and have a long history in space radiation research at NASA. These phantoms have been coupled to the deterministic radiation transport code HZETRN (High charge (Z) and Energy TRaNsport) [Wilson et al. 1991; Slaba et al. 2008] through an interpolation-based procedure capable of generating point values, mass averaged tissue values, and effective dose. The term "value" in this context refers to some exposure-related quantity such as particle fluence, dose, dose equivalent, or linear energy transfer (LET). In this paper, only dose equivalent is considered, and the terms dose and dose equivalent are used interchangeably.

In order to calculate the dose at a single point using the interpolation-based procedure mentioned above, ray tracing techniques are used to determine the amount of tissue and shielding material along each of a large number of rays covering the full 4π steradian, emanating from the specified target point and terminating at the exterior surface of the shield. The distribution of thicknesses generated by the ray tracing procedure is then analyzed, and HZETRN is used to generate a dose versus depth database encompassing the necessary material types and depths. A point dose is calculated by integrating over the dose values for each of the ray traced shield and target thicknesses. Note that the dose values for each of the ray traced shield and target thicknesses are computed by interpolating over the dose versus depth database. Mass averaged organ doses are computed by repeating this process for several target points within a given organ and averaging over the selected point doses.

Anderson et al. [2007] have provided one of the few uncertainty estimates for a portion of this process by examining spatial discretization in the interpolation databases and angular discretization in the ray distributions. It was found that 512 rays were sufficient for the lunar lander and habitat studied, and that for solar particle events (SPE), at least 20 approximately log-distributed spatial grid points were necessary to provide sufficient accuracy in the interpolation database. No human phantoms were included in the study, and therefore, a potentially large gap exists in the uncertainty estimate associated with the interpolation-based procedure described above. In particular, to the authors' knowledge, the fidelity of target point distributions used to calculate mass averaged tissue dose has never been studied and could have a significant impact on mass averaged dose estimates. Further, the CAM and CAF were developed to model the 50^{th} percentile U.S. Air Force male and female using extremely limited computational resources by modern standards. Since no published updates exist for either model, it is expected that significant differences could exist between these models and the anatomical properties of the International Commission on Radiological Protection (ICRP) reference male and female [ICRP 2001].

In this paper, we make comparisons between CAM, CAF, MAX (Male Adult voXel model) [Kramer et al. 2003], and FAX (Female Adult voXel model) [Kramer et al. 2004] human phantoms. The CAM and CAF are mathematical geometric models of the human body composed of more than one thousand three dimensional geometric solids. Each solid piece of the CAM and CAF is defined by a number of mathematical surfaces that intersect to form the object's boundaries and create a topologically closed volume. An example of such an object is shown in Figure 1. Each object defines the physical extent of a small region of the body that, by definition, is comprised of a single type of body tissue. In general, adjacent objects share common boundary surfaces so that there are no gaps between parts, and the body is a contiguous solid.

Alternatively, the MAX and FAX models have been constructed using a voxel representation of the body's tissues. The term "voxel" is a blend of the words "volumetric" and "element". Voxels are typically used as a convenient method of specifying data values within a regularly spaced, three dimensional grid. They are a three dimensional analog of pixels (picture elements) used to store digital image data in two dimensions. The MAX and FAX models used in these analyses are composed of arrays of cubic voxels, with each voxel measuring 3.6 mm on a side. Similar to the geometric solids that comprise the CAM and CAF, each MAX and FAX voxel has a single tissue type associated with it as shown in Figure 2.

To allow direct comparisons of the two very different types of models (geometry based and voxel based) using identical tools, algorithms, and analysis software, a computational procedure was developed to convert the CAM and CAF models from their geometric solid representation into a voxel representation identical to that used in MAX and FAX. Figure 3 shows the CAM in its original form as a geometric model (A), the CAM after its conversion into a voxel based model (B), and the MAX (C).

Volumetric and mass comparisons for the effective dose tissues are made between the CAM, MAX, and ICRP reference male [ICRP 2001] as well as the CAF, FAX, and ICRP reference female [ICRP

2001]. This examination provides insight into the anatomical accuracy of CAM and CAF and reveals significant deviations from published quantities for the ICRP reference humans. Alternatively, since the MAX and FAX were developed specifically to meet the ICRP recommendations, these models are found to be in good agreement with the reference anatomical data of the ICRP.

We next introduce a numerical method for generating tissue target point distributions in a voxel model. This target point distribution method is used to obtain multiple point distributions of varying fidelity and character in many of the ICRP effective dose tissues identified in the MAX, FAX, CAM, and CAF models. The only published set of target point distributions for CAM and CAF are also included in this comparison. Mass averaged tissue doses are computed using each of the target point distributions under a variety of shielding conditions and space radiation environments.

2. Comparison of Human Phantoms

The CAM and CAF are mathematical geometric models based on second order (quadric) surfaces of the form

$$A_0 + A_1x + A_2y + A_3z + A_4x^2 + A_5y^2 + A_6z^2 + A_7xy + A_8yz + A_9xz = 0 \qquad (1)$$

where A_0, A_1,…A_9 are real constant coefficients and x, y, z are the usual Cartesian coordinate variables. Roughly 1100 unique quadric surfaces are used to create some 2450 solid objects. An integer value specifying a particular tissue type is assigned to each object, and multiple objects are combined to form geometrically complex organs. The computer program CAMERA [Billings et al. 1973; Yucker et al. 1990, 1992] was developed to enable various geometric analyses of the CAM and CAF. Most notably, it will ray trace any number of target points supplied in an input list, ray trace points created by an internal random target point generator, and identify the specific tissue type associated with each target point. It should be noted that many target point distribution sets have been developed and used for CAM and CAF, but to our knowledge, only one set of point distributions has ever been published. Further, no work has been found that addresses the uncertainty associated with any of these target point distributions.

The MAX and FAX phantoms are voxel (tomographic) models based on CT (Computed Tomography) images of human bodies. The MAX was developed using a combination of the voxel models VOXELMAN, MANTISSUE3-6, and VOXTISS8 [Kramer et al. 2003]. The FAX model was developed using CT images of a 37 year old female for the neck and torso, CT images of a 62 year old female for the legs and feet, and scaled versions of the MAX for the head and arms. More detailed descriptions of these models, with references, can be found in Kramer et al. [2003, 2004]. The MAX and FAX are comprised of 478 and 453 voxel layers, respectively, with each layer being 158 voxels (left to right) by 74 voxels (back to front). It should also be noted that Kramer et al. [2006] have provided updated versions of both models, but those results were not available when this work was performed. The versions of MAX and FAX used here are those published by Kramer et al. in 2003 and 2004.

In order to compare the characteristically different sets of models, the CAMERA code was used to create voxel versions of the CAM and CAF, hereafter referred to as VCAM and VCAF. A uniform, cubic grid of target points with 3.6 mm spacing was generated, and CAMERA was used to determine the tissue type associated with each target point. The resulting array of target points and material types was then written in binary form with the same binary format as the MAX and FAX data. For each effective dose tissue in MAX, FAX, VCAM, and VCAF, search algorithms were used to count the number of tissue voxels. The volume of each tissue was obtained by summing the volumes of the voxels. Since each tissue is assumed to be homogeneous in the models, the mass of each organ was obtained by multiplying the total volume by the appropriate density. The densities used for VCAM and VCAF were those given by Billings et al. [1973] and Yucker et al. [1990, 1992] for CAM and CAF, respectively. The densities used for MAX and FAX were those given by Kramer et al. [2003, 2004]. Most tissue masses in MAX and FAX have already been computed by Kramer et al. [2003, 2004], but they have been included here to verify our methodology of isolating individual tissues in the voxel models. Table 1 shows the density (ρ in units of g/cm^3), mass (M in units of g), and volume (V in units of cm^3), comparisons for VCAM, MAX, and the ICRP reference male, and Table 2 gives the density, mass, and volume comparisons for VCAF, FAX, and the ICRP reference female for the effective dose tissues. The symbol "-" in the density, mass, or volume columns of a given tissue and model indicates that this tissue type was not represented in the model.

Comparisons for the lymphatic nodes, extrathoracic (ET) region, gall bladder, salivary glands, and oral mucosa are not given in the tables because they are not represented in any of the models and contribute very little to effective dose. Bone surface was also left out because mass and volume comparisons are not appropriate, and surface area approximations are difficult in voxel models. Along with the tissues mentioned above, it is clear from Tables 1 and 2 that MAX and FAX are missing the BFO (Blood Forming Organs) and male breasts. The latest versions of MAX and FAX include these tissues as well as the lymphatic nodes, ET, gall bladder, salivary glands, and oral mucosa. These improved versions were not available in time for this report but will be analyzed in a future study. VCAM and VCAF do not have salivary glands, skin, adrenals, a thymus, a male prostate, or male breasts. The colon and small intestines are grouped together as a single organ in VCAM and VCAF, so their masses cannot be computed separately. The VCAM intestines have a volume of 6020.11 cm^3, a mass of 2715.07 g, and a density of 0.451 g/cm^3. The VCAF intestines have a volume of 4897.48 cm^3, a mass of 2208.76 g, and a density of 0.451 g/cm^3. The absence of specific tissues in the CAM and CAF has been verified by existing documentation [Billings et al. 1973; Yucker et al. 1990, 1992] and was determined not to be a result of insufficient fidelity in the voxel conversion process. No updates are expected for CAM and CAF, so these tissues are likely to remain absent.

MAX and FAX compare extremely well to the ICRP reference values for all of the tissues given in Tables 1 and 2, except for the heart and skin. The skin representation has been improved in MAX06 and FAX06 [Kramer et al. 2006] by reducing the voxel size from 3.6 mm to 1.2 mm, and the heart masses have also improved. Conversely, VCAM and VCAF compare poorly to the ICRP reference data values. In some cases, the models and reference data differ by more than a factor of two. Note that the esophagus has been given a mass and density of zero because it is modeled as a cylindrical internal void with zero density in CAM and CAF. If the common density of 1.058 g/cm^3 were assumed, the mass of the esophagus would still be significantly underestimated in both CAM and CAF. It is concluded that major discrepancies exist between CAM and CAF and the ICRP reference data for almost all of the effective dose tissues.

3. Numerical Target Point Distribution Method

Only a single set of published tissue target point distributions have been found in the literature for CAM [Billings et al. 1973] and CAF [Yucker et al. 1992]. In these distributions, single points were used to represent the CAM testes, heart, and thyroid, while a random target point generator was used to distribute points in the BFO and skin. In the previously published CAF target point distributions, single points were used to represent the esophagus, stomach, heart, liver, pancreas, colon, kidneys, bladder, ovaries, and uterus, while a random point generator was used to distribute target points in the thyroid, breasts, lungs, BFO, and skin. Note that skin is not explicitly modeled in the CAM and CAF; these points were placed at a depth of 0.1 mm along the inward normal direction of various external surfaces. Undocumented target points have been added to and removed from this initial set over the years, but these points were either manually selected or chosen with a pseudorandom point generator. In this section, we examine the interpolation based procedure for calculating effective dose and introduce a new numerical method for distributing target points in many of the effective dose tissues.

The effective dose, $\bar{E}$, is defined by the ICRP [ICRP 1990, 2007] as

$$\bar{E} = \sum_T w_T \bar{H}_T \,, \tag{2}$$

where w_T is the tissue weighting factor, $\bar{H}_T$ is the mass averaged equivalent dose for tissue *T*, and the summation is taken over all relevant tissues. Equivalent dose is defined as [ICRP 2007]

$$\bar{H}_T = \sum_R w_R D_{T,R} \,, \tag{3}$$

where w_R is the radiation weighting factor for radiation *R*, and $D_{T,R}$ is the mass averaged absorbed dose in tissue *T* due to radiation of type *R*. The National Council on Radiation Protection and Measurements

(NCRP) reports 132, 142, and 153 [NCRP 2000, 2002, 2006] recommend the use of mass averaged tissue dose equivalent instead of equivalent dose to calculate effective dose in low Earth orbit (LEO) space environments. Dose equivalent is defined in terms of linear energy transfer (LET) dependent quality factors as

$$h(\mathbf{r},\mathbf{\Omega}) = \int_L Q(L)D(L,\mathbf{r},\mathbf{\Omega})\,dL\,, \tag{4}$$

where L is LET, $D(L,\mathbf{r},\mathbf{\Omega})$ is the spectral distribution of dose in terms of L associated with the ray emanating from the target point $\mathbf{r}$ in the direction of $\mathbf{\Omega}$, and $Q(L)$ is the LET dependent quality factor defined by ICRP 60 [ICRP 1990] as

$$Q(L) = \begin{cases} 1 & \text{if} \quad L < 10 \\ 0.32L - 2.2 & \text{if} \quad 10 \le L < 100 \\ 300/\sqrt{L} & \text{if} \quad L > 100 \end{cases}, \tag{5}$$

where L is in units of $keV/\mu m$.

In this paper, effective dose is computed using dose equivalent according to

$$E = \sum_T w_T H_T\,, \tag{6}$$

where w_T are the same tissue weighting factors used in equation (2), and H_T is the mass averaged dose equivalent for tissue T. For a given tissue with volume V, the mass averaged dose equivalent is

$$H_T = \frac{1}{V}\frac{1}{4\pi}\int_V \int_\Omega h(\mathbf{r},\mathbf{\Omega})\,d\Omega\,dV\,, \tag{7}$$

where $h(\mathbf{r},\mathbf{\Omega})$ is the dose equivalent (scalar quantity) associated with the ray emanating from the target point $\mathbf{r}$ in the direction of $\mathbf{\Omega}$. For a set of points $\mathbf{r}_i$ within the volume V and a set of direction vectors $\mathbf{\Omega}_j$, the integrals in equation (7) can be approximated by

$$H_T \approx \frac{1}{N_\mathbf{r}}\frac{1}{N_\mathbf{\Omega}}\sum_{i=1}^{N_\mathbf{r}}\sum_{j=1}^{N_\mathbf{\Omega}} h(\mathbf{r}_i,\mathbf{\Omega}_j)\,, \tag{8}$$

where $N_\mathbf{r}$ are the number of discrete points within V, and $N_\mathbf{\Omega}$ are the number of discrete angles. The approximation in equation (8) is a simple discretization of the integrals in equation (7), but it is based on several assumptions. First, the solid angles subtended by each $\mathbf{\Omega}_j$ must be approximately equal, disjoint, and cover the unit sphere. Similarly, the set of target points, $\mathbf{r}_i$, must be evenly distributed throughout the volume V so that the small volumes accounted for by each point are approximately equal, disjoint, and extend throughout V. Finally, one must have enough rays and target points so that the radiation field within any element of volume and solid angle is nearly uniform.

In this report, we focus on the distribution of target points within the effective dose tissues and use the 968 ray distribution used by Anderson et al. [2007]. The distribution is depicted in Figure 4; each angle can be visualized as the set of rays emanating from the center of the sphere and exiting through the vertices at the corners of the surface elements.

The *distmesh3d* MATLAB program [Persson et al. 2004] was originally developed to generate a tetrahedral mesh for any volume with a boundary defined by a signed distance function. The signed

distance function gives the distance from any point in space to the nearest boundary of the volume; the sign is negative for points inside the volume and positive for points outside the volume. Computing the values of a discrete signed distance function for a given tissue in a voxel model is relatively simple. Voxels of the desired tissue type were first separated from voxels that were not of the desired tissue type, and the voxels of the desired type were then separated into boundary and interior voxels. Boundary voxels were specified as having at least one shared face with an exterior voxel, and interior voxels were specified as having no shared faces with an exterior voxel. Finally, the signed distance was calculated at the center of each exterior and interior voxel, and points in the center of the boundary voxels were assigned the constant distance value of negative 1.8 mm. The array of discrete distances was then stored and interpolated on to generate a continuous signed distance function. An illustration of the boundary, interior, and exterior voxels in a slice of the FAX heart is given in Figure 5.

The *distmesh3d* program is initialized with a seed number that specifies a pseudorandom distribution of points in and around the volume of interest. An iterative procedure is used to create, destroy, and reposition the points within and on the surface of the volume to achieve some user specified grid spacing. Boundary or surface nodes are separated from interior nodes as a post processing step. For this application, the program was modified to ensure that each tetrahedron was nearly regular and had approximately the same volume, criteria that were established by specifying a single spacing parameter, h. The spacing parameter represented the desired distance between any two nodes on a tetrahedron and was found to be inversely proportional to the number of target points generated in the tissue. It is important to note that the quality of the *distmesh3d* results is not dependent on the initialization process mentioned above. The code requires some initial distribution, and we have chosen a pseudorandom approach to reduce any initialization bias. Further, the only other documented target point distribution method [Billings et al. 1973; Yucker et al. 1990, 1992] for this application relies entirely on pseudorandom point selection (no conditioning algorithm is applied to adjust the point locations), and so a pseudorandom initialization approach allows for more informative comparisons to be made.

For the MAX and FAX, the modified *distmesh3d* program was used to distribute target points in the colon, lungs, stomach, female breasts, gonads, bladder wall, liver, thyroid, brain, skin, adrenals, heart, kidneys, pancreas, small intestine, spleen, thymus, prostate, and uterus. For the VCAM and VCAF, the modified *distmesh3d* program was used to distribute target points in the lungs, stomach, female breasts, gonads, bladder wall, liver, thyroid, brain, heart, kidneys, pancreas, skin, spleen, and uterus. The colon and small intestine are identified in CAM and CAF simply as the intestines, and so these tissues were meshed as one.

It was noted above that a post processing step was added to *distmesh3d* to separate interior and boundary nodes. Interior nodes were used to represent all of the tissues meshed in MAX, FAX, VCAM, and VCAF except for the bladder wall and skin; further modifications were made to distribute target points in these tissues. The bladder was isolated in each of the models and was filled in with bladder voxels. The resulting mass of bladder was meshed, and the boundary nodes were kept. This ensured that all target points would lie near the bladder wall and not in the bladder interior. A similar approach was used for the skin point distribution with an additional post processing step of shifting the nodes to a precise depth of 0.1 mm under the surface of the skin, as recommended by the ICRP [ICRP 2007]. The CAM and CAF do not have skin, and so every voxel in VCAM and VCAF was replaced with a common tissue type to allow a full body mesh. The boundary nodes were kept and then shifted to the 0.1 mm skin depth.

It was initially hoped that *distmesh3d* could be used to distribute target points in all of the effective dose tissues given in Tables 1 and 2; however, applying it to certain tissues revealed a weakness in the algorithm that could not be resolved. For highly segmented or non contiguous volumes, the signed distance function is not smooth, and *distmesh3d* produces malformed point distributions that do not accurately represent the tissue volumes. As a result, target points were manually selected in these tissues to enable the most complete and balanced effective dose comparison between the models.

In both sets of models, the muscle, bone, and esophagus tissues could not be meshed, and in the VCAM and VCAF, the BFO tissues could not be meshed. Since the esophagus in these models resembles a long, right circular cylinder, target points were manually placed along the primary axis of the tissue. Two different techniques were used for the muscle in MAX and FAX and the muscle in VCAM and VCAF. Muscle tissues in MAX and FAX were first segmented into the following regions: head and neck, left arm, right arm, upper torso, mid torso, lower torso, upper legs, and lower legs. The number of muscle voxels in each region was then used to provide guidance on the number of target points to create. Conversely, muscle tissue in CAM and CAF appears to have been used to fill empty regions throughout the body and so

segmentation was difficult. As a result, we chose the 50 muscle target points currently used by OLTARIS (On-Line Tool for the Assessment of Radiation In Space) [OLTARIS, 2008].

A very similar approach was taken to select target points in the bone. In MAX and FAX, bone tissues are already segmented into left and right arms, left and right legs, skull, mandible, pelvis, ribs, and spine; approximately 20 target points were selected in each of these regions. Since BFO was not identified in this version of MAX and FAX, but has a high effective dose weighting factor, BFO target points were taken to be the same as the bone points. For CAM and CAF, we chose the 50 bone points and 50 BFO points used by OLTARIS [OLTARIS, 2008].

The adrenals and thymus are not identified in CAM and CAF, but target points were manually selected with guidance from the MAX and FAX models to represent these tissues. Salivary glands are not identified in any of the models, but, because it has a weighting factor of 0.01, 12 target points were placed in each model to represent this tissue. It should be noted that the motivation behind manually placing these points was to provide the most complete and balanced effective dose comparison between the models.

4. Mass Averaged Tissue Dose Error Analysis

The *distmesh3d* software is initialized by specifying a spacing parameter h and a seed number, both of which were explained in the previous section. Seven target point groups were created by adjusting the value of the spacing parameter, and within each group, ten different point distributions were generated by changing the initial seed number. A group is defined here as a set of point distributions with each distribution having approximately the same number of points. For MAX, FAX, VCAM, and VCAF, and for all of the tissues except skin, group one contained point distributions with 500±50 points, group two contained point distributions with 250±25 points, group three contained point distributions with 100±10 points, group four contained point distributions with 50±5 points, group five contained point distributions with 30±4 points, group six contained point distributions with 15±3 points, and group seven contained point distributions with 7±2 points. For the MAX, FAX, VCAM, and VCAF skin, the distribution sizes in the various groups were increased to 8000±800 points, 6000±600 points, 4000±400 points, 2000±200 points, 1000±100 points, 500±50 points, and 250±25 points. Tolerances in each group were used to account for variability in the point distributions that results from using different seed numbers.

Each target point distribution was analyzed by computing mass averaged doses according to equation (8). Single point distributions have also been published for the CAF bladder, breasts, heart, kidneys, liver, lungs, ovaries, pancreas, stomach, thyroid, and uterus [Yucker 1992], as well as the CAM heart, testes, and thyroid [Billings 1973]. Mass averaged doses were computed using these distributions as well. Average group doses were calculated by taking the ten distributions in a given group and averaging over the doses computed with each distribution. The group with the largest number of points will be referred to as group 1 and used in later analysis.

We considered separately the 1977 solar minimum GCR spectrum [O'Neill 2006] and August 1972 King SPE spectrum [King 1974] impinging isotropically on the human phantoms shielded by a spherical Aluminum shell and calculated the mass averaged tissue dose equivalent according to equation (8). Three different shell areal densities of 0.4 g/cm^2, 2.0 g/cm^2, and 10.0 g/cm^2 of Aluminum were chosen to represent typical values for a space suit, thinly shielded locations in a space vehicle, and thicker shields, respectively. Figures 6-79 give the results from this analysis. The data marked FAX, MAX, VCAF, or VCAM dose were computed using point distributions generated in the FAX, MAX, VCAF, or VCAM, respectively. The symbols with lines labeled as average group dose were obtained by averaging over the individual groups as described above. The data points marked VCAF or VCAM documentation dose were obtained using the previously published target point distributions described above. In certain plots, the results for the 2.0 g/cm^2 or 10.0 g/cm^2 Aluminum shells have been left off due to data overlap.

It is apparent that, for many of the organs analyzed, the trend lines continue to increase with the number of tissue points instead of rapidly approaching an asymptotic limit. This is caused by a systematic error associated with the *distmesh3d* point distribution method. As more mesh points are added (resulting in a smaller node spacing), the distance between the tissue boundary and the mesh boundary decreases. Thus, the shielding provided by the body to the mesh points decreases. Therefore, the average group dose continues to rise slightly as more target points are added. It is also clear that this trend is amplified in the SPE environment. For SPE environments, the dose declines rapidly as a function of depth over the first 10-20 g/cm^2 of shielding and tissue. For GCR environments, the dose declines very slowly even over the first

few g/cm^2 of shielding. Hence, small variations in the total shield-tissue thickness can dramatically change the interpolated dose for SPE environments, while having only a small effect in GCR environments. For almost all of the tissues studied, this systematic error is reduced by using a larger number of target points. However, the male and female brains, CAM and CAF intestines, and CAM and CAF hearts appear to have non-negligible systematic errors even when more than 250 points are used. These errors are most noticeable for the 0.4 g/cm^2 Aluminum shell in the SPE environment and are much less apparent in the thicker shields and GCR environment cases. It should also be noted that the vertical axis of these plots has been adjusted to amplify the systematic error, and even in the 0.4 g/cm^2 Aluminum shell in the SPE environment case, the differences between the 250 point group and 500 point group are bounded by 5%.

The systematic error described above is the dominant source of error for most of the tissues in Figures 6-79; however, the statistical error, or data-spread within the individual groups is also important. This error is caused by differences between target point distributions generated with different random number seeds. Large statistical errors within a particular group of target points indicate that they do not accurately sample the tissue volume, and more points should be used.

With that said, all of the previously published target point distributions generated for CAM and CAF lie in the regions of highest statistical error. While these point distributions have been modified over the past three decades, it is now common to use roughly 10-50 points per organ, generated either randomly or manually. Given that this point distribution method was initialized with a random distribution of points and was unable to sufficiently reduce the statistical error to acceptable levels if only 10-50 points are used, it must be concluded that large statistical errors are likely to occur if purely random methods are used. Furthermore, manually placed points are unlikely to be placed uniformly and could therefore introduce a large bias or systematic error. In all of the figures, the statistical error is reduced to an acceptable level by adding a sufficient number of target points. It is concluded that the most accurate point distributions that can be chosen at this time are those we have designated as group 1 (500±50 points in each non-skin distribution, 8000±800 in each skin distribution) and verifies the applicability of our point distribution method.

If one now examines Figures 6-79 and compares the results across body phantom models instead of comparing the characteristics of the individual target point distributions, it is obvious that large differences exist between FAX and VCAF as well as MAX and VCAM. Reasonable agreement is achieved between the models only for the female heart, female stomach, and male gonads. Errors routinely exceed 15% for the remaining tissues with almost a full order of magnitude difference between the VCAM and MAX thyroid doses behind 0.4 g/cm^2 of Aluminum in the SPE environment (see Figure 61). These large differences were investigated and it was found that the MAX thyroid has at least 1.44 cm of other body tissues shielding it, while the VCAM has a large portion of the thyroid directly exposed to the environment with no other tissue shielding it. Since the CAM and CAF have no skin, the thyroid actually appears as an external region in both of these models. Given the large discrepancies between the mass and volume comparisons given in Tables 1 and 2, these differences are to be expected and reiterate the deficiencies of CAM and CAF.

Recommended sets of target points to be used for future studies with VCAM, VCAF, MAX, or FAX are given in Appendices A-D, respectively. Since CAM and CAF are still widely used in radiation analyses, we have verified that, except for the skin points, all VCAM target points can be used in CAM and all VCAF target points can be used in CAF. Due to the voxel conversion process, the external body boundaries of the VCAM and VCAF differ slightly from the original boundaries of the CAM and CAF. Hence, skin target points shifted to a precise depth of 0.1 mm in VCAM and VCAF voxels will likely not be at the correct depth in CAM and CAF. We have shifted the VCAM and VCAF skin points to the required distance inside the CAM and CAF boundaries, and these target points are given in Appendices E and F, respectively. It should be noted that the coordinate system for all of the models has its origin placed at the top of the head with the positive x axis pointing in the direction the phantom is facing, the positive y axis pointing to the phantom's right, and the positive z axis pointing down. Note that the data has been arranged in a two column format. The number of tissue target points used in these distributions is summarized for VCAM and VCAF in Table 3 and for MAX and FAX in Table 4. The symbol "-" is used to indicate the absence of a gender specific tissue.

We have selected the smallest target point distribution in the smallest group that has a within-group error that is less than 15% for all three Aluminum shield depths in both environments. The terms and error metrics used in defining this selection criterion are defined below, but to be clear, the 15% error tolerance only includes error due to the target point distribution. It does not include errors due to the

modeling of the space radiation environment, particle transport, dose versus depth database interpolation, nuclear physics, or human phantoms.

The size of a point distribution is simply the number of points in the distribution, and the size of a group is the average number of target points used in each of the distributions in the group. Below is a summary of the remaining terms and error metrics used in this selection criterion. Consider the average group 1 dose for tissue *T* given by

$$H_T^{(1)} = \frac{1}{10}\sum_{i=1}^{10} H_{T,i}^{(1)}\,, \tag{9}$$

where $H_{T,i}^{(j)}$ is the mass averaged tissue dose equivalent for tissue *T* computed using the i^{th} point distribution from the j^{th} group. Recall from above that there are 10 target point distributions in each of the 7 groups, so $i:1\rightarrow 10$ and $j:1\rightarrow 7$. The group 1 dose is an important reference value because it has been shown that all of the group 1 point distributions are highly accurate with very little systematic and statistical error. The percent difference of $H_{T,i}^{(j)}$ from $H_T^{(1)}$ is

$$\varepsilon_{T,i}^{(j)} = 100\frac{\left|H_T^{(1)} - H_{T,i}^{(j)}\right|}{H_T^{(1)}}\,, \tag{10}$$

and can be computed for each of the 10 distributions in each of the 7 groups so that, for a given group, the group error can be taken as the maximum of these percent differences

$$\varepsilon_T^{(j)} = \max_i \varepsilon_{T,i}^{(j)}\,. \tag{11}$$

The selection criterion can now be reworded in the following way: for each effective dose tissue, select the smallest point distribution in the smallest group, *j*, satisfying $\varepsilon_T^{(j)} < 15\,\%$ for all three Aluminum shield depths in both environments. The mass averaged tissue dose equivalent results and the errors generated by these point distributions are given in Tables 5-12 along with the 2007 ICRP effective dose weighting factor of each tissue [ICRP 2007] and the number of points used. For those effective dose tissues to which *distmesh3d* could not be applied, only the manually generated point distribution exists, and the error is taken to be the average of the available errors over those tissues that have error estimates. Also, note that the 2007 ICRP recommendations specify that a 0.12 weighting factor be divided evenly among the remainder tissues. Since the ET, gall bladder, oral mucosa, and lymphatic nodes were not used in this study, a common weighting factor of 0.013333 = 0.12/9 was used for the nine remainder tissues that were used in this study.

5. Effective Dose Comparisons

As a final comparison, we use the mass averaged dose equivalent values and error estimates given in Tables 5-12 to estimate the error associated with using these point distributions to compute effective dose. Using the errors computed in the previous section, equation (6) can now expressed as

$$\tilde{E} = \sum_T w_T H_T (1 \pm \tilde{\varepsilon}_T)\,, \tag{12}$$

where $\tilde{\varepsilon}_T = \varepsilon_T\,/100$ is the error identified in the previous section. It can be easily shown that

$$\left|\tilde{E} - E_{comp}\right| \le E_{error}\,, \tag{13}$$

where the computed effective dose is

$$E_{comp} = \sum_T w_T H_T \ , \tag{14}$$

and the error term is

$$E_{error} = \sum_T w_T H_T \tilde{\varepsilon}_T \ . \tag{15}$$

The values of E_{comp} and E_{error} are given in Tables 13 and 14 for all four phantoms in all three Aluminum shield thicknesses and both environments. As expected, significant differences exist between the CAM and MAX as well as CAF and FAX. The sources of these differences can be found by examining the dose estimates for individual tissues found in Tables 5-12. These differences are summarized Tables 15 and 16 by considering the percentage difference from the average tissue dose between two phantoms for each of the effective dose tissues

$$PD = 100 \frac{\left| H_T^A - H_T^B \right|}{0.5\left(H_T^A + H_T^B \right)}, \tag{16}$$

where *T* is the tissue type, *A* refers to FAX or MAX, and *B* refers to VCAF or VCAM, respectively. Table 15 shows that the differences exceed 50% for the male adrenals, breasts, muscle, esophagus, pancreas, prostate, thymus, and thyroid. Table 16 shows that differences exceed 50% for the female adrenals, muscle, esophagus, pancreas, thyroid, and uterus. Recall that the adrenals, prostate and thymus are not identified in the CAM or CAF, so these differences are likely due to poor point placement. The differences in the thyroid have already been determined to be caused by a poor representation in the CAM and CAF. The male breasts are not identified in either model, and so the large differences are most likely caused by target point placement. The differences in the esophagus and muscle could be caused by both point selection and model differences since these tissues are included in both models. Differences in the pancreas and uterus are caused entirely by model differences, since the point distributions have been determined to satisfy the accuracy requirement defined above.

6. Segmentation of BFO and Muscle in MAX and FAX

Recall that the muscle and BFO tissues in MAX and FAX were segmented into various regions. This segmentation provides the ability to compute mass averaged doses in each region and use mass fractions as weighting factors to compute the total muscle or BFO dose. The non-gender specific mass fraction weighting factors used for BFO were taken from ICRP 70 [ICRP 1995] and are given in Table 17. The mass fraction weighting factors for muscle were found by counting the number of muscle voxels in each region and dividing by the total number of muscle voxels in the body. The muscle weighting factors for MAX and FAX are given in Table 18.

The effect of using these weighting factors instead of a pure average, as was shown in Tables 5-12, is shown in Tables 19-26. It appears that using the weighted average tends to reduce the calculated dose. The reduction is significant enough to have a non-negligible impact on effective dose as well. The effective dose values calculated in MAX and FAX using the segmented muscle and BFO are given in Tables 27 and 28.

7. Conclusions

The CAM and CAF human phantoms were converted into a voxel representation to enable detailed comparisons to the MAX and FAX models and the ICRP reference data. Mass and volume comparisons reveal significant differences between the two sets of models and show that CAM and CAF compare poorly to the ICRP recommended values. Mass differences exceed 30% in the CAM BFO, stomach, bladder, esophagus, thyroid, heart, kidneys, muscle, pancreas, and spleen. Similarly, mass differences exceed 30% in the CAF BFO, bladder, esophagus, thyroid, heart, kidneys, muscle, pancreas,

spleen, uterus, and ovaries. These CAM and CAF tissues account for approximately 40% of the effective dose weights. These comparisons have also revealed deficiencies in the MAX and FAX models, but it was noted that Kramer et al. have resolved these issues in recent versions of MAX and FAX [Kramer et al. 2006]. It is concluded that MAX and FAX provide a more accurate representation of the human body than CAM and CAF for analyses attempting to conform to ICRP recommendations.

A computational procedure for generating point distributions in many of the effective dose tissues, based on the *distmesh3d* algorithm, was introduced and tested. Approximately 70 point distributions were generated in most of these tissues, and mass averaged tissue dose equivalents were calculated in various shielding conditions using both an SPE and a GCR environment. Results indicated that statistical and systematic errors were present, but in every case the error was reduced by using a sufficient number of points. A selection criterion was developed to identify reasonably accurate point distributions, and these point distributions, along with their error estimates, were used to compute whole body effective doses. Large differences in the effective dose estimates were found between the models. For the SPE environment, effective dose differences ranged from 33%-60% for the male and 13%-27% for the female depending on the shield thickness. For the GCR environment, effective dose differed by 4%-13% for the male phantoms and 2%-3% for the female phantoms, depending on shield thickness. If the segmented BFO and muscle doses are used in MAX and FAX, these differences increase to 37%-65% for the male, 17%-34% for the female in the SPE environment. In the GCR environment, the differences are 5%-7% for the male phantoms, and 2%-3% for the female phantoms.

Future work will focus on developing a point distribution method that can accommodate more complex structures such as the BFO, bone surface, and muscle. It has also been shown that segmentation of these tissues has a large impact on mass averaged dose equivalent, and due to the high effective dose weighting factor of BFO, has a non-negligible impact on effective dose. Therefore, when a viable point distribution method is developed for these tissues, the impact of tissue segmentation should be studied in detail. This type of study should also be repeated, using both isotropic and anisotropic low earth orbit environments, for more complex and realistic shielding distributions such as those inside the International Space Station and the Crew Exploration Vehicle.

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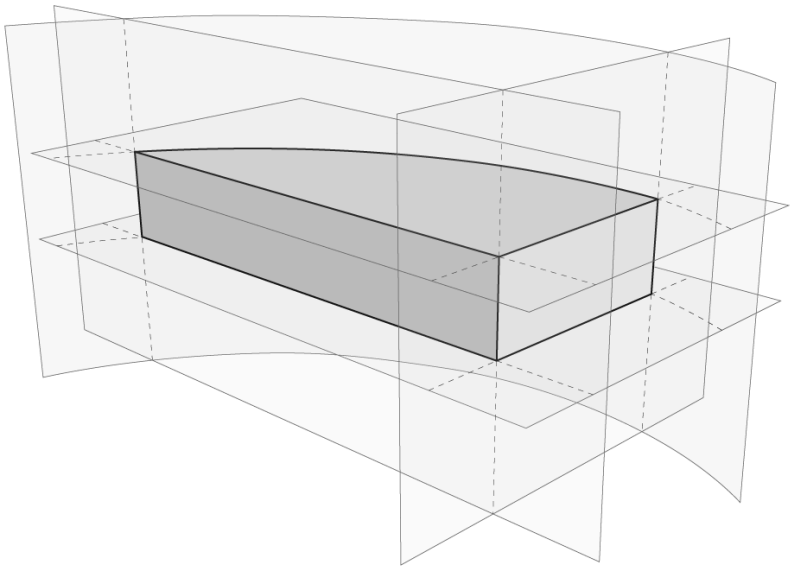

Figure 1. The CAM and CAF models are constructed of over 1000 solid objects, with each object defined by a group of bounding surfaces that intersect to form a closed, three dimensional solid.

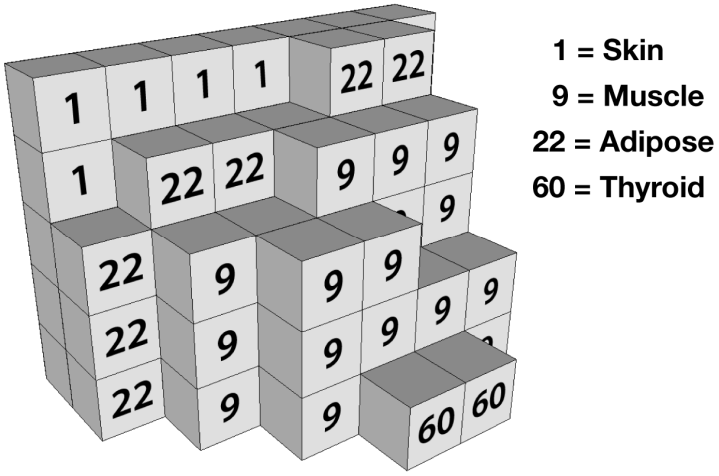

Figure 2. Each voxel in MAX and FAX is cubic, measuring 3.6 mm along each edge, and has associated with it a single integer that identifies its tissue type. A voxel can only be associated with a single tissue type and has constant properties throughout its volume.

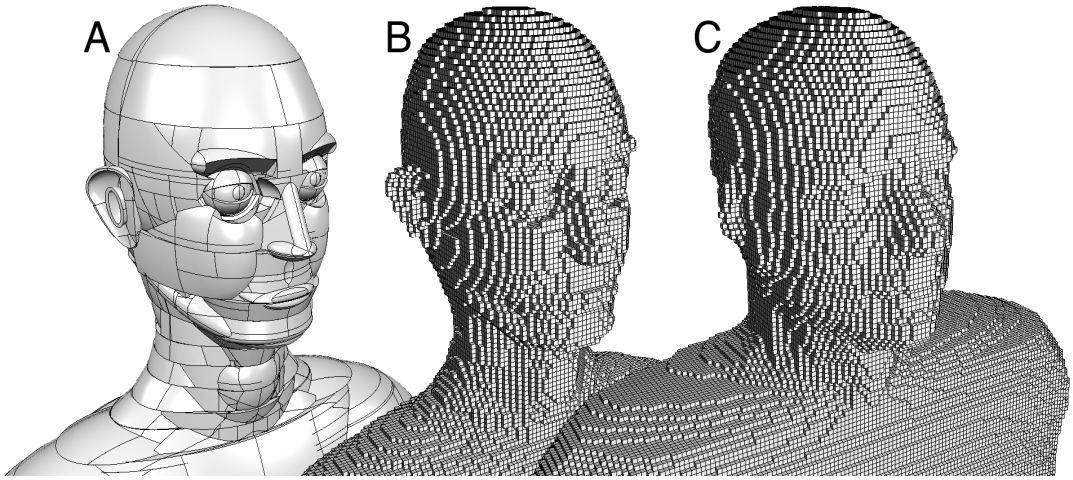

Figure 3. Close up views of the three male human phantoms models used in this study: the CAM in its original form as a geometry model (A), the CAM after its conversion into a voxel-based model (B), and the MAX (C). Both voxel models use 3.6 mm voxels.

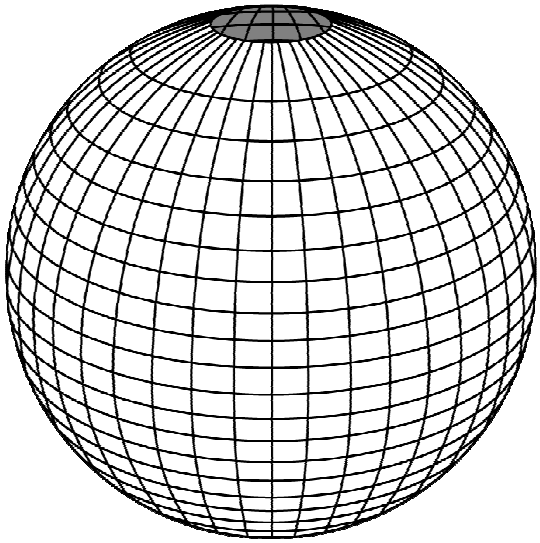

Figure 4. A 968 ray distribution.

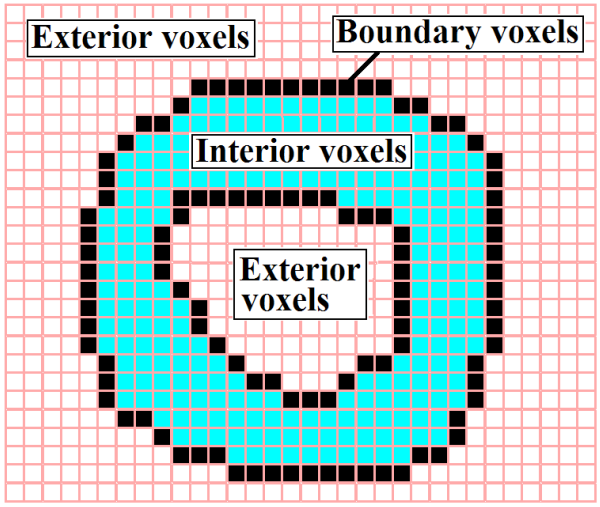

Figure 5. Boundary, interior, and exterior voxels in a slice of the FAX heart.

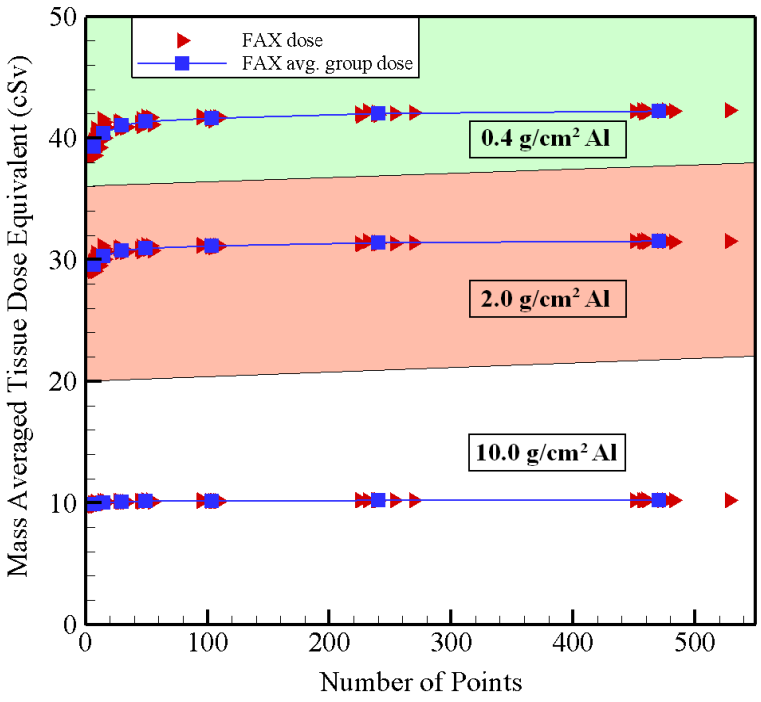

Figure 6. Mass averaged tissue dose equivalent in female adrenals behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

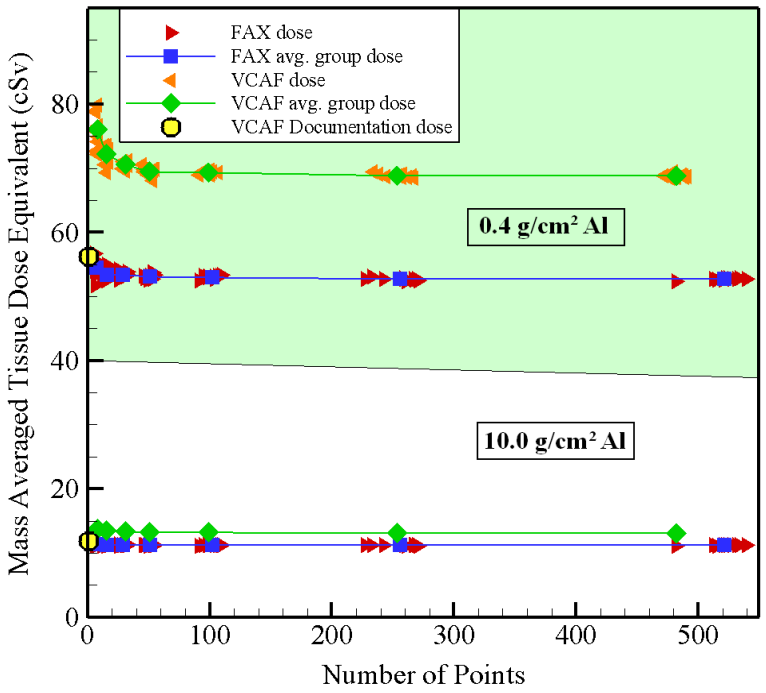

Figure 7. Mass averaged tissue dose equivalent in female bladder behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

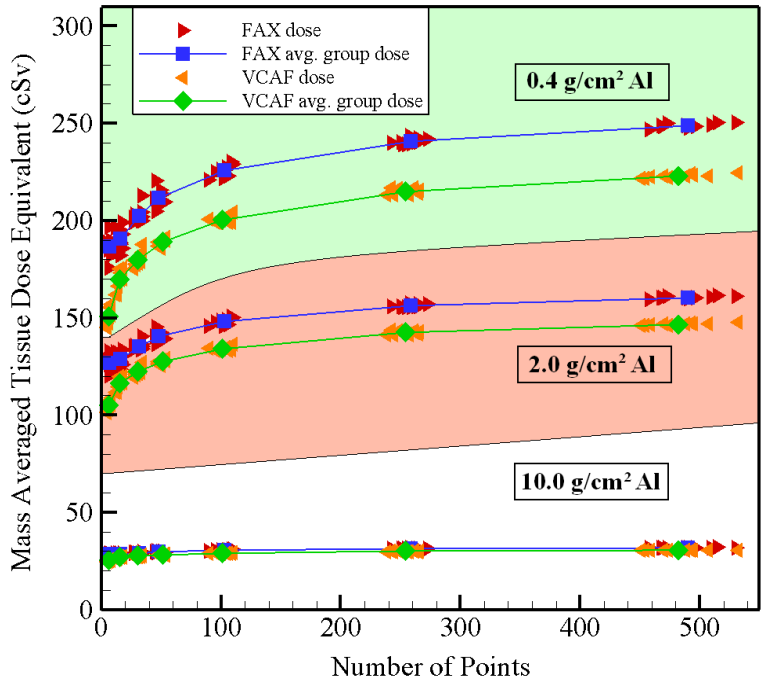

Figure 8. Mass averaged tissue dose equivalent in female brain behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

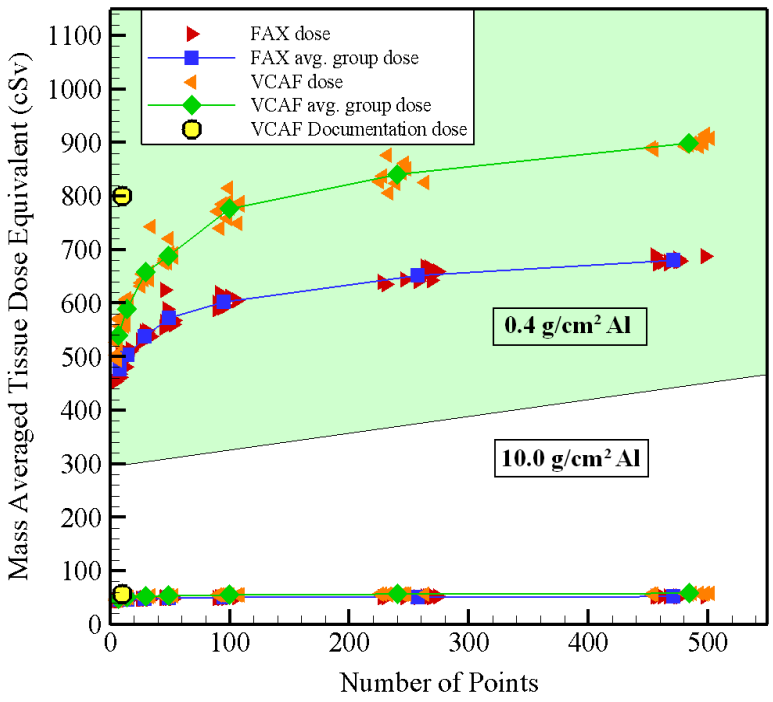

Figure 9. Mass averaged tissue dose equivalent in female breast behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

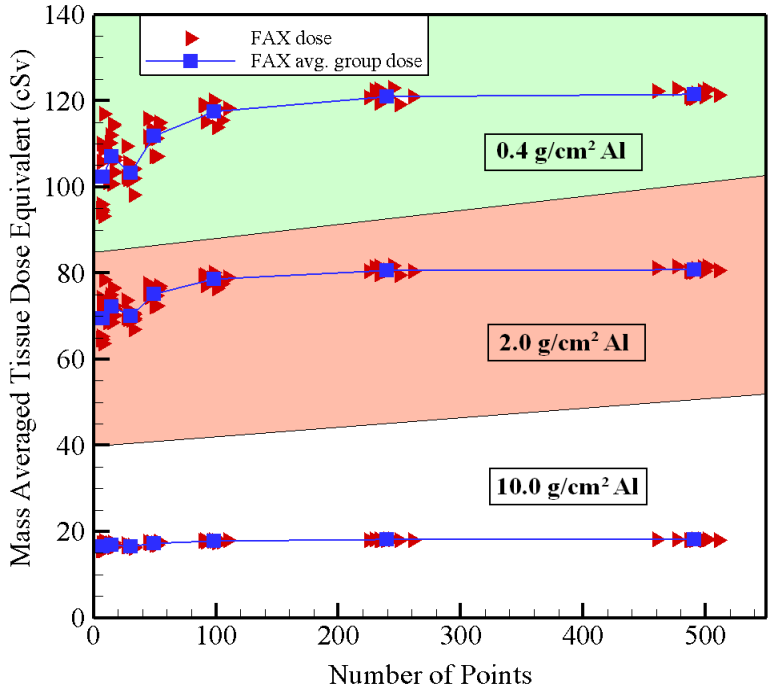

Figure 10. Mass averaged tissue dose equivalent in FAX colon behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

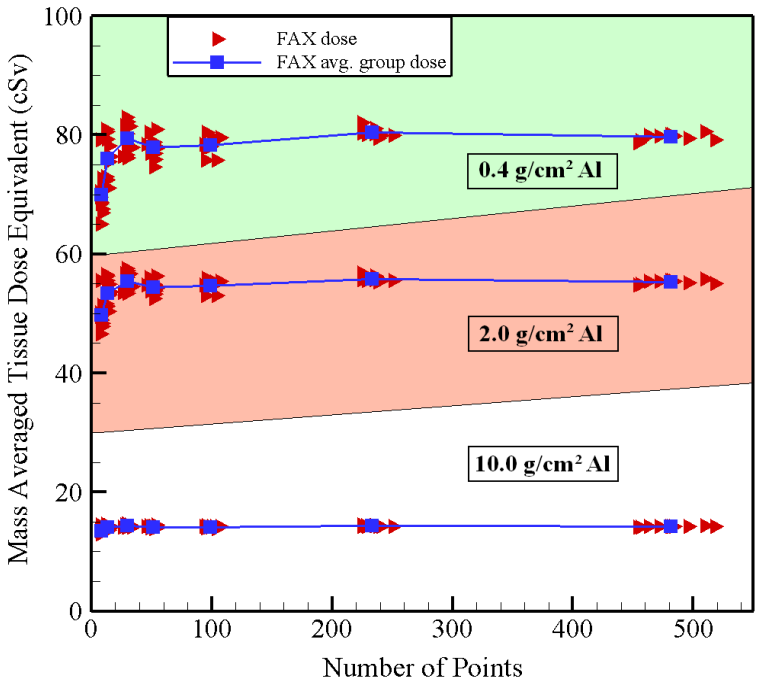

Figure 11. Mass averaged tissue dose equivalent in FAX small intestine behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

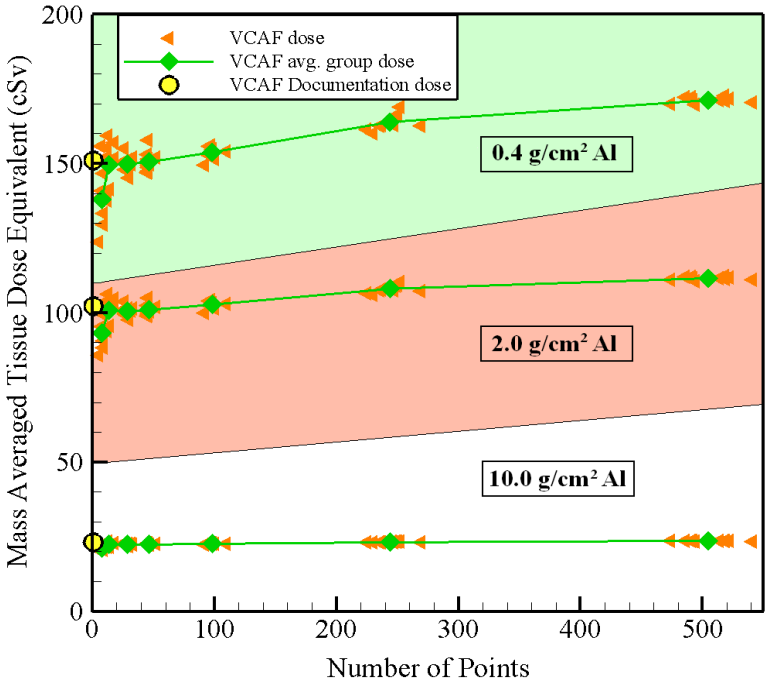

Figure 12. Mass averaged tissue dose equivalent in VCAF colon/intestines behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

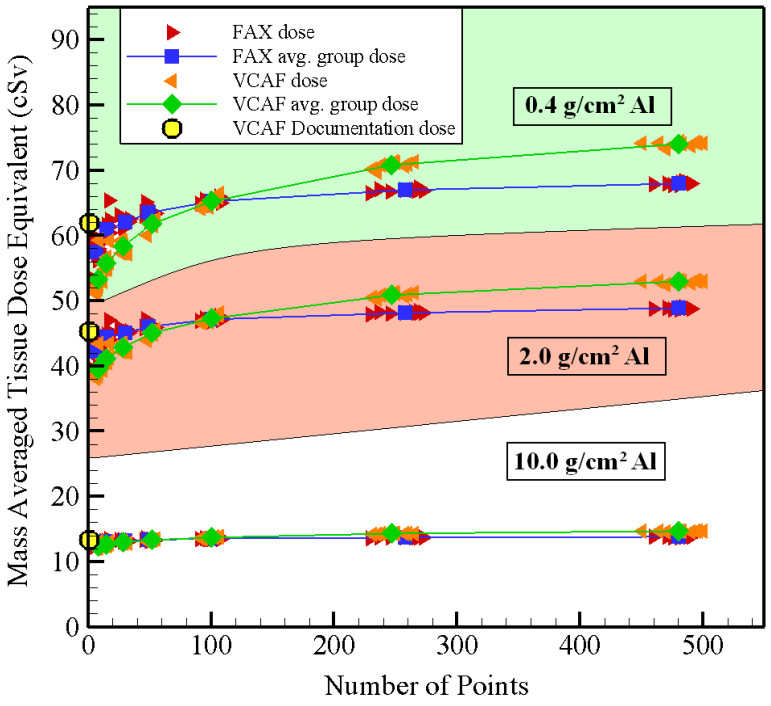

Figure 13. Mass averaged tissue dose equivalent in female heart behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

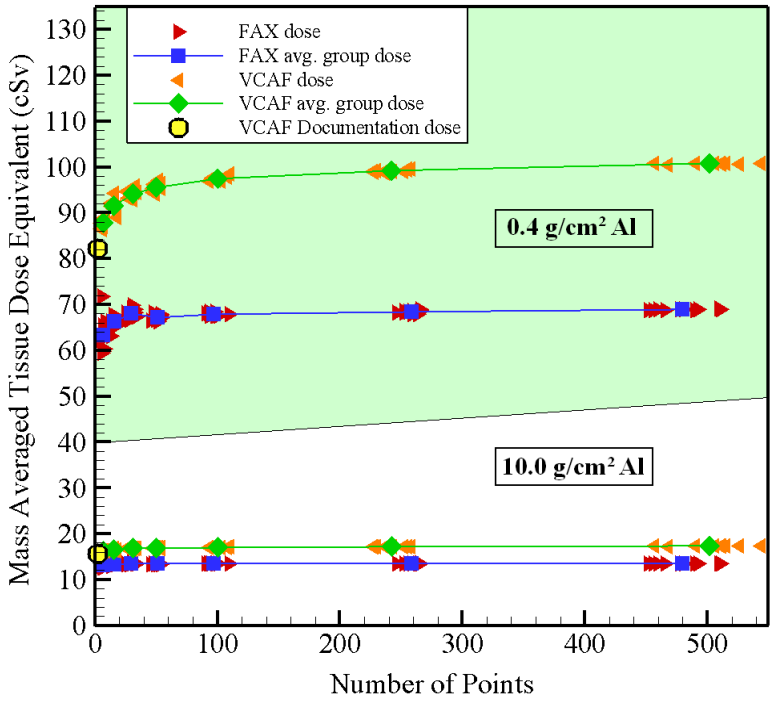

Figure 14. Mass averaged tissue dose equivalent in female kidneys behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

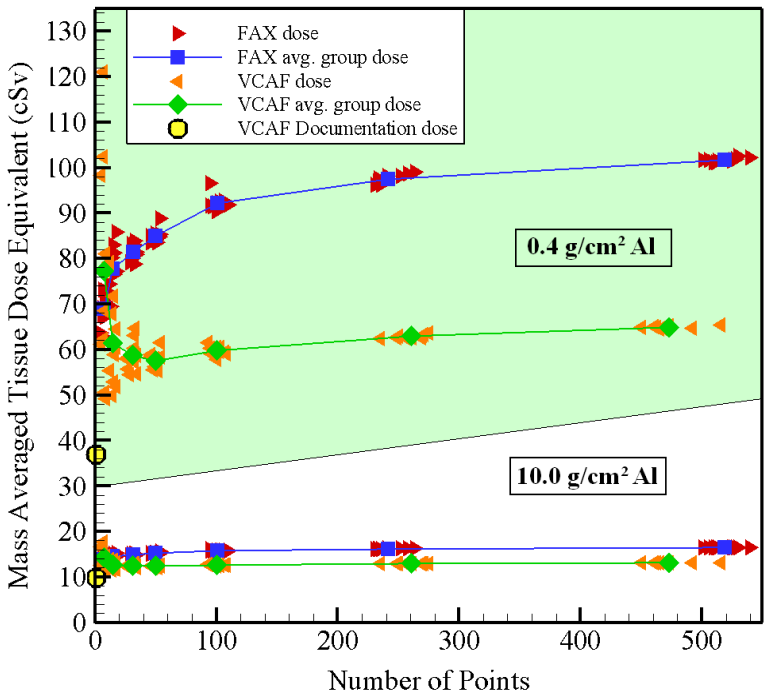

Figure 15. Mass averaged tissue dose equivalent in female liver behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

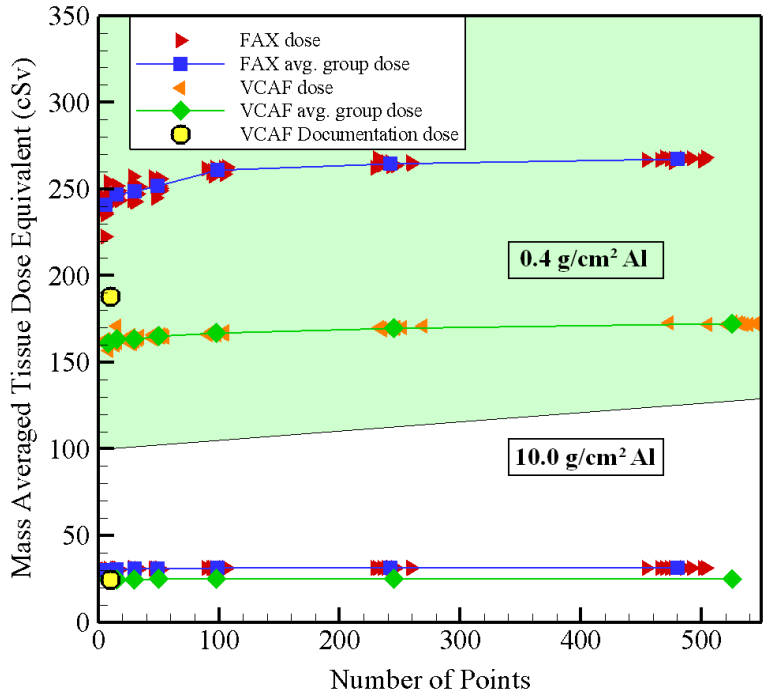

Figure 16. Mass averaged tissue dose equivalent in female lungs behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

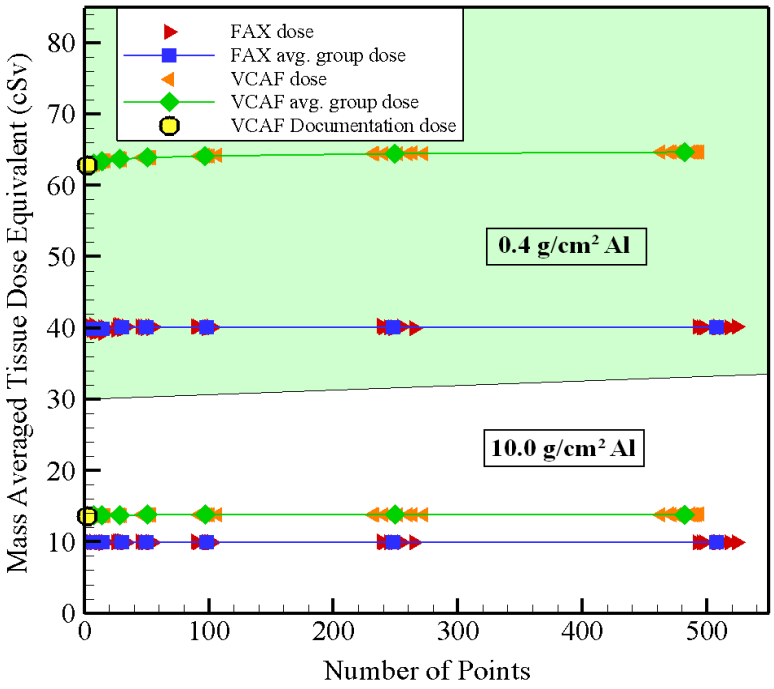

Figure 17. Mass averaged tissue dose equivalent in female ovaries behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

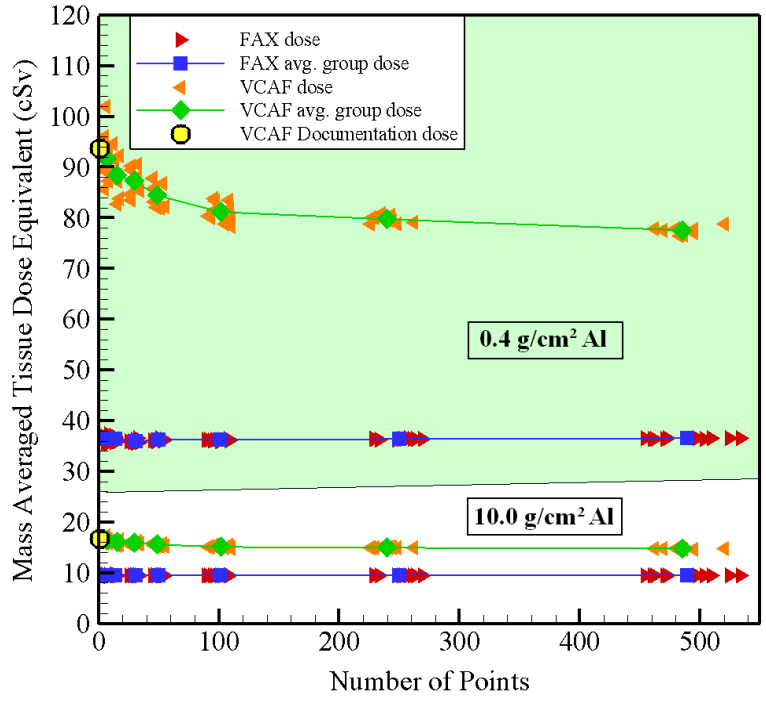

Figure 18. Mass averaged tissue dose equivalent in female pancreas behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

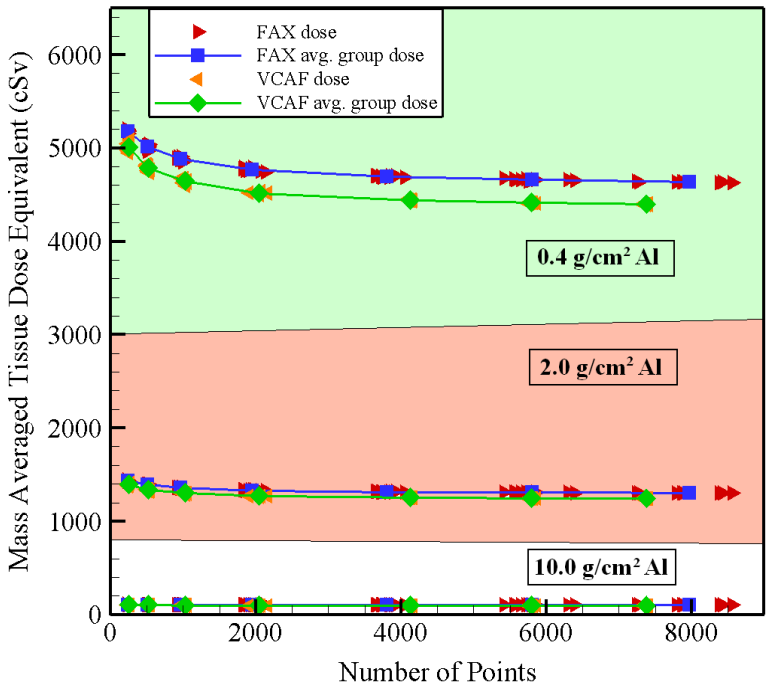

Figure 19. Mass averaged tissue dose equivalent in female skin behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

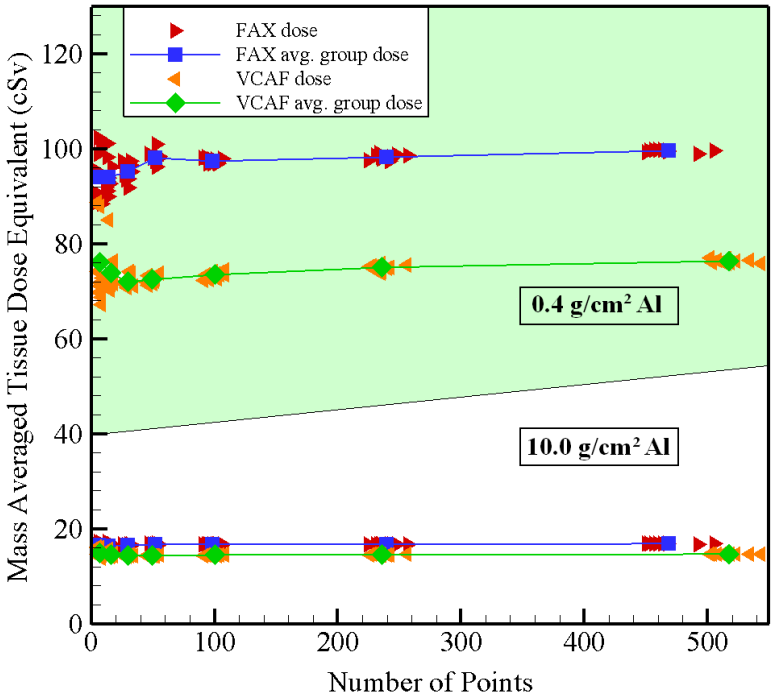

Figure 20. Mass averaged tissue dose equivalent in female spleen behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

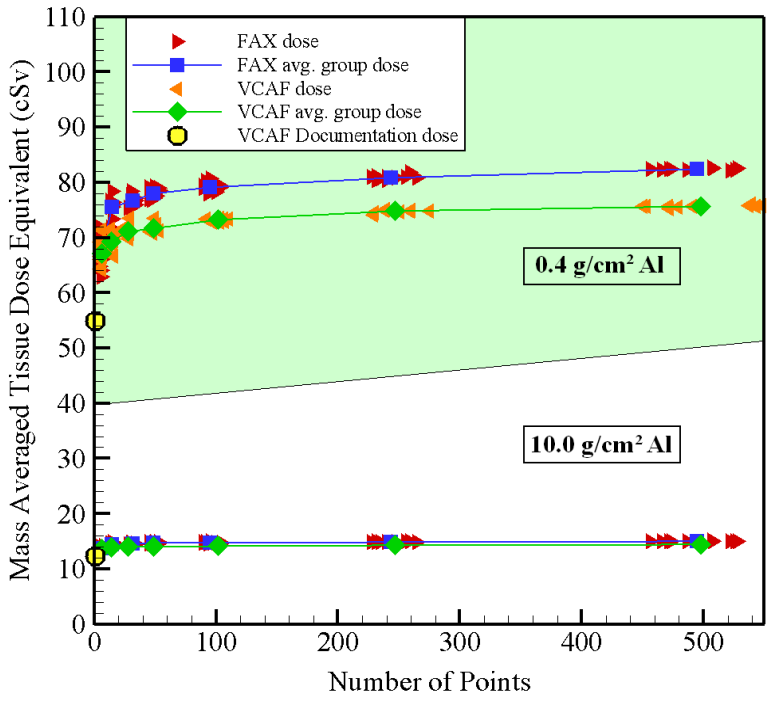

Figure 21. Mass averaged tissue dose equivalent in female stomach behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

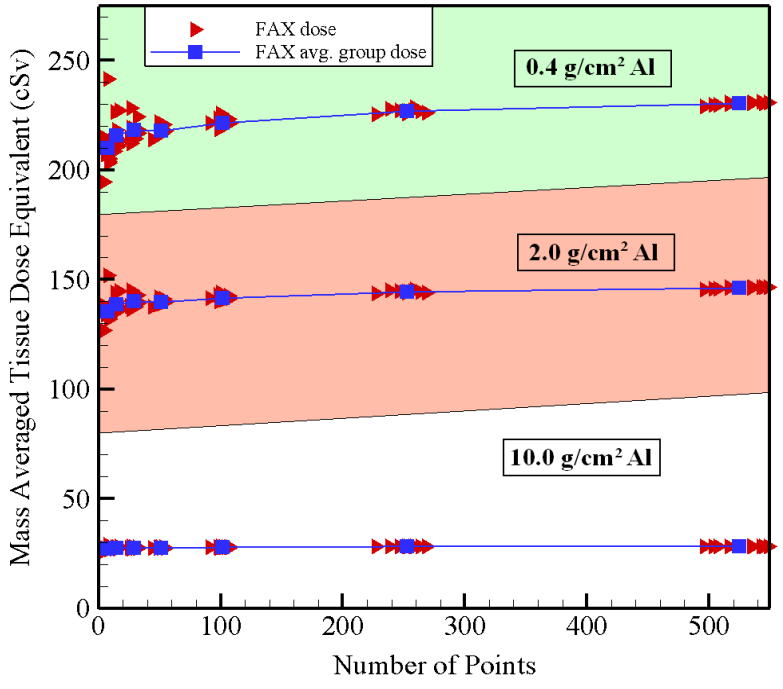

Figure 22. Mass averaged tissue dose equivalent in female thymus behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

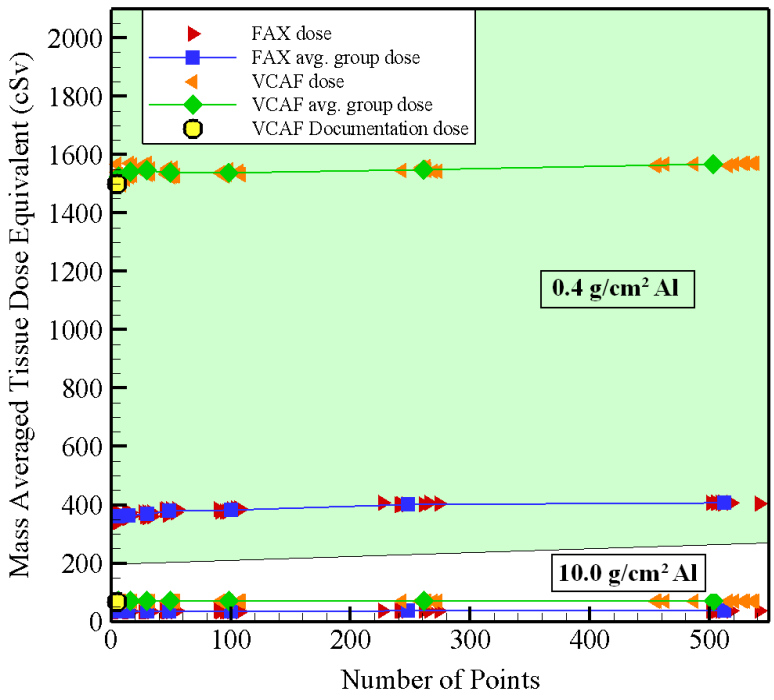

Figure 23. Mass averaged tissue dose equivalent in female thyroid behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

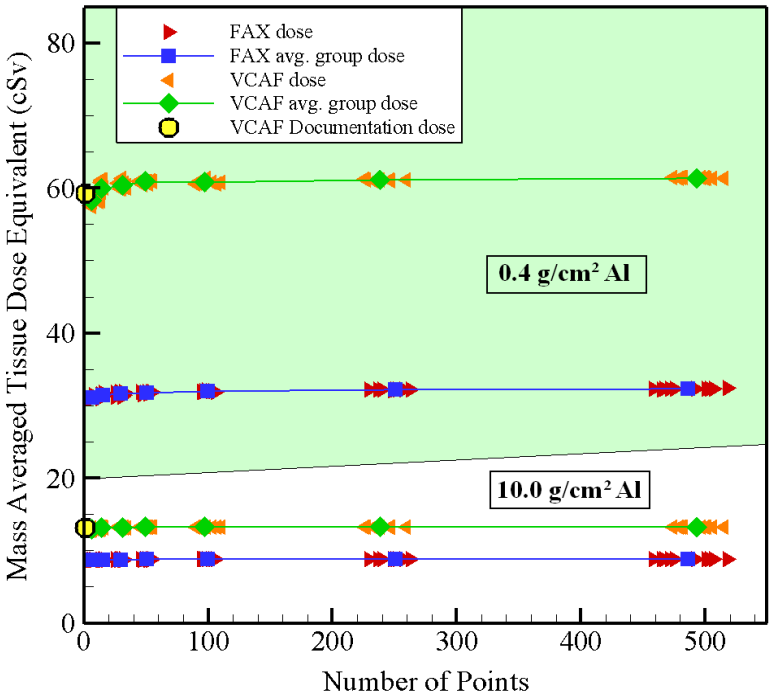

Figure 24. Mass averaged tissue dose equivalent in female uterus behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

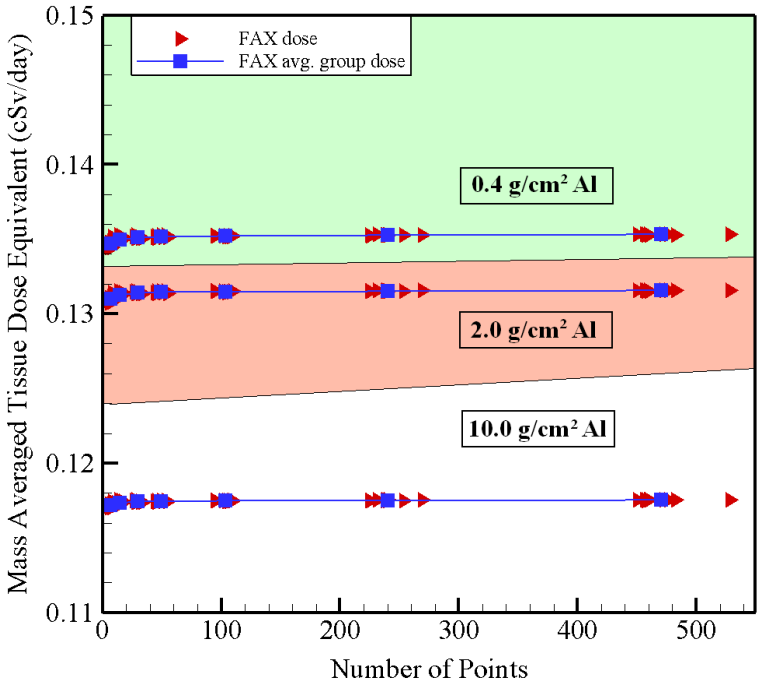

Figure 25. Mass averaged tissue dose equivalent in female adrenals behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

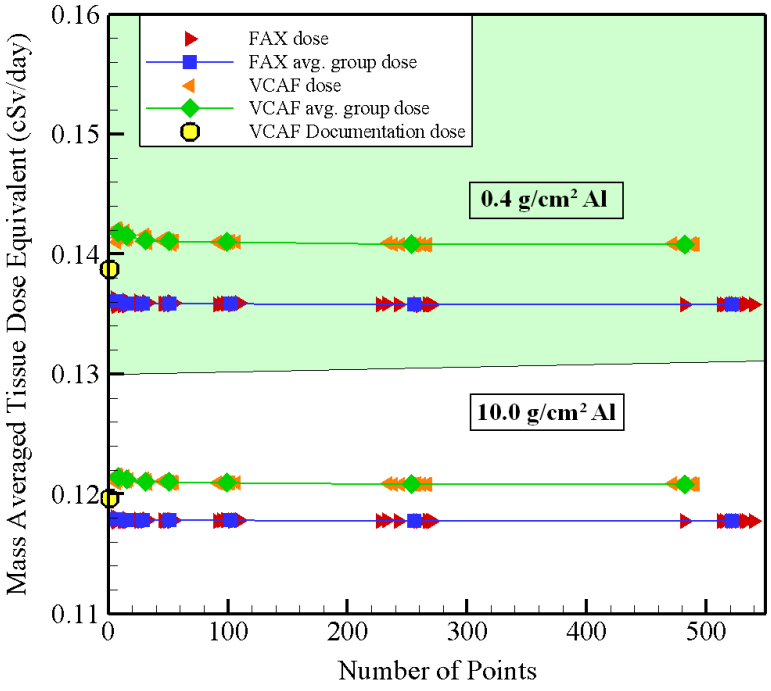

Figure 26. Mass averaged tissue dose equivalent in female bladder behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

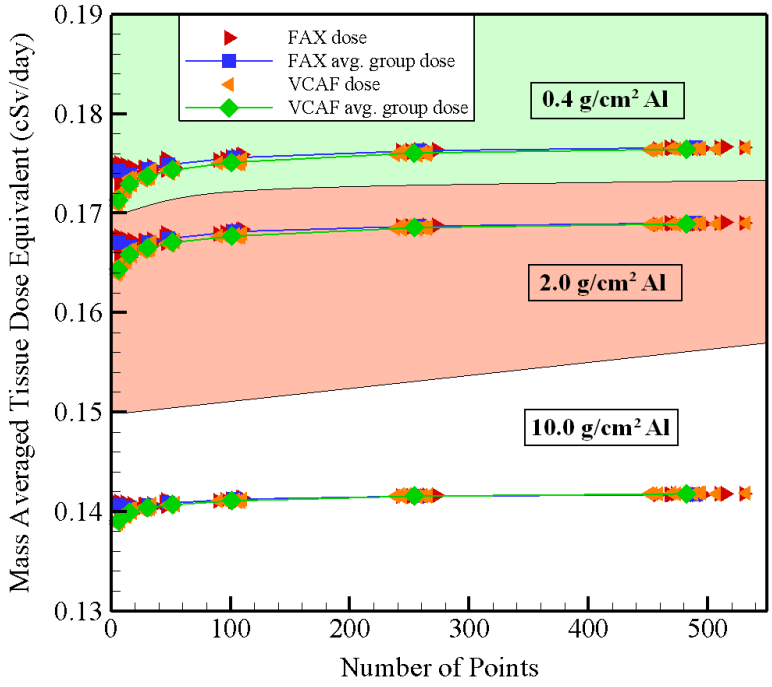

Figure 27. Mass averaged tissue dose equivalent in female brain behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

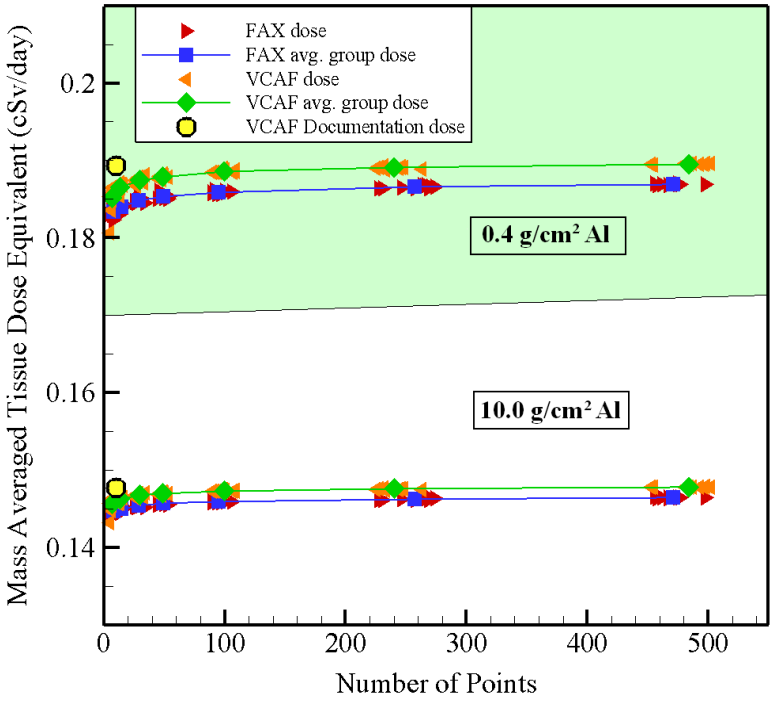

Figure 28. Mass averaged tissue dose equivalent in female breast behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

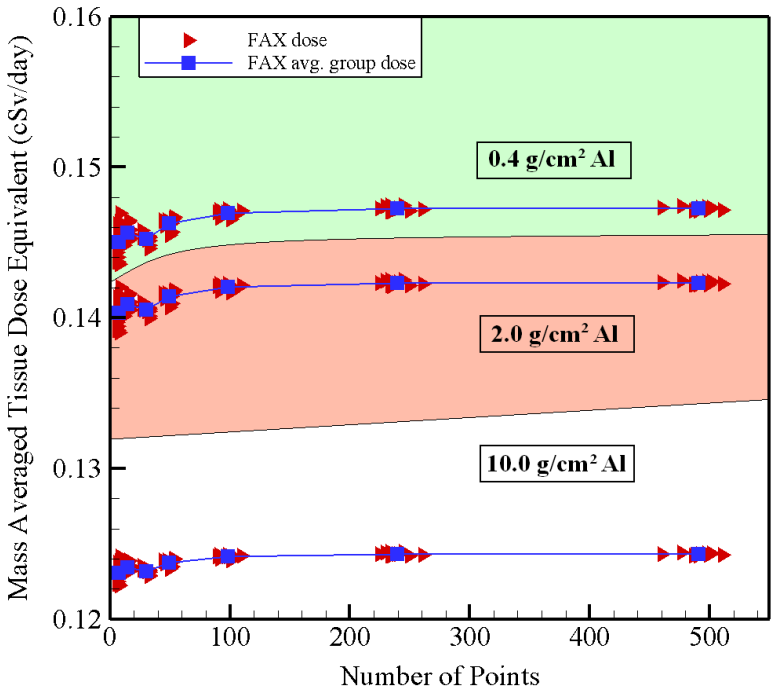

Figure 29. Mass averaged tissue dose equivalent in FAX colon behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

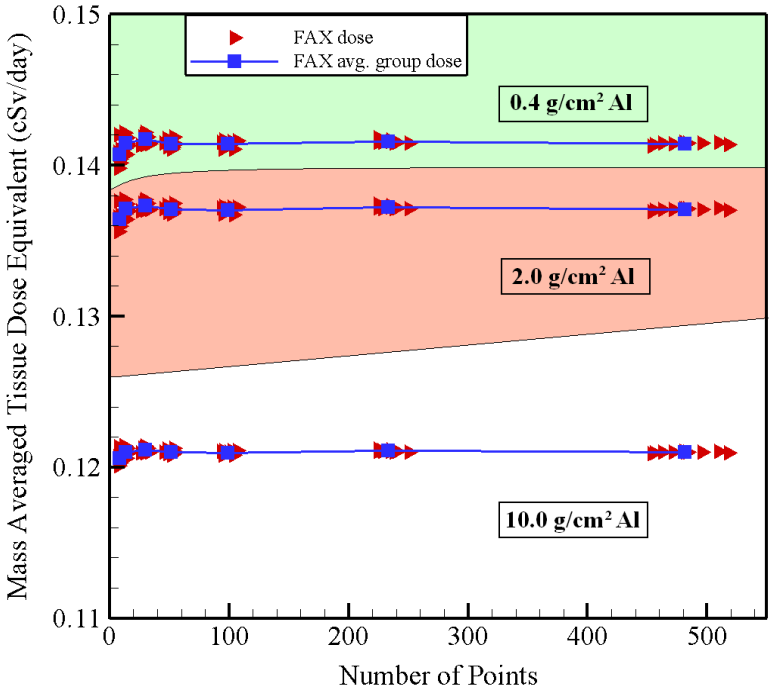

Figure 30. Mass averaged tissue dose equivalent in FAX small intestine behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

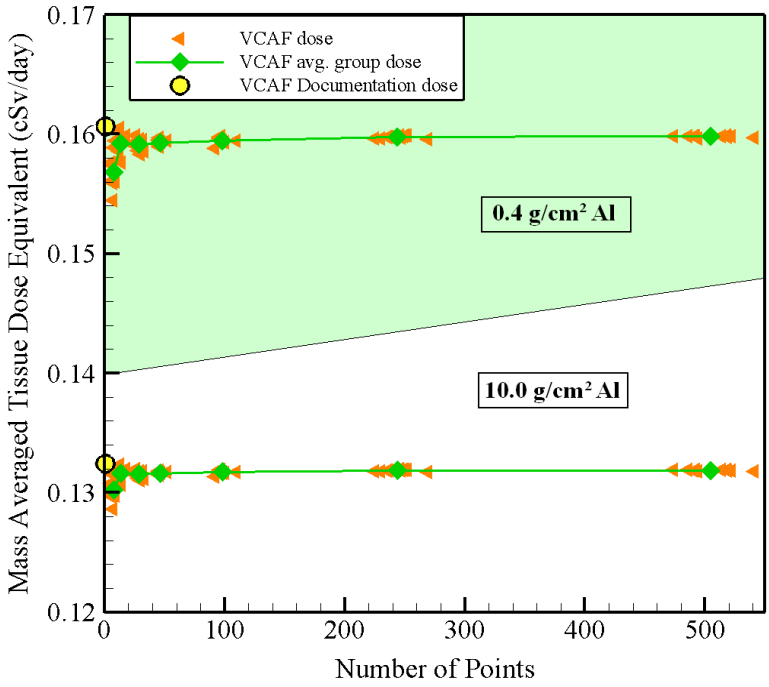

Figure 31. Mass averaged tissue dose equivalent in VCAF colon/intestines behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

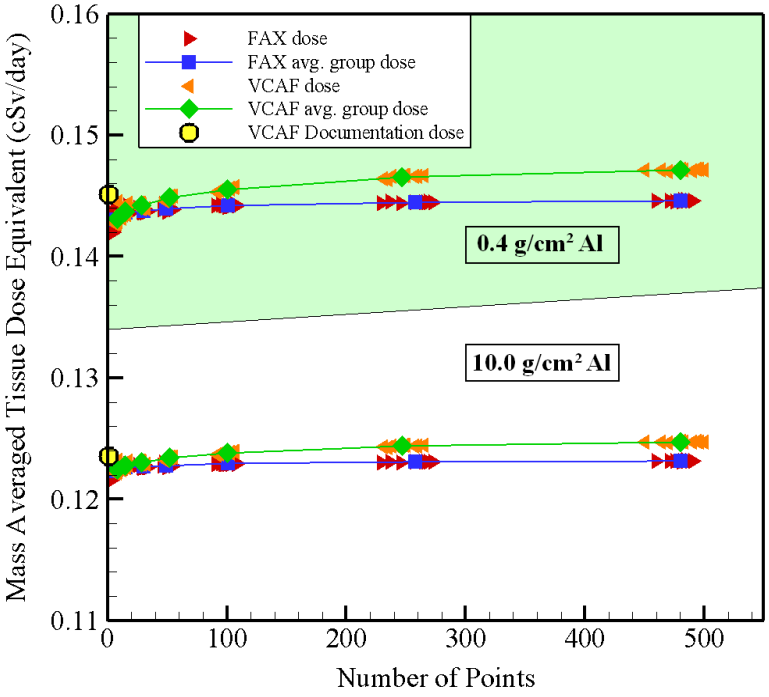

Figure 32. Mass averaged tissue dose equivalent in female heart behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

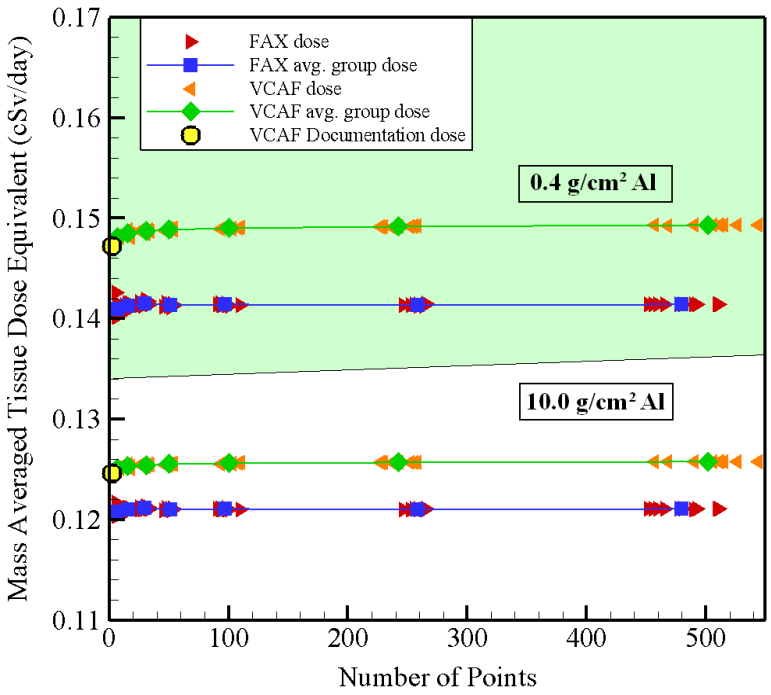

Figure 33. Mass averaged tissue dose equivalent in female kidneys behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

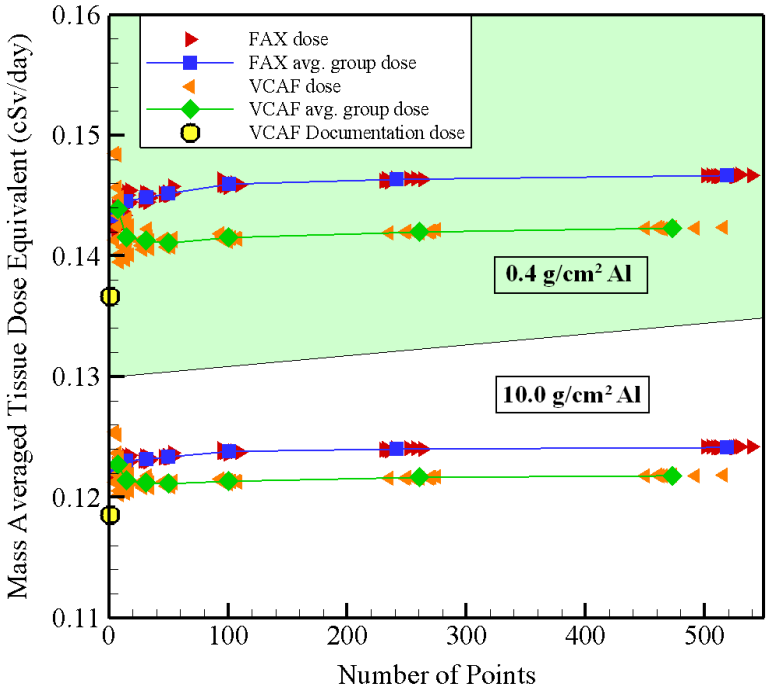

Figure 34. Mass averaged tissue dose equivalent in female liver behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

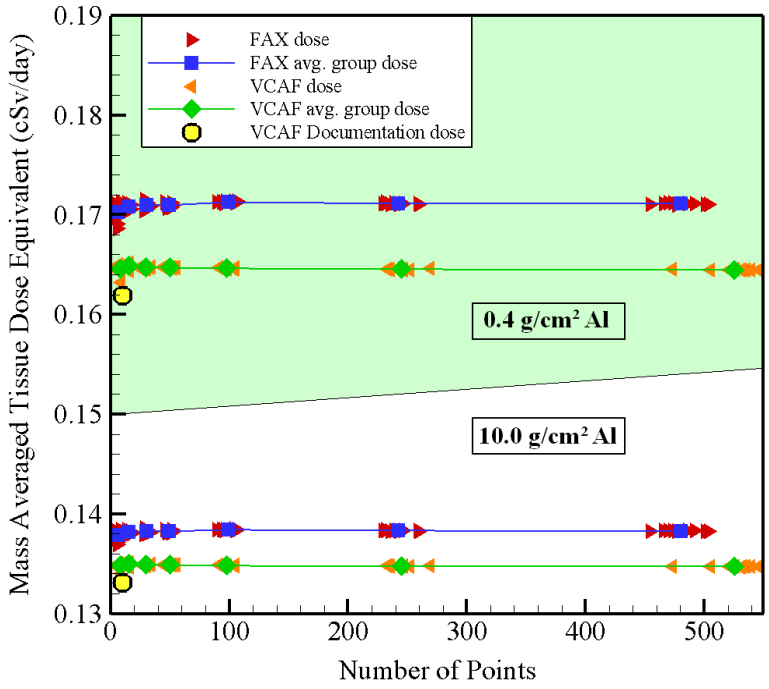

Figure 35. Mass averaged tissue dose equivalent in female lungs behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

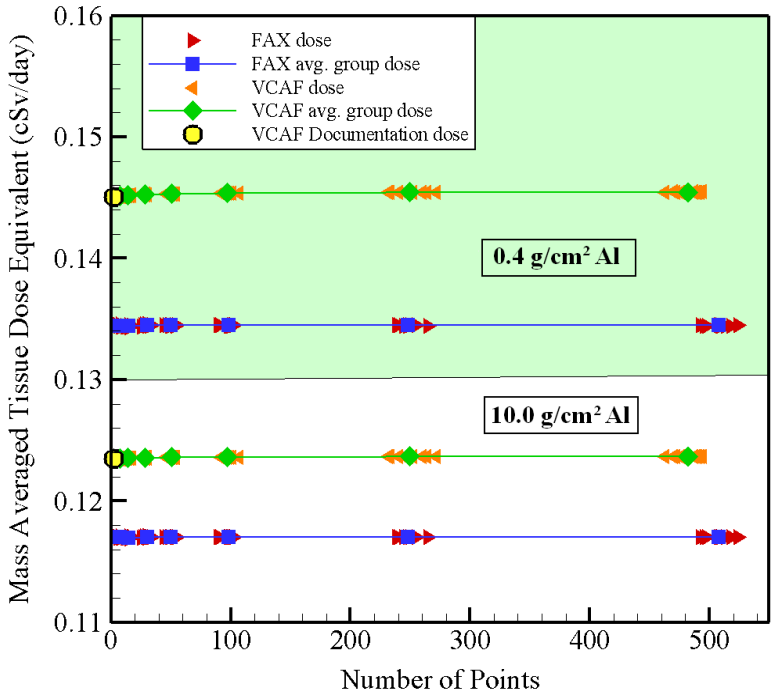

Figure 36. Mass averaged tissue dose equivalent in female ovaries behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

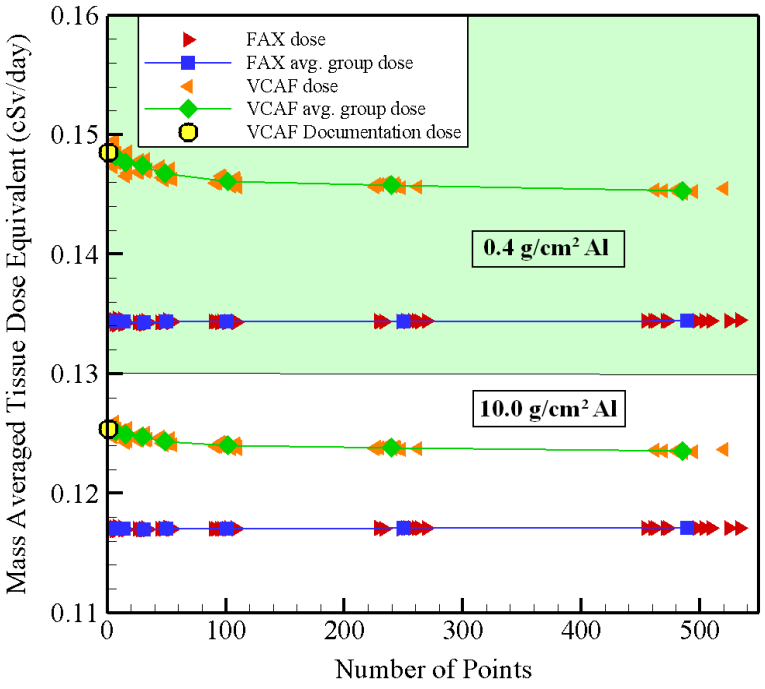

Figure 37. Mass averaged tissue dose equivalent in female pancreas behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

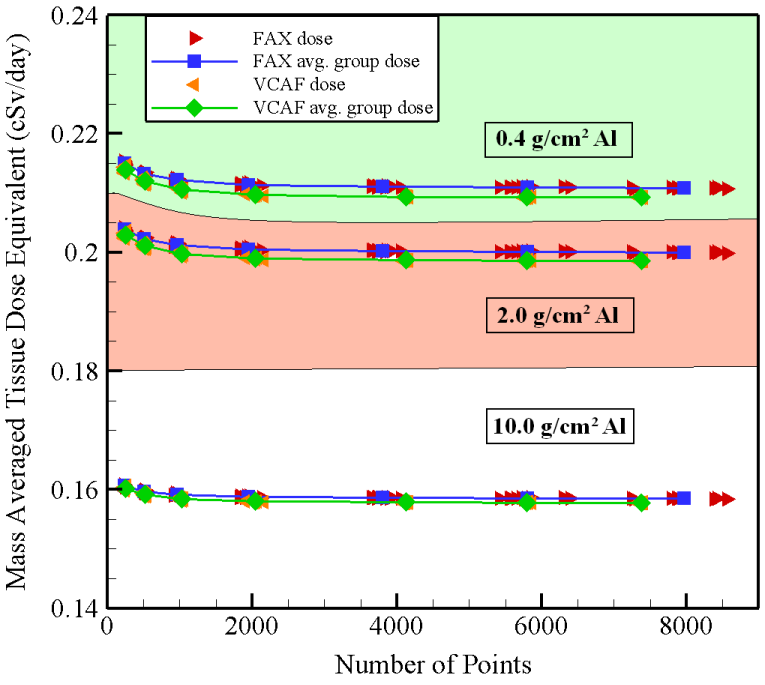

Figure 38. Mass averaged tissue dose equivalent in female skin behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

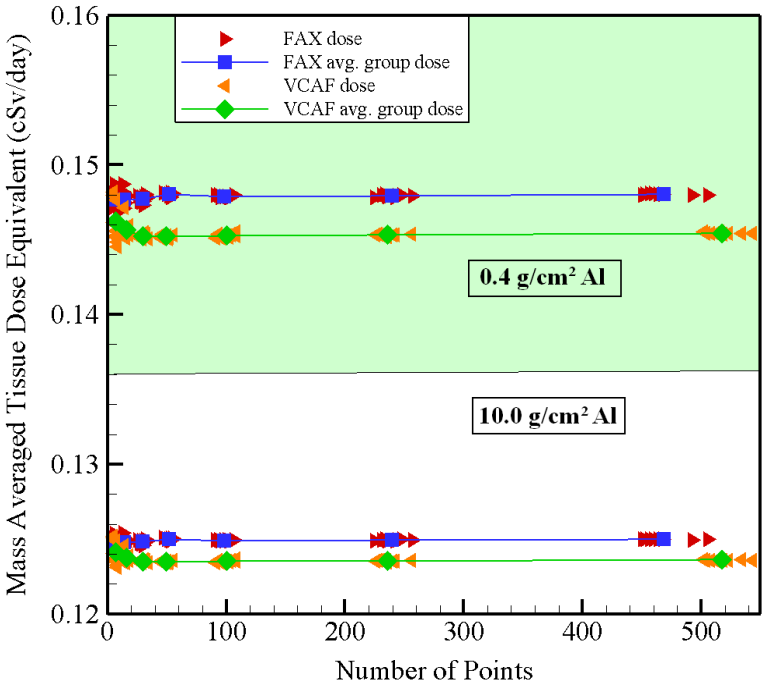

Figure 39. Mass averaged tissue dose equivalent in female spleen behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

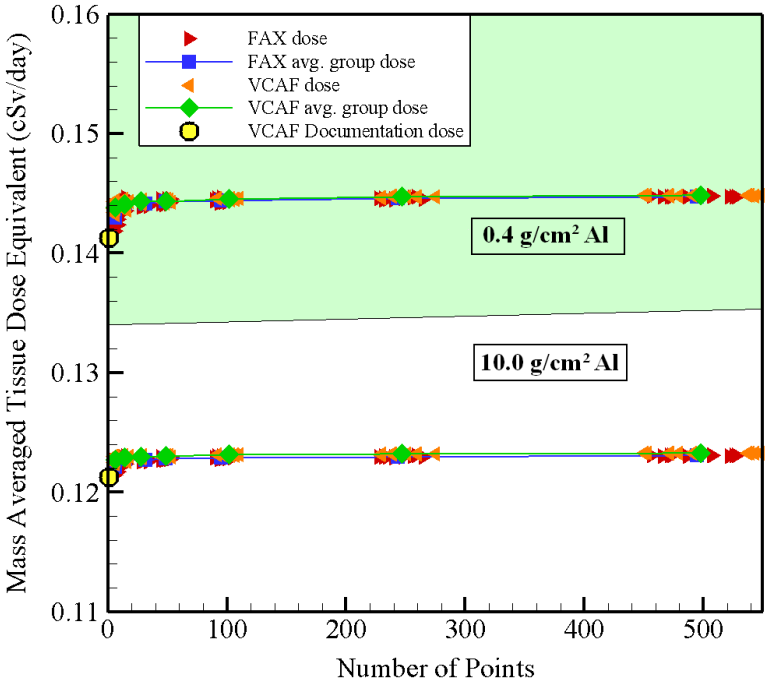

Figure 40. Mass averaged tissue dose equivalent in female stomach behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

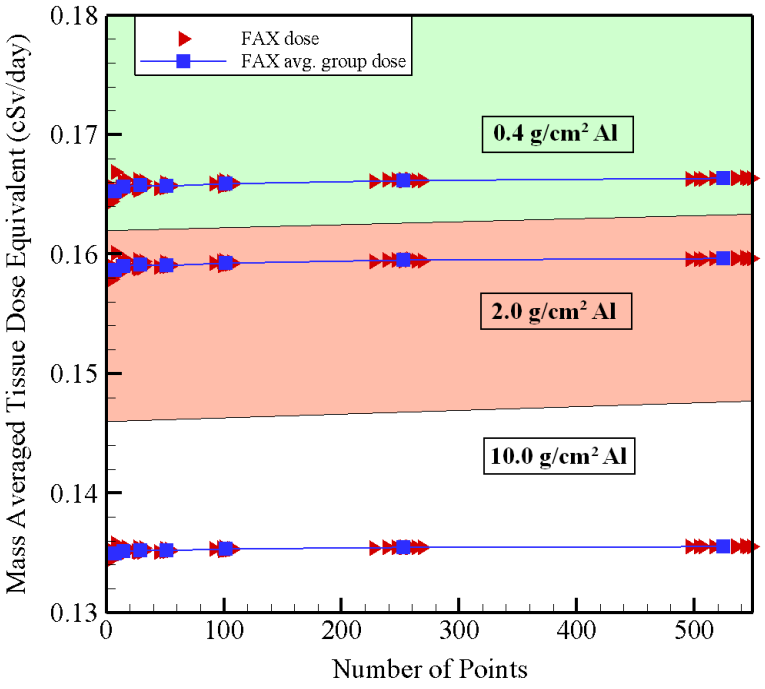

Figure 41. Mass averaged tissue dose equivalent in female thymus behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

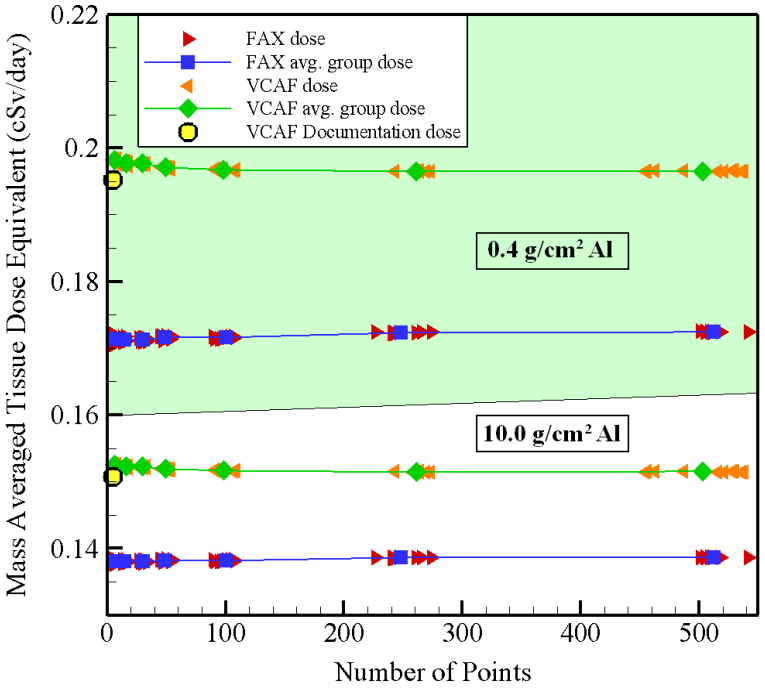

Figure 42. Mass averaged tissue dose equivalent in female thyroid behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

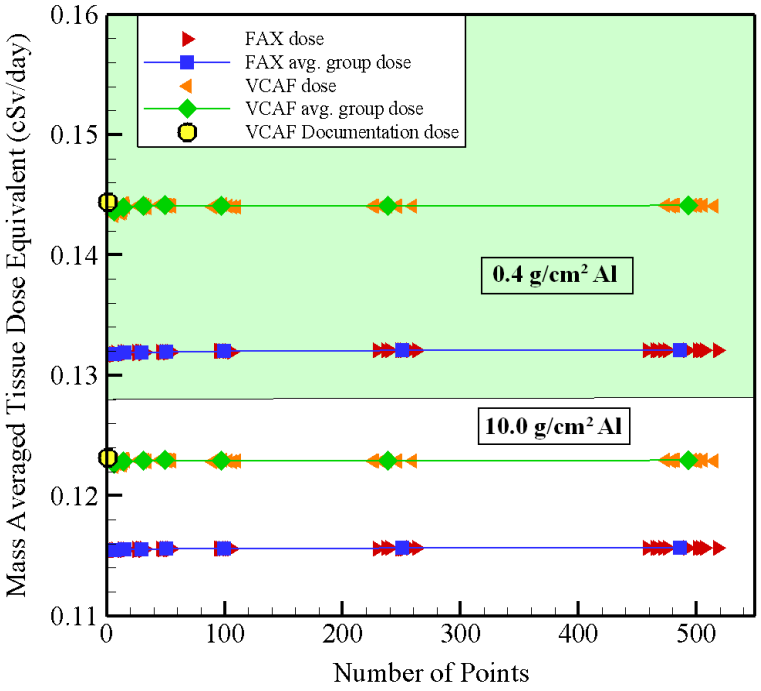

Figure 43. Mass averaged tissue dose equivalent in female uterus behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

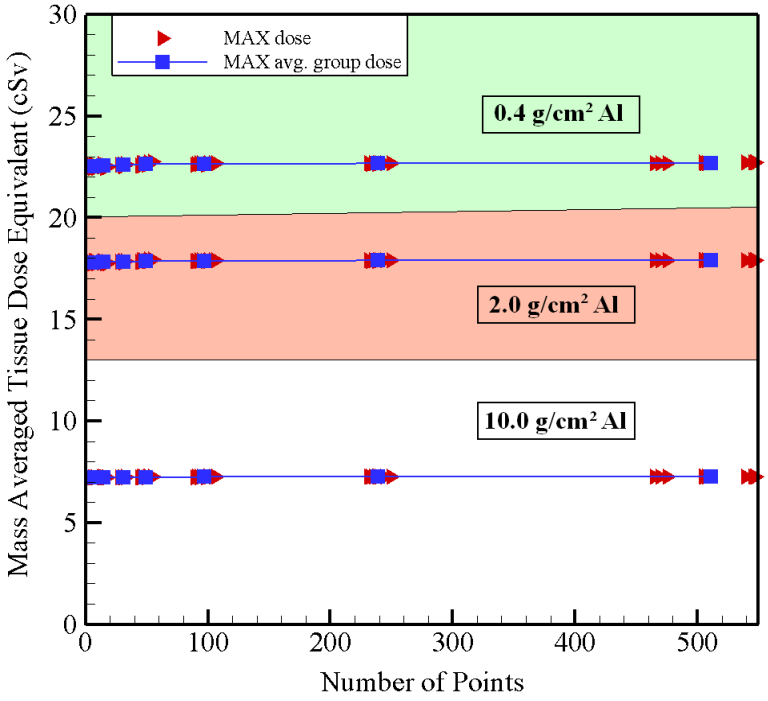

Figure 44. Mass averaged tissue dose equivalent in male adrenals behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

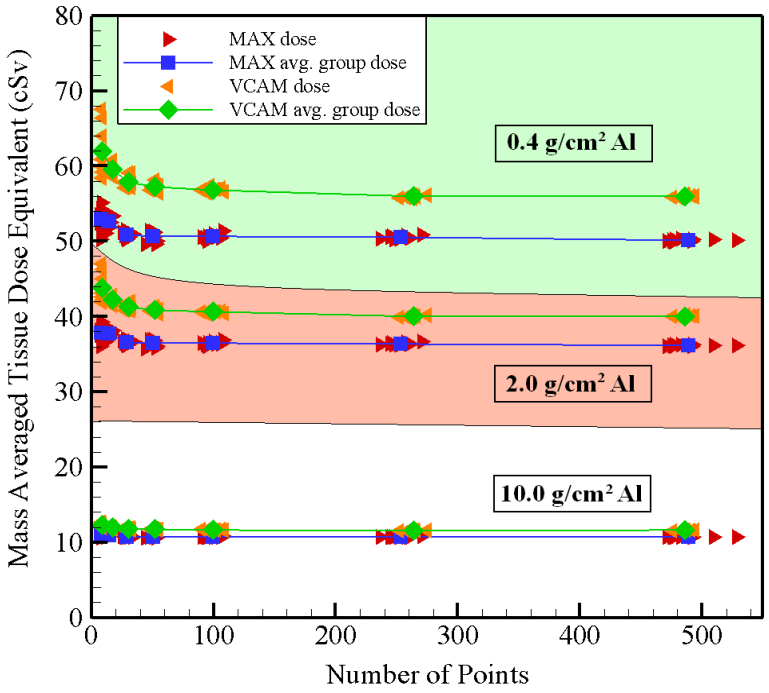

Figure 45. Mass averaged tissue dose equivalent in male bladder behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

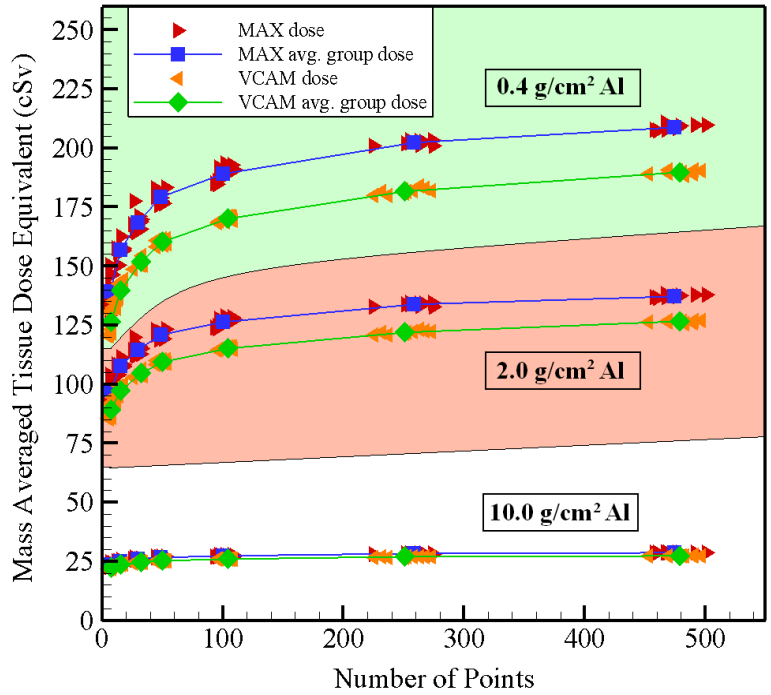

Figure 46. Mass averaged tissue dose equivalent in male brain behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

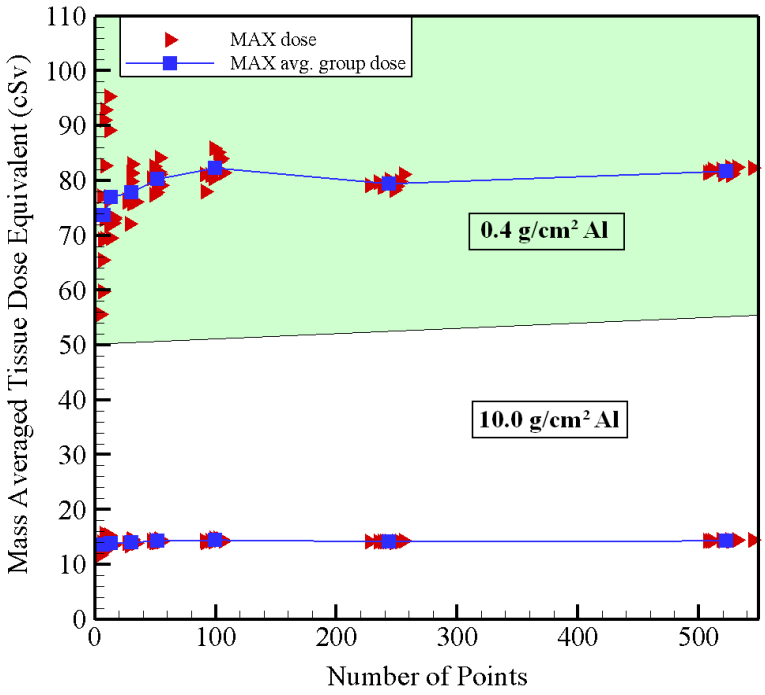

Figure 47. Mass averaged tissue dose equivalent in MAX colon behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

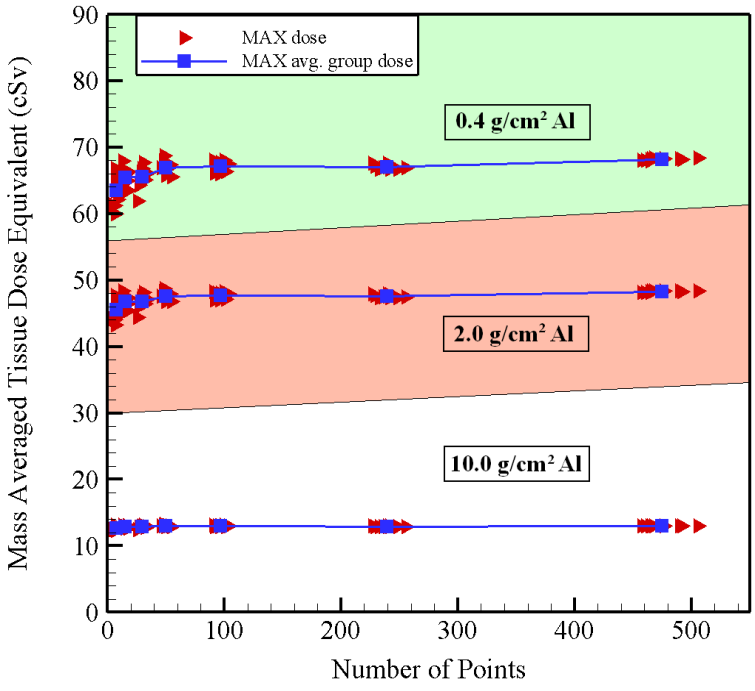

Figure 48. Mass averaged tissue dose equivalent in MAX small intestines behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

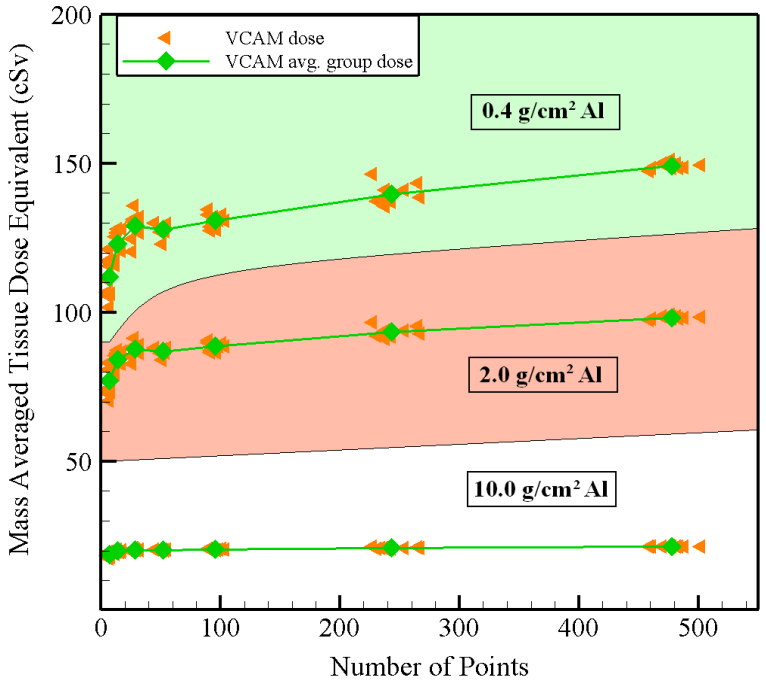

Figure 49. Mass averaged tissue dose equivalent in VCAM colon/intestines behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

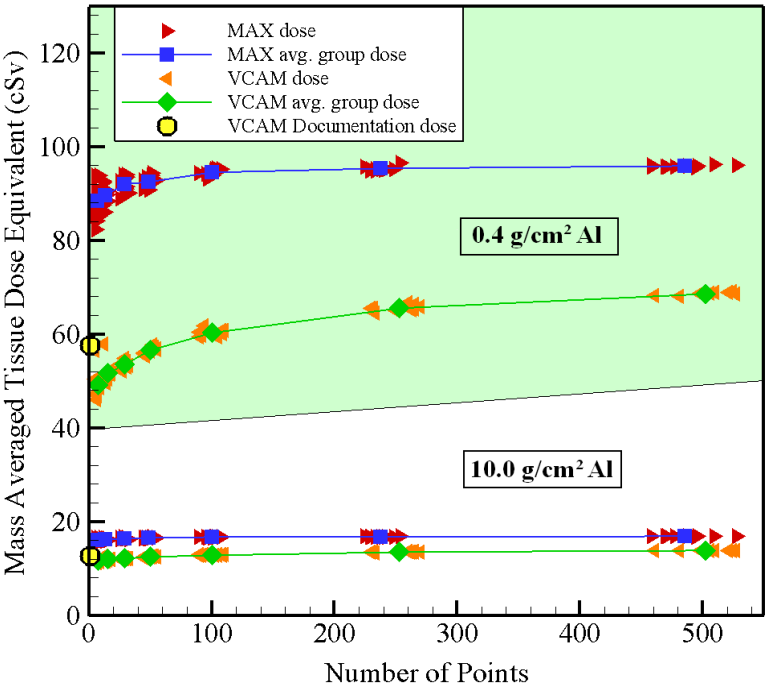

Figure 50. Mass averaged tissue dose equivalent in male heart behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

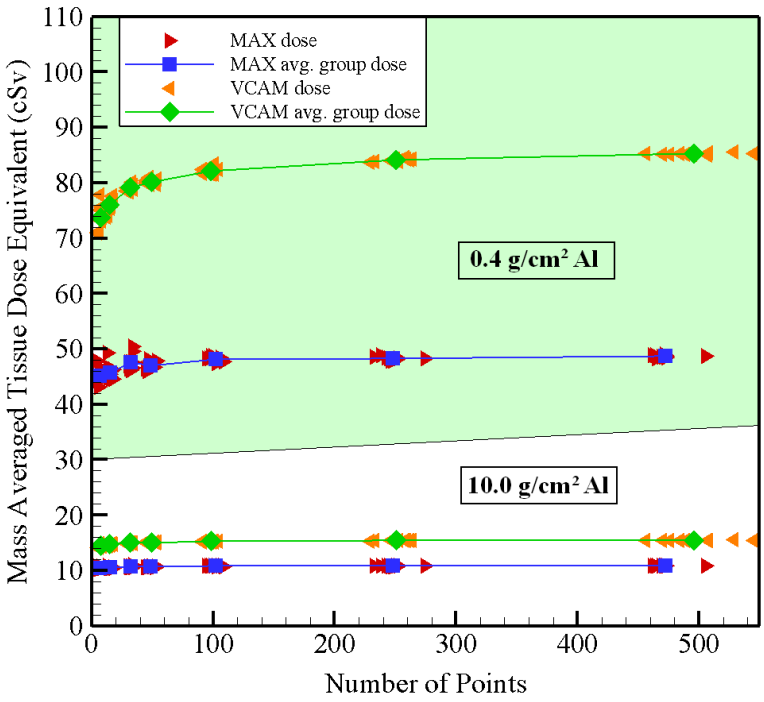

Figure 51. Mass averaged tissue dose equivalent in male kidneys behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

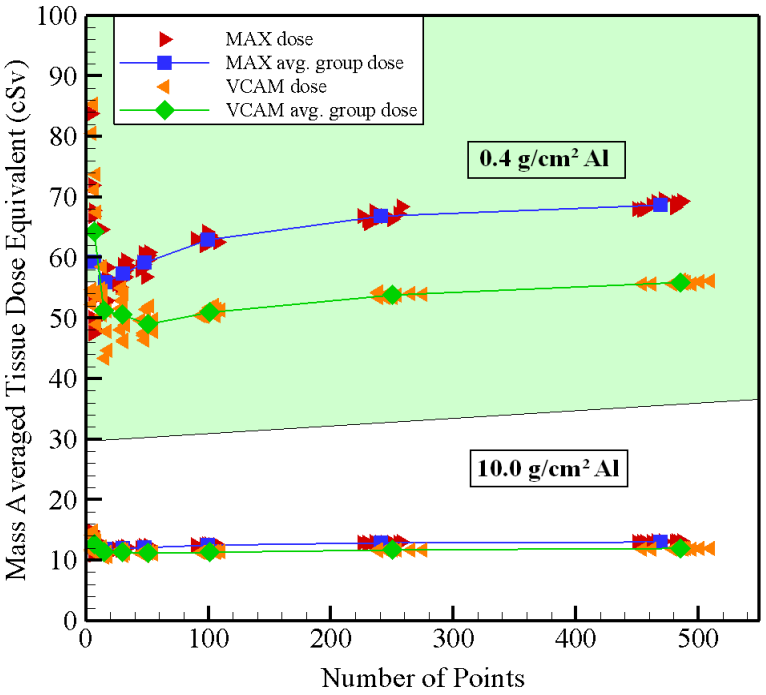

Figure 52. Mass averaged tissue dose equivalent in male liver behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

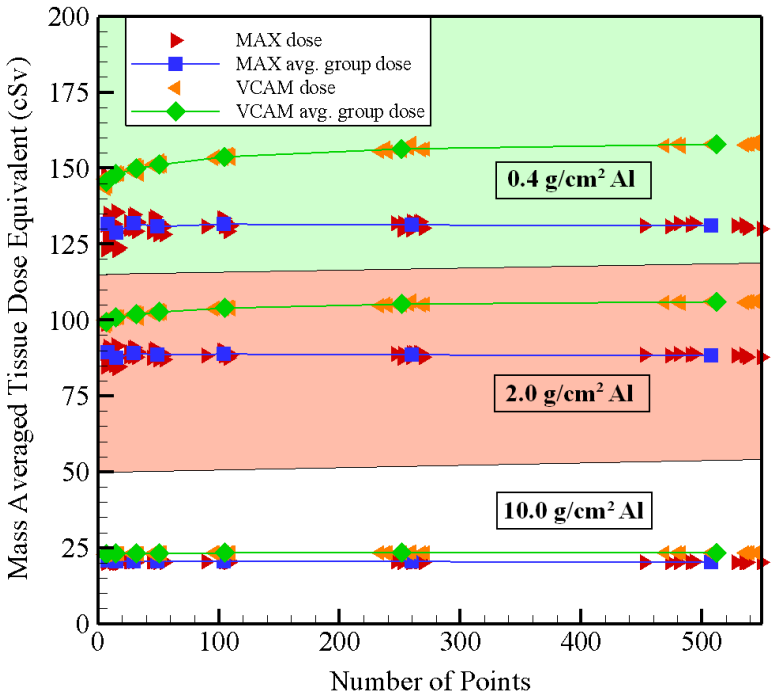

Figure 53. Mass averaged tissue dose equivalent in male lungs behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

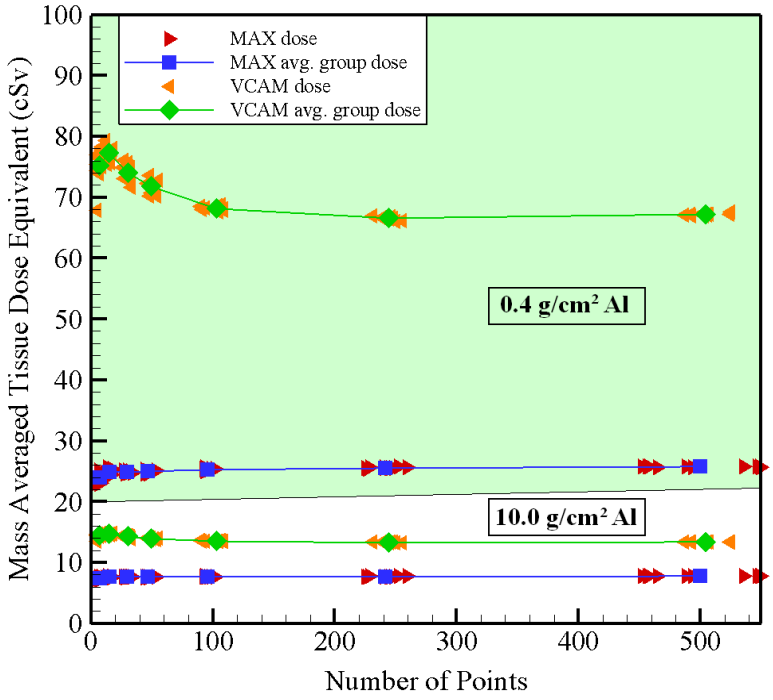

Figure 54. Mass averaged tissue dose equivalent in male pancreas behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

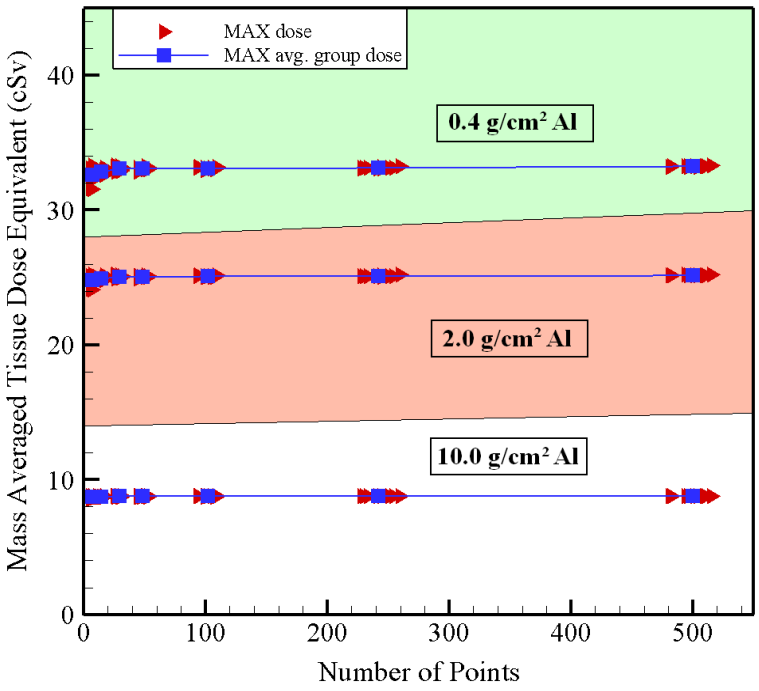

Figure 55. Mass averaged tissue dose equivalent in male prostate behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

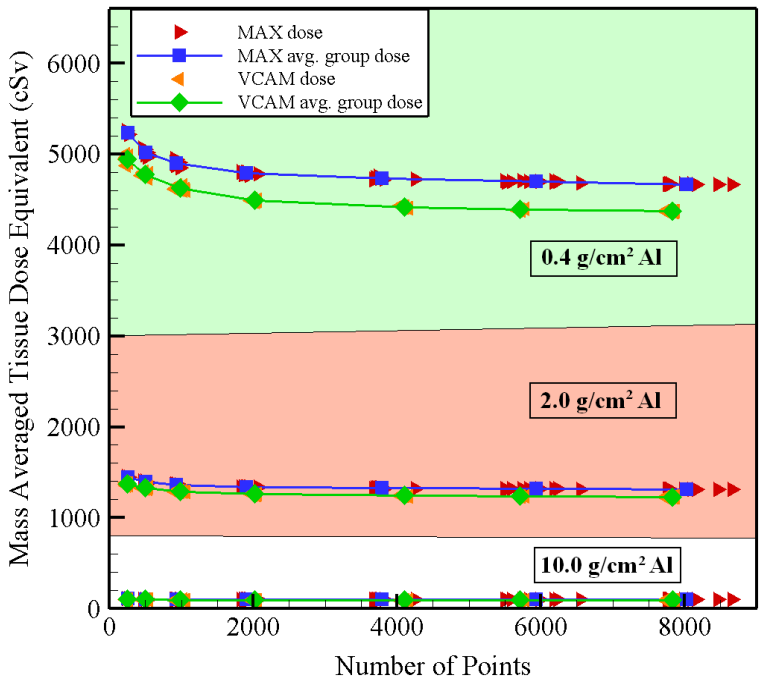

Figure 56. Mass averaged tissue dose equivalent in male skin behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

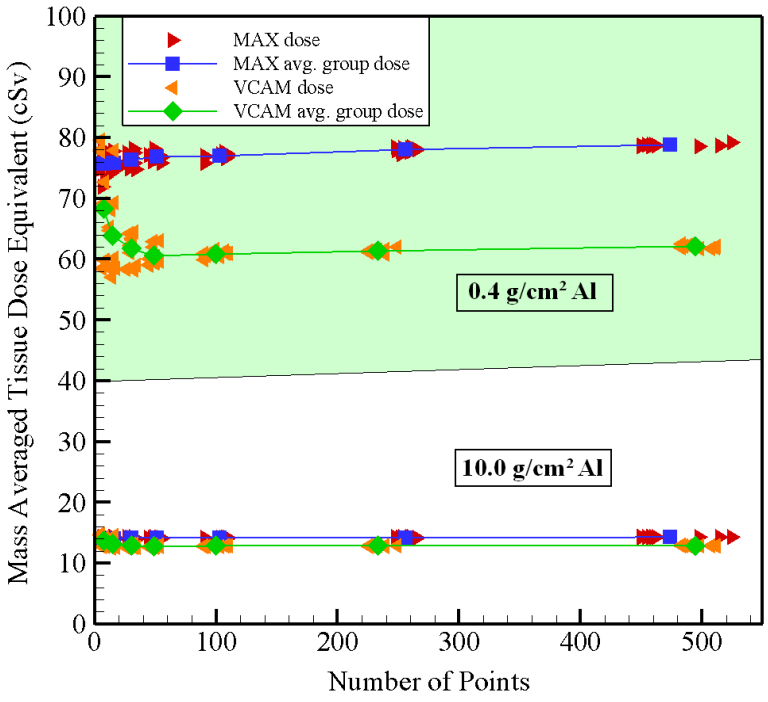

Figure 57. Mass averaged tissue dose equivalent in male spleen behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

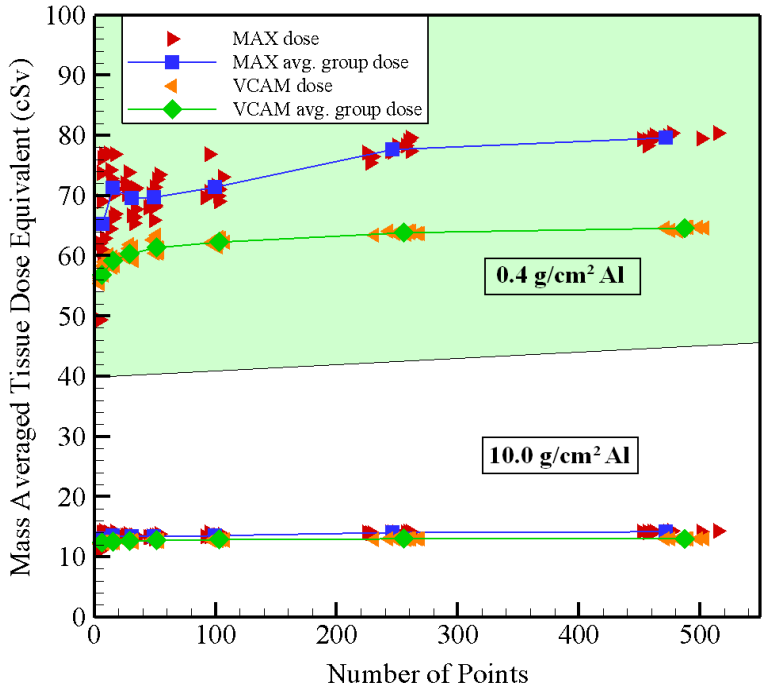

Figure 58. Mass averaged tissue dose equivalent in male stomach behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

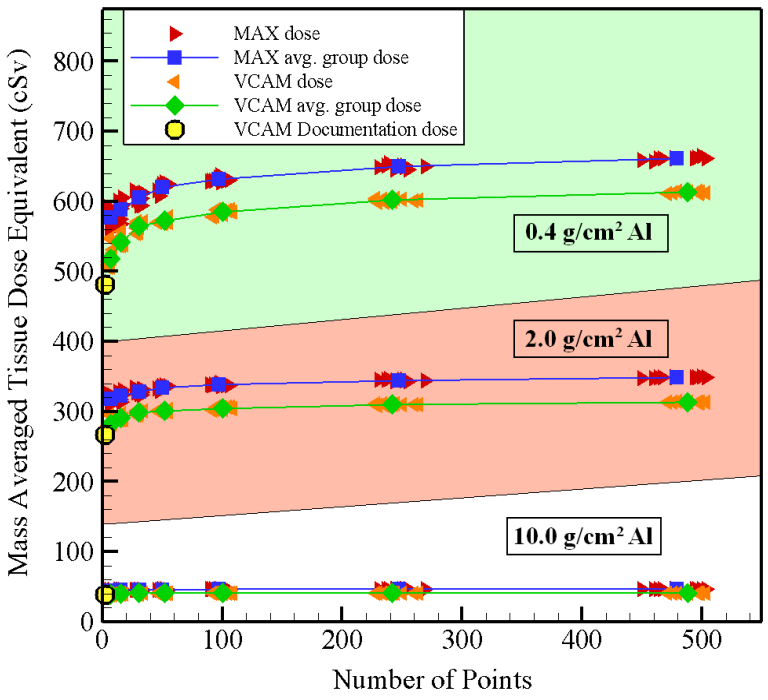

Figure 59. Mass averaged tissue dose equivalent in male testes behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

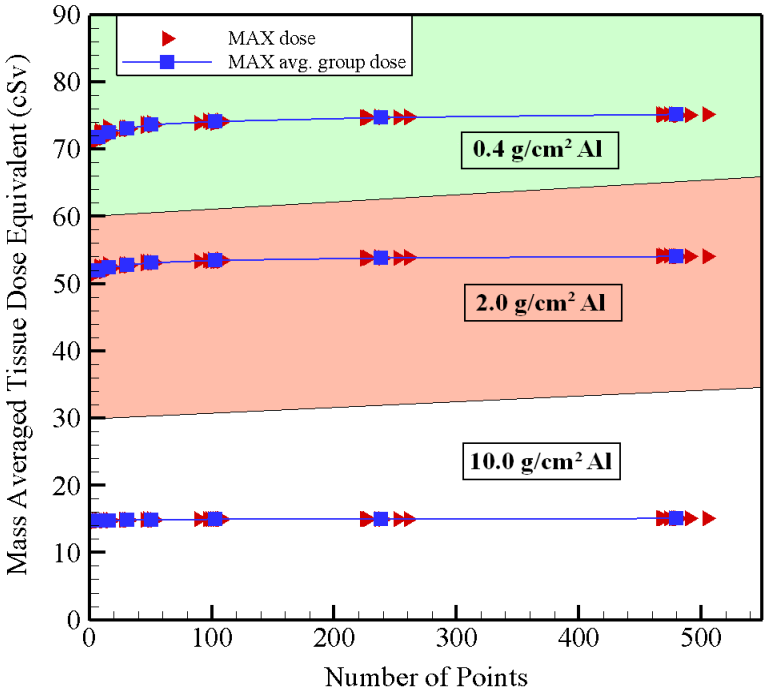

Figure 60. Mass averaged tissue dose equivalent in male thymus behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

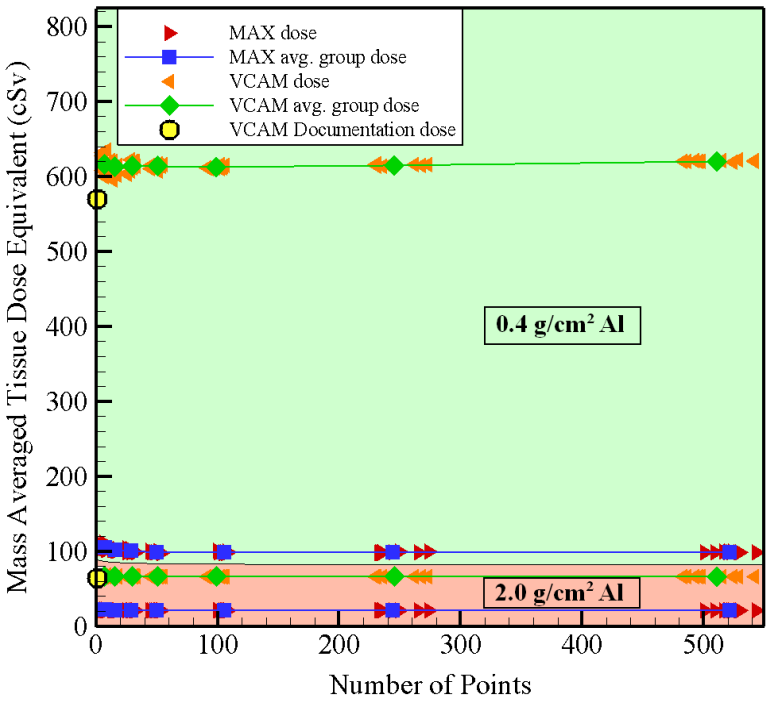

Figure 61. Mass averaged tissue dose equivalent in male thyroid behind various Aluminum shields exposed to the August 1972 King SPE spectrum.

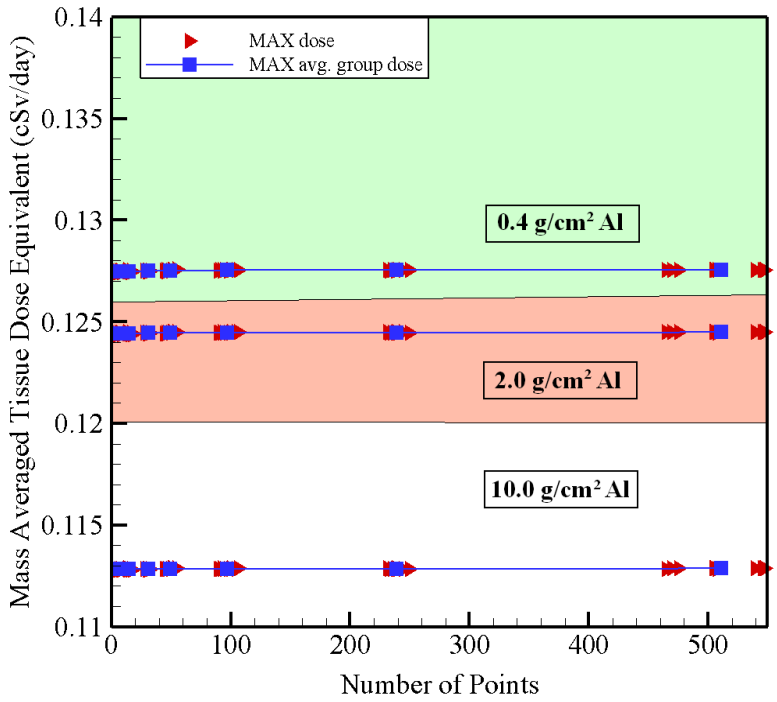

Figure 62. Mass averaged tissue dose equivalent in male adrenals behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

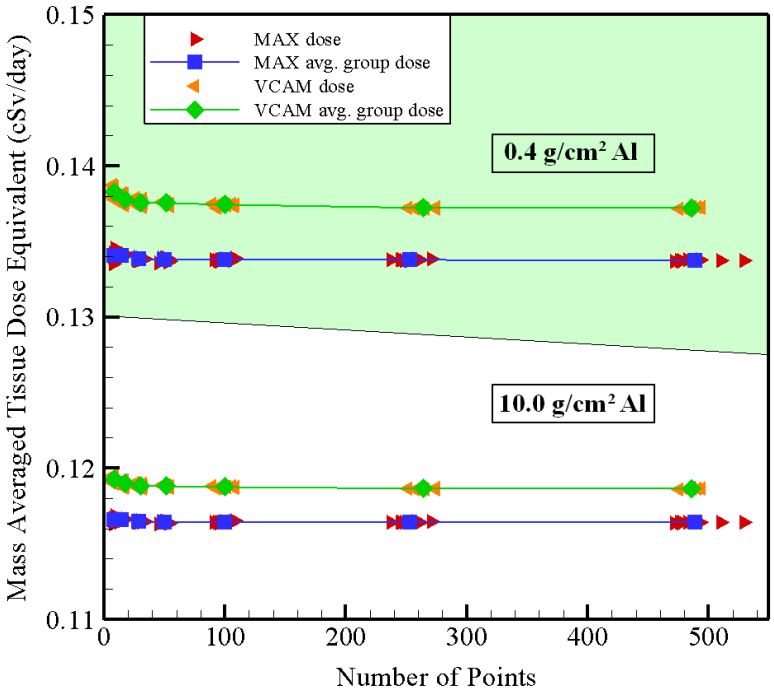

Figure 63. Mass averaged tissue dose equivalent in male bladder behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

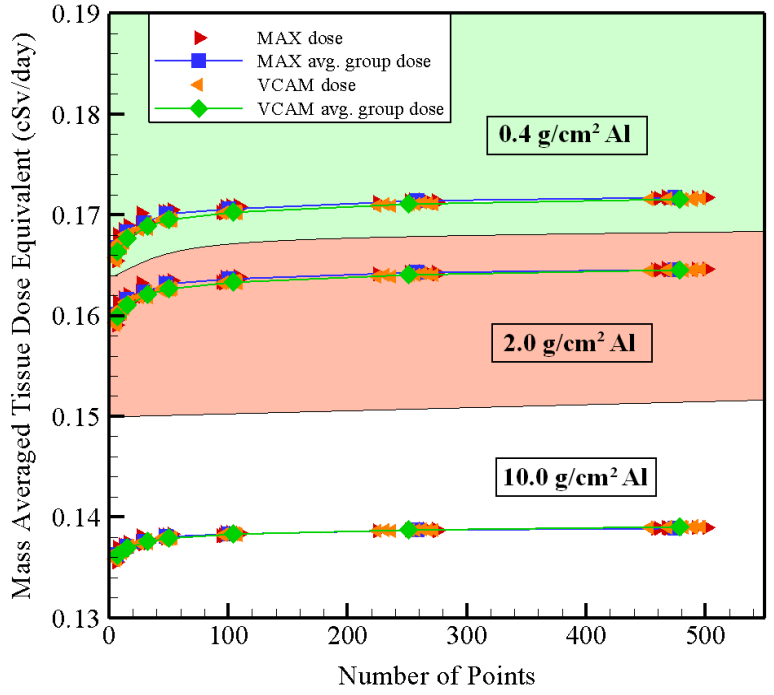

Figure 64. Mass averaged tissue dose equivalent in male brain behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

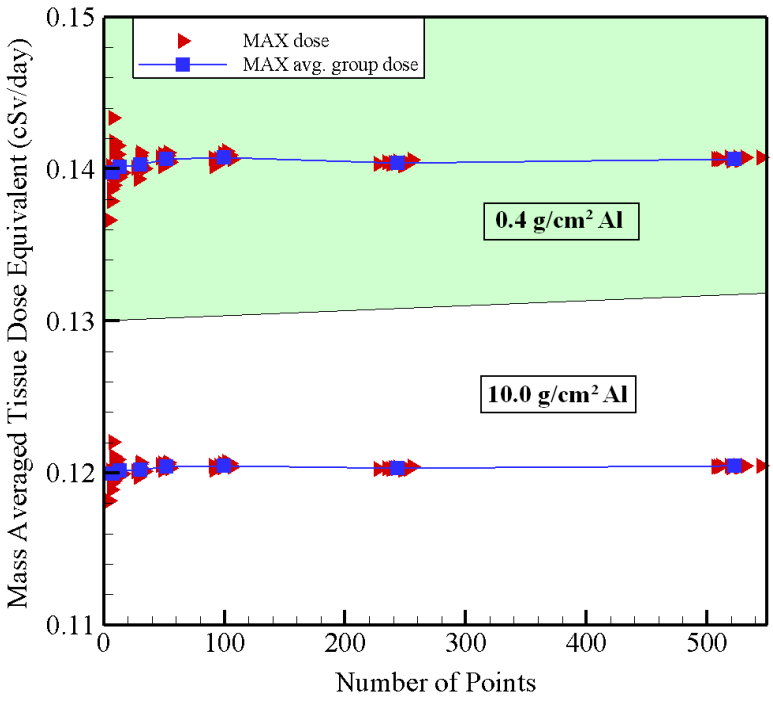

Figure 65. Mass averaged tissue dose equivalent in MAX colon behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

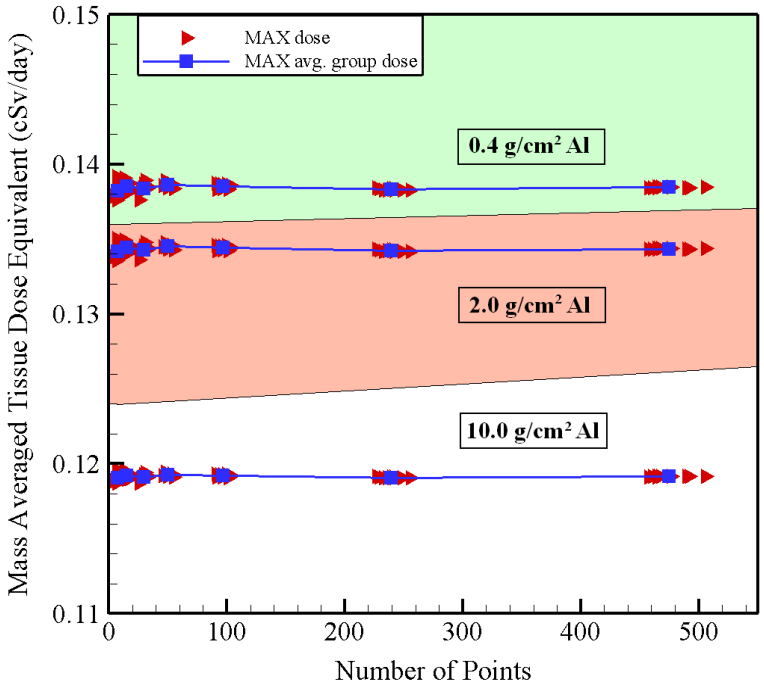

Figure 66. Mass averaged tissue dose equivalent in MAX small intestine behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

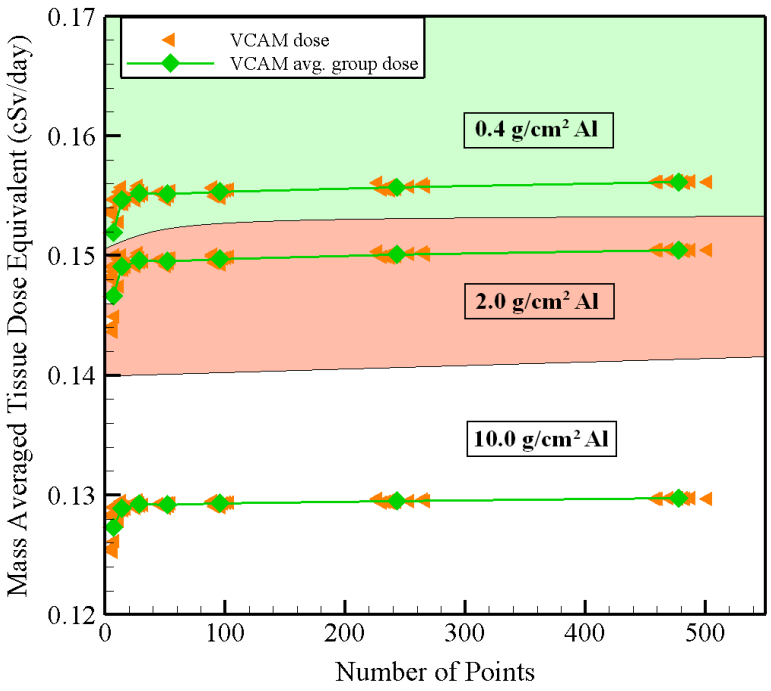

Figure 67. Mass averaged tissue dose equivalent in VCAM colon/intestines behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

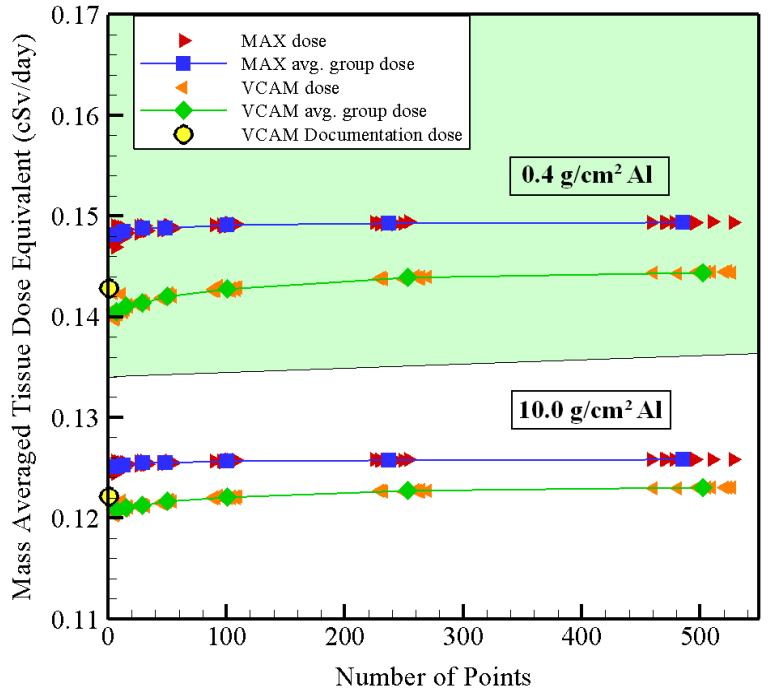

Figure 68. Mass averaged tissue dose equivalent in male heart behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

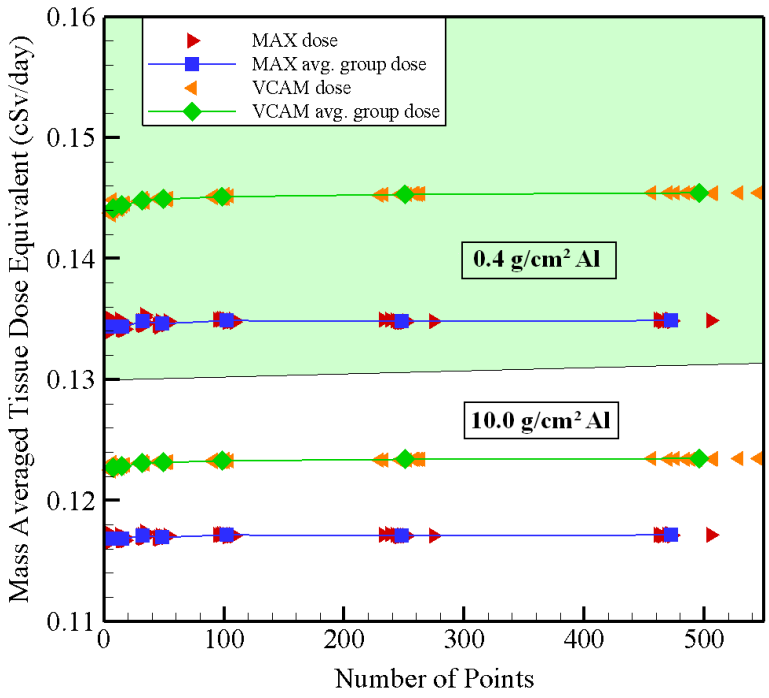

Figure 69. Mass averaged tissue dose equivalent in male kidneys behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

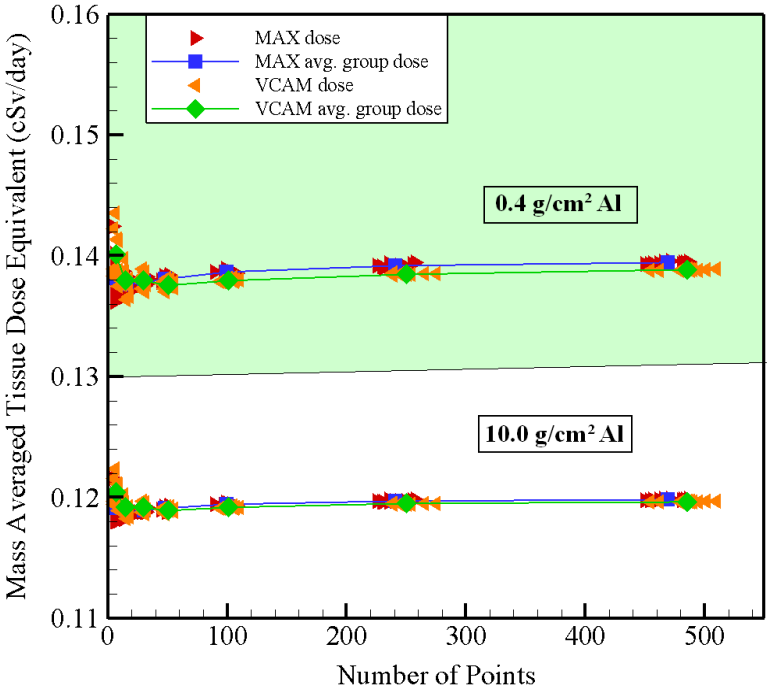

Figure 70. Mass averaged tissue dose equivalent in male liver behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

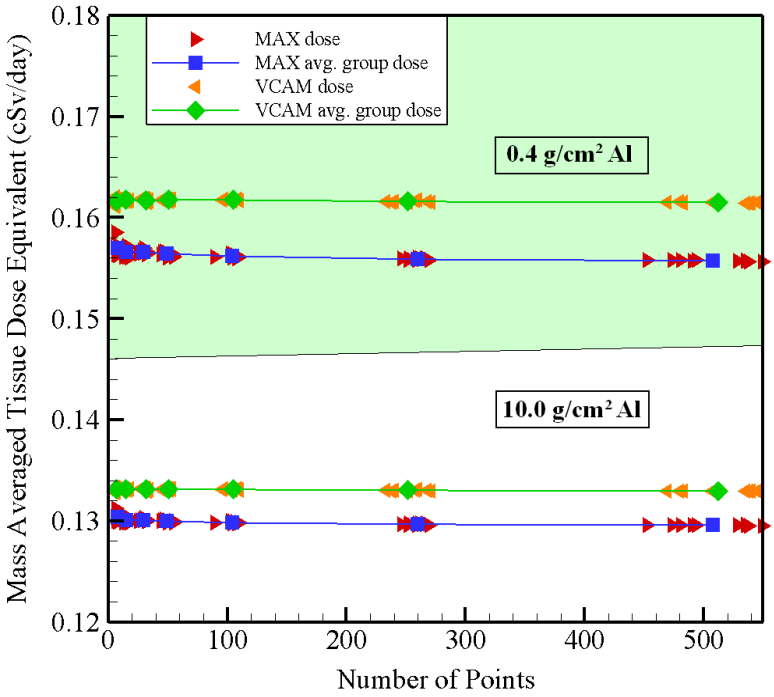

Figure 71. Mass averaged tissue dose equivalent in male lungs behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

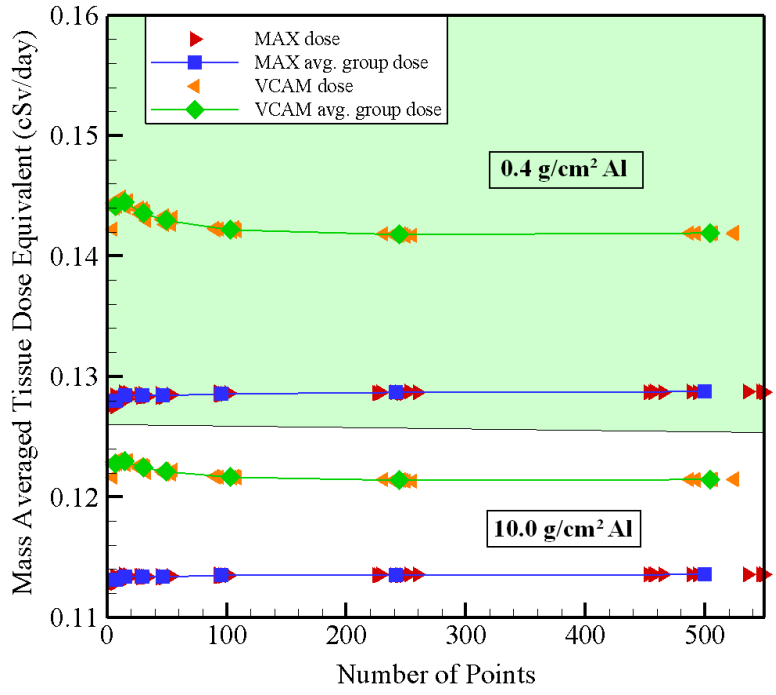

Figure 72. Mass averaged tissue dose equivalent in male pancreas behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

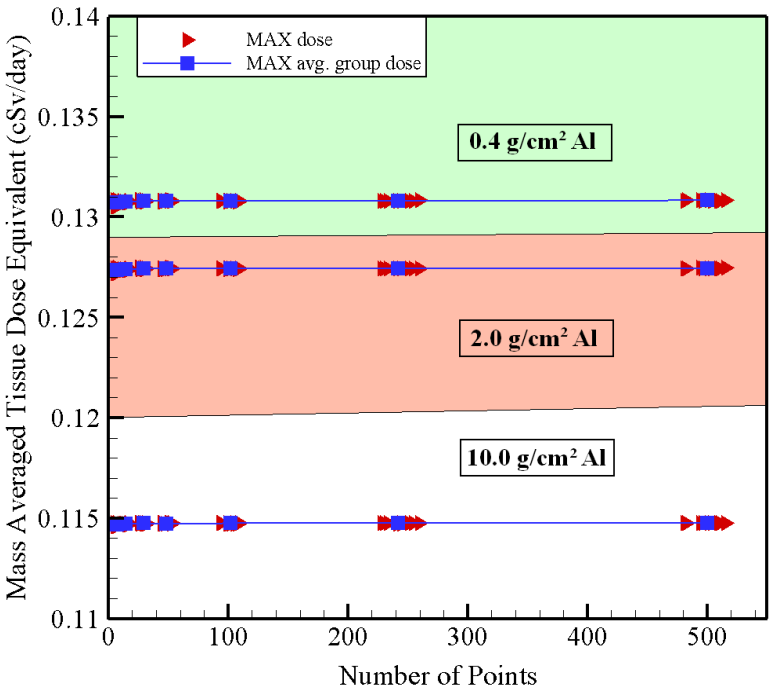

Figure 73. Mass averaged tissue dose equivalent in male prostate behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

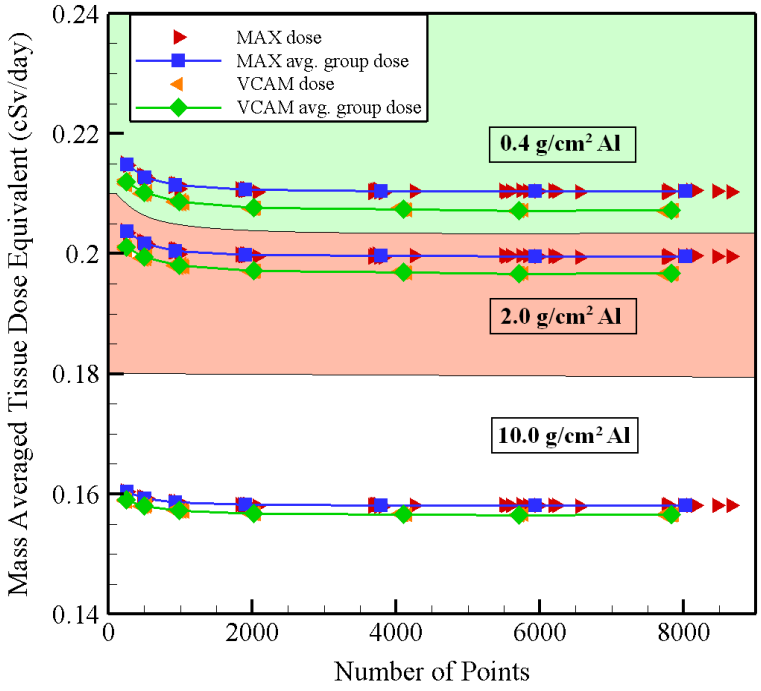

Figure 74. Mass averaged tissue dose equivalent in male skin behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

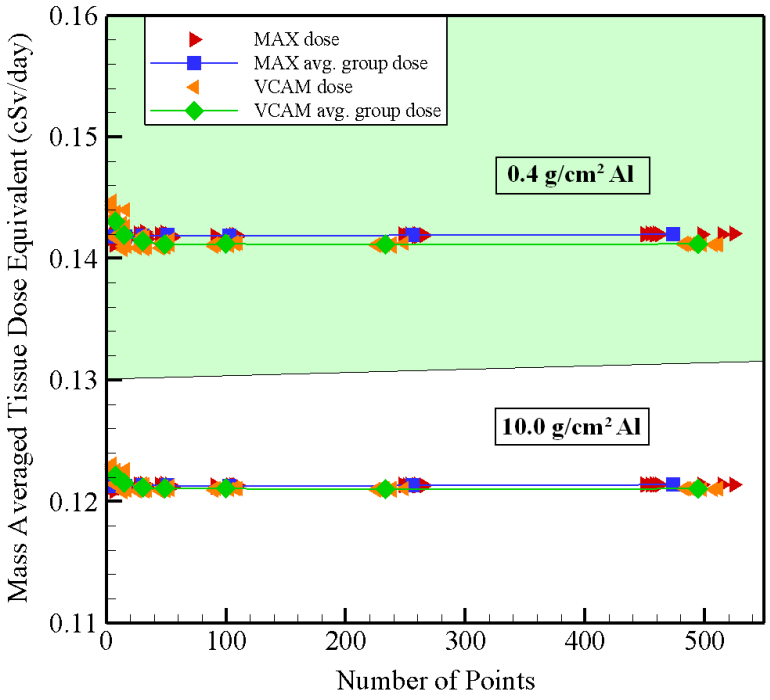

Figure 75. Mass averaged tissue dose equivalent in male spleen behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

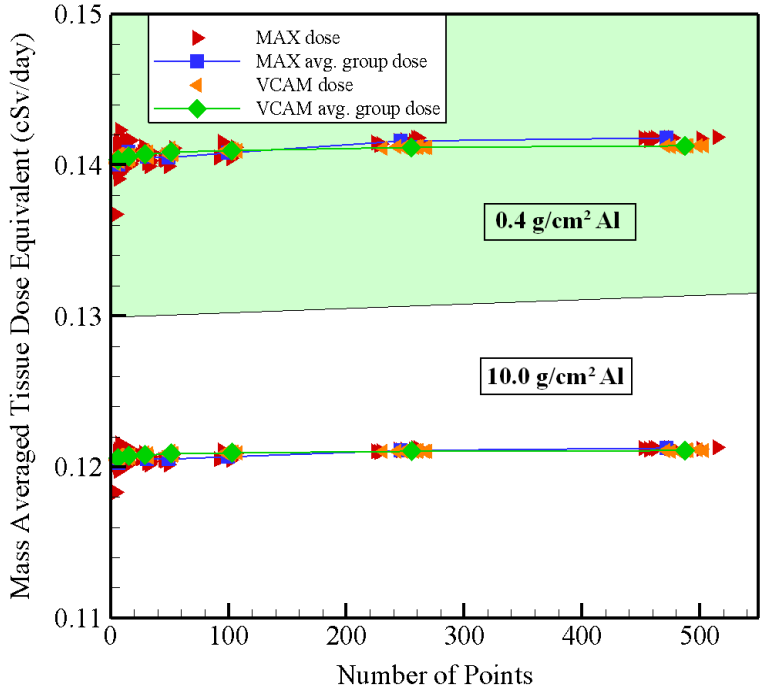

Figure 76. Mass averaged tissue dose equivalent in male stomach behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

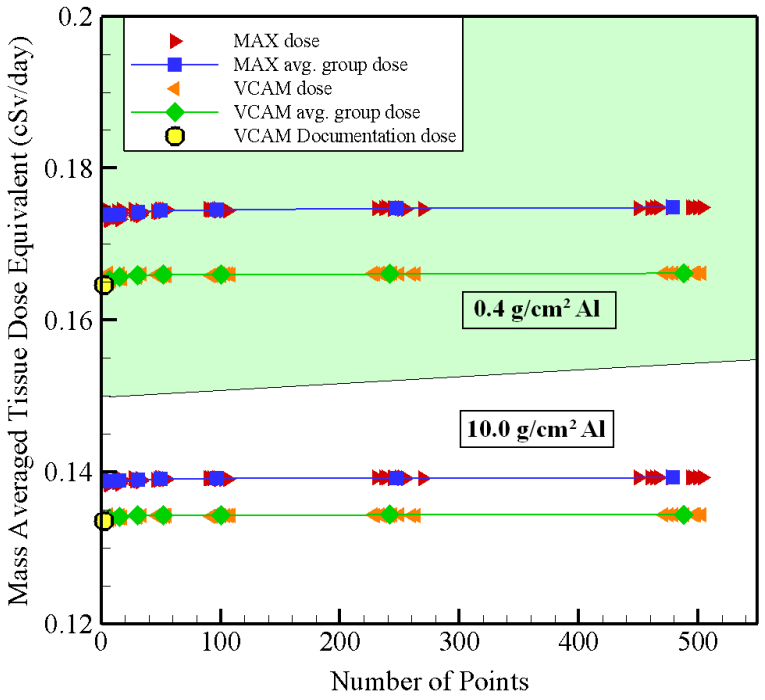

Figure 77. Mass averaged tissue dose equivalent in male testes behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

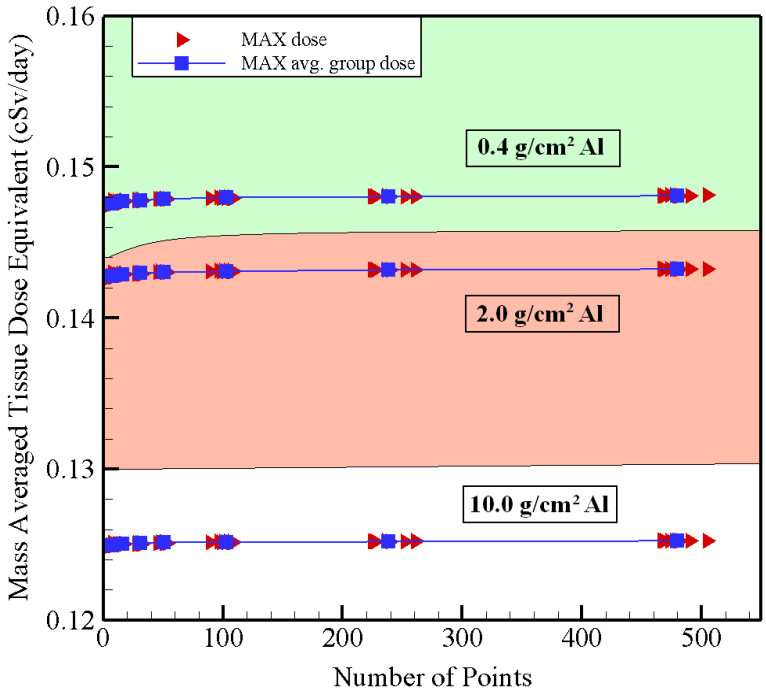

Figure 78. Mass averaged tissue dose equivalent in male thymus behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

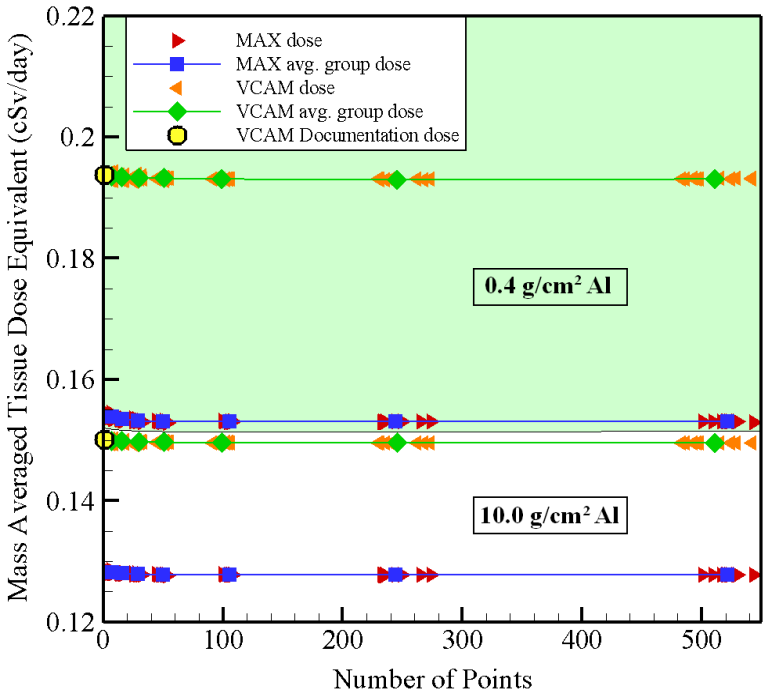

Figure 79. Mass averaged tissue dose equivalent in male thyroid behind various Aluminum shields exposed to the 1977 solar minimum GCR spectrum.

Table 1. Density (ρ in units of g/cm^3), mass (M in units of g), and volume (V in units of cm^3) comparisons for effective dose tissues in VCAM, MAX, and the ICRP Reference Male (lymphatic nodes, extrathoracic region, oral mucosa, gall bladder, salivary glands, and bone surface not listed). The symbol "-" in the density, mass, and volume columns of a given tissue and model indicates that this tissue type was not represented in the model.

Tissue	VCAM			MAX			ICRP89
	ρ	M	V	ρ	M	V	M
BFO	1.43	3815.40	2668.07	-	-	-	1170
Colon	-	-	-	1.05	607.020	578.114	670
Lung	0.257	1113.93	4334.34	0.26	1061.50	4082.68	1200
Stomach	1.058	568.947	537.757	1.05	399.993	380.946	400
Breast	-	-	-	-	-	-	25
Bladder	1.058	204.655	193.436	1.05	50.0176	47.6358	50
Esophagus	0.0	0.0	22.3949	1.05	40.0239	38.1180	40
Liver	1.058	1976.36	1868.01	1.05	1799.99	1714.28	1800
Thyroid	1.058	13.2290	12.5038	1.05	19.8405	18.8957	20
Brain	1.058	1383.52	1307.67	1.05	1450.02	1380.97	1450
Skin	-	-	-	1.09	6063.90	5563.21	3300
Adrenals	-	-	-	1.05	14.6962	13.9968	14
Heart	1.058	1472.42	1391.70	1.05	77.4023	73.7165	330
Kidneys	1.058	530.247	501.179	1.05	310.001	295.239	310
Muscle	1.06	46845.2	44193.6	1.05	30809.8	29342.7	29000
Pancreas	1.058	93.8866	88.7397	1.05	140.010	133.343	140
Small Intestine	-	-	-	1.05	1000.01	952.389	1000
Spleen	1.058	90.6287	85.6604	1.05	150.004	142.861	150
Thymus	-	-	-	1.05	24.9843	23.7946	25
Prostate	-	-	-	1.05	21.4571	20.4353	17
Testes	1.058	35.6888	33.7323	1.05	34.7331	33.0791	35

Table 2. Density (ρ in units of g/cm^3), mass (M in units of g), and volume (V in units of cm^3) comparisons for effective dose tissues in VCAF, FAX, and the ICRP Reference Male (lymphatic nodes, extrathoracic region, oral mucosa, gall bladder, salivary glands, and bone surface not listed). The symbol "-" in the density, mass, or volume columns of a given tissue and model indicates that this tissue type was not represented in the model.

Tissue	VCAF			FAX			ICRP89
	ρ	M	V	ρ	M	V	M
BFO	1.43	3074.33	2148.79	-	-	-	900
Colon	-	-	-	1.05	680.014	647.632	680
Lung	0.257	871.256	3376.96	0.26	950.004	3653.86	950
Stomach	1.058	444.456	420.091	1.05	370.013	352.393	370
Breast	1.02	610.033	598.223	1.05	500.000	476.171	500
Bladder	1.058	172.669	163.203	1.05	40.024	38.1180	40
Esophagus	0.0	0.0	13.1570	1.05	35.0270	33.3590	35
Liver	1.058	1548.69	1463.79	1.05	1400.00	1333.33	1400
Thyroid	1.058	9.28007	8.77133	1.05	17.0000	16.1896	17
Brain	1.058	1075.80	1016.82	1.05	1300.02	1238.11	1300
Skin	-	-	-	1.09	4995.39	4582.93	2300
Adrenals	-	-	-	1.05	13.0310	12.4105	13
Heart	1.058	1137.26	1074.91	1.05	620.002	590.478	250
Kidneys	1.058	414.987	392.237	1.05	275.023	261.927	275
Muscle	1.06	37635.3	35505.0	1.05	17553.1	16717.2	17500
Pancreas	1.058	73.1546	69.1442	1.05	120.022	114.307	120
Small Intestine	-	-	-	1.05	879.986	838.082	880
Spleen	1.058	69.4030	65.5983	1.05	130.016	123.825	130
Thymus	-	-	-	1.05	19.9874	19.0356	20
Uterus	1.058	49.5595	46.8426	1.05	80.0000	76.1892	80
Ovaries	1.058	18.6589	17.6360	1.05	10.7075	10.4976	11

Table 3. Number of tissue target points used in the recommended distributions for VCAM and VCAF. The symbol "-" is used to indicate the absence of a gender specific tissue.

Tissue	VCAM points	VCAF points
Adrenals	6	6
BFO	50	50
Bladder	16	14
Bone	50	50
Brain	96	90
Breast	10	225
Esophagus	11	11
Heart	90	92
Intestines	90	45
Kidneys	12	5
Liver	94	46
Lungs	5	6
Muscle	50	50
Ovaries	-	6
Pancreas	26	45
Prostate	9	-
Salivary Glands	12	12
Skin	224	493
Spleen	26	13
Stomach	5	12
Testes	12	-
Thymus	5	9
Thyroid	5	5
Uterus	-	5
Total	904	1290

Table 4. Number of tissue target points used in the recommended distributions for MAX and FAX. The symbol "-" is used to indicate the absence of a gender specific tissue.

Tissue	MAX points	FAX points
Adrenals	5	5
BFO	193	191
Bladder	7	6
Bone	193	191
Brain	94	90
Breast	10	90
Colon	27	45
Esophagus	12	11
Heart	5	26
Kidneys	5	5
Liver	90	95
Lungs	6	14
Muscle	108	115
Ovaries	-	5
Pancreas	5	5
Salivary Glands	12	12
Skin	241	229
Small Intestine	5	12
Spleen	5	5
Stomach	92	13
Testes	13	-
Thymus	5	12
Thyroid	5	13
Uterus	-	5
Total	1144	1195

Table 5. Tissue doses (H_T in units of cSv/day) and errors (ε_T in units of %) in FAX protected by various thicknesses of Aluminum exposed to the 1977 solar minimum GCR spectrum.

Tissue	w_T	0.4 g/cm^2		2.0 g/cm^2		10.0 g/cm^2	
		H_T	ε_T	H_T	ε_T	H_T	ε_T
Adrenals	0.01333	0.134569	0.544736	0.130895	0.505835	0.117107	0.358942
BFO	0.12	0.163785	0.43054	0.157231	0.403286	0.133818	0.286737
Bladder	0.04	0.135862	0.039909	0.132035	0.035731	0.117771	0.022627
Bone	0.01	0.163785	0.43054	0.157231	0.403286	0.133818	0.286737
Brain	0.01	0.175331	0.705142	0.167876	0.648509	0.141082	0.453967
Breast	0.12	0.185848	0.559465	0.176919	0.514202	0.145909	0.360181
Colon	0.12	0.146497	0.501341	0.141635	0.467254	0.123876	0.338366
Heart	0.01333	0.144002	0.412037	0.139507	0.38088	0.122817	0.266897
Kidneys	0.01333	0.140724	0.491448	0.136467	0.452809	0.120675	0.314431
Liver	0.04	0.146327	0.223136	0.141546	0.204226	0.123976	0.138958
Lungs	0.12	0.171179	0.053225	0.164018	0.061922	0.138397	0.074088
Muscle	0.01333	0.174593	0.43054	0.166933	0.403286	0.139901	0.286737
Esophagus	0.04	0.147643	0.43054	0.142811	0.403286	0.124951	0.286737
Ovaries	0.08	0.134562	0.076791	0.130879	0.072026	0.117075	0.053087
Pancreas	0.01333	0.134483	0.037381	0.13083	0.033391	0.117102	0.019717
Salivary Glands	0.01	0.183223	0.43054	0.174599	0.403286	0.144493	0.286737
Skin	0.01	0.215096	2.008794	0.203907	1.945034	0.160706	1.391962
Small Intestine	0.01333	0.142157	0.51509	0.137731	0.481683	0.121413	0.349756
Spleen	0.01333	0.147859	0.120915	0.142941	0.111476	0.124886	0.080204
Stomach	0.12	0.14432	0.287011	0.139741	0.262521	0.122833	0.178322
Thymus	0.01333	0.165556	0.471692	0.15893	0.43434	0.135115	0.305146
Thyroid	0.04	0.171659	0.454666	0.164291	0.417636	0.138243	0.290839
Uterus	0.01333	0.131767	0.246951	0.128346	0.229677	0.115447	0.163776

Table 6. Tissue doses (H_T in units of cSv) and errors (ε_T in units of %) in FAX protected by various thicknesses of Aluminum exposed to the August 1972 King SPE.

Tissue	w_T	0.4 g/cm^2		2.0 g/cm^2		10.0 g/cm^2	
		H_T	ε_T	H_T	ε_T	H_T	ε_T
Adrenals	0.01333	38.854	7.99134	29.26396	7.125602	9.814522	4.079884
BFO	0.12	340.4682	6.253128	186.3838	5.182756	29.97509	2.872593
Bladder	0.04	53.96372	2.399935	38.75756	1.879615	11.25939	0.731996
Bone	0.01	340.4682	6.253128	186.3838	5.182756	29.97509	2.872593
Brain	0.01	220.9121	11.24714	145.5799	9.260968	30.28954	5.000866
Breast	0.12	600.218	11.76631	338.5703	8.62753	49.57179	4.154405
Colon	0.12	115.8606	4.704768	77.48583	4.177092	17.62111	2.721737
Heart	0.01333	63.15146	7.100423	45.84783	6.116112	13.32985	3.324728
Kidneys	0.01333	62.28215	9.627124	45.11786	8.263433	12.94124	4.390473
Liver	0.04	96.56272	5.03809	65.84141	4.212742	16.10711	2.16625
Lungs	0.12	247.081	7.538501	158.1387	5.314912	30.71601	1.82689
Muscle	0.01333	396.517	6.253128	231.3393	5.182756	37.54691	2.872593
Ovaries	0.08	40.30139	0.438774	30.2773	0.447516	10.00816	0.362433
Esophagus	0.04	75.97644	6.253128	54.33501	5.182756	14.96856	2.872593
Pancreas	0.01333	36.90725	1.109174	27.98405	1.056422	9.602227	0.635459
Salivary Glands	0.01	907.8467	6.253128	424.5596	5.182756	51.22705	2.872593
Skin	0.01	5163.727	11.39566	1429.82	9.827907	107.5164	7.302136
Small Intestine	0.01333	80.92663	1.600157	56.52276	2.17077	14.56118	2.38652
Spleen	0.01333	95.39568	4.157492	66.30304	3.153247	16.62124	1.214423
Stomach	0.12	76.64496	6.993247	54.4222	5.883854	14.60759	2.961808
Thymus	0.01333	213.2616	7.376755	137.3422	6.077362	27.36069	3.32374
Thyroid	0.04	372.0256	8.448009	218.6002	6.45496	35.60503	3.293231
Uterus	0.01333	31.14806	3.623404	23.94731	3.239569	8.685125	1.829687

Table 7. Tissue doses (H_T in units of cSv/day) and errors (ε_T in units of %) in MAX protected by various thicknesses of Aluminum exposed to the 1977 solar minimum GCR spectrum.

Tissue	w_T	0.4 g/cm^2		2.0 g/cm^2		10.0 g/cm^2	
		H_T	ε_T	H_T	ε_T	H_T	ε_T
Adrenals	0.01333	0.127517	0.022989	0.124458	0.021654	0.112844	0.016973
BFO	0.12	0.156889	0.578773	0.151012	0.54362	0.129848	0.39081
Bladder	0.04	0.133925	0.142929	0.130243	0.131121	0.116508	0.09042
Bone	0.01	0.156889	0.578773	0.151012	0.54362	0.129848	0.39081
Brain	0.01	0.170234	0.852295	0.163274	0.787876	0.138142	0.559717
Breast	0.12	0.15749	0.578773	0.151605	0.54362	0.130367	0.39081
Colon	0.12	0.140078	0.411586	0.135823	0.380428	0.120117	0.267447
Heart	0.01333	0.147624	1.16745	0.142755	1.093095	0.124818	0.806311
Kidneys	0.01333	0.135105	0.160052	0.131337	0.152227	0.117272	0.116816
Liver	0.04	0.138672	0.530908	0.134585	0.491706	0.119414	0.347134
Lungs	0.12	0.157042	0.837926	0.151301	0.79576	0.130379	0.615942
Muscle	0.01333	0.168552	0.578773	0.1615	0.54362	0.13646	0.39081
Esophagus	0.04	0.14248	0.578773	0.138108	0.54362	0.12186	0.39081
Pancreas	0.01333	0.127617	0.856899	0.124548	0.799852	0.1129	0.579023
Prostate	0.01333	0.130818	0.002062	0.127448	0.002072	0.114754	0.00175
Salivary Glands	0.01	0.178716	0.578773	0.170527	0.54362	0.141875	0.39081
Skin	0.01	0.215036	2.211794	0.203834	2.143926	0.160537	1.53297
Small Intestine	0.01333	0.137879	0.410415	0.133842	0.373875	0.118862	0.246884
Spleen	0.01333	0.141688	0.227862	0.137324	0.210253	0.121198	0.147503
Stomach	0.12	0.140516	0.885198	0.136262	0.822142	0.120513	0.588801
Testes	0.08	0.174321	0.276306	0.166415	0.258773	0.139008	0.187468
Thymus	0.01333	0.14747	0.434878	0.142666	0.404904	0.124886	0.291869
Thyroid	0.04	0.15367	0.407592	0.148137	0.371872	0.128092	0.246747

Table 8. Tissue doses (H_T in units of cSv) and errors (ε_T in units of %) in MAX protected by various thicknesses of Aluminum exposed to the August 1972 King SPE.

Tissue	w_T	0.4 g/cm^2		2.0 g/cm^2		10.0 g/cm^2	
		H_T	ε_T	H_T	ε_T	H_T	ε_T
Adrenals	0.01333	22.57753	0.506346	17.83119	0.445307	7.232978	0.226087
BFO	0.12	260.001	6.653977	145.1948	5.70835	24.98988	3.378763
Bladder	0.04	52.47376	4.657749	37.5229	3.781636	10.85739	1.672259
Bone	0.01	260.001	6.653977	145.1948	5.70835	24.98988	3.378763
Brain	0.01	184.9891	11.38064	124.0079	9.665095	27.05103	5.535749
Breast	0.12	185.4311	6.653977	118.6345	5.70835	23.73213	3.378763
Colon	0.12	76.39754	6.536713	53.393	5.67296	13.87676	3.201204
Heart	0.01333	86.16912	10.11588	60.60715	9.119222	15.82185	5.941057
Kidneys	0.01333	47.87228	1.607904	35.24983	1.075144	10.83803	0.015064
Liver	0.04	63.07226	8.141043	44.92247	7.077709	12.51504	3.997371
Lungs	0.12	131.2113	0.087125	89.15244	0.90358	20.7103	1.938025
Muscle	0.01333	313.9468	6.653977	189.4852	5.70835	32.77876	3.378763
Esophagus	0.04	59.76495	6.653977	43.59103	5.70835	12.85864	3.378763
Pancreas	0.01333	22.97772	10.67654	18.11223	9.658089	7.292625	5.641159
Prostate	0.01333	33.08429	0.44672	25.09002	0.310049	8.763748	0.070515
Salivary Glands	0.01	888.4779	6.653977	408.6492	5.70835	48.5747	3.378763
Skin	0.01	5254.18	12.57518	1453.053	10.72319	108.849	7.982068
Small Intestine	0.01333	61.35929	10.02272	44.10258	8.631302	12.43842	4.527
Spleen	0.01333	74.90449	4.91194	52.79783	4.038344	14.00789	1.957382
Stomach	0.12	69.7464	12.42046	49.26329	10.73213	13.32579	6.141184
Testes	0.08	600.3036	9.208908	327.9336	5.93256	45.28581	2.467789
Thymus	0.01333	71.14749	5.312577	51.536	4.712702	14.63944	2.812399
Thyroid	0.04	159.07	4.509165	103.5474	4.562926	21.5948	3.312654

Table 9. Tissue doses (H_T in units of cSv/day) and errors (ε_T in units of %) in VCAF protected by various thicknesses of Aluminum exposed to the 1977 solar minimum GCR spectrum.

Tissue	w_T	0.4 g/cm^2		2.0 g/cm^2		10.0 g/cm^2	
		H_T	ε_T	H_T	ε_T	H_T	ε_T
Adrenals	0.01333	0.147417	0.59921	0.14256	0.561331	0.124696	0.40743
BFO	0.12	0.15837	0.59921	0.152361	0.561331	0.130774	0.40743
Bladder	0.04	0.141484	0.421926	0.137173	0.3943	0.121206	0.286773
Bone	0.01	0.172481	0.59921	0.165044	0.561331	0.138739	0.40743
Brain	0.01	0.175055	0.801782	0.167672	0.742595	0.141061	0.531329
Breast	0.12	0.188995	0.292986	0.179679	0.274266	0.14752	0.192367
Heart	0.01333	0.145337	1.221636	0.140741	1.139914	0.123681	0.827678
Intestines	0.13333	0.159546	0.168832	0.153544	0.14232	0.131775	0.066261
Kidneys	0.01333	0.14818	0.754392	0.143258	0.6957	0.125153	0.486933
Liver	0.04	0.141421	0.638644	0.137157	0.591391	0.121293	0.416064
Lungs	0.12	0.164397	0.038379	0.157969	0.030345	0.134697	0.012848
Muscle	0.01333	0.176123	0.59921	0.168288	0.561331	0.140527	0.40743
Esophagus	0.04	0.181996	0.59921	0.173535	0.561331	0.143966	0.40743
Ovaries	0.08	0.145136	0.229131	0.140541	0.214066	0.123495	0.156499
Pancreas	0.01333	0.14724	1.340154	0.142411	1.249113	0.124636	0.901303
Salivary Glands	0.01	0.190804	0.59921	0.181486	0.561331	0.148874	0.40743
Skin	0.01	0.212242	1.422622	0.201326	1.383201	0.159349	0.979701
Spleen	0.01333	0.145655	0.14614	0.140994	0.144295	0.123759	0.124722
Stomach	0.12	0.14439	0.304578	0.139845	0.281032	0.123024	0.19607
Thymus	0.01333	0.16302	0.59921	0.156644	0.561331	0.133677	0.40743
Thyroid	0.04	0.19837	0.930345	0.188081	0.882138	0.152631	0.754903
Uterus	0.01333	0.143655	0.276599	0.139204	0.255285	0.12266	0.177996

Table 10. Tissue doses (H_T in units of cSv) and errors (ε_T in units of %) in VCAF protected by various thicknesses of Aluminum exposed to the August 1972 King SPE.

Tissue	w_T	0.4 g/cm^2		2.0 g/cm^2		10.0 g/cm^2	
		H_T	ε_T	H_T	ε_T	H_T	ε_T
Adrenals	0.01333	90.08251	7.500921	63.10714	6.460531	16.13872	3.732861
BFO	0.12	242.1857	7.500921	143.9125	6.460531	25.60895	3.732861
Bladder	0.04	70.8384	2.633481	49.79629	2.817132	13.42552	2.190281
Bone	0.01	407.5006	7.500921	229.2738	6.460531	36.27371	3.732861
Brain	0.01	200.904	9.883536	134.3492	8.45244	29.03414	4.933166
Breast	0.12	826.9308	7.980724	428.6347	5.25715	55.83973	2.340269
Heart	0.01333	64.09584	13.42012	46.59067	11.94248	13.58885	7.281193
Intestines	0.13333	152.9014	10.70866	102.4048	8.253269	22.72558	3.62458
Kidneys	0.01333	87.7629	12.85576	62.12285	11.03251	16.23864	6.041343
Liver	0.04	58.89951	9.284264	42.65793	8.293674	12.50208	4.84824
Lungs	0.12	163.303	5.229509	110.3733	3.901589	24.58905	1.411373
Muscle	0.01333	812.2219	7.500921	353.7194	6.460531	43.95657	3.732861
Esophagus	0.04	636.3318	7.500921	334.5423	6.460531	46.2102	3.732861
Ovaries	0.08	62.97325	2.620022	46.23178	2.328627	13.67081	1.390894
Pancreas	0.01333	87.63355	13.01544	61.50911	11.98094	15.88355	7.882668
Salivary Glands	0.01	1086.234	7.500921	482.5002	6.460531	56.46993	3.732861
Skin	0.01	4808.764	9.33035	1339.934	7.790247	102.2423	5.588047
Spleen	0.01333	72.84912	4.534058	52.36164	3.488616	14.5265	1.078752
Stomach	0.12	71.30305	5.813468	50.93521	4.88489	14.06049	2.527756
Thymus	0.01333	206.6582	7.500921	130.8396	6.460531	25.87427	3.732861
Thyroid	0.04	1568.494	0.091858	682.7796	2.021948	71.75787	2.417568
Uterus	0.01333	58.1069	5.112563	42.83031	4.462461	12.94462	2.436786

Table 11. Tissue doses (H_T in units of cSv/day) and errors (ε_T in units of %) in VCAM protected by various thicknesses of Aluminum exposed to the 1977 solar minimum GCR spectrum.

Tissue	w_T	0.4 g/cm^2		2.0 g/cm^2		10.0 g/cm^2	
		H_T	ε_T	H_T	ε_T	H_T	ε_T
Adrenals	0.01333	0.144209	0.740173	0.13963	0.693826	0.122739	0.499321
BFO	0.12	0.154962	0.740173	0.149264	0.693826	0.128739	0.499321
Bladder	0.04	0.138296	0.714517	0.134263	0.667404	0.119268	0.485266
Bone	0.01	0.168758	0.740173	0.161686	0.693826	0.136582	0.499321
Brain	0.01	0.170141	0.843997	0.16324	0.780803	0.138244	0.555432
Breast	0.12	0.186536	0.740173	0.177393	0.693826	0.145925	0.499321
Heart	0.01333	0.142758	1.146804	0.138369	1.070833	0.122061	0.778989
Intestines	0.13333	0.155707	0.300854	0.150062	0.268424	0.129508	0.16426
Kidneys	0.01333	0.144349	0.743789	0.139763	0.689777	0.122833	0.491852
Liver	0.04	0.137866	0.692661	0.1339	0.643486	0.1191	0.458796
Lungs	0.12	0.161484	0.007846	0.15533	0.00412	0.132987	0.028361
Muscle	0.01333	0.173211	0.740173	0.165319	0.693826	0.138765	0.499321
Esophagus	0.04	0.179013	0.740173	0.170824	0.693826	0.142181	0.499321
Pancreas	0.01333	0.143856	1.381705	0.139325	1.289928	0.122586	0.934189
Prostate	0.01333	0.137585	0.740173	0.133537	0.693826	0.118619	0.499321
Salivary Glands	0.01	0.187998	0.740173	0.178937	0.693826	0.14721	0.499321
Skin	0.01	0.211727	2.172955	0.200851	2.10276	0.158907	1.494436
Spleen	0.01333	0.140886	0.219416	0.136646	0.199772	0.120884	0.13162
Stomach	0.12	0.140334	0.657457	0.13615	0.607024	0.120583	0.42361
Testes	0.08	0.165659	0.305172	0.158613	0.289405	0.13407	0.213016
Thymus	0.01333	0.164318	0.740173	0.15773	0.693826	0.13419	0.499321
Thyroid	0.04	0.193996	0.43507	0.184107	0.405996	0.150079	0.33134

Table 12. Tissue doses (H_T in units of cSv) and errors (ε_T in units of %) in VCAM protected by various thicknesses of Aluminum exposed to the August 1972 King SPE.

Tissue	w_T	0.4 g/cm^2		2.0 g/cm^2		10.0 g/cm^2	
		H_T	ε_T	H_T	ε_T	H_T	ε_T
Adrenals	0.01333	79.69402	9.30282	56.30277	7.941633	14.84844	4.661721
BFO	0.12	214.6112	9.30282	129.5632	7.941633	23.74173	4.661721
Bladder	0.04	60.09813	6.640493	42.80729	6.214722	12.11152	4.074245
Bone	0.01	359.8549	9.30282	204.8836	7.941633	33.51519	4.661721
Brain	0.01	168.353	11.2411	114.3493	9.601927	25.90263	5.509579
Breast	0.12	1080.917	9.30282	514.7048	7.941633	59.13779	4.661721
Heart	0.01333	60.43199	11.95082	43.97222	10.71815	12.91444	6.659857
Intestines	0.13333	134.5774	9.778067	90.57371	7.851398	20.67911	3.828275
Kidneys	0.01333	76.06511	10.77816	54.25214	9.360399	14.66378	5.310855
Liver	0.04	50.44275	9.702686	36.9836	8.568474	11.30283	4.943407
Lungs	0.12	146.4818	7.196548	99.98841	5.605998	22.94397	2.221986
Muscle	0.01333	741.7924	9.30282	334.0532	7.941633	42.09457	4.661721
Esophagus	0.04	624.4971	9.30282	325.7814	7.941633	44.72931	4.661721
Pancreas	0.01333	74.942	11.50947	53.31769	10.87178	14.39966	7.597537
Prostate	0.01333	158.0366	9.30282	81.11972	7.941633	14.67722	4.661721
Salivary Glands	0.01	1060.492	9.30282	470.3265	7.941633	54.86903	4.661721
Skin	0.01	4938.289	13.03713	1369.943	11.16275	103.5588	8.249982
Spleen	0.01333	58.37476	5.983289	42.59319	5.092792	12.55621	2.55187
Stomach	0.12	56.83063	11.98137	41.45817	10.32724	12.28699	5.544734
Testes	0.08	545.8215	10.95634	292.1713	6.75657	39.66848	2.78812
Thymus	0.01333	290.0156	9.30282	170.1229	7.941633	29.2332	4.661721
Thyroid	0.04	1401.954	0.181194	627.4691	1.109023	67.57739	1.321927

Table 13. Computed effective dose (E_{comp} in units of cSv) and effective dose error (E_{error} in units of cSv) in VCAM, VCAF, MAX, and FAX protected by various thicknesses of Aluminum exposed to the August 1972 King SPE.

Model	Points	0.4 g/cm^2		2.0 g/cm^2		10.0 g/cm^2	
		E_{comp}	E_{error}	E_{comp}	E_{error}	E_{comp}	E_{error}
VCAM	904	412.7445	35.65472	203.7957	14.46095	29.78305	1.204615
VCAF	1278	360.0135	23.49756	182.5079	9.83182	28.65358	0.851838
MAX	1144	223.7977	18.58547	118.0012	7.284768	21.27758	0.736365
FAX	1195	272.7068	23.9954	146.036	9.574895	25.2135	0.784092

Table 14. Computed effective dose (E_{comp} in units of cSv/day) and effective dose error (E_{error} in units of cSv/day) in VCAM, VCAF, MAX, and FAX protected by various thicknesses of Aluminum exposed to the 1977 solar minimum GCR spectrum.

Model	Points	0.4 g/cm^2		2.0 g/cm^2		10.0 g/cm^2	
		E_{comp}	E_{error}	E_{comp}	E_{error}	E_{comp}	E_{error}
VCAM	904	0.160447	0.000897	0.154186	0.000804	0.131785	0.000493
VCAF	1278	0.16188	0.000658	0.155546	0.000588	0.132799	0.000358
MAX	1144	0.151003	0.000884	0.145708	0.000799	0.126460	0.000501
FAX	1195	0.157137	0.000573	0.151247	0.000514	0.13004	0.000314

Table 15. Percent difference (%) between mass averaged tissue doses in MAX and VCAM.

Tissue	1977 solar min. GCR			August 1972 SPE		
	0.4 g/cm^2	2.0 g/cm^2	10.0 g/cm^2	0.4 g/cm^2	2.0 g/cm^2	10.0 g/cm^2
Adrenals	12.28591	11.49011	8.400436	111.6958	103.7894	68.9762
BFO	1.235847	1.164262	0.857738	19.12711	11.37845	5.122548
Bladder	3.211361	3.039629	2.341205	13.54578	13.15667	10.92024
Bone	7.289488	6.827034	5.054986	32.21842	34.10025	29.14383
Brain	0.054646	0.020826	0.07381	9.416427	8.104307	4.337377
Breast	16.88593	15.67669	11.262	141.4281	125.0737	85.44876
Heart	3.351447	3.120331	2.233483	35.11178	31.81302	20.23511
Kidneys	6.615758	6.216156	4.63214	45.49528	42.46233	30.00375
Liver	0.582922	0.510271	0.263297	22.2517	19.3853	10.179
Lungs	2.789097	2.627914	1.980514	10.99811	11.4581	10.23345
Muscle	2.726451	2.337073	1.674993	81.05138	55.22728	24.88419
Esophagus	22.72709	21.18007	15.39231	165.0631	152.7945	110.6852
Pancreas	11.96362	11.20008	8.226391	106.1365	98.57343	65.52592
Prostate	5.042418	4.666169	3.312294	130.7574	105.5076	50.45416
Salivary Glands	5.062256	4.813085	3.690956	17.6518	14.0339	12.16957
Skin	1.550744	1.474233	1.020523	6.198518	5.888071	4.981173
Spleen	0.567639	0.494945	0.259416	24.80466	21.39539	10.92964
Stomach	0.129607	0.082228	0.058068	20.40776	17.20678	8.111576
Testes	5.095594	4.800817	3.616549	9.507182	11.53427	13.22436
Thymus	10.80734	10.02943	7.182448	121.2018	106.9994	66.52784
Thyroid	23.19813	21.65276	15.80826	159.2396	143.3406	103.1321

Table 16. Percent difference (%) between mass averaged tissue doses in FAX and VCAF.

Tissue	1977 solar min. GCR			August 1972 SPE		
	0.4 g/cm^2	2.0 g/cm^2	10.0 g/cm^2	0.4 g/cm^2	2.0 g/cm^2	10.0 g/cm^2
Adrenals	9.112509	8.531568	6.277011	79.46316	73.27656	48.73532
BFO	3.361736	3.146076	2.300901	33.73615	25.71709	15.71005
Bladder	4.054142	3.817123	2.874754	27.0423	24.93111	17.55024
Bone	5.172096	4.848654	3.610988	17.92385	20.63718	19.01505
Brain	0.157541	0.121592	0.014886	9.486646	8.02396	4.232374
Breast	1.679103	1.547962	1.098051	31.77143	23.47857	11.89232
Heart	0.922793	0.880649	0.70102	1.484322	1.607209	1.924313
Kidneys	5.161576	4.855483	3.643198	33.96413	31.71368	22.6005
Liver	3.409928	3.149589	2.187802	48.4532	42.73479	25.2019
Lungs	4.042005	3.757295	2.70969	40.82908	35.57785	22.15696
Muscle	0.872501	0.808422	0.44646	68.78324	41.83515	15.72856
Esophagus	20.8428	19.4243	14.14191	176.1753	166.803	128.7908
Ovaries	7.561012	7.119593	5.337324	18.7164	16.11512	9.062699
Pancreas	9.056414	8.476766	6.233195	81.46134	74.92206	49.29277
Salivary Glands	4.053718	3.868178	2.986703	17.89168	12.77548	9.736355
Skin	1.335711	1.273835	0.847979	7.118843	6.49054	5.028731
Spleen	1.501802	1.371441	0.906513	26.80209	23.49713	13.45035
Stomach	0.048492	0.074396	0.155375	7.221334	6.619354	3.816789
Thymus	1.543631	1.448789	1.069972	3.145077	4.849397	5.584375
Thyroid	14.43725	13.50278	9.892943	123.3142	102.9931	67.34699
Uterus	8.632571	8.116614	6.058621	60.40861	56.55488	39.38553

Table 17. Segmented weighting factors for BFO in MAX and FAX.

Specific Bone	BFO mass percentage (%)
Upper arm bones	0.023
Ribcage (ribs, sternum, clavicles, scapulae)	0.228
Spine/sacrum	0.422
Skull/Mandible	0.084
Pelvis	0.175
Upper leg bones	0.067

Table 18. Segmented weighting factors for muscle in MAX and FAX.

Muscle Segment	MAX Weighting Factor	FAX Weighting Factor
Head and Neck	0.038592	0.014214
Upper Torso	0.104058	0.196370
Mid Torso	0.087828	0.122788
Lower Torso	0.214296	0.204651
Upper Legs	0.301527	0.232155
Lower Legs	0.121689	0.140482
Left Arm	0.069350	0.054665
Right Arm	0.062660	0.034674

Table 19. BFO doses (cSv/day) in FAX protected by various thicknesses of Aluminum exposed to the 1977 solar minimum GCR spectrum.

BFO Segment	Points	Weight	0.4 g/cm^2	2.0 g/cm^2	10.0 g/cm^2
Left Arm	20	0.0115	0.173374	0.165947	0.139493
Left Leg	22	0.0335	0.150736	0.145585	0.126657
Mandible	14	0.042	0.177783	0.169772	0.14166
Pelvis	27	0.175	0.137154	0.133198	0.118484
Ribs	23	0.228	0.169537	0.162393	0.137068
Right Arm	20	0.0115	0.173699	0.166241	0.139686
Right Leg	22	0.0335	0.150574	0.145439	0.126564
Skull	19	0.042	0.198934	0.188633	0.153183
Spine	24	0.422	0.142277	0.137866	0.121566
Average			0.163785	0.157231	0.133818
Weighted Avg.			0.152604	0.147137	0.127364

Table 20. BFO doses (cSv) in FAX protected by various thicknesses of Aluminum exposed to the August 1972 King SPE spectrum.

BFO Segment	Points	Weight	0.4 g/cm^2	2.0 g/cm^2	10.0 g/cm^2
Left Arm	20	0.0115	283.9716	178.06	33.20581
Left Leg	22	0.0335	90.99732	64.65514	16.98474
Mandible	14	0.042	546.2884	293.9371	42.09913
Pelvis	27	0.175	56.48458	40.79156	11.82719
Ribs	23	0.228	372.797	212.3238	34.15437
Right Arm	20	0.0115	287.8256	179.9867	33.41457
Right Leg	22	0.0335	90.3248	64.20605	16.89988
Skull	19	0.042	1258.331	589.699	67.10554
Spine	24	0.422	77.19295	53.79457	14.08455
Average			340.4682	186.3838	29.97509
Weighted Avg.			215.9019	123.7968	22.2885

Table 21. Muscle doses (cSv/day) in FAX protected by various thicknesses of Aluminum exposed to the 1977 solar minimum GCR spectrum.

Muscle Segment	Points	Weight	0.4 g/cm^2	2.0 g/cm^2	10.0 g/cm^2
Head and Neck	10	0.014241	0.179651	0.171411	0.142597
Left Arm	13	0.054665	0.189767	0.180497	0.148278
Lower Legs	26	0.140482	0.193546	0.18415	0.151117
Lower Torso	10	0.204651	0.149495	0.144334	0.12557
Mid Torso	9	0.122788	0.162436	0.155903	0.132733
Right Arm	13	0.034674	0.190071	0.180761	0.148429
Upper Legs	24	0.232155	0.160722	0.15458	0.132357
Upper Torso	10	0.19637	0.171056	0.163832	0.138127
Average			0.174593	0.166933	0.139901
Weighted Avg.			0.168155	0.161185	0.13636

Table 22. Muscle doses (cSv) in FAX protected by various thicknesses of Aluminum exposed to the August 1972 King SPE spectrum.

Muscle Segment	Points	Weight	0.4 g/cm^2	2.0 g/cm^2	10.0 g/cm^2
Head and Neck	10	0.014241	517.3076	292.5508	43.59989
Left Arm	13	0.054665	635.2365	353.3013	51.34395
Lower Legs	26	0.140482	442.8185	270.9234	46.30972
Lower Torso	10	0.204651	135.7951	89.77725	19.54899
Mid Torso	9	0.122788	325.1653	189.9399	31.18337
Right Arm	13	0.034674	647.0215	359.1617	51.80875
Upper Legs	24	0.232155	166.1254	110.3334	23.81901
Upper Torso	10	0.19637	302.666	184.7264	32.76161
Average			396.517	231.3393	37.54691
Weighted Avg.			292.4534	177.5774	31.52248

Table 23. BFO doses (cSv/day) in MAX protected by various thicknesses of Aluminum exposed to the 1977 solar minimum GCR spectrum.

BFO Segment	Points	Weight	0.4 g/cm^2	2.0 g/cm^2	10.0 g/cm^2
Left Arm	21	0.0115	0.161014	0.15483	0.132462
Left Leg	22	0.0335	0.151738	0.146495	0.127235
Mandible	10	0.042	0.176932	0.168954	0.141005
Pelvis	25	0.175	0.129808	0.126496	0.114037
Ribs	22	0.228	0.154524	0.148862	0.128458
Right Arm	21	0.0115	0.159849	0.153773	0.131777
Right Leg	21	0.0335	0.149999	0.144927	0.126245
Skull	26	0.042	0.190985	0.181559	0.148889
Spine	25	0.422	0.137156	0.133214	0.118526
Average			0.156889	0.151012	0.129848
Weighted Avg.			0.145078	0.140327	0.122969

Table 24. BFO doses (cSv) in MAX protected by various thicknesses of Aluminum exposed to the August 1972 King SPE spectrum.

BFO Segment	Points	Weight	0.4 g/cm^2	2.0 g/cm^2	10.0 g/cm^2
Left Arm	21	0.0115	161.1005	108.4844	23.97357
Left Leg	22	0.0335	92.21236	65.65507	17.29918
Mandible	10	0.042	629.4114	322.1284	43.64194
Pelvis	25	0.175	33.99325	25.70251	8.809441
Ribs	22	0.228	196.5614	122.318	23.3944
Right Arm	21	0.0115	155.9451	105.1774	23.38416
Right Leg	21	0.0335	83.8085	60.09838	16.2853
Skull	26	0.042	932.7517	458.0146	56.57986
Spine	25	0.422	54.22514	39.17484	11.54107
Average			260.001	145.1948	24.98988
Weighted Avg.			148.8014	88.35409	17.62492

Table 25. Muscle doses (cSv/day) in MAX protected by various thicknesses of Aluminum exposed to the 1977 solar minimum GCR spectrum.

Muscle Segment	Points	Weight	0.4 g/cm^2	2.0 g/cm^2	10.0 g/cm^2
Head and Neck	12	0.038592	0.168483	0.161483	0.136567
Left Arm	11	0.06935	0.182158	0.173713	0.144097
Lower Legs	22	0.121689	0.197087	0.187291	0.153016
Lower Torso	10	0.214296	0.14554	0.140772	0.123301
Mid Torso	11	0.087828	0.149352	0.144074	0.125124
Right Arm	11	0.06266	0.182065	0.173629	0.14405
Upper Legs	20	0.301527	0.168089	0.161144	0.136366
Upper Torso	11	0.104058	0.155645	0.149895	0.129156
Average			0.168552	0.1615	0.13646
Weighted Avg.			0.165712	0.158958	0.13488

Table 26. Muscle doses (cSv) in MAX protected by various thicknesses of Aluminum exposed to the August 1972 King SPE spectrum.

Muscle Segment	Points	Weight	0.4 g/cm^2	2.0 g/cm^2	10.0 g/cm^2
Head and Neck	12	0.038592	314.3328	186.3992	31.96685
Left Arm	11	0.06935	441.6388	263.4978	42.98172
Lower Legs	22	0.121689	523.5933	311.2327	50.28734
Lower Torso	10	0.214296	103.5952	70.22006	16.66036
Mid Torso	11	0.087828	214.5244	129.0625	22.96425
Right Arm	11	0.06266	453.5755	267.9762	43.15708
Upper Legs	20	0.301527	278.9247	170.904	30.84224
Upper Torso	11	0.104058	181.3897	116.589	23.37029
Average			313.9468	189.4852	32.77876
Weighted Avg.			278.9146	170.1794	30.35687

Table 27. Computed effective dose (E_{comp} in units of cSv) and effective dose error (E_{error} in units of cSv) using segmented muscle and BFO in FAX and MAX protected by various thicknesses of Aluminum exposed to the August 1972 King SPE.

Model	Points	0.4 g/cm^2		2.0 g/cm^2		10.0 g/cm^2	
		E_{comp}	E_{error}	E_{comp}	E_{error}	E_{comp}	E_{error}
FAX	1195	253.3713	22.97392	137.8087	9.148496	24.21078	0.755288
MAX	1144	209.9866	17.66649	110.9229	6.880713	20.36149	0.705413

Table 28. Computed effective dose (E_{comp} in units of cSv/day) and effective dose error (E_{error} in units of cSv/day) using segmented muscle and BFO in FAX and MAX protected by various thicknesses of Aluminum exposed to the 1977 solar minimum GCR spectrum.

Model	Points	0.4 g/cm^2		2.0 g/cm^2		10.0 g/cm^2	
		E_{comp}	E_{error}	E_{comp}	E_{error}	E_{comp}	E_{error}
FAX	1195	0.15571	0.000567	0.149959	0.000509	0.129182	0.000311
MAX	1144	0.149548	0.000876	0.144392	0.000792	0.125613	0.000498

9. Appendix A – Target Point Locations in VCAM

Table A1. Target points in the VCAM adrenals.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-3.060	5.940	59.580	-3.060	5.940	58.860
-3.060	5.940	58.140	-3.060	-6.300	56.700
-3.060	-6.300	55.980	-3.060	-6.300	55.260

Table A2. Target points in the VCAM BFO.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
0.994	-1.988	16.620	0.138	0.055	1.353
8.338	-0.083	6.737	8.089	1.518	9.304
-5.108	-5.660	11.209	5.494	2.512	16.869
-0.055	1.684	29.127	6.930	0.110	35.781
7.013	0.000	35.532	6.985	0.000	35.670
7.068	-0.193	35.477	-5.825	3.948	35.808
-0.911	0.690	35.256	-2.153	-0.248	34.980
8.807	0.911	40.640	8.890	2.982	42.352
8.780	0.939	40.557	9.304	-3.451	50.883
6.737	-7.703	60.905	-8.255	2.595	40.695
-8.034	-2.512	40.530	-9.249	3.009	48.260
-9.415	2.927	48.260	-9.359	-3.285	48.398
-3.865	0.028	44.119	-6.240	1.215	44.450
-3.755	-0.193	50.717	-5.218	2.098	51.656
-5.328	-0.028	55.328	-5.025	-0.110	55.797
-5.218	-0.801	55.852	-7.620	0.000	55.825
-2.761	-1.877	66.040	-1.298	0.911	64.383
-3.865	0.138	68.635	-2.288	0.850	70.761
-2.203	0.464	72.086	-4.874	0.000	79.485
-5.680	0.375	76.890	-7.707	-0.446	82.053
-0.522	-12.136	76.200	-6.636	7.395	77.691
-6.627	-7.265	79.513	-7.383	-3.871	81.308
-1.830	-7.696	82.909	-2.125	-6.884	85.973
-0.842	5.164	89.342	-0.597	-4.544	91.247
0.705	-4.567	91.385	-5.025	-0.110	55.797

Table A3. Target points in the VCAM bladder.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-0.551	4.997	86.675	-1.123	-1.260	86.401
3.388	4.193	86.591	-3.578	-1.864	86.803
5.231	0.456	86.580	2.256	-4.902	86.580
2.372	1.536	86.401	-0.974	-4.860	86.601
-0.708	2.085	86.401	1.134	2.826	89.820
-3.515	2.203	86.622	3.060	-0.127	89.799
4.563	-2.637	86.622	0.222	-2.805	89.852
1.620	-1.536	86.401	-1.249	0.551	90.169

Table A4. Target points in the VCAM bone.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-0.001	-0.361	1.515	-1.799	20.626	65.182
-8.281	-0.033	7.698	-2.043	0.106	70.212
-4.913	-5.199	10.938	-3.727	4.140	78.957
7.698	0.033	16.073	-9.911	0.635	79.932
0.359	0.033	27.942	-8.597	-0.540	76.298
-2.711	0.085	27.942	-6.268	7.561	79.454
-0.666	-14.772	33.492	-4.266	9.361	81.414
7.559	0.106	35.841	3.759	6.555	85.892
6.681	-0.001	35.534	5.378	8.323	88.729
6.713	-8.365	42.479	2.816	-9.043	83.319
8.534	0.911	40.319	5.378	-8.344	88.898
8.809	0.879	40.723	0.721	-19.833	81.275
9.721	-1.959	50.273	-0.085	-19.441	93.071
0.540	3.452	24.883	3.578	9.900	119.763
-7.559	2.955	39.927	3.769	-9.774	119.329
-7.919	-2.456	40.616	-7.401	-3.452	7.020
-9.687	3.536	48.643	3.769	-9.666	119.382
-9.414	-3.367	48.283	3.822	-9.645	119.382
0.687	19.102	36.138	4.319	-9.656	118.885
1.079	17.449	39.812	3.081	-8.841	118.801
1.186	19.323	39.504	7.317	-6.576	129.599
1.271	19.439	39.622	4.776	5.940	139.871
1.715	19.439	39.144	4.828	5.580	139.723
1.239	19.439	39.643	1.959	-8.641	135.921
1.239	19.302	39.622	7.178	-7.624	60.765

Table A5. Target points in the VCAM brain.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
1.076	3.679	5.771	2.027	2.156	4.262
0.004	2.200	4.414	-2.005	1.098	5.566
-2.506	1.973	4.068	-4.363	1.688	5.224
5.184	0.011	5.314	3.434	0.018	3.992
1.285	0.396	3.359	-0.720	0.608	3.355
-3.982	-0.245	4.360	3.575	-1.800	4.781
1.573	-1.490	4.014	-0.356	-1.649	3.953
-2.236	-0.338	3.787	1.372	-3.229	5.004
-0.792	-3.406	5.368	-2.545	-2.344	4.439
3.301	3.182	6.228	-0.061	4.356	7.394
-1.300	3.539	5.371	5.263	1.926	6.649
3.726	1.782	4.975	1.469	1.750	6.516
-0.612	2.124	6.808	-3.352	3.254	6.124
-5.227	2.063	7.182	5.994	-0.439	7.423
3.517	0.202	6.552	1.800	0.112	5.530
-0.115	0.094	5.443	-0.983	0.166	7.585
-3.568	-0.097	6.667	-5.724	0.173	6.008
4.806	-1.901	6.451	2.182	-1.649	6.462
0.101	-1.768	6.347	-2.048	-1.228	5.990
-4.403	-2.023	5.630	-5.771	-1.508	6.980
3.287	-3.398	6.480	1.235	-3.935	6.883
-0.871	-4.140	7.358	-2.822	-3.499	6.422
0.248	4.248	9.371	-2.048	3.913	7.585
3.240	1.685	7.999	1.987	1.199	8.852
0.338	2.272	8.593	-2.959	1.688	7.409
5.303	0.875	8.204	3.582	-0.688	8.222
1.033	-0.166	7.830	-2.390	-0.108	8.849
-4.759	0.162	8.395	-6.703	0.137	8.172
4.910	-2.531	8.291	2.545	-2.156	8.406
-3.632	-1.786	8.042	-4.590	-3.334	7.762
0.616	-2.560	8.334	-1.570	-2.228	7.834
2.120	3.744	7.848	2.362	3.456	9.810
-1.746	2.243	9.018	-3.982	1.620	9.428
-3.996	3.546	8.622	-6.170	2.070	9.101
-0.371	0.572	9.850	-4.176	-0.752	10.256
-0.482	-1.483	9.464	-2.570	-2.185	9.968
-5.890	-1.843	9.180	-6.404	-0.162	10.307
1.386	-3.146	10.422	-2.740	-4.064	8.824
-4.590	-3.164	10.109	0.648	-4.748	9.050
0.756	2.599	11.005	-0.972	2.812	10.876
-3.060	3.571	10.861	-4.979	3.190	10.685
-0.450	0.756	11.963	-2.826	1.192	10.811
-4.046	2.308	12.481	0.310	-1.256	11.376
-2.131	-0.533	11.218	-5.533	1.310	11.066
-5.468	-2.048	11.585	-1.127	-2.527	11.588
-3.078	-3.805	11.268	-2.066	1.778	12.496
-1.498	-0.706	13.133	-3.359	0.137	13.414
-4.511	-0.007	12.175	-3.514	-2.088	12.402

Table A6. Target points in the VCAM breast.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
5.940	6.660	33.300	5.940	-7.020	33.300
6.300	3.780	33.300	6.300	-4.500	33.300
6.660	4.860	34.020	6.660	-5.940	34.020
6.660	6.660	34.740	6.660	-7.020	34.740
7.020	3.780	34.740	7.020	-4.500	34.740

Table A7. Target points in the VCAM esophagus.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
2.700	0.180	30.780	2.700	0.180	30.060
2.700	0.180	29.340	3.060	0.180	28.620
3.060	0.180	27.900	3.060	0.180	27.180
3.060	0.180	26.460	3.060	0.180	25.740
3.060	0.180	25.020	3.060	0.180	24.300
3.060	0.180	23.580			

Table A8. Target points in the VCAM heart.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
2.369	2.444	35.302	4.388	2.437	40.518
3.874	-1.534	40.885	2.452	1.289	41.760
5.018	0.925	41.191	0.302	0.216	41.764
5.180	-0.896	41.400	4.957	2.826	42.865
3.298	3.341	42.224	1.454	2.668	42.451
0.047	1.436	42.854	6.138	0.886	43.265
4.140	1.004	42.952	1.919	-0.569	42.955
5.886	-0.504	44.064	5.281	-1.602	43.168
3.359	-0.810	43.052	0.310	-1.699	42.815
4.709	-2.822	43.924	3.377	-2.801	42.167
1.915	-2.966	43.517	4.406	3.838	46.696
3.067	3.942	44.291	1.289	3.438	43.974
5.728	2.099	45.014	4.730	3.352	45.058
3.136	1.696	44.287	0.655	2.545	45.004
-0.720	1.577	45.328	4.241	0.108	45.122
1.735	0.738	44.305	0.976	0.734	46.480
-0.313	0.086	44.284	5.540	-2.117	45.896
3.463	-1.393	45.220	1.868	-1.336	45.202
-0.007	-1.328	44.777	3.416	-3.532	44.708
0.911	-3.096	45.238	2.189	4.255	46.217
6.574	0.878	46.012	2.725	2.358	46.170
0.522	3.344	46.706	-0.824	0.342	46.793
4.522	1.217	46.598	2.650	0.396	46.634
-0.821	-0.284	48.496	6.383	-0.734	46.112
4.363	-0.932	47.588	3.143	-2.102	47.509
1.415	-1.357	47.092	-0.547	-1.501	46.544
4.788	-3.355	46.512	2.632	-3.740	46.328
0.652	-3.254	47.362	5.814	2.804	47.563
4.792	3.794	49.050	3.002	4.252	48.211
6.865	1.210	48.038	4.223	1.796	48.398
2.477	2.444	48.164	-0.583	2.059	48.060
-0.576	2.005	50.126	5.814	0.126	48.352
3.143	0.101	48.632	1.102	1.361	48.406
6.764	-1.415	48.182	5.580	-2.502	48.564
3.517	-1.933	49.990	1.285	-0.882	48.618
-0.238	-2.264	48.906	4.180	-3.712	48.377
1.948	-3.582	48.546	4.777	3.467	50.504
2.617	4.406	50.346	0.929	3.920	48.629
6.473	1.973	50.054	4.892	1.292	50.134
2.668	2.495	50.213	0.706	3.100	50.263
2.790	0.623	50.314	1.051	0.428	50.378
-0.760	0.130	50.137	6.800	-0.392	50.180
4.741	-0.727	50.242	-0.032	-1.966	50.540
5.717	-2.650	50.407	3.744	-3.971	50.166
2.084	-1.750	50.152	1.487	-3.748	50.256

Table A9. Target points in the VCAM intestine.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
0.626	-1.080	65.776	5.573	-1.066	67.291
5.321	-3.323	66.017	4.450	-5.886	66.283
5.900	1.105	68.980	1.667	1.879	67.986
5.731	-2.117	69.635	2.383	-3.172	68.083
5.648	-4.536	68.929	2.074	-5.609	66.276
2.221	-8.618	66.395	4.288	-7.610	68.501
0.943	-9.688	68.681	-0.338	9.626	71.215
4.748	6.628	69.728	2.894	5.407	72.313
5.299	3.244	70.268	2.902	3.067	69.408
3.175	0.241	70.906	2.567	-0.994	69.192
3.046	-5.249	69.768	0.760	-6.556	68.947
-0.670	-4.435	69.466	3.100	-9.004	70.178
1.328	-6.858	71.802	-2.347	-7.380	70.798
-0.511	-9.518	70.974	1.735	11.135	71.366
4.334	8.748	72.137	2.794	9.065	69.397
-0.230	6.246	73.228	1.894	3.524	71.993
3.640	1.955	73.285	3.395	-3.517	71.564
2.333	-4.889	73.516	-0.666	-5.213	72.295
-3.830	-4.824	72.252	1.418	7.304	71.161
-3.946	4.741	72.767	6.181	-1.094	71.917
3.625	-1.325	73.163	4.720	-2.995	75.074
0.770	-6.833	75.370	1.609	8.942	77.537
0.338	7.589	75.928	2.282	5.602	75.661
4.565	3.510	74.984	2.693	2.135	76.921
2.880	-0.634	76.126	4.478	-4.766	78.066
2.142	-4.194	77.069	0.198	-5.843	78.858
2.902	-7.330	76.982	1.930	-8.730	78.455
-2.135	-8.161	76.633	-0.295	9.302	79.340
2.855	7.265	78.746	-2.016	8.053	79.394
-3.683	7.020	78.415	3.931	4.993	78.332
-0.205	5.792	78.437	0.983	3.902	78.782
5.069	2.844	78.430	3.589	2.218	81.000
1.588	1.688	79.873	5.170	0.155	78.595
1.998	-0.774	78.620	5.033	-2.365	78.239
3.622	-2.930	81.155	-1.642	-2.966	80.813
3.593	-5.976	80.017	1.289	-2.977	79.376
-0.202	-9.173	78.048	-3.272	-7.218	78.869
-1.318	-8.701	80.194	4.183	5.540	81.133
1.566	4.993	81.389	2.952	2.192	83.560
0.500	2.966	83.174	-1.454	2.891	81.230
4.493	-0.479	81.191	1.076	-0.716	81.896
-2.812	-0.778	83.189	3.370	-3.064	83.970
1.231	-4.532	81.864	-0.076	-2.776	83.682
-0.684	0.706	83.902	-6.235	0.727	84.323
-3.931	1.393	83.254	2.408	-0.346	83.963

Table A10. Target points in the VCAM kidneys.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-3.074	-6.343	59.976	-3.604	-5.216	61.700
-2.945	-7.531	62.791	-2.581	-4.982	63.724
-3.002	6.538	63.335	-2.696	4.864	64.656
-2.232	-6.340	65.401	-1.462	7.625	66.175
-3.413	6.970	66.017	-3.013	5.353	67.540
-1.044	5.112	66.449	-1.872	6.556	68.450

Table A11. Target points in the VCAM liver.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-2.678	-0.644	51.080	-0.637	-9.547	55.181
3.308	8.143	54.047	-0.385	6.862	53.654
-1.681	6.649	55.228	5.551	4.162	54.007
2.822	4.010	53.978	0.821	5.069	54.306
-1.714	4.741	53.593	6.703	2.102	54.702
4.291	2.336	54.259	2.020	1.404	53.975
0.198	2.981	54.007	5.864	0.403	54.007
3.769	-0.335	54.151	-0.583	0.572	54.122
5.774	-2.333	53.737	1.170	-1.084	54.036
3.190	-2.236	54.122	-0.536	-2.632	53.777
-2.459	-3.953	53.802	4.180	7.808	55.714
2.149	9.176	56.124	1.105	8.194	54.288
-0.277	8.683	56.016	5.584	6.397	55.541
2.646	6.142	55.026	0.929	6.926	56.074
-1.181	6.408	56.981	6.476	4.363	55.724
4.014	4.856	55.937	2.344	3.139	55.742
-0.630	4.529	55.944	-2.952	4.406	55.865
7.024	2.560	57.240	0.299	2.376	55.919
-1.645	3.067	57.341	7.070	-0.734	54.922
4.032	0.904	55.861	1.534	0.486	55.642
6.912	-3.323	55.404	5.144	-1.332	55.980
2.581	-1.141	56.290	2.102	8.741	58.378
0.418	9.677	57.978	-1.609	8.395	57.758
5.152	6.347	57.787	4.111	8.482	57.406
2.804	6.505	57.600	0.482	7.034	58.324
-2.873	5.706	57.589	5.868	4.579	57.888
3.334	4.100	57.946	1.238	4.874	56.844
-0.781	4.878	58.651	-3.478	3.906	58.561
4.939	2.686	56.606	2.678	1.922	57.445
0.695	2.984	58.018	6.822	0.670	56.574
4.954	0.227	57.625	1.152	0.317	57.762
-0.785	0.914	56.693	7.034	-1.638	57.355
3.110	-0.061	58.514	-0.428	-1.382	55.735
2.228	8.820	60.455	-0.353	8.755	59.864
4.108	7.528	59.587	1.894	6.818	60.088
6.149	3.665	59.602	3.874	5.159	59.688
1.606	4.734	59.188	6.581	1.685	59.062
4.360	2.416	59.033	0.655	3.791	60.725
-1.494	3.265	59.814	6.962	-0.328	58.914
2.002	1.984	59.821	-0.256	1.609	59.324
6.646	-1.274	60.638	-0.374	-0.911	58.032
0.328	8.554	61.607	3.888	6.948	61.765
2.531	7.852	62.568	5.569	5.695	60.340
2.174	5.206	61.798	-0.169	6.080	60.566
3.305	3.697	60.916	-0.144	2.383	61.859
6.613	1.303	61.067	0.346	0.464	61.589
4.748	0.061	59.864	2.808	6.138	64.415

Table A12. Target points in the VCAM lungs.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-1.714	-7.283	44.114	-0.306	7.816	44.924
-3.262	7.326	48.654	0.554	-8.737	47.866
-4.090	-6.242	49.342			

Table A13. Target points in the VCAM muscle.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-7.624	-0.033	14.220	1.260	-20.700	100.260
-1.302	2.542	20.955	0.022	11.637	92.214
2.711	-2.456	27.942	-8.100	0.540	3.357
2.626	7.538	30.675	-4.193	6.353	97.932
8.313	-2.487	35.841	-5.982	8.428	122.772
-2.847	-16.593	38.043	2.256	7.614	119.351
8.978	3.812	40.679	2.085	7.391	119.214
-10.165	-10.271	48.262	4.045	9.233	101.763
-0.254	13.416	50.633	0.022	-2.308	101.605
10.218	5.104	62.226	-0.001	-9.285	92.182
10.134	-5.052	62.226	-7.603	-7.146	94.755
9.414	-0.033	67.860	0.275	-6.237	99.498
2.595	18.551	40.637	2.256	-7.359	119.159
0.169	-21.144	38.096	-6.776	-9.614	116.978
2.456	-18.498	40.637	1.599	-7.751	119.298
4.944	-21.144	55.662	-3.588	-9.466	124.041
-7.666	-12.197	79.517	3.822	-9.414	101.795
8.767	0.372	79.041	-5.580	6.660	129.420
-10.462	-9.361	85.342	-1.302	6.458	154.715
-2.584	4.713	88.932	-1.715	3.504	157.944
-1.683	-4.447	89.292	4.172	3.759	162.306
-6.014	-6.978	92.595	0.805	-3.675	137.106
-7.624	7.233	82.799	-4.087	-7.146	137.106
0.900	16.740	91.620	12.622	-8.725	174.239
3.294	-19.757	76.287	0.022	15.121	89.292

Table A14. Target points in the VCAM pancreas.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-1.642	-6.055	58.500	3.600	-1.523	61.484
5.533	1.876	63.302	4.892	-0.295	63.166
4.831	-1.066	62.435	4.525	3.319	64.379
5.321	3.632	64.379	5.418	2.646	63.497
4.774	2.524	64.098	6.091	1.238	63.828
5.526	2.264	64.721	5.591	0.554	63.288
5.940	1.750	63.637	4.867	2.153	64.523
5.641	0.162	63.331	4.882	1.184	64.235
5.454	2.819	63.112	5.530	3.604	64.451
4.849	3.463	64.199	6.199	3.492	64.256
6.210	2.534	64.159	6.336	3.028	64.184
5.911	2.189	64.541	5.818	0.986	64.091
4.687	1.498	64.476	4.777	0.810	64.127

Table A15. Target points in the VCAM prostate.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
1.620	0.180	91.260	-1.260	0.180	91.260
0.540	1.260	91.260	0.540	-1.260	91.260
0.900	-0.180	91.620	1.620	0.180	91.980
-1.260	0.180	91.980	0.540	1.260	91.980
0.540	-1.260	91.980			

Table A16. Target points in the VCAM salivary glands.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
1.980	5.940	14.580	1.980	-5.940	14.580
4.140	5.580	18.180	4.140	-5.580	18.180
6.660	3.420	21.420	6.660	-3.420	21.420
4.860	4.140	20.700	4.860	-4.140	20.700
5.940	1.260	19.620	4.860	1.260	19.620
5.940	-1.260	19.620	4.500	-1.260	19.620

Table A17. Target points in the VCAM skin.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
6.470	2.150	2.170	-2.510	5.030	1.810
-1.620	9.350	10.980	8.630	-5.030	8.290
1.070	-4.670	1.450	-7.550	-3.950	4.690
6.470	6.110	9.540	12.230	0.710	14.410
-0.180	-8.630	10.260	-6.830	-5.390	14.750
1.070	11.510	29.530	-8.990	3.590	7.930
6.830	-0.900	26.100	-8.630	1.790	16.910
8.990	-3.590	18.540	-3.230	-3.230	24.660
5.390	16.910	34.930	-2.870	6.470	16.910
-6.110	11.700	33.490	5.750	5.390	20.150
-2.150	4.310	24.300	1.980	-6.470	18.710
-6.830	-10.790	34.210	-1.430	-21.230	34.930
-2.510	18.710	33.130	5.750	6.470	30.970
8.270	-3.590	34.930	-5.750	5.030	31.330
4.670	-8.990	30.610	-10.790	-5.410	41.050
3.950	-16.550	32.770	-2.510	-11.510	29.890
6.830	20.870	44.460	-1.790	22.670	38.340
-3.230	16.380	44.100	8.270	11.510	39.250
-10.070	5.220	39.970	11.510	-4.310	43.930
-7.190	-2.340	34.210	8.270	-11.510	39.250
-4.310	-20.150	49.860	-2.510	22.670	48.780
-8.990	13.670	47.700	7.190	11.870	46.810
6.110	19.790	54.900	-8.990	13.670	39.970
9.350	3.590	37.810	11.870	4.670	46.090
7.190	-20.510	39.970	-6.470	-17.990	37.980
-1.070	-23.030	43.380	8.990	11.150	54.180
-1.790	23.030	58.860	-11.150	6.830	52.910
12.590	-5.030	52.020	-11.510	3.610	46.090
7.910	-11.150	48.230	3.230	-15.300	45.540
-9.350	3.060	59.940	6.830	-20.150	48.230
-8.630	-14.030	43.740	0.540	-23.390	53.460
0.180	14.770	52.020	7.550	10.430	61.550
12.590	4.140	55.260	-7.190	14.030	55.980
11.510	-5.390	60.110	8.630	-9.350	66.250
-11.150	-3.610	52.190	0.900	-13.670	56.340
-11.510	-8.990	48.230	6.110	-18.370	55.790
-3.950	-20.870	60.110	1.790	14.030	61.740
-8.270	10.790	61.910	7.550	-11.870	56.510
-8.990	-6.660	70.020	2.870	-22.310	63.180
-7.910	-13.310	54.540	-3.230	-21.590	68.580
-5.390	12.590	68.220	11.870	2.510	75.060
-8.990	4.500	69.300	11.510	2.340	64.620
-7.910	-12.590	77.410	4.670	-20.510	71.460
-5.390	-12.590	65.890	3.950	13.670	79.380
3.950	21.230	68.770	-3.590	19.980	67.140
-0.710	9.710	156.590	4.670	10.790	137.510
-5.030	-3.250	142.380	2.510	10.430	146.870
-5.030	7.910	151.190	-3.950	2.170	148.670
1.430	-10.790	145.980	-5.390	7.550	140.220
3.950	3.970	154.430	-1.070	-10.070	154.790
7.550	2.170	167.050	-2.870	3.250	162.900
3.950	-8.270	160.570	-2.870	-3.250	162.540

Table A17 continued.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-10.430	8.460	77.580	9.350	8.630	77.220
3.230	13.310	71.270	11.510	-4.310	70.570
-8.990	-10.070	60.110	11.510	-1.980	81.540
-2.340	-14.030	73.620	2.870	-13.310	64.620
-3.230	-21.590	77.030	8.990	9.350	68.770
-5.750	13.310	75.420	-4.310	15.830	83.170
-11.870	1.070	76.330	10.070	-7.550	78.470
-8.990	-3.250	62.820	3.230	-14.390	82.260
-11.510	-7.190	78.850	3.950	-21.230	80.270
1.070	22.670	88.740	-11.870	11.510	84.970
3.950	21.230	80.270	10.790	3.590	86.390
-2.510	22.310	76.140	-14.390	4.330	85.690
5.750	-11.870	74.700	4.670	-2.530	92.340
-1.430	-22.670	86.750	-5.750	-15.110	84.250
-12.950	-11.150	86.940	-11.510	12.950	95.030
8.270	8.990	84.950	7.550	10.260	94.500
3.420	1.620	92.150	-5.580	1.090	92.340
7.910	-10.790	86.410	-14.390	-3.610	86.580
-12.590	-3.610	94.310	3.230	-16.190	90.900
-7.190	-16.550	92.170	7.550	-11.340	95.580
6.110	19.430	97.930	-3.590	22.310	97.380
4.310	15.110	89.100	-6.470	16.190	90.370
-14.030	6.490	93.950	-8.990	3.250	100.430
9.710	-4.670	88.910	-1.620	-1.090	95.940
9.350	-0.710	97.910	-3.780	-15.470	101.700
-12.950	-10.070	96.110	-3.230	-23.030	98.820
-8.630	-14.750	101.150	-2.150	21.060	105.830
9.710	10.430	101.700	-3.420	16.550	99.540
9.900	1.070	94.690	-8.990	10.790	103.670
4.500	-1.810	99.900	-7.910	-2.530	101.150
9.710	-10.430	101.700	-3.420	-14.750	109.260
-2.150	-21.060	105.830	3.230	20.530	108.350
3.420	16.550	106.380	7.910	13.670	110.870
-4.140	2.170	102.420	-6.830	3.610	109.070
8.990	-4.690	107.990	-5.750	-2.890	111.420
6.110	-19.260	100.980	2.150	-23.030	95.050
2.870	-21.230	108.710	-4.310	14.750	109.430
8.630	4.690	116.100	-8.270	9.710	114.110
1.620	-0.370	107.460	8.990	4.690	107.100
-8.990	-9.180	106.740	7.910	-13.670	109.980
4.310	-15.470	116.270	-7.910	-9.710	116.630
0.370	15.110	117.540	7.550	12.590	119.870
0.540	0.730	116.460	-6.470	4.330	119.700
8.630	-4.690	115.380	6.830	-12.590	124.190
-1.620	1.810	123.300	7.910	-3.970	122.750
-4.310	-14.390	111.420	8.270	5.770	125.630
1.980	-1.450	127.620	-6.110	-4.330	122.750
-3.230	-13.310	122.030	4.670	13.310	128.150
-4.670	12.230	123.110	6.110	3.250	133.550
-4.670	3.970	129.590	7.550	-5.770	131.390
5.750	-5.410	140.030	-5.390	-7.910	131.030
-0.540	-13.310	129.060	-2.510	11.150	132.470
4.310	2.890	143.460	-1.260	-1.810	135.540

Table A17 concluded.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
15.470	-1.090	171.370	-3.590	-8.270	171.710
5.750	8.630	164.890	8.820	9.350	175.670
7.910	-8.630	168.130	11.700	-9.710	175.670
2.870	-2.170	174.950	21.950	-7.550	174.590
20.150	8.990	173.530	-3.590	8.270	171.710
-3.950	-9.710	140.410	3.950	-11.870	134.990
4.670	-4.330	150.660	-5.390	-5.940	151.550

Table A18. Target points in the VCAM spleen.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-2.372	-4.709	56.977	-2.002	-5.623	56.754
-1.746	-6.610	56.916	-2.581	-7.434	56.794
-2.484	-3.924	57.524	-1.487	-4.406	57.730
-1.210	-5.522	57.467	-1.022	-6.512	57.715
-1.055	-7.553	58.093	-1.555	-7.499	57.337
-2.146	-8.284	57.233	-1.526	-3.456	58.730
-1.595	-8.446	58.093	-2.419	-9.047	57.895
-3.380	-9.011	58.212	-2.394	-2.920	59.238
-0.727	-7.697	59.112	-1.130	-8.492	58.849
-1.976	-9.317	58.669	-2.916	-9.533	58.907
-1.390	-3.265	59.846	-0.878	-8.446	59.926
-1.476	-9.144	59.450	-2.174	-9.652	59.713
-0.436	-7.351	60.026	-1.487	-9.238	60.538

Table A19. Target points in the VCAM stomach.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
1.570	-6.923	55.728	4.082	-6.660	55.915
4.943	-5.807	58.147	2.592	-8.327	58.028
3.161	-7.225	60.520			

Table A20. Target points in the VCAM testes.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
6.235	1.350	96.649	5.191	1.382	97.092
5.533	1.393	96.232	6.318	-1.368	97.474
5.947	-1.404	96.736	5.335	-1.508	97.135
6.246	1.476	97.596	5.530	1.408	98.082
5.879	-2.146	97.999	5.213	-1.228	97.988
6.268	-1.321	98.374	5.587	-1.307	98.752

Table A21. Target points in the VCAM thymus.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
1.620	0.180	32.940	2.700	0.900	32.220
1.980	-0.900	32.220	2.700	-0.900	31.140
1.980	10.980	31.140			

Table A22. Target points in the VCAM thyroid.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
5.177	1.940	27.680	5.620	1.192	28.292
5.134	-1.969	28.372	5.173	2.110	29.153
5.342	-1.598	29.840			

10. Appendix B – Target Point Locations in VCAF

Table B1. Target points in the VCAF adrenals.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-3.060	5.220	54.900	-3.060	5.220	54.180
-3.060	5.220	53.460	-2.340	-5.580	52.020
-2.340	-5.580	51.300	-2.340	-5.580	50.580

Table B2. Target points in the VCAF BFO.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
0.914	-1.829	15.291	0.127	0.051	1.245
7.671	-0.076	6.198	7.442	1.397	8.560
-4.699	-5.207	10.312	5.055	2.311	15.519
-0.051	1.549	26.797	6.375	0.102	32.918
6.452	0.000	32.690	6.426	0.000	32.817
6.502	-0.178	32.639	-5.359	3.632	32.944
-0.838	0.635	32.436	-1.981	-0.229	32.182
8.103	0.838	37.389	8.179	2.743	38.964
8.077	0.864	37.313	8.560	-3.175	46.812
6.198	-7.087	56.032	-7.595	2.388	37.440
-7.391	-2.311	37.287	-8.509	2.769	44.399
-8.661	2.692	44.399	-8.611	-3.023	44.526
-3.556	0.025	40.589	-5.740	1.118	40.894
-3.454	-0.178	46.660	-4.801	1.930	47.523
-4.902	-0.025	50.902	-4.623	-0.102	51.333
-4.801	-0.737	51.384	-7.010	0.000	51.359
-2.540	-1.727	60.757	-1.194	0.838	59.233
-3.556	0.127	63.144	-2.108	0.787	65.100
-2.032	0.432	66.319	-4.521	0.000	73.127
-5.258	0.356	70.739	-7.163	-0.432	75.489
-0.483	-11.481	70.104	-6.147	7.036	71.476
-6.147	-6.960	73.152	-6.858	-3.734	74.803
-1.702	-7.468	76.276	-1.981	-6.756	79.096
-0.787	5.131	82.194	-0.559	-4.547	83.947
0.660	-4.572	84.074	-4.623	-0.102	51.333

Table B3. Target points in the VCAF bladder.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
3.727	3.483	79.761	3.801	-3.409	79.751
0.414	5.262	79.708	0.666	-5.262	79.719
0.508	1.483	79.561	-2.361	-3.748	79.782
-2.826	3.049	79.824	2.732	0.614	82.599
4.902	0.001	79.698	-0.075	2.784	82.652
0.732	-1.407	79.561	-1.704	-0.614	82.662
-3.515	-0.403	79.708	1.155	-2.763	82.694

Table B4. Target points in the VCAF bone.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-0.001	-0.001	1.397	-1.833	18.974	59.972
-7.593	-0.022	7.083	-1.875	0.106	64.588
-4.532	-4.776	10.058	-3.452	3.961	72.645
7.201	0.022	14.759	-9.191	0.614	73.536
0.327	0.022	25.708	-7.919	-0.508	70.178
-2.487	0.075	25.708	-5.908	7.201	73.134
-0.614	-13.584	30.812	-4.066	9.001	74.997
7.041	0.106	32.972	3.504	6.426	79.020
6.481	-0.001	32.685	5.039	8.258	81.635
6.174	-7.698	39.092	2.519	-8.788	76.658
7.921	0.837	37.441	5.028	-8.281	81.719
8.100	0.816	37.462	0.359	-19.441	74.774
9.001	-1.799	46.249	-0.075	-19.441	85.626
-8.460	0.254	8.652	3.304	9.275	110.182
-7.009	2.721	36.732	3.483	-9.169	109.778
-7.199	-2.256	37.365	1.991	-2.001	1.260
-8.915	3.252	44.757	3.483	-9.064	109.833
-8.662	-3.102	44.428	3.536	-9.043	109.833
0.635	17.576	33.119	3.993	-9.064	109.376
0.995	16.052	36.624	2.847	-8.302	109.292
1.092	17.778	36.348	6.734	-6.045	119.308
1.165	17.999	36.445	4.395	5.399	128.679
1.578	17.883	36.022	4.447	5.136	128.553
1.144	17.999	36.477	1.812	-7.932	125.047
1.144	17.757	36.445	6.607	-7.009	55.799

Table B5. Target points in the VCAF brain.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
0.756	3.139	5.108	2.844	2.736	4.853
1.480	1.480	3.676	-0.486	2.246	3.668
-2.268	1.354	3.924	4.784	-0.457	5.033
3.226	0.558	4.079	1.674	-0.673	3.103
-0.328	0.392	3.157	-2.358	-0.662	3.503
-4.212	0.130	4.219	-4.885	0.871	5.814
3.928	-2.326	5.731	2.956	-1.552	4.396
0.965	-2.477	4.334	-0.342	-1.555	3.434
-1.811	-2.502	4.439	-3.820	-1.714	5.000
1.894	-3.384	5.612	-0.547	-3.514	5.584
1.969	3.521	6.714	4.363	1.570	5.443
1.984	1.436	5.911	-0.259	1.375	5.461
-1.656	3.125	5.101	-3.560	2.232	5.321
5.353	-0.781	6.890	3.161	-0.140	6.383
1.206	-0.317	4.925	-0.911	-0.374	5.040
-2.650	0.241	5.584	1.854	-1.746	6.491
-2.264	-1.951	6.088	-5.281	-1.141	6.127
-0.126	-1.825	6.109	-3.485	-4.032	5.537
3.676	2.635	7.016	0.648	4.716	7.970
-0.428	3.668	6.613	-2.736	3.503	7.002
2.322	1.188	7.985	0.536	2.243	7.571
-1.595	1.912	6.782	-3.197	1.084	7.391
-4.522	2.606	7.333	5.152	1.058	7.027
0.742	0.094	6.880	-1.213	-0.112	7.146
-3.575	-0.734	7.243	-5.580	0.742	7.423
4.068	-2.038	7.434	2.092	-1.148	8.258
-1.742	-2.167	7.888	-3.931	-2.779	7.178
-5.490	-1.487	8.111	2.873	-3.373	7.589
0.623	-3.654	7.250	-1.746	-3.870	7.204
-2.772	-3.758	8.928	2.264	3.287	8.734
0.115	3.384	9.490	-1.436	3.816	8.528
-3.427	3.931	9.187	-5.198	2.171	9.130
1.102	1.757	9.918	-0.652	1.480	10.735
-1.030	1.588	8.719	-2.898	2.052	8.860
0.464	0.227	8.809	-1.818	-0.382	8.885
-4.140	0.252	9.065	-4.792	0.702	10.883
-6.178	0.061	9.079	0.875	-1.908	10.134
0.094	-1.768	8.204	-3.280	-1.566	9.295
-5.098	-1.372	10.372	1.724	-3.244	9.050
-0.396	-3.928	8.957	-4.712	-2.995	9.184
-1.865	2.790	10.573	-3.863	2.462	10.714
-2.909	1.253	12.006	-0.299	-0.490	10.307
-2.524	0.486	10.314	-1.789	-1.534	11.192
-3.496	-0.799	11.815	-1.195	-2.560	9.961
-3.348	-2.794	10.890	-1.220	0.094	12.179

Table B6. Target points in the VCAF breast.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
7.927	9.680	39.344	8.986	8.334	38.920
9.853	7.229	39.168	9.983	-6.750	39.366
8.964	-8.204	38.923	8.086	-9.439	39.208
6.404	11.437	40.738	7.200	10.631	40.122
8.942	9.162	39.935	9.864	8.244	39.964
10.678	6.977	39.996	10.735	5.854	39.992
10.865	-5.828	39.931	10.786	-7.200	40.133
9.781	-7.877	39.874	10.156	-8.356	40.590
9.094	-8.971	39.967	8.482	-9.918	40.450
7.337	-10.433	39.845	6.293	-11.250	40.622
8.100	10.541	41.569	9.169	9.774	41.137
8.233	10.127	40.547	11.120	8.989	40.259
10.606	9.018	41.105	9.558	8.845	40.900
11.473	7.481	40.964	10.411	7.848	40.615
10.627	6.746	41.252	12.071	6.624	41.641
11.538	6.134	40.759	11.254	4.939	40.784
11.254	-5.062	40.828	11.650	-6.347	40.939
10.616	-6.408	40.986	11.516	-7.571	41.188
10.393	-7.427	41.213	9.727	-9.421	40.993
9.155	-8.971	41.339	7.535	-10.782	41.026
7.196	11.192	41.836	6.170	11.891	42.401
9.054	10.494	42.163	10.098	9.706	42.016
8.759	9.572	42.469	11.012	9.108	42.419
9.634	8.752	42.030	11.444	8.330	41.634
10.357	7.942	41.756	12.208	7.510	42.181
11.059	7.078	42.300	11.120	5.681	41.789
12.247	5.458	41.746	11.592	4.392	41.836
11.603	-4.356	41.738	12.265	-5.414	41.738
11.034	-6.804	42.239	12.197	-7.700	42.293
11.758	-8.600	42.174	10.930	-8.586	41.332
10.033	-8.320	42.019	8.546	-10.184	41.512
7.481	-11.009	42.221	6.332	-11.750	42.080
7.078	11.250	43.369	8.989	10.303	43.502
8.071	10.832	42.865	9.968	10.055	43.052
12.103	8.935	43.589	11.016	9.317	43.398
9.799	8.964	43.229	12.978	7.610	43.153
11.840	8.237	42.804	10.530	8.136	42.851
12.920	6.469	42.487	12.082	6.970	43.337
10.811	7.304	43.412	11.542	6.196	42.746
12.456	4.849	42.714	11.502	5.141	42.959
11.862	3.802	42.854	11.981	-3.773	42.862
12.740	-4.370	43.726	11.621	-4.662	42.790
12.560	-5.116	42.872	11.524	-5.933	42.865
12.845	-6.167	42.545	11.902	-7.074	43.132
9.515	-10.494	43.348	8.312	-10.750	43.427
8.158	10.685	45.472	11.401	9.313	45.320
8.964	9.990	45.115	12.416	8.723	44.780
9.968	8.950	45.313	11.772	8.006	45.130
10.703	8.060	45.148	13.619	6.998	44.676
12.366	7.157	45.403	13.842	5.828	44.989
11.646	6.037	44.960	13.032	4.669	44.748
11.779	4.910	44.035	12.236	-3.784	44.921

Table B6 continued.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
13.064	-4.576	45.004	13.756	-5.710	44.939
12.650	-6.728	45.050	11.491	-6.196	44.856
13.630	-7.146	45.184	11.837	-7.330	44.428
10.678	-7.477	44.809	13.064	-8.024	44.554
11.992	-8.888	45.608	10.966	-8.460	44.734
9.925	-8.906	45.346	11.218	-9.461	44.885
10.303	-9.896	44.266	9.004	-9.742	44.611
9.133	-10.616	44.568	7.974	-10.822	44.298
6.941	-11.297	44.611	11.084	9.137	46.202
10.238	9.904	45.461	13.230	7.801	45.270
12.244	8.474	45.997	12.949	7.704	46.440
11.254	6.833	45.792	13.637	6.786	45.976
13.457	5.627	46.303	12.409	6.401	46.163
12.434	-6.678	46.008	12.089	-5.634	45.986
11.311	-6.790	45.706	13.619	-6.869	46.206
11.862	-7.780	45.396	12.917	-8.024	45.598
10.757	-8.158	45.961	10.897	-9.288	46.044
10.048	-9.914	45.338	9.011	-10.127	45.860
8.050	-10.660	45.342	9.209	9.918	46.170
10.102	9.263	46.703	11.819	8.435	47.081
10.796	8.176	46.130	12.474	7.258	47.207
11.509	7.456	46.487	11.581	6.368	47.088
12.460	4.766	46.735	13.021	-5.648	46.908
12.269	-4.932	47.110	13.014	-6.566	47.113
11.711	-6.181	46.976	12.791	-7.776	46.512
12.269	-7.351	47.315	11.408	-7.326	46.559
11.869	-8.482	46.588	10.487	-8.813	47.045
9.774	-9.544	46.541	10.732	8.392	47.297
11.419	7.510	47.830	13.108	6.350	47.066
12.046	6.379	47.999	12.431	5.486	47.344
12.092	-6.041	47.844	11.506	-7.243	47.959
11.106	-8.158	47.376	9.104	-9.612	43.524
10.303	9.886	44.255	11.200	9.248	44.514
9.382	9.338	44.186	12.906	7.974	44.078
11.527	8.053	43.927	10.350	8.366	44.147
13.435	6.577	43.747	12.305	7.013	44.341
11.030	7.135	44.611	13.504	5.386	43.956
12.856	5.731	42.998	12.359	5.767	43.952
11.221	6.206	43.852	12.744	4.424	43.675
12.200	3.784	44.845	11.876	3.539	43.884
11.801	-3.564	43.916	11.948	-4.810	44.136
12.326	4.043	45.947	12.236	-4.151	46.102
13.082	-4.910	45.972	11.794	-4.892	45.295
13.543	-5.908	45.868	12.618	-5.717	44.824
13.316	-5.198	43.949	11.488	-5.418	43.924
13.637	-6.660	44.230	13.432	-6.048	43.517
12.344	-6.228	43.794	12.931	-7.474	43.880
11.549	-8.050	43.600	10.624	-7.729	43.618
12.452	-8.456	43.315	10.030	-8.824	44.226
12.236	-8.716	44.464	11.372	-9.284	43.729
10.994	-6.674	43.715	13.115	-7.207	42.966
10.850	-7.675	42.458	11.214	-8.867	42.761
10.105	-8.640	43.171	10.508	-9.421	41.998

Table B6 concluded.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
9.590	-10.134	42.138	9.263	-9.306	42.455
8.528	-10.555	42.509	7.261	-11.632	43.240
7.027	11.189	44.719	6.023	11.880	43.992
9.299	10.588	44.593	8.125	10.739	44.201
10.411	-9.749	43.164	11.981	5.519	46.094
11.250	-5.641	41.875	12.254	-6.696	41.861
13.212	4.914	45.680	11.941	4.939	45.176
12.841	6.016	45.047			

Table B7. Target points in the VCAF esophagus.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
2.700	0.180	28.260	2.700	0.180	27.540
2.700	0.180	26.820	2.700	0.180	26.100
2.700	0.180	25.380	3.060	-0.180	24.660
3.060	-0.180	23.940	3.060	0.180	23.220
3.060	0.180	22.500	3.060	0.180	21.780
2.700	-0.180	21.060			

Table B8. Target points in the VCAF heart.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
1.663	2.174	32.220	0.731	2.210	38.405
2.794	-2.430	38.686	2.243	3.431	39.582
3.766	2.333	38.045	5.368	0.965	38.779
4.388	2.311	39.211	2.059	1.490	38.822
0.421	0.234	38.556	0.040	0.259	39.816
5.468	-1.044	39.470	3.658	0.054	38.754
0.648	-1.649	38.318	4.162	-2.156	39.168
4.115	3.240	41.234	2.290	4.172	42.257
5.476	2.196	41.022	3.258	3.049	40.378
0.958	2.963	40.532	-0.043	1.850	40.320
5.555	0.536	40.504	3.740	0.799	40.540
2.059	1.127	40.248	3.528	-0.878	40.655
2.092	-0.774	38.711	2.034	-0.947	40.363
-0.140	-0.803	40.489	0.616	-2.182	40.183
1.980	-2.912	40.068	3.521	3.582	42.844
5.368	1.782	42.732	2.365	1.836	42.300
1.282	3.082	41.951	-0.058	2.498	42.754
5.623	-0.418	41.796	3.780	1.217	42.131
1.534	0.580	41.796	-0.176	1.152	41.828
3.258	-1.271	42.451	1.602	-0.778	42.163
-0.756	0.094	42.512	5.389	-1.710	41.386
4.115	-2.812	40.828	1.649	-2.819	42.502
0.443	-2.758	42.037	-0.306	-1.213	42.278
2.761	-3.121	41.461	1.807	2.545	44.248
6.311	0.547	42.797	4.597	0.648	44.431
1.015	1.058	43.841	-0.886	0.446	44.089
6.138	-0.385	44.194	3.960	-0.176	42.829
1.249	-0.752	43.855	5.508	-1.638	43.704
4.612	-2.664	42.847	1.055	-3.010	44.428
-0.292	-2.077	43.960	3.560	-3.244	43.700
5.044	3.132	43.319	3.182	4.140	44.518
1.195	3.935	44.104	5.929	1.915	44.791
4.669	3.110	45.094	3.449	1.937	44.194
0.065	2.448	45.947	-0.364	2.268	44.442
4.129	0.932	46.156	2.588	0.371	44.147
0.788	0.756	45.882	-0.864	0.648	46.130
6.106	-0.464	45.810	3.895	-1.116	44.734
5.562	-1.829	46.098	3.816	-0.929	46.285
2.459	-1.793	44.384	-0.252	-0.868	44.831
6.044	-3.736	44.342	4.716	-2.956	45.238
2.606	-4.046	43.902	2.675	4.162	46.087
1.098	3.326	46.152	4.550	3.103	46.436
2.610	2.246	46.026	5.879	1.195	46.253
1.750	-1.206	46.022	2.290	0.518	45.846
3.528	-3.042	46.148	0.760	-2.790	46.091
-0.360	-1.404	46.314	2.398	-3.416	45.997

Table B9. Target points in the VCAF intestine.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
5.238	-3.222	61.956	2.423	-1.692	61.135
3.395	-5.418	61.171	2.570	1.300	64.051
5.090	0.428	63.680	3.020	-2.264	63.799
0.828	-4.241	64.069	3.809	-6.080	64.174
0.526	-8.305	63.889	2.045	-7.801	61.848
1.660	9.223	65.272	3.658	6.754	64.537
5.191	4.147	65.498	2.344	3.766	65.048
4.723	-4.230	65.754	0.720	-4.925	66.085
-3.290	-4.633	66.539	-1.843	-6.419	66.470
0.119	-8.838	66.312	2.628	-2.844	69.941
-3.337	-5.652	70.229	-1.541	-6.970	69.242
-1.908	7.934	71.460	-0.828	5.382	70.078
2.542	6.563	70.967	4.295	1.552	70.405
2.534	3.359	70.830	4.122	-3.654	72.425
1.652	-0.612	70.963	3.532	-4.766	75.820
3.164	-6.008	71.899	0.374	-5.375	71.114
-1.253	-8.377	72.479	1.847	7.862	72.698
-0.065	8.766	72.914	3.960	4.374	73.120
-0.007	4.518	72.752	4.104	1.426	73.861
1.091	1.480	73.174	4.439	-0.821	72.785
1.897	-2.538	73.879	-2.722	-6.624	73.285
0.810	-8.413	72.799	5.072	-1.667	76.514
3.132	2.498	76.558			

Table B10. Target points in the VCAF kidneys.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-3.013	-5.537	55.786	-2.509	-5.339	58.032
-2.048	-5.612	59.965	-1.908	6.797	60.869
-2.052	5.537	62.417			

Table B11. Target points in the VCAF liver.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
1.768	-9.144	50.170	1.026	-9.130	50.213
2.171	-9.166	50.188	2.102	6.343	49.442
0.439	7.085	50.522	4.295	5.738	50.054
4.842	3.344	49.763	2.138	3.416	49.979
0.151	3.949	50.965	5.814	1.116	50.422
3.121	0.846	49.882	0.490	1.098	50.360
4.982	-1.530	49.896	2.070	-1.418	49.964
-0.547	-1.393	50.634	0.828	8.521	52.679
2.977	7.700	51.721	-1.098	6.984	53.140
4.579	5.936	52.888	3.006	4.604	51.840
1.505	5.785	52.448	-1.364	5.688	51.113
-2.452	4.439	53.320	5.713	3.841	51.898
1.375	2.686	52.747	5.962	1.760	53.219
3.611	1.926	51.872	3.697	3.161	53.978
6.314	-0.850	52.070	4.100	-0.443	52.308
1.598	0.011	52.322	3.391	6.768	54.695
1.588	7.470	54.540	-0.374	7.826	55.494
2.074	4.414	54.943	-0.061	4.824	53.701
5.119	4.288	54.893	-0.724	1.904	52.780
3.582	0.619	54.551	1.336	1.606	54.904
5.846	-0.468	54.781	0.245	-0.396	54.133
3.712	5.375	56.693	0.702	5.519	56.473
-0.558	3.157	55.296	0.706	2.941	57.380

Table B12. Target points in the VCAF lungs.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-1.804	6.257	40.741	-0.288	-6.862	39.326
-4.302	5.260	44.392	-0.590	-7.996	44.096
-0.853	8.125	44.363	-3.946	-5.447	46.645

Table B13. Target points in the VCAF muscle.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-7.009	-0.022	13.077	1.037	-20.521	92.096
-1.197	2.340	19.281	0.022	11.679	84.833
2.487	-2.256	25.708	-4.500	0.359	0.900
2.414	6.936	28.218	-3.938	6.447	90.096
7.645	-2.287	32.972	-5.517	7.793	112.955
-2.616	-15.268	35.005	2.085	7.136	109.801
8.258	3.504	37.439	1.927	6.936	109.673
-9.348	-9.445	44.397	3.780	9.243	93.622
-0.233	12.346	46.588	0.022	-2.308	93.473
9.403	4.702	57.252	-0.001	-9.317	84.812
9.317	-4.647	57.252	-7.136	-7.243	87.174
8.662	-0.022	62.428	0.254	-6.300	91.546
2.393	17.068	37.386	2.085	-6.904	109.631
0.148	-19.452	35.047	-6.279	-9.096	107.618
2.256	-17.016	37.386	1.473	-7.264	109.757
4.542	-19.452	51.205	-3.304	-8.715	114.121
-7.115	-11.679	73.155	3.578	-9.424	93.654
8.132	0.359	72.721	-5.028	6.024	119.456
-9.753	-9.169	78.513	-1.197	5.940	142.338
-2.414	4.668	81.816	-1.578	3.228	145.313
-1.578	-4.416	82.144	3.833	3.452	149.325
-5.643	-7.009	85.193	0.732	-3.378	126.138
-7.083	7.009	76.172	-3.759	-6.576	126.138
0.540	17.100	84.420	11.605	-8.026	160.296
3.049	-18.698	70.178	-0.001	14.727	82.144

Table B14. Target points in the VCAF ovaries.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-3.308	3.067	75.600	-3.326	-3.042	75.676
-3.240	3.035	76.334	-3.200	-3.049	76.370
-3.344	-3.049	77.040	-3.348	3.046	77.076

Table B15. Target points in the VCAF pancreas.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-0.424	-3.049	54.540	4.203	0.382	58.944
1.767	-3.155	55.557	3.452	-1.906	58.500
2.795	-1.620	55.896	5.856	4.214	59.283
1.788	-3.197	55.536	5.220	3.367	59.273
3.420	-0.414	55.938	5.982	2.763	59.136
4.881	1.260	59.007	4.702	3.399	59.220
4.203	1.652	59.188	4.298	3.186	59.199
5.378	0.603	58.447	4.256	2.955	59.178
4.426	1.079	59.018	5.167	3.315	59.157
4.256	0.784	59.041	4.235	2.340	59.209
4.692	0.719	57.896	5.357	1.567	58.308
4.532	2.298	58.468	5.527	2.532	58.521
5.748	3.283	59.157	5.475	0.582	58.734
6.066	2.902	59.209	4.986	1.271	58.923
5.146	2.172	59.443	4.035	1.715	59.115
5.685	3.420	59.188	5.824	1.652	58.986
5.231	2.287	59.485	4.266	2.795	59.167
5.357	1.557	58.298	5.336	1.864	59.443
5.252	2.487	58.532	4.161	1.980	59.104
5.052	2.424	58.605	4.797	0.169	58.140
6.003	2.329	58.860	5.866	1.609	58.881
5.136	0.424	58.098	4.161	-1.715	57.197
4.849	1.176	59.052			

Table B16. Target points in the VCAF salivary glands.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
1.980	5.580	13.500	1.980	-5.580	13.500
4.500	4.860	16.740	4.500	-4.860	16.740
6.660	2.340	19.980	6.660	-2.340	19.980
4.500	3.420	19.260	4.500	-3.420	19.260
4.140	1.260	18.180	5.220	1.260	18.180
4.140	-1.260	18.180	5.220	-1.260	18.180

Table B17. Target points in the VCAF skin.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
2.870	4.670	2.170	-2.150	3.950	1.090
6.110	-1.070	1.810	1.260	-1.070	0.010
-6.470	-0.710	1.810	-2.150	-3.950	1.090
7.910	4.670	7.570	3.590	6.470	6.130
-5.750	4.670	3.970	8.990	0.350	5.770
-8.990	1.430	6.490	4.140	-5.030	4.140
-2.150	-6.470	4.690	-7.190	-4.310	6.130
8.630	3.590	13.500	-0.540	7.910	11.870
-2.870	6.830	7.570	-7.550	4.310	11.150
-8.990	-0.350	13.310	7.910	-3.950	9.010
3.230	-6.830	9.180	-1.980	-8.630	11.150
-7.550	-4.310	11.150	4.310	6.110	13.860
11.510	-0.350	13.500	-3.950	5.390	15.830
7.550	-4.670	14.750	2.340	-6.110	15.660
-2.870	-6.110	15.110	3.230	5.750	17.630
8.990	2.150	19.430	-6.470	2.150	17.270
8.270	-2.870	19.430	-1.790	-4.310	22.690
-5.030	-3.950	17.630	2.510	5.030	21.780
5.750	2.150	23.580	2.510	-5.030	21.780
0.180	10.070	27.010	-1.790	4.310	22.690
-4.310	1.070	22.310	5.750	-1.790	25.740
1.070	-10.070	27.010	-2.870	-10.430	27.730
-0.710	20.150	32.770	2.510	17.270	30.610
-1.430	14.750	28.810	5.390	13.670	31.330
3.950	8.990	28.090	-5.750	9.540	30.610
-4.670	6.110	27.730	7.190	-0.180	30.610
5.390	5.940	28.810	-5.750	2.700	29.530
7.910	-4.310	33.130	-5.030	-4.310	27.900
4.670	-7.190	28.090	5.750	-11.510	30.970
3.590	-15.470	30.250	1.070	-17.630	30.250
-3.590	-14.750	29.890	6.830	18.710	36.730
3.230	21.230	36.540	-4.310	19.430	35.100
6.830	13.310	36.710	-4.670	14.030	30.610
-6.110	16.190	35.100	7.190	9.540	34.210
-3.590	16.020	39.060	-8.630	8.460	34.930
7.910	4.310	33.130	9.710	-1.980	37.810
-7.190	1.260	33.300	-7.190	-3.590	32.770
7.550	-9.350	34.930	-6.470	-8.820	31.690
6.470	-14.220	35.460	-7.910	-11.510	34.570
-0.180	-20.510	34.020	-4.310	-19.430	35.100
6.470	17.460	43.020	-8.270	12.590	36.730
6.110	12.590	41.940	11.150	8.270	39.250
-9.350	3.970	36.730	11.510	5.410	39.250
9.710	1.980	37.810	-10.430	3.610	40.330
6.830	-18.710	36.730	3.230	-21.230	36.540
1.260	-21.230	41.580	4.670	20.150	46.980
-1.070	21.230	41.220	0.180	13.140	43.910
-7.910	12.950	44.270	-7.910	12.950	40.500
12.590	10.070	45.350	9.710	11.150	46.070
-10.430	8.990	43.740	13.670	3.610	43.570
12.590	-2.530	44.990	7.020	-11.870	45.710
9.710	-0.180	39.780	-10.790	-7.190	43.740

Table B17 continued.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-9.710	-1.090	41.050	14.030	-5.770	42.130
11.150	-7.190	38.890	-9.350	-3.250	37.090
6.660	-10.430	37.980	-10.070	-8.270	38.890
-5.750	-16.910	35.100	-8.270	-12.590	37.980
9.350	-11.510	41.770	6.110	-18.350	45.350
3.950	-14.220	40.500	-5.390	-13.670	40.860
6.830	-17.290	41.750	-3.230	-19.790	41.580
-0.350	21.590	47.700	5.750	17.460	50.220
-3.950	18.710	47.340	1.430	13.690	50.390
-0.180	13.690	46.980	6.830	11.150	48.420
14.750	6.830	46.790	10.790	0.180	46.260
-10.070	2.890	48.590	11.510	-0.900	49.140
-9.710	-1.090	47.150	-10.430	-4.140	47.510
11.870	-10.430	45.710	6.830	-11.150	51.470
1.620	-12.590	44.460	-0.540	-13.690	46.260
-6.470	-13.310	46.070	-8.990	-11.150	45.900
5.750	-16.930	49.860	-3.950	-18.710	46.620
2.510	-21.230	46.620	0.350	21.590	53.100
4.670	19.070	54.710	-3.590	19.430	54.350
-5.390	13.310	53.630	-6.470	12.950	48.420
9.350	8.270	53.630	-0.540	12.950	53.460
-9.710	8.270	49.310	11.510	5.390	51.470
-8.990	7.190	53.270	11.510	-3.420	52.550
-8.630	-1.810	54.350	14.390	-7.550	47.150
10.430	-6.830	52.910	-9.350	-6.830	51.110
8.990	-8.990	52.910	2.340	-12.230	52.740
-8.630	-8.990	53.630	-0.180	-13.690	50.940
-6.470	-12.230	55.430	-5.580	-13.310	51.660
5.390	-17.990	53.270	-3.950	-16.930	52.380
-0.350	-21.590	50.220	1.430	21.230	60.300
3.950	16.210	57.590	-3.590	18.710	59.220
6.830	10.790	52.910	-7.190	11.150	56.150
10.430	4.670	58.670	-8.630	3.420	55.260
9.350	-7.190	59.390	3.230	-12.230	57.780
0.180	-12.590	59.580	-7.190	-8.990	62.820
-7.910	-7.550	59.390	-3.950	-12.590	58.670
3.590	-15.490	56.340	-3.590	-19.070	57.420
1.790	-21.230	54.900	-1.790	21.590	66.780
4.310	19.070	63.730	-3.230	18.010	65.150
-2.510	12.950	60.850	3.590	12.230	57.060
-6.470	10.430	59.220	10.070	-6.110	64.450
10.430	-3.060	59.940	-8.270	-3.250	59.030
6.470	-10.430	58.860	-4.670	-12.590	65.530
1.430	-21.230	60.300	3.230	21.230	68.580
3.950	12.230	64.980	-1.790	14.030	69.130
7.910	9.350	63.370	1.070	12.590	61.380
-6.830	10.070	64.980	10.430	1.450	62.290
8.270	8.630	59.580	-8.990	6.830	66.970
10.790	3.230	66.420	-9.350	-4.500	67.690
-8.270	3.250	63.540	-8.270	-2.530	64.450
4.670	-11.870	64.620	-0.180	-12.950	65.700
3.950	-16.930	61.210	4.310	-16.930	65.700
-3.230	-17.290	64.070	-1.430	-21.590	64.810

Table B17 continued.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-3.230	20.510	72.900	4.310	17.650	72.350
3.230	12.590	68.410	-4.670	12.590	66.420
8.990	7.550	67.140	3.950	13.310	72.900
-10.790	2.870	70.210	11.150	1.260	70.190
-7.190	0.180	66.060	10.430	-4.670	67.860
-9.350	-7.550	69.490	7.190	-9.710	67.140
-7.190	-11.150	68.410	-0.180	-14.030	70.380
4.670	-19.070	69.830	0.180	-22.310	70.020
2.510	22.310	81.710	-0.710	22.670	74.700
3.590	19.260	77.390	-0.540	15.830	77.220
-4.670	14.750	72.900	-7.910	12.590	72.900
8.270	8.990	71.820	-9.350	10.070	71.650
10.790	2.510	73.620	-10.430	0.180	81.540
10.430	-4.670	71.820	-11.150	-0.180	71.290
6.830	-10.430	72.540	3.420	-13.310	73.070
-11.510	-7.190	74.170	1.260	-15.470	77.220
-3.950	-15.110	73.980	-7.190	-13.310	72.900
3.950	-18.370	75.590	-3.230	-20.510	71.820
3.950	15.470	79.740	-5.030	15.830	78.850
9.350	7.190	75.590	-12.230	9.350	77.050
10.430	1.620	79.550	-12.950	5.220	77.050
-13.310	-3.610	80.270	10.070	-5.390	75.420
10.070	-3.950	79.550	-11.870	-2.530	75.970
-3.950	-16.190	78.490	-10.430	-11.510	76.690
1.430	-22.670	75.970	-0.010	23.390	87.490
-2.510	21.950	80.820	3.590	16.190	84.780
-4.670	16.910	83.170	-8.990	13.310	78.490
7.190	11.510	79.740	0.180	16.910	86.220
-12.950	10.790	82.260	8.630	6.110	82.430
3.590	1.810	85.140	-11.510	2.530	85.140
-12.950	2.700	79.740	8.270	1.070	84.950
-3.420	1.090	85.860	-5.580	0.900	84.950
8.630	-4.500	83.150	3.780	-1.980	84.950
7.910	-8.990	82.070	-13.310	-8.630	79.380
7.550	-10.790	79.740	4.310	-15.110	79.570
-8.990	-13.670	79.570	-13.310	-10.790	83.890
4.310	-15.470	84.060	-4.310	-16.910	82.450
2.510	-22.310	81.710	-2.510	-21.950	79.020
-3.950	20.170	89.630	5.390	19.070	95.030
-7.550	16.190	86.390	-10.790	14.030	85.140
7.550	9.350	82.430	-11.870	8.990	89.630
-6.830	2.170	93.060	-13.670	6.850	84.950
-1.260	-1.450	88.740	-3.060	-1.450	88.020
-9.350	-2.170	88.190	-12.230	-3.250	85.140
7.550	-6.850	89.100	-12.950	-7.380	87.110
6.830	-11.510	86.410	3.230	-16.550	91.260
1.620	-16.910	86.220	-10.790	-14.030	85.140
5.390	-18.540	94.860	-5.750	-16.190	90.710
-6.110	-16.910	86.030	0.710	-23.030	86.050
-3.950	-21.590	86.580	-2.870	21.590	93.950
2.870	19.620	100.070	5.750	14.030	86.940
4.310	22.310	90.540	1.430	16.910	93.590
-5.390	16.190	91.070	7.550	9.180	87.850

Table B17 continued.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-9.710	10.260	93.060	7.190	5.410	89.290
0.540	0.730	91.980	-10.070	3.610	89.990
5.750	-3.250	88.570	-2.340	-1.450	95.580
-6.110	-1.810	93.230	6.830	-13.310	90.730
-1.430	-15.470	97.190	-11.150	-9.710	90.710
5.750	-18.540	91.980	-1.260	-16.550	93.060
1.620	-23.390	90.710	-3.230	-21.420	92.510
-1.430	19.980	98.630	8.270	12.590	94.670
5.750	14.750	91.980	-8.270	14.030	93.230
-8.270	6.130	96.300	7.550	2.890	93.610
-4.670	2.170	98.460	6.470	-1.810	93.610
1.980	-0.370	97.020	-8.270	-6.490	98.990
8.990	-7.020	94.140	-9.350	-5.050	93.590
8.630	-11.510	94.860	-7.190	-11.870	97.910
-8.270	-14.030	93.230	3.950	-21.230	96.110
-1.790	-19.980	97.910	7.190	13.310	100.070
-0.350	15.470	98.630	8.990	7.380	95.580
-5.030	13.670	98.270	-8.270	8.990	100.070
7.550	2.890	99.710	0.540	0.730	99.180
-4.670	2.170	102.230	8.270	-4.330	98.820
1.980	-0.370	103.500	-2.340	-1.450	103.860
-5.750	-2.890	99.900	7.190	-13.670	98.270
3.780	-15.470	98.820	-3.950	-13.670	101.870
1.790	-19.260	100.790	4.310	15.110	100.980
-3.950	13.310	103.670	8.630	8.820	101.700
1.620	0.730	107.460	-7.910	8.270	104.030
7.550	3.250	106.190	6.830	-2.170	103.500
-4.310	-2.170	107.270	8.630	-9.350	102.230
-3.590	-12.950	106.550	-7.910	-8.630	103.670
2.340	-14.750	104.030	6.470	12.590	108.350
2.530	14.390	106.550	-2.870	12.950	108.710
8.270	8.630	107.820	-4.310	2.170	107.270
-7.550	6.850	107.270	1.620	-0.730	111.420
-7.550	-6.850	107.270	6.830	-12.590	105.830
2.700	-14.030	109.070	4.670	12.950	113.750
7.910	7.550	113.750	-1.620	2.530	119.700
-5.030	10.790	112.670	-6.830	7.020	111.950
6.830	2.890	113.390	-1.430	1.090	115.380
7.910	-4.330	107.100	6.470	-2.170	111.230
-3.590	-2.170	111.420	7.910	-9.710	109.790
-2.510	-12.230	112.860	-6.110	-9.710	111.950
-0.350	12.950	115.550	7.190	6.660	119.870
-3.950	3.610	123.490	-5.030	3.610	114.470
7.190	-3.970	115.910	-2.150	-2.170	122.770
-6.110	-5.410	114.830	7.550	-9.350	114.110
-5.030	-7.910	119.870	3.950	-12.950	115.190
5.750	11.150	118.790	-3.590	10.790	118.790
5.030	-1.810	118.980	-2.870	-2.170	119.150
6.830	-8.270	121.310	-2.150	-11.870	118.790
5.030	9.350	126.350	1.090	11.150	123.110
-2.510	9.350	126.900	5.390	3.250	124.910
1.620	1.810	125.460	-5.030	4.330	129.060
6.110	-5.410	125.990	3.590	-2.170	125.270

Table B17 concluded.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-4.670	-3.970	126.010	4.670	-11.510	120.590
0.730	-10.790	124.190	5.030	6.470	131.030
-4.670	7.910	133.740	-3.950	2.170	135.710
1.980	-1.450	130.500	-2.870	-1.450	130.500
3.590	-9.350	128.700	-3.590	-8.630	126.370
1.070	10.070	133.020	-3.950	8.270	139.310
3.230	2.170	134.460	2.870	-2.170	138.420
-5.030	-4.140	133.740	4.310	-7.910	133.190
-2.510	-9.710	130.500	1.790	9.350	140.030
4.670	5.580	138.230	4.310	-3.250	133.740
-3.230	-1.810	137.340	1.790	-9.710	137.150
-3.230	-9.350	135.350	-2.510	7.550	145.790
2.870	2.890	142.910	-3.230	2.530	141.830
3.950	-5.050	142.550	-0.710	-1.810	143.270
1.790	-8.990	142.190	-4.310	-7.550	140.390
3.590	7.550	147.780	3.950	-2.530	149.050
-3.230	-4.330	145.790	-0.710	-7.910	146.870
-2.510	2.890	149.410	4.140	-2.170	155.340
-2.870	-2.890	151.570	5.750	2.170	152.820
-2.870	7.550	153.540	5.390	-7.910	151.930
6.110	8.270	154.620	-2.870	2.530	155.530
11.150	-3.060	156.610	-3.590	-2.890	157.670
17.630	8.990	160.550	11.340	8.990	161.630
20.870	3.250	160.380	14.390	3.780	157.690
8.820	2.890	160.550	3.970	8.270	161.630
1.620	2.170	161.270	-2.870	6.110	160.550
20.870	-3.250	160.380	14.410	-1.620	161.630
5.390	-2.170	160.550	-2.150	-5.750	161.630
19.430	-7.910	160.380	14.410	-9.710	160.380
9.540	-8.630	158.770	4.500	-8.270	161.630
0.730	-8.270	156.610	-5.030	6.660	120.230
5.030	1.810	118.620	-3.060	1.810	90.900
4.670	2.170	88.020	-8.270	3.970	59.390
10.790	1.450	55.790	-3.590	19.070	41.220
3.230	20.870	41.580	-10.790	5.940	42.660
10.430	0.540	42.660			

Table B18. Target points in the VCAF spleen.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-1.148	-5.702	52.679	-1.721	-7.409	52.783
-2.070	-6.462	52.315	-2.099	-3.355	53.280
-2.347	-8.158	53.179	-2.030	-2.887	54.194
-1.026	-6.811	53.284	-1.368	-7.942	53.737
-3.103	-8.467	53.795	-2.174	-8.795	54.112
-0.580	-6.530	54.356	-0.770	-7.520	54.569
-1.436	-8.525	54.673			

Table B19. Target points in the VCAF stomach.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
1.516	-4.622	51.736	3.334	-6.088	50.832
1.246	-6.404	50.839	3.517	-4.313	52.859
4.871	-5.828	52.276	3.215	-7.769	52.297
0.904	-8.003	52.290	5.252	-4.666	54.457
3.964	-6.646	54.583	1.771	-8.338	54.450
4.396	-5.105	56.740	2.441	-7.715	56.534

Table B20. Target points in the VCAF thymus.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
2.340	0.180	30.060	1.260	0.180	30.060
1.980	1.260	30.060	1.980	-1.260	30.060
1.980	-0.180	29.340	2.700	-0.900	28.620
2.700	0.900	28.620	1.980	-0.900	28.620
1.980	0.900	28.620			

Table B21. Target points in the VCAF thyroid.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
5.209	0.439	26.280	5.080	1.091	26.359
5.339	-0.169	26.147	5.238	-0.868	26.150
5.069	1.008	27.184			

Table B22. Target points in the VCAF uterus.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-1.197	0.911	77.527	-0.264	-0.732	76.881
-0.148	0.687	76.839	-2.647	0.127	77.993
-1.441	-0.742	77.622			

11. Appendix C – Target Point Locations in MAX

Table C1. Target points in the MAX adrenals.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-1.649	1.285	53.269	-1.145	-2.938	53.748
-1.422	-2.952	53.312	-0.916	-2.782	54.185
-0.464	1.656	54.374			

Table C2. Target points in the MAX BFO (left arm).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
0.360	-17.820	30.780	0.360	-17.460	32.220
-0.180	-17.100	33.660	-0.720	-18.900	35.100
-0.360	-19.800	36.540	-1.620	-19.800	37.980
-1.980	-19.800	39.420	-1.980	-19.800	40.860
-2.880	-20.880	42.300	-2.880	-20.880	43.740
-3.420	-21.240	45.180	-3.780	-21.600	46.620
-4.140	-21.960	48.060	-4.500	-22.500	49.500
-4.860	-22.500	50.940	-5.220	-23.220	52.380
-5.040	-23.220	53.820	-5.040	-23.220	55.260
-5.040	-23.220	56.700	-5.400	-23.580	58.140
-4.860	-23.220	59.580			

Table C3. Target points in the MAX BFO (left leg).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-0.540	-9.540	81.900	-1.440	-12.060	84.060
-2.520	-13.140	86.220	-2.520	-12.780	88.380
-1.980	-13.140	89.820	-1.800	-13.140	90.540
-1.080	-13.140	92.700	-1.260	-12.780	94.860
-0.720	-12.960	97.020	-0.360	-12.780	99.180
-0.180	-12.960	101.340	-0.000	-12.960	103.500
-0.000	-12.780	105.660	-0.000	-12.780	107.820
-0.000	-12.780	109.980	0.180	-12.420	112.140
0.180	-12.420	114.300	0.180	-12.420	116.460
0.180	-12.420	118.620	-0.000	-12.780	120.780
-0.180	-12.780	122.940	-0.900	-12.780	125.100

Table C4. Target points in the MAX BFO (mandible).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
0.839	5.533	15.977	4.172	4.482	15.970
0.893	-4.784	15.930	1.296	4.878	19.692
6.134	3.377	21.190	9.572	0.155	16.330
4.378	-1.584	16.283	6.016	-3.787	20.707
1.606	-4.820	19.696	8.824	0.180	21.503

Table C5. Target points in the MAX BFO (pelvis).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-4.068	3.960	70.571	-6.206	3.366	71.528
-2.840	4.248	72.691	-5.339	3.179	73.278
-3.215	2.182	73.206	-3.366	-5.177	72.954
-4.003	-6.829	72.115	-5.296	-6.451	72.760
-3.474	3.820	74.048	-4.936	-4.972	73.865
-6.725	-5.468	74.401	-3.395	-6.948	74.164
-4.831	-6.790	74.556	-2.783	-8.122	75.424
0.601	7.049	78.044	-0.770	5.814	78.372
-0.886	-9.101	78.221	-0.572	7.186	79.942
0.443	5.515	79.938	-1.883	5.602	79.675
0.468	-8.140	80.237	-2.243	-7.985	79.704
-0.817	-9.461	79.693	-3.992	-6.725	85.777
-3.424	3.578	86.699			

Table C6. Target points in the MAX BFO (ribs).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-5.580	12.060	27.900	-5.940	-12.060	27.900
-4.500	7.020	29.700	-4.140	-9.180	29.700
2.340	7.380	31.500	1.260	-9.180	31.500
0.900	5.220	33.300	4.140	-0.900	35.100
4.860	-7.380	36.900	-3.060	-12.060	38.700
-8.100	6.660	40.500	0.900	10.980	42.300
8.460	0.180	44.100	6.120	-12.420	45.900
-5.400	-12.060	47.700	-5.220	10.980	49.500
6.660	11.340	51.300	10.440	-8.100	53.100
-5.220	-12.780	54.900	-7.380	6.660	56.700
1.260	12.420	58.500	-4.860	-12.420	60.300

Table C7. Target points in the MAX BFO (right arm).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
0.360	16.560	30.780	0.360	16.560	32.220
-0.180	16.020	33.660	-0.720	18.180	34.740
0.180	17.820	36.540	-0.720	18.540	37.980
-0.720	18.900	39.420	-1.080	19.260	40.860
-1.620	19.800	42.300	-1.800	19.980	43.740
-1.980	20.160	45.180	-2.700	20.700	46.620
-3.060	21.240	48.060	-3.240	21.420	49.500
-3.420	21.600	50.940	-3.780	21.960	52.380
-3.600	22.140	53.820	-4.140	22.140	55.260
-3.960	22.320	56.700	-3.060	22.860	58.140
-3.600	22.860	59.580			

Table C8. Target points in the MAX BFO (right leg).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-0.180	7.020	81.900	-1.440	9.360	84.060
-2.160	10.620	86.220	-2.340	10.260	88.380
-1.260	10.620	90.540	-1.080	10.980	92.700
-0.180	10.440	94.860	-0.000	10.440	97.020
0.540	10.440	99.180	0.720	10.440	101.340
0.720	10.440	103.500	1.080	10.260	105.660
0.900	10.440	107.820	0.900	10.440	109.980
0.900	10.440	112.140	0.900	10.260	114.300
0.900	10.440	116.460	0.720	10.260	118.620
0.900	10.440	120.780	0.900	10.620	122.940
0.180	11.340	125.100			

Table C9. Target points in the MAX BFO (skull).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
0.875	5.994	3.096	6.210	2.844	2.650
0.270	0.619	0.360	-5.526	2.477	1.930
5.299	-2.354	2.650	0.428	-4.921	3.308
-5.188	-3.150	2.668	5.926	6.026	7.715
-0.482	7.459	9.306	-5.062	7.139	5.540
8.561	0.770	7.740	2.236	1.228	8.424
-3.643	0.940	11.070	-9.734	2.286	6.797
6.433	-4.126	7.708	1.516	-5.256	8.525
-4.100	-6.458	8.194	-8.964	-2.999	6.790
-1.980	7.398	14.602	-7.427	6.354	10.638
2.369	0.709	14.296	-9.943	0.580	13.169
-0.871	-6.005	14.184	-7.434	-4.532	12.096
-4.813	3.744	16.168	-4.169	-2.495	16.200

Table C10. Target points in the MAX BFO (spine).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-1.260	0.540	17.460	-1.260	0.360	19.980
-1.260	-0.360	22.500	-2.340	-0.000	25.020
-3.060	-0.540	27.540	-3.060	-0.720	30.060
-3.780	-0.900	32.580	-4.500	-1.080	35.100
-4.860	-1.080	37.620	-5.220	-0.720	40.140
-5.580	-0.900	42.660	-5.220	-0.900	45.180
-4.860	-1.260	47.700	-4.500	-1.080	50.220
-4.140	-1.260	52.740	-4.140	-1.260	55.260
-3.780	-1.260	57.780	-3.420	-1.440	60.300
-2.700	-2.340	62.820	-1.980	-2.160	65.340
-1.620	-2.340	67.860	-1.620	-1.800	70.380
-4.140	-1.440	72.900	-7.020	-1.440	75.420
-8.820	-1.260	77.940			

Table C11. Target points in the MAX bladder.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
0.263	1.066	76.986	3.830	-1.901	75.733
0.281	-3.218	76.961	4.630	0.439	79.355
0.896	1.260	81.958	1.962	-3.503	81.544
-2.455	-1.757	79.402			

Table C12. Target points in the MAX bone (left arm).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
0.360	-17.820	30.780	0.360	-17.460	32.220
-0.180	-17.100	33.660	-0.720	-18.900	35.100
-0.360	-19.800	36.540	-1.620	-19.800	37.980
-1.980	-19.800	39.420	-1.980	-19.800	40.860
-2.880	-20.880	42.300	-2.880	-20.880	43.740
-3.420	-21.240	45.180	-3.780	-21.600	46.620
-4.140	-21.960	48.060	-4.500	-22.500	49.500
-4.860	-22.500	50.940	-5.220	-23.220	52.380
-5.040	-23.220	53.820	-5.040	-23.220	55.260
-5.040	-23.220	56.700	-5.400	-23.580	58.140
-4.860	-23.220	59.580			

Table C13. Target points in the MAX bone (left leg).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-0.540	-9.540	81.900	-1.440	-12.060	84.060
-2.520	-13.140	86.220	-2.520	-12.780	88.380
-1.980	-13.140	89.820	-1.800	-13.140	90.540
-1.080	-13.140	92.700	-1.260	-12.780	94.860
-0.720	-12.960	97.020	-0.360	-12.780	99.180
-0.180	-12.960	101.340	-0.000	-12.960	103.500
-0.000	-12.780	105.660	-0.000	-12.780	107.820
-0.000	-12.780	109.980	0.180	-12.420	112.140
0.180	-12.420	114.300	0.180	-12.420	116.460
0.180	-12.420	118.620	-0.000	-12.780	120.780
-0.180	-12.780	122.940	-0.900	-12.780	125.100

Table C14. Target points in the MAX bone (mandible).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
0.839	5.533	15.977	4.172	4.482	15.970
0.893	-4.784	15.930	1.296	4.878	19.692
6.134	3.377	21.190	9.572	0.155	16.330
4.378	-1.584	16.283	6.016	-3.787	20.707
1.606	-4.820	19.696	8.824	0.180	21.503

Table C15. Target points in the MAX bone (pelvis).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-4.068	3.960	70.571	-6.206	3.366	71.528
-2.840	4.248	72.691	-5.339	3.179	73.278
-3.215	2.182	73.206	-3.366	-5.177	72.954
-4.003	-6.829	72.115	-5.296	-6.451	72.760
-3.474	3.820	74.048	-4.936	-4.972	73.865
-6.725	-5.468	74.401	-3.395	-6.948	74.164
-4.831	-6.790	74.556	-2.783	-8.122	75.424
0.601	7.049	78.044	-0.770	5.814	78.372
-0.886	-9.101	78.221	-0.572	7.186	79.942
0.443	5.515	79.938	-1.883	5.602	79.675
0.468	-8.140	80.237	-2.243	-7.985	79.704
-0.817	-9.461	79.693	-3.992	-6.725	85.777
-3.424	3.578	86.699			

Table C16. Target points in the MAX bone (ribs).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-5.580	12.060	27.900	-5.940	-12.060	27.900
-4.500	7.020	29.700	-4.140	-9.180	29.700
2.340	7.380	31.500	1.260	-9.180	31.500
0.900	5.220	33.300	4.140	-0.900	35.100
4.860	-7.380	36.900	-3.060	-12.060	38.700
-8.100	6.660	40.500	0.900	10.980	42.300
8.460	0.180	44.100	6.120	-12.420	45.900
-5.400	-12.060	47.700	-5.220	10.980	49.500
6.660	11.340	51.300	10.440	-8.100	53.100
-5.220	-12.780	54.900	-7.380	6.660	56.700
1.260	12.420	58.500	-4.860	-12.420	60.300

Table C17. Target points in the MAX bone (right arm).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
0.360	16.560	30.780	0.360	16.560	32.220
-0.180	16.020	33.660	-0.720	18.180	34.740
0.180	17.820	36.540	-0.720	18.540	37.980
-0.720	18.900	39.420	-1.080	19.260	40.860
-1.620	19.800	42.300	-1.800	19.980	43.740
-1.980	20.160	45.180	-2.700	20.700	46.620
-3.060	21.240	48.060	-3.240	21.420	49.500
-3.420	21.600	50.940	-3.780	21.960	52.380
-3.600	22.140	53.820	-4.140	22.140	55.260
-3.960	22.320	56.700	-3.060	22.860	58.140
-3.600	22.860	59.580			

Table C18. Target points in the MAX bone (right leg).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-0.180	7.020	81.900	-1.440	9.360	84.060
-2.160	10.620	86.220	-2.340	10.260	88.380
-1.260	10.620	90.540	-1.080	10.980	92.700
-0.180	10.440	94.860	-0.000	10.440	97.020
0.540	10.440	99.180	0.720	10.440	101.340
0.720	10.440	103.500	1.080	10.260	105.660
0.900	10.440	107.820	0.900	10.440	109.980
0.900	10.440	112.140	0.900	10.260	114.300
0.900	10.440	116.460	0.720	10.260	118.620
0.900	10.440	120.780	0.900	10.620	122.940
0.180	11.340	125.100			

Table C19. Target points in the MAX bone (skull).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
0.875	5.994	3.096	6.210	2.844	2.650
0.270	0.619	0.360	-5.526	2.477	1.930
5.299	-2.354	2.650	0.428	-4.921	3.308
-5.188	-3.150	2.668	5.926	6.026	7.715
-0.482	7.459	9.306	-5.062	7.139	5.540
8.561	0.770	7.740	2.236	1.228	8.424
-3.643	0.940	11.070	-9.734	2.286	6.797
6.433	-4.126	7.708	1.516	-5.256	8.525
-4.100	-6.458	8.194	-8.964	-2.999	6.790
-1.980	7.398	14.602	-7.427	6.354	10.638
2.369	0.709	14.296	-9.943	0.580	13.169
-0.871	-6.005	14.184	-7.434	-4.532	12.096
-4.813	3.744	16.168	-4.169	-2.495	16.200

Table C20. Target points in the MAX bone (spine).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-1.260	0.540	17.460	-1.260	0.360	19.980
-1.260	-0.360	22.500	-2.340	-0.000	25.020
-3.060	-0.540	27.540	-3.060	-0.720	30.060
-3.780	-0.900	32.580	-4.500	-1.080	35.100
-4.860	-1.080	37.620	-5.220	-0.720	40.140
-5.580	-0.900	42.660	-5.220	-0.900	45.180
-4.860	-1.260	47.700	-4.500	-1.080	50.220
-4.140	-1.260	52.740	-4.140	-1.260	55.260
-3.780	-1.260	57.780	-3.420	-1.440	60.300
-2.700	-2.340	62.820	-1.980	-2.160	65.340
-1.620	-2.340	67.860	-1.620	-1.800	70.380
-4.140	-1.440	72.900	-7.020	-1.440	75.420
-8.820	-1.260	77.940			

Table C21. Target points in the MAX brain.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
1.465	3.571	4.612	-1.598	4.882	5.512
3.596	2.938	4.626	1.728	1.822	4.122
-0.153	3.478	4.477	-2.322	2.736	4.230
-3.744	3.892	5.324	-5.706	2.117	5.321
3.946	0.688	4.129	1.861	-0.457	4.068
-0.101	1.422	4.025	-2.302	0.551	3.750
-4.244	1.494	4.126	3.600	-1.296	4.810
0.817	-2.084	4.608	-0.576	-0.763	4.169
-3.625	-0.767	4.550	-5.476	-0.079	5.029
-7.088	0.288	6.199	2.300	-2.840	5.339
-2.081	-1.969	4.633	-4.442	-2.300	5.674
2.657	4.673	5.933	0.392	4.842	6.286
-2.538	5.321	7.009	5.836	2.786	7.690
4.709	3.370	5.994	2.297	2.970	6.919
0.551	2.437	6.480	-1.685	3.013	6.311
-3.438	3.067	7.564	-5.540	3.593	6.487
5.368	1.379	5.753	2.887	1.336	5.861
1.026	0.263	5.803	-0.997	1.094	5.735
-3.499	1.505	6.088	-7.250	2.117	7.394
5.569	-0.875	5.724	2.041	-1.073	6.732
-0.310	-1.379	6.566	-2.120	-0.198	6.343
-4.514	-0.425	6.782	3.884	-2.560	6.836
1.166	-3.074	6.973	-0.814	-3.154	5.429
-2.585	-1.854	7.092	-6.329	-1.656	6.808
-1.044	-3.690	7.391	-2.959	-3.672	6.102
-5.094	-3.535	7.200	4.018	4.194	7.700
1.555	4.777	8.006	-0.196	5.577	8.473
-2.956	5.238	9.054	-4.565	4.835	7.578
4.115	1.814	7.992	1.953	1.220	8.150
-0.918	3.892	7.902	-2.657	2.617	9.259
-6.718	3.503	8.377	5.782	0.446	7.682
3.794	-0.137	6.642	-1.480	1.595	7.891
-3.470	0.493	8.330	-5.476	1.228	7.423
5.321	-1.732	7.830	3.596	-0.569	8.701
0.198	0.382	7.909	-1.354	-0.544	8.662
-7.621	-0.274	8.125	2.876	-2.693	8.604
1.289	-1.264	8.744	-0.684	-2.099	8.780
-2.995	-1.760	9.443	-4.464	-1.894	8.363
-6.847	-2.405	8.683	0.821	-3.798	8.766
-2.959	-3.881	8.302	-5.094	-3.852	9.392
0.936	4.457	10.019	-1.382	5.206	10.235
-3.751	4.133	10.080	-5.422	4.662	9.619
0.648	2.531	8.849	-1.116	3.413	9.817
-4.964	2.491	8.795	-6.934	3.193	10.364
-6.624	1.102	9.720	-8.381	1.714	9.432
0.774	-2.894	10.307	-1.487	-3.643	9.911
-7.745	-0.979	9.920	-3.679	-3.463	10.390

Table C22. Target points in the MAX breast.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
2.340	8.820	35.820	1.620	8.100	34.740
3.780	7.380	35.820	4.500	6.660	35.820
4.500	5.940	35.820	3.420	-9.900	36.540
4.140	-9.180	36.180	4.860	-8.460	36.720
5.400	-7.740	36.720	5.040	-6.660	36.000

Table C23. Target points in the MAX colon.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
4.579	4.352	59.533	3.100	5.530	59.324
0.376	5.793	59.336	5.947	4.640	59.526
5.432	2.347	58.907	2.149	4.554	59.468
7.020	0.541	58.860	5.429	0.922	59.440
4.064	3.236	59.569	7.895	0.691	59.594
7.375	-0.905	60.664	7.027	-2.333	59.189
7.088	-2.666	59.894	6.213	-5.677	59.948
1.300	7.952	62.107	2.034	7.398	61.168
-0.446	7.794	61.222	2.149	5.411	62.935
0.756	5.868	62.791	2.221	7.556	63.724
1.516	7.704	64.681	2.959	6.278	63.511
-0.137	6.505	63.443	2.560	6.973	66.247
1.814	6.707	67.288	0.371	6.887	65.074
3.172	5.839	65.398			

Table C24. Target points in the MAX esophagus.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-1.080	0.360	28.260	-1.080	-0.180	28.980
-0.720	-1.080	50.580	0.360	-1.800	49.500
0.180	-1.980	48.780	-1.800	-1.800	31.860
-2.160	-1.440	34.380	-2.440	-1.580	37.500
-2.340	-1.080	39.420	-2.160	-0.900	41.940
-1.620	-1.440	44.460	-0.720	-1.440	46.980

Table C25. Target points in the MAX heart.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
2.215	-2.402	40.520	1.631	-2.340	44.413
5.251	-2.308	43.220	2.327	-2.344	44.562
4.101	-3.090	46.666			

Table C26. Target points in the MAX kidneys.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-3.328	-6.614	55.617	-3.256	4.968	55.124
-4.029	6.762	58.133	-4.432	-8.147	56.124
-4.130	-8.392	58.776			

Table C27. Target points in the MAX liver.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
3.992	9.504	50.267	1.976	9.670	50.123
-0.025	9.410	50.209	-2.995	9.266	49.889
3.913	7.661	49.662	1.523	7.276	49.777
-1.166	8.467	49.871	-4.259	7.996	50.386
-5.443	7.207	51.862	0.335	6.091	50.382
-1.282	6.901	50.357	-3.298	6.613	49.864
4.108	4.313	50.072	3.287	5.720	50.195
1.318	4.223	49.673	-0.072	3.265	50.324
-1.523	4.518	49.590	-3.568	5.256	50.508
4.961	1.951	49.979	2.783	2.833	50.418
2.041	1.368	49.723	8.863	1.480	51.793
4.183	0.112	50.008	2.282	-0.914	50.249
0.338	1.256	50.710	7.218	-2.905	49.896
6.912	-0.554	50.047	4.756	-2.369	49.608
4.226	9.529	52.038	1.854	10.274	52.178
-0.306	10.307	51.912	-2.257	9.875	52.060
-4.198	9.616	52.132	6.073	8.348	52.157
2.023	7.960	51.728	0.101	8.125	52.268
-2.128	8.021	52.340	7.276	5.918	51.991
4.892	6.692	53.017	3.704	6.700	51.808
1.296	6.116	53.096	-0.623	6.134	53.186
-1.292	5.184	52.067	-5.450	5.695	51.404
7.870	3.827	52.895	4.810	4.212	52.103
3.085	4.090	52.780	1.721	5.026	51.757
0.360	3.596	52.546	4.903	2.142	51.973
3.053	1.368	52.301	7.492	0.925	52.312
4.828	-0.320	51.736	1.976	10.037	53.885
-0.209	10.418	54.068	-2.225	10.206	53.996
4.655	9.022	54.745	3.802	8.798	53.453
0.176	8.536	54.133	-3.694	8.950	54.464
-4.975	8.482	53.248	8.118	5.746	55.159
7.574	6.494	53.723	3.424	5.486	54.162
2.210	7.492	54.104	0.256	6.181	55.415
6.016	4.489	53.240	5.022	3.434	55.102
2.192	2.916	54.882	0.720	4.295	54.572
6.286	1.987	52.834	3.798	2.614	54.317
8.435	0.414	54.346	6.444	0.166	54.968
2.336	10.112	55.505	0.184	10.213	56.340
-1.562	9.673	56.239	-3.103	9.724	56.542
6.772	7.481	56.297	2.430	7.747	55.739
6.466	7.902	54.443	2.696	5.112	55.534
7.729	4.183	55.433	5.558	5.278	55.188
4.554	7.006	55.699	8.514	2.581	54.475
6.379	2.074	54.846	2.117	9.925	57.712
4.640	9.198	56.689	0.932	9.666	59.191

Table C28. Target points in the MAX lungs.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-2.902	5.000	38.938	-3.496	-7.880	38.070
2.732	6.095	42.408	-1.937	4.486	43.463
-1.044	-9.047	44.338	4.252	-9.040	43.607

Table C29. Target points in the MAX muscle (head and neck).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-4.500	2.700	23.940	3.420	6.840	8.820
3.780	-4.500	10.260	4.140	5.220	11.700
2.700	-4.140	13.140	0.900	2.340	14.580
-5.220	-3.780	16.020	-5.220	3.420	17.460
1.620	2.340	18.900	1.980	-2.700	20.340
3.780	0.360	21.780	-5.220	-2.700	23.220

Table C30. Target points in the MAX muscle (left arm).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-2.340	-24.300	85.500	-3.060	-23.220	76.500
-4.500	-21.780	71.460	-1.620	-22.500	66.420
-2.340	-23.940	61.380	-5.580	-20.340	56.340
-7.380	-22.860	51.300	-4.500	-24.300	46.260
-2.340	-22.140	41.220	-4.140	-21.780	36.180
-4.500	-20.340	31.140			

Table C31. Target points in the MAX muscle (lower legs).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-6.300	12.060	129.780	-7.020	-12.060	129.780
-4.860	9.540	133.740	-5.580	-9.900	133.740
-7.380	14.940	137.700	-7.740	-15.660	137.700
-4.500	10.260	141.660	-4.500	-10.260	141.660
-6.300	13.140	145.620	-7.380	-13.500	145.620
-7.020	14.580	149.580	-7.380	-15.660	149.580
-5.220	12.780	153.540	-5.940	-13.140	153.540
-5.940	13.860	157.500	-5.940	-14.220	157.500
-5.580	14.580	161.460	-5.580	-15.300	161.460
-6.300	14.220	165.420	-5.580	-14.940	165.420
-1.980	13.860	173.340	-0.900	-16.020	173.340

Table C32. Target points in the MAX muscle (lower torso).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-4.500	7.380	72.180	-3.780	-12.780	75.420
-7.380	4.860	78.660	3.060	-13.140	81.900
3.060	9.900	85.140	-6.660	-9.540	88.380
-0.180	4.860	91.620	-0.900	-8.100	91.620
-0.540	6.300	94.500	-0.540	-8.100	94.500

Table C33. Target points in the MAX muscle (mid torso).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-9.540	2.340	48.780	10.620	-0.540	50.940
-8.820	-7.740	53.100	-8.100	8.100	55.260
-8.100	-7.380	57.420	-4.860	2.340	59.580
-3.060	-5.940	61.740	3.780	10.620	63.900
2.700	-13.140	66.060	-3.420	-5.940	68.220
0.180	3.780	70.380			

Table C34. Target points in the MAX muscle (right arm).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
3.060	23.580	85.140	-1.260	23.940	76.500
-3.420	22.500	71.460	-3.060	25.020	66.420
-0.000	22.860	61.380	-1.980	18.180	56.340
-0.900	21.780	51.300	-5.580	19.260	46.260
1.980	18.900	41.220	-2.340	21.420	36.180
-3.780	19.980	31.140			

Table C35. Target points in the MAX muscle (upper legs).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
0.540	13.860	95.580	0.180	-16.380	95.580
-2.700	4.860	98.820	-3.780	-6.660	98.820
0.540	4.860	102.060	0.900	-7.740	102.060
4.860	12.780	105.660	2.700	-15.300	105.660
-3.780	5.940	109.260	-4.140	-7.020	109.260
0.540	14.220	112.500	-0.900	-16.020	112.500
3.780	7.740	116.100	3.780	-10.980	116.100
-4.500	9.180	119.700	-4.500	-9.540	119.700
1.980	7.020	123.300	1.980	-9.180	123.300
-4.860	13.140	126.900	-6.660	-14.220	126.900

Table C36. Target points in the MAX muscle (upper torso).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-5.220	2.700	25.380	-5.220	-5.220	27.540
-7.380	5.940	29.700	0.180	7.740	31.860
3.420	-7.740	34.380	-9.540	-4.140	36.540
-9.540	1.620	38.700	-7.380	12.060	40.860
-5.580	-14.940	43.020	-9.540	1.980	45.180
-1.260	13.500	47.340			

Table C37. Target points in the MAX pancreas.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
0.464	-1.832	54.014	1.742	-3.787	54.018
-0.037	-3.414	54.067	1.116	-0.994	55.339
-0.407	-2.794	55.498			

Table C38. Target points in the MAX prostate.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-0.533	-0.749	83.135	0.115	-0.864	83.801
0.050	-1.793	83.887	0.252	-0.835	84.676
0.256	-1.699	84.726	-0.234	-1.354	86.141

Table C39. Target points in the MAX salivary glands.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
1.980	-7.020	14.940	1.980	7.380	14.940
2.340	6.300	18.540	2.700	-5.940	18.540
4.500	4.140	21.780	4.500	-3.060	21.780
3.420	-4.140	21.060	3.780	4.860	21.060
4.860	0.900	19.980	3.420	0.900	19.980
3.060	-0.540	19.980	4.860	-0.540	19.980

Table C40. Target points in the MAX skin.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-7.190	2.510	1.090	4.670	-3.230	1.810
-0.730	-6.110	3.250	-6.830	-3.230	1.810
4.670	2.510	0.370	2.510	7.910	5.410
8.990	5.030	8.650	-2.510	8.270	4.690
-7.190	7.550	6.130	8.630	-3.950	8.290
-0.730	-8.270	9.540	-9.710	-4.670	7.930
1.620	8.270	16.910	7.910	5.750	14.750
-10.790	3.950	10.070	8.990	-3.590	14.580
-1.430	-8.990	15.110	-10.430	-2.870	12.590
10.790	0.710	20.870	-12.230	1.260	31.330
-7.190	6.830	15.830	5.390	-6.110	18.710
-7.910	2.150	22.140	-10.790	9.350	29.530
5.750	1.790	25.380	1.260	5.390	23.580
-12.590	-9.350	35.650	-7.190	-4.310	19.260
-10.790	-6.660	28.450	-4.310	24.830	32.050
3.590	21.590	32.770	-5.750	18.350	26.650
-8.990	19.790	32.220	3.230	17.630	28.090
-5.220	10.070	25.930	-10.790	16.550	35.460
5.750	7.020	30.970	3.230	10.620	27.730
4.310	-7.380	28.450	4.310	-14.580	28.810
-7.910	-14.750	26.650	-3.060	-9.350	25.930
2.150	-20.510	28.090	-6.110	-21.590	28.090
0.710	24.470	40.310	6.470	17.990	39.230
-10.070	14.750	40.670	8.270	0.730	36.010
7.910	-4.140	35.650	8.990	-8.100	37.810
7.910	-15.470	37.090	-2.340	-17.460	44.460
2.870	-23.390	35.990	-4.670	-25.550	35.290
-11.150	-16.910	35.290	2.510	22.670	46.980
-6.470	25.550	43.570	-8.990	20.340	47.510
8.270	12.060	38.340	10.430	4.860	41.050
11.870	-8.460	49.500	-12.590	-0.540	39.060
8.990	-13.310	43.740	-9.710	-19.090	44.100
-7.550	-25.550	42.300	2.870	-21.230	45.540
1.790	23.030	53.460	-6.830	24.830	54.350
6.470	13.310	47.700	-11.510	7.190	48.420
11.870	3.060	47.700	11.870	-3.420	47.170
4.310	-16.190	49.670	-8.990	-23.220	51.660
-1.450	-26.630	47.340	2.150	24.110	61.570
-6.470	20.890	65.870	-8.630	12.230	52.380
3.230	14.390	55.980	11.870	2.700	59.220
-1.980	15.110	46.620	-11.870	3.590	57.230
11.150	-10.790	54.350	11.870	-2.700	58.500
-12.230	-2.340	48.780	8.990	-11.870	60.110
-8.990	-13.310	50.750	-7.910	-23.580	64.260
-0.010	-24.470	65.510	1.430	24.470	70.190
3.230	14.030	62.820	-5.750	15.470	76.330
-7.190	13.310	57.970	11.150	4.310	66.950
-10.430	9.350	64.620	-10.430	0.180	64.620
11.150	1.430	71.990	-11.510	-8.270	55.980
3.950	-15.470	61.020	-7.550	-14.750	60.490
-2.510	26.990	72.710	-2.700	14.390	65.340
-9.350	12.590	70.570	7.910	10.430	65.870

Table C40 continued.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
11.150	-5.750	67.310	1.070	-16.910	73.620
2.150	-16.190	66.780	-8.270	-14.390	69.300
-1.450	-27.350	76.140	-3.590	25.210	79.020
1.980	15.470	82.980	-3.590	17.270	87.130
-11.510	5.750	74.340	1.070	15.110	73.620
-11.510	-0.900	82.260	6.830	10.790	72.900
-11.870	0.180	71.290	8.270	-9.350	83.700
8.270	-10.430	71.460	-11.870	-6.300	73.790
3.950	-16.190	78.490	-4.670	-26.270	81.730
-10.070	-12.950	77.050	6.110	22.690	83.890
-8.630	13.670	82.260	6.470	12.590	84.420
-10.790	7.190	91.430	7.910	7.190	80.100
9.350	1.790	81.370	-1.980	-1.980	89.270
8.270	-6.830	77.940	-11.510	-8.630	85.500
4.310	-16.910	83.890	-6.830	-16.550	80.100
4.310	22.670	93.230	5.750	23.220	91.260
-10.790	8.100	82.980	7.910	11.510	91.090
10.430	-2.150	88.020	8.270	-8.290	94.500
-7.550	-15.660	86.940	2.510	-25.190	84.060
-5.390	-23.750	90.540	-1.430	27.710	85.330
-2.510	22.860	92.510	8.270	12.230	97.930
8.270	4.690	101.700	-6.110	0.730	98.100
-10.430	0.730	91.430	10.070	1.790	91.430
-10.790	-5.940	92.510	7.190	-15.110	91.090
-0.010	-22.310	93.590	-7.910	-14.750	98.270
2.870	-20.700	91.980	-6.830	-17.270	92.340
-5.390	16.550	99.180	-7.190	15.470	91.620
5.750	15.470	100.810	-7.550	2.170	102.780
-8.270	11.510	100.980	6.110	1.090	97.740
-0.180	-0.350	95.030	5.750	-5.050	104.030
-0.180	-2.890	105.300	8.270	-13.670	101.700
-7.550	-15.470	107.100	5.390	-17.630	102.060
10.790	9.350	57.230	-11.510	-8.270	43.740
-1.980	-15.830	55.620	-7.550	-25.550	57.610
0.710	-24.110	56.340	-5.390	25.550	61.570
-7.910	3.610	109.070	-8.270	-5.770	104.220
6.830	-9.540	110.340	-8.270	-14.030	114.830
6.110	-16.190	112.310	-1.430	-19.070	102.780
3.590	16.910	110.510	-3.590	16.550	111.230
7.190	6.850	111.950	-7.910	5.770	114.110
-0.370	2.530	117.350	-2.170	-3.610	114.110
3.590	-6.130	116.100	-7.910	-6.490	115.550
0.180	-18.710	112.670	3.590	15.470	118.070
6.110	7.210	119.700	-3.950	3.970	124.550
-7.190	11.510	121.500	5.030	-8.650	121.670
-7.190	-7.930	125.270	-3.230	-17.630	118.620
3.230	14.030	128.870	-2.510	16.190	122.050
5.030	8.650	125.990	-4.310	6.130	132.830
5.030	-14.750	123.110	-8.630	-14.750	127.810
0.350	10.090	139.670	-8.270	14.030	130.860
-1.090	-5.410	125.990	-2.340	-17.270	126.350
0.350	16.910	138.060	-1.090	-8.650	135.180
11.150	9.350	50.410	-12.590	6.830	39.950

Table C40 concluded.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
1.070	-16.190	133.550	-10.790	-15.110	135.900
-9.710	16.190	137.700	-8.990	-7.570	137.700
-7.550	-19.070	139.670	-1.450	17.270	148.310
-9.350	16.550	146.870	-8.630	7.570	142.380
-0.370	-17.270	144.350	-4.690	-7.930	146.510
-10.430	-14.220	147.950	-2.530	10.090	149.750
-8.270	13.330	157.670	-2.170	-13.330	156.230
-6.830	-18.350	155.510	-1.090	16.190	160.020
-5.050	11.890	168.130	0.350	-17.990	165.610
-7.910	-14.410	165.970	3.780	-18.710	171.900
3.060	17.990	171.900	10.790	-12.420	171.730
10.790	12.610	171.730	-8.630	15.830	171.900
-7.020	-12.250	171.900	-7.910	13.670	110.510
0.540	17.630	101.340	3.230	2.170	109.430
7.910	12.950	109.620	-7.550	-23.750	71.630
-10.430	-8.460	64.260			

Table C41. Target points in the MAX small intestine.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
2.833	-7.146	59.162	2.133	-9.016	60.570
2.315	-9.184	62.622	4.964	-0.108	65.610
4.723	-3.352	67.511			

Table C42. Target points in the MAX spleen.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-2.585	-11.225	52.520	-4.277	-10.091	52.009
-0.130	-12.064	52.999	-3.946	-11.272	53.482
-1.926	-12.132	54.079			

Table C43. Target points in the MAX stomach.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-3.316	-9.677	49.320	1.163	-4.831	50.591
0.104	-4.590	50.490	-1.411	-4.939	50.364
1.760	-6.149	50.620	0.889	-6.523	50.324
0.032	-5.857	50.393	-1.310	-6.210	50.310
-2.887	-6.538	50.141	3.020	-6.167	50.882
2.459	-7.250	50.620	-1.937	-7.416	50.476
3.737	-8.334	50.821	0.886	-8.773	50.202
-0.302	-7.459	50.274	-1.483	-8.388	50.522
2.261	-9.562	50.285	-0.749	-9.644	50.260
-2.408	-9.511	50.116	0.508	-12.247	50.317
-0.277	-10.930	50.274	-1.825	-10.951	50.155
-1.073	-12.427	50.198	6.286	-5.155	51.080
5.350	-5.404	50.861	4.532	-5.047	51.091
2.884	-4.288	51.901	1.246	-4.313	51.638
-0.382	-4.568	51.358	-1.984	-4.752	51.325
-2.887	-5.080	50.638	6.667	-7.362	50.954
5.699	-6.401	51.836	4.331	-6.487	50.886
3.542	-5.148	51.008	2.282	-5.047	50.692
1.742	-5.526	51.941	0.641	-5.630	51.595
-0.835	-5.648	51.419	7.063	-7.196	51.991
5.454	-6.872	50.810	3.683	-7.337	50.616
3.049	-6.476	51.934	1.202	-7.621	50.612
-0.266	-6.998	51.239	-1.422	-6.962	51.419
6.559	-8.406	50.936	5.954	-8.366	51.948
5.116	-7.942	50.868	4.486	-7.423	51.984
2.408	-8.384	50.486	1.912	-7.877	51.876
0.652	-8.042	51.545	6.041	-10.040	50.836
5.256	-9.061	50.789	3.758	-9.238	50.616
-0.043	-8.687	50.760	7.909	-4.288	52.164
6.822	-4.424	52.052	6.707	-3.413	53.003
6.721	-5.879	52.430	5.551	-4.205	52.034
4.298	-4.244	52.117	8.496	-5.414	52.218
7.596	-5.832	51.746	5.515	-5.242	52.315
4.309	-6.016	52.006	2.592	-5.288	52.081
8.492	-6.826	52.222	3.427	-7.351	52.013
1.865	-6.804	51.944	7.715	-7.891	52.085
7.405	-6.707	53.197	5.670	-7.463	52.261
4.478	-8.582	52.024	2.920	-8.104	51.937
7.337	-8.852	52.070	5.908	-9.342	52.232
4.946	-9.734	51.764	7.686	-3.542	53.244
8.647	-4.414	53.248	6.379	-4.666	53.399
5.580	-3.758	53.050	7.344	-5.022	53.172
6.073	-6.052	53.392	4.742	-4.995	53.194
8.978	-7.186	53.150	8.158	-5.890	53.305
6.116	-7.268	53.176	7.837	-7.873	53.309
6.646	-8.176	53.158	7.927	-9.414	52.999

Table C44. Target points in the MAX testes.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
6.386	-0.137	91.764	7.474	-0.425	91.566
7.258	-1.890	91.764	7.229	-3.348	91.544
7.207	0.086	92.678	7.142	0.313	91.876
7.222	-2.506	92.603	6.451	-2.462	91.642
7.668	-2.704	91.692	6.696	-3.060	92.210
6.728	-0.335	93.226	6.361	-2.030	92.394
6.696	-2.491	93.247			

Table C45. Target points in the MAX thymus.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
1.638	0.187	34.517	1.883	-0.922	34.718
0.752	-0.688	34.657	2.268	-0.378	35.424
1.177	-0.014	35.399			

Table C46. Target points in the MAX thyroid.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
2.599	-0.338	30.719	1.897	-0.025	30.834
2.628	-1.066	30.701	1.966	-1.300	30.794
1.548	-0.677	30.784			

12. Appendix D – Target Point Locations in FAX

Table D1. Target points in the FAX adrenals.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-2.243	-1.811	52.668	-2.632	-2.297	52.146
-3.049	-1.944	52.459	-2.185	3.748	52.726
-2.229	4.196	53.453			

Table D2. Target points in the FAX BFO (left arm).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-1.440	-14.940	29.340	-0.000	-15.660	30.780
-0.720	-16.020	32.220	-1.080	-16.560	33.660
-1.260	-16.740	35.100	-2.520	-17.100	36.540
-2.880	-17.100	37.980	-3.240	-17.640	39.420
-3.420	-17.640	40.860	-3.960	-18.000	42.300
-4.140	-18.540	43.740	-4.500	-18.900	45.180
-5.040	-19.080	46.620	-5.400	-19.620	48.060
-5.400	-19.980	49.500	-5.580	-19.800	50.940
-5.400	-20.160	52.380	-6.660	-20.340	53.820
-5.760	-20.340	55.260	-6.120	-19.980	56.700

Table D3. Target points in the FAX BFO (left leg).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-0.180	-8.280	77.580	-0.000	-10.440	79.380
-0.000	-11.700	81.180	0.540	-11.340	82.980
-0.180	-11.160	84.780	-0.180	-11.160	86.580
0.180	-10.620	88.380	0.540	-10.620	90.180
0.720	-10.440	91.980	0.900	-10.260	93.780
1.080	-9.900	95.580	1.080	-9.720	97.380
1.260	-9.720	99.180	1.440	-9.360	100.980
1.080	-9.360	102.780	1.440	-9.180	104.580
1.440	-9.000	106.380	1.440	-8.820	108.180
1.440	-8.640	109.980	1.260	-8.460	111.780
1.260	-8.100	113.580	0.720	-8.280	115.380

Table D4. Target points in the FAX BFO (mandible).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
3.013	4.471	15.268	-0.108	3.751	14.933
3.791	-4.129	16.366	1.246	-2.408	14.908
0.497	-4.781	16.304	0.918	4.410	18.608
4.817	3.478	18.623	3.798	1.552	16.776
7.610	0.580	15.257	7.103	-1.645	18.198
3.978	-1.516	16.758	4.860	-2.365	19.616
1.580	-4.144	18.871	6.700	1.022	19.624

Table D5. Target points in the FAX BFO (pelvis).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-5.879	-5.346	68.670	-5.508	6.217	70.189
-6.786	5.987	69.131	-5.101	-5.353	69.944
-4.500	6.790	70.826	-5.159	4.975	70.200
-7.085	5.256	70.175	-5.645	3.913	70.488
-4.111	-4.234	70.096	-5.465	-3.352	70.272
-5.843	-4.799	71.014	-3.679	-5.994	70.297
-4.435	7.243	72.486	-5.479	6.102	71.770
-6.390	5.245	71.467	-3.100	-6.656	71.784
-3.017	7.949	72.756	-0.266	-8.316	73.537
-1.253	9.400	74.160	-2.830	8.104	74.524
-1.721	-7.405	73.598	-0.706	9.263	75.488
-2.110	8.413	75.575	-0.806	-7.600	75.064
0.328	-8.280	75.125	-2.034	-7.438	75.546
-4.208	7.207	79.643			

Table D6. Target points in the FAX BFO (ribs).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
0.180	5.940	25.020	3.060	-2.340	26.460
3.780	7.380	27.900	-6.480	-8.280	29.340
-6.480	9.360	30.780	3.600	-11.160	32.220
1.800	12.600	33.660	-2.520	12.240	35.100
5.760	-10.800	36.540	3.420	12.600	37.980
-7.020	-3.240	39.420	-4.680	12.240	40.860
7.560	-8.280	42.300	6.120	11.160	43.740
-7.560	-6.660	45.180	-7.200	10.440	46.620
5.760	-11.160	48.060	6.660	9.180	49.500
-6.660	-7.740	50.940	-5.580	10.800	52.380
0.900	-11.880	53.820	-2.520	12.780	55.260
-0.540	-11.700	56.700			

Table D7. Target points in the FAX BFO (right arm).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-1.620	14.760	29.340	-0.000	15.660	30.780
-0.900	15.660	32.220	-1.080	16.560	33.660
-1.080	16.740	35.100	-2.340	17.100	36.540
-2.880	17.100	37.980	-3.240	17.640	39.420
-3.420	17.820	40.860	-3.960	18.000	42.300
-4.140	18.540	43.740	-4.500	19.080	45.180
-5.040	19.080	46.620	-5.400	19.620	48.060
-5.580	19.980	49.500	-5.580	19.800	50.940
-5.400	20.160	52.380	-6.660	20.340	53.820
-5.760	20.160	55.260	-6.120	19.800	56.700

Table D8. Target points in the FAX BFO (right leg).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-0.180	8.460	77.580	-0.000	10.440	79.380
0.180	11.880	81.180	0.540	11.340	82.980
-0.180	11.160	84.780	-0.000	11.160	86.580
0.360	10.620	88.380	0.540	10.620	90.180
0.900	10.440	91.980	0.900	10.260	93.780
1.080	10.080	95.580	1.260	9.720	97.380
1.260	9.720	99.180	1.440	9.360	100.980
1.440	9.360	102.780	1.440	9.180	104.580
1.440	9.000	106.380	1.440	8.820	108.180
1.260	8.640	109.980	1.260	8.460	111.780
1.080	8.100	113.580	0.720	7.920	115.380

Table D9. Target points in the FAX BFO (skull).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
0.353	2.804	1.566	-5.857	3.874	3.017
4.849	-0.547	1.836	-1.066	-4.313	2.732
-6.322	-1.264	1.516	6.120	3.312	7.297
-0.803	6.106	7.772	-7.812	4.946	8.593
6.718	-2.736	7.996	-10.390	-0.151	7.121
1.393	-5.749	8.921	-6.646	-5.357	7.445
5.220	4.457	12.805	-0.565	5.904	14.281
-5.548	5.198	13.903	2.365	-1.066	13.561
-3.528	-0.954	15.120	-9.608	-0.191	13.835
-2.963	-6.383	13.504			

Table D10. Target points in the FAX BFO (spine).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-0.900	-0.000	16.740	-1.620	-0.180	19.620
-1.620	-0.360	22.500	-3.420	-0.180	25.380
-4.140	-0.180	28.260	-4.500	-0.180	31.140
-4.500	0.180	34.020	-4.500	-0.360	36.900
-4.860	0.180	39.780	-4.500	0.360	42.660
-3.780	0.540	45.540	-3.780	0.720	48.420
-3.780	0.540	51.300	-3.420	0.720	54.180
-3.420	0.720	57.060	-2.700	0.720	59.940
-2.340	0.720	62.820	-2.700	0.360	65.700
-3.780	0.540	68.580	-7.380	-0.000	71.460
-9.360	-0.000	74.340	-9.360	-0.000	77.220
-8.820	0.180	80.100	-7.380	0.360	82.980

Table D11. Target points in the FAX bladder.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-0.054	2.009	73.548	0.216	2.354	76.961
2.477	-0.436	74.920	-0.511	-1.076	74.826
-0.197	-1.276	79.092	1.249	0.842	80.172

Table D12. Target points in the FAX bone (left arm).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-1.440	-14.940	29.340	-0.000	-15.660	30.780
-0.720	-16.020	32.220	-1.080	-16.560	33.660
-1.260	-16.740	35.100	-2.520	-17.100	36.540
-2.880	-17.100	37.980	-3.240	-17.640	39.420
-3.420	-17.640	40.860	-3.960	-18.000	42.300
-4.140	-18.540	43.740	-4.500	-18.900	45.180
-5.040	-19.080	46.620	-5.400	-19.620	48.060
-5.400	-19.980	49.500	-5.580	-19.800	50.940
-5.400	-20.160	52.380	-6.660	-20.340	53.820
-5.760	-20.340	55.260	-6.120	-19.980	56.700

Table D13. Target points in the FAX bone (left leg).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-0.180	-8.280	77.580	-0.000	-10.440	79.380
-0.000	-11.700	81.180	0.540	-11.340	82.980
-0.180	-11.160	84.780	-0.180	-11.160	86.580
0.180	-10.620	88.380	0.540	-10.620	90.180
0.720	-10.440	91.980	0.900	-10.260	93.780
1.080	-9.900	95.580	1.080	-9.720	97.380
1.260	-9.720	99.180	1.440	-9.360	100.980
1.080	-9.360	102.780	1.440	-9.180	104.580
1.440	-9.000	106.380	1.440	-8.820	108.180
1.440	-8.640	109.980	1.260	-8.460	111.780
1.260	-8.100	113.580	0.720	-8.280	115.380

Table D14. Target points in the FAX bone (mandible).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
3.013	4.471	15.268	-0.108	3.751	14.933
3.791	-4.129	16.366	1.246	-2.408	14.908
0.497	-4.781	16.304	0.918	4.410	18.608
4.817	3.478	18.623	3.798	1.552	16.776
7.610	0.580	15.257	7.103	-1.645	18.198
3.978	-1.516	16.758	4.860	-2.365	19.616
1.580	-4.144	18.871	6.700	1.022	19.624

Table D15. Target points in the FAX bone (pelvis).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-5.879	-5.346	68.670	-5.508	6.217	70.189
-6.786	5.987	69.131	-5.101	-5.353	69.944
-4.500	6.790	70.826	-5.159	4.975	70.200
-7.085	5.256	70.175	-5.645	3.913	70.488
-4.111	-4.234	70.096	-5.465	-3.352	70.272
-5.843	-4.799	71.014	-3.679	-5.994	70.297
-4.435	7.243	72.486	-5.479	6.102	71.770
-6.390	5.245	71.467	-3.100	-6.656	71.784
-3.017	7.949	72.756	-0.266	-8.316	73.537
-1.253	9.400	74.160	-2.830	8.104	74.524
-1.721	-7.405	73.598	-0.706	9.263	75.488
-2.110	8.413	75.575	-0.806	-7.600	75.064
0.328	-8.280	75.125	-2.034	-7.438	75.546
-4.208	7.207	79.643			

Table D16. Target points in the FAX bone (ribs).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
0.180	5.940	25.020	3.060	-2.340	26.460
3.780	7.380	27.900	-6.480	-8.280	29.340
-6.480	9.360	30.780	3.600	-11.160	32.220
1.800	12.600	33.660	-2.520	12.240	35.100
5.760	-10.800	36.540	3.420	12.600	37.980
-7.020	-3.240	39.420	-4.680	12.240	40.860
7.560	-8.280	42.300	6.120	11.160	43.740
-7.560	-6.660	45.180	-7.200	10.440	46.620
5.760	-11.160	48.060	6.660	9.180	49.500
-6.660	-7.740	50.940	-5.580	10.800	52.380
0.900	-11.880	53.820	-2.520	12.780	55.260
-0.540	-11.700	56.700			

Table D17. Target points in the FAX bone (right arm).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-1.620	14.760	29.340	-0.000	15.660	30.780
-0.900	15.660	32.220	-1.080	16.560	33.660
-1.080	16.740	35.100	-2.340	17.100	36.540
-2.880	17.100	37.980	-3.240	17.640	39.420
-3.420	17.820	40.860	-3.960	18.000	42.300
-4.140	18.540	43.740	-4.500	19.080	45.180
-5.040	19.080	46.620	-5.400	19.620	48.060
-5.580	19.980	49.500	-5.580	19.800	50.940
-5.400	20.160	52.380	-6.660	20.340	53.820
-5.760	20.160	55.260	-6.120	19.800	56.700

Table D18. Target points in the FAX bone (right leg).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-0.180	8.460	77.580	-0.000	10.440	79.380
0.180	11.880	81.180	0.540	11.340	82.980
-0.180	11.160	84.780	-0.000	11.160	86.580
0.360	10.620	88.380	0.540	10.620	90.180
0.900	10.440	91.980	0.900	10.260	93.780
1.080	10.080	95.580	1.260	9.720	97.380
1.260	9.720	99.180	1.440	9.360	100.980
1.440	9.360	102.780	1.440	9.180	104.580
1.440	9.000	106.380	1.440	8.820	108.180
1.260	8.640	109.980	1.260	8.460	111.780
1.080	8.100	113.580	0.720	7.920	115.380

Table D19. Target points in the FAX bone (skull).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
0.353	2.804	1.566	-5.857	3.874	3.017
4.849	-0.547	1.836	-1.066	-4.313	2.732
-6.322	-1.264	1.516	6.120	3.312	7.297
-0.803	6.106	7.772	-7.812	4.946	8.593
6.718	-2.736	7.996	-10.390	-0.151	7.121
1.393	-5.749	8.921	-6.646	-5.357	7.445
5.220	4.457	12.805	-0.565	5.904	14.281
-5.548	5.198	13.903	2.365	-1.066	13.561
-3.528	-0.954	15.120	-9.608	-0.191	13.835
-2.963	-6.383	13.504			

Table D20. Target points in the FAX bone (spine).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-0.900	-0.000	16.740	-1.620	-0.180	19.620
-1.620	-0.360	22.500	-3.420	-0.180	25.380
-4.140	-0.180	28.260	-4.500	-0.180	31.140
-4.500	0.180	34.020	-4.500	-0.360	36.900
-4.860	0.180	39.780	-4.500	0.360	42.660
-3.780	0.540	45.540	-3.780	0.720	48.420
-3.780	0.540	51.300	-3.420	0.720	54.180
-3.420	0.720	57.060	-2.700	0.720	59.940
-2.340	0.720	62.820	-2.700	0.360	65.700
-3.780	0.540	68.580	-7.380	-0.000	71.460
-9.360	-0.000	74.340	-9.360	-0.000	77.220
-8.820	0.180	80.100	-7.380	0.360	82.980

Table D21. Target points in the FAX brain.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
1.562	1.343	3.442	-0.400	1.469	3.092
-2.347	2.603	4.032	-3.694	1.098	3.146
-4.561	2.444	3.845	3.298	0.126	3.406
1.418	-0.076	2.462	-2.066	0.666	2.714
-3.852	-0.839	2.945	-5.742	0.641	3.355
1.588	-1.526	3.485	-0.515	-1.040	2.678
-2.056	-1.634	3.269	-3.859	-2.513	4.144
-5.645	-1.350	3.611	-4.100	3.283	5.702
3.215	1.386	4.982	1.285	1.840	5.083
-0.605	2.380	4.874	-3.672	1.548	5.674
-6.005	2.048	5.184	4.637	0.061	5.450
1.368	-0.407	4.918	-0.320	0.018	4.115
-2.117	0.846	4.961	-4.626	0.284	4.968
-6.602	-0.202	5.310	3.323	-1.152	4.576
-0.824	-1.433	5.598	-2.545	-0.626	4.979
-4.349	-1.361	5.486	-5.976	-2.430	5.483
-0.047	-2.380	4.212	-2.034	-2.930	4.961
-4.000	-3.460	6.030	0.374	3.064	6.368
-0.331	3.424	7.888	-2.027	3.334	6.116
-5.893	2.956	7.027	3.949	1.958	6.757
2.228	2.585	7.013	-1.814	1.872	6.959
-3.809	2.621	7.567	-5.540	1.051	7.114
-7.416	1.242	6.581	4.198	0.565	7.614
2.376	0.216	6.314	0.302	1.292	7.070
-0.306	0.389	6.026	-1.811	0.022	7.340
-3.596	0.292	7.121	-7.366	-1.177	6.811
3.503	-1.501	6.336	1.076	-1.098	6.966
-0.673	-1.508	7.610	-2.891	-1.660	6.869
-5.267	-0.824	7.060	1.692	-2.484	5.688
-0.130	-3.182	6.404	-2.045	-3.229	6.973
-6.458	-2.657	7.502	-3.744	3.442	9.324
-7.164	2.149	8.575	2.138	0.871	7.934
1.206	2.549	8.856	-1.030	1.786	8.986
-2.002	3.427	8.582	-3.107	1.192	8.957
-5.080	1.001	8.942	-7.211	0.788	9.781
0.302	0.324	8.604	-1.296	-0.242	9.611
-7.247	-0.148	8.338	4.687	-0.954	7.556
2.974	-2.369	7.654	0.497	-1.469	9.274
-1.991	-1.868	8.968	-3.636	-1.030	8.910
-5.396	-0.860	8.856	1.120	-2.995	8.039
-0.706	-3.478	8.802	-3.110	-3.395	8.748
-4.554	-2.797	7.546	-5.188	-2.988	9.392
-7.088	-1.894	9.292	0.126	3.712	10.066
-5.609	2.732	9.115	-0.072	1.728	10.692
0.126	-0.540	10.919	0.425	-2.992	10.526

Table D22. Target points in the FAX breast.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
9.549	-8.091	36.177	8.460	-8.842	36.266
8.107	11.286	37.890	8.568	9.929	37.148
7.898	9.623	36.191	8.428	-10.156	37.062
8.158	-11.192	37.958	8.125	11.466	39.337
9.094	10.400	38.189	9.896	-6.829	37.940
10.667	-6.934	39.283	9.958	-8.298	38.354
8.550	-9.958	38.855	9.428	-10.321	38.027
9.421	-11.063	39.229	8.154	-11.351	39.280
9.338	10.944	39.136	10.292	10.004	39.514
9.310	8.867	39.056	8.698	9.954	39.787
10.674	8.647	39.226	9.792	9.403	38.048
10.004	7.740	38.304	9.990	6.134	39.118
10.073	-5.778	39.373	9.702	-7.495	39.690
10.886	-8.471	39.200	9.385	-9.191	39.424
10.336	-9.871	39.175	9.536	-10.966	40.496
8.222	-11.524	40.568	9.529	11.045	40.471
8.244	11.311	40.662	10.595	9.576	40.648
9.770	10.314	41.256	10.868	8.226	40.435
8.683	9.803	41.288	9.454	8.748	40.457
10.872	7.106	39.550	9.745	7.452	39.910
10.418	5.810	40.165	10.001	4.716	40.493
10.048	-4.986	40.471	10.969	-6.318	40.644
9.817	-6.613	40.813	11.156	-7.668	40.471
9.598	-8.464	40.424	10.832	-8.921	40.468
10.375	-10.163	40.489	8.690	-10.026	40.334
8.028	10.645	42.995	10.289	9.356	42.138
10.832	8.204	41.566	9.439	8.424	41.558
10.919	6.613	41.036	9.698	6.984	41.065
10.138	5.537	41.627	9.817	4.342	41.947
10.282	-5.029	41.627	10.166	-6.152	41.875
10.937	-7.690	41.800	9.853	-7.830	41.501
10.721	-9.209	41.674	9.256	-9.396	41.335
9.583	-10.350	41.951	8.528	-11.084	41.609
8.492	11.099	41.965	9.256	9.886	42.692
10.642	7.488	42.296	9.421	6.905	42.548
10.361	6.005	42.602	9.814	-4.914	42.790
10.411	-6.548	42.689	9.418	-7.470	42.851
10.048	-8.986	42.649	9.331	-9.173	43.679
8.950	-10.094	43.013	8.035	-10.955	42.739
8.802	9.551	43.765	10.231	8.590	43.232
9.086	8.287	42.840	10.289	7.225	43.636
9.724	5.990	44.071	9.803	4.867	43.225
10.001	-5.929	43.636	9.839	-6.926	44.262
10.534	-7.945	43.160	9.670	-8.140	44.266
9.191	8.410	44.305	9.450	7.304	44.359

Table D23. Target points in the FAX colon.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
3.654	5.551	53.629	4.046	4.594	54.616
1.940	-6.710	54.400	5.346	5.216	54.806
2.783	5.238	54.652	5.033	4.493	58.183
3.589	8.068	59.872	3.542	6.811	59.602
4.957	5.512	58.820	2.495	-8.633	59.749
2.786	8.846	59.861	4.054	8.035	61.182
4.676	6.538	60.242	5.180	4.741	60.052
5.627	2.970	60.250	0.850	10.948	62.312
3.071	9.335	60.959	2.516	9.889	62.208
3.398	7.020	61.218	5.029	5.202	61.290
3.938	5.756	61.099	5.670	3.485	61.380
5.731	1.595	61.618	3.607	8.500	62.309
4.723	6.754	62.122	3.712	6.844	62.676
5.828	2.304	62.784	5.962	0.529	62.996
-0.299	-8.741	64.973	3.420	-7.625	67.903
4.507	-5.940	70.340	2.790	-3.467	73.840
-7.414	-1.284	75.157	-9.124	-0.529	75.376
-7.355	1.573	76.770	-8.328	0.701	76.700
-5.155	2.084	77.738	-6.278	1.940	77.216
-5.204	0.696	76.779	-6.365	0.839	78.034
-7.369	0.007	77.501	-4.856	-0.792	78.142
-4.496	1.051	78.311	-4.126	-0.076	78.739
-5.951	-0.644	77.692			

Table D24. Target points in the FAX esophagus.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-1.440	-0.360	25.020	-1.620	-0.900	26.820
-1.800	-0.360	28.620	-1.440	-0.900	30.420
-1.620	-0.540	32.220	-1.800	-0.720	34.020
-2.160	-1.080	35.820	-2.340	-1.260	37.620
-2.520	-1.440	39.420	-2.520	-1.260	41.220
-2.340	-1.260	43.020			

Table D25. Target points in the FAX heart.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
3.244	1.789	37.422	0.446	1.296	36.972
4.795	-0.648	37.447	0.079	-1.480	37.343
1.714	1.843	38.282	4.637	1.044	38.513
2.701	0.195	40.111	0.292	-0.220	38.574
5.051	-1.696	39.197	4.007	-2.862	37.591
2.675	-0.618	36.248	0.662	-1.404	40.306
1.778	-2.747	37.206	4.885	1.638	42.016
5.087	0.194	40.270	3.128	-1.764	41.098
2.799	-2.333	38.648	5.076	-0.688	42.451
3.096	0.475	42.188	5.411	-2.232	41.389
1.739	-1.721	43.013	0.922	-3.193	41.785
4.273	-3.892	42.116	2.297	-4.388	42.181
2.329	-3.841	44.176	4.111	-5.090	43.970

Table D26. Target points in the FAX kidneys.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-2.084	7.643	59.292	-3.327	7.073	57.407
-2.340	-4.854	55.974	-2.267	-5.804	57.644
-2.291	-6.292	59.200			

Table D27. Target points in the FAX liver.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
3.049	7.427	45.072	5.015	5.720	44.802
3.056	4.954	44.413	1.098	6.001	45.076
5.033	3.859	44.582	0.968	4.147	44.276
5.986	9.983	46.865	3.596	8.874	46.584
1.742	9.238	46.584	3.539	6.260	46.516
1.530	7.405	46.526	-0.144	6.743	46.818
5.756	5.800	46.987	1.955	4.799	46.444
6.250	4.075	46.292	4.043	4.280	46.512
5.094	2.250	45.850	2.855	2.920	45.205
0.432	3.218	46.242	6.329	0.630	46.170
3.686	1.253	46.411	4.990	-0.284	46.663
3.046	10.703	48.244	-0.688	10.681	48.578
4.270	9.389	48.384	1.249	10.465	48.272
-0.115	8.777	47.891	5.332	7.848	47.268
2.099	8.413	48.550	-1.894	7.607	48.535
5.267	6.084	48.726	3.517	7.092	48.175
1.814	6.044	48.337	0.259	7.189	48.805
3.568	4.644	48.474	1.544	3.913	48.485
0.018	5.036	47.326	5.584	1.354	48.298
4.457	2.869	47.851	2.466	2.617	47.434
-0.673	3.618	48.478	3.740	0.691	48.658
1.339	1.069	46.375	0.392	2.005	47.999
2.527	11.696	50.036	0.601	11.585	49.846
4.176	10.264	50.314	2.225	9.619	50.159
0.090	9.202	50.087	-1.944	8.975	49.795
5.076	8.104	49.622	3.362	7.992	50.357
1.332	7.434	50.501	-1.033	7.056	50.684
-3.157	6.980	50.537	5.087	6.142	50.594
0.504	5.360	49.946	-1.408	5.778	48.935
4.640	4.273	50.238	3.024	6.005	50.170
2.160	4.273	50.422	-1.926	4.712	50.281
4.928	2.592	49.975	2.988	2.340	49.687
1.105	2.048	49.712	2.758	11.423	51.952
0.410	11.758	51.336	-1.408	11.794	52.178
-1.699	10.742	50.472	3.881	9.619	52.038
1.379	9.943	51.710	-0.706	9.817	52.232
-2.794	10.156	52.445	2.052	8.406	52.434
-0.140	8.028	52.088	-2.538	8.525	51.703
-0.378	5.623	51.937	-2.855	5.911	51.973
0.727	11.560	53.287	-1.318	10.998	54.270
4.216	9.004	53.910	2.650	10.487	53.748
-1.616	10.004	55.804	-3.211	9.468	54.148
2.311	8.150	54.227	0.562	9.443	53.888
-1.537	8.528	54.011	0.310	7.092	53.917
-1.703	6.750	53.107	0.652	10.850	55.231
4.684	9.781	55.908	2.491	9.068	55.678
0.194	8.564	55.559	2.362	10.937	55.764
-0.007	10.822	56.938			

Table D28. Target points in the FAX lungs.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-1.217	5.414	29.390	0.432	-5.580	28.634
-1.076	8.201	31.928	-2.531	-6.458	30.816
-0.518	-8.111	32.951	0.464	9.558	36.673
-3.132	7.862	36.662	1.138	-9.209	37.498
-3.172	-7.913	38.988	2.286	8.975	39.931
-3.398	7.477	40.435	-0.994	10.451	41.202
-3.503	8.327	44.309	-1.868	-8.586	45.220

Table D29. Target points in the FAX muscle (head and neck).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-6.660	2.700	15.300	-7.740	0.180	16.740
-7.200	1.980	18.180	-6.840	-1.980	18.900
4.140	1.260	19.620	3.780	-1.260	20.340
-5.580	2.700	21.060	-5.940	-2.340	21.780
-6.300	1.620	22.500	-5.940	-3.420	23.220

Table D30. Target points in the FAX muscle (left arm).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-1.440	-20.700	81.180	-5.040	-19.440	67.500
-3.420	-21.420	63.900	-2.340	-19.260	60.300
-5.580	-17.460	56.700	-5.580	-21.060	53.100
-7.200	-18.180	49.500	-5.940	-17.460	45.900
-5.040	-20.700	42.300	-8.280	-17.640	38.700
-4.860	-18.180	35.100	-3.420	-17.460	31.500
-1.440	-16.740	27.900			

Table D31. Target points in the FAX muscle (lower legs).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-5.220	7.740	160.740	-4.500	-8.100	160.740
-8.460	8.100	152.460	-8.460	-8.100	152.460
-4.860	10.260	120.420	-5.220	-10.260	120.420
-5.580	8.100	123.300	-5.580	-7.740	123.300
-6.300	10.620	126.180	-6.300	-10.980	126.180
-5.940	7.020	129.060	-5.940	-7.020	129.060
-8.100	10.620	131.940	-8.100	-10.620	131.940
-6.660	6.660	134.820	-6.660	-7.020	134.820
-8.100	9.540	137.700	-8.100	-9.900	137.700
-7.020	8.100	140.580	-7.020	-8.100	140.580
-8.100	8.820	143.460	-8.460	-9.180	143.460
-7.740	8.460	146.340	-7.740	-8.460	146.340
-8.100	8.460	149.220	-8.100	-8.460	149.220

Table D32. Target points in the FAX muscle (lower torso).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-5.940	6.300	64.980	-7.020	-2.340	67.140
-4.140	10.260	69.300	-3.060	-10.620	71.460
-5.940	10.980	73.620	1.620	-12.060	75.780
1.620	13.860	77.940	-1.620	2.340	80.100
0.540	-4.860	82.260	-5.940	-11.340	84.420

Table D33. Target points in the FAX muscle (mid torso).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-1.260	-13.680	44.820	6.480	10.620	46.980
-4.860	11.340	49.140	-6.660	-5.580	51.300
-7.920	7.380	53.460	8.640	-0.180	55.620
-6.300	-4.860	57.780	-6.300	5.940	59.940
-6.660	-1.620	62.100			

Table D34. Target points in the FAX muscle (right arm).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-2.700	21.060	80.100	-3.240	16.920	27.180
-3.420	18.180	30.780	-0.180	18.900	34.380
-5.940	18.180	37.980	-5.580	20.700	41.580
-1.260	18.540	45.180	-4.680	17.820	48.780
-5.940	18.180	52.380	-3.060	20.700	55.980
-5.940	17.460	59.580	-4.140	21.420	63.180
-5.040	19.080	66.780			

Table D35. Target points in the FAX muscle (upper legs).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-5.580	10.980	85.500	-5.580	-10.980	85.500
2.340	13.140	88.380	2.340	-12.780	88.380
-3.420	11.340	91.260	-2.700	-11.700	91.260
-3.420	8.100	94.140	-3.420	-7.740	94.140
-3.420	11.700	97.020	-3.420	-11.340	97.020
0.900	12.420	99.900	0.900	-12.420	99.900
-3.420	10.620	102.780	-3.060	-10.980	102.780
-5.220	8.460	105.660	-5.220	-8.100	105.660
0.900	5.940	108.540	1.260	-5.940	108.540
3.420	7.020	111.420	3.600	-8.100	111.420
-3.060	6.660	114.300	-2.700	-6.300	114.300
-4.500	8.820	117.180	-4.500	-9.180	117.180

Table D36. Target points in the FAX muscle (upper torso).

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
2.340	-0.180	24.300	-1.620	11.700	26.460
-1.260	-13.500	28.620	-8.280	5.220	30.780
-4.500	-16.740	32.940	-6.660	13.860	35.100
-0.900	-13.860	37.260	7.740	4.140	39.420
-8.280	-6.300	41.580	-1.980	-13.500	43.740

Table D37. Target points in the FAX ovaries.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-0.536	4.576	71.118	-0.515	-3.852	71.165
0.014	4.910	71.453	0.328	5.303	71.935
0.817	-4.187	72.040			

Table D38. Target points in the FAX pancreas.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
2.851	0.187	52.506	3.272	-1.278	51.991
1.919	-1.973	52.466	2.444	1.487	53.712
2.837	-0.778	53.503			

Table D39. Target points in the FAX salivary glands.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
1.260	6.300	12.420	0.900	-6.300	12.420
1.260	6.300	16.380	1.260	-6.300	16.380
2.340	3.060	20.340	0.540	3.780	20.340
0.540	-3.780	20.340	1.980	-3.060	20.340
4.500	0.900	19.260	2.700	0.900	19.260
2.340	-1.260	19.260	4.140	-0.900	19.260

Table D40. Target points in the FAX skin.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
3.950	-0.350	0.370	-7.910	2.510	2.170
-0.730	5.030	2.530	6.110	-3.950	5.770
-3.590	-4.310	1.810	-10.790	-2.150	7.210
6.830	3.950	7.930	-3.230	7.190	8.650
7.550	-3.230	13.500	-1.090	-7.190	8.290
4.670	5.750	15.110	-2.150	6.470	17.630
-9.350	3.950	12.590	8.630	0.710	19.070
1.070	-7.190	16.190	-7.550	-5.390	13.140
-6.110	14.390	24.490	2.150	12.950	26.290
-9.710	9.350	27.370	-8.270	2.870	21.970
-6.470	-10.260	24.130	1.070	-17.630	28.450
-1.810	20.150	28.810	-8.270	19.070	32.410
-2.700	5.580	23.410	3.590	6.110	25.570
-9.710	-5.410	26.650	4.310	-5.030	25.930
-8.630	-2.870	18.350	0.350	-12.060	24.490
-9.350	-14.030	28.810	-5.390	-19.430	28.090
3.230	17.630	33.850	7.910	9.710	34.210
-10.070	12.230	34.020	6.830	1.620	29.530
0.540	-4.310	21.060	-10.070	3.250	32.050
8.630	-3.420	34.570	6.470	-8.630	31.330
7.380	-13.670	38.510	3.230	-17.630	33.850
-9.350	-18.710	36.540	10.790	12.230	39.610
-1.450	21.950	37.980	-9.350	19.430	41.940
3.590	15.110	41.940	7.190	11.870	47.870
-10.070	10.070	41.030	-10.070	2.890	39.060
10.070	1.620	38.890	-2.340	-15.300	43.190
-10.070	-4.860	33.300	11.510	-11.510	39.610
-10.070	-11.700	37.260	-3.420	-21.950	35.460
-2.170	22.670	46.260	-8.630	19.790	50.750
12.230	6.490	43.550	-3.420	15.300	43.190
-9.710	2.700	47.700	-10.070	-4.140	41.580
12.590	-7.380	42.470	9.350	-9.350	48.590
-9.710	-9.710	45.900	3.950	-14.750	47.340
0.710	-20.150	42.470	-8.990	-17.650	45.350
10.430	6.660	53.100	-9.710	9.710	48.780
10.430	-0.180	48.780	-9.710	-5.220	51.660
-6.110	-13.310	51.470	6.110	-11.510	55.980
-8.270	-19.790	55.070	-2.530	-22.310	60.660
-3.420	14.750	48.420	-4.310	13.670	57.060
7.550	9.710	57.420	-9.350	8.630	55.980
-9.350	1.620	54.900	10.430	-6.470	55.620
-9.350	-8.630	57.780	0.350	-14.390	56.150
-8.270	19.980	59.940	2.870	13.670	59.940
-9.710	7.910	63.370	-9.350	-0.900	60.660
10.790	0.180	58.860	2.510	-13.670	65.340
-5.030	-12.950	61.740	-10.070	-8.630	66.250
-1.090	-19.810	66.780	-1.090	20.870	63.900
9.350	6.830	63.710	2.510	13.670	65.340
9.710	-0.710	68.030	-10.430	1.260	68.220
8.990	-7.190	63.900	-5.390	-22.670	71.820
1.790	15.110	72.010	-7.190	21.230	67.670
7.550	8.630	69.660	-6.470	12.230	64.810

Table D40 continued.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-5.750	15.470	72.010	7.550	3.420	75.230
-11.510	8.100	72.900	7.550	-8.630	71.630
-7.550	-13.310	70.570	1.790	-16.190	74.170
3.230	16.550	78.130	-1.620	23.030	73.620
-12.230	12.230	79.210	7.190	11.510	77.410
-13.310	3.250	77.410	7.190	-1.620	79.190
-4.140	0.370	85.310	-12.590	-5.940	74.170
5.390	-14.390	77.770	-0.370	-22.670	80.100
-7.190	-16.190	76.330	7.910	12.950	85.500
1.790	21.230	82.430	-6.830	16.910	78.130
7.910	5.770	84.250	-13.310	5.940	84.060
3.060	0.730	84.780	7.910	-9.010	81.010
-13.310	-4.140	82.620	-10.070	-12.950	87.470
8.270	-12.230	88.190	-12.230	-12.230	79.740
2.870	17.270	89.270	-4.310	21.590	83.340
-9.350	14.030	86.390	7.550	11.870	93.590
-11.150	10.790	90.900	2.340	0.730	91.980
-10.790	3.250	87.830	7.190	-4.690	87.660
-11.870	-6.850	89.270	5.030	-16.190	86.220
-0.370	-18.350	89.630	-5.750	-17.630	84.590
-4.670	17.270	89.990	7.550	5.410	92.510
-11.150	10.790	97.550	-1.260	0.730	98.100
-6.470	1.090	92.700	-4.140	-0.730	86.940
-9.710	-3.970	98.270	6.830	-5.050	95.580
4.310	-2.890	101.870	-11.150	-10.790	97.020
7.190	-11.870	95.390	2.870	-15.830	96.470
-5.390	-16.550	94.140	2.510	15.830	97.910
-5.390	16.550	95.390	6.830	10.790	102.060
-8.990	12.590	103.670	5.390	3.970	100.980
-10.430	4.690	97.550	-7.910	2.890	103.310
-8.630	-5.050	108.350	2.510	-14.750	105.830
-5.030	-15.830	101.150	-4.140	15.470	103.140
2.870	14.390	106.740	-9.710	8.100	107.270
4.670	3.610	108.540	-2.700	1.090	106.740
-0.540	-1.810	109.980	6.830	-6.300	109.980
-7.190	-4.690	116.820	6.830	-10.790	104.390
-3.950	-14.390	110.150	-9.350	-11.150	105.830
-3.230	14.390	111.230	6.830	9.710	110.870
0.350	14.030	117.350	1.070	2.170	115.910
-6.470	3.970	114.660	-3.250	-2.530	124.190
0.710	-2.170	116.630	1.070	-14.030	115.190
-7.550	-10.430	116.460	-6.110	14.030	122.410
5.750	7.210	116.990	-8.990	6.490	123.130
-7.550	10.430	115.740	-0.730	-6.490	131.390
1.430	-11.150	124.550	5.390	-8.100	118.070
-9.710	-6.490	125.650	-5.750	-14.390	122.770
-2.530	14.390	127.430	2.870	9.710	122.750
-10.430	-11.510	132.490	-3.610	-14.390	131.750
-0.010	8.290	131.750	-10.070	11.510	130.690
-7.910	-3.970	135.350	-2.170	-8.290	140.390
-7.910	-13.310	140.390	-6.660	14.390	135.710
-2.170	9.710	140.390	-10.790	7.210	140.220
-6.300	3.970	136.430	-7.550	12.230	146.510

Table D40 concluded.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-10.430	-7.210	145.260	-5.050	-11.510	149.940
-6.130	5.050	146.870	-7.910	-5.410	154.620
-2.170	-11.510	159.130	-2.890	11.510	158.410
-10.070	7.570	154.260	-10.790	-8.630	162.540
6.470	10.070	162.540	-0.900	4.690	162.710
-10.430	6.850	163.070	6.470	-10.070	162.540
-1.260	-4.690	162.710	-6.830	-22.670	45.180
-1.810	-21.950	51.300	3.590	14.390	52.190
-2.530	22.310	54.900	-2.170	2.530	123.110
-6.470	2.890	129.230			

Table D41. Target points in the FAX small intestine.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
4.860	-2.156	59.375	3.035	-0.986	59.591
4.046	-3.942	59.288	2.149	-4.219	58.824
2.783	6.753	66.027	3.798	0.990	66.733
3.158	7.791	68.528	4.469	4.115	67.951
1.635	4.527	65.952	3.788	1.627	69.659
1.897	2.563	68.411	2.986	6.171	71.469

Table D42. Target points in the FAX spleen.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-0.972	-8.737	50.573	0.522	-9.940	50.807
2.430	-9.842	54.086	1.076	-9.630	54.922
-0.562	-9.079	54.968			

Table D43. Target points in the FAX stomach.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
2.596	-3.776	48.334	4.428	-4.946	48.229
2.164	-6.149	47.956	5.242	-6.757	47.912
3.704	-6.718	50.195	1.638	-5.807	49.741
3.622	-7.517	48.233	4.936	-4.327	51.800
3.748	-4.536	50.180	4.432	-6.350	52.049
5.364	-4.712	53.953	5.879	-0.504	54.763
5.573	-2.653	53.705			

Table D44. Target points in the FAX thymus.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
1.544	0.536	27.108	1.357	-0.025	27.029
2.066	-0.914	27.202	2.495	0.529	27.792
1.901	0.536	27.598	1.836	-0.212	27.760
1.555	-0.695	27.068	3.020	-0.202	28.292
2.574	-0.058	28.202	3.672	-0.068	29.124
3.215	-0.371	28.883	4.396	-0.043	29.855

Table D45. Target points in the FAX thyroid.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
1.858	1.433	21.362	1.228	1.440	21.251
0.695	1.469	21.226	2.455	1.300	21.640
2.506	-1.292	21.604	1.976	-1.505	21.578
0.745	-1.519	21.287	1.415	-1.516	21.402
1.541	1.541	21.856	0.828	1.526	21.848
1.742	-1.451	22.226	0.799	-1.508	21.794
1.177	-1.325	23.188			

Table D46. Target points in the FAX uterus.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-0.083	-0.587	72.342	-2.081	0.673	74.632
-2.329	-0.666	74.866	-2.531	0.713	75.938
-2.610	-0.630	76.187			

13. Appendix E – Skin Target Points for CAM

Table E1. Target points in the CAM skin.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
6.376	2.274	2.551	11.706	4.609	46.529
-2.294	5.104	2.171	7.297	-20.034	40.378
-1.593	9.217	11.056	-6.280	-17.754	38.256
8.664	-4.747	8.777	-0.856	-22.857	43.461
1.057	-4.493	1.637	8.832	10.975	54.184
-7.379	-3.738	4.879	-1.372	23.011	59.106
6.354	6.030	9.692	-10.943	6.807	52.872
12.175	0.560	14.797	12.503	-4.753	52.217
-0.058	-8.278	10.538	-11.338	3.789	46.446
-6.630	-5.188	14.800	7.992	-10.716	48.309
0.932	11.453	29.717	3.182	-15.196	45.843
-8.687	3.626	8.172	-9.179	3.093	60.257
6.860	-0.603	26.153	6.718	-19.777	48.117
-8.206	1.870	17.016	-8.436	-13.859	44.003
9.132	-3.179	18.617	0.889	-23.213	53.541
-3.058	-3.056	24.703	0.538	14.941	52.195
5.448	16.763	35.331	7.374	10.254	61.392
-2.468	6.375	16.756	12.660	4.157	55.452
-5.930	12.011	33.673	-6.963	13.978	56.007
5.604	5.249	19.998	11.357	-4.866	60.245
-1.741	4.366	24.480	8.714	-8.919	66.680
2.029	-6.233	18.823	-10.895	-3.550	52.243
-6.650	-10.493	34.381	1.240	-13.492	56.590
-1.228	-21.057	35.103	-11.238	-8.733	48.252
-2.244	18.764	33.395	5.933	-18.538	55.677
5.593	6.431	31.213	-3.767	-20.696	60.108
8.203	-3.173	35.231	1.662	13.892	62.060
-5.579	5.112	31.593	-7.989	10.803	61.894
4.781	-8.780	31.032	7.483	-11.598	56.600
-10.614	-5.517	41.232	-8.819	-6.649	70.099
4.092	-16.056	33.051	2.953	-21.914	63.390
-2.324	-11.321	30.071	-7.724	-13.136	54.890
6.661	20.720	44.581	-3.059	-21.413	68.741
-1.460	22.501	38.405	-5.000	12.670	68.259
-3.055	16.381	44.445	11.730	2.347	75.409
8.158	11.600	39.717	-8.814	4.533	69.340
-9.885	5.303	40.167	11.343	2.434	64.941
11.446	-3.903	44.398	-7.731	-12.419	77.654
-7.011	-2.309	34.381	4.642	-20.101	71.569
8.266	-11.129	39.669	-5.186	-12.410	66.063
-4.138	-19.961	50.050	3.958	13.518	79.494
-2.292	22.551	48.850	3.830	21.062	69.247
-8.608	13.854	47.920	-3.419	20.302	67.304
7.046	11.707	47.252	-10.253	8.765	77.604
5.955	19.706	55.191	9.193	8.516	77.507
-8.671	13.822	40.481	3.181	13.142	71.113
9.196	3.546	38.083	11.378	-3.946	70.869

Table E1 continued.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-8.789	-9.854	60.130	-8.778	10.686	103.751
11.375	-1.923	81.735	4.696	-1.790	100.059
-2.314	-13.855	73.646	-7.401	-2.498	101.337
3.015	-13.125	64.772	9.549	-10.103	102.029
-3.052	-21.411	76.864	-3.388	-14.576	109.594
8.861	9.182	69.022	-1.902	-20.931	105.701
-5.516	13.281	75.535	3.196	20.754	108.207
-3.877	15.783	83.369	3.571	16.498	106.424
-11.693	1.132	76.629	7.734	13.494	110.722
10.024	-7.152	78.341	-4.117	2.341	102.428
-8.803	-3.112	62.896	-6.655	3.800	109.179
3.328	-14.171	82.322	8.813	-4.867	107.932
-11.317	-6.967	79.022	-5.298	-2.804	111.462
3.811	-21.014	80.295	6.111	-18.929	101.108
0.955	22.534	89.073	2.290	-22.739	95.337
-11.436	11.621	85.193	2.703	-20.887	108.753
3.790	21.070	80.128	-3.972	14.641	109.406
10.621	3.608	86.349	8.501	4.929	116.248
-2.259	22.198	76.207	-7.991	9.807	114.236
-14.200	4.537	85.915	1.839	-0.442	107.638
5.807	-11.558	74.885	8.952	5.203	107.236
4.514	-2.421	92.353	-8.814	-9.173	107.037
-1.230	-22.483	86.841	7.879	-13.376	110.062
-5.557	-14.935	84.455	4.471	-15.178	116.316
-12.771	-10.966	86.979	-7.740	-9.430	116.786
-11.108	12.995	94.885	0.772	14.968	117.894
8.106	8.814	84.913	7.373	12.428	119.833
7.481	10.439	94.501	0.548	0.909	116.585
3.637	1.803	92.196	-6.297	4.538	120.025
-5.575	1.267	92.636	8.503	-4.849	115.687
7.939	-10.339	86.772	6.889	-12.125	124.246
-14.116	-3.574	86.790	-4.131	-14.215	111.554
-12.295	-3.544	94.170	8.157	6.280	125.566
3.270	-16.013	91.125	-1.595	1.988	123.511
-6.991	-16.376	92.648	7.733	-4.137	122.720
7.633	-11.134	95.751	1.983	-1.284	127.761
6.027	19.452	98.452	-5.726	-4.291	122.771
-3.291	22.375	97.541	-2.992	-13.133	122.162
4.200	15.056	89.362	4.539	13.152	128.003
-5.950	16.197	90.623	-4.163	12.278	123.015
-13.789	6.912	94.069	6.148	3.725	133.464
-8.813	3.440	100.440	-4.460	4.456	129.677
9.541	-4.323	88.855	7.373	-5.907	131.290
-1.524	-1.241	96.124	5.574	-5.583	139.856
9.365	-0.243	97.746	-5.169	-7.400	131.145
-3.777	-15.284	101.939	-0.511	-13.131	129.407
-12.771	-9.822	96.166	-2.164	11.050	132.413
-3.060	-22.851	98.919	4.224	3.157	143.467
-8.458	-14.549	101.077	-1.034	-1.752	135.597
-1.971	21.094	105.684	-3.770	-9.512	140.711
9.532	10.300	101.700	3.811	-11.685	134.835
-3.320	16.428	99.871	-0.590	9.534	156.414
9.901	0.918	95.195	4.494	10.614	137.348

Table E1 concluded.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-4.733	-3.207	142.394	3.861	-7.994	160.947
2.346	10.253	146.857	-2.554	-3.305	162.640
-4.838	7.757	151.275	20.119	9.033	174.042
-3.754	2.351	148.803	-3.151	8.104	171.567
1.574	-10.593	146.273	15.375	-1.074	171.830
-5.207	7.587	140.382	-3.263	-8.005	171.568
3.915	4.496	154.362	5.794	8.534	165.368
-0.563	-9.891	154.954	9.178	9.257	175.503
4.517	-4.477	150.991	7.937	-8.413	168.350
-5.210	-5.607	151.454	11.784	-9.297	175.504
7.693	2.528	167.488	2.724	-2.188	174.835
-2.679	3.424	162.948	21.895	-7.033	174.761

14. Appendix F – Skin Target Points for CAF

Table F1. Target points in the CAF skin.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
2.772	4.707	2.551	5.303	13.671	31.752
-1.928	4.130	1.482	3.803	9.094	28.356
6.253	-0.791	2.237	-5.567	9.829	30.788
1.611	-0.859	0.206	-4.437	6.069	28.127
-6.299	-0.509	2.001	7.091	0.157	30.947
-1.920	-3.770	1.281	5.273	6.278	29.042
7.811	4.649	7.968	-5.580	2.845	29.709
3.422	6.309	6.644	7.791	-3.858	33.346
-5.550	4.699	4.418	-4.789	-4.082	28.121
8.876	0.455	6.075	4.832	-6.748	28.558
-8.818	1.426	6.859	5.676	-11.192	31.245
4.381	-4.850	4.178	3.591	-15.197	30.482
-1.978	-6.296	4.940	1.146	-17.430	30.466
-7.004	-4.126	6.351	-3.410	-14.517	30.065
8.466	3.613	13.747	6.653	18.553	36.730
-0.540	7.736	11.837	3.285	21.090	36.677
-2.377	6.753	7.844	-3.885	19.432	35.187
-7.258	4.271	11.062	6.669	13.267	36.557
-8.807	0.052	13.312	-4.458	14.170	30.830
8.045	-3.627	9.527	-5.930	16.044	35.324
3.206	-6.646	9.490	7.074	9.833	34.533
-1.923	-8.267	11.021	-3.414	16.048	39.214
-7.353	-4.127	11.332	-8.449	8.725	35.116
4.148	5.942	13.930	7.838	4.334	33.659
11.430	-0.036	13.538	9.633	-1.841	38.126
-3.494	5.364	15.690	-7.005	1.389	33.301
7.570	-4.385	14.706	-7.016	-3.094	32.961
2.696	-5.936	15.919	7.580	-8.823	35.378
-2.617	-5.878	15.190	-6.300	-8.784	31.891
3.138	5.572	17.519	6.463	-14.117	35.804
8.854	2.010	19.385	-7.726	-11.326	34.756
-6.123	2.270	17.380	-0.130	-20.324	34.054
8.357	-2.551	19.509	-4.099	-19.212	35.207
-1.604	-4.087	22.860	3.186	20.707	41.643
-4.732	-3.738	17.639	-3.391	19.233	41.542
2.513	4.865	21.952	6.474	17.717	43.115
5.604	1.986	23.626	-8.032	12.687	37.189
2.559	-4.856	22.054	6.125	12.442	41.984
0.516	10.065	27.183	11.145	8.140	39.606
-1.380	4.394	22.934	-9.159	4.185	36.908
-4.080	0.999	22.224	11.651	5.705	39.660
5.640	-1.353	26.086	9.730	2.277	38.258
1.112	-9.887	27.222	-10.238	3.792	40.511
-2.594	-10.169	28.035	-9.450	-1.054	41.351
-0.230	20.080	33.032	13.895	-5.650	42.395
2.611	17.337	31.128	11.160	-6.807	39.188
-1.122	14.846	29.012	-9.177	-3.346	37.269

Table F1 continued.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
6.998	-10.167	37.994	-6.077	13.001	48.554
-9.892	-8.087	39.063	9.216	8.100	53.477
-5.564	-16.505	35.319	-0.293	12.833	53.611
-8.099	-12.304	38.089	-9.451	8.340	49.336
6.725	-18.403	37.257	11.346	5.266	51.391
3.350	-20.779	36.709	-8.811	7.252	53.130
1.580	-21.058	41.764	11.373	-3.275	52.619
4.522	19.972	46.980	-8.436	-1.774	54.182
-0.701	21.194	41.560	14.283	-7.170	47.010
0.490	13.336	43.948	10.346	-6.605	52.793
-7.412	12.986	44.342	-9.112	-6.360	51.274
-7.736	12.838	40.700	8.860	-8.704	52.975
12.414	9.894	45.242	2.643	-12.056	52.936
9.649	10.987	45.969	-8.445	-8.781	53.597
-10.198	9.163	43.952	0.008	-13.822	51.143
13.855	4.073	43.983	-6.252	-12.055	55.433
10.620	0.568	42.985	-5.570	-13.135	51.981
-10.618	6.143	42.682	5.222	-17.518	53.132
12.423	-2.695	44.850	-3.735	-16.821	52.498
7.341	-11.683	45.736	-0.123	-21.420	50.500
9.888	-0.019	40.021	1.290	21.161	60.496
-10.611	-6.985	44.098	3.884	16.599	57.603
9.320	-11.304	42.035	-3.379	18.809	59.349
5.983	-18.040	45.478	6.697	10.622	52.781
4.093	-13.959	40.737	-6.826	11.169	56.182
-5.196	-13.498	41.168	10.253	4.505	58.626
6.668	-17.278	41.609	-8.455	3.432	55.602
-3.059	-19.610	41.653	10.647	1.930	55.634
0.082	21.425	47.990	-8.083	4.170	59.417
5.585	17.513	50.471	9.274	-6.822	59.353
-3.704	18.778	47.599	3.352	-12.002	57.845
1.529	13.933	50.555	0.519	-12.229	59.843
0.089	13.867	47.329	-7.007	-8.808	62.860
6.758	11.003	48.533	-7.736	-7.310	59.513
14.588	6.662	46.671	-3.763	-12.414	58.669
10.956	0.247	46.314	3.428	-15.614	56.535
-9.850	3.138	48.662	-3.419	-18.865	57.630
11.373	-0.576	49.219	1.785	-20.979	55.101
-9.412	-0.901	47.033	-1.393	21.594	67.040
-10.231	-3.933	47.601	4.149	18.915	64.048
11.997	-10.047	45.725	-3.051	18.304	65.062
7.004	-10.701	51.589	-2.333	12.800	61.300
1.952	-12.413	44.772	3.422	12.053	57.060
-0.280	-13.720	46.498	-6.277	10.303	59.470
-6.291	-13.114	46.104	9.979	-5.851	64.903
-8.814	-10.948	46.038	10.355	-2.909	60.209
5.586	-17.091	50.093	-8.055	-3.378	59.108
-3.777	-18.521	46.664	6.456	-10.168	58.999
2.629	-20.999	46.758	-4.432	-12.416	65.775
0.318	21.410	53.100	1.588	-21.030	60.316
4.493	18.893	54.610	3.070	21.133	68.676
-3.310	19.447	54.351	3.889	12.112	65.232
-4.968	13.152	53.587	-1.292	13.903	69.361

Table F1 continued.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
7.785	9.187	63.862	-4.711	15.766	79.117
1.146	12.440	61.515	9.174	7.014	75.457
-6.457	10.239	65.029	-11.916	9.535	77.286
10.308	1.917	62.562	10.280	1.702	79.404
8.108	8.472	59.791	-12.779	5.431	77.225
-8.819	6.799	67.149	-13.075	-3.655	80.450
10.643	3.064	66.524	9.985	-4.995	75.561
-9.175	-4.188	67.872	9.974	-3.629	79.395
-8.089	3.499	63.572	-11.658	-2.460	76.335
-8.049	-2.463	64.664	-3.755	-16.000	78.679
4.625	-11.697	64.697	-10.246	-11.332	76.869
0.157	-12.775	65.716	1.537	-22.405	76.199
3.795	-17.043	61.665	-0.061	23.256	87.951
4.173	-17.039	65.887	-2.267	22.067	80.950
-2.953	-17.132	63.908	3.495	16.037	85.025
-1.253	-21.398	64.988	-4.156	16.972	83.698
-2.993	20.605	73.135	-8.750	13.204	78.760
4.146	17.857	72.293	7.013	11.335	79.740
3.096	12.496	68.853	0.281	16.980	86.327
-4.416	12.552	66.631	-12.741	10.919	82.401
8.852	7.448	67.294	8.474	6.009	82.315
3.795	13.227	73.134	3.742	1.989	85.347
-10.593	3.020	70.399	-11.321	2.731	85.453
11.016	1.479	70.083	-12.741	2.712	80.065
-6.999	0.182	66.109	8.093	1.003	84.773
10.376	-4.303	68.050	-3.079	1.264	86.061
-9.171	-7.339	69.664	-5.427	0.909	84.957
7.304	-9.412	67.356	8.567	-4.292	83.029
-6.976	-10.950	68.582	3.802	-1.766	84.816
0.159	-13.858	70.479	7.830	-8.477	82.042
4.506	-18.750	69.695	-13.125	-8.254	79.619
0.535	-22.132	70.048	7.467	-10.398	79.960
2.334	22.143	81.710	4.340	-14.839	79.792
-0.432	22.569	75.003	-8.816	-13.475	79.806
3.413	19.278	77.228	-13.135	-10.577	84.071
-0.292	16.004	77.400	4.375	-15.158	84.389
-4.246	14.710	72.924	-4.025	-16.726	82.630
-7.569	12.451	73.133	2.576	-21.794	81.556
8.176	8.876	72.034	-2.339	-21.779	79.207
-9.172	10.198	72.171	-3.737	20.540	89.697
10.612	2.371	73.620	5.213	18.900	94.953
-10.258	0.394	81.880	-7.295	16.043	86.513
10.428	-4.173	72.072	-10.356	14.055	85.269
-10.979	-0.033	71.598	7.418	9.289	82.299
7.003	-10.193	72.697	-11.575	8.918	89.702
3.593	-12.930	73.133	4.672	2.405	88.378
-11.334	-6.999	74.349	-2.952	1.983	91.230
1.594	-15.276	77.252	-6.639	2.350	93.371
-3.772	-14.923	74.026	-13.450	7.352	85.099
-6.961	-12.989	73.133	-1.177	-1.282	88.750
3.774	-18.527	75.445	-2.723	-1.285	88.265
-3.059	-20.304	71.889	-8.903	-2.264	88.162
3.783	15.303	79.790	-11.987	-3.376	85.274

Table F1 continued.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
7.435	-6.739	89.368	-8.071	8.889	99.995
-12.671	-7.322	87.289	7.573	3.394	99.729
6.773	-11.200	86.836	0.706	0.907	99.281
3.236	-16.328	91.561	-4.474	2.365	102.370
1.938	-16.737	86.318	8.121	-4.500	98.854
-10.491	-13.847	85.498	2.136	-0.426	103.616
5.361	-18.257	95.171	-2.148	-1.266	103.957
-5.487	-15.991	90.852	-5.473	-2.972	100.206
-5.920	-16.727	85.983	7.037	-13.469	98.222
0.873	-22.776	86.310	4.131	-15.296	99.011
-3.754	-21.420	86.857	-3.746	-13.455	101.970
-2.416	21.671	93.820	1.850	-19.260	100.634
2.698	19.620	99.899	4.297	14.943	100.998
5.607	13.883	87.216	-3.625	13.197	103.599
4.232	22.225	90.763	8.496	9.171	101.780
1.375	16.747	93.431	1.701	0.902	107.729
-4.891	16.039	90.934	-7.688	8.210	104.182
7.445	9.425	88.236	7.427	3.526	106.053
-9.326	10.417	93.419	6.718	-2.322	103.756
7.127	5.583	89.736	-3.971	-2.254	107.184
0.609	0.903	92.271	8.481	-9.022	102.296
-9.759	3.847	90.151	-3.416	-12.750	106.654
5.606	-3.405	88.855	-7.735	-8.196	103.844
-2.267	-1.271	95.717	2.480	-14.567	104.143
-5.867	-1.954	93.132	6.293	12.413	108.244
6.832	-12.874	91.020	2.551	14.212	106.413
-1.201	-15.268	97.338	-2.668	12.794	108.627
-10.953	-9.280	90.736	8.109	8.634	107.946
5.716	-18.232	92.270	-4.112	2.346	107.228
-1.000	-16.022	93.420	-7.377	7.280	107.191
1.873	-23.216	90.544	1.795	-0.753	111.633
-2.992	-21.180	92.435	-7.356	-6.999	107.268
-1.144	20.029	98.609	6.711	-12.325	105.902
8.094	12.414	94.547	2.881	-13.851	109.006
5.595	14.603	92.049	4.493	12.773	113.660
-7.929	13.978	93.295	7.732	7.466	113.624
-8.090	6.315	96.648	-1.608	2.703	120.032
7.552	3.272	93.936	-4.707	10.708	112.741
-4.483	2.347	98.753	-6.637	7.182	112.097
6.368	-1.854	93.792	6.672	3.103	113.503
2.079	-0.411	97.048	-1.253	1.278	115.727
-8.090	-6.600	98.890	7.786	-4.483	107.270
8.842	-6.872	94.353	6.293	-2.333	111.210
-8.946	-4.932	93.462	-3.384	-2.267	111.644
8.520	-11.206	94.863	7.809	-9.222	109.939
-6.999	-11.644	97.930	-2.314	-12.054	113.146
-8.064	-13.778	93.418	-5.939	-9.418	112.137
4.018	-20.751	96.080	0.085	12.799	115.407
-1.544	-19.844	97.774	7.041	6.779	119.705
7.013	13.146	100.039	-3.751	3.783	123.721
0.066	15.307	98.753	-4.853	3.786	114.531
8.879	7.553	95.715	7.020	-4.129	115.754
-4.544	13.686	98.416	-1.724	-2.130	123.211

Table F1 concluded.

x (cm)	y (cm)	z (cm)	x (cm)	y (cm)	z (cm)
-5.839	-5.489	115.008	-2.570	-1.488	130.597
7.416	-9.068	113.978	3.534	-9.152	128.799
-4.845	-7.602	119.865	-3.412	-8.453	126.584
4.130	-12.683	115.282	0.918	9.915	133.188
5.574	10.974	118.622	-3.476	8.448	139.167
-3.255	10.783	118.643	3.398	2.375	134.731
5.199	2.147	118.698	2.751	-2.196	138.676
-4.858	6.861	120.276	-4.821	-3.785	134.082
4.872	-1.966	119.137	4.241	-7.513	133.172
-2.353	-2.175	119.167	-2.332	-9.537	130.611
6.680	-7.835	121.346	1.623	9.189	140.009
-1.962	-11.672	118.791	4.493	5.580	138.065
4.869	9.216	126.240	4.155	-3.308	133.885
1.469	11.005	122.987	-3.022	-1.910	137.513
-2.282	9.272	127.049	1.836	-9.445	137.192
5.224	3.467	124.949	-3.042	-9.174	135.512
1.972	1.991	125.565	-2.289	7.402	145.774
-4.859	4.508	129.134	2.890	3.294	142.775
5.934	-5.543	125.829	-3.048	2.743	141.975
3.452	-2.347	125.132	4.407	-2.129	155.635
-4.418	-3.805	126.523	-2.643	-2.991	151.956
4.595	-11.206	120.729	5.871	2.460	152.821
1.108	-10.556	124.344	-2.653	7.444	153.606
4.863	6.430	130.876	5.436	-7.699	152.286
-4.325	8.070	133.949	6.006	8.227	154.779
-3.770	2.353	135.893	-2.686	2.703	155.710
2.277	-1.580	130.550	11.306	-2.814	156.830
3.774	-5.160	142.374	-3.286	-2.819	157.687
-0.408	-1.957	143.116	17.472	8.822	160.686
1.651	-8.790	142.067	11.580	8.857	161.462
-4.109	-7.353	140.517	20.783	3.671	160.581
3.455	7.672	147.932	14.354	4.102	157.879
3.933	-2.638	149.438	9.097	3.416	160.529
-2.786	-4.147	145.813	4.358	8.163	161.462
-0.268	-7.627	146.959	1.815	2.550	161.175
-2.129	3.060	149.601	-2.516	6.264	160.386
14.625	-9.535	160.549	20.707	-3.385	160.387
9.674	-8.416	158.945	14.815	-1.297	161.462
4.538	-8.042	161.463	5.341	-2.293	160.381
0.969	-8.099	156.846	-1.914	-5.500	161.464
19.375	-7.615	160.446			

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4. TITLE AND SUBTITLE
Analysis of Mass Averaged Tissue Doses in CAM, CAF, MAX, and FAX

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14. ABSTRACT

To estimate astronaut health risk due to space radiation, one must have the ability to calculate exposure-related quantities averaged over specific organs and tissue types. In this study, we first examine the anatomical properties of the Computerized Anatomical Man (CAM), Computerized Anatomical Female (CAF), Male Adult voXel (MAX), and Female Adult voXel (FAX) models by comparing the masses of various tissues to the reference values specified by the International Commission on Radiological Protection (ICRP). Major discrepancies are found between the CAM and CAF tissue masses and the ICRP reference data for almost all of the tissues. We next examine the distribution of target points used with the deterministic transport code HZETRN to compute mass averaged exposure quantities. A numerical algorithm is used to generate multiple point distributions for many of the effective dose tissues identified in CAM, CAF, MAX, and FAX. It is concluded that the previously published CAM and CAF point distributions were under-sampled and that the set of point distributions presented here should be adequate for future studies involving CAM, CAF, MAX, or FAX. It is concluded that MAX and FAX are more accurate than CAM and CAF for space radiation analyses.

15. SUBJECT TERMS
Space radiation; CAM; CAF; MAX; FAX; Human phantoms; Dose; Exposure; Shielding; Radiation transport

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