



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS 77058

REPLY TO
ATTN OF: DC71/8/M58/71 (F&N)

August 25, 1971

MEMORANDUM

TO: DA/Director of Medical Research and Operations
FROM: DC71/Food and Nutrition
SUBJECT: Apollo 15 Bone Mineral Results

Measurement of os calcis by iodine-125 photonabsorptiometry indicated the following percent changes from the mean base-line established preflight:

	<u>R+0</u>	<u>R+1</u>	<u>R+6</u>	<u>R+14</u>
Scott	-6.1	-2.5	-2.3	-0.4
Worden	-7.0	-5.3	-3.2	-1.3
Irwin	-0.4	-1.5	+0.5	-

Controls:

Jernigan	-1.4	-0.3	-1.9	-
LaPinta	-1.1	-1.6	-0.8	+1.8
Vogel	-	-	-2.4	+0.5
Alexander	-1.0	-0.5	-2.3	-1.3

The following readings were obtained on the radius:

Scott	+0.1	-1.5	+1.3	+0.4
Worden	-3.1	+0.2	-1.3	-0.3
Irwin	-0.4	-0.3	+1.7	-
Jernigan	-0.6	-	-	-
LaPinta	-	+1.0	-	+0.4
Vogel	+0.7	-2.2	-	-
Alexander	-	-	-	-

There was a loss in the os calcis in Scott and in Worden. The rate of return in Scott was more rapid than in Worden. Irwin never really lost anything. All crewmembers returned to baseline by R+14. Scott returned to baseline somewhere between R+6 and R+14. There were no losses in the radius.

The os calcis data obtained from Scott and Worden on Apollo 15 is at variance with that obtained on Apollo 14 in which none of the three crewmembers lost bone mineral mass. The Apollo 14 data and the Apollo 15 data from Irwin in the calcaneus is in concert with results observed in bed rest situations in which no significant losses occur in the first 12 days of recumbency. However, it is interesting to note that the recovery period for Scott and Worden after Apollo 15 was approximately 12 days. In bed rest studies, the length of time it takes for bone mineral values to return to the pre-test levels is approximately equivalent to the length of time these changes take to induce. The 5 to 6 percent losses in bone mineral observed in Apollo 15 would have taken approximately 6 to 8 weeks of bed rest to induce and, in bed rest, 6 to 8 weeks to return to original levels. (ImPT)

The error of the method is normally established at $\pm 2\%$. Measurements made on the prime crew prior to flight were all within $\pm 1\%$. These measurements were unusually tight and their reliability is considered to be exceptionally good. Measurements made on the controls prior to flight were all within $\pm 1.3\%$ and postflight within $\pm 2.4\%$.

It is emphasized that the data is preliminary. The effect of soft tissue absorption has not yet been fully accounted for. In the 15 crew, there were changes in soft tissue in terms of the calf circumference measurements. If these changes occurred only with respect to water or lean body mass, there would not be any effect expected upon the gamma ray attenuation. If the differences in calf circumference were due to changes in fat, there would be differences in gamma ray attenuation. Further examination of the Apollo 15 bone scans data will enable corrections to be made for the effects of this tissue absorption. In the worst case, the reported data could be altered by 2 to 3%.

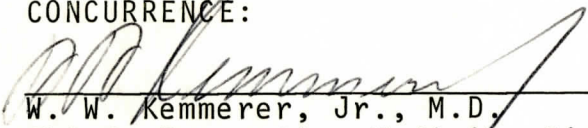
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If we compare the data obtained on Apollo 15 with all previous flights in which bone density measurements have been made, the results are not unusual. If the losses in Apollo 15 were allowed to continue unabated for a prolonged period of time, the consequences might be severe since the losses observed are probably not confined to the os calcis.

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Final

10 Sept. '71

MINERAL CONTENT CHANGES

APOLLO 15

Per cent change from mean baseline

Right Radius

	Scott	Worden	Irwin	Jernigan	LaPinta	Vogel	Alexander
F-27	-0.3	+0.4	-0.6	+0.7	+2.3	+1.4	+2.1
F-13	+0.7	+0.7	+0.3	-2.2	-3.2	+0.8	+1.1
F-5	-0.4	-1.1	+0.3	+1.5	+0.8	-2.2	-3.2
R-2	--	--	--	+0.6	-2.8	-2.0	+2.7
R+0	+0.1	-3.1	-0.4	--	--	--	--
R+1	-1.5	+0.2	-0.3	-0.6	+1.0	-1.3	-1.1
R+5	+1.3	-1.3	+1.7	-0.6	+1.2	-2.1	+3.8
R+14	+0.4	-0.3	--	--	+0.4	-2.1	+0.1

Final

10 Sept '71

MINERAL CONTENT CHANGES

APOLLO 15

Per cent change from mean baseline

Left Os Calcis

	Scott	Worden	Irwin	Jernigan	LaPinta	Vogel	Alexander
F-27	-0.5	-0.5	+0.1	-0.6	-1.7	0.0	0.0
F-13	+0.4	+0.8	-0.2	+0.6	+2.1	+0.3	+0.2
F-5	+0.1	-0.3	+0.1	0.0	-0.5	-0.3	-0.3
R-2	--	--	--	-3.4	-0.6	-1.2	-2.6
R+0	-6.1	-7.0	-0.5	--	--	--	--
R+1	-2.5	-5.3	-0.9	-0.1	-2.3	-2.8	-5.3
R+5	-2.3	-3.2	-1.5	-1.1	-1.1	-2.5	-4.7
R+14	-0.9	-1.3	--	--	+1.5	0.0	+1.2