



VARIATIONS IN HAIR TRACE ELEMENT CONCENTRATIONS IMPORTANCE OF PROPER SPECIMEN COLLECTION

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The accuracy of any laboratory test is largely dependent upon properly obtained samples submitted for testing. Improper sampling techniques can compromise test results regardless of how sensitive and sophisticated the analytical instrumentation used. If proper collection protocols for obtaining hair samples for mineral testing are not followed, the clinical validity of the trace element results can be markedly compromised. Much of the critical opinions and skepticism concerning hair tissue mineral analysis (HTMA) has been based upon erroneously derived data due to improper sampling protocols. Therefore, I would like to briefly review protocols for obtaining hair samples for analysis as well as discuss the effects of improperly obtained samples.

Hair Sampling Protocol

Location – The vast majority of hair tissue mineral analysis (HTMA) research is based upon data obtained from scalp samples. Likewise, the reference intervals and interpretation of HTMA at Trace Elements are based upon results obtained from properly collected scalp samples. Proper sampling requires that the hair specimen be taken in small portions from different areas of the scalp (mid-

parietal to the occipital region). The reason for collecting samples from several different locations is due to the variation in the growth and/or resting phase of hair follicles. (The Molecular and Structural Biology of Hair. Steen, K, et al, Eds. *Annals of the NY Acad. of Sci.* Vol. 642, N.Y.1991) It is known that the test results of samples taken from only one location can be different when compared to a sample taken from a different location. Therefore, it is critical that multiple sample locations are used in order to give a better representation of the most recent metabolic events. In addition, care should be taken to insure there are no chemical residues on the hands or instruments when taking a sample.

Weight - Approximately 250 milligrams is required for a complete trace element panel.

Length – The hair should be cut at the scalp and the sample submitted for analysis should be no longer than 1½ inches (4 cm). If the person's hair is several inches long, the strands beyond the proximal 1½ inches should be cut and discarded. As we will discuss later in detail, the clinical validity of test results from hair samples over 1½ inches can be markedly compromised.

Instruments – Scissors used for cut-

ting samples should be of high-grade stainless steel and free of any type of residue. It should be noted that there have been numerous incidences of contamination of samples from the use of low-grade metal scissors that have deteriorated.

Ultimately, the clinician should be aware of potential external contaminants and the effects of hair treatments such as dyes and shampoos.

Effects of Improper Sampling

The concentration of minerals in the hair provides useful information of recent metabolic events concerning nutritional intake and toxic metal exposure (internal or external). However, the value and clinical significance of HTMA can be severely compromised by improper sampling since the mineral content may be markedly different in distal segments compared to the more recent growth in proximal segments.

Two HTMA results of a 45-year old female physician is shown in Figure 1. The physician has completely natural, waist length hair that has never been treated with dyes, bleaches, tints, or medicated shampoos. The test results are one year apart and



show a good consistency. The similarity in the two test results reflects the fact that she had not made any major lifestyle modifications between the two tests. After obtaining her sample for the second test, the lab retained the distal portion which was approximately 22 inches long. The portion closest to the scalp was marked and the strands were divided into 1½ inch (4cm) segments totaling 14 segments. Each segment was identified as M-1 through M-14. The lab then analyzed each 4cm segment. Figure 2 shows the mineral results on the M-1(4-8 centimeters from the scalp), M-2 (8-12 centimeters from the scalp), M-8 (28-32 cm from the scalp) and the M-12 (44-48 cm from the scalp), samples compared to the original test results.

We can observe that the original samples were properly obtained and

show a good consistency, even though they were taken one year apart. However, we find a significant and progressive rise in the calcium and magnesium concentrations of the hair from the proximal to distal ends. This phenomenon has been found by others and has confirmed our research.

The significance of these findings clearly indicate that a person's metabolic classification can be inaccurate if the laboratory results are from an improperly obtained hair specimen. Calcium levels rose from 27mg% to over 200mg% in the distal hair. Even the sample beyond 4 cm from the original sample taken at the scalp was almost twice as high in calcium. This clearly illustrates the importance of obtaining proper hair samples for mineral analysis and metabolic classification.

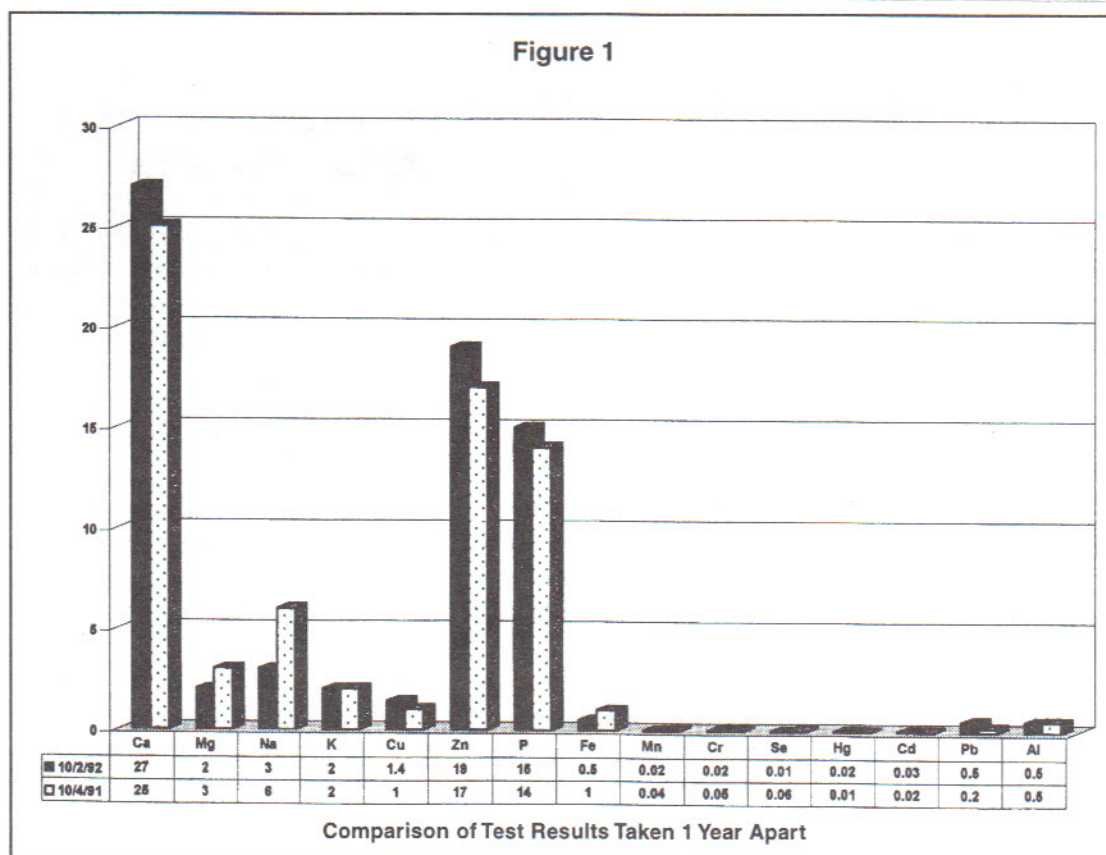
These results also show how false assumptions and opinions about HTMA can occur. This study should also lay to rest the erroneous conclusion concerning HTMA by Barrett, in which two hair samples were obtained from two young girls for analysis. (Commercial hair analysis: science or scam? *JAMA*. 1985) The samples were not properly taken at the scalp and were several inches long. The hair was divided into several samples and sent to different laboratories for analysis. The fact that the mineral results on these samples were not all reproducible between laboratories would be no surprise and in fact would be expected. This article has been quoted for years in an attempt to discredit the value of HTMA, however the conclusions made in this small study are inappropriate and unsupported. This study does however support our findings in

that improper sampling can lead to a variation in mineral results leading to an erroneous conclusion.

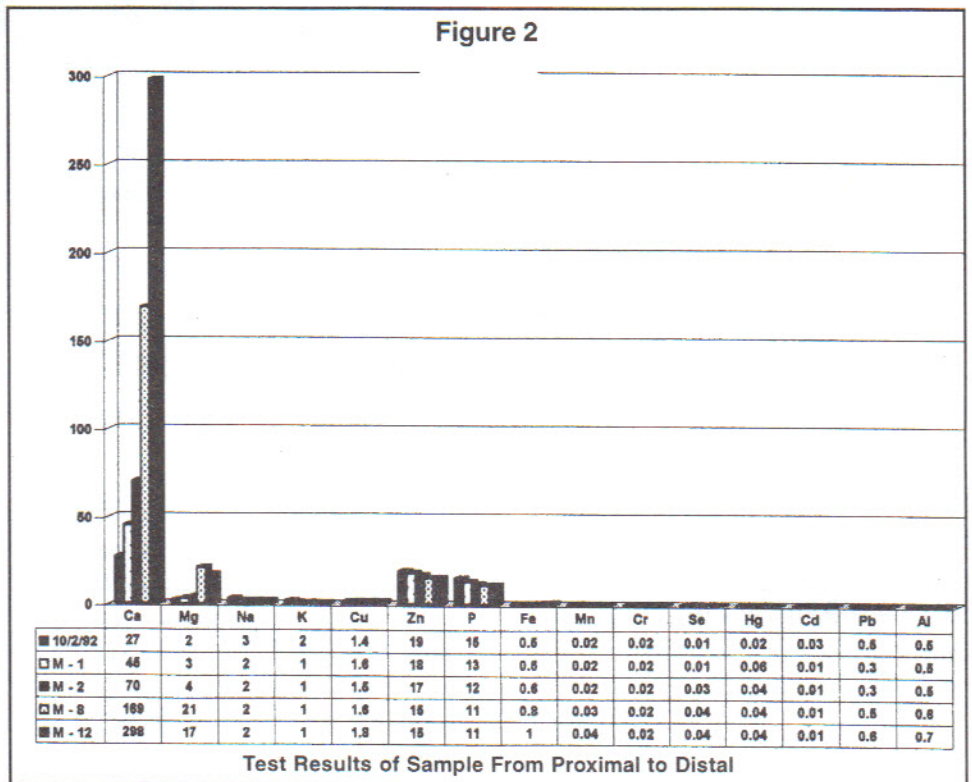
Comparison Between Scalp and Pubic Hair Mineral Results

Many authors have stated that pubic samples would be better for mineral analysis since pubic samples are less likely to be affected by external, environmental factors and not being subject to cosmetic treatments. However, this is clearly not the case. Pubic

Figure 1

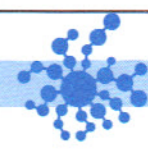
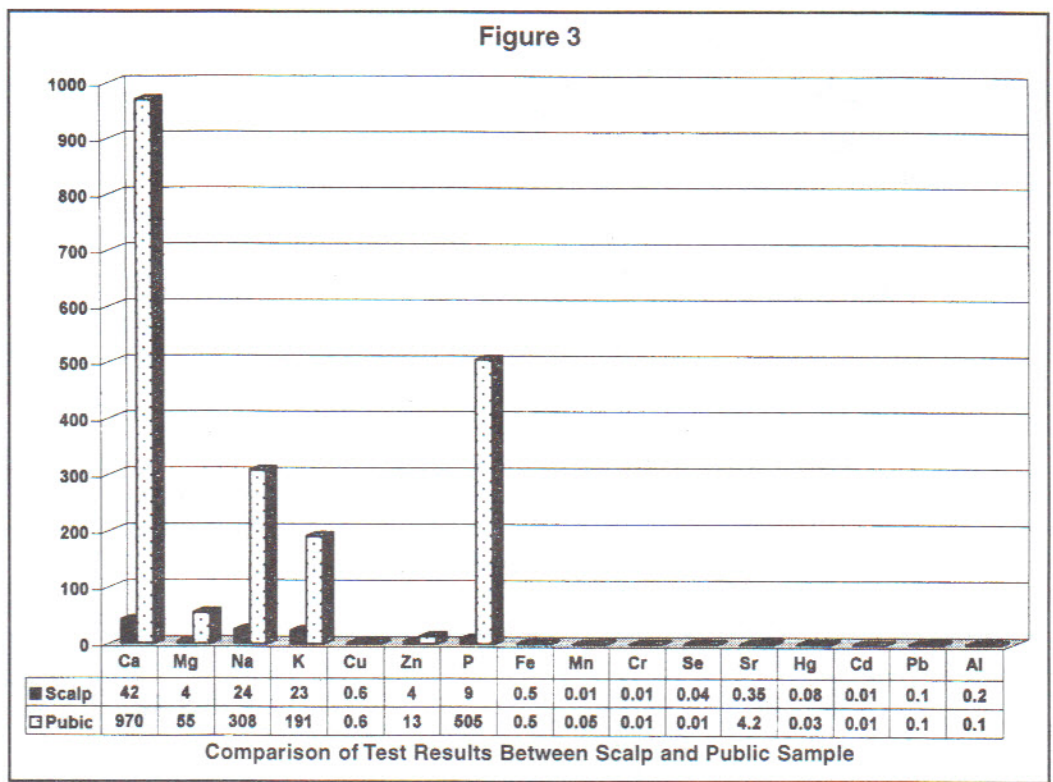


samples can be highly contaminated as illustrated in Figure 3 (previous page). These graphs show a comparison of mineral results between a pubic and scalp sample submitted on the same individual. Pubic samples are subject to contamination from soap residues, talc's and other hygiene products. A common indication that a pubic sample is contaminated is when the phosphorus level is markedly elevated. Normally, the phosphorus content of pubic samples is only slightly higher than levels found in scalp samples. However, when phosphorus levels are significantly higher it is a sure sign that the specimen is contaminated. In this case, the markedly elevated calcium also indicates contamination. It is because of this that we cannot stress enough that pubic samples should only be used as a secondary resort when scalp hair is not available, or as a means to confirm elevated levels found in the scalp hair.



Conclusion

The validity of mineral results obtained from hair is only as good as the sample that is used. It is imperative that samples are properly obtained to insure proper interpretation of the results. The clinician should be thoroughly familiar with proper sampling of specimens and should have strict control over obtaining hair samples from patients, otherwise the test results may have little clinical significance. Should you have further questions or concerns regarding procedures, do not hesitate to call us.





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