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## ABSTRACT

Applied Kinesiology (AK) is a scientifically unproven method used in complementary medicine to recognize the (in)tolerance of dental materials. Test-retest reliability of AK was examined. The working hypothesis was the assumption that the reliability of AK would not exceed random chance. Two dentists qualified in AK examined 112 volunteers to determine individual (in)tolerance toward two dental composite materials. After the first examination, 31 subjects were excluded from further testing. At the end of the open test phase, 34 of 81 participants had been classified as "tolerant", and seven as "intolerant" to both materials. The remaining 40 individuals showed a combination of either tolerant (to material I)/intolerant (to material II), or the reverse ( $n = 20$  each). Retrieval rate was tested under blind conditions. In 14 cases, the results of the open and blinded tests matched, whereas in 26 cases they did not (95% confidence interval, 21%-52%;  $p = 0.98$ ). This outcome confirmed our working hypothesis.

**KEY WORDS:** diagnostic tests, reproducibility of results, double-blind method, applied kinesiology, complementary therapies.

# Double-blind Study on Materials Testing with Applied Kinesiology

## INTRODUCTION

Complementary medicine is gaining increasing popularity (Eisenberg *et al.*, 1993, 1998). Polls in the United States have shown that more than two-thirds of Americans undergo unconventional treatments at some time during their life, spending more than US\$20 billion annually (Eisenberg *et al.*, 1998; Kessler *et al.*, 2001). A well-known procedure in the field of complementary medicine is Applied Kinesiology (AK). It was developed by George Goodheart, Jr. in the 1960s. AK, which is considered by its supporters as a so-called 'bioenergetic diagnostic method', has also been used in dentistry (Goodheart, 1983, 1987). It is based on manual exploration of the muscle tone of the patient (Walther, 1988; Goldberg, 1999).

The validity of AK has been critically reviewed in the literature (Schissel and Dodes, 1997). For example, the ability of allergies and/or nutrition incompatibilities to be diagnosed by means of AK has been seriously questioned (Kenney *et al.*, 1988; Lüdtke *et al.*, 2001; Teuber and Porch-Curren, 2003). Nonetheless, this procedure is still used by some dentists to test their patients' tolerance of certain dental materials, although no controlled studies addressing the test-retest reliability of AK are available thus far.

It was therefore the objective of the present study to test the hypothesis that the ability of AK to make a consistent statement about the (in)tolerance of a dental material is not significantly greater than what would be expected by chance alone (*e.g.*, by tossing a coin). The alternative hypothesis contended that a significantly higher reliability could be achieved by using the AK test as compared with random probability.

## MATERIALS & METHODS

### General Remarks

The test materials consisted of 2 composite resins in combination with enamel/dentin adhesives ((Material I) Filtek Z 250/Scotchbond 1, 3M/Espe, Seefeld, Germany; (Material II) Tetric Ceram/Syntac Classic, Ivoclar/Vivadent, Schaan, Liechtenstein). Of each material, 250 specimens were produced. For this purpose, the adhesives and composite materials (shade code: A 3,5) were inserted and light-cured in identical moulds of flexible plastic material (diameter, 13 mm; height, 1 mm) according to the manufacturers' instructions. It was ensured that the surfaces of the specimens were free of protruding spikes and other mechanical irritations. The specimens were then stored in closed plastic containers.

A total of 112 volunteers (65 females and 47 males) participated in the investigation. AK testing was performed by two dentists experienced in the diagnosis and treatment of "intolerance to dental materials". Both dentists had earned the medical diploma ("Ärztgediplom") of the International Medical Society for Applied Kinesiology (IMAK), including 160 hours of supervised training (for further details, see <http://www.applied-kinesiology.com>). The



envelope.

The test person arbitrarily chose an envelope with a code number, opened it, and put the specimen in his/her mouth in such a way that neither he/she nor the tester could see the sample. Immediately thereafter, testing was continued. After the tester had made his decision, the result was recorded. The individual specimen was either tolerable (1) or intolerable (2). There was only one result for each participant. At this point, testing on the subject was finished. To prevent any influence on testers or tested subjects during the investigation, the participants were not given any results before the entire study was finished. During the ensuing evaluation of the results, all that was relevant was whether the statements of the open and the blinded test phases coincided. All relevant data were recorded on a previously prepared protocol page (Table 1) under the supervision of an observer who had been chosen by the AK dentists (G.S.). Randomization and test evaluation were carried out by a test monitor (T.P.) after all testing had been terminated. Other observers of the evaluation process were the principal investigator of the study (H.S.), a participant in the study (M.K.), both AK dentists (R.M., C.F.), and a supervisor appointed by the AK representatives (G.S.) (see ACKNOWLEDGMENTS).

### Biometric Evaluation

This evaluation determined how many matches were found between open and blinded testing. For clinically relevant validity to be achieved, the number of matches (correct statement repetitions) should be significantly greater than 50%.

The retrieval rate on all test persons (remaining part of equally classified test persons with discordant findings) was then compared by means of a simple binomial test and rate probability (Trampisch and Windeler, 2000). The exact 95% confidence interval was calculated.

## RESULTS

Of the 112 individuals examined by the AK dentists (Table 2), 31 (28%) were considered inappropriate for further testing after kinesiologic pre-testing, for the following reasons: the presence of scars (11 persons), so-called "switching" (neurologic disorganization) (10 participants), "general muscle hypertone" (six individuals), "missing normal tone" (three subjects), and piercing (one person). All further testing was conducted on the remaining 81 study participants.

### Examination 1

Thirty-four test persons were classified as "tolerant" to both materials during open testing; seven test participants were classified as "intolerant" for both materials. These 41 test persons were excluded from the subsequent blinded test (Study 2).

The remaining 40 test persons were divided into two categories. The first category was tolerant to material I but intolerant to material II; for the second category, the opposite

was true (n = 20, respectively).

During the open test phase (n = 81), both composites were classified by the AK dentists. Thirty-four test persons (42%) were classified as tolerant for both composites; 47 (7 + 40; 58%) were intolerant for at least one composite.

### Examination 2

In the double-blinded test, a match with the results obtained in the first open test was found in 14 cases. In the remaining 26 cases, there was no agreement. The rate of correct judgments, therefore, was  $14/40 = 0.35$ .

The performances of the two AK dentists differed: Dentist I (R.M.) examined 15 of the 40 cases in the blinded test, and achieved correspondence in four cases (27%). The assessment of dentist II (C.F.), who examined the remaining 25 cases, resulted in 10 matched cases (40%).

The 95% confidence interval of the retrieval rate was 35% (21%; 52%). Statistical evaluation with the binomial test yielded a p value of 0.9766. Hence, the working hypothesis was confirmed, *i.e.*, accuracy of AK testing for the determination of the (in)tolerance of dental materials is not significantly higher than random probability.

## DISCUSSION

Although AK was introduced as early as 1964 (Goldberg, 1999) and has been used, by dentists at least, for more than two decades (Goodheart, 1983, 1987), no study had yet been performed to assess its diagnostic validity. According to estimates of AK representatives, AK is routinely used in German-speaking Central Europe by about 1000 to 2000 health care providers to assess the purported (in)tolerance of dental materials. The present study attempted, for the first time, to examine the reproducibility of AK judgments by means of a dental materials test.

Our results showed that almost 30% of the initial pool of test persons had to be eliminated from further testing because of possible "negative influences" (such as scars, improper muscle tone, etc.). More than one-third of the initial pool of test persons (37%) showed equal reactions to both materials and had to be excluded for subsequent blinded reliability testing. Only 40 of the 112 initial individuals were available for this test. This means that, for future studies, it must be expected that three times as many test persons should be recruited to provide an adequate pool for the final test evaluation.

During open testing, the composite probes were judged by 42% of all subjects as "tolerable" and by 58% of the individuals as "intolerable" for at least one material. Hence, the kinesiologically obtained rate of intolerability of dental materials (58%) is much higher than estimates reported in the dental literature, which considers adverse reactions as very rare events (McHugh, 1992; Stanley, 1992; Lygre *et al.*, 2003).

It must be emphasized that the present study did not test actual intolerance or tolerance of these materials. Therefore,

our investigation did not directly evaluate the validity of Applied Kinesiology by using a gold standard. However, any method that fails to be reliable cannot be valid.

Even though both AK dentists were highly experienced and

**Table 2.** Number of Persons during the Investigation

	Start of the Investigation	After Kinesiologic Pre-screening	Tolerability to Both Materials	Intolerability to Both Materials	Combination of Tolerability and Intolerability
No. of persons	112	81	34	7	40

qualified, their accuracy rates differed significantly (27% vs. 40%). They were given the prerogative to refuse testing due to insufficient or biased conditions in each individual case. No adverse influences were brought to light during testing, with regard to either exterior conditions or participating test persons.

According to Cohen (1988), effect sizes should be graded as small in the case of 60%, medium in the case of 74%, and large in the case of 86% hits, compared with a statistical likelihood of 50%. The chosen sample size of 40 evaluable subjects resulted in a power of 91.2% in the case of a medium effect size, and a power exceeding 99.9% in the case of a large effect size, to yield a statistically significant result. The sample size, therefore, was certainly sufficient for the detection of a reliable diagnostic tool (Cohen, 1988; Altman *et al.*, 2000). The lack of statistically significant results cannot be explained by statistical weaknesses.

Possible causes for the frequent discrepancies between the results found in the open and blind tests were discussed at length with the AK dentists after completion of the investigation. As potential sources of error, the procedures for sample production, sample storage, and exterior conditions during testing were mentioned. The AK dentists suggested that storage of the encoded materials in the paper envelopes might have had a negative impact on the results. They believed that it was possible that material from the envelopes had contaminated the samples in a hitherto unknown way. As a consequence, the AK dentists proposed that future studies should also test the influence of the material samples' storage conditions on the results of AK. Therefore, the results of the present study did not cause the two AK practitioners to cast any doubt on the validity of AK as being a suitable method for dental materials testing. Nonetheless, as far as testing of the tolerance of dental composites is concerned, AK does not appear to be a suitable diagnostic method.

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