

SCREENING

The ankle-jerk half-relaxation time as a screening test for thyroid disease

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In 1884, William Ord first noticed delayed tendon reflexes in myxoedematous patients and in 1929 fast reflexes in thyrotoxicosis were described by Mussio Fournier. Exact measurement of the times involved was first carried out by Chaney in 1924 who showed that the times returned to normal on treating myxoedematous patients.

Abraham *et al.* (1966) showed a good separation between thyrotoxic, euthyroid and hypothyroid patients using the reflex time. This was also found by Sherman and his colleagues (1963) who concluded that it was as reliable or better than the other tests that were standard at the time. Nordyke and Gilbert (1967) used the test to screen over 2,000 people at the Hawaii Health Fair and found 2.7 per cent who had abnormally slow times. Unfortunately they were only able to follow up ten of these of whom nine were proven to have hypothyroidism. Engström *et al.* (1970) reported a close correlation between the ankle-jerk time and clinical evaluation of thyroid status and recommended it as a screening test.

Method

The test was carried out on an unselected sample of patients attending the BUPA medical centre for screening examinations between 1 July 1971, and 13 March 1972. As only about 20 per cent of the patients at the Centre were female, preference was given to them to ensure an adequate sample. Patients with any severe disability of the lower limbs, whether neurological or musculoskeletal were excluded but no other selection was employed. Overall about 14 per cent of the men attending during this period had the test and about 22 per cent of the women. The age and sex distribution is shown in Table 1.

TABLE 1
ANKLE-JERK HALF RELAXATION TIME BY AGE AND SEX

Sex		Age						Total
		<25	25-34	35-44	45-54	55-64	65+	
Female	Number	16	49	101	106	89	14	375
	Ankle-jerk Time (m.sec.)	299 (15.4)	294 (24.8)	297 (26.6)	298 (29.0)	298 (32.1)	287 (20.9)	297 (27.9)
Male	Number	10	108	299	317	204	33	971
	Ankle-jerk Time (m.sec.)	280 (13.3)	293 (26.8)	295 (21.5)	295 (24.2)	296 (26.4)	295 (36.1)	295 (24.6)

Numbers in brackets are the standard deviations.

Patients attending the centre are virtually all from social class I or II. Details of the tests carried out have been published elsewhere (Wright, 1971).

The procedure was carried out by specially trained nurses who also perform the other tests. All measurements were made on a naked foot with the patient kneeling on a couch. The time taken was that from applying the stimulus using a standard reflex hammer to the half relaxation point (Miles and Surveyor, 1965).

A Cranlea reflexometer* was used which consists of a central, light source surrounded by a photo-electric cell. This 'head' is mounted on a flexible arm fixed to a heavy base containing the electronics and batteries. Standard Cambridge Transrite four electrocardiographs were used as recorders. They were run at double speed (50 mm/sec) to improve the accuracy of the timing which was recorded to the nearest ten milliseconds. The recording paper is marked in one mm squares and in practice nearly all measurements were recorded in 'whole squares' or 20 millisecond intervals.

For all patients with a reading greater than 360 milliseconds or less than 260 milliseconds a serum thyroxine estimation was carried out by our pathology laboratory in addition to the standard biochemical profile. This was estimated by the Oxford T-4 column elution method (Bittner, 1968). The normal range used in our laboratory is 0.19–0.47 micro moles/litre.

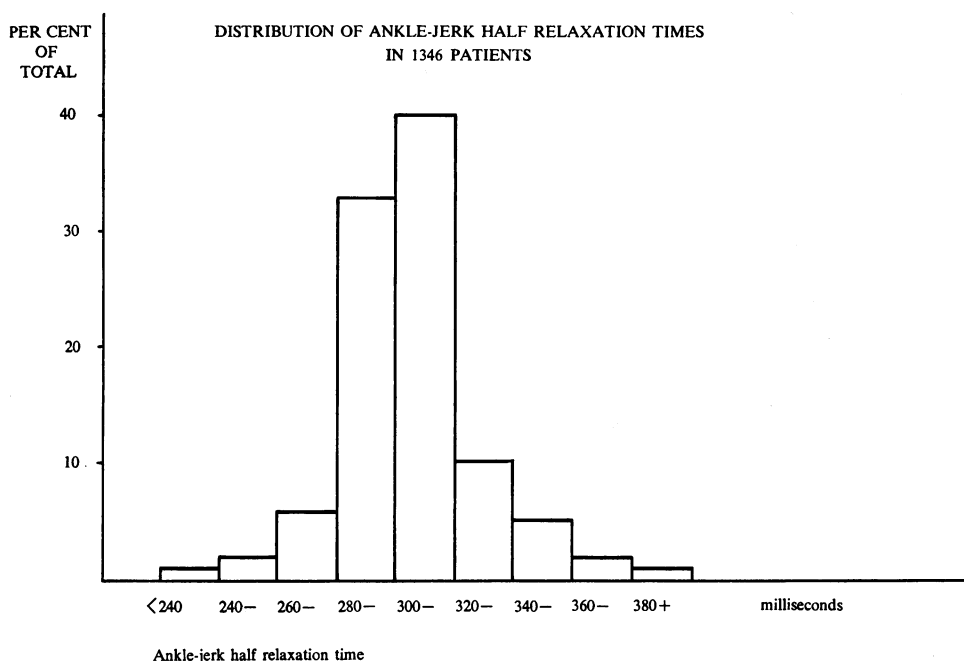


Figure 1

Figure 1 shows the distribution of the results; this closely fitted a Gaussian model. Table 1 gives the means and standard deviations for the ankle jerk half-relaxation time broken down by age and sex. There was no significant difference between the sexes ($t=1.22$) or between the age groups (for women, $F_{5,369}<1$; for men, $F_{5,965}=1.07$) nor was there any significant correlation between age and mean ankle-jerk time for men or for women. The overall mean was 295 milliseconds with a standard deviation of 25.6 milliseconds giving a 'normal range' of 244–346 milliseconds.

At the start of the study an arbitrary 'normal range' was chosen of 260–360 milliseconds inclusive. Of the 49 patients outside this range, only four had thyroid disease as shown by their thyroxine level, giving an overall yield of three per 1,000. However, the yield was eight times as high in women as in men (Table 2). One of the women with high readings was a known hypothyroid on thyroxine, presumably taking too high a dose. None of the other three were taking a drug known to affect the serum thyroxine level. A further 23 patients had times of 360 milliseconds. Unfortunately, it was not possible to do thyroxine estimations on them retrospectively, and some of them may have undiagnosed hypothyroidism.

The mean age of the patients was 47.0 years. The mean age (46.8 years) of those below

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TABLE 2
ABNORMAL RESULTS

	High abnormal (>360 m.sec.)			Low abnormal (<260 m.sec.)			Overall yield of confirmed disease per thousand	
	Number	Per cent	Thyroxine* not measured	Confirmed by thyroxine	Number	Per cent		Thyroxine* not measured
Men	8	0.8	3	0	18	1.9	2	1
Women	7	1.9	1	2	16	4.3	2	1
								8

*Measurement not done owing to inadequate blood.

the normal range was the same as for the whole group but the mean age (50.5) for those above the normal range was higher than the whole group though the difference was not significant. There was no significant difference in age between the sexes either in the normals or in those above or below the normal range.

Discussion

The test proved easy to teach to nurses and to carry out and the equipment was rugged and reliable. Some initial difficulty was found in reading the tracings, but this soon disappeared with practice. Patients did not find the test objectionable and they co-operated readily. The equipment is cheap and could easily be used by any general practitioner who already owns an ECG machine that could be used as a recorder. It could readily fit into the well-equipped group practice.

Our distribution agrees well with other findings. Nordyke and Gilbert (1967) give a range of 260–420 milliseconds. They found 58 out of 2,167 (2.7 per cent) who had values above the top of the range as compared to 38/1,346 (2.8 per cent) in our series using our calculated upper normal level of 346 milliseconds rather than the originally estimated one. Miles and Surveyor (1965) also found an absence of age or sex differences and a mean and standard deviation of 289 ± 22 milliseconds which was very close to ours. Sherman and his colleagues (1963) quote a similar normal range of 250–370.

The manufacturers in their instructions quote a range of 265–345 milli-seconds. In 291 young Italian women a rather lower range 264 ± 32 milliseconds was found (de Lutterotti *et al.*, 1970). In Australia, Martin *et al.* (1970) found a somewhat similar normal range of 200 to 300 milliseconds. The small differences between these various ranges may be attributable to differences in techniques or may reflect the differences between the populations.

The value of screening is still controversial. Tests of thyroid function have often been excluded from multiphasic screening programmes largely on the grounds of a low yield. In the Varmland project (Jungner and Jungner, 1966) out of 30,000 patients screened (not including a test of thyroid function) 3,200 were examined clinically and 49 had thyroid disease, some of whom had non-toxic goitre. This gives a net yield of 1.5 per thousand.

Percy Robb and his colleagues (1971) screening in general practice in Edinburgh found seven patients out of 937 with previously unknown or known but inadequately treated, thyroid disease. These, however, were symptomatic patients, so that a yield of half this in our largely asymptomatic patients is in fair agreement with their results.

No attempt was made to assess the true incidence of disordered thyroid function in our population. However, comparison with the two series quoted above and general clinical experience suggests that it is unlikely that many cases were missed. The sensitivity of the test cannot therefore, be calculated, but a very close approximation to the specificity is possible. Using our calculated normal range, the test has a specificity of 95 per cent which would be unaltered even if the true incidence of disease was twice that found. This agrees with the findings of Martin *et al.* (1970) that five per cent of the normal thyroid patients were outside their normal range for the ankle-jerk time.

In view of the low yield in males the test is probably only worth carrying out in women. Further research to establish the sensitivity and validity of the test is required.

Summary

The ankle-jerk half relaxation time has been measured in 971 men and 375 women. No age or sex differences were found in mean values; overall the mean time was 295 ± 25.6 milliseconds. Forty patients were found outside an arbitrary normal range (established before the start of the study) of 260–360 milliseconds. Four of these were confirmed as having disordered thyroid function by serum thyroxine estimations (two hyperthyroid, two hypothyroid). The overall yield of confirmed abnormalities was one per thousand in men and eight per thousand in women.

The test is simple, cheap, and of reasonable specificity (95 per cent), however, in view of the low yield in men, it is probably only worth carrying out routinely in women. Each unit will wish to establish its own normal range based on its own techniques, a synthesis of our results with other published series suggests a normal range of about 245–350 milliseconds.

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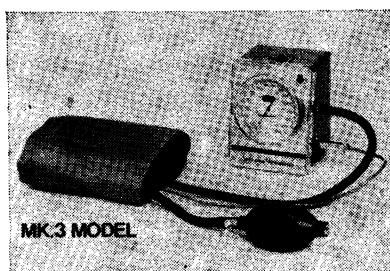
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