

## The Evaluation of the Musician's Hand: An Approach to Prevention of Occupational Disease

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The occupational diseases of musicians are certainly not a very important chapter of medicine. It consists, however, largely of unsolved problems. Some time ago we questioned 160 orchestral musicians (string players) about complaints in the locomotor system which had occurred in connection with their instrumental play. Only 32 of the 160 instrumentalists *never* had any occupational complaints. Of the other 120 the doctor would have certainly sent home a group as completely healthy – but only because the diagnostic means to discover the finer functional disturbances were not adequate. BLAU and HENSON (1977) expressed it in the following manner: “Even the most detailed neurological examination does not demand the degree of integration required by, say, Sevcik’s finger exercises.” SIELAFF (1979) who has gone into diseases of string players very thoroughly has pointed out the therapeutic results: a period of treatment of four weeks up to several years, an inclination to chronic course of illness, frequency of recidivism, and treatment success among students of about 50 percent.

Therefore everything would depend on finding out the primary causes of players’ illnesses in order to be able to prevent them. The essential point of departure for this is seen by doctors and pedagogues who deal with such disturbances in the analysis of defects in the playing technique. SINGER (1960) had already given the recommendation “to clear up before the beginning of every treatment by the test of a recognized pedagogue about whether the technique was correct.” If one asked *three* recognized pedagogues for such a test then there would be probably three different results. Even if we try to describe the process of playing by means of objective methods of registration we shall hardly be able to demonstrate the essential elements of “incorrect technique”.

The second step would then be to avoid the defect recognized. Is everyone in the position to do that? Are there perhaps people who, sooner or later, so to say, make mistakes on the instrument simply because the

professional demand does not fit in with their physical preconditions? (A question which is put in sport *before* the beginning of training which is intended to lead to top performance.) With other words: Are there risk factors which make the learning and the practise of instrumental play more difficult and in the end favour the development of occupational diseases? Which part is played by the hand in this connection?

The biomechanical characteristics of the hand which can principally influence its dexterity can be summarized in the following points:

1. Shape and size of the hand (and of the arm).
2. Mobility of the joints of the hand (and of the arm).
3. Strength of the muscles which act upon the joints of the hand (and those of the arm).

Naturally the individual instruments challenge the hand very differently. Therefore one has to examine the question about the essential factors separately for each instrument. We have concentrated largely on the piano and string instruments and at present we are considering factors of the first two points, shape and mobility (see Figure 1). The size of the hand is examined according to the rules of anthropometry; for the measurement of

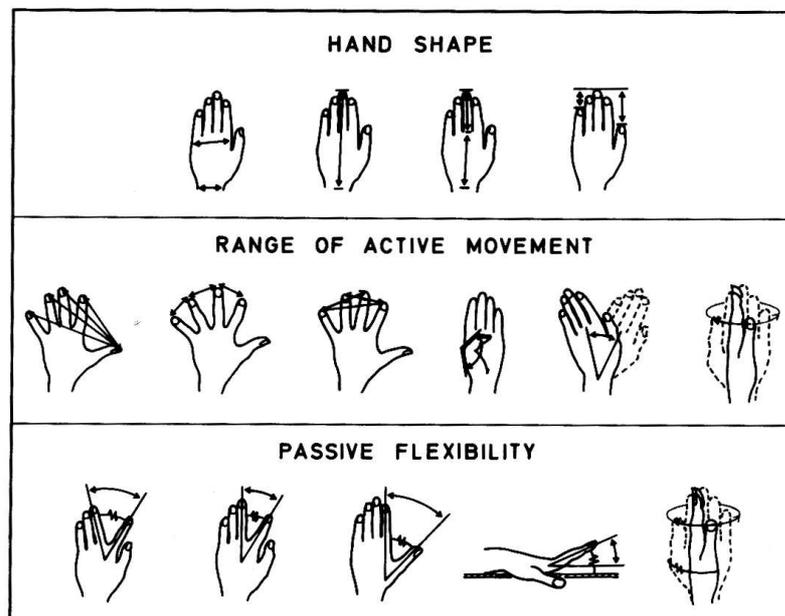


Figure 1. Hand characteristics investigated. The symbol  $\ast$  indicates the application of an external torque when measuring passive flexibility.

the active and passive joint mobility we have developed special methods (WAGNER 1974, 1977).

Depending on the instrument 20 to 30 individual measurements are undertaken on one hand. With the pianists the examination lasts about 40 minutes, with the strings about 20 minutes because in this case we only examine the left hand at present.

The reliability of the method was checked in test-retest measurements on both hands of 30 subjects and seems to us satisfactory. 66 of the 79 test-retest correlations are above .8 and 55 above .9. In some regards we hope to be able to make progress through technical improvement. However, like other investigators we have made the experience that determination of joint mobility causes considerable difficulties precisely in the area of the hand (HAMILTON and LACHENBRUCH 1969, HASSELKUS et al. 1981, WAGNER and DRESCHER 1984).

As you see our examination covers only a part of the biomechanical factors which in principle come into consideration. We intend to bring in further factors, above all the mobility of the wrist. On the other hand such a test must not be too time-consuming because otherwise one cannot persuade the busy professional musicians anymore to take part in the test series. I consider such test series to be indispensable. I don't share the opinion of ZENTEK (1982) that nowadays it is easily possible to have detailed specific medical and pedagogical suitability criteria for string instrumentalists to be derived from general anatomico-physiological demands of the individual string subject. This way has again and again led to classical contradictions between theoretical statements and musical performance. As we have seen in our examinations of some 600 professional musicians, variability of some characteristics has reached such an extent (WAGNER 1984) that in contrast hardly anything can be done with principle anatomico-physiological demands.

From our data ordered according to sex, age, instrument and level of technical ability we have formed reference groups whose data we can use as a basis in the counselling of individual persons. The results of the investigation are summarized in a "hand-profile" (see Figure 2). This way we get a quick survey about in which characteristics and by which amount the person examined deviates in positive or negative direction. From this it is possible to name individual and quite detailed consequences for the technique on their instrument.

Resulting from the individual examinations and counselling we have recently compared instrumentalists of different technical ability with each

HAND-PROFILE PIANISTS, MALE  FEMALE   
 DATE: 31.1.77 NAME: Vp H 22 DATE OF BIRTH: 31.1.61  
 HANDEDNESS: RIGHT INSTRUM./PROFESSION: PIANO, PUPIL  
 (REFERENCE GROUP: 112 PIANISTS)

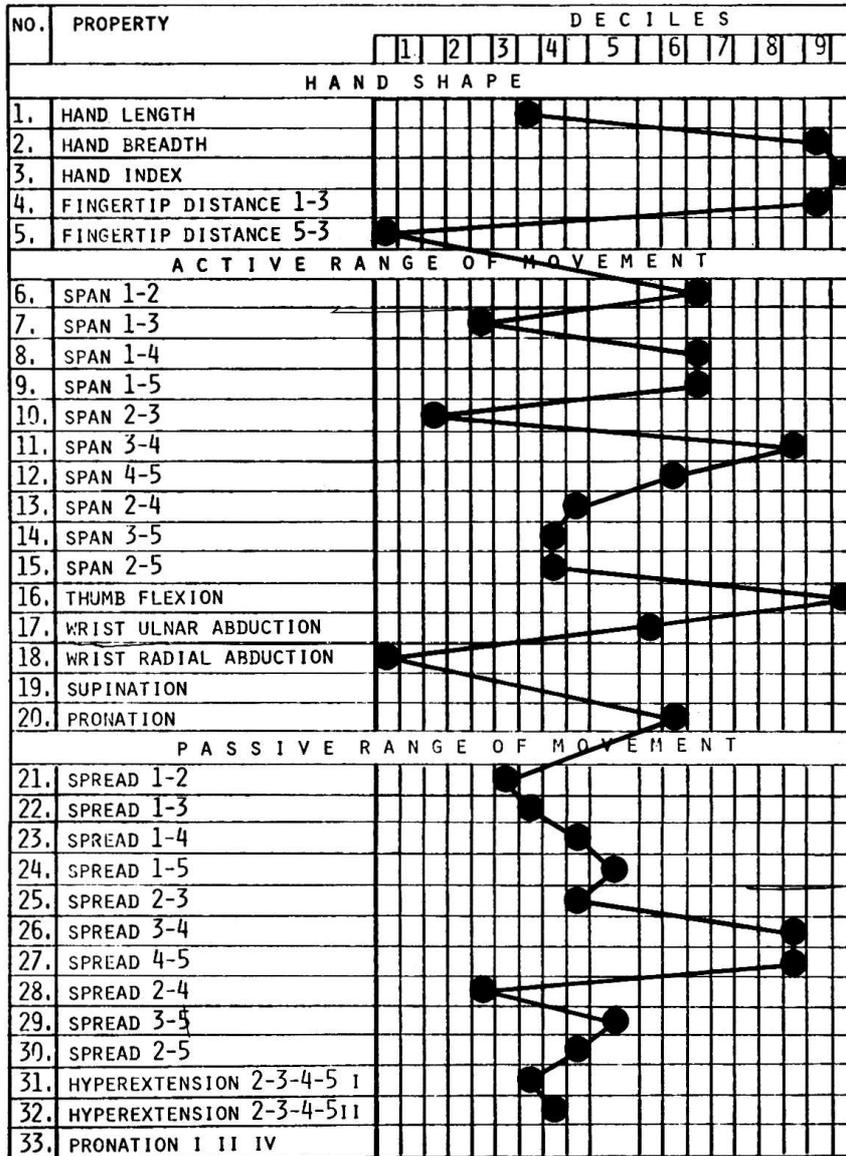
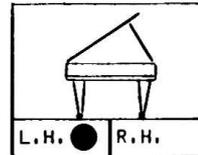


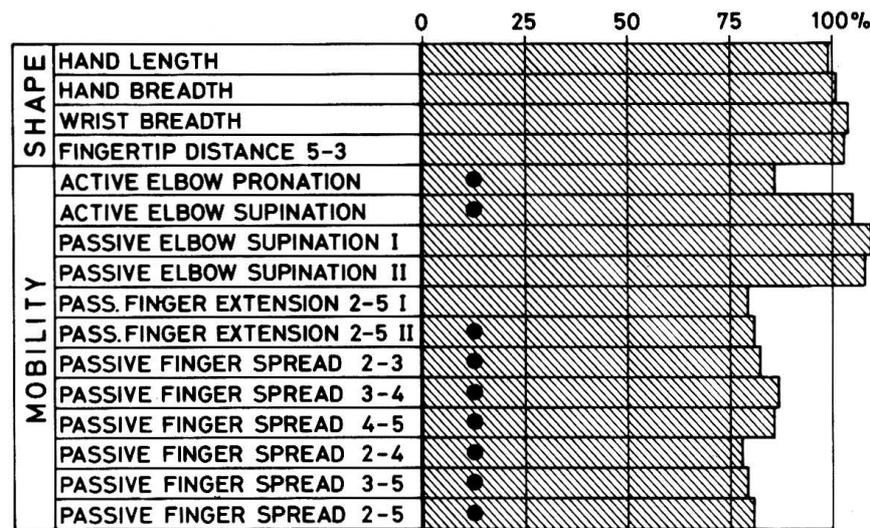
Figure 2. Hand-profile of a piano student. Note the critical combination of an extremely small range of active radial abduction of the wrist (line 18) with the shortness of the little finger (line 5).

other. On the one hand were musicians who had shown evidence of the mastery of their instrument in practical terms, on the other hand instrumentalists who had serious technical difficulties during their training or later. The comparison has shown that the group of problem cases had a disadvantage from a biomechanical point of view (WAGNER 1984). One might suppose that these differences depended on training effects. I must therefore emphasize that all the data available – which originate from cross-section investigations, however – essentially speak *against* the influence of training factors, and much more for the effect of genetic disposition.

This observation naturally leads on to the question as to whether there are also certain differences between healthy instrumentalists and those with professional diseases regarding their manual preconditions, especially as numerous individual findings have nourished this suspicion. At present we are analysing our data from this point of view and I would like to report about a first partial result.

From the group of 160 orchestral musicians two groups were compared with each other: on the one hand 26 violinists and violists between 24 and 63 years old who *never* had any sort of complaint in the area of their locomotor system; on the other hand 86 violinists and violists between 22 and 65 who not at the time of the examination but nevertheless earlier had complaints in the area of the left or left and right upper extremity. As we depend on the statements of the musicians regarding the type and degree of severity of the disturbance it seemed suitable to me at first only to differentiate basically between the occurrence and nonoccurrence of disturbances. The statistical test was carried out with the U-test by MANN and WITHNEY (SIEGEL 1956) within every individual characteristics.

The result is shown in Figure 3. Each of the columns gives the median of the group “disease” as a percentage of the median of the group “healthy”. As we can see no differences have emerged between both groups concerning the morphological factors. In contrast the differences are clear in the passive mobility of metacarpo-phalangeal joints II to V. Here the values of those with diseases are on average about 20 percent below those of the healthy. If you consider what static and dynamic demands playing violin makes on the left hand regarding speed, precision and endurance then you must see there is a permanent strain in the higher joint resistance among this group. The 5% higher range of supination in the mean seems somewhat paradoxical among those with disease. However, a 15% lower pronation range is set against it. Perhaps it is a matter of a training effect in this case, probably only in the sense of a shifting of the range of action, not of an independent



● p < .05

Figure 3. Left hand characteristics; comparison of healthy male violinists (median = 100%) with male violinists who had had complaints in the area of the left upper extremity (shaded columns). Passive elbow supination and finger extension were measured with two different torques I and II. Significant differences between both groups are marked by ●.

increase of the supination part. Perhaps also a more differentiated picture will result later on with the allocation to different disease symptoms. It should be mentioned that the variability in the group of those with diseases on average is higher than with the comparative group. Possibly this indicates the existence of certain subgroups. Here we must wait for the further analysis of the data.

The statistical methods applied up to now have one disadvantage: they do not pay attention to the intra-individual combination of factors and their weighing; but that is a particularly important aspect because precisely the *combination* of certain factors increases the risk of technical failure and the risk of occupational disease. It is still too early at the present stage for a factor analysis of these connections. The "hand-profiles" are therefore all the more useful to us because they call attention to the critical combinations (see e. g. figure 2 line 5 and 18). Here it is shown that we have to consider those characteristics, too, in which for example the groups "healthy" and "disease" are *not* significantly differentiated from each other. I would like to make that clear with an example.

Figure 4 shows three hand-profiles which, although they originate from different people, mark the stages of a development.

## PHYSICAL HANDICAPS IN VIOLIN PLAYING

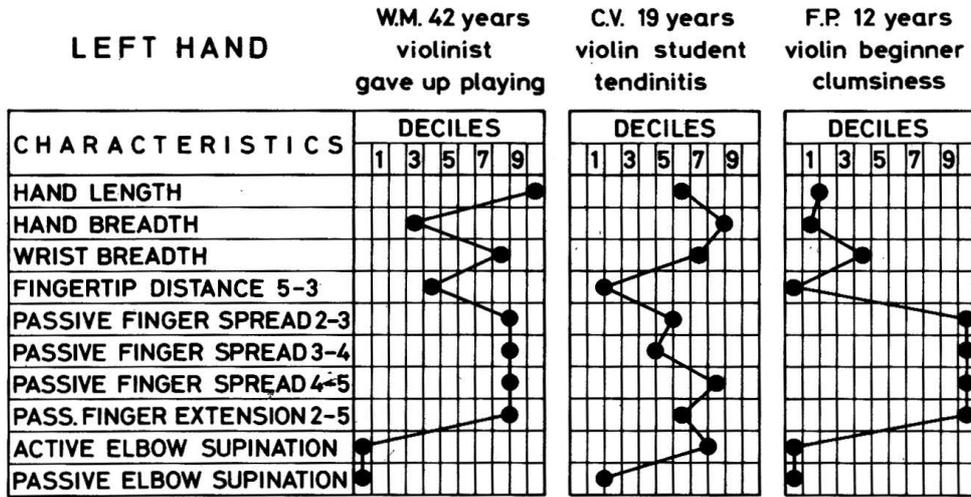


Figure 4. Hand-profiles of violinists with similar physical handicaps (see text).

The 12 year old violin beginner F.P. (on the right) came to us because the teacher had noticed the clumsy behavior of the left hand on the finger-board.

The 19 year old student C.V. (middle) visited us after he had got a "tendinitis" (or epicondylitis?) during the preparation for his first public concert. Now he had to face the decision for or against a professional instrumental training.

The 42 year old violinist W.M. (on the left) recently had to give up instrumental play completely as the result of coordination disturbances on the left hand. He had visited numerous doctors, several non-medical practitioners, and had also asked a violin teacher for advice. There were no medical findings; all therapeutic attempts were without success (see also WAGNER 1979).

The primary cause of difficulties is probably the same in all three cases: a limited to extremely limited supination mobility combined with a more or less marked shortness of the little finger. I am sure that it would have been possible to ascertain the high supination resistance with both the adults even at the age of a child, so just as it is visible already with our 12 year old boy.

In this last case we had the opportunity also to examine the hands of both parents (see Figure 5). According to that it seems obvious that the boy

### LEFT HAND CHARACTERISTICS

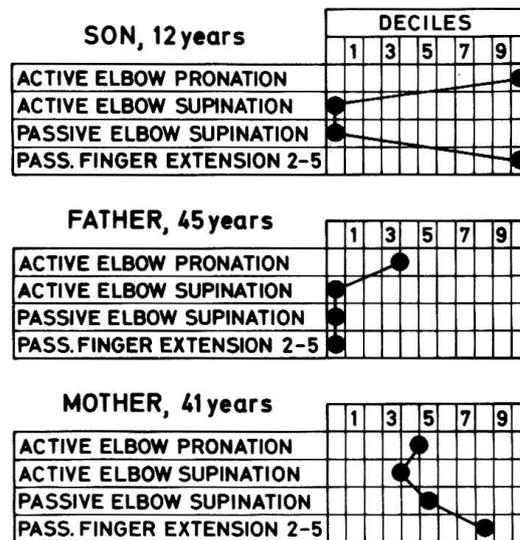


Figure 5. Partial hand-profiles of violin beginner F. P. (see figure 4) and his parents. Note the similarity of supination mobility of the son and his father.

inherited the biomechanics of his left elbow joint from his father. – Keeping in mind those biomechanical conditions as shown in the three cases we shall hardly be surprised at chronic course of diseases or unsuccessful therapeutic attempts.

If it is now correct that certain biomechanical characteristics are above all genetically given and can be little influenced or not influenced at all by training then a certain part of the risk factors would at least be predictable for a later occupational disease. I do not think that one should prevent those affected from entering an occupational music training or even from instrumental play at all, apart from certain exceptions. On the other hand I find it absolutely unsatisfactory that in instrumental training the real physical preconditions of the individual are still so little taken into account. TRENDELENBURG (1925) and ORTMANN (1929) have warned us more than fifty years ago.

It is curious, indeed, how much time it takes to put even easily understandable knowledge into practice.

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