Incidence of Atypical Pencil Grasps Among Nondysfunctional Adults

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Three groups of nondysfunctional adults were observed for atypical pencil grasps (i.e., nondynamic tripod grasps) used during functional writing situations: 58 occupational therapy students signing out equipment, 314 voters signing for their ballots, and 113 medical students taking a written examination. Among the total right-handed population, the most frequently used grasp was the dynamic tripod grasp (86%). The second most frequently used grasp was the lateral tripod grasp (10%). Other grasps were observed less often (less than 2% of the time).

The surprisingly high incidence of the lateral tripod grasp suggests that this grasp may be considered a functional alternative to the traditionally accepted dynamic tripod grasp. Only 1% of the total sample showed immature grasp patterns (i.e., cross-thumb and static tripod grasps), thus indicating that most adults develop a mature grasp for functional handwriting.

The development of hand function represents an important part of occupational therapy practice. In schools, children are frequently referred to occupational therapy because of poor handwriting or awkward pencil grasp. These referrals may reflect a wide range of dysfunction. Two of the elements that influence diagnosis and treatment are the method of pencil control and the type of prehension used. When the fine motor components of handwriting are worked on, much of the remedial effort is focused on development of the optimal grasp pattern for control of the pen or pencil. The dynamic tripod grasp is generally considered the most desirable (Weiser, 1986) and therefore is the targeted pencil grasp among educators and therapists. The dynamic tripod grasp is described as “the position in which the pencil is controlled by minute movements of flexion and extension between the pads of the index finger and the thumb while resting against the distal phalanx of the middle finger” (Jaffe, 1987, p. 1) (see Figure 1). This grasp, in which the point of pencil control is at such a distal position (i.e., at the fingertips) and involves such small finger movements, is widely believed to be the most efficient grasp for writing. More proximally controlled grasps (i.e., grasps in which the pencil is stabilized against the finger shaft, thumb and index web space, or palm) have been described as maladaptive for handwriting (Levine, Brooks, & Shonkoff, 1980), because they seem to limit writing speed and endurance.

In the developmental literature, the dynamic tripod grasp is described as the most mature grasp pattern, acquired between the ages of 4 and 6 years (Erhardt, 1982; Rosenbloom & Horton, 1971; Saïda & Myashita, 1975; Schneck & Henderson, in press). Educators have come to expect that by the first grade, a child will have established a dynamic tripod grasp on a pencil. The dynamic tripod grasp is generally seen as the typical, or standard, pencil grasp in adults, with all others being considered atypical and awkward.

The results of two recent studies by Schneck and Henderson (in press) and Jaffe (1987) challenged the traditionally accepted need for the dynamic tripod grasp. Schneck and Henderson (in press) investigated grasps in nondysfunctional children aged 3 years 0 months to 6 years 11 months and found that 25% of the 6-year-olds demonstrated a lateral tripod rather than a dynamic tripod grasp on a pencil. The lateral tripod grasp is described as the position in which the pencil is stabilized against the radial side of the third digit with the index pulp on top of the shaft of the pencil and the thumb adducted and braced over or along the lateral border of the index finger (Schneck & Henderson, in press) (see Figure 1). Unlike the dynamic tripod grasp, movement in the lateral tripod grasp is controlled more proximally, mainly at the...
students who were observed while signing their names. Identical ballpoint pens were supplied to the students.

Group 2 consisted of 314 voters who were observed while signing their names to register to cast their votes in the November 1988 presidential election. All of the voters were given identical ballpoint pens.

Group 3 consisted of 113 medical students who were observed as they took a written examination. The students were given No. 2 pencils.

I collected all of the data myself. All 38 left-handed persons were eliminated from the observations, because left-handedness appears to stimulate the development of wrist and finger positions distinct from the typical right-handed writing posture (e.g., hooking) as an adaptation to the direction of writing (Harrison, 1981). Observations made on the remaining (447) right-handed subjects were recorded descriptively. They then were classified according to the developmental grasp positions of dynamic tripod, lateral tripod, cross-thumb, static tripod (Schneck & Henderson, in press), or transpalmar interdigital grasp (Benbow, 1989). An additional writing position that had not previously been recorded in the literature, which I termed the dynamic bipod grasp, was also included.

Results
Of the 55 right-handed occupational therapy students, 9 did not use a dynamic tripod grip when writing. Five of these 9 students (9% of the total group) used a lateral tripod grasp and 4 (7% of the total group) used one of the nontripod grasps, as described below (see Table 1).

Of the 285 right-handed voters, 37 demonstrated grasps other than the dynamic tripod. Twenty-four (8% of the total group) of these signed their names using a lateral tripod grasp and 13 (5% of the total group) used one of the nontripod grasps (see Table 1).

Of the 107 right-handed medical students, 16 (15% of the total group) used a lateral tripod grasp, 2

<table>
<thead>
<tr>
<th>Grasp</th>
<th>Group 1 (n = 55)</th>
<th>Group 2 (n = 285)</th>
<th>Group 3 (n = 107)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic tripod</td>
<td>46 (83.6%)</td>
<td>248 (87.0%)</td>
<td>89 (85.2%)</td>
<td>383 (85.7%)</td>
</tr>
<tr>
<td>Lateral tripod</td>
<td>5 (9.1%)</td>
<td>24 (8.4%)</td>
<td>16 (15.0%)</td>
<td>45 (10.1%)</td>
</tr>
<tr>
<td>Transpalmar interdigital</td>
<td>0 (0.0%)</td>
<td>7 (2.5%)</td>
<td>1 (0.9%)</td>
<td>8 (1.8%)</td>
</tr>
<tr>
<td>Cross-thumb</td>
<td>1 (1.8%)</td>
<td>2 (0.7%)</td>
<td>1 (0.9%)</td>
<td>4 (0.9%)</td>
</tr>
<tr>
<td>Dynamic bipod</td>
<td>3 (5.5%)</td>
<td>5 (1.1%)</td>
<td>0 (0.0%)</td>
<td>6 (1.3%)</td>
</tr>
<tr>
<td>Static tripod</td>
<td>0 (0.0%)</td>
<td>1 (0.4%)</td>
<td>0 (0.0%)</td>
<td>1 (0.2%)</td>
</tr>
</tbody>
</table>

Note: Group 1 consisted of occupational therapy students; Group 2, voters; and Group 3, medical students.

Does not include Group 1.
(2% of the total group) used a nontripod grasp as described below, and the remainder used a dynamic tripod grasp (see Table 1).

The nontripod grasps used among the total sample of 447 subjects were as follows (Figure 1 illustrates these grasps):

- A transpalmar interdigital grip, in which the pencil is stabilized against the web space between the thumb and index finger and the movement is controlled by the pads of the third and fourth or fourth and fifth digits (Benbow, 1989) was used by 8 subjects. (Seven of these 8 subjects were women who may have been using this grasp as an adaptation to long fingernails.)

- A cross-thumb grasp, in which the fingers are fisted loosely into the palm, the pencil is held against the index finger with the thumb crossed over the pencil toward the index finger, finger and wrist movement is present, and the forearm is positioned on the table (Schneck & Henderson, in press), was used by 4 subjects.

- A dynamic bipod grasp, used by 6 subjects, is similar to a dynamic tripod grasp except that either the index finger is omitted and is held loosely resting on the lateral aspect of the third digit (4 subjects) or the third digit is omitted and is flexed toward the palm (2 subjects).

- A static tripod grasp, in which the finger position is similar to a dynamic tripod grasp except that the hand moves as a unit (Rosenbloom & Horton, 1971), was used by 1 subject.

A three-way analysis of variance with unequal cell numbers (Weinberg & Goldberg, 1979) was used to determine whether the frequency of grasp was significantly different in any of the three groups. No statistical difference was found in the frequencies of five of the six grasps: dynamic tripod ($F = 0.57$, $p > .10$), lateral tripod ($F = 1.87$, $p > .10$), transpalmar interdigital ($F = 1.08$, $p > .10$), cross-thumb ($F = 0.32$, $p > .10$), and static tripod ($F = 0.28$, $p > .10$). The means for these grasps were calculated through the combining of all three sample groups. The incidence of the dynamic bipod differed significantly among the three groups ($F = 4.39$, $p < .05$). Using the Scheffé test (Weinberg & Goldberg, 1979), I determined that the incidence of the dynamic bipod was significantly higher in the occupational therapy student group than in the other two groups ($F = 3.41$, $p < .05$). The mean for this grasp, therefore, reflects data from the voter and medical student groups only. On the basis of these considerations, the following results were obtained: The incidence of the dynamic tripod grasp was 86% ($SD = 2\%$) and of the lateral tripod, 10% ($SD = 1\%$). The incidence of the remaining grasps did not exceed 2% within the total sample (see Table 1).

Discussion

The present study documents that the dynamic tripod is by far the most commonly used grasp (86% of the sample), but many adults (10% of the sample) use the lateral tripod grip for their everyday writing needs. A variety of nontripod grasps were also observed but were used by less than 2% of the total sample. The surprisingly high incidence of use of the lateral tripod grasp among 6-year-olds in the Schneck and Henderson (in press) study appears not to an isolated phenomenon but instead is reflected in the adult population. This finding confirms the possibility of the lateral tripod grasp as a functional alternative to the dynamic tripod grasp. Certainly, the use of the lateral tripod grasp cannot be regarded as a handicap in educational achievement; medical students showed no significant difference in the incidence of this grasp as compared with the other groups. Incidence of the lateral tripod grasp did not seem to be related to the subjects' sex—The predominantly female occupational therapy students (96.5%) and the predominantly male medical students (65%) showed no significant difference in the use of this grasp. The relatively low incidence of other grasps is consistent with Schneck and Henderson's findings. In their findings, however, all 6-year-olds who did not use a dynamic or lateral tripod grasp showed immature grasp patterns, whereas only 26% of the adult nontripod users in the present study demonstrated such grasps. A mature grasp can be differentiated from an immature pattern by dynamic rather than static wrist control, use of the intrinsic as well as the extrinsic hand musculature, and distal finger control of the writing implement. The two most frequent nontripod grasp patterns seen in adults can thus be characterized as mature grasps: the transpalmar interdigital grasp, developed as an adaptation to long fingernails, conceivably after a primary mature grasp had been attained, and the dynamic bipod grasp, representing only a slight variation from the dynamic tripod grasp (interestingly, both of these grasps were seen primarily in women). Immature grasp patterns were used by only 1% of the surveyed adults, which suggests the need for mature grasp development for the production of functional handwriting.

Movement in the lateral tripod grasp is controlled at a point somewhat more proximal than in the dynamic tripod grasp. It is thus possible that this grasp could limit handwriting endurance. In her study showing the lack of influence of grip on legibility, speed, and fatigue, Jaffe (1987) used a relatively short-term writing task (i.e., copying three para-
graphs), thus leaving unanswered the question of long-term endurance. That 10% of nondysfunctional adults use the lateral tripod grasp indicates that this limitation is not significant. Perhaps this more proximal grasp is not as maladaptive as previously indicated by Levine et al. (1980). Because adaptive and maladaptive are relative terms and can be defined only in relation to the needs specified by a cultural and technological setting, the need for handwriting in our current society should be examined. It appears that with the advent of increased oral communication (i.e., use of the telephone versus letter writing), technical writing implements (e.g., typewriters, word processors), and electronic documentation (e.g., audio and video recordings), the need for extensive handwriting is becoming more limited. In many schools, questionnaires and multiple-choice tests are taking the place of essays, and such elements of handwriting as letter formation and line orientation are receiving less emphasis and instructional time (Loikith & Ritter, 1989). Levine et al. described a more proximal grasp as working well for tasks such as circling or filling in blanks but as insufficient for more demanding tasks. For many of today's students, even those in the higher grades (including medical school, as in the present study), much of their written output consists only of circling choices, filling in blanks, and blackening squares on answer sheets.

In summary, writing needs in today's society continue to require speed and legibility, but there seems to be less emphasis on long-term endurance. The dynamic tripod grasp may still be the optimal grasp in many respects, but considering the writing requirements of society, the lateral tripod grasp may have become just as adaptive.

Conclusion

This study showed that nondysfunctional right-handed adults use a variety of pencil grasps other than the dynamic tripod grasp. It is therefore suggested that the concept of correct pencil grasp be expanded to allow for more variations; certainly, the high incidence of the lateral tripod grasp proves its adaptiveness for normal handwriting needs in today's society. Boehme (1988) and Keogh and Sugden (1985) have suggested that the ability to form letters has less to do with the exact prehension pattern used and more with the extent to which the grasp allows for use of the intrinsic hand musculature, smooth coordination of movements, and precision control. The findings presented in this paper support this approach, because 99% of the adults in the sample demonstrated such mature movement control. This study suggests that in facilitating a functional pencil grasp, we should shift our emphasis from the use of a particular prehension pattern to the development of the elements of mature movement control.

Due to its design, the present study could give only limited information on the actual functionality of atypical grasps. An expansion on Jaffe's (1987) research would allow for the more careful study of specific atypical grasps. A direct comparison of writing speed, legibility, and long-term endurance among the dynamic tripod grasp and the various atypical grasp patterns could yield data on the relative effectiveness of these grasps (normal coordination of the subjects could be ascertained with screening tests). The results could also be analyzed to test for any differences in functionality between those grasp patterns that show elements of mature versus immature movement control, as suggested by Benbow (1987). To test the hypothesis of a societal trend toward atypical grasps, one could repeat the described survey at regular intervals (e.g., each election year), which would provide information on changes over time. Information on a possible reduction in the need for handwriting could be gained from a simultaneously distributed questionnaire regarding personal writing habits and preferred mode of communication.

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References


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