A CLASSIFICATION OF MANIPULATIVE HAND MOVEMENTS

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We use our hands to accomplish an enormous range of everyday actions. In reaching for, grasping and using objects, the whole upper limb and trunk are involved, but in many cases where fine manipulation is required it involves movement of an object within the hand itself. Such manipulations thus depend on the organisation and co-ordination of movements of the digits. Little systematic description of patterns of digit co-ordination in dextrous movements has been attempted, despite their likely clinical significance. Separate assessment procedures for such conditions as cerebral palsy (Holt 1965) and rheumatoid arthritis (Dickson and Nicolle 1972) have used whatever descriptions of action were convenient for the particular condition, with a consequent lack of comparability between methods (Elliott 1979).

Landsmeer (1962) drew an important distinction between gripping and handling objects. He considered the power grip as the means by which an object could be immobilised within the hand, *i.e.* gripped, this terminology and usage deriving from Napier (1956). When considering objects held in the fingers and opposed thumb, however, Landsmeer used the term 'precision handling', whereas Napier referred to the 'precision grip'. Landsmeer thus retained Napier's power/precision dichotomy, objecting only to the term 'grip' for the precision configuration. However, while the distinction between gripping and handling is important, it should not be confused with the power/precision dichotomy, since to do so is to confound anatomical and functional descriptions which need to be kept separate. There is a strong case for a functional distinction between digital prehensile patterns and palmar grips, independently of their anatomical character.

If an object is gripped so that it is held immobile in the hand and cannot be moved within the hand by the digits, then it has fewer degrees of freedom of movement. The movement of an object held in this way has to be achieved by moving the hand as a whole, using some combination of wrist, upper limb and trunk. The compensating gain is that greater force can be applied with the object. A suitable grip for immobilising the object (unless it is small) is one in which the object is held in contact with the palm, and this normally means a power grip.

If, alternatively, an object is held in the digits so that it can be manipulated within the hand itself, then the gain is not in precision or delicacy of movement, but rather in variety of movement. This in turn leads to convenience and economy of action, since it is usually an advantage to minimise involvement of the upper limb or

Developmental Medicine & Child Neurology, 1984, 26, 283–296

trunk when moving a prehended object. It would be awkward, for example, if the only way of winding a watch was by rotating the wrist. To some extent digital grips encourage delicacy and precision of movement as a simple consequence of the variety of movement possible, but delicate and precise movements are perfectly possible with power grips, as Napier (1956) recognised. Nor is it the case that digital prehensile patterns are inevitably precision configurations in the anatomical sense. Studies on the development of hand function suggest that during the first five years or so there is a considerable improvement in the ability to manipulate objects, using prehensile patterns which do not fall clearly into a power grip/precision handling dichotomy, where the latter refers to an opposed thumb with digital manipulation (Connolly and Elliott 1972, Connolly 1973, Moss and Hogg 1981). In this paper also, manipulative patterns are described which do not meet the anatomical criteria of precision, but which nonetheless are digital patterns.

Palmar grips immobilise objects in the hand by maintaining them in contact with the palm, and are usually power grips. Digital manipulative patterns entail independently co-ordinated digit movements intended to move objects within the hand at the expense of some reduction in stability and power. The anatomical relationships displayed in such a case may be quite varied. They do not all fall into the category of precision handling, anatomically defined, and they do not necessarily offer greater functional precision.

Classification of movement patterns

The importance of digital manipulative patterns was noted by Elliott (1979) in the context of a distinction between intrinsic and extrinsic movements of the hand. Intrinsic movements are defined as co-ordinated movements of the digits to manipulate an object within the hand*. They are contrasted with extrinsic movements, defined as movements of a prehended object by displacement of the hand as a whole, using the upper limb.

At first glance the hand displays a bewildering variety of intrinsic manipulative movements. However, we believe that these can be reduced to three basic classes, which we call *simple synergies, reciprocal synergies* and *sequential patterns.* Within each of these classes a range of movement patterns may be described. In forming these three classes we have not included flexor/extensor movements of individual digits, as used, for example, in keyboard skills such as piano playing and typing, or in certain grooming movements. Nor have we considered unique patterns devised *ad hoc*, or systematically taught, to accomplish particular tasks. What we have sought are descriptions of all the common intrinsic manipulative patterns shown by normal individuals.

The three classes are derived as follows. Most kinds of intrinsic movement involve a single co-ordinated pattern of digit movements. The movements may be reversed, as in screwing *vs* unscrewing with thumb and fingers, but they involve the simultaneous use of the digits in a single pattern. However, some other patterns entail the independent co-ordination of digits in a characteristic sequence. Some digits support the object while others are repositioned: these then move the object on, in turn supporting while the previous supports are themselves repositioned, and so on. This results in a characteristic discontinuous motion of the object. A distinction between simultaneous and sequential movement patterns is therefore established and used to distinguish the two synergy classes from sequential patterns.

Within the simultaneous patterns, simple and reciprocal synergies are distinguished. Simple synergies are defined as those in which all movements of the participating digits, including the thumb, are convergent flexor synergies. There may be an alternation of flexor and extensor synergies, as in repeatedly squeezing a rubber bulb, but in either case the movements of all the digits are the same. Reciprocal synergies, by contrast, involve combinations of movements in which the thumb and the other participating digits show dissimilar or reciprocating movements, such as flexion of the fingers with adduction or extension of the thumb. The justification for distinguishing these two classes of synergy is

*Intrinsic movements are not defined as movements made with the intrinsic muscles of the hand, though these are often involved.

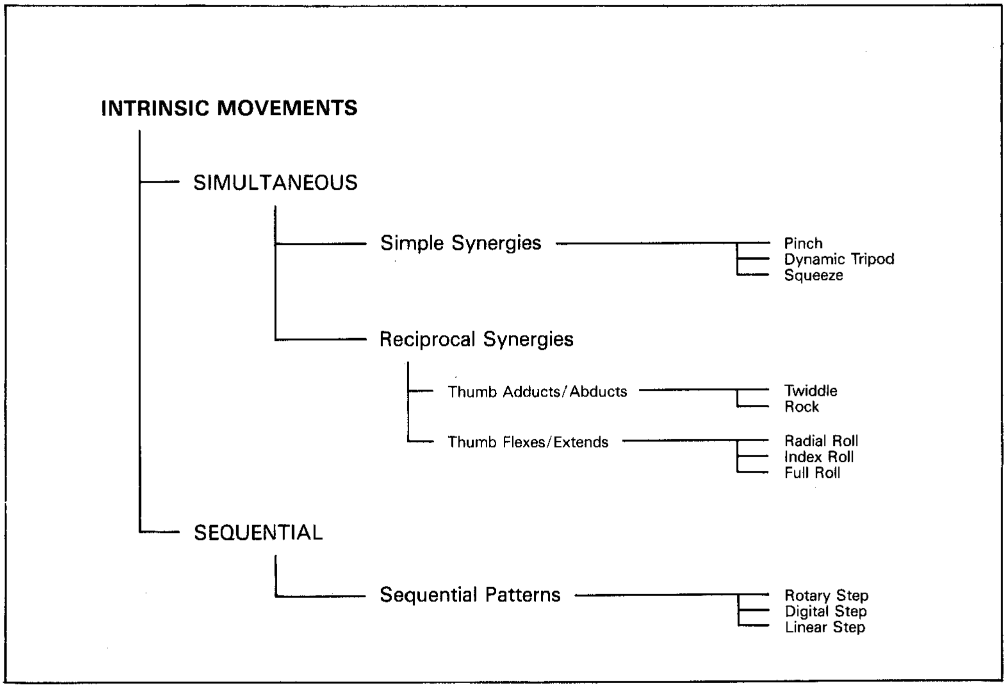

Fig. 1. Classification of intrinsic hand movements.

that only in the case of reciprocal synergies is the thumb's capacity for movement independent of the fingers used in the manipulation of objects. A high proportion of intrinsic movements appear to fall into this category.

Our observations indicate that although in many patterns of intrinsic movement the thumb shows some proportion of both adduction/abduction and flexion/extension, one or other of these types of movement predominates in any given pattern. A subdivision of reciprocal synergies therefore is made into those involving principally thumb adduction and abduction, and those involving principally thumb flexion and extension, though we recognise that this distinction is one of degree and is not absolute. Circumduction of the thumb, for example, involves both types of thumb movement in succession. However, the distinction is usually practicable, and the patterns so distinguished plainly different.

Under each of the three classes of intrinsic movement described above, a number of separate patterns may be listed. They are distinguished mainly by the number of digits involved, and are described in the following section. The classification is shown in Figure 1.

Individual patterns of intrinsic movement

Certain conventions of terminology have been adopted in describing the individual patterns of movement listed in Figure 1. The digits are identified as thumb, index, and digits 3, 4 and 5. Naming the thumb and index reflects their particular functional importance in many patterns.

In synergistic movements of the fingers, adduction and abduction are conventionally defined relative to the neutral digit 3. However, individual fingers, including digit 3, are capable of independent radial or ulnar deviation. These latter terms therefore are used to refer to movements of the fingers in the plane of the palm, except where a synergistic adduction or abduction of all fingers is involved (Fig. 2). The conventional definitions of abduction and adduction in the thumb are retained, and it is accepted that thumb abduction necessarily entails rotation.

Some intrinsic movements impart a rotary motion to an object, others a linear one. It is useful to describe the characteristic axis about which or along

Developmental Medicine & Child Neurology, 1984, 26, 283–296

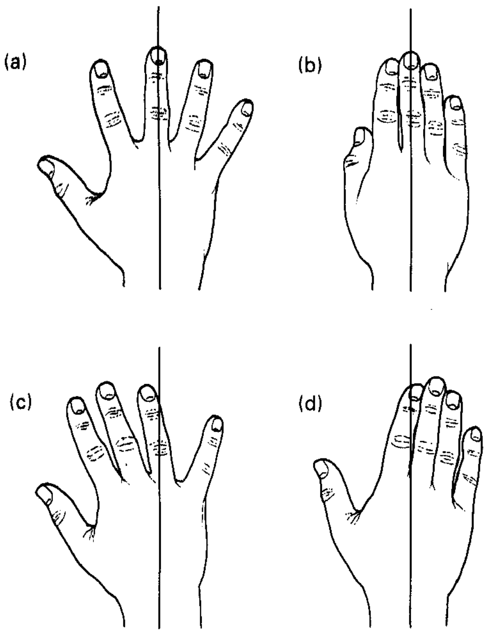

Fig. 2. Dorsal view of right hand. (a) *Abduction of fingers and extension of thumb.* (b) *Adduction of fingers and partial flexion of thumb.* (c) *Radial deviation of fingers and extension of thumb. It should be noted that some individuals cannot easily radially deviate digit 5.* (d) *Ulnar deviation of fingers and extension of thumb.*

which such movements are made. There are three principal axes, running distal-proximal, ventro-dorsal and radio-ulnar (Fig. 3a). An axis intermediate to these may be described by a compound name, *e.g.* distal-ventral refers to the axis running obliquely downward and forward from the dorsum of the hand (Fig. 3b).

Detailed descriptions of individual patterns of intrinsic movement are given below, following their grouping under the basic classes shown in Figure 1. The descriptions are derived from observations and video recordings made on a number of adults and some children. The activities involved included a range of natural and contrived manipulative tasks.

Simple synergies

Pinch

The object, typically small, is held between the pulp surfaces of the opposed thumb and index finger (Fig. 4). Concurrent flexion of these digits moves the object towards the radial hand, concurrent extension moves it away. The pinch is used in tasks such as removing splinters or manipulating thread. It is often combined with extrinsic movement of the whole hand.

Dynamic Tripod

This pattern has been described by Rosenbloom and Horton (1971), and is typically seen in using a pen (Fig. 5). The pen is grasped between the radial distal surface of digit 3 and the pulp surfaces of the thumb and index. The latter is somewhat less flexed than the other fingers, which tend to be in the neutral position. The thumb is relatively fully opposed.

Simultaneous flexion or extension of the radial digits, especially at the interphalangeal joints, results in movement of the pen in a proximal-distal axis. Although this basic pattern may be supplemented by a certain amount of lateral deviation of the fingers, giving a component of movement in the radio-ulnar axis, the principal movement is a simple flexor or extensor synergy. When used in writing, this creates

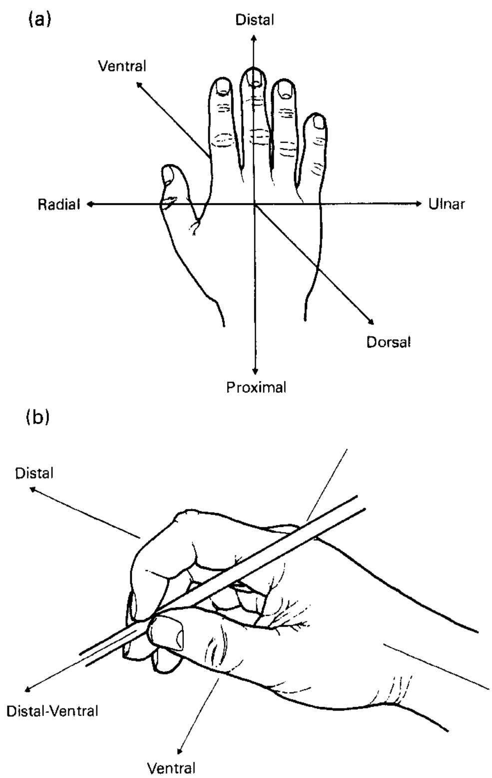

Fig. 3. System of reference axes for hand: (a) *three orthogonal axes,* (b) *intermediate axis.*

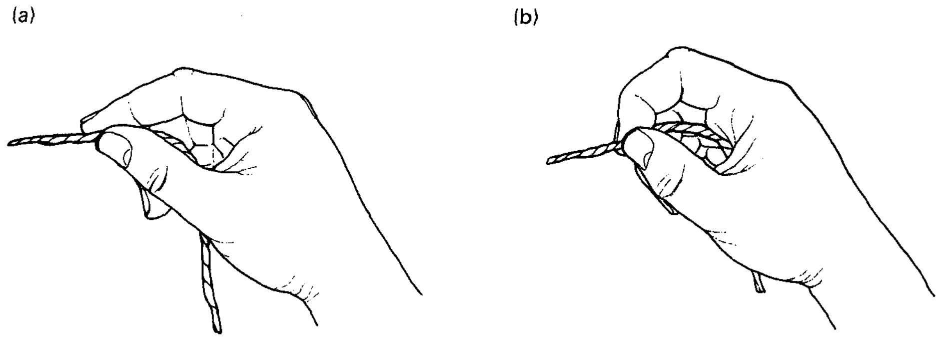

Fig. 4. Pinch: (a) *thumb and index extended,* (b) *thumb and index flexed. These represent terminal positions for digits when executing this pattern of movement.*

vertical elongation of letters. The sequence of letters themselves, and to some extent the horizontal component in their formation, are the result of actions of the wrist. This further illustrates the combination of intrinsic and extrinsic movements in dextrous actions.

Squeeze

With the thumb opposed and all the digits relatively extended, the object is squeezed by synergistic flexion of the digits. A simple example is squeezing a rubber bulb. The size of the object determines how many digits are involved, and its shape affects both their number and disposition. For example, the use of a syringe by means of the thumb and the two radial digits provides an instance of the application of the pattern by a restricted set of digits in a characteristic disposition, dictated by the shape of the object and the required movement (Fig. 6).

Reciprocal synergies: (A) patterns with thumb principally moving in abduction/adduction

Twiddle

This pattern is used to roll small objects to and fro between thumb and index finger (Fig. 7). The digits may be flexed or extended slightly from the neutral position, but generally they are close to it. The axis of rotation is roughly distal-ventral but may vary a good deal. The pattern of movement consists of abduction of the thumb, combined with metacarpo-phalangeal extension and some ulnar deviation of the index. The reverse combination

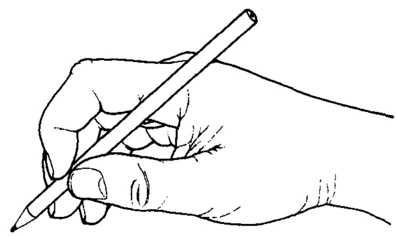

Fig. 5. Dynamic tripod: small, simultaneous flexion and extension movements of thumb, index and digit 3 manipulate pen.

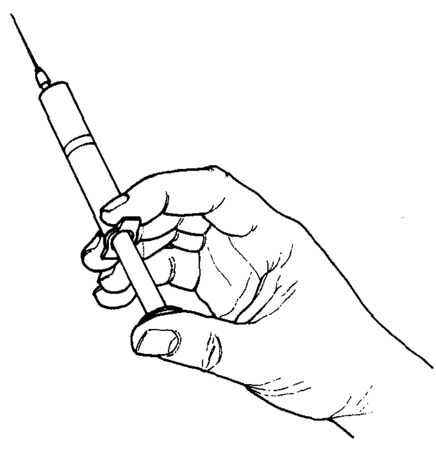

Fig. 6. Squeeze: precise configuration of fingers is determined by shape of syringe. Simultaneous flexion of thumb, index and digit 3 will drive plunger into barrel.

Developmental Medicine & Child Neurology, 1984, 26, 283–296

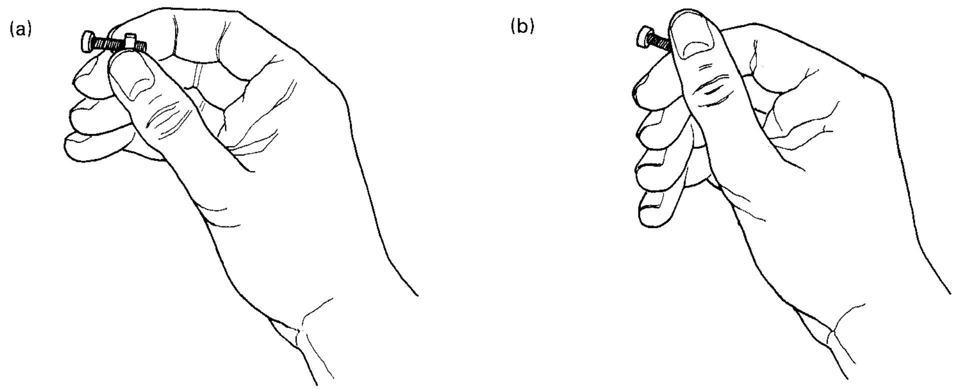

Fig. 7. Twiddle: (a) *thumb in full abduction,* (b) *thumb in partial adduction, with concurrent index flexion. Extent of thumb adduction is quite variable, depending on extent of movement required in alternating between postures illustrated.*

(adduction with index flexion and some radial deviation) occurs alternately, resulting in the reversing rotary movement of the object characteristic of this pattern.

The pattern is used when objects are being manipulated at the distal tip of the index finger and a typical use is to screw or unscrew a small freely-turning nut. If the object is rolled around to the radial aspect of the index finger, the deviation component of index movement is lost.

We have the strong impression that use of the radial aspect of the index in twiddle confers a greater potential power to the movement, and also a more stable hold upon the object before or after movement. It is possible to demonstrate a shift to a more radial use by requiring a subject to tighten progressively stiffer nuts.

Rock

With large objects the pattern described under Twiddle above is executed with the thumb fully opposed, and with increasing recruitment of the ulnar digits, moving in synchrony with the index but having a greater excursion (Fig. 8). The pattern can be seen when a coin is turned to read the lettering running around the face, or in screwing a freely moving screw-top lid.

A version of Rock occurs when a thin object is held transversely in the digits and rocked (Fig. 9). In this case the thumb and third digit tend to be almost stationary, and flexion of the ulnar digits is accompanied by extension of the index. Although this appears to be a rather different movement pattern, the extension of the index is in fact passive, caused mechanically because the radial end of the object has to rise as a result of depression of the ulnar end. The basic pattern is still Rock, as can be demonstrated by the use of a graded series of progressively thicker objects, such as a pencil, a matchbox and a cup.

Reciprocal synergies: (B) patterns with thumb principally moving in flexion/extension

Radial Roll

With the thumb in relatively slight opposition, the object is rolled between the ball of the thumb and the radial surface of the distal phalanx of the index finger (Fig. 10). The action is typically employed on small objects, and the axis of rotation is ventral. During movement, slight inter-phalangeal extension of the thumb is combined with flexion of the index finger, principally at the metacarpo-phalangeal and first inter-phalangeal joint. Digits 3 to 5, though not in contact with the object, may move in synchrony with it.

The reverse pattern, slight thumb flexion and index-finger extension, occurs alternately, thus giving an over-all rotary movement to the object. Movement of the index finger is typically more extensive than movement of the thumb, which may be almost immobile. This is the reverse pattern from Twiddle, in which the thumb tends to move more extensively against

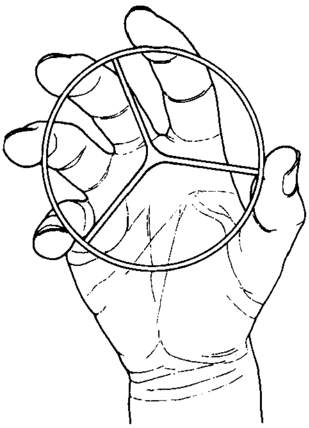

Fig. 8. Rock: illustrated in ventral view with a petri dish. (a) *Thumb in partial abduction,* (b) *thumb in partial adduction.*

Developmental Medicine & Child Neurology, 1984, 26, 283–296

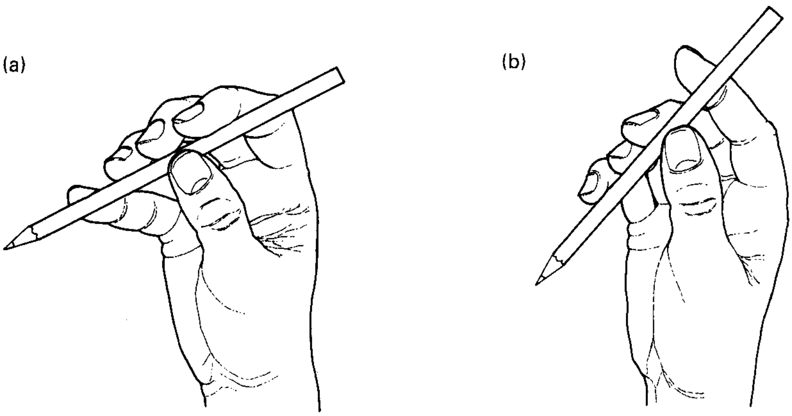

Fig. 9. Rock: illustrated with pencil held transversely, in radio-ulnar axis. Movements of thumb and digit 3 are much reduced compared with movements of other digits. (a) *Ulnar digits relatively extended,* (b) *ulnar digits relatively flexed.*

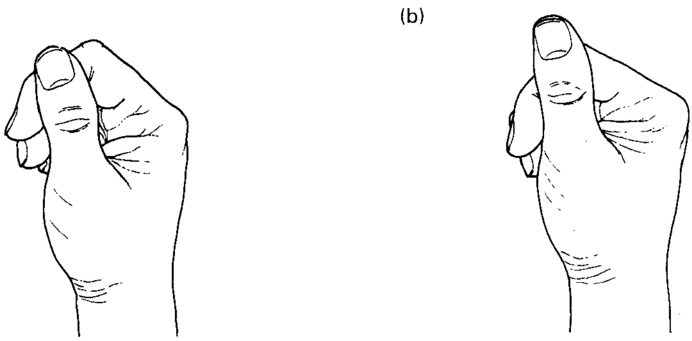

Fig. 10. Radial Roll. In this example the thumb is adducted throughout; in other instances it may be partially abducted, consequently operating radial index more distally. (a) *Index less flexed,* (b) *index more flexed.*

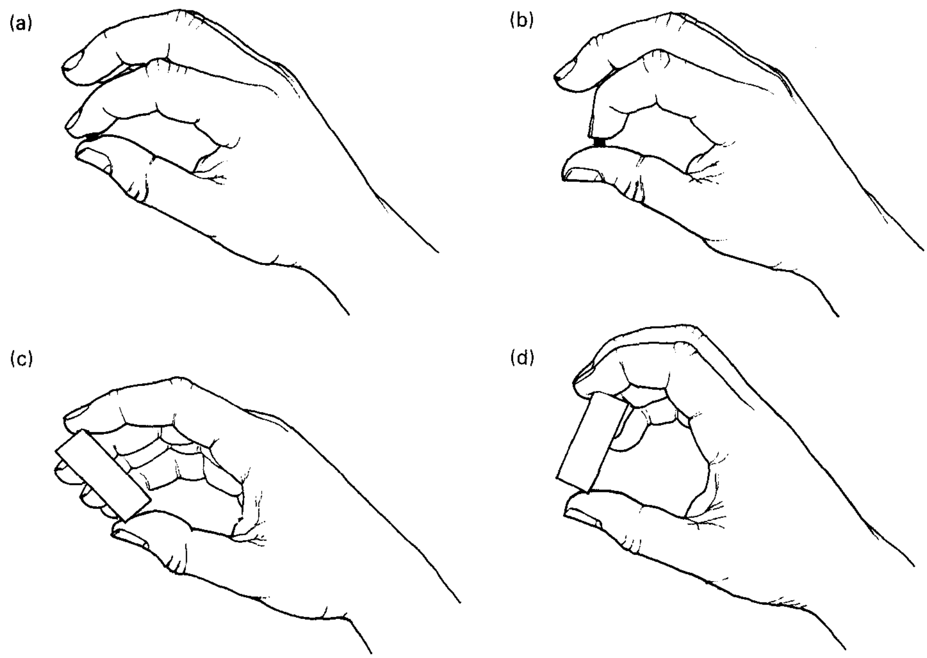

Fig. 11. Index Roll (a,b), *showing slight reciprocal flexion of thumb and extension of index* (a), *and the reverse* (b). *Full roll* (c,d), *as for index roll, but with involvement of additional digits. The object rocks about the radio-ulnar axis as result of movement between positions illustrated.*

an index finger which may be almost stationary. Radial Roll is used in winding a watch.

Index Roll

With the thumb in full opposition, the object is rolled between the pulp surfaces of the thumb and the index finger (Fig. 11a,b). The axis of rotation is radio-ulnar. The movement grades readily into Radial Roll if the object is moved around to the radial aspect of the index. As in Radial Roll, the object is usually very small. During movement, inter-phalangeal and metacarpo-phalangeal extension and flexion of the thumb are combined with predominantly inter-phalangeal flexion and extension of the index finger, respectively. These alternating movements impart, as in other roll patterns, a rotary movement of the object. A combination of Index Roll and Twiddle (which may amount to circumduction) is almost always found in fine manipulations in which a small object has to be turned about between thumb and index finger, and can usually be elicited by a request to make a tiny pellet of plasticine into a ball between these two digits.

Full Roll

The pattern is similar to Index Roll, but using additional digits, often all five (Fig. 11c,d). The axis of rotation is radio-ulnar. Flexion and extension of the thumb are mainly inter-phalangeal. In the use of the fingers, both the inter-phalangeal and metacarpo-phalangeal joints tend to be involved, the latter more so if the extent of movement is greater.

Sequential patterns

Rotary Step

This pattern entails an intermittent rotary movement of an object in the distal-ventral axis (Fig. 12). The object is stepped around, with brief pauses while the position of the digits is readjusted, using a sequential or phased set of movements. For rotation in a dorsal to radial direction, these movements are as follows. Thumb:- abduction (in contact with the object), then a repositioning sequence of extension, adduction and flexion. Index finger:- radial deviation and some inter-phalangeal flexion (in contact with the object), then to reposition, extension with ulnar deviation followed by flexion. Ulnar digits:- extension and some radial deviation (in contact with

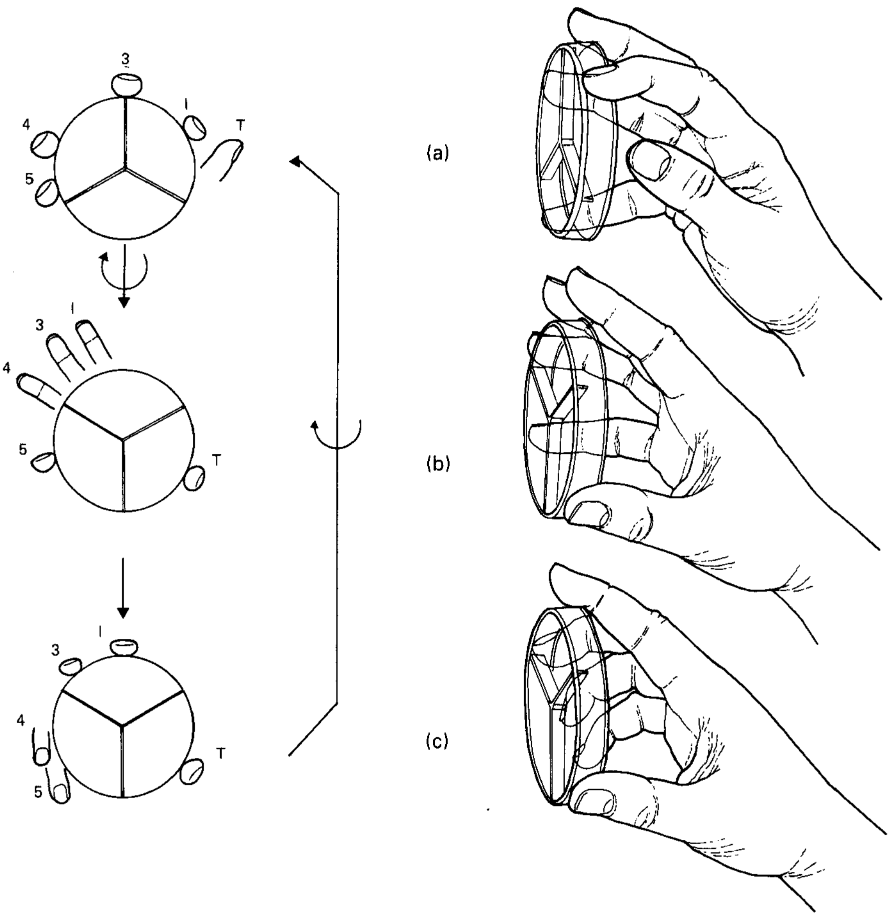

Fig. 12. Rotary Step. A schematic representation of positions in which the digits are placed (left), *and successive postures of the hand* (right). *Sequence* (a-b-c-a) *shows successive phases in clockwise rotation totalling approximately 120° of object rotation. This occurs between transitions* a-b *and* c-a, *as indicated by the rotary arrows.*

the object), then to reposition, ulnar deviation followed by flexion, especially at the metacarpo-phalangeal joint. At any one time, two of these three digit groupings are in contact with the object and moving it around, while the other is repositioning and thus not in contact. The order in which the groups release and reposition is ulnar digits/thumb/index finger.

If the direction of rotation is radial to dorsal, the sequence of movements is as follows. Thumb:- adduction (in contact with the object), then to reposition, abduction with the minimum extension and flexion needed to keep the thumb clear of the object. In this regard the repositioning sequence differs from that in the reverse movement (see above), when the thumb is moved well clear of the object. Index finger:- metacarpo-phalangeal and inter-phalangeal extension with ulnar deviation (in contact with the object), then to reposition, extension of all joints with radial deviation and then flexion. The degree of inter-phalangeal flexion is apt to be greater than in the reverse movements described above. Ulnar digits:- flexion and ulnar deviation (in contact with the object), then to reposition, extension of all joints with radial deviation, then flexion, especially at the metacarpo-phalangeal joint. As with the reverse movement, at any one time two of these three digit groupings are in contact with and moving the object, while the third is repositioning free of contact.

Developmental Medicine & Child Neurology, 1984, 26, 283–296

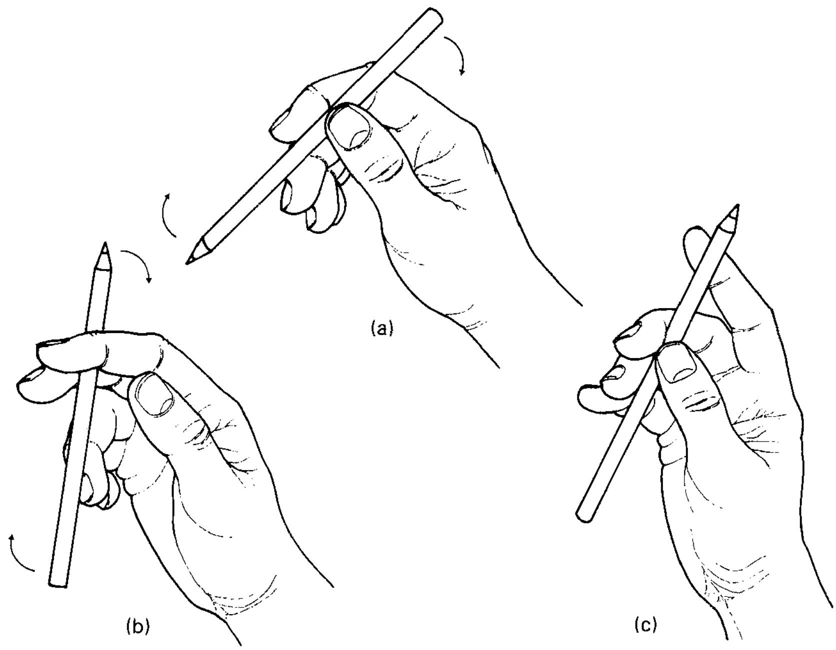

Fig. 13. Interdigital Step: from (a) *to* (b) *the object is rotated by extension of ulnar digits, especially digit 3. Flexed thumb passes under rotating object to assume its position at* (b). *From* (b) *to* (c), *thumb and ulnar digits flex to grasp object and index extends and may lose contact with it. From* (c) *to* (a), *index flexes to preserve position of object against thumb, while ulnar digits flex to reposition below object in readiness for next cycle.*

In either direction of movement, the ulnar digits 4 and 5 move together, with slightly greater movement of the 5th by virtue of its smaller size, but subject to irregularities of the object itself. Digit 3 tends to be neutral and may move with the index finger, but if so the movement tends to be less extensive. This sequence of movements is found in actions such as turning an object completely over in the hand.

Interdigital Step
The Step combination may be applied to long, thin objects (Fig. 13). The dorsal and radial surfaces of the distal ulnar-digit phalanges are applied to the object and the ulnar as well as ventral surfaces of the distal index phalanx are used. With this combination the third digit tends to move with the ulnar digits and little radial or ulnar deviation of the fingers is observed. Movements of this kind may be used to turn a pen end over end.

Linear Step
The Step combination can be adapted to give a linear movement of an object in a radial-ventral axis (Fig. 14). In this case deviation of the fingers is prominent and the third digit moves with digits 4 and 5. The digits are not free of the object in the repositioning sequence, but slide along it.

These three step patterns are not common, and may seem clumsy or elaborate, but they do occur, and the nature of the movement phasing is very characteristic. Natural examples are hard to find, but in contrived situations the same characteristic pattern appears in different individuals, suggesting that it reflects a natural organisation of movement, and not a completely artificial and *ad hoc* one.

Palmar combinations
Tasks for which intrinsic movements are used may also need the manipulated object to be held firmly in the hand while a part of it is manipulated. In such cases an immobilising palmar grip is used, in combination with the intrinsic pattern. Typical tasks are tying knots in string or squeezing toothpaste from a tube. The

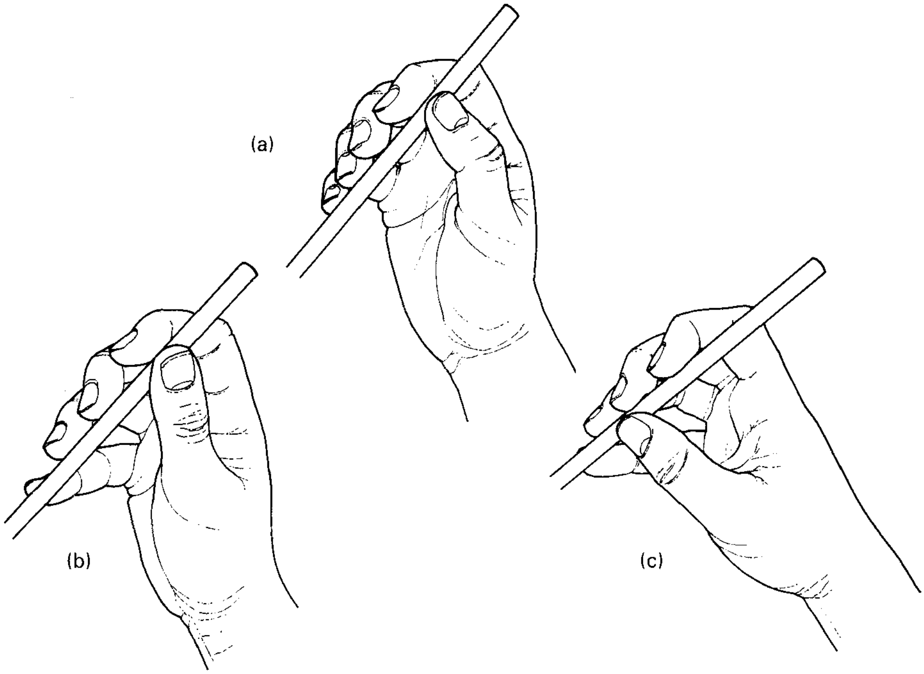

Fig. 14. Linear Step: from (a) *to* (b), *ulnar digits extend inter-phalangeally, but flex at carpo-metacarpal joints, sliding along object. From* (b) *to* (c), *thumb abducts to oppose ulnar digits. From* (c) *to* (a), *index flexes to restore initial posture.*

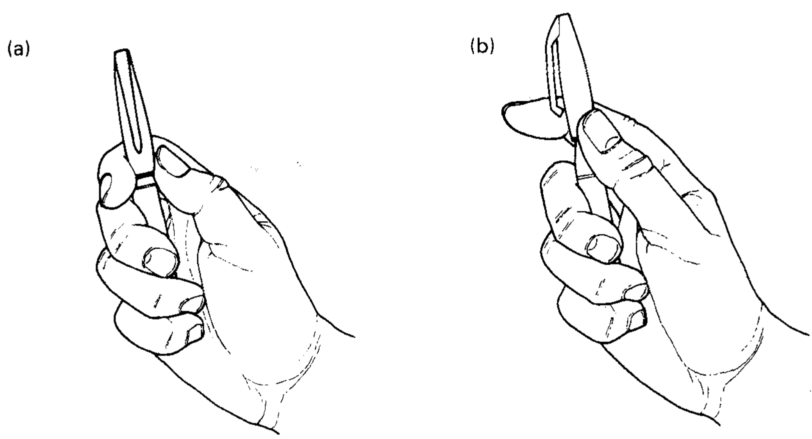

Fig. 15. Palmar Slide: the movement, illustrated in change from (a) *to* (b), *involves extension of thumb and radial deviation of index, with some extension.*

Developmental Medicine & Child Neurology, 1984, 26, 283–296

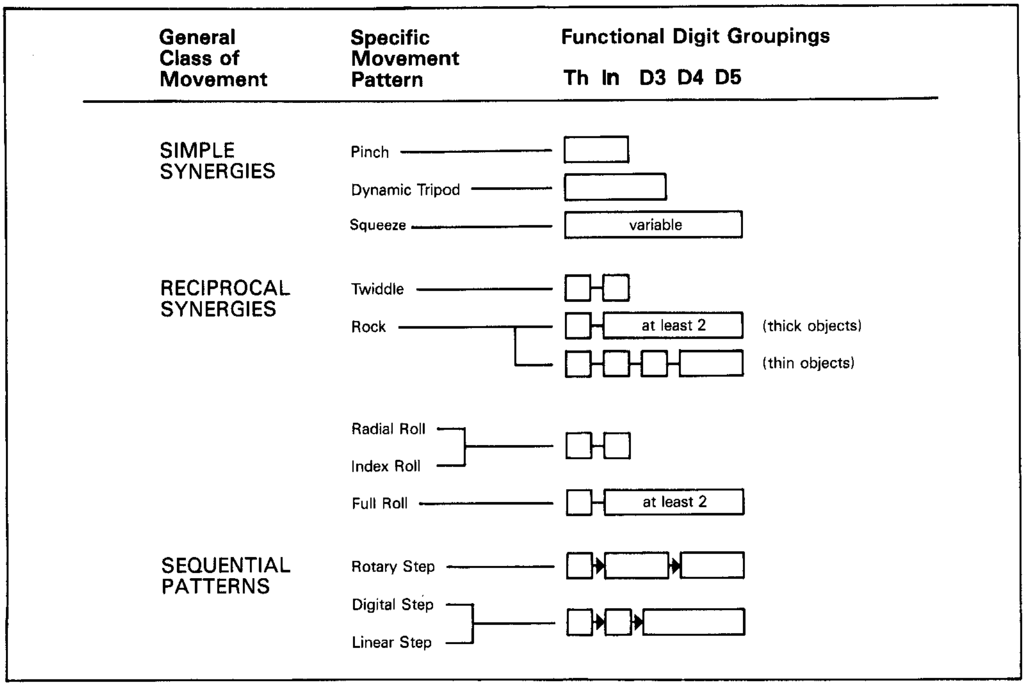

Fig. 16. *Digits employed in specific movement patterns and their functional groupings. Each box represents one or more digits; if more than one they move together in same way. Linking boxes by simple lines indicates reciprocal action between groups defined by boxes; linking by arrows represents sequential action.*

radial two or three digits provide the intrinsic movement in such cases, and the ulnar digits the grip. Occasionally a single radial digit is used to manipulate a firmly-held object, for example the use of the thumb to strike a cigarette lighter. In such cases we refer to the 'solo' use of the digit concerned; this entails a palmar grip in which the designated digit is employed, hence solo thumb, solo index.

Apart from these solo configurations, we have found only one other pattern of intrinsic palmar combination which is not covered by the patterns already described.

Palmar Slide

The palmar element of immobilisation is combined with a manipulative movement of index finger and thumb, designed to move the radial part of the prehended object in a radial direction (Fig. 15). The object is held between the radio-ventral aspect of the index and the ball of the thumb, both of these digits being flexed and adducted, the index finger especially. Extension of the thumb and radial deviation of the index finger are then applied to the object and result in movement in a radial-distal axis. This movement, which is axial rather than rotary, is seen in the removing of a pen cap or in other tasks in which small parts are to be separated using only one hand.

Discussion

This paper offers a classification of the patterns of hand movement employed in the dextrous manipulation of objects. Three classes of intrinsic movement are distinguished. It is instructive to compare these classes in terms of the number and groupings of digits used for each. The difference between the patterns within a class, described in the previous section, relates primarily to the recruitment of additional digits to the basic pattern. Such recruitment brings with it changes in the details of the patterns, arising from the fact that movement in the ulnar digits tends to be more extensive than the corresponding movement in the radial digits. Moreover, the index finger may be moved separately from the other digits, or with only the third digit. Functionally, the digits can be thought of as acting in separate groups. These groups are the thumb, the index finger, ulnar digits 4 and 5, and the axial or neutral digit 3, which sometimes may act with the index finger and sometimes with the ulnar digits. On occasion it is almost stationary. This separation of groups is most clearly seen in the Step patterns described above. Figure 16 sets out the patterns in terms of the groupings of digits involved. The centre column of the figure corresponds to the right-hand side of Figure 1.

Whilst idiosyncratic patterns may occur occasionally, we consider that the movements described here are carried out more or less spontaneously and automatically, and so comprise a family of naturally developed patterns. To what extent a child has to train his hand to do what is natural for an adult is an open question. However, it is noticeable that the training of manual actions is usually a major concern only of teachers of the handicapped (*e.g.* Hogg 1981), or of those concerned with special skills such as playing musical instruments. Parents usually do not concern themselves with teaching their infants to pick up and manipulate objects; the child begins to do this naturally, and practice serves to improve performance. A concern with messy eating-habits or clumsiness seldom extends to the control of the actual movements used; usually attention is directed to the goals of action rather than the means.

The classification should be of value in providing a means of describing the dynamic actions of the hand in manipulating objects. As such, it offers a way of identifying and systematically describing deficits in hand function, whether congenital or acquired. It should also aid in the study of variations in the way in which the hand is used, both between individuals and by the same person on different occasions. Since the movements of the various digits are described for each pattern, it should be possible to predict the consequences of constraints on movement following injury, disease or surgical intervention. These will affect an individual's ability to produce a given pattern. This in turn should permit predictions about the capacity to perform various manual tasks. It has been stated that in the surgical reconstruction of the hand every effort must be made to retain the thumb, even if not mobile. Apley (1977) puts it thus: 'In the thumb every millimetre is worth preserving; even a stiff or deformed thumb is worth keeping' (p. 187). This appreciation of the thumb's importance could be made more explicit and precise by using the classification offered here.

A further use of the classification will be in investigating the development of hand function. It is clear from existing studies (Connolly and Elliott 1972, Connolly 1973) that the prehensile patterns of infants and young children are very variable. An understanding of how the typical adult range emerges requires a scheme in which to describe and catalogue the changes that occur.

In considering the actions of the hand, we have focused on movement, and specifically on intrinsic movements. In reducing the seemingly endless variety to three classes, we are aware that other factors also influence the way in which the hand is used. The force required to perform an action, the size and shape of objects and the speed of movements may have effects on the manipulative pattern. The extent of any such effects remains for investigation, but we think it unlikely that any new modes of movement or organisation of the digits will be found, except perhaps in the most extreme and unusual cases.

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SUMMARY
The nature of manual manipulation of objects is discussed. It is argued that a functional distinction should be made between palmar grips which immobilise an object in the hand, and digital patterns which permit manipulation. Such a distinction is separate from any anatomically defined power and precision

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configurations. Manipulative hand movements may be grouped into three classes, based on differences between sequenced patterns of movement and synergies, the latter being further subdivided into simple and reciprocal patterns. Within each of the three classes, a number of individual movement patterns are described. These differ mainly in the number of digits involved and the way in which the thumb is employed. The classification is concerned with movements of the digits directed at manipulating an object within the hand. It is not concerned with movements of the hand as a whole, using the wrist or more proximal joints, while holding an immobilised object.

RÉSUMÉ

Une classification des mouvements de main manipulatifs

La nature de la manipulation manuelle des objets est discutée. Les auteurs demandent une distinction fonctionnelle entre la pince palmaire qui immobilise un objet dans la main et les actions digitales qui permettent une manipulation. Une telle distinction est indépendante de n'importe quelle configuration anatomiquement définie assurant force et précision. Les mouvements manipulatifs de main peuvent être groupés en trois classes basés sur des différences entre les groupements successifs de mouvements et les synergies, ces dernières étant elles-mêmes subdivisées en groupements simples et réciproques. Un certain nombre de groupements individuels de mouvements sont décrits dans chacune des trois classes. Celles-ci different principalement dans le nombre des doigts impliqués et dans la façon dont le pouce est utilisé. La classification se rapporte aux mouvements des doigts dirigés vers une manipulation d'objets dans la main. Elle ne concerne pas les mouvements de la main prise comme un tout, utilisant le poignet ou des articulations plus proximales et tenant un objet immobilisé.

ZUSAMMENFASSUNG

Klassifizierung der manipulativen Handbewegungen

Es wird über die manuelle Manipulation von Gegenständen diskutiert. Die Autoren sind der Meinung, daβ zwischen dem palmaren Greifen, wobei der Gegenstand in der Hand immobilisiert wird, und den digitalen Mustern, die eine Manipulation erlauben, ein funktioneller Unterschied gemacht werden sollte. Diese Unterscheidung hat nichts mit einer anatomisch definierten Kraft oder Präzisionsstruktur zu tun. Manipulative Handbewegungen können in drei Gruppen eingeteilt werden basierend auf Unterschieden zwischen Sequenzmustern von Bewegung und Synergismen, wobei letztere noch in einfache und reziproke Muster unterteilt werden. Bei jeder der drei Gruppen werden mehrere individuelle Bewegungsmuster beschrieben. Diese unterscheiden sich hauptsächlich durch die Anzahl der beteiligten Finger und die Art, wie der Daumen eingesetzt wird. Die Einteilung berücksichtigt Fingerbewegungen, die darauf ausgerichtet sind, einen Gegenstand in der Hand zu manipulieren. Sie befaβt sich nicht mit Bewegungen der ganzen Hand beim Halten eines Gegenstandes unter Einbeziehung des Handgelenkes oder proximaler Gelenke.

RESUMEN

Classificación de los movimientos manipulativos de la mano

Se discute la naturaleza de la manipulación manual de objetos. Se arguye que debe hacerse una distinción entre la prensión palmar que inmoviliza un objeto en la mano y los movimientos digitales que permiten la manipulación. Esta distinción es aparte de cualquier configuración anatómicamente definida de fuerza y precisión. Los movimientos manuales manipulativos pueden agruparse en tres clases basadas en diferencias entre esquemas secuenciales de movimientos y sinergias, estas últimas subdivididas en esquemas simples y recíprocos. En cada una de estas tres clases se describe un número de esquemas de movimientos individuales. Estos difieren especialmente en el número de dedos involucrados y en la manera como es usado el pulgar. La clasificación está en relación con los movimientos de los dedos dirigidos hacia la manipulación de un objeto dentro de la mano. No está en relación con los movimientos de la mano en conjunto, utilizando la muñeca o las articulaciones más proximas, cuando se mantiene en la mano un objeto inmobilizado.

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