The Prehensile Movements of the Human Hand

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85.1 Author

Napier JR.

85.2 Reference

J Bone Joint Surg Br. 1956;38:902–913.

85.3 Institution

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85.4 Abstract

Napier's classic paper points out that the nature of the intended activity finally influences the pattern of the grip. He distinguishes between the 'precision grip' and the 'power grip' and states that these patterns, 'either separately or in combination, provide the anatomical basis for all prehensile activities, whether skilled or unskilled'.

This paper reviewed the movements of the hand as a whole dividing hand movements into prehensile and non-prehensile.

The limitations of the classification systems of hand function at that time are discussed. A system is proposed to divide the prehensile movements into precision grip and power grip, and a detailed description of the functional anatomy of each is given.

85.5 Summary

John Napier published this classic paper in 1956 addressing the question "what is a scientific terminology for describing the movements and functions of the hand as a whole?"

Napier argued that Slocum and Pratt's postures (grasp, pinch, hook) were not clearly defined nor comprehensive, and that a classification was needed that was based on both a functional and anatomical description [1]. Napier made the following key points

1. Influences on the posture chosen for the grasp come from multiple sources. These include object shape, size, weight, surface characteristics (texture, temperature, and dryness), and human motivations (fear, hunger, etc.). He stressed, however, that the most important influence on the chosen posture is the goal of the task i.e., the intended activity.
2. He described prehension as the 'application of a system of forces in a given direction', and argued that prehensile tasks can be resolved into power and precision requirements (with one fundamental requirement being a secure grasp). Power requirements relate to the ability to apply forces and resist arbitrary forces that may be applied to the object; precision requirements involve small adjustments of posture in order to control the direction in which force is being applied.
3. Napier's insight was to suggest that the power and precision requirements of tasks could be met by the power and

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precision capabilities of the human hand. The power requirements of a task could be met by the hand's ability to oppose arbitrary forces, especially when the thumb is used to reinforce the action of the fingers. Meeting the precision requirements of a task could be accomplished by placing the skin receptors in contact with the object, providing the nervous system with cutaneous information for making the fine adjustments

85.6 Citation Count

472

85.7 Related References

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85.8 Key Message

Napier identified two discrete patterns of prehensile movements, the power grip and the precision grip, distinguished by the relative thumb position and palm involvement. In the power grip the flexed fingers hold the object against the palm with the thumb adducted. The precision grip holds the object away from the palm using the volar aspect of the fingers and the opposed thumb.

Prehensile movements of the hand can be divided into power and precision grip, and that most functions are a combination of the two. It is mainly the nature of the intended activity that influences grip pattern – the size and shape of the object merely fine-tunes the chosen pattern.

85.9 Why Is It Important

The prehensile movements of the hand as a whole are analysed from both an anatomical and a functional viewpoint. It was shown that movements of the hand consist of two basic patterns of movements which are termed precision grip and power grip. In precision grip the object is pinched between the flexor aspects of the fingers and that of the opposing thumb. The position of the thumb in precision grip allows maximum sensory advantage. In power grip the object is held as in a clamp between the flexed fingers and the palm, counter pressure being applied by the thumb lying more or less in the plane of the palm. These two patterns appear to cover the whole range of prehensile activity of the human hand.

85.10 Strengths

It unifies and simplifies a number of previous attempts at classifying the complex topic of prehensile movements.

85.11 Weaknesses

This is a rather subjective topic and is probably ultimately a matter of opinion.

Although thought to be a classic description of hand function, Napier's description did not directly address the dynamic relationship of object and movement. Landsmeer [2] discussed this point and suggested adding a dynamic perspective by changing the term precision grip to precision handling. Precision handling involves no forceful gripping of an object and is a dynamic process without a static phase

85.12 Relevance

Prehension is the ability to grasp or hold, and is fundamental to the understanding of human evolution. Napier was an anatomist and studied grip looking at the thumb and finger movements separately. He noticed during activity the thumb at the MCP and CMC joints is either abducted (precision grip), or adducted (power grip).

It has been proposed using palaeoanthropological evidence that a group of chimpanzee-like apes may have developed into the Hominid line by the advantages given from improved throwing and clubbing [3]. This may provide an evolutionary explanation for Napier's division of prehensile grip into precision (throwing) and power (clubbing).

Napier looked at the various types of grip and in particular the hook grip, in which the thumb has little involvement. He noted that in the normal hand it is rarely used, but in a hand disabled by paralysis of the intrinsic muscles it is the only form of prehensile grip possible.

More recently the importance of the 'dart throwing motion' describing the movement of the human hand at the wrist during activities has been noted [4]. Kinematic studies have shown during this motion the proximal carpal row to be stable and it has been suggested this provides a stable base for power and precision grip. Napier had already noted the hand relative to the forearm to be ulnar deviated and in neutral flexion in power grip and more radial deviated and dorsiflexed in precision grip.

Napier's insights in this article stemmed from his research into the evolution of the hand. In comparing the human hand to the hand of other primates he was able to recognize its simplicity and general purpose nature. Arguing that the human hand is highly unspecialized, he pointed to the dead ends that

extreme specialization can lead to, such as in the animals the pott (stubbed index, specialized for firm gripping), the gibbon (long fingers, short thumb, specialized for brachiation) and the aye aye (extremely skinny middle finger, specialized for scooping insects from holes). Extreme specialization for one purpose limits other possible uses of the hand.

Napier's study is of further relevance when considering the stages of a child's development, and in areas such as the design of tools and robotics.

References

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