In the early phase post-stroke, there is prompt initial improvement in function as the pathologic processes in the ischemic penumbra resolve. The later, ongoing improvement in neurological function occurs by a different set of mechanisms that allow structural and functional reorganization within the brain. The resolution of local edema, the resorption of local toxins, improved local circulation, and recovery of partially damaged ischemic neurons are the first mechanisms that account for the recovery.
The processes involved in this reorganisation represent neuroplasticity and may continue for many months. Neuroplasticity can take place early or late. The main mechanisms consist in:
* Collateral sprouting of new synaptic connections
* Unmasking of previously latent functional pathways.
* Assumption of function by undamaged redundant neural pathways
* Reversibility from diaschisis,
* Denervation supersensitivity,
* Regenerative proximal sprouting of transected neuronal axons.

Particular mechanism is the compensation exerted by ipsilateral pathways (Presciutti, Tarducci et al. 1998).
1.1.1. The clinical aspects of recovery
The neurological recovery after stroke is in two different, but related, ways.
* A reduction of neurologic impairment can result from spontaneous natural neurologic recovery, from the effects of treatments that limit the extent of the stroke, or from other interventions that enhance neurologic functioning.
* Improved ability to perform daily functions within the limitations of their physical impairments. A patient may regain the capacity to do the activities of daily living (ADL) such as feeding, dressing, bathing, and toileting, even if some degree of residual physical impairment remains. The ability to perform these tasks can improve through adaptation and training in the presence or absence of natural neurologic recovery, thought to be the element of recovery on which rehabilitation exerts the greatest effect.

The normal pattern of recovery of upper limb pass through the movement synergies:
Firstly appear the flexor synergy :
* Shoulder flexion > elbow flexion > finger and wrist flexion > shoulder adduction/internal rotation
* Clinically, flexor synergy also can present as scapula retraction/elevation, shoulder abduction (90°)/external rotation, elbow flexion (acute angle), and forearm supination (full range).

Later on apper the upper limb extensor synergy:
* Shoulder > elbow > wrist/finger extension
* Clinically, extensor synergy presents as scapula protraction, humerus flexion/internal rotation, elbow extension, and forearm pronation.

A key aspect of neuroplasticity that has important implications for rehabilitation is that the modifications in neuronal networks are use dependent. Animal experimental studies and clinical trials in humans have shown that forced use and functional training contribute to improved function (Liepert, Miltner et al. 1998; Miltner, Bauder et al. 1999; Taub, Uswatte et al. 1999; Liepert, Bauder et al. 2000).
Recent advances in the control of movement demonstrate that there is a strong between the perceptive and motor systems. Rizzolatti defines these connection fronto-parietal functional units basis for motor control (Rizzolatti and Luppino 2001). The system is characterized by specific circuits codified for different modality. There are groups of neurons responsible for force and for direction correlated with ocular movement (Rizzolatti, Fadiga et al. 1997; Fogassi, Gallese et al. 2001).
Some systems are involved in the three-dimensional transformation of the movement of upper limb and another system that transforms “mirror movement” observed in other subjects (Fadiga, Fogassi et al. 2000).
This sensitive-motor integration suggests that the movement is not generically facilitated but it is particularly induced also from the contextual condition