



Quantitative Prediction of Grasp Impairment Following Peripheral Neuropathies of the Hand

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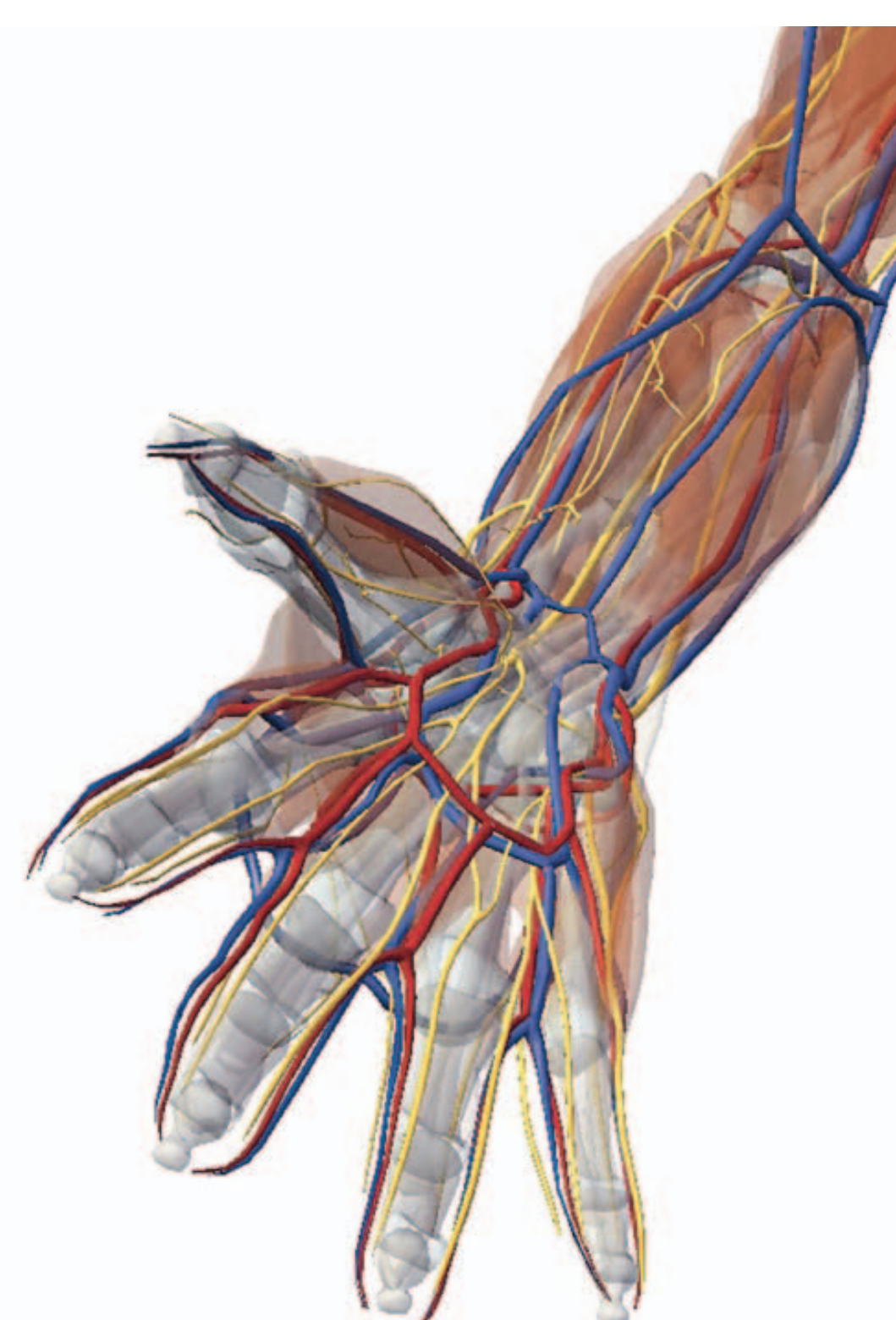


Introduction

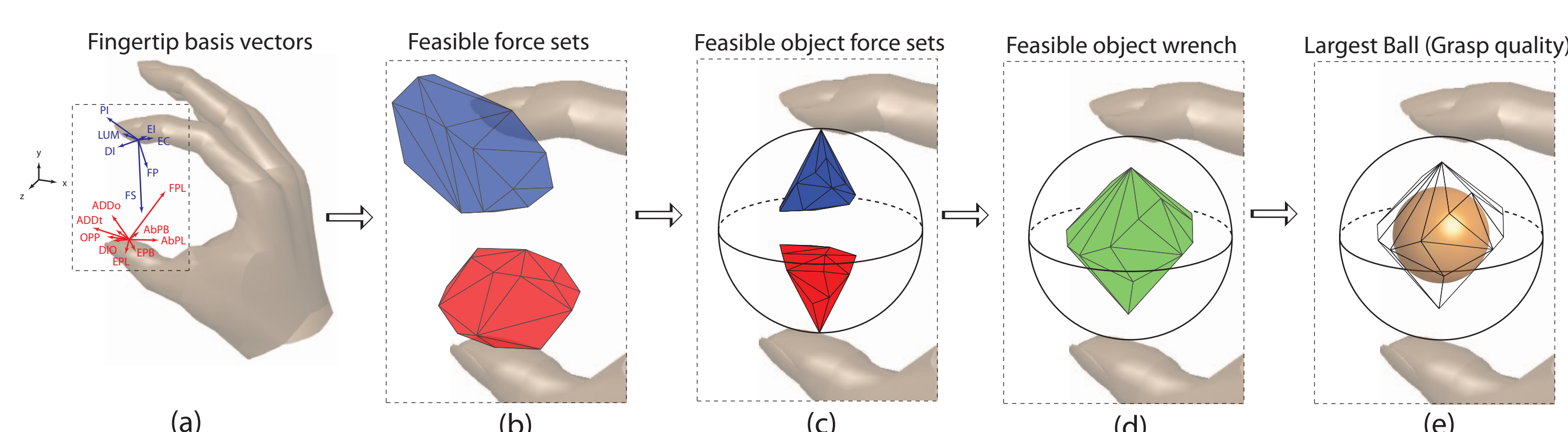
• Grasping is a fundamental hand function that is impaired or eliminated following peripheral neuropathies of the hand [1].

• While finger force deficits subsequent to muscle dysfunction have been analyzed [2,3], there has been no framework for analyzing grasp dysfunction.

• We developed [4] and applied a computational framework for predicting grasp quality for different degrees of simulated peripheral neuropathies.



Methods



• We used the technique illustrated above to calculate grasp quality for healthy hands and impaired hands [4].

• We simulated nerve pathologies by progressively weakening innervation groups (shown below) individually and calculating the resulting grasp quality [5,6]

Finger	Muscle	Innervation group
Index	Flexor digitorum profundus (FDP)	M
	Flexor digitorum superficialis (FDS)	M
	Extensor indicis proprius (EIP)	R
	Extensor digitorum communis (EDC)	R
	First lumbrical (LUM)	M,CTS
	First dorsal interosseous (FDI)	U
	First palmar interosseous (FPI)	U

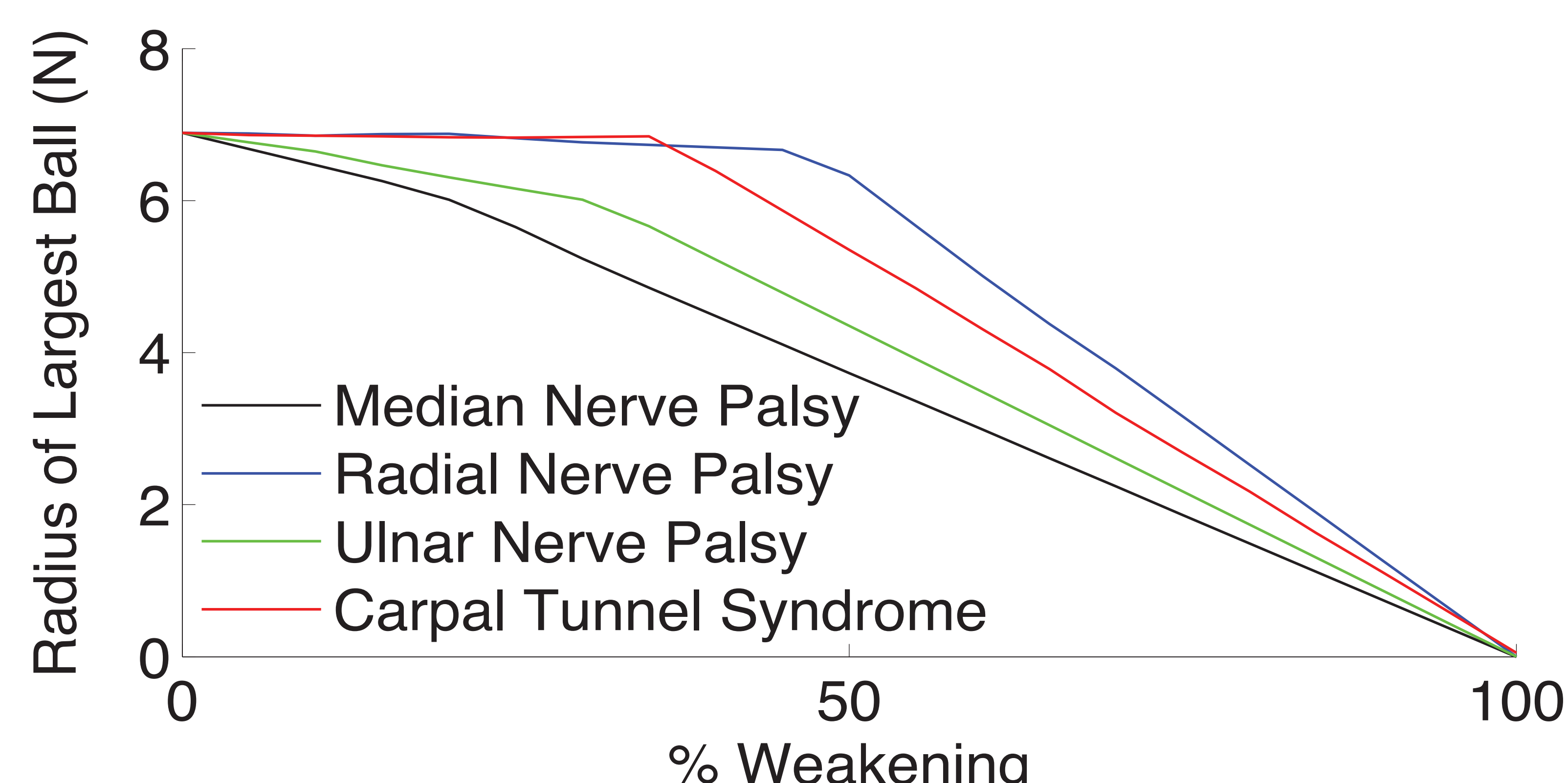
Finger	Muscle	Innervation group
Thumb	Abductor pollicis brevis (AbPB)	M,CTS
	Abductor pollicis longus (AbPL)	R
	Adductor pollicis oblique (ADDo)	U
	Adductor pollicis transverse (ADDt)	U
	First dorsal interosseous (DIO)	U
	Extensor pollicis brevis (EPB)	R
	Extensor pollicis longus (EPL)	R
	Flexor pollicis brevis (FPB)	M,CTS
	Flexor pollicis longus (FPL)	M
	Opponens pollicis (OPP)	M,CTS

Muscles in each nerve pathology group. M: median, R: radial, U: ulnar, CTS: Carpal Tunnel Syndrome (modeled as low median nerve palsy not affecting extrinsic muscles [7])

Results

Predictions of Grasp Deterioration:

- Low median nerve palsy compromises grasp most severely.
- Complete loss of any innervation group makes grasp impossible.



Conclusions and future work

- Low median nerve palsy affects grasp quality most severely.
- Modest levels of low median and low ulnar nerve palsies affect grasp quality disproportionately when compared with low radial nerve palsy and Carpal Tunnel Syndrome.
- Although low radial nerve palsy affects the extensors of the fingers, they, counterintuitively, are necessary for grasp [8].
- Our ability to predict grasp quality enables a rigorous comparison of functional deficits across peripheral neuropathies.
- Comparison of patient outcomes with these quantitative predictions will enable development of effi-

References

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Introduction figure from <http://techcon.blogspot.com>.

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