

MOMENT ARMS AND MOMENT POTENTIAL BALANCE AT THE INDEX MCP JOINT

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INTRODUCTION

This study extends prior investigations of muscle moment arms at the index metacarpo-phalangeal joint (MCPJ) to provide a more detailed description of muscle balance. By combining moment arm data with known tension fractions a renewed understanding of moment potential balance helps to describe clinical conditions as well as provide knowledge relevant to reconstruction and joint arthroplasty.

METHODS

Twelve fresh cadaver arms (6 male, 6 female, average age 71) were acquired through the Texas willed body program. Specimens were dissected through limited incisions but sufficiently to attach nylon cable to the index finger tendons using previously described methods.² The muscles studied were the flexor digitorum profundus, flexor digitorum sublimus, extensor digitorum communis, extensor indicis proprius, first palmar interosseous, lumbrical, and two paths of the first dorsal interosseous based on origination on the first metacarpal and the second metacarpal (FDPI, FDSI, EDCl, EIP, 1stPI, Lum, 1DIMc1, and 1DIMc2). Muscle excursions, flexion-extension (FE) and ulnar-radial (UR) MCPJ angles were measured and moment arms determined using methods previously described.^{1, 2}

RESULTS AND DISCUSSION

The average UR moment arm values for each muscle with the MCPJ at neutral are combined with the same for FE as described in an earlier study.² Results yield the moment arm balance described in Figure 1.

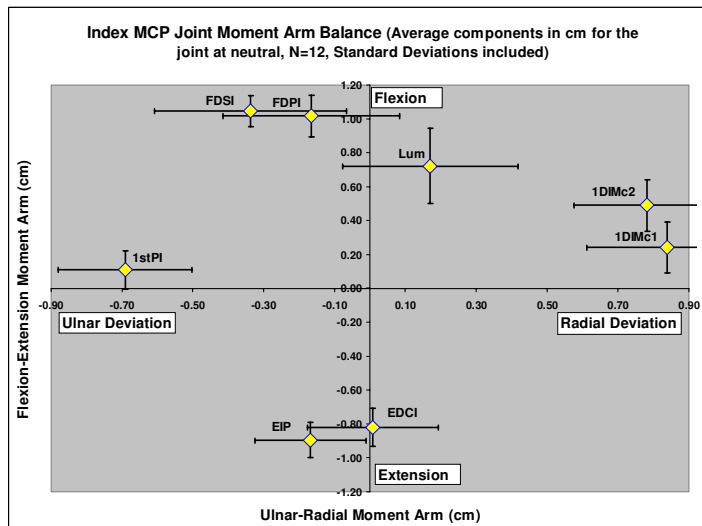


Figure 1. Average moment arms for the index MCPJ at neutral, indicating primary FE and UR functions.

To provide an indication of moment potential balance, the moment arms are multiplied by the respective muscle tension fractions³ and combined to indicate the potential moment in the principal rotation directions (flexion, extension, ulnar and radial deviation). The result for the normal hand appears in Figure 2.

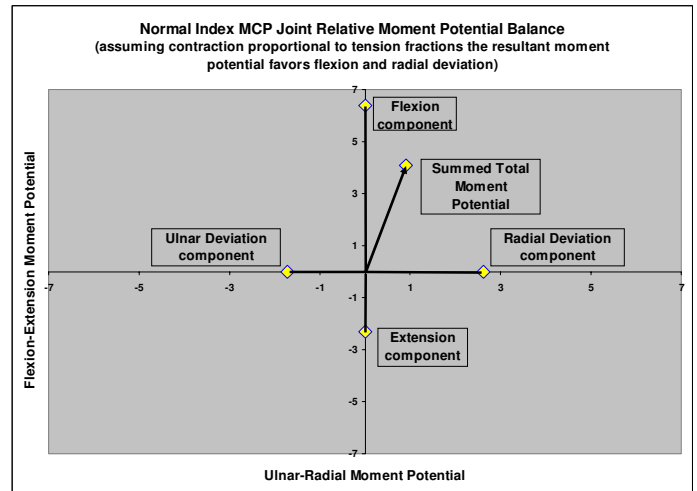


Figure 2. Summary of the moment producing potential of the muscles at the index MCPJ for the normal hand.

When the effects of the intrinsic muscles are removed these results define the moment potential balance for the intrinsic minus hand shown in Figure 3.

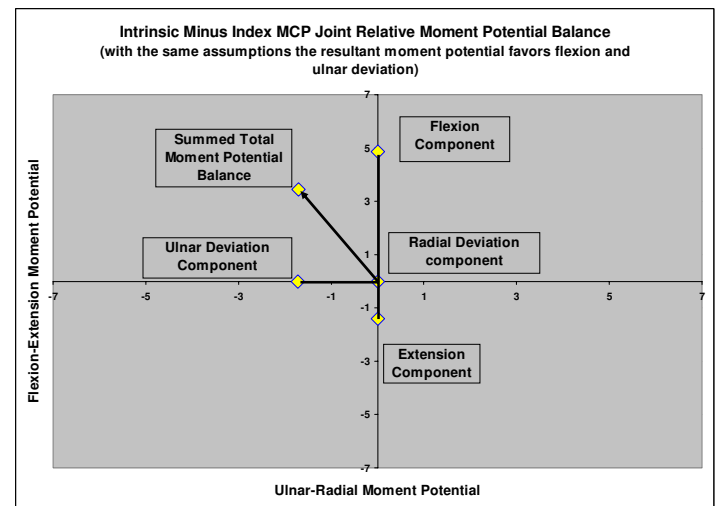


Figure 3. Index MCPJ moment potential balance without the effects of the intrinsic muscles.

CONCLUSIONS

These results combining improved investigations of moment arms for the index in FE and UR motion with previously described tension fractions provide a clear graphical understanding of joint muscle balance. For example, it is readily seen by comparing figures 2 and 3 that the intrinsic minus joint will eventually migrate ulnarly. Also it can be concluded that arthroplasty should seek to reconstruct the balance defined by Figure 2.

REFERENCES

1. An, KN, et al., *J. Biomech* 16:6, 419-425, 1983.
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3. Brand, PW, et al., *J Hand Surg*; 6:209-219; 1981.