MINUTES

DELEGATES' COUNCIL MEETING
INTERNATIONAL FEDERATION OF SOCIETIES FOR SURGERY OF THE HAND

11am UTC, Saturday 3rd July 2021 via Videoconference

(London: 12 noon; Barcelona/Budapest: 1pm; Delhi: 4:30pm; Beijing: 7pm; Seoul: 8pm; Sydney: 9pm; Chicago: 6am)

Marc Garcia-Elias, IFSSH President, opened the meeting at 11:05am UTC, welcomed the delegates and guests, and requested that Raja Sabapathy, IFSSH Secretary-General, chair the meeting.

1. Present

Marc Garcia-Elias	President
Daniel Nagle	President Elect
Raja Sabapathy	Secretary-General
David Warwick	Historian
Jin Bo Tang	Member-at-Large
Belinda Smith	Administrative Secretary
Eduardo Zancolli	Argentina; Sociedad Argentina de Cirugia de la Mano
Greg Bain	Australia; Australian Society for Surgery of the Hand
Ilse Degreef	Belgium; Belgium Hand Group
Carlos Henrique Fernandes	Brazil; Sociedade Brasileira de Cirurgia Da Mao
Kalin Dimitrov	Bulgaria; Bulgarian Society for Surgery of the Hand
David Tang	Canada; Canadian Society for Surgery of the Hand
Sebastian von Unger	Chile; Sociedad Chilena de Cirugía de la Mano
Jin Bo Tang	Chinese-Speaking; Association of Chinese-speaking Hand Surgeons United
Luis Scheker - *proxy*	Dominican Republic; Dominican Republic Society
Fidel Cayon	Ecuador; Ecuadorian Society of Hand Surgery
Nash Naam	Egypt ; Egyptian Society for Surgery of the Hand and Microsurgery
Joerg van Schoonhoven	Germany; Deutsche Gesellschaft fur Handchirurgie
Wing-Lim Tse	Hong Kong; Hong Kong Society for Surgery of the Hand
Pankaj Ahire	India; Indian Society for Surgery of the Hand
Uri Farkash - *proxy*	Israel; Israel Society for Surgery of the Hand
Andrea Atzei	Italy; Societa Italiana Di Chirurgia Della Mano
Ryosuke Kakinoki	Japan; Japanese Society for Surgery of the Hand
Hyun Sik Gong - *proxy*	Korea; Korean Society for Surgery of the Hand
Mohamad Iskandar	Malaysia; Malaysian Society for Surgery of the Hand
Emmanuel Ruiz	Mexico; Asociacion Mexicana De Cirugía De La Mano A.C.
Gerardo Zarate	Mexico; Sociedad Mexicana De Cirugia De La Mano Y Microcirugia S.C.
Johan Vehof	Netherlands; Netherlands Society for Hand Surgery
Mirko Tello Vinces	Peru; Peruvian Association of Hand Surgery and Microsurgery
Nathaniel Orillaza	Philippines; Philippine Society for Surgery of the Hand

J Alexendre Marques	Portugal; Portuguese Society for Surgery of the Hand
Alexander Georgescu	Romania; Romanian Society for Surgery of the Hand
Mark Puhaindran	Singapore; Singapore Society for Hand Surgery
Ajmal Ikram	South Africa; South African Society for Surgery of the Hand
Roberto Rosales	Spain; Sociedad Espanola de Cirugia de la Mano
Per Hessman	Sweden; Swedish Society for Surgery of the Hand
Esther Voegelin	Switzerland; Switzerland Society for Surgery of the Hand
TBC	Taiwan; Taiwan Society for Surgery of the Hand
Melih Bagır	Turkey; Turkish Hand Society
Jonathan Hobby	UK; British Society for Surgery of the Hand
Peter Amadio	USA; American Association for Hand Surgery
Don Lalonde; *Julie Katarincic (Incoming ASH Delegate);* *Pamm Schroeder (ASSH staff)*	USA; American Society for Surgery of the Hand

David Shewring	London 2022 Congress
Anthony Berger	APFSSH (President-Elect)
Daniel Herren	FESSH (Secretary-General)
Jefferson Braga Silva	FLACM (President)
Zong-Ming Li	HBWI (Chair, Board of Directors)
Nicola Goldsmith	IFSHT (President)

2. Apologies

Rohit Arora	Austria; Austrian Society for Surgery of the Hand
Otoniel Diaz C	Dominican Republic; Dominican Republic Society
Gero Meyer	France; Societe Francaise De Chirurgie De La Main
Babak Shojaie	Iran; Iranian Society for Surgery of the Hand
Shai Luria	Israel; Israel Society for Surgery of the Hand
Goo Hyun Baek	Korea; Korean Society for Surgery of the Hand
Sandeep Patel	New Zealand; New Zealand Society for Surgery of the Hand

3. Confirmation of previous minutes – 12th September 2020

Motion: To accept the minutes as a true record of the 2020 Delegates' Council Meeting

Proposed: David Warwick

Seconded: Peter Amadio

Carried unanimously

4. Membership Application: Peruvian Association of Hand Surgery and Microsurgery

Raja Sabapathy reported that Peruvian surgeons first enquired about IFSSH membership in 2014 when establishing their society. It was explained that the society must be in existence for a minimum of 2 years prior to IFSSH membership being possible; they continued to establish their society with knowledge of the IFSSH membership criteria.

In 2019 Dr. Mirko Tello Vinces, the President of the Peruvian Association of Hand Surgery and Microsurgery (APCMM), renewed the society's interest and then provided the IFSSH with the APCMM application on 24th September, 2020. The documents included:

- the Charter, detailing establishment in 2015;
- the list of Committee members;
- the full membership list; and
- letters of support from Bolivia, Colombia and Ecuador.

These documents satisfied the requirements of the IFSSH and the ExCo has endorsed the application. The Delegates' Council

Motion: To admit the Peruvian Association of Hand Surgery and Microsurgery (APCMM) to IFSSH membership

Proposed: Marc Garcia-Elias

Seconded: Jin Bo Tang

Carried unanimously

Dr Mirko Tello Vinces was invited to join the Council Meeting. Marc Garcia-Elias and Raja Sabapathy provided their congratulations on behalf of the Delegates' Council.

The Peruvian Association of Hand Surgery and Microsurgery is now the 61st IFSSH member society (from 59th country).

5. President's Report

Marc Garcia-Elias delivered his Presidential report:

Barcelona, July 3rd 2021

Since the last meeting of this council of delegates (September 12th, 2021) we have been quite busy implementing the decisions taken that day. It's been hard coping with all of this, in the middle of so much unpleasant pandemic news coming from all over the world. The resignation, for personal reasons and against the ExCo's will, of our Secretary-General didn't help either. That position was automatically filled by Dr. Sabapathy, the Secretary-General Elect, whose knowledge and "savoir faire" is now safely guiding the IFSSH.

One of the decisions taken last year by this Delegates' Council was to retain the triennial mode of congresses while moving onto a biennial renewal of leadership. That means that next year, at the London Congress, you will be asked to elect an expanded Executive Committee, including an increase of member-at-large positions from one to five (to improve geographic representation), as well as two more positions for the Nominating Committee. Furthermore, the Historian position will be redesigned into a more complex position as Communications Director. Today we will discuss these changes, emphasizing the opportunities that will open up. So, please, ensure that your society participates in such important decisions.

Needless to say, the main message today is: please be safe! We are looking forward to seeing all of you, less than a year from now, in London. The London 2022 team led by Drs David Shewring and Jonathan Hobby are doing their best to provide us with a successful congress.

Let's not forget, however, that the meaning of "success" today is not the same as it was a couple of years ago. Success in an immediate post-Covid situation cannot be measured by how much money has been collected or by the number of attending delegates. It will be a successful meeting if, like a lighthouse in the middle of a storm, we are able to reach out, guide, expand and develop all of us collectively.

Thank you, and once again, please be safe.

Marc Garcia-Elias, IFSSH President

6. Secretary-General's Report

The minutes of this meeting constitute the Secretary-General's report.

7. Finance Report

Delegates were provided with the enclosed finance report prior to the meeting. The summary of finances distributed to Delegates for this 2021 meeting was closed at April 30th, 2021.

Raja Sabapathy expanded on this information, detailing that the current balance (June 30th, 2021) is now $1,629,294.50. This is held in bank accounts with Wells Fargo and an investment account with Fidelity (Mr Chris Crenshaw). This balance is pleasing, being an increase of >$200K since we sent out the reports for the 2020 Delegates' Council Meeting, mostly composed of returns in the investment portfolio (>$185K). This is the highest total ever reported by the IFSSH.

The increase may be at least partially attributable to the change in spending during Covid - requests for educational sponsorship have decreased while our member society's activities and courses are reduced. ExCo expenses are also minimal whilst we are unable to undertake site visits for congresses or attend annual meetings in person.

Work has been done with Wells Fargo to improve the business records and we are now looking at options to receive membership payments through credit cards (in addition to the current bank transfer system). This will hopefully make the dues payments easier for a number of societies, and with lower bank fees than are charged through international transfers.

IFSSH Funds
30th June 2006 - 30th April 2021

	PERIOD ENDING															
	June 30, 2006	December 31, 2007	December 31, 2008	December 31, 2009	December 31, 2010	December 31, 2011	December 31, 2012	December 31, 2013	December 31, 2014	December 31, 2015	December 31, 2016	December 31, 2017	December 31, 2018	December 31, 201	December 31, 202	April 30, 2021
OPENING BALANCE (US$)																
Wells Fargo #1		178,469.94	207,934.27	271,238.34	320,018.21	378,457.80	403,121.69	383,725.79	437,624.90	416,992.11	347,723.23	440,886.62	516,551.86	307,547.30	320,461.31	323,085.39
Wells Fargo #2			0.00	0.00	0.00	0.00	10,955.75	1,188.75	2,120.75	1,961.75	1,817.75	1,781.75	1,781.75	1,781.75	1,781.75	1,781.75
Fidelity			479,003.40	307,683.67	401,760.92	426,334.49	421,690.43	460,416.18	485,313.05	537,710.27	528,355.15	515,925.87	590,862.79	773,448.66	969,410.37	1,192,104.66
INCOME (US$) - Wells Fargo #1																
Membership dues		19,439.00	97,773.42	78,814.42	51,829.92	77,115.02	73,307.91	87,746.85	71,844.21	80,189.37	93,027.46	78,379.17	89,576.63	106,452.57	68,593.98	8,080.00
IFSSH Congress		44,919.04	0.00	0.00	100,300.00	0.00	0.00	50,000.00	14,221.57	0.00	89,960.00	106,490.30	0.00	0.00	132,104.31	0.00
Ezine		0.00	0.00	0.00	0.00	N/A -See Wells Fargo #2			1,635.00	2,600.00	1,300.00	1,000.00	1,000.00	6,500.00	2,000.00	0.00
Interest - Wells Fargo Bank		4,122.37	2,009.35	97.10	23.73	55.61	36.51	37.13	37.74	13.26	0.00	0.00	0.00	0.00	0.00	0.00
Merchandise		100.00	0.00	0.00	0.00	0.00	0.00	600.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Misc		4,913.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4,629.16	0.00	0.00	0.00
Total		**73,494.31**	**99,782.77**	**78,911.52**	**152,153.66**	**77,170.63**	**73,344.42**	**138,383.98**	**87,738.62**	**82,802.63**	**184,287.46**	**185,869.47**	**86,205.79**	**112,952.67**	**202,698.29**	**8,080.00**
INCOME (US$) - Wells Fargo #2																
Ezine sponsorship		N/A - Opened 2011				17,975.00	0.00	1,088.00	N/A - see Wells Fargo #1							
Misc (incorrect acct for deposit)		N/A - Opened 2011				9,650.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total		**0.00**	**0.00**	**0.00**	**0.00**	**27,625.00**	**0.00**	**1,088.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
EXPENDITURE (US$) - Wells Fargo #1																
IFSSH Triennial Congress		7,596.33	0.00	0.00	67,285.90	0.00	5,283.15	17,410.00	40,000.00	54,889.96	5,053.60	7,080.82	1,242.00	5,053.40	108,327.51	0.00
IFSSH Annual ExCo/Council Meetings		0.00	0.00	0.00	0.00	0.00	0.00	0.00	897.91	0.00	1,490.22	0.00	1,976.87	759.00	325.52	0.00
Executive Expenses		31,375.61	21,457.35	29,762.91	22,975.79	36,104.22	25,096.00	23,667.25	18,230.19	21,926.69	19,879.93	36,218.45	30,662.49	21,070.67	0.00	0.00
Secretariat		Included in Executive Travel/Wages						11,744.20	13,630.72	12,693.33	11,988.21	15,960.10	13,280.64	13,289.62	17,000.00	7,500.00
Bursaries and Grants		0.00	15,000.00	0.00	2,850.00	15,000.00	40,999.99	15,050.00	19,350.00	35,000.00	9,500.00	26,000.00	30,900.00	34,100.00	28,300.00	4,779.00
Ezine		0.00	0.00	0.00	0.00	See Wells Fargo #2	6,000.00	12,459.00	11,729.98	11,025.29	22,511.48	19,784.44	19,777.11	20,589.70	23,754.99	6,216.84
Lawyer/Accountant Services		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	14,123.38	18,571.33	2,435.81	2,659.00	2,476.00	19,714.92	2,925.00
IT Services		0.00	0.00	0.00	0.00	0.00	0.00	0.00	500.00	0.00	0.00	450.00	1,660.00	960.00	960.00	1,325.00
Bank fees - Wells Fargo Bank		144.14	21.35	368.74	602.37	1213.52	2,086.49	2,107.67	3,132.51	2,412.86	2,129.30	1,674.61	2,052.24	1,740.17	1,657.56	578.35
Transfer to Investment Account		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	200,000.00	0.00	0.00	0.00
Misc		4,913.90	0.00	0.00	0.00	189.00	13,274.69	2,046.75	900.00	0.00	0.00	600.00	0.00	0.00	33.71	0.00
Total		**44,029.98**	**36,478.70**	**30,131.65**	**93,714.06**	**52,508.74**	**82,740.32**	**84,484.87**	**108,371.31**	**152,071.61**	**81,124.07**	**110,204.23**	**304,210.35**	**100,038.58**	**200,074.21**	**23,324.19**
EXPENDITURE (US$) - Wells Fargo #2																
Editorial / layout set up fees		N/A - Opened 2011				16,526.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bank Fees - Wells Fargo Bank		N/A - Opened 2011				143.25	117.00	156.00	159.00	144.00	36.00	0.00	0.00	0.00	0.00	0.00
Misc (incorrect deposit reversed)		N/A - Opened 2011				0.00	9,650.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total		**0.00**	**0.00**	**0.00**	**0.00**	**16,669.25**	**9,767.00**	**156.00**	**159.00**	**144.00**	**36.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
FIDELITY INVESTMENTS (US$)																
Transfer from Wells Fargo account		Records not available in secretariat office		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	200,000.00	0.00	0.00	0.00
Change in Investment Value				97,368.25	28,599.47	-349.96	43,678.12	30,568.59	58,475.77	-15,744.35	-6,062.87	81,021.51	-10,188.73	205,379.96	233,321.29	78,311.26
Advisor Fees				3,291.00	4,026.00	4,294.00	4,703.51	4,985.38	5,189.29	5,353.00	5,366.20	5,418.00	6,500.00	8,595.00	9,827.00	5,988.00
Transaction Costs & Charges				Within advisor fee						93.98	83.53	105.57	101.00	112.93	19.80	9.88
Taxes Withheld				Within advisor fee			248.86	686.34	889.26	721.71	916.68	561.02	624.40	710.32	780.20	622.28
Total Change				**94,077.25**	**24,573.47**	**-4,643.96**	**38,725.75**	**24,896.87**	**52,397.22**	**-21,913.04**	**-12,429.28**	**74,936.92**	**182,585.87**	**195,961.71**	**222,694.29**	**71,691.10**
CLOSING BALANCE (US$)																
Wells Fargo #1		**207,934.27**	**271,238.34**	**320,018.21**	**378,457.80**	**403,121.69**	**383,725.79**	**437,624.90**	**416,992.11**	**347,723.23**	**440,886.62**	**516,551.86**	**307,547.30**	**320,461.31**	**323,085.39**	**307,841.20**
Wells Fargo #2		**0.00**	**0.00**	**0.00**	**0.00**	**10,955.75**	**1,188.75**	**2,120.75**	**1,961.75**	**1,817.75**	**1,781.75**	**1,781.75**	**1,781.75**	**1,781.75**	**1,781.75**	**1,781.75**
Fidelity Investments		**479,003.40**	**307,683.67**	**401,760.92**	**426,334.49**	**421,690.43**	**460,416.18**	**485,313.05**	**537,710.27**	**528,355.15**	**515,925.87**	**590,862.79**	**773,448.66**	**969,410.37**	**1,192,104.66**	**1,263,786.78**
Fidelity $ change from previous year			-171,319.73	94,077.25	24,573.47	-4,643.96	38,725.75	24,896.87	52,397.22	-9,355.12	-12,429.28	74,936.92	182,585.87	195,961.71	222,694.29	71,691.10
Fidelity % change from previous year			-35.77	30.58	6.12	-1.09	9.18	5.41	10.80	-1.74	-2.35	14.52	30.90	25.34	22.97	8.01
Total Funds (US$)	584,252.37	686,937.67	578,922.01	721,779.13	804,792.19	835,767.87	845,330.72	925,058.70	956,664.13	877,896.13	958,594.24	1,109,196.40	1,082,777.71	1,291,653.43	1,516,971.80	1,573,418.71

8. Committee for Educational Sponsorship Report (Daniel Nagle)

Daniel Nagle, CES Chair, provided the report on behalf of the committee members (Jin Bo Tang and Raja Sabapathy).

The Covid pandemic has had a negative impact on requests for CES grants. However, the CES recently received and accepted a grant request sponsored by the Romanian Society for Surgery of the Hand. The grant was requested by Dr. Veronica Romanescu with support of Dr. Alexandru Georgescu, the Romanian IFSSH Delegate and Dr. Zorin Crainiceanu, the President of the Romanian Society for Surgery of the Hand. A sum of $16,975 was awarded to sponsor seven hand surgeons from different regions of Romania, to attend a two-day international course on complex wrist reconstruction using distal femoral free tissue transfer. The course has been specifically organized by the Romanian Society for Surgery of the Hand (RSSH) together with the Oldenburg- Groningen Advanced Training Program in Reconstructive Microsurgery and hosted by The Anatomy Section in the Department of Neuroscience at the University of Medicine Groningen, the Netherlands. The course is scheduled for October 14-15, 2021.
The CES urges all Delegates to inform their societies of the availability of grants. The guidelines and details of the application process are available on the IFSSH website - https://ifssh.info/educational_sponsorship.php.

Respectfully submitted,

Daniel J. Nagle MD
Chair IFSSH CES

9. Historian's Report, including Communications (Website, Social Media Newsletter, Ezine)

David Warwick presented the Historian's report – ***Appendix A***. He summarised that the website usage tracker shows worldwide, regular views. Information is regularly updated on the website, most recently including the educational resource details of the OMT Classification app and the associated Scientific Committee report.

Delegates were asked to submit their society history if not already displayed on the website (https://ifssh.info/member_nation-histories.php).

The IFSSH Social Media following continues to grow. Topics placed on Twitter and Instagram relate to IFSSH news, congresses and Member Society/Allied Organisation updates.

The Historian term ends in 2022, with the position being retired and a Communications Director to be elected instead.

10. 15th IFSSH Congress - London, 2022

David Shewring presented on the London 2022 site and logistics. He reported:

- The congress will be run from June 6th -10th, 2022.
- The Organising Committee has been meeting regularly to plan the congress logistics, scientific and social programmes, and general updates:
    - David Shewring (Chair)
    - Jonathan Hobby (Chair of Programme Committee)
    - Dean Boyce (BSSH Treasurer)
    - Rupert Eckersley (Social events)
    - Christy Fowler (BAHT)
    - Sue Fullilove (BSSH President)
    - Stephen Hodgson (Humanitarian)
    - Wee Lam (Deputy Chair of Programme Committee)
- The Programme Committee is led by Jonathan Hobby with international representatives present from each of the continents.
- Asszisztencia is the congress PCO. This group has been competent and efficient as the FESSH secretariat and are now preparing the 2022 Congress.
- The change from the original QEII centre to the ExCeL centre, for reasons beyond the control of the IFSSH or the BSSH, is confirmed. The ExCeL centre is situated in the London Docklands and was one of the sites for the London 2012 Olympics. It has significant advantages, with a horizontal footprint for easy movement and versatile room configurations. It can accommodate >4000 participants with a key area for industry use.
- Accommodation is available nearby or in central London with good transportation options.
- A core instructional course with plenary sessions will run throughout the congress: Tendon problems in the hand and wrist. The book will be produced by Thieme, included in the registration fee. Chapters are underway.
- Keynote speakers are Prof Tim Davis (Swanson Lecture) and Prof Duncan McGrouther (Presidential guest lecture). Nicki Moffatt, the first woman to achieve the rank of Brigadier in the British Army, will present a lecture on diversity.
- Fellowships have been set up to coincide with the congress, available to international participants to visit main centres in the UK.
- The congress dinner will be at the Old Billingsgate (capacity 1800) on the Thursday evening.
- The congress budget is based on a break-even attendance of 2500. This aims to keep registration fees at the same level as Berlin 2019. Options are being explored to safeguard losses from a Covid-type cancellation.
- The IFSSH has provided a US$100,000 seed grant, repayable two weeks prior to the congress. This is with Asszisztencia.

- The congress is a joint meeting with FESSH, including the exam, instructional course tradition, and FESSH business meetings. FESSH are agreeable with the arrangement.

Delegate questions included:

- The Congress website details a 2-step abstract system, including a video. What is involved?
  - Jonathan Hobby explained the first round is a standard system of a paper abstract (~300 words). These will be screened and those who will be recommended for acceptance will be asked to submit a 3-minute video. Based on the video, they will be allocated a podium presentation or a form of hybrid/video presentation. This is more work but advantageous as participants will be able to view the video presentations that they usually cannot attend at a big meeting with concurrent sessions, and also it will allow the organisers to assess the quality and provide feedback for improvement prior to the congress from the session chairs – a peer review process for presentations. An appropriate time slot and duration may also be provided based on the pre-submitted video. If a hybrid meeting is required at the last minute, videos already being available will also be helpful with the

    Delegates suggested more instructions should be provided on the website, preferably with an example. Through the chat board, it was also suggested that the 3 minute duration should be lengthened.

- How can the IFSSH Allied Organisations (e.g. HWBI) be involved? For example, as engineers, what contributions can be included and can registrations for PhD/engineers be considered?
  - Raja Sabapathy recommended that the Allied Organisations write to the programme committee with their requests and offers and directly discuss the involvement. Jonathan Hobby and David Shewring agreed this was appropriate.

Daniel Herren (FESSH Secretary-General) thanked the IFSSH and the London 2022 Organising Committee for their good collaborations with FESSH throughout these preparations.

11. Business arising

a. ExCo composition; 2022 elections

All delegates and societies were provided with a document detailing all positions on the Executive Committee and Nominating Committee, their succession vs election, and the criteria and process to apply for those that will be elected in 2022. This was provided one month prior to this Delegates' Council Meeting – ***Appendix B.***

Raja Sabapathy summarised that in London at the 2022 Delegates' Council Meeting the following will occur:

- the current President, Marc Garcia-Elias, automatically moves to **Past President**
- the current President Elect, Daniel Nagle, automatically moves to **President**
- the current Secretary-General, Raja Sabapathy, automatically moves to **President-Elect**
- the Secretary-General Elect position, now empty, is removed from the ExCo as per the 2020 Bylaw revisions
- the Historian position is also removed (a Communications Director is established instead)

The Delegates' Council will then need to elect the following officers at the London 2022 meeting, as per the ExCo composition described in the 2020 Bylaws:

- **the incoming Secretary-General**
- **a Communications Director**
- **5 ExCo Members-at Large** (an increase from the current 1 position)

In addition, outside of the Executive Committee, but to specifically be a part of the Nominating Committee only:

- **2 Nominating Committee Members-at-Large** (new positions)

As this is the first year of this revised system, and further positions are due to alter in 2025, Appendix B details the full guidelines for nomination and election specifically for the 2022 process. Raja Sabapathy urged all delegates to read this document.

To detail some points about each of the positions to be elected:

- As recommended by the delegates at the 2020 meeting, the **Secretary-General** needs to have good experience already within the IFSSH. Therefore, the selection criteria specify that nominees for this position must have completed at least one term within the IFSSH Executive Committee. This does not need to be within the current triennium and, as the ExCo expands its membership over the coming years, the pool will increase with time.
- The **Communications Director** will be a person with good skills in the areas of websites, social media, etc. It is not essential that they have been an IFSSH ExCo member or Delegate, but it is desirable that they know about our Federation and experience within it is favourable.
- The **5 ExCo Members-at-Large** will be chosen as regional representatives. All will apply directly to the IFSSH, but your society's regional placement will mean that you apply for the e.g. European Member-at-Large position. A full list of our societies and their regional allocation is on page 9 of Appendix B and also on the IFSSH website, under the Member Nations tab: https://ifssh.info/regional_allocation.php.

Five Members-at-Large will be elected: two from Europe (including Africa), one from Asia-Pacific, one from North America (including Central America) and one from South America.

Again, it is not essential that applicants have been or are current IFSSH Delegates, but experience within the Federation – for example participation in congresses or organising committees – is desirable.

These Members-at-Large will help the ExCo with knowledge of their region's developments and issues, and provide "local" experience to guide future IFSSH undertakings.

These positions are a little complicated in the 2022 term. The intention is that every year we will hold elections for some of the Members-at-Large, to increase the number of people able to be a part of the IFSSH Executive and broaden our inclusion, plus allow continuity and institutional memory in the years when the President and Secretary-General etc changeover. In "even" years (2024, 2026, etc) three positions will be placed up for election; in "odd" years (e.g. 2025, 2027 etc) two positions will be elected. Therefore in 2022 we will elect the 5 Members-at-Large based on their geographic region and then have a lottery to decide which positions have initial two or three year terms. The full selection process is detailed in the Appendix B.

Applicants apply directly to the IFSSH, not to their regional Federation. The process could be streamlined if the regional Federations were to discuss candidates and propose limited numbers of candidates, but this will not be enforced as the countries with membership of the IFSSH are not always identical to those with membership of the regional Federations.

- The **2 Nominating Committee Members-at-Large** will need to be senior member of the hand surgery community with good knowledge of the IFSSH processes, as the tasks of this committee involve the assessment of Pioneer candidates and future ExCo members. For these reasons, applicants for these positions need to have been current or previous IFSSH Delegates to know the demands of the positions and experience required. There is no geographic component involved in the selection of these positions.

In summary, there are some overall principles involved in these processes too:

- The IFSSH is a Federation of societies, not a society of individuals.
- It is important to note that societies can only endorse one person per position. For example, the Indian Society cannot endorse the four applicants all for the Communications Director position. However, they could endorse one person for the Communications Director and one person for the Nominating Committee Member-at-Large.
- For societies to endorse a candidate and to subsequently vote, the society must be in good financial standing with the IFSSH. Societies with overdue fee payments of 3 years are unable to submit candidates or vote. This will be revised following the 2022 elections to a 2 year period to coincide with the ExCo's new 2 year tenure.

- The Executive Committee may also endorse applications, as detailed in the attachment. This means that occasionally there may be two applicants from the same society for one position – for example the Singaporean Society might endorse their applicant for the Asian-Pacific Member-at-Large position but another Singaporean may also be amongst the nominees with their endorsement coming from the ExCo.
- The application process is detailed under each position. Applications will not be accepted unless they comply with all of the points. For example, the letter of endorsement must be signed by the appropriate officers; the selection criteria must be fulfilled; and most importantly no applications will be received after the deadline.
- The deadline for applications is February 6th, 2022. After the deadline, the applications are passed to the IFSSH Nominating Committee. As we have 60 societies in theory it is possible that we could receive a lot of nominations for every position. The Nominating Committee will assess the applications and recommend a shortlist (where appropriate) for each position to the Delegates' Council. These shortlists will be forwarded to the IFSSH Delegates in advance and we ask that each delegate discuss the options with their society as the elections are the chance for the societies to vote – not for the delegates to vote as an individual; delegates are the representative of the IFSSH member (society). Voting will occur in the processes detailed in Appendix B.

Delegate questions included:

- Regional representation of the 5 ExCo Members-at-Large: is this pre-determined from within e.g. APFSSH, FESSH?
    - This is possible. If the regional Federation wishes to discuss candidates amongst themselves and propose only one from this candidate's particular member society (or two in the case of Europe), then the IFSSH would not need to hold an election for that position and would accept the candidate. However, it is possible that some IFSSH societies are not members of the regional group (or not in the same regional alignment as the IFSSH table). It is also possible that individuals may approach the IFSSH Executive Committee for nomination, rather than their society, and therefore there may still be elections. All candidates who directly apply to the IFSSH (with society endorsement, etc, as per the application process) will be considered by the IFSSH Nominating Committee, who provide the list of recommended nominees to the Delegates' Council.

- Time frames: what are the application deadlines and selection time lines?
    - Appendix B, plus application forms specific to each position, will be placed on the IFSSH website by September 1st, 2021. At this time we invite all societies to start considering their proposals and to contact the secretariat if you have any questions.

Submissions must be emailed to the secretariat by February 6th 2022. No late submissions will be accepted.
All submissions are placed before the Nominating Committee.
The recommendations of the Nominating Committee are provided to the IFSSH Delegates by May 6th, 2022 to allow Delegates to discuss their society's vote with their society members.
Voting will occur at the IFSSH Delegates' Council Meeting (~June 6-10, 2022).
Please do not leave the applications to the last minute as, if correspondence is required as they are not complete, and the deadline occurs in the meantime, they are not eligible.

Raja Sabapathy explained that the IFSSH ExCo is excited to be expanding the Executive Committee and Nominating Committee. A lot of effort has gone in to accomplish these processes following the Delegates' Council Meeting in 2020. It is going to be a challenge on this first occasion and therefore he asked again that all delegates read the document carefully and be patient while we help with any questions.

b. 2022 Pioneers of Hand Surgery: Call for Nominations

Raja Sabapathy explained the Pioneers of Hand Surgery honour is one of the highlights of the congress. As a previous congress chair, many participants provided feedback that the Pioneer ceremony was one of the most inspirational components of the whole congress.

The IFSSH states that the Secretary-General is required to call for nominations from member societies at least nine months before the date of the Congress. Raja Sabapathy announced that **nominations are now open.**

He reminded delegates that this is a big honour; those being nominated must be exceptional candidates with large contributions to our field. Applications per society must be managed to only the most worthy candidates.

The person must be recommended in writing, be at least 70 years of age at the time of the next Federation Congress (or deceased), have made a significant contribution to hand surgery nationally or internationally, and may only be nominated following approval by the members of the hand surgery society to which he/she belong(ed). Submission of an application for Pioneer must be accompanied by written recommendations from three of his/her peers.

Full details of the submission process will be emailed to all delegates following this meeting. They are also on the website, under the Pioneer tab: https://ifssh.info/pioneers_hand_surgery.php. The nomination form must be used and instructions followed for the submission to be accepted.

Nominations **MUST** be received by the Secretariat (administration@ifssh.info) six months prior to the triennial congress. Therefore, the deadline for submissions is **December 6th, 2021.** The IFSSH Nominating Committee will assess the applications and inform the recommended Pioneers in due course.

The Pioneers are honoured within the triennial congress opening ceremony.

c. 17th IFSSH Congress: Call for Nominations

Raja Sabapathy announced that the nomination process for host societies for the 17th IFSSH Congress in 2028 is **now open**. As per the Congress Rotation, the 2028 host society should be within the Asian-Pacific region (following London in 2022 and Washington DC in 2025).

The congress guidelines are on the website – https://ifssh.info/guidelines.php. Bids should address these principles. The application must come from the society (not from a PCO representative).

The applying societies must submit a formal petition to the Secretary General at least three months ahead of the Council meeting – the deadline is therefore March 6th, 2022.

The applying society (not the IFSSH secretariat) must send the same documentation to each member country delegate and IFSHT representative for evaluation at least three months before the Council Meeting. The list of recipients is that listed on the Member Society page of the IFSSH website - https://ifssh.info/member_nation.php.

If a society intends to apply, the delegate should check your geographic category (https://ifssh.info/regional_allocation.php) and, if in the Asian-Pacific region, please let the IFSSH ExCo know of the intent to submit a bid in 2022.

Daniel Nagle reminded the Council that if a society has already hosted a meeting they are not eligible to bid again unless all other societies in the region will not be entering a bid. Raja Sabapathy advised that Australia, Japan, South Korea and India have already hosted IFSSH congresses within the Asian-Pacific region.

Mark Puhaindran (Delegate, Singapore Society for Hand Surgery) advised that the SSHS intends to place a bid for the 2028 congress.

Ryosuke Kakinoki (Delegate, Japanese Society for Surgery of the Hand) advised that the JSSH also wishes to host another IFSSH congress, questioning whether they have the opportunity to do so. Raja Sabapathy advised that a society yet to host the congress has preference to allow for as many as possible to have this opportunity. Ryosuke Kakinoki suggested that the JSSH understands this principle, but would like to pursue this as they are a large society and under the current rotation system it will be 2040 before another opportunity (56 years since the 3rd IFSSH Congress in Tokyo) and competition within bids is important to have high quality options.

Daniel Nagle detailed that this is a major reason for why the ExCo presented the recommendation to move from triennial to biennial congresses. This provides more opportunity to host congresses, returning to each of the regions more often.

d. Future congress schedule

The congress schedule has been updated to reflect the change to four geographic regions (https://ifssh.info/regional_allocation.php). It will now follow this schedule:

- 2028 - Asia Pacific
- 2031 - South America
- 2034 - Europe
- 2037 - North America
- 2040 - Asia Pacific
- 2043 - South America
- 2046 - Europe
- 2049 - North America

This is published within the Congress Guidelines on the website - https://ifssh.info/guidelines.php.

A suggestion from the Delegates via the chat board was to revisit the congress frequency proposal again in the future.

e. Administration succession

Since the Berlin triennial congress, the IFSSH ExCo have been considering options for the administrative functions of the Federation. Belinda Smith has undertaken this since 2008 but the Federation has grown and become more active. It is now beyond a part time position for one person and therefore it is time for a group to take on the associated duties.

Proposals have been requested from interested parties. Asszisztencia (based in Hungary, secretariat for FESSH) has expressed interest, as has the American Society's office. Covid disruptions have delayed the process and further proposals are still welcomed from any group.

Belinda is to write a job description for potential candidates and then submissions will be evaluated by the Executive Committee.

12. New business

a. Hand Surgery Resource

Raja Sabapathy announced that Larry Hurst has prepared a free, online resource: the Hand Surgery Resource. He has provided his consent for this to be on the IFSSH website – refer to "Educational Resources" tab.

Daniel Nagle has discussed the IFSSH involvement in this project with Larry Hurst and reported the following:

The IFSSH Executive Committee is pleased to announce an opportunity for IFSSH Society members to collaborate with the Hand Surgery Resource (HSR) founded and led by Dr. Larry Hurst of New York. The Hand Surgery Resource is a free, well organized Internet based, living document containing 450 chapters covering the fundamental principles of hand surgery.

The IFSSH Executive Committee and Dr. Hurst would like to invite IFSSH Societies to each nominate one to three of their members to become part of the ***Hand Surgery Resource's International Hand Surgery Resource Advisory Group (IHSRAG).*** *As members of the International Hand Surgery Resource Advisory Group (IHSRAG), your colleagues would be working with the HSR staff to review, edit and rejuvenate the Hand Surgery Resource.*

This is an opportunity to contribute to global hand surgery education. In recognition of their contribution, those who participate as Advisors will have their name prominently displayed on the HSR website and Apps as well as in the IFSSH Ezine. In addition, participation in the Advisory Group will provide an opportunity to share unique techniques and procedures with hand surgery colleagues around the world.

You will be receiving a more detailed invitation to participate in the Advisory group in the near future.

b. JHSE Congress issue

Jin Bo Tang thanked all contributors for their assistance in preparing an exceptional issue to coincide with the 2022 IFSSH Triennial Congress. This is being finalised and will be delivered on time because of the dedication of each author.

c. IFSSH Ezine

Marc Garcia-Elias provided thanks to Ulrich Mennen (IFSSH President 2010-2013) for his ongoing commitment to the IFSSH through the production of the Ezine. This has now been in existence for over 10 years and continues to share news around the hand surgery world.

13. IFSSH Allied Organisations

Raja Sabapathy introduced each of the representatives present from the five IFSSH Allied Organisations, as below. These groups share common interests with the IFSSH, enhance regional support, contribute to congresses, and provide friendship. Each was invited to submit a report for inclusion in the minutes.

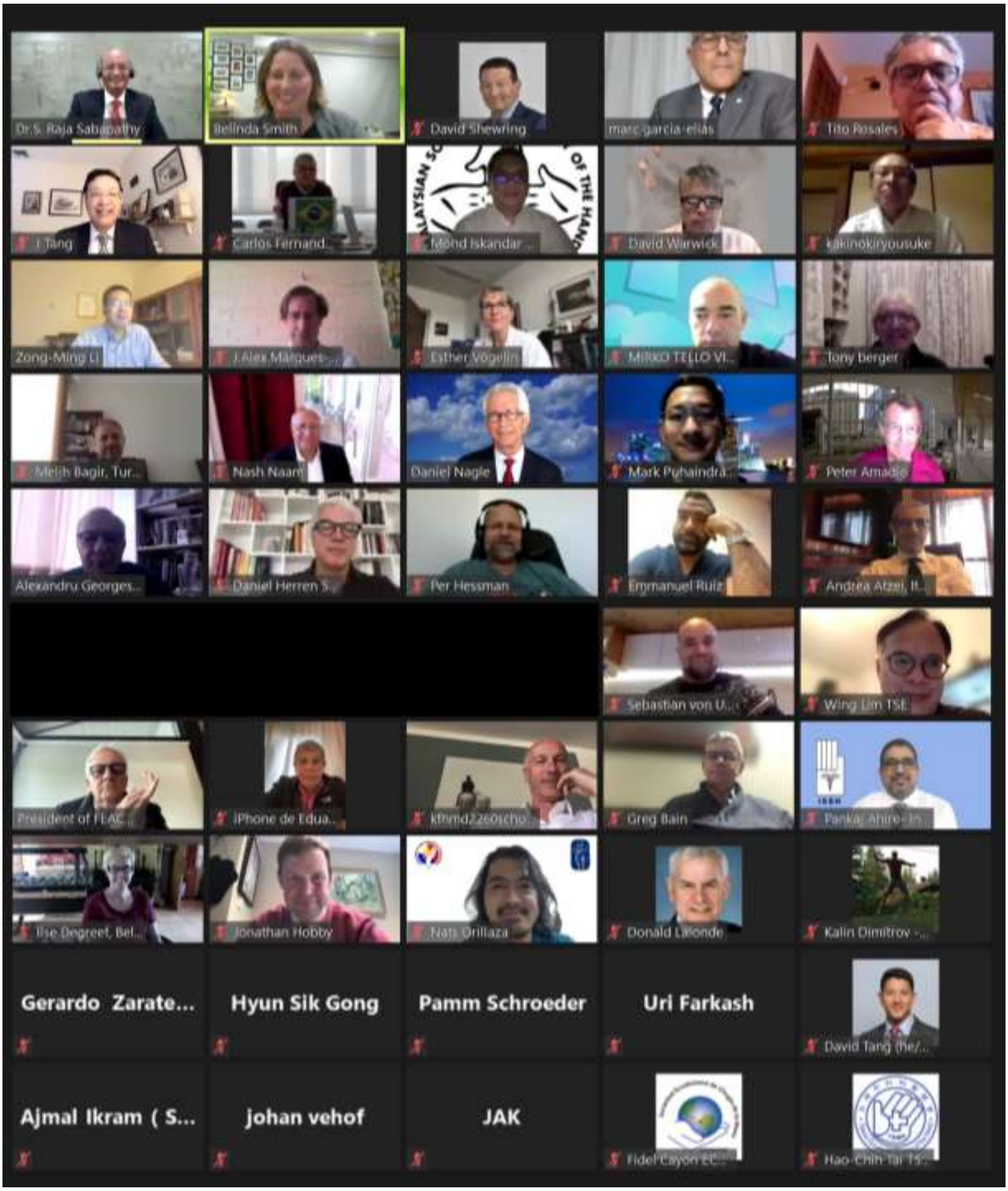
- Asia-Pacific Federation of Societies for Surgery of the Hand (APFSSH) - Tony Berger (President-Elect) – ***Appendix C***
- Federation of European Societies for Surgery of the Hand (FESSH) - Daniel Herren (Secretary-General) – ***Appendix D***
- Hand and Wrist Biomechanics International - Zong-Ming Li (Chair, Board of Directors) - ***Appendix E***
- International Federation of Societies for Hand Therapy (IFSHT) - Nicola Goldsmith (President)
- Latin American Federation for Hand Surgery (FLACM) - Jefferson Braga Silva (President) – ***Appendix F***

Marc Garcia-Elias discussed that in 2019 the South American Federation for Hand Surgery moved to include the Central American countries (Spanish speaking language) into its Federation. This expansion resulted in the Federation updating its constitution and name to the Latin American Federation for Hand Surgery (Federación Latinoamericana de Cirugía de la Mano - FLACM). The IFSSH congratulates FLACM on this achievement and has recognised this update within the IFSSH Allied Organisations.

14. Next meeting of the Delegates' Council

To be held within the 2022 Triennial Congress - June 6^{th} -10^{th} 2022, London, UK

Meeting closed: 12:25pm UTC


Dr.S. Raja Sabapathy
Belinda Smith
David Shewring
marc garcia-elias
Tito Rosales
J Tang
Carlos Fernand...
Mohd Iskandar ...
David Warwick
kakinokiryousuke
Zong-Ming Li
J.Alex Marques-...
Esther Vögelin
MIRKO TELLO VI...
Tony berger
Melih Bagir, Tur...
Nash Naam
Daniel Nagle
Mark Puhaindra...
Peter Amadio
Alexandru Georges...
Daniel Herren S...
Per Hessman
Emmanuel Ruiz
Andrea Atzei, It...
Sebastian von U...
Wing Lim TSE
President of FLAC...
iPhone de Edua...
Greg Bain
Ilse Degreef, Bel...
Jonathan Hobby
Nats Orillaza
Donald Lalonde
Kalin Dimitrov -...
Gerardo Zarate...
Hyun Sik Gong
Pamm Schroeder
Uri Farkash
David Tang (he/...
Ajmal Ikram (S...
johan vehof
JAK
Fidel Cayon EC...
Hao-Chih Tai TS...

APPENDIX A

Historian and Social Media Report

Delegates Meeting July 2021

David Warwick

Website visits

Website – What's new?

- Updates
  - Member's History
  - Delegates meetings
  - Ezine archive
  - Educational sponsorship reports
  - Updated bylaws after delegates approval 2020
  - Past President profiles
    - M Tonkin
    - U Mennin
    - A pardine
    - Y Yamamuchi
    - B O Brien

Website – What's new?

- New Material
  - Oberg Manske Tonkin congenital anomalies classification App details
  - IFSSH Scientific Committee Reports

Website Histories

- Added since last year:
  - Czech Republic
  - Israel
  - Norway
  - Portugal
  - Turkey

Journal of Hand and Microsurgery
Singapore
Malaysia
Hong Kong
Thailand
Japan.

Awaiting permission to reproduce

Please can delegates send me their member histories so we can add them to the website

IFSSH Social Media
June 2021

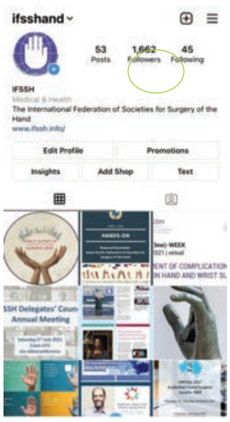
Twitter and Instagram

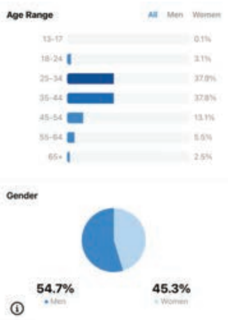
- Same material placed on each
- Growth

	12th August 2019	18th June 2021
Twitter	615	1451
Instagram	504	1662

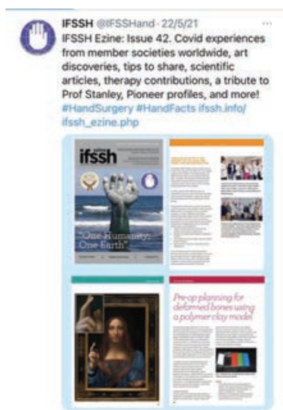
Twitter

Instagram





Topics - IFSSH information



Topics - IFSSH Allied Organisations

Topics - IFSSH Member Societies

Topics - IFSSH Triennial Congress

Topics - Sharing of Hand-related posts

NB: Selective use for international events, posts related to surgeons involved in IFSSH history, posts verified by other IFSSH national societies, etc - not a personal forum to promote work of individuals (unless related to IFSSH), or for promoting/discussing medical opinions

Change of Title 2022

Historian → Communications Director

APPENDIX B

IFSSH EXECUTIVE COMMITTEE AND NOMINATING COMMITTEE

2022 COMPOSITION AND ELECTION PROCESSES

INTRODUCTORY REMARKS

1. Executive Committee nominations

The members of the IFSSH Executive Committee reserve the right to nominate candidates for any and all elected positions.

2. Society nominations

- Each IFSSH member society may nominate one candidate only for each elected position.
- The society may only nominate a candidate if in financial good standing with the IFSSH.
- Letters of nomination must come from the member society's Executive Committee (or equivalent); letters from individual members of the society will not be accepted.

3. Voting eligibility

For all elected positions:

- Each Executive Committee member is entitled to one vote.
- Each IFSSH Delegate (or an appointed proxy) is entitled to one vote, excluding those not compliant with the financial dues requirement. A proxy must be executed in writing and delivered to the Secretary-General no later than the start of the meeting at which voting is to occur.
- A quorum is required at the meeting of 50% of the number eligible to vote.

<u>1. POSITIONS OF AUTOMATIC SUCCESSION</u>

PRESIDENT

Term: 2022-2025

Succession: Automatic - President Elect moves to this position

Position Description: The President shall be the principal executive officer of the Federation. The President shall preside at all meetings of the Council and Executive Committee. The President may sign, with any other proper officer authorized by the Executive Committee, any deeds, mortgages, bonds, contracts or other instruments, which the Executive Committee has authorized to be executed, except documents the execution of which shall expressly be delegated by law, the Articles of Incorporation, these Bylaws, or the Executive Committee to some other officer or agent. The President shall appoint the members of all committees, subject to the approval of the Executive Committee, except as otherwise provided by these Bylaws. The President shall be an ex-officio member of all committees, except the Nominating Committee or as otherwise provided by these Bylaws but shall not vote on any question in any committee except where such vote is necessary to break a tie. The President shall, in general, perform all duties customarily incident to the office of President and such other duties as may be prescribed from time to time by the Executive Committee.

The President shall serve as a member of the IFSSH Nominating Committee.

Application Process: N/A

Election Process: N/A

PRESIDENT-ELECT

Term: 2022-2025

Succession: Automatic - Secretary-General moves to this position

Position Description: The President-Elect shall assist the President in the discharge of the duties of the President as the President may direct, and shall perform such other duties as may be assigned from time to time by the President or the Executive Committee.

The President Elect shall serve as Chair of the Committee for Educational Sponsorship.

Application Process: N/A

Election Process: N/A

IMMEDIATE PAST-PRESIDENT

Term: 2022-2025

Succession: Automatic - President moves to this position

Position Description: The Immediate Past President shall preside at meetings of the Federation or the Council in the absence, or upon request, of the President and, when so acting, shall have all the powers of and be subject to all of the restrictions upon the President. In the event the Immediate Past President is unable to serve, the next most immediate past president shall fill the remainder of the term.

The Immediate Past President shall serve as Chair of the Nominating Committee.

Application Process: N/A

Election Process: N/A

2. POSITIONS REQUIRING ELECTIONS

NB: Candidates may submit a nomination for one position only.

SECRETARY-GENERAL

Term: 2022-2025

Succession: N/A - Election required

Position Description: The Secretary-General shall be the principal administrative officer of the Federation. The Secretary-General shall in general, supervise and direct all of the business affairs of the Federation, subject to the direction and control of the Executive Committee. The Secretary-General will be responsible for (i) maintaining minutes of Council and Executive Committee meetings; (ii) providing notices of meetings; (iii) coordinating the activities of the Executive Committee; (iv) maintaining adequate books of account and financial records for the Federation; (v) receiving, depositing and disbursing funds; (vi) paying expenses; (vii) working with the Federation's independent certified public accounting firm; and (viii) in general, performing all other duties as may be prescribed from time to time by the Executive Committee.

Application Process

Essential Criteria: Applicants must have served a full term on the Executive Committee.

Nomination / Election Process:

1. A call for nominations will be issued by the IFSSH Secretary-General to all IFSSH Delegates at least 6 months prior to the date of the triennial IFSSH Delegates' Council Meeting (to be held within the London congress, June 6-10, 2022).
2. Submissions must include:
    a. A completed application form
    b. Three signed letters of nomination, one each from:
        i. the Executive Committee (or equivalent) of the applicant's Society
        ii. the Executive Committee (or equivalent) of another IFSSH Member Society
        iii. an IFSSH Executive Committee Member (past or present)
    c. A summary of the applicant's contributions to the IFSSH (1 page maximum)
    d. A summary of the applicant's contributions to his/her society and administrative experience in organizations (hospitals, universities, professional societies, etc) (1 page maximum)
    e. A statement of how the applicant envisions contributing to the pursuit of the mission and goals of the IFSSH (1 page maximum)
    f. An abbreviated curriculum vitae (1 page maximum)
    g. A recent high resolution JPEG photograph.

3. **Submissions must be emailed to the secretariat (administration@ifssh.info) by February 6th, 2022. NO LATE SUBMISSIONS WILL BE ACCEPTED.**
4. All submissions are placed before the Nominating Committee.
5. The recommendations of the Nominating Committee are provided to the IFSSH Delegates by May 6th, 2022 to allow Delegates to discuss their society's vote with their society members.
6. Voting will occur at the IFSSH Delegates' Council Meeting (~June 6-10, 2022).

COMMUNICATIONS DIRECTOR

Term: 2022-2025

Succession: N/A - Election required (NB: The Communications Director may serve two consecutive terms. However, the continuation for a second term is subject to reapplication and election.)

Position Description: The Communications Director will enhance the Federation's media presence, foster communication among members, and maintain the Federation's electronic/Internet presence. The Communications Director will perform such additional duties as may be assigned by the Executive Committee.

The Communications Director's duties will include, but not be limited to, the following:

1. Overseeing
    a. the maintenance of the IFSSH website
    b. the promotion of the IFSSH and its member societies through social media
    c. the dissemination of official IFSSH documents via electronic media
    d. the maintenance of a secure archive of all IFSSH documents
2. Maintaining the artefacts of the Federation in cooperation with museums and libraries designated by the Executive Committee;
3. Performing regular updates of Member Histories, Pioneers and Giants of Hand Surgery profiles, and Swanson Lectures;
4. Securing financial support for the Ezine and other IFSSH publications; and
5. Serving as a member of the IFSSH Committee for Educational Sponsorship.

<u>Application Process</u>

Essential Criteria:

- Endorsement of application by the applicant's IFSSH member society OR by a member of the IFSSH Executive Committee.
  NB: Each IFSSH Member Society may only nominate one person for this position.

Desirable Criteria*:*

- Knowledgeable in the areas of website management, utilization of social media and archival systems.
- Previous communications experience within a hand surgery society or in relation to congress organisation.
- Involvement within IFSSH activities

Nomination / Election Process:

1. A call for nominations will be issued by the IFSSH Secretary-General to all IFSSH Delegates at least 6 months prior to the date of the triennial IFSSH Delegates' Council Meeting (to be held within the London congress, June 6-10, 2022).
2. Submissions must include:
   a. A completed application form
   b. One signed letter of nomination, from either:
      i. the Executive Committee (or equivalent) of the applicant's Society; OR
      ii. an IFSSH Executive Committee Member (past or present)
   c. A statement of how the applicant envisions contributing to the pursuit of the mission and goals of the IFSSH (1 page maximum)
   d. A summary (2 pages maximum) of the knowledge and experience the applicant would bring to this position, including:
      i. Experience managing organizational websites, social media and archives
      ii. A portfolio of examples may be included (additional 2 pages maximum).
   e. An abbreviated curriculum vitae (1 page maximum)
   f. A recent high resolution JPEG photograph.
3. **Submissions must be emailed to the secretariat (administration@ifssh.info) by February 6th, 2022. NO LATE SUBMISSIONS WILL BE ACCEPTED.**
4. All submissions are placed before the Nominating Committee.
5. The recommendations of the Nominating Committee are provided to the IFSSH Delegates by May 6th, 2022 to allow Delegates to discuss their society's vote with their society members.
6. Voting will occur at the IFSSH Delegates' Council Meeting (~June 6-10, 2022).

MEMBERS-AT-LARGE (5 positions)

In 2022, five Members-at-Large will be elected. These will provide regional representation on the IFSSH Executive Committee: two from Europe, one from Asia-Pacific, one from North America and one from South America. The societies and regions are defined as follows:

Asia / Oceania	Europe + Africa	North America	South America
Australia	Austria	Canada	Argentina
Bangladesh	Belgium	Dominican Republic	Bolivia
Chinese speaking association	Bulgaria	Guatemala	Brazil
Hong Kong	Czech Republic	Mexico MASH	Chile
India	Denmark	Mexico MSHSM	Colombia
Indonesia	Egypt	Puerto Rico	Ecuador
Iran	Finland	USA - AAHS	Uruguay
Japan	France	USA - ASSH	Venezuela
Kuwait	Georgia		
Malaysia	Germany		
New Zealand	Greece		
Philippines	Hungary		
Singapore	Israel		
South Korea	Italy		
Taiwan	Lithuania		
Thailand	Netherlands		
	Norway		
	Poland		
	Portugal		
	Romania		
	Russia		
	Slovakia		
	South Africa		
	Spain		
	Sweden		
	Switzerland		
	Turkey		
	UK		

The intention is that the Member-at-Large positions will be elected on a rolling basis to allow for continuity of knowledge within the Executive Committee. To prepare for this, in 2022 all five positions will be elected but with three Members-at-Large commencing a two-year term and two Members-at-Large commencing a three-year term. In 2024 (and all future "even" years), three positions will be elected; in 2025 (and all future "odd" years) two positions will be elected.

In 2022, one two-year position will be allocated to Europe; the other to either Asia-Pacific, North America or South America (determined by a lottery).

Term: 2022-2024 (3 positions, inc. 1 Europe); 2022-2025 (2 positions, inc. 1 Europe)

Succession: N/A - Election required

Position Description: To provide regional representation and advice for all matters of the IFSSH Executive Committee. Members-at-Large are expected to attend all ExCo meetings.

Application Process

Essential Criteria:

- Endorsement of application by the applicant's IFSSH member society OR by a member of the IFSSH Executive Committee.

NB: Each IFSSH Member Society may only nominate one person for this position.

Desirable Criteria:

- Previous administrative experience within a hand surgery society and/or congress organisation.
- Experience as an IFSSH Delegate

Election Process:

1. A call for nominations will be issued by the IFSSH Secretary-General to all IFSSH Delegates at least 6 months prior to the date of the triennial IFSSH Delegates' Council Meeting (to be held within the London congress, June 6-10, 2022).
2. Submissions must include:
    a. A completed application form
    b. One signed letter of nomination, from either:
        i. the Executive Committee (or equivalent) of the applicant's Society; OR
        ii. an IFSSH Executive Committee Member (past or present)
    c. A statement of how the applicant envision contributing to the pursuit of the mission and goals of the IFSSH (1 page maximum)
    d. A summary (2 pages maximum) of the knowledge and experience the applicant would bring to this position, including:
        i. the applicant's involvement in IFSSH activities
        ii. the applicant's contributions to his/her society and administrative experience in organizations
    e. An abbreviated curriculum vitae (1 page maximum)
    f. A recent high resolution JPEG photograph.
3. **Submissions must be emailed to the secretariat (administration@ifssh.info) by February 6th, 2022. NO LATE SUBMISSIONS WILL BE ACCEPTED.**
4. All submissions are placed before the Nominating Committee.
5. The recommendations of the Nominating Committee are provided to the IFSSH Delegates by May 6th, 2022 to allow Delegates to discuss their society's vote with their society members.
6. Voting will occur at the IFSSH Delegates' Council Meeting (~June 6-10, 2022).
7. Whilst the positions are allocated per region, the full Delegates' Council will vote on each. Due to this being the first year of a rolling, alternate system and therefore having a number of different initial positions, elections will occur in the following order:
        i. Asia-Pacific – 1 person

ii. North America – 1 person
iii. South America – 1 person
iv. Europe – 2 persons

v. Member-at-large terms
   1. The names of the elected representatives from the Asia-Pacific, North America and South America Regions will be placed in a lottery draw - the person whose name is drawn first will be appointed for a 3-year term; the representatives not selected for the 3-year term will be appointed for a 2-year term.
   2. The names of the two elected representatives from the Europe region will be placed in a lottery draw - the person whose name is drawn first will be appointed for a 3-year term; the representative not selected for the 3-year term will be appointed for a 2-year term.

vi. Committee for Educational Sponsorship
One Member-at-Large will serve on the Committee for Educational Sponsorship. This will be one of the two Members-at-Large chosen to serve 3-year terms, selected via lottery draw.

NOMINATING COMMITTEE MEMBERS-AT-LARGE

Term: 2022-2025

Succession: N/A - Election required
NB: From 2025, election of the Nominating Committee Members-at-Large will occur every two years.

Position Description: The Nominating Committee Members-at-Large shall participate in all activities of the Nominating Committee. This includes the review of the Executive Committee and Pioneer of Hand Surgery nominations. Further duties may be requested by the Executive Committee.

These positions are not based within the Executive Committee; the elected persons do not attend ExCo meetings but report to the Nominating Committee only.

Application Process

Essential Criteria:

- Endorsement of application by the applicant's IFSSH member society OR by a member of the IFSSH Executive Committee.
- Shall have served (or be serving) as a Delegate to the IFSSH Delegates' Council.

NB: Each IFSSH Member Society may only nominate one person for this position.

Desirable Criteria:

- Previous administrative experience within a Hand Surgery society and/or congress organisation.
- Attendance at two IFSSH congresses.

Election Process:

1. A call for nominations will be issued by the IFSSH Secretary-General to all IFSSH Delegates at least 6 months prior to the date of the triennial IFSSH Delegates' Council Meeting (to be held within the London congress, June 6-10, 2022).
2. Submissions must include:
   a. A completed application form
   b. One signed letter of nomination, from either:
      i. the Executive Committee (or equivalent) of the applicant's Society; OR
      ii. an IFSSH Executive Committee Member (past or present)
   c. A summary (2 pages maximum) of the knowledge and experience the applicant would bring to this position, including:
      i. the applicant's involvement in IFSSH activities
      ii. the applicant's contributions to this/her society and administrative experience in organizations
   d. An abbreviated curriculum vitae (1 page maximum)
   e. A recent high resolution JPEG photograph.

3. **Submissions must be emailed to the secretariat (administration@ifssh.info) by February 6th, 2022. NO LATE SUBMISSIONS WILL BE ACCEPTED.**
4. All submissions are placed before the Nominating Committee.
5. The recommendations of the Nominating Committee are provided to the IFSSH Delegates by May 6th, 2022 to allow Delegates to discuss their society's vote with their society members.
6. Voting will occur at the IFSSH Delegates' Council Meeting (~June 6-10, 2022).

APPENDIX C

VOLUME 1, ISSUE 1, NO. 1

JUNE 1, 2021

HANDS-ON

Biannual Newsletter

Asian-Pacific Federation of Societies for Surgery of the Hand

IN THIS ISSUE

"A journey of a thousand miles begins with a single step"
- Lao Tzu

Welcome to the inaugural issue of 'Hands-On', the official newsletter of the Asian-Pacific Federation of Societies for Surgery of the Hand (APFSSH). This electronic magazine was born out of a desire by the President and the current executive committee of the APFSSH to have greater communication between member nations and to be able to share information easily among hand surgeons in the region.

The success of this newsletter depends on the involvement and participation of all our members. Please support us by contributing letters, stories, short articles, and by advertising Hand Surgery related products and services.

Stay Safe & Happy Reading.

Editorial Team @ APFSSH Newsletter
Jennifer, Norimasa, Pankaj, Raymar & Sandeep

Message from Our President

Raja Sabapathy

A Vision for the Decade

My warm greetings to all in the APFSSH. We are in the midst of a pandemic, which has regrettably caused severe loss of lives and livelihoods. I am penning this message in the midst of a lockdown in our state. Times like these allow us to introspect and to look beyond. The good past gives you strength, and hope allows you to build a future.

As I write this, I am looking to set a goal for the APFSSH for the next decade. Tony Berger was kind enough to invite me to deliver the Presidential Guest lecture at the Melbourne APFSSH Congress which he conducted so well despite challenging circumstances. Speaking on the value of having purpose and goals for progress, I suggested 'Providing Quality Hand Surgery care to the Millions who are less privileged' as a purpose for the APFSSH. We are a 13-member Federation, representing 29% of the worlds population. Less privileged are those who are not able to obtain the necessary quality surgical care at the time they need it. It can occur in any country, and more often happens in developing countries. Research on delivery of surgical care points to lack of Awareness, Availability and Affordability as the main causes of this gap. As a Federation we can do our bit through education, teaching and training and spreading the successful best practice models to the world. This will occur through our meetings, journal, training fellowships, and now the newsletter.

"Providing Quality Hand Surgery care to the Millions who are less privileged."

Raja Sabapathy
PRESIDENT APFSSH

The service gap will even be higher in many countries of Asia Pacific, who are not members of the Federation. Getting them into our fold is the important agenda of this Council. Anyone can help and do it. I would like to recollect as to how India joined the Federation. It is because of one man – Lam Chuan Teoh, who thought he would 'nudge' us to join. As the Secretary of the Federation as it was being formed, Prof. Teoh had sent out a letter to all the hand societies in the Asian-Pacific region in November 1994 to participate in a meeting in Singapore in January 1995 and join the Federation. It is worthy to recollect some lines from the letter. ‘Communication among the developed countries may not be a problem, but communication with less developed countries the problem seems to be unsurmountable. We have a difficult task ahead and we expect to move slowly.’ India was one of the countries that had not responded.

International Faculty with SGH Team @ Advanced Instructional Course, January 1995
Standing (L to R): Ueli Buchler, AK Kour, Kazutero Doi, Luis Scheker, Yong Fok Chuan, Michael Tonkin, PC Leung, Simo Vilkki, CL Foo, KC Tan; Seated (L to R): Robert Pho, Alain Gilbert, Tatsuya Tajima, Ralph Manktelow, Teoh Lam Chuan
(Photo Courtesy Teoh Lam Chuan)

In January 1995, I had registered for the Advanced Instructional Course in Hand and Microsurgery and the Federation was being formed on the side-lines of the meeting. As I entered the hall, he loudly exclaimed, ‘Hi, you are from India? I was looking for you. We are forming the Federation and we have not heard from your country. Never mind lah. Don't go off after the scientific sessions. Join the council meeting, listen and take the message to your country. You must make it happen’. He was also kind enough to extend an invitation for the dinner in a revolving restaurant in a high tower. I saw stars. That experience of being with Tatsuya Tajima, Wayne Morrison, Fu-Chan Wei, Robert Pho, Kazutero Doi, Michael Tonkin, and so many stalwarts who were representing their countries left an indelible impression on a young mind and that led

Message from Our President
Raja Sabapathy

Delegates @ Instructional Course
Dr Sabapathy and Dr Scheker having an animated discussion. Dr Panupan (red arrow) in the background
(Photo Courtesy Teoh Lam Chuan)

India to join. I would say that the proactiveness of Prof. Teoh to 'NUDGE' made it happen. So, I would request the members who have connections, friends and trainees in countries like Cambodia, Myanmar, Nepal, Pakistan, Sri Lanka, Vietnam and so many nations who are not members of the Federation to talk to them, 'nudge' and make them join. That would be the first step we take to reach our purpose.

While embarking on a major journey, we should celebrate small victories to make it pleasant. We have an occasion now - the inaugural newsletter. As your President, I congratulate and convey our appreciation to Jennifer, Norimasa, Pankaj, Raymar and Sandeep who made it happen.

Stay safe. Looking forward to meeting all of you soon.

Raja Sabapathy, President, APFSSH
rajahand@gmail.com

Secretary General's Brief

Fuminori Kanaya

An Eventful Year

I am happy to be able to report about the society's activities for the last year in this inaugural issue of our newsletter. We managed to have a very successful Congress in Melbourne in March 2020, just as many countries were starting to lock down for the Covid-19 pandemic. The meeting was well attended and organized under the able leadership of our current President-Elect Anthony Berger and his team. For many of us, Melbourne was the last physical congress we have had an opportunity to attend. Preparations are underway for the next Congress in Singapore from May 31st to June 3rd, 2023. We hope by then international travel would have normalized, but the planning team are catering for all eventualities. Singapore 2023 will also be the last of our congresses in the triennial format, as the meetings will revert after that to the biannual congresses that we previously had. This increase in the meeting tempo will provide hand surgeons in the region more opportunities to share their work and network.

> **"Towards making the Asian Pacific Hand Surgery community even more connected, cohesive, and vibrant."**
>
> **Fuminori Kanaya**
> **SECRETARY GENERAL, APFSSH**

Reach is an important part of the work of our federation. This newly launched newsletter is one means for us to better inform our existing and potential members and other interested parties about our work. In addition, our President Dr Raja Sabapathy has worked to revamp our website (www.apfssh.net), making it much more informative and useful. Please visit it if you have not done so. We are also asking individual member societies to contribute a short write up of their society to be featured on the site. We have also set up a society facebook account for better engagement (www.facebook.com/apfssh).

With the registration of the society in Singapore, we

Secretary General's Brief

Fuminori Kanaya

Opening of the APFSSH Bank Account
Alphonsus Chong, Anthony Berger and Goo Hyun Baek celebrating the milestone of the APFSSH Bank Account

have since managed to open a bank account to handle society financial matters. Formalizing a constitution fitting for our society and compatible with Singapore law was an important part of this work which was spearheaded by Anthony Berger, Alphonsus Chong, Sandeep Sebastin and Wendy Teo. The formal registration of the society and bank account is an important milestone in our history, and enable us to do much more. We greatly appreciate the donations from our Hong Kong and Japanese members to build our financial war chest, and more recently, Australia has donated proceeds from the 2020 meeting as well. We have also started collecting membership subscriptions. Thank you all for your support. These resources will greatly help our society achieve its aims.

Online AGM of the APFSSH (6 February 2021)

The pandemic has put a hold on physical meetings and fellowships which we were planning to launch. Nevertheless, we are still working on our mission and engaging our members. We have strengthened our bench by adding the member-at-large (MAL) position to get more representation and diversity for the APFSSH leadership. We currently have three MALs and plan to increase the number by another two to make five.

It has been an eventful year for the society. The next few years will be even more exciting as we push even harder to make the Asian Pacific Hand Surgery community even more connected, cohesive, and vibrant.

Take care and stay safe.

Fuminori Kanaya, Secretary General, APFSSH
fkanaya@med.u-ryukyu.ac.jp

Update on Our Journal

Goo Hyun Baek

To Improve is to Change

First of all, I would like to congratulate the executive committee on the birth of the APFSSH Newsletter.

The Journal of Hand Surgery, Asian-Pacific Volume is the official journal of the APFSSH. It was first published in 1996 as a biannual issue, became a triennial issue in 2005 and has been published 4 times a year since 2017. The title of our journal changed from Hand Surgery to The Journal of Hand Surgery Asian-Pacific Volume from 2016. Along with the American and the European Volumes of the Journal of Hand Surgery, our journal serves as one of the legs of a tripod to expand and refine wisdom on hand and upper limb surgery and related research.

> **"I think all the studies deserve to be published as long as they are well formatted and add value to existing literature"**
>
> Goo Hyun Baek
> EDITOR, JHS-AP

Over the past few years, we noted a delay of about a year between acceptance of the article and publication. Early exposure of the accepted articles is important to the authors as well as the editorial office. We started an electronically published (e-pub) system from this year. Articles that are accepted for publication are 'e-pub' ahead of their print version and are available on pubmed and other databases. Of late, there has been an increase in the number of submitted articles. To address this, the editorial office has decided to publish the journal bimonthly from 2022 (six issues a year).

In 2020, 288 manuscripts were submitted to our journal from 37 countries. The acceptance rate was 39%. Most editors are trying to maintain or improve the quality of their journal. But this is a double-edged sword. The editor should pick up well-designed prospective studies or studies which proved 'something new' to increase the impact

Update on Our Journal

Goo Hyun Baek

factor. Certain journals do not accept case reports which decrease the impact factor significantly. However, impact factor cannot be the sole metric of journal quality. Techniques using expensive instrumentation or newer medical treatment may not be available in developing countries. Studies performed in the developing countries with poor infrastructure generally have greater difficulty in getting accepted.

I think all studies including retrospective case series or case reports, irrespective of whether they were performed in the developed or developing countries, deserve to be published as long as they are well formatted and add value to the existing literature. In this way, we can move forward together.

Stay Safe. Stay Inspired.

Goo Hyun Baek, Editor-in-Chief, JHS-AP
ghbaek@snu.ac.kr

List of Countries that Submitted Manuscripts to JHS-AP in 2020

No. of Manuscripts	Countries
74	Japan
38	India
23	United Kingdom
17	South Korea & United States
15	Italy
14	Australia
12	Singapore
07	Belgium & Turkey
05	China, France, Ireland & Malaysia
04	Thailand
03	Canada, Colombia, Greece, Hong Kong, Philippines & Spain
02	Egypt, Germany, Indonesia, Iran, Israel & Switzerland
01	Argentina, Brazil, Cyprus, Finland, Iraq, Netherlands, New Zealand, Oman, Russia & Taiwan

Sajedur Reza Faruquee

Bangladesh Society for Surgery of the Hand (BDSSH)

The war for liberation of Bangladesh ended in 1971 and ushered in a phase of growth of our health care system. It was initially focused on providing basic health needs and addressing war related injuries. Specialty care in Orthopaedic Surgery and Plastic Surgery began in 1975. The nationalization of the major industries led to an era of rapid industrialization with a resultant increasing incidence of hand injuries. The treatment outcomes were poor, and complications were high, as there were no hand specialists around.

In 1988, Professor Ramdew Ram Kairy underwent training in Hand Surgery at the National University Hospital, Singapore. Upon his return, he started the practice of Hand Surgery. In 2004, Professor Kairy met Dr. Raja Sabapathy and Professor Bhaskaranand Kumar at the annual meeting of the Indian Society for Surgery of the Hand at Gangtok. He was encouraged to start a society for Hand Surgery in Bangladesh.

Historic meeting at NITOR on 18 August 2005 to form BDSSH
Attended by Prof RR Kairy, Dr. Md. Abul Kalam, Dr Sk. Abbasuddin, Dr. Monowarul Islam, Dr. OFG Kibria, Dr Shaymol C Debnath, Dr. ASM Monirul Alam, Dr. Shah MH Rahman, and Dr. Sajedur Reza Faruquee.

At a historic meeting on 18 August 2005 at the National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR) in Dhaka, the decision to form Bangladesh Society for Surgery of the Hand (BDSSH) was made. The objectives of BDSSH were:

- To promote and direct development of Hand Surgery in Bangladesh.
- To foster and coordinate education and research in Hand Surgery.
- To have trained manpower, arrange instructional hand courses and to send young surgeons abroad for training.
- To establish an independent specialty in future.

Society in the Spotlight - Bangladesh

Sajedur Reza Faruquee

In 2006, Orthopaedic and Plastic surgeons that were interested in hand surgery were invited to become members of the Society. Later that year, by-laws and constitution of BDSSH were formulated and approved by 27 members with Professor Kairy as founding President, Professor Abul Kalam as founding Vice-President and Dr. A S M Monirul Alam as founding Honorary Secretary. The logo of the society was designed by Dr. Shah MH Rahman, showing two hands of a surgeon in a functional position protecting the national emblem and aiding growth.

We started sending surgeons for specialty training abroad. Dr OFG Kibria went to Stanley Hospital (Chennai, India) in 2004 under Dr G Balakrishnan and I received my hand surgical training in 2006 at Ganga Hospital, (Coimbatore, India) under Dr Raja Sabapathy. Since then more than 25 surgeons received training at different centers overseas. The 1st national conference 'BDSSHCON-06' was held at NITOR on 25 November 2006. It was attended by 125 surgeons from Bangladesh and there were 27 podium presentations.The first AGM of BDSSH was held and the first executive committee was voted in.

BDSSHCON-06, NITOR, 25 Nov 2006
(L to R): Dr ASM Monirul Alam, Prof Siraj-ul-Islam, Prof Shamsuddin Ahmed, Prof RR Kairy

'BDSSHCON' has been held annually since then and is attended by 150+ surgeons and includes a number of foreign faculty as well. Delegates from BDSSH joined the IFSSH congress at Sydney in 2007 and in 2008 at the delegates meeting at Lucerne, Bangladesh became the 50th member nation of IFSSH. Our membership had also increased to 63 at that point. We became the youngest member of the APFSSH at the Cebu meeting in 2017 and our members now regularly attend meetings and have presented scientific papers in Australia, Germany, India, Thailand, Singapore and the United Kingdom. Despite Covid-19 pandemic, five surgeons attended the last APFSSH meeting in Melbourne in March 2020.

The Bangladesh government has recognized Hand Surgery as a separate specialty. There are now 42 positions for Hand Surgeons at Government Medical Colleges across the nation. These include residents as well as professors. The Hand Surgery clinic at NITOR, now headed by Prof Jahangir, has been serving the nation since 2006. A Hand

Society in the Spotlight - Bangladesh

Sajedur Reza Faruquee

Team Bangladesh @ IFSSH, Sydney, 2007
(L to R): Dr ASM Monirul Alam, Prof NK Datta, Prof Kh Abdul Awal, Prof MA Samad, Dr Md Abul Kalam, Prof RR Kairy

Bangladesh becoming 50th Member of IFSSH, Lucerne, 2008
(L to R): Prof RR Kairy, Dr S Raja Sabapathy, Dr ASM Monirul Alam, Dr Md Abul Kalam

Surgery wing was started in 2017 at the Bangabandhu Sheikh Mujib Medical University, helmed by Prof KP Das. A post-graduate course in Hand Surgery was started at the Sheikh Hasina Institute of Burns and Plastic Surgery with a dedicated Hand Surgery Outpatient clinic. Hand Surgeons are practising in private sector also. Our membership has now risen to 101.

Team Bangladesh @ APFSSH, Melbourne, 2020
(L to R): Dr Lata, Dr Wee Lam, Dr Sajedur Reza Faruquee, Dr Monsoor, Dr Sumi

Sajedur Reza Faruquee, Honorary Secretary, BDSSH
rocky_29th@yahoo.com

Executive Body BDSSH

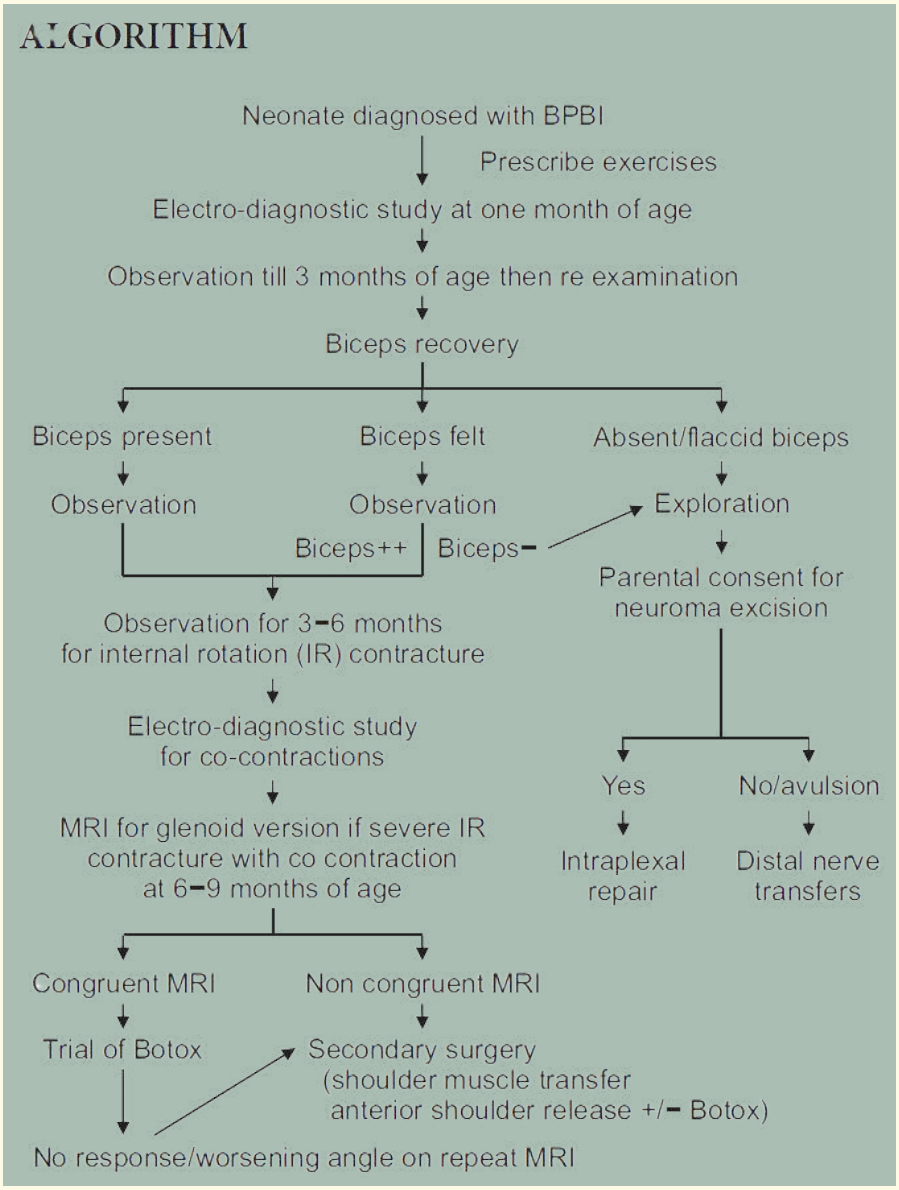
- President: Dr. Md. Abul Kalam
- Vice-President: Dr. Nakul K Datta
- Hon. Secretary: Dr. Sajedur Reza Faruquee
- Treasurer: Dr. Krishna Priya Das
- Joint Secretary: Dr. Md. Mohiuddin
- Editor: Dr. Tanveer Ahmed
- Members: Dr. R R Kairy (Ex-Officio); Dr. ASM Monirul Alam (Ex-Officio) Dr. Dipankar Nath Talukder, Dr. Md. Jahangir Alam, Dr. Md. Asraful Islam, Dr. Ahmed Asif Iqbal & Dr. OFG Kibria

JHS-AP Article In-Focus

Alphonsus Chong

Management of Birth Brachial Plexus Injury Including Use of Distal Nerve Transfers.
Thatte MR, Nayak NS, Hiremath AS. J Hand Surg Asian Pac Vol. 2020;25(3):267-275.

Brachial plexus palsy at birth is a well recognized condition where early diagnosis and treatment can optimize outcomes and prevent late complications. Although most patients spontaneously recover from these injuries, a significant proportion of them do not. For this latter group of patients, there is only a limited window in which nerve surgery is helpful.



In this timely review, the authors, who have extensive clinical experience with this condition, share their views on the initial assessment and treatment of birth brachial plexus injury. They point out key decision points in recognizing inadequate or no spontaneous recovery, pointing to a need for surgery. The article provides insight into the disputed area of timing and indications for surgery, as well as the different types of surgical reconstruction currently being practiced.

Finally the review provides the management algorithm that has worked for the author's practice, including surgical techniques such as the more standard intra-plexal repair of the plexus, as well as the more recently applied distal nerve transfers.

JHS-AP Article In-Focus

Alphonsus Chong

Time of Evaluation of Pain Catastrophizing after Surgery for Upper Extremity Motor Disorders. Hirata J, Inoue K. J Hand Surg Asian Pac Vol. 2021 Mar;26(1):41-46.

Pain is a common symptom and also influences outcomes following hand surgery. However, pain is variably experienced by different individuals. This can be explained by the fact that pain does not correlate perfectly with physiological insult or injury. Other factors, including cultural, interpersonal and cognitive aspects of the individual influence the pain experienced.

Pain catastrophizing occurs when a patient engages in cognitive activities which exaggerates the actual or anticipated pain, i.e. the patient approaches pain with a negative mental set. The level of pain catastrophizing is typically measured using a questionnaire and has been shown to predict pain outcomes, including intensity of post-surgical pain, response and misuse of opioids and persistent surgical pain. Pain catastrophizing has been shown to predict finger stiffness, grip strength and range of motion following distal radius fractures as well as lower patient satisfaction after carpal tunnel release.

However, the level of pain catastrophizing is affected by the pain a patient is experiencing. So the timing of evaluation may be important. This work addresses this question by studying changes in pain in the early post-operative period and their corresponding pain catastrophizing scores using a commonly used scale. They studied this in a range of upper extremity surgery ranging from finger fractures to rotator cuff surgery.

Their findings suggest that scale scores at 2-weeks post-op best predicts pain and Hand 20(a Japanese Hand Outcomes questionnaire) at 8 weeks. As the authors acknowledge, the limited scope of the surgeries performed and exclusion of patients with severe pain (which is not qualified or explained in their paper), limits the generalizability of their findings.

Alphonsus Chong, Deputy Editor, JHS-AP
alfchong@gmail.com

Diversity in Hand Surgery

Jennifer Green

Diversity at the Australian Hand Surgery Society 2021

The Australian Hand Surgery Society (AHSS) recently held the most diverse, albeit “virtual” Annual Scientific Meeting (ASM) in its history. The four outstanding guest speakers (below) were of diverse background and gender, the moderators were almost 50% female and there was strong representation of women among the speakers in the program. In addition, the 2021 AHSS ASM included the first ever diversity session.

Dr Eva-Maria Baur
Germany

Dr Paco del Pinal
Spain

Professor Max Haerle
Germany

Dr PC Ho
Hong Kong

Perhaps the most powerful statement of AHSS’s dedication to gender equity is that 9 of the 17 (53%) Post Fellowship Education & Training (PFET) graduates in Hand Surgery to date are female. AHSS has strongly committed to diversity in hand surgery in its adopted Ethics Guidelines: “**AHSS is committed to diversity and gender equality in healthcare and to removing any practices that hinder that commitment. The AHSS strives to implement this commitment through its policies, practices, and inclusive culture. It is an expectation that every individual who attends the AHSS ASM is respected and treated equally regardless of their cultural background, gender, role or particular circumstance.**”

What is the science supporting the AHSS decision to support diversity? There is overwhelming evidence that diversity of the healthcare workforce is critical for healthcare equity. Hand surgery must reflect the composition of the community we serve in order to provide the best care– not only the women, but our indigenous and under-represented minority (URM) communities. There is increasing data in orthopaedics and other specialties showing the healthcare inequity that results from workforces that lack diversity. A man is between 3 and 22 times more likely to be offered a knee replacement than a woman with the same symptoms. The outcomes for orthopaedic trauma and arthroplasty are much poorer in URM patients

in wealthy nations. A recent study of over a million births in Florida show that the survival rate of black infants increased by 50% when they were treated by a black doctor. Diversity in healthcare can be the difference not only between access to surgical treatment & poorer outcomes, but in some specialties it can mean the difference between life and death. What are the evidence-based strategies to increase the inclusion of women and URM in hand surgery? The strategies include creating visible role models; mentoring; mitigating bias in our selection process and appointments to leadership roles; and increasing flexibility in training for everyone. This requires commitment from the leadership and initiatives to support parenting, particularly during training. The nation with the highest percentage of women in surgery is Estonia and it is no coincidence that is also has the best parental leave and child support policies in the OECD.

Diversity is powerful. Diverse organisations attract the top talent (as they select from a larger pool of candidates), they are more innovative and they make better decisions. They are even more profitable. As the past chair of the Australian Orthopaedic Association Orthopaedic Women's Link, I became curious about diversity initiatives beyond Australia. The network snowballed and the result has been the formation of the International Orthopaedic Diversity Alliance (IODA) – a collaboration to advance diversity in orthopaedics representing all six continents. We are extremely fortunate to have the immediate Past President of the American Association of Orthopaedic Surgeons (AAOS) Kristy Weber, as our President with a rapidly growing membership of orthopaedic association presidents, surgeons, trainees, junior doctors, orthopaedic industry members and medical students. IODA is honoured to be supported by AAOS and the British Orthopaedic Association (BOA) and shall be hosting free webinar symposia from the AAOS (31 Aug-3 Sep, 2021) and the BOA (Friday 24 Sep, 2021) Annual Meetings in collaboration with Women in Orthopaedics Worldwide (WOW). WOW is a network including more than 40 orthopaedic women's societies. IODA welcomes hand surgeons – including those who are not orthopaedic - who are interested in diversity in surgery. Membership is free at www.orthopaedicdiversity.org

Dr Kristy Weber
Past President AAOS

Jennifer Green, Diversity Champion, APFSSH
jennifer.green1312@gmail.com

News from IFSSH

Marc Garcia Elias

International Federation of Societies for Surgery of the Hand

The IFSSH is 55 years old and is growing from strength to strength. Since the Berlin congress, the Ex-Co of the IFSSH is busy in formatting the new by-laws of the Federation. This is being done with the goals of ensuring greater member participation, increasing the opportunities in leadership positions in the Federation and reaching out to the needs of the Member nations.

The main change is the decision taken by the delegates to retain the triennial mode of congresses while moving on to a mode of leadership change once in two years. In addition, there will be an increase of the Member-at-large position to five from the present one. A regional distribution has been planned as per the number of member societies and number of members. One each from North and South America, two from Europe and one from the Asian-Pacific region will be selected. Elections for these posts will happen during the London Congress. We hope to have a meeting of the delegates of the member nations probably in the last week of June or first week of July to explain to the delegates the changes and the opportunities that will open up. Please ensure that your national delegate participates in this important meeting. Another matter of importance to the Asian-Pacific region is that it is a chance for the region to host the IFSSH 2028. The venue will be voted during the London Congress in June 2022. The timelines for submitting the bid process will be announced after the next delegates meeting. Meanwhile if your country wishes to bid, please get ready to welcome the world to your place by getting ready with an attractive bid.

IFSSH has a wonderful e-magazine called EZine and it is the 10th year since its publication. Past President Ulrich Mennon has steered it well over these 10 years. Please visit the IFSSH website www.ifssh.info to read the back numbers of the EZine and also to know the news and notes.

This year has been like no other due to the pandemic. While we all hoped that we will be free in 2021, the target still eludes us. I am sure it will soon be fine. Meanwhile be safe and we look forward to seeing you in London from June 6-10, 2022 for the next IFSSH congress. The team led by David Shewring and Jonathan Hobby are working very hard to provide us a congress to remember.

Marc Garcia Elias, President, IFSSH
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S Raja Sabapathy, Secretary General, IFSSH
rajahand@gmail.com

Report from APFSHT

Hercy Li

Asian-Pacific Federation of Societies for Hand Therapy (APFSHT)

APFSHT, together with APFSSH, had successfully hosted a special and memorable Congress in Melbourne in March 2020 amid the Covid-19 pandemic. APFSHT council had collaborated closely with the Congress organizing committee in Australia led by Anthony Berger and Hamish

APFSHT Executive Committee Group Photo @ Cebu 2017

Hand Therapist Delegates from Hong Kong, Singapore, Malaysia and Bangladesh @ Melbourne 2020

Anderson to put forth an enriching programme for the hand therapists. Hand therapists from twenty over countries congregated and engaged enthusiastically with current updates in hand therapy and hand surgery topics. Shortly after the 2020 APFSHT congress, we have several exciting events in the pipeline. Currently, we are working along with IFSHT under the lead of Nicola Goldsmith, in planning for the 12th IFSHT Congress 2022 in London. Meantime, we are also gearing up for the next APFSSH/APFSHT Congress in Singapore in 2023.

If you are interested to know more about APFSHT, our members and our ongoing activities, please find us on our website. We look forward to many eventful regional and international meetings with the Asian-Pacific Hand surgery community.

Hercy Li, Immediate Past President, APFSHT
hercyli@gmail.com

Executive Body APFSHT

President:	Ahmad Yazid Jus (Malaysia)
Imm. Past President:	Hercy Li (Hong Kong)
Secretary:	Kris Tong (Singapore)
Treasurer:	Eng Wah Tan (Malaysia)
Historian:	Kent Chang (Taiwan)
Committee Member:	Cecilia Li Wai Ping (Hong Kong) & Seiji Nishimura (Japan)

Member Society Status - Australia

Jeffrey Ecker

Australian Hand Surgery Society (AHSS)

Australia has been very fortunate with the Covid pandemic. This is largely due to the fact that we are an isolated country and have implemented a quarantine system for returning travellers. In addition, we have a very efficient contact-tracing system where contacts of people who have tested positive can be quickly identified. At times, it was necessary to isolate and restrict travel between states within the country. We are now immunising the population. It is proving to be a challenge to get a sufficient quantity of vaccines and vaccines that people trust and feel comfortable using. Each state in Australia has fared differently and adopted slightly different approaches.

The impact on myself as a surgeon in Western Australia is that I cannot leave Australia without government permission and on return I will face two weeks of mandatory quarantine in a selected hotel. The problem with hotel quarantine is that it is still possible to get infected while in quarantine because the airflow is not appropriate for a quarantine situation. People have acquired the virus while in quarantine. We are coming to the realisation that this virus is something we will live with and that it will impact our economy in terms of debt. We have had social policies to keep people employed and keep small businesses open. This is an expense that will need to be repaid in the future. I believe that Australians have been remarkably fortunate in the way Covid has impacted our population. We feel very sad to see the impact of Covid on other countries.

Jeffrey Ecker, President, AHSS
jeff@ecker.com.au

Executive Body AHSS

President:	Jeffrey Ecker
Secretary:	Mark Rose
Treasurer:	Cameron Mackay & Ian Hargreaves
Newsletter Editor:	Douglas Wheen
Archivist:	Roland Hicks

Member Society Status - India

Pankaj Ahire

Indian Society for Surgery of the Hand (ISSH)

ISSH under the leadership of Ravi Mahajan continuously engaged with the members through periodic academic postings like Sunday Reads, Article of the month, Drawing of the month, Surgical Video of the month and a Monthly Journal club. ISSH also launched its YouTube channel.

Parag Lad conducted the CME on OrthoTV platform and had a collective viewership of more than 6000. Nilesh Satbhai's efforts with the 'webinar series' brought in stalwarts of Hand Surgery from across the globe to our screens. The first edition of IWS (ISSH Webinar Series) had eighteen, 90 minute heart-to-heart talks. IWS-1 is available on ISSH website for the members and on The MediTube for the non-members.

Ravi Mahajan
President, ISSH

Parag Lad
Member, ISSH

Nilesh Satbhai
Executive Member, ISSH

Praveen Bhardwaj
Editor, ISSH

ISSH & British Society for Surgery of the Hand (BSSH) conducted a joint CME in March 2021 led by Praveen Bhardwaj (ISSH) and Sumedh Talwalkar (BSSH). Our annual conference that was to be held in Chennai in August 2020 has been rescheduled to August 2021 as a virtual conference with BSSH as Guest society. As we improve our activities on digital platforms, we hope and await the post pandemic normalcy.

Pankaj Ahire, Secretary, ISSH
secretary@issh.org

Executive Body ISSH

Ruban Sivanoli

Malaysian Society for Surgery of the Hand (MSSH)

Greetings From Malaysia,
We are going through our biggest wave of COVID, We find ourselves trying to be safe while pursuing our goals of improving the quality of hand care and services to our patients.

We managed to organise our 16th Annual Scientific meeting together with the Malaysian Hand Therapist Society. It was held virtually from the 25th -27th of March 2021. Simultaneous tendon workshops in 7 different centres throughout our country were held on the first day. We had 15-20 participants for each tendon workshop and 192 doctors and 76 hand therapists for the virtual meeting. The meeting recordings have been posted on YouTube for your viewing (Day 1/ Day 2).

President MSSH, Dr Iskander at UKM Tendon Worksop

We will be hosting the 2nd Combined ASEAN Hand Meeting from 3rd-5th September 2021 at the world famous KLCC. This will be a hybrid meeting as we understand there may be travel constraints. We are in the midst of confirming a cadaver workshop for flap dissection and a saw bone workshop for internal and external fixators. There is a logo design competition for the ASEAN Hand Society. We would love for you to join us especially if you are from the ASEAN region. Please look for updates at our Facebook page and website.

Ruban Sivanoli, Honorary Secretary, MSSH
rubansivanoli@gmail.com

Executive Body MSSH

President:	Mohd Iskander Mohd Amin
Vice-President:	Jeremy Prakash
Honorary Secretary:	Ruban Sivanoli
Honorary Treasurer:	Shams Amir
Committee Members:	Aniza Faizi, Mohd Sallehuddin, Sachin Shivdas & Shalimar Abdullah

Raymar Sibonga

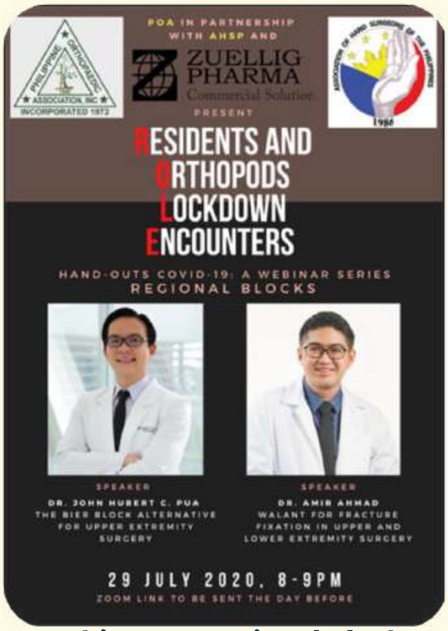
Association of Hand Surgeons of the Philippines (AHSP)

The latin phrase “Omnia mutantur, nos et mutamur in illis” means "All things change, and we change with them". The COVID-19 pandemic may have caught everyone by surprise, but not off-guard. The AHSP continued promoting medical education in hand surgery. During these difficult and uncertain times, we have organized webinar lecture series, with different orthopaedic training institutions nationwide and the Philippine Orthopaedic Association (POA). The society also launched its website "handsurgeons.ph" in order to facilitate online booking of appointments, and finding nearby hand surgeons based on patients' location.

Raymar Sibonga, Member, AHSP
raymar_sibonga@yahoo.com

Upper Extremity Workhorse Free Flaps
ASSH Webinar Emmanuel Estrella
(Past President, AHSP)

Webinar on Soft Tissue Surgery of Elbow
Nathaniel Orillaza Jr. (Past President, AHSP), Raymar Sibonga, Ajeet Tiwari (India) & Ellen Lee (Singapore)



Webinar on Regional Blocks
John Huber Pua (President AHSP) & Amir Ahmad (Malaysia)

Webinar on Hand Infections
Ameena Santos

Executive Body AHSP

President:	John Hubert Pua
Vice-President:	Eugenio Brito
Secretary:	Jessica Anne Gandionco
Treasurer:	Precious Grace Handog
Ex-Officio:	Nathaniel Orillaza, Jr.

Member Society Status - Singapore

Robert Yap

Singapore Society for Hand Surgery (SSHS)

Covid-19 has impacted us all. SSHS had to adapt to these changes. Our annual Hand review course and scientific meeting was postponed from 2020 and was held online via Zoom from 29 to 31 January 2021. It was attended by 148 participants. 44 local and international faculty presented at the conference. The Symposia on Advances in Reconstructive Microsurgery on 31 Jan 2021 included presentations from Prof Yuan-Kun Tu (Taiwan), Prof Sang-Hyun Woo (Korea), Prof Joon-Pio Hong (Korea) and Prof Zeng-Tao Wang (China).

Faculty and Participants @ SSHS Virtual Meeting January 2021

SSHS organized a Resident Review Series for Hand, Orthopaedics and Plastic Surgery resdents over a virtual platform on a weekly basis from 30 May to 18 July 2020 (8 sessions). The society also conducted 3 online teaching sessions for Hand Surgery trainees in 2020/2021.

- 26 Sep 2020, Lower Limb Reconstruction, Hand Surgery @ Tan Tock Seng Hospital
- 20 Feb 2021, Wrist Trauma, Hand Surgery @ Singapore General Hospital
- 20 Mar 2021, PIPJ Injuries, Ortho-Hand Partners @ Gleneagles Hospital

The SSHS Travelling Fellowship was suspended in 2020. The 6th Congress of the Asia Pacific Wrist Association scheduled for 2020 will be held along with the APFFSH meeting in 2023. SSHS intends to hold a joint meeting with the British Society for Surgery of the Hand from 11-13 February 2022 in Singapore. Further updates will be posted on the society's web page. Our society has 81 members.

Robert Yap, Secretary, SSHS
robertyap@yahoo.com

Executive Body SSHS

President:	Mark Puhaindran
Vice-President:	Sreedharan Sechachalam
Secretary:	Robert Yap
Treasurer:	Jackson Jiang
Editor:	Rebecca Lim
Committee Members:	Duncan McGrouther & Soumen Das De
Auditors:	Jacqueline Tan & Dawn Chia

Member Society Status - South Korea

Hyun Sik Gong

Korean Society for Surgery of the Hand (KSSH)

Members of the Korean Society for Surgery of the Hand (KSSH) are also suffering from the continued impact of COVID-19 and many local in-person meetings have been cancelled. Eager to see each other, at least online, we held two online symposia and a one day combined meeting.

- Triangular fibrocartilage complex injury: controversies and challenges on February 22, 2021
- Treatment of the contracture inducing hand malfunction: principle and strategy on May 3, 2021
- The Past, Present, and Future in Hand and Microsurgery" on May 29, 2021. Annual Combined Symposium of the KSSH and Korean Microsurgery Society

1st KSSH Webinar Symposium 2021

The number of attendees were more than we expected, reflecting the desire to continue learning and sharing knowledge in hand surgery. We found this platform was welcomed by our younger members who appreciated the time and energy saved compared to in-person meetings. We are planning to continue this bimonthly webinar.

The annual congress of the KSSH is planned for November 5-7, 2021 with Kwang Seog Kim (Chonnam National University) as Chairman and Jong Woong Park (Korea University) as President. We sincerely hope all members of the APFSSH stay healthy and happy through this difficult period.

Hyun Sik Gong, Scientific Committee Chair, KSSH
hsgong@snu.ac.kr

Executive Body KSSH

President:	Jong Woon Park
Chairman (Board):	Kwang Seog Kim
Director, General Affairs:	Hong il Kim
Treasurer:	Jae Sung Lee & Jin Soo Kim
Directors:	Dong Hyo Shin, Hyun Sik Gong, In Hyeok Rhyou, Jae Ha Hwang, Jae Hoon Lee, Jin ho Kim, Joo Yup Lee, Sae Hwi Ki, Seok CHan Eun, Seung Suk Choi, Soo Hong Han, Young Cheon Na, Young Ho Kwon & Young Ho Lee

Upcoming Events

Upcoming Events

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APPENDIX D

FESSH report

IFSSH Delegates' Council meeting
3 July 2021

History of FESSH

FESSH was established in 1990 by 13 European national hand societies. Now FESSH has 29 full and associate members and also corresponding members. http://fessh.com/member-societies/ FESSH represents approximately 4000 hand surgeons in Europe.

Since 1993 FESSH holds the European hand congress yearly including among several programmes an instructional course and lately live surgery sessions.

http://fessh.com/past-fessh-congresses/

The FESSH Council members lead the committees responsible for different activities.

http://fessh.com/council-members/

FESSH is the organising body behind the European Board of Hand Surgery Examination since 1996 which is much valued outside Europe as well. In 2021 100 examinees applied to prove their knowledge on the written and oral EBHS Exam. http://fessh.com/examination-committee/examination-2022/

FESSH MEMBER NATIONAL SOCIETIES

- Austrian Society for Surgery of the Hand (ÖGH)
- Belgian Hand Group (BHG)
- Bulgarian Society for Surgery of the Hand (BSSH)
- Czech Society for Surgery of the Hand (CSCR)
- The Danish Society for Surgery of the Hand (DSFH)
- Estonian Society for Surgery of the Hand (EKKS)
- The Finnish Society for Surgery of the Hand (SKKY)
- French Society for Surgery of the Hand (SFCM/GEM)
- German Society for Surgery of the Hand (DGH)
- Hellenic Society for Surgery of the Hand and Upper Limb (EEXX)
- Hungarian Society for Surgery of the Hand (MKT)
- Irish Hand Surgery Society (IHSS)
- Italian Society for Surgery of the Hand (SICM)
- Latvian Association for Surgery of the Hand (LRKA)
- Society for Surgery of the Hand of Republic of North Macedonia
- Norwegian Society for Surgery of the Hand (NFH)
- Polish Society for Surgery of the Hand (PTCR)
- Portuguese Society of Hand Surgery (SPOCMA)
- Romanian Society for Surgery of the Hand (SRCR)
- Spanish Society for Surgery of the Hand (SECMA)
- Swedish Society for Surgery of the Hand (SFH)
- Swiss Society for Surgery of the Hand (SGH)
- The Netherlands Society for Surgery of the Hand (N
- Turkish Society for Surgery of the Hand and Upper Extremity (TCD)
- Ukrainian Hand Surgery Society (UHSS)
- The British Society for Surgery of the Hand (BSSH)

Associate member

- The Israeli Society for Surgery of the Hand (ISSH)

Corresponding members

- Egyptian Society for Surgery of the Hand and Microsurgery (ESSHM)
- Hong Kong Society for Surgery of the Hand
- Lithuanian Society for Surgery of the Hand (LSSH)
- Slovak Association for Hand Surgery (SSCR)
- Slovene Society for Surgery of the Hand

FESSH COUNCIL MEMBERS

Secretary General
Daniel Herren *(Switzerland)*

Treasurer / Finance Committee
Alex Lluch *(Spain)*

Academic Committee / Journal of Hand Surgery
J. Henk Coert *(The Netherlands)*

Academic Committee / Research
Simon Farnebo *(Sweden)*

Communication Committee
Zafar Naqui *(UK)*

Congress Committee
Brigitte van der Heijden *(The Netherlands)*

Examination Committee
Martin Richter *(Germany)*

Relationship and Subspecialties Committee
Frederik Verstreken *(Belgium)*

Relationship and Subspecialties Committee / Hand Trauma
Pierluigi Tos *(Italy)*

Training and Education Committee
David Shewring *(UK)*

Editor-in-Chief of the Journal of Hand Surgery (European Volume)
Jin Bo Tang *(China)*

Young European Hand Surgeons (YEHS) delegate
Letizia Marenghi *(Italy)*

FESSH-ON(line)- WEEKs (FESSH online congresses in 2020/2021)

Registration total: 1148/1421
- participants: 923/1214
- company representatives: 225/207

Companies 13/22
Virtual stands 8/13

61 countries
TOP 10

1. Switzerland
2. The Netherlands
3. Germany
4. United Kingdom
5. Spain
6. Austria
7. Poland
8. Finland
9. Italy
10. Belgium

57 countries
TOP 10

1. The Netherlands
2. Switzerland
3. United Kingdom
4. Germany
5. Spain
6. Austria
7. Belgium
8. France
9. Italy
10. Greece

FUTURE FESSH CONGRESSES

2022 IFSSH-IFSHT-FESSH London, UK
2023 FESSH Rimini, Italy
2024 FESSH Rotterdam, Netherlands
2025 FESSH Helsinki, Finland
2026 FESSH Switzerland

http://fessh.com/future-fessh-congresses/

FESSH EDUCATIONAL EVENTS in 2021

- FESSH Online Workshops 22-24 April 2021 (free of charge)
- FESSH Academy (live 4 day course for trainees in Budapest, Hungary) 20-23 October 2021
- FESSH MasterClass (online course for advanced surgeons) 18-20 November 2021

FESSH support for the hand surgeons' community

- FESSH Travel Award http://fessh.com/travel-award/
- FESSH Basic Research Grant http://fessh.com/basic-research-grant/
- FESSH Clinical Research Grant http://fessh.com/clinical-research-grant/
- FESSH Patronage for high quality hand surgical events http://fessh.com/patronage/

Keep in contact with FESSH

- **FESSH Hand Out** – bimonthly newsletter

Send your request to office@fessh.com for signing up

- **FESSH social media platforms**

https://twitter.com/FESSHEurope
https://www.facebook.com/FESSH
https://www.linkedin.com/company/11803216/admin/
https://www.instagram.com/fessh_europe/

- **FESSH Office** via office@fessh.com

Hand and Wrist Biomechanics International Symposium

In conjunction with XXVIII Congress of the International Society of Biomechanics

Digital Congress
headquartered in Stockholm, Sweden
25-29 July 2021

Table of contents

Notes from the chair

Dear All,

It is our great pleasure to welcome you to the Hand and Wrist Biomechanics International (HWBI) Symposium, digitally held in conjunction with the XXVIII Congress of the International Society of Biomechanics (ISB). HWBI is grateful to ISB for sponsoring the HWBI program and providing the platform for our scientific exchange.

The Program Committee led by Frederic Werner, Angela Kedgley, and Ronit Wollstein have put together a scientific program composed of keynote lectures, podium presentations, a membership meeting, an award session, and networking opportunities. Marc Garcia-Elias, MD, Veronique Feipel, PhD, and Kan-Nan An, PhD, will deliver keynote lectures on wrist kinetics and clinical applications, wrist biomechanics, and a history of hand/wrist biomechanics, respectively. The scientific sessions cover hand biomechanics, wrist kinematics, carpal bone motion, hand-wrist interaction, modeling, imaging, motor control, hand arthritics, surgical technique, prosthesis, and other hot topics. Those who are able to attend the symposium will have the opportunity to listen to these innovative ideas and network with other research professionals.

This opportunity for mutual scientific exchange and collaboration in hand and wrist biomechanics began by an innovative group of hand surgeons, engineers, and therapists who organized the first International Hand and Wrist Biomechanics Symposium in Brussels, Belgium in 1995. In 2012 at the 8th Triennial International Hand and Wrist Biomechanics Symposium in Yokohama, Japan, the international advisory board decided to form HWBI to enhance the development of hand and wrist biomechanics and its clinical applications. A Board of Directors was established to steer the HWBI initiative. These directors have included Kai-Nan An, Moroe Beppu, Marc Garcia-Elias, Zong-Ming Li, David Nelson, Frederic Schuind, William Seitz, Fong-Chin Su, and Frederick Werner.

The purposes of the HWBI are (1) to provide an international forum for those interested in the biomechanical aspects of basic and clinical research focusing on the hand and the wrist, (2) to encourage international collaborations among engineers, clinicians, therapists, and others in the area of hand and wrist biomechanics, (3) to promote knowledge of hand and wrist biomechanics and its clinical and practical applications, (4) to plan on regularly occurring symposia of HWBI, and (5) to cooperate with the International Society of Biomechanics (ISB), the International Federation of Societies for Surgery of the Hand (IFSSH), and other related organizations for synergistic activities.

Given these initiatives and the increasing need for innovative cross-disciplinary collaboration to further this field of study, HWBI would like to get more people involved in its leadership. We have been reforming the governance structure by renaming the Board of Directors as the International Advisory Board and establishing an Executive Committee. It is wonderful to present to you our first Executive Committee. The Executive Committee is currently preparing its future symposia. We will be presenting at the Congress of International Federation of Societies for Surgery of the Hand in London and World Congress of Biomechanics in Taipei, both in 2022. Please continue to join us.

Enjoy the 2021 HWBI Symposium.

Sincerely,

Zong-Ming Li, PhD

History of HWBI

The hand and wrist represent one of the most challenging structures in the study of biomechanics, as well as in the evaluation of many biomechanical principles. Hand and wrist biomechanics have been somewhat underdeveloped in comparison to mainstream biomechanics research over the past century. While numerous biomechanical studies have been initiated by surgeons and engineers, collaborative efforts among scientists and clinicians are required for continuing progression in research and further improvement of treatment modalities and outcomes. The 2021 HWBI symposium within the 2021 ISB conference continues our tradition of reporting on the latest research in the field of hand and wrist biomechanics.

Previous meetings and symposia:

- 2020 Cleveland, USA (Cancelled due to COVID-19)
- 2019 Berlin, Germany
- 2018 Copenhagen, Denmark
- 2017 Brisbane, Australia
- 2016 Buenos Aires, Argentina
- 2015 Milan, Italy
- 2012 Yokohama, Japan
- 2010 Cleveland, USA
- 2007 Tainan, Taiwan
- 2004 Syracuse, USA
- 2001 Izmir, Turkey
- 1998 Minneapolis, USA
- 1995 San Francisco, USA
- 1992 Brussels, Belgium

Executive Committee

President: Zong-Ming Li
Secretary: Frederick W. Werner
Treasurer: William H. Seitz, Jr.
President-Elect: Joseph J. Crisco
Secretary-Elect: Angela Kedgley
Treasurer-Elect: Ronit Wollstein
Councillors: Veronique Feipel
Toshiyasu Nakamura
Li-Chieh Kuo

International Advisory Committee

Kai-Nan An, Chair
Moroe Beppu
Marc Garcia-Elias
Zong-Ming Li
David L. Nelson
Frederic Schuind
William H. Seitz, Jr.
Fong-Chin Su
Frederick W. Werner

2021 Symposium

Programme committee:

Fred Werner
Angela Kedgley
Ronit Wollstein
Zong-Ming Li

We thank the ISB for supporting the keynote lectures and awards for the 2021 Symposium.

Upcoming Meetings

Join us at:

- IFSSH, London, June 6-10, 2022
  https://www.ifssh-ifsht2022.co.uk
- WCB, Taipei, July 10-14, 2022
  http://wcb2022.com

We look forward to seeing you there.

Membership

We encourage all those who are interested in the biomechanics of the hand and wrist to register with HWBI. It is free to join. Simply complete the form at www.hwbi.org/membership. This will ensure that you hear about upcoming symposia, conferences, and events in which HWBI is participating.

Keynote speakers

Dr. Garcia-Elias graduated in 1978 at the Universitat Autònoma Medical School, Barcelona, Spain. He obtained his certification as specialist in Orthopaedic Surgery in 1982, and his doctoral degree (PhD) by the University Autònoma of Barcelona, Spain in 1985. From 1986 to 1989, he worked as visiting scientist at the Orthopedic Biomechanics Laboratory of the Mayo Clinic. Since returning to his homeland, he has kept his interest in basic science of the upper limb. Since its foundation in 1994, Dr Garcia-Elias co-directs the Institut Kaplan for Hand Surgery in Barcelona, Spain. He is PhD coordinator of the Upper Limb Biomechanics laboratory of the Department of Anatomy of the Universitat Autònoma de Barcelona Medical School, in Bellaterra, Barcelona, Spain. Since 2019, he is also President of the International Federation of Societies for Surgery of the Hand (see https://www.ifssh.info/officers.php). His areas of major interest are the anatomy and biomechanics of the wrist and the treatment of wrist and distal radioulnar instability. He has published 3 books, 74 chapters, and 168 peer reviewed (Pubmed indexed) articles, most of them on the anatomy and biomechanics of the wrist, or on surgery of the carpus and distal radioulnar joint instability

Veronique Feipel is a Professor of Functional Anatomy at the Université Libre de Bruxelles (ULB), Belgium. She is currently Dean of the Faculty of Motor Sciences and coordinator of the Research Master in Motor Sciences at ULB. She completed her PhD at ULB in 1997 and was a postdoctoral fellow in the LIS-3D – Sainte-Justine Hospital, Montreal, in 2000. Veronique has been a member of the ISB since 1999, has been a council member of ISB and has enjoyed the ISB meetings since attending her first ISB meeting in Calgary in 1999. She is Fellow of the ISB.

Veronique's research interests include spine, wrist and knee kinematics, clinical applications of musculoskeletal modelling and gait analysis. Over the past few years, her personal interest in sports led her to broaden her research efforts on the prevention of running related injuries and its link to running biomechanics. Veronique leads a group of researchers in the Laboratory of Functional Anatomy aiming to facilitate clinical penetration of biomechanics research. She will continue supporting with energy research in the field of her first love, wrist biomechanics..

Kai-Nan An received his B.S. degree from the National Cheng-Kung University in 1969 in Taiwan; and Ph.D. in mechanical engineering and applied mechanics in 1975 from Lehigh University in Bethlehem, PA, USA. He served as the Director (1993-2014) of the Orthopedic Biomechanics Laboratory at the Mayo Clinic in Rochester, MN, and Professor of Bioengineering, Mayo Medical School. He was named the John and Posy Krehbiel Professor of Orthopedics, Mayo Medical School, in 1993. He has co-authored more than 940 scientific articles and book chapters. He actively serves as a mentor and advisor to graduate students and research fellows, as well as various medical and engineering organizations. His research interests include biomechanics, biomaterials, medical imaging, orthopedics and rehabilitation. He has received several awards from various societies, including the You-Li Chou Medal from the Taiwanese Society of Biomechanics, the Borelli Award from the ASB, and the Muybridge Award, the ISB; the Neer Award from ASES, the Kappa Delta Award from AAOS.

Monday, 26 July 2021
12:00-13:00 CET
Chairs: Verónica Gracia Ibáñez and Zong-Ming Li

Time	Talk	Speaker
12:00-12:12	Scan-driven fully automated pipeline for a personalized, 3D printed low-cost prosthetic hand	Yair Herbst
12:12-12:24	Complementary functions of the joint morphology and ligaments in providing stability to first the carpometacarpal joint	Wan Mohd Radzi Rusli
12:24-12:36	Uniformity of performance during the collection of maximum voluntary contraction tasks for the muscles of the wrist	Oluwalogbon Akinnola
12:36-12:48	The effect of wrist posture on grip and muscle force capacities: comparison of a prehensile and a non-prehensile task	Mathieu Caumes
12:48-13:00	Characteristics of palmar and dorsal flexion muscle strength in college baseball players	Kazuhiro Ikeda

Tuesday, 27 July 2021
13:45-14:45 CET
Chairs: Kai-Nan An and Angela Kedgley

Time	Talk	Speaker
13:45-14:09	Keynote: My understanding of wrist kinetics	Marc Garcia-Elias
14:09-14:21	Fused with motion: A biomechanical comparison of dart throw motions after partial wrist fusions	Frederick Werner
14:21-14:33	In vivo validation of musculoskeletal model of the wrist featuring a consistent anatomical data set	Oluwalogbon Akinnola
14:33-14:45	Palmar musculature and its role as a dynamic compressor of the carpal tunnel	Ronit Wollstein

17:15-18:15 CET
Chairs: Jennifer Nichols and Fred Werner

Time	Talk	Speaker
17:15-17:27	Biomechanical evaluation of a fracture fixation system for transverse fractures of the metacarpal neck	Rena Mathew
17:27-17:39	Reproducibility of trapeziometacarpal joint angle measurements using dynamic CT	Michael Kuczynski
17:39-17:51	Three-dimensional carpal tunnel reconstruction and analysis using multimodal co-registration of ultrasonography and computed tomography	Hui Zhang
17:51-18:03	Model of the midcarpal joint accounting for structural difference	Ronit Wollstein
18:03-18:15	An implantable differential mechanism to restore individuated finger flexion following tendon transfer surgery	Suraj Chakravarthi Raja

Wednesday, 28 July 2021

13:30-14:30 CET

Chairs: Benjamin Goislard de Monsabert and Ronit Wollstein

Time	Talk	Speaker
13:30-13:54	Keynote: Recent advances in wrist biomechanics	Véronique Feipel
13:54-14:06	A new radiographic index for early diagnosis of perilunate injuries	Fernando Pinto
14:06-14:18	Force transmission via intertendinous linkages of the m. flexor digitorum profundus	Guido Geusebroek
14:18-14:30	Monitoring development in children using hand function	Vasiliki Vardakastani

15:45-16:45 CET

Poster session

17:00-18:00 CET

Chairs: Zong-Ming Li and Fred Werner

HWBI General Meeting		
https://arizona.zoom.us/j/85273588356		
17:00-17:15	Keynote: History of hand and wrist biomechanics	Kai-Nan An
17:15-17:25	Awards	
17:25-18:00	Business Meeting	

Posters
Wednesday, 28 July 2021
15:30-16:30 CET

Title	Presenter
Inter- and intra-participant uniformity of muscle activation during wrist motion	Oluwalogbon Akinnola
In-vivo measurement of wrist angles during the dart-throwing motion using inertial measurement units	Gabriella Fischer
Thumb range of motion in osteoarthritis and effect on hand function	Verónica Gracia-Ibáñez
Carpal bone arch changes in response to carpal bone rotation	Jocelyn Hawk
Relationship between the global movement of the hand and the forearm muscles during typing	Takanori Ito
Reduction of number of tasks to obtain hand kinematic synergies	Néstor Jarque-Bou
Learning from the measurable: Predicting changes in Hill-type muscle parameters from lateral pinch	Kalyn Kearney
Concurrent changes in median nerve deformation and displacement during gripping	Aaron Kociolek
Effect of thumb IP joint posture on CMC joint movement during thumb opposition	Hiroshi Kurumadani
Open vs closed articular architecture of the forearm for an analysis of muscle recruitment during throwing motions	Claire Livet
Evaluating anthropometrically scaled models of lateral pinch to characterize the pediatric hand	Tamara Ordonez Diaz
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UNIFORMITY OF PERFORMANCE DURING THE COLLECTION OF MAXIMUM VOLUNTARY CONTRACTION TASKS FOR THE MUSCLES OF THE WRIST

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Summary

Maximum voluntary contraction (MVC) plays an important role in how we interpret electromyographical data. No protocol exists for finding MVC in forearm muscles though recommendations are available. This investigates the uniformity of MVC performance in recommended tasks and whether variance muscle activity is due to variance in force generated.

Introduction

Electromyography (EMG) is commonly used to record muscle activity. To enable inter- or intra-subject comparisons, measurements of maximum voluntary contraction (MVC) are used to normalize EMG data. There is no standardised protocol for obtaining MVCs of muscles of the upper limb. To create the most efficient protocol, it is important to understand the relationship between the forces and moments applied by participants during tasks designed to elicit MVCs. Therefore, the objective of this study was to quantify EMG signals and kinetics during a series of isometric tasks to provide a basis for an efficient and effective protocol to obtain MVCs in muscles of the forearm.

Methods

Fifteen right-handed participants (10 female, 5 male, 23.67 ± 4.5 years old) had nine surface EMG sensors (Delsys, Natick, MA) placed on their dominant forearm to capture muscle activity of the flexor carpi radialis (FCR), flexor digitorum superficialis (FDS), flexor carpi ulnaris (FCU), extensor digitorum communis (EDC), extensor carpi ulnaris (ECU), extensor carpi radialis (ECR), pronator teres (PT), biceps and triceps. Adapting the method from Ngo and Wells [1], participants performed tasks designed to elicit MVC of each muscle. These were: pull up, push down, radial pull, ulnar pull, pull, pronation, finger flexion, finger extension, grip, as well as two activities of daily living (ADL), which were turning a key in a lock and pouring a glass of water from a jar. The ADL tasks provided a baseline measure for expected muscle activations. A six degree of freedom load cell mounted to a handle measured the forces and moments applied.

Results and Discussion

The activity that elicited MVC for each muscle varied between participants (Fig. 1). For example, the MVC for PT occurred for most participants during the pronation-supination task, but it occurred during the pull up task and pull down tasks for two participants. Data from the load cell confirmed that the directions of the external forces exerted by the hand were the same for all participants (Fig. 2), indicating that the participants performed the activities correctly.

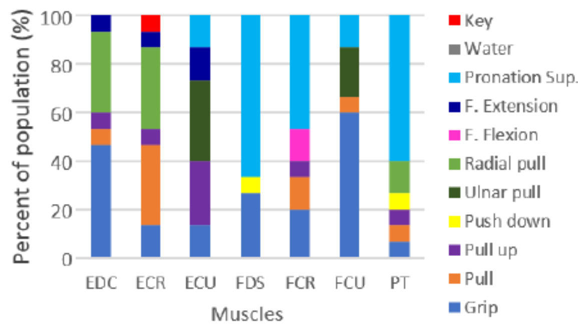

Figure 1:The percentage of people that generated maximum voluntary contraction for each muscle for all tasks.

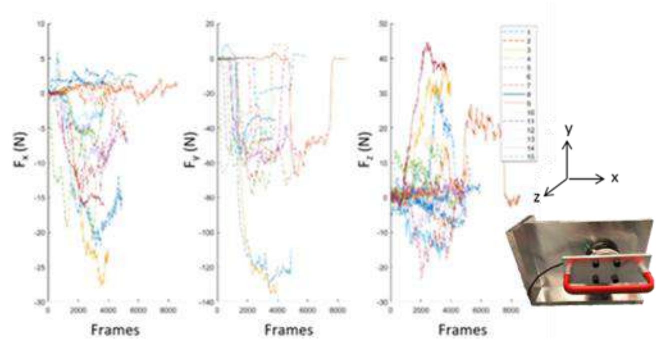

Figure 2:Load cell readings for all 15 participants for the push down task.

The forces and moments applied to the load suggest participants used different combinations of muscles to achieve the same external reaction force at the hand. Physiological differences may the reason. This agrees with the findings of Maier et al., who investigated muscle synergies during precision grip and found that the interindividual variability was large enough to preclude the creation of a standard synergistic pattern [2]. They concluded that it was not the moments involved in the task but the central nervous system that chooses short-term, flexible synergies to achieve the task. This could result in participants using different muscles to achieve the same end task-oriented goal.

Conclusions

These findings indicate that, rather than prescribing a single activity to obtain the MVC of each muscle, a range of activities should be used to quantify the MVCs of wrist and hand extrinsic muscles to account for variations in activation strategies across the population.

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IN VIVO VALIDATION OF A MUSCULOSKELETAL MODEL OF THE WRIST FEATURING A CONSISTENT ANATOMICAL DATA SET

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Summary

Activity of seven forearm muscles during wrist flexion-extension and radial-ulnar deviation was compared to muscle forces predicted from corresponding kinematics. The model predicted agonist muscle activity but perform poorly predicting antagonist activity. Co-contraction is needed for models to accurately predict forearm muscle activity.

Introduction

Musculoskeletal models of the wrist have been developed with averages of anatomical parameters, which has been shown to significantly affect model predictions [1]. The Imperial College London wrist model was developed from a consistent anatomical data set and previously validated in vitro [1]. However, in vitro validation risks omitting factors present in vivo. To improve the clinical applicability of the model, this study sought to validate the model outputs with electromyographical (EMG) data.

Methods

23 participants (1.71 ± 0.08 m, 68.26 ± 12.66 kg, 28.6 ± 4.60 years) took part in this study. Each performed 15 cycles of wrist FE and RUD with their dominant hand. Muscle activity of extensor digitorum communis (EDC), extensor carpi radialis (ECR), extensor carpi ulnaris (ECU), flexor digitorum superficialis (FDS), flexor carpi radialis (FCR), flexor carpi ulnaris (FCU), and pronator teres (PT) were recorded using surface EMG (Delsys, Natick, USA). Joint kinematics recorded using an eight-camera optical motion capture system (Qualisys, Gothenburg, Sweden) were used as inputs for the model. An inversion of the EMG-to-force method was used to generate model-predicted muscle activity [2]. These were qualitatively compared to the recorded EMG data using Statistical Parametric Mapping (SPM) t-testing, Magnitude-Phase-Comprehensive (MPC), and Pearson's Correlation Coefficients (PCC).

Results and Discussion

The qualitative comparison showed a good match between the model output and the recorded EMG. FCU and FCR were observed to coactivate during flexion (Figure 1). ECU, ECRL and ECRB were observed to coactivate during extension, but muscles were only activated in the model when acting as agonists. The PCC between the predicted and recorded muscle activity was 0.04 on average. The average MPC values were 0.81 (M), 0.25 (P), and 0.83 (C). Only the ECRL predicted force was different (p=0.01) to in vivo estimates.

Both the qualitative comparison and the SPM statistical testing indicate that the model can accurately predict the muscle activation patterns of agonist muscles involved with wrist motion. However, the PCC values indicate that the model is not able to replicate the muscle activation pattern for all the muscles, specifically the antagonist muscles. This is further supported by the MPC values, which showed that the model underestimated muscle activity. The absence of co-contraction means that less activity is needed by the agonist muscles to generate the kinematics. As the model optimizes by minimizing muscle stress, if a muscle is not needed to generate the motion, it is effectively switched off. However, this is not the case in vivo, as antagonist muscles also act as stabilisers. Thus, there is a poor correlation as the model-predicted activity can be zero while the EMG shows activity. In conclusion, the model has been validated for the in vivo muscle activation patterns of agonist muscles during wrist motion. However, the inclusion of co-contraction in the model is needed to accurately capture the complete biomechanical picture.

Conclusions

In conclusion, the model has been validated for the in vivo muscle activation patterns of agonist muscles during wrist motion. However, the inclusion of co-contraction in the model is needed to accurately capture the complete biomechanical picture.

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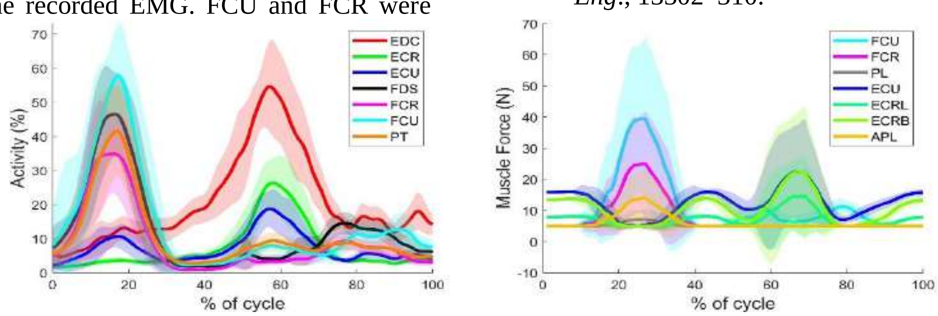

Figure 1: The muscle activity recorded by EMG (left) & simulated muscle force (right) for a participant performing flexion-extension of the wrist.

INTER- AND INTRA-PARTICIPANT UNIFORMITY OF MUSCLE ACTIVATION DURING WRIST MOTION

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Summary

The activity of seven forearm muscles were recorded during wrist flexion-extension, radial-ulnar deviation, and dart thrower's motion. Inter- and intra-participant comparisons showed people perform tasks with a consistent muscle activity pattern unique to them. The presence of co-contraction indicates that stability, not energy efficiency, may be a priority at the wrist.

Introduction

Electromyography (EMG) has been used to diagnose pathology and validate musculoskeletal models [1, 2]. Muscle activation patterns have been found to be similar for people performing the same task in the lower limb [3]. Standard activation patterns have not been reported for the upper limb, but it has been found that finger contact forces and moments are similar between people performing prehensile tasks [4]. This study seeks to establish if muscle activation patterns for fundamental and functional motions of the wrist are consistent both within and between people.

Methods

23 participants (1.71 ± 0.08 m, 68.26 ± 12.66 kg, 28.6 ± 4.60 years) took part in this study. Each participant performed three sets of five cycles of wrist flexion-extension (FE) radial-ulnar deviation (RUD), pronation-supination (PS), and dart throwing motion (DTM) with their dominant hand. The muscle activity of extensor digitorum communis (EDC), extensor carpi radialis (ECR), extensor carpi ulnaris (ECU), flexor digitorum superficialis (FDS), flexor carpi radialis (FCR), flexor carpi ulnaris (FCU), and pronator teres (PT) were recorded using surface EMG sensors (Delsys, Natick, MA). Statistical Parametric Mapping (SPM) non-parametric Multivariate ANOVA (MANOVA) was used to test for differences between the muscle activation patterns. The mean Pearson Correlation Coefficient (PCC) between the participants also calculated.

Results and Discussion

No difference was found within participants between the muscle activation patterns for each set of cycles. Activation patterns for different motions performed by the same participant differed ($p < 0.01$). Post-hoc analysis found that activation patterns for all participants differed from all other participants in every motion ($p < 0.0002$). Qualitative comparison showed different levels of co-contraction (Figure 1). Mean PCCs varied between 0.40 – 0.66.

People showed a consistent muscle activation pattern when performing a specific motion repeatedly, but this pattern differed from one individual to another. Moderate correlation across participants for all the muscles was seen. Muscles have specific anatomical functions, so some correlation is expected but it was not strong. This could be different neuromuscular strategies or a consistent strategy applied to different physiology. Co-contraction was consistent in a participant across motions but varied across them. This ranged from co-activation of multiple synergistic agonists to activation of only a select few muscles. Literature showed extended activation increases metabolic cost [5] and proposed that co-activation of the antagonist muscles in the upper limb is adopted to manage unstable interactions with the environment [6]. Thus, wrist stability during motion may be more important than conserving energy to allow for precise manipulation. This has implications for the level of subject-specificity required for the development of musculoskeletal models of the wrist.

Conclusions

Our data indicate that physiological differences may lead to varying levels of co-contraction to achieve stability. The presence of co-contraction indicates that minimising energy expenditure is not a priority at the wrist.

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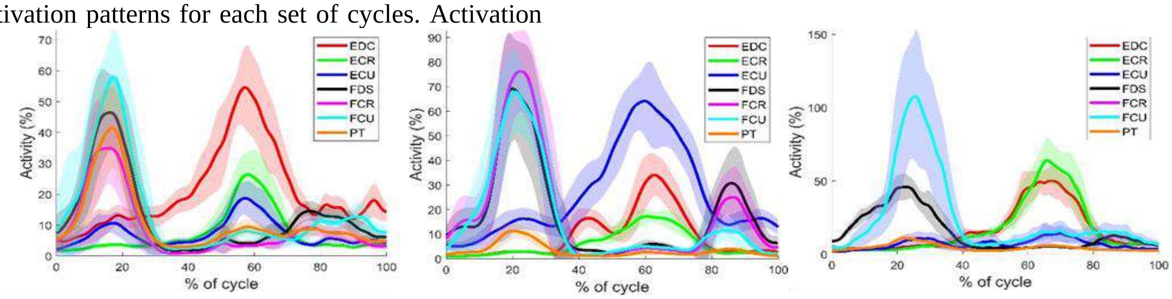

Figure 1:Mean (± 1STD) muscle activation patterns for three participants with different levels of co-contraction for 15 cycles of flexion-extension.

The effect of wrist posture on grip and muscle force capacities: comparison of a prehensile and a non-prehensile task.

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Summary

The wrist and finger are biomechanically coupled because of the hand extrinsic muscles, originating in the forearm. This coupling also influences the force-generating capabilities of the muscles crossing it. The goal of this study was to compare the effect of wrist posture on the grip and muscle force capabilities of 4 forearm muscles in a prehensile and a non-prehensile task. The non-prehensile task resulted in less co-contraction of extensors which modified the interaction between the force-length relationships of flexor and extensor muscles.

Introduction

The hand musculoskeletal system is composed of many joints and more than thirty muscles. The specific configuration of the hand musculature, including extrinsic muscles originating in the forearm, results in mechanical couplings between finger forces and the wrist joint equilibrium [1]. More precisely, it has been shown that the position of the wrist has a direct influence on the maximal grip force [2]. This influence seems to be explained by the interaction of the different force-length properties of forearm muscles [3]. However, this interaction could be modified in non-prehensile tasks, like finger pressing, as the wrist equilibrium constraints results in less antagonist activation [4]. The objective of this study was to compare the effect of wrist posture on grip and muscle force capacities for two different tasks: a finger pressing and a pinch grip task.

Methods

Nineteen volunteers (9 females, age: 21.7±2.5 years, hand length: 18.4±1.0cm) were instructed to exert a maximum force with their fingers in either a four-finger pressing or a thumb-index pinch grip configuration and in four different wrist postures. One posture was freely chosen by the participants, referred to as a “spontaneous” (S) position. The other three were imposed on the participants: a neutral (N) posture (0° of flexion and deviation), a maximal flexion (F) and a maximal extension (E). The force was recorded by a 6-axis force gauge (Nano25, ATI, Apex, NC). Simultaneously, the posture of the wrist and index finger was recorded using a 7-camera motion capture system (Qualysis, Göteborg, Sweden; 100Hz) tracking fourteen markers. Surface electromyographic (EMG) signals of six hand muscles were also simultaneously acquired (Trigno, Delsys, Natick, MA, 2000Hz).

For each trial, the maximal finger force was calculated as the mean on a window centered on the finger force peak. On this same window, joint angles were deduced from average marker positions and the activation from RMS of the EMG signal normalized by the maximal RMS. Muscle length and force of different forearm muscles were computed from joint angles and activation using a biomechanical model [3, including a geometrical model of tendon excursion and muscle force-length-activation relationships [5].

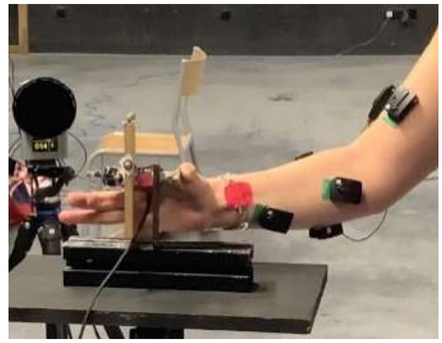

Figure 1: Photography of the experimental setup.

Results and Discussion

Wrist posture influenced differently the maximal force exerted in pinch grip and finger pressing. The highest maximal finger force in pinch grip was observed for the spontaneous wrist posture, as it has been observed for power grip [2,3]. This confirms participants spontaneously chose the wrist posture resulting in optimal flexor and extensors capabilities [3]. The maximal finger force during pressing task was less influenced by wrist posture. These different influences were explained by a change of muscle coordination, identified by EMG activity. The pressing task indeed reduced the level of co-contraction of finger and wrist extensors compared to the pinch grip task. As a result, the spontaneous posture is more variable. As the activation of extensors is low, the grip force is primarily influenced by force-length relationships of flexors which seems to produce a near-optimal force for a wide range of wrist posture. In this case, wrist posture might be more related to the participant’s daily hand use, such as sports or professional activities.

Conclusions

This study showed that wrist posture influences differently the grip capabilities and the muscle mechanics in non-prehensile and prehensile tasks. These results could help surgeons in designing tendon transfers at the wrist or give insight to ergonomic engineers in optimizing hand-object interfaces.

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An Implantable Differential Mechanism to Restore Individuated Finger Flexion following Tendon Transfer Surgery

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Summary

We developed a passive device implanted between the *flexor digitorum profundus* (FDP) tendons of insertion to construct a passive "differential mechanism" between the *extensor carpi radialis longus* (ECRL) muscle and the finger tendons (US Patents 9,925,035 and 10,595,984). This differential mechanism enables some finger(s) to continue to flex and make contact with the object even if other finger(s) are locked (checkreined) by already having made contact.

Introduction

High median-ulnar nerve injury paralyzes part of the FDP muscle and the entire *flexor digitorum superificialis* (FDS) muscle, resulting in limited grasp function by the patient. One of the current surgical solutions to restore flexion of the four fingers is a tendon transfer procedure that re-routes and directly sutures all four FDP tendons of insertion to the single tendon of insertion of the ECRL muscle, a wrist extensor innervated by the radial nerve.[e.g., 1] However, this procedure has a fundamental drawback: the surgery couples the previously independent movement of all four fingers because the excursion of the ECRL determines the excursion of all four FDP tendons of insertion. With this coupled finger flexion, all fingers cease to flex as soon as one finger makes contact with the object. This prevents all fingers from making contact when grasping irregularly shaped objects. Simple tasks such as holding an apple or using a knife with a contoured handle become challenging. This results in reduced function affecting quality of life.

Methods

We tested the implant's ability to create differential flexion between the index and middle fingers during grasp when actuated by a single muscle in two human cadaver hands using a closed-loop computer-controlled actuation and measurement paradigm. In the cadaveric models, the implants enabled significantly more differential flexion between the index and middle fingers for a wide range of donor tendon tensions. The implants also redistributed fingertip forces between fingers.

Results and Discussion

When grasping uneven objects, the difference in contact forces between the index and middle fingers was reduced by 23% when compared with the current suture-based surgery. This means that force distribution is more even with the implant in spite of the difference in flexion angle of the fingers. These results suggest that self-adaptive grasp is possible in tendon transfers that drive multiple distal flexor tendons with one donor muscle.

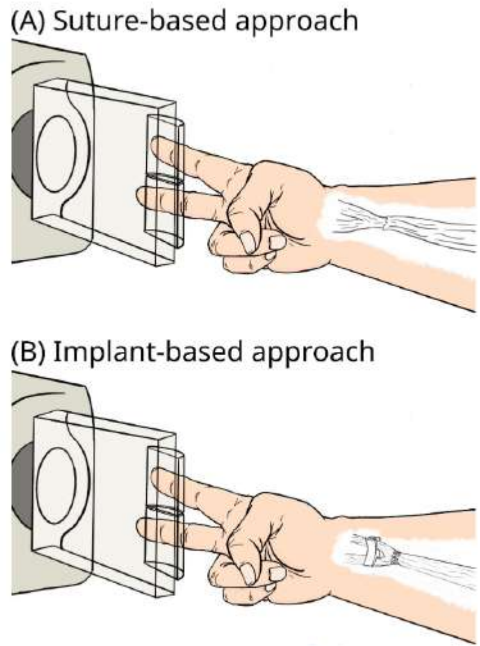

Figure 1: Experimental set up with cadaveric hands. For the traditional (A) and implant conditions (B), we measured the fingertip forces on the sensing paddle for a given tension in the donor tendon for different rotation angles of the sensing paddle.

Conclusions

The addition of an implant in the transfer of the ECRL to the FDP of the index and middle finger enhanced the cadaveric model's ability to flex each finger different amounts and apply variable pressure. Translating this biomechanical advantage to patients would likely enhance hand functional recovery after high median nerve palsy surgical reconstruction.

Acknowledgments

US Department of Defense grant *MR150091* to Balasubramanian and Valero-Cuevas; NIAMS *R01-AR050520* and *R01-AR052345* grants to Valero-Cuevas.

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In-Vivo Measurement of Wrist Angles During the Dart-Throwing Motion Using Inertial Measurement Units

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Summary

This study investigates the clinically relevant dart-throwing motion (DTM) by comparing an inertial measurement unit based system (IMU) previously validated for basic motion tasks (BMT) with an optoelectronic motion capture system (OMC). Ten healthy volunteers performed the DTM equipped with both systems. Results of both systems were comparable, but bigger differences between the systems were found than in BMT and different possible reasons were identified in this study. Its easy applicability makes the IMU interesting for clinically measuring DTM range of motion (ROM).

Introduction

Movements in the wrist during activities of daily living often occur in an oblique plane from flexion-radial deviation to extension-ulnar deviation, this movement is referred to as DTM. The DTM is clinically relevant but its ROM is not usually clinically measured with goniometers due to the complexity of the movement [1] and systems like OMC capable of capturing this movement are very complex to use and require a laboratory setting. We investigated an easy to use IMU previously validated for motion analysis of BMT in the flexion/ extension and radial/ ulnar deviation planes [2] for this more complex movement by comparing it to the motion analysis gold standard, an OMC [3].

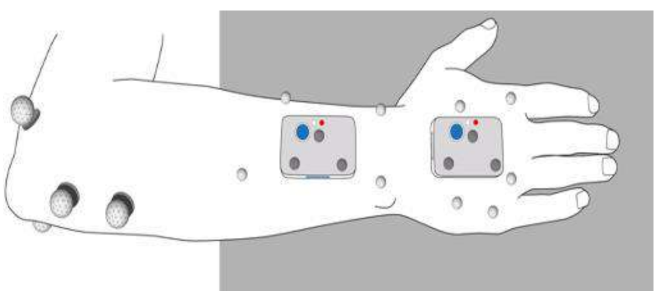

Figure 1: Sensor (IMU), skin marker (light grey, OMC1) and sensor marker (dark grey, OMC2) placement

Methods

Ten healthy volunteers were equipped with both OMC skin markers and IMU on their right hands as depicted in Figure 1 and performed the DTM a total of 10 times on two different days.

The kinematic evaluation of the OMC was based on marker clusters [4] and a functional determination of the wrist joint centre and flexion axis. Joint rotations were calculated according to an established protocol [5]. The kinematic evaluation of the IMU was carried out by the software included in the DyCare® system. The resulting mean ± standard deviation angle curves over all trials and subjects were aligned and compared. Absolute ROM in both movement axes were calculated for both systems as well as mean absolute differences (MAD) between the two systems.

Results and Discussion

We found ROM values of 99° for both systems in the flexion/ extension plane with a MAD of 7°. A ROM of 47° for the OMC1 and 62 ° for the IMU with a MAD of 17° in the radial-ulnar deviation plane was calculated. The calculated angle and velocity curves are depicted in Figure 2. The results show lower agreement between the systems than we found for BMT in an earlier study [1], possible explanations being a differently calculated orientation of the DTM plane for both systems and skin movement artefacts due to the weight of the sensors and skin markers at high velocity movements.

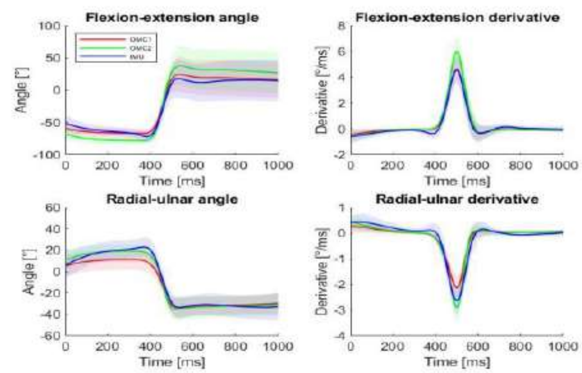

Figure 2: Wrist movement angles and movement speeds in the flexion/ extension and radial/ ulnar deviation plane during DTM

Conclusions

This study shows the challenge of comparing results of different kinematic motion capture systems for complex movements. Further investigations regarding calculation of the orientation of the DTM plane, probably using an imaging technique, would be helpful. Nevertheless, IMU are promising for future clinical application as they allow for measurement of dynamic and coupled wrist movements.

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Force transmission via intertendinous linkages of the m. flexor digitorum profundus

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Summary

Force transmission via intertendinous linkages of the extrinsic finger flexors has been proposed as one of the factors causing limited independent finger movement. We assessed force transmission via linkages between the tendons of the flexor digitorum profundus (FDP) in fresh frozen cadaver hands by exerting force on the tendon of one finger and measuring the flexion force exerted by the other fingers. Our results show that intertendinous linkages of the FDP transmit force to neighboring fingers and that the extent of such force transmission increases upon flexion of the target finger (TF).

Introduction

The independent movement of fingers is limited [1]. Unintended movement or force production of fingers is termed enslavement [2]. Besides neural factors, mechanical coupling between finger flexor tendons via intertendinous tissue may cause enslavement [3], but this has not been investigated. We assessed the effects of finger position on force transmission between FDP tendons via mechanical linkages.

Methods

In six fresh-frozen cadavers, lower arms were amputated, the volar skin was removed until the carpal tunnel, and the myotendinous junctions of the FDP were severed. The arm was secured to a frame with the fingers pointing upward and the wrist fixed at ~20° dorsiflexion. The dorsal aspect of each proximal phalangeal bone of the fingers was connected to force transducers to measure flexion force. Each non-targeted finger (NTF) tendon was loaded with a weight of 3N. Then the TF tendon was loaded with 10N. Flexion force of each finger was measured before and after loading the TF tendon and the difference was calculated (ΔForce). Each of the four fingers was tested with the TF extended and flexed in ~90°. ΔForce exerted at each NTF was expressed as a percentage of the total flexion force exerted at all fingers.

Results and Discussion

For all fingers, applying a load on the TF tendon resulted in changes of force exerted at the adjacent NTFs (Table 1). ΔForce was higher for fingers adjacent to the TF than for fingers not adjacent to the TF. ΔForce of adjacent NTFs increased upon TF flexion, ranging from 18 to 58%. except for the index finger when the middle finger was targeted (Figure 1).

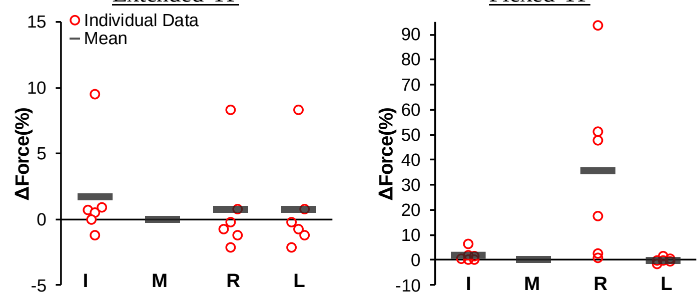

Figure 1: ΔForce(%) exerted by the NTF of each hand when the middle finger(M) was the TF; tested in extended and flexed position.

Results indicate that the linkages between the FDP tendons do transmit force when pulled on only one of the tendons and that force transmission increases upon TF flexion. Thus, intertendinous linkages of the FDP do contribute to finger enslavement, especially when one finger is moved relative to the other fingers. Intertendinous force transmission should be taken into account in the design of musculoskeletal models of the hand.

Acknowledgements

Funded by the European Commission through MOVE-AGE, an Erasmus Mundus Joint Doctorate program (2011–0015).

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Table 1: Mean ± SD per NTF for each TF. Significant ($p<0.05$) *main effects of position and interaction effects assessed with a mixed ANOVA.

ΔForce(%)		**Targeted Finger**							
		Index-finger		Middle-finger*		Ring-finger		Little-finger*	
		Extended	*Flexed*	*Extended*	*Flexed*	*Extended*	*Flexed*	*Extended*	*Flexed*
NTF	Index	-	-	1.7 ± 3.9	1.8 ± 2.3	1.1 ± 0.7	1.2 ± 1.6	0.3 ± 1	0.5 ± 0.6
	Middle	3.1 ± 9.1	18.3 ± 34.8	-	-	5.3 ± 8.4	17.9 ± 26.5	1.9 ± 3.1	0.8 ± 1.8 *
	Ring	0.7 ± 1.4	2.4 ± 3.7	0.8 ± 3.8	35.6 ± 35.8	-	-	13.7 ± 20.7	57.9 ± 33.5
	Little	0.6 ± 1.4	0.3 ± 0.7	0.2 ± 0.9	-0.1 ± 1	1.9 ± 3.1	22.8 ± 30.8	-	-

THUMB RANGE OF MOTION IN OSTEOARTHRITIS AND EFFECT ON HAND FUNCTION

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Summary

Flexion active range of motion (AROM) of thumb joints and the functional one (FROM) of 35 osteoarthritis (HOA) patients were compared with those of healthy subjects, to determine the impact of range of motion changes on hand function. AROM and FROM were measured with a Cyberglove, and FROM were computed for the angles used while performing the Sollerman Hand Function Test (SHFT). 37% of HOA patients presented an AROM reduction of CMC flexion larger than 30%. For them, an impact larger than 30% was estimated in 6 ADL, with longer execution times but only slightly lower SHFT scores. The sum of flexion AROM values of the thumb joints was also analyzed to consider inter-joint compensation. Although partial compensation was detected, it was not enough to overcome functional problems.

Introduction

It has been proposed [1] inferring the functional impact of mobility reduction in joints caused by hand diseases through the analysis of the joint angles of healthy subjects while developing activities of daily living (ADL). However, due to the complexity of hand kinematics, motion of other joints might compensate the loss of mobility. In this work, we compare the flexion ranges of motion of thumb joints of hand HOA patients to those of healthy subjects and analyze the impact of range of motion changes on hand function.

Methods

AROM and FROM of the right-hand thumb were measured to 35 HOA patients using a Cyberglove (carpometacarpal -CMC-, metacarpophalangeal -MCP- and interphalangeal -IP- joints). FROM was computed as percentiles 5% and 95% of the angles used while performing the SHFT tasks. ROM, FROM and sum of flexion AROM of the three joints (sROM) were compared to those of healthy subjects [1, 2]. The functional impact in ADL was estimated according to [1] and compared to real functionality measured through the SHFT scores and times to develop each task.

Results and Discussion

37% of HOA patients (subsample A) presented an AROM reduction in CMC flexion larger than 30%. Table 1 shows AROM and FROM of healthy subjects (37.83 ± 8.07 years) and subsample A (69.9 ± 11.2 years). These patients with reduced AROM in CMC flexion present a reduction in IP flexion, as well as in FROM values in these joints (CMC and IP), but larger FROM in MCP flexion, to compensate for the constraints in the adjacent joints. This compensation may be the origin of structural changes at MCP joint, which becomes into larger flexion AROM. However, this larger flexion does not compensate for the total sROM (Table 2) and is not enough to overcome functional problems, as patients needed longer times (Table 2) to execute those tasks where a functional impact was expected according to [1]: zipping and unzipping (T1), turning the handle (T2), fastening and unfastening buttons (T3), cutting with knife (T4), writing (T5), and pouring water (T6). Patients' age may have also contributed to these longer times [3]. However, SHFT scores are similar (Table 2).

Table 1: Statistics across subjects of AROM&FROM of patients of subsample A and healthy subjects, in degrees. Extension (E), Flexion (F), and abduction (A).

			CMC			MCP		IP	
			E	F	A	E	F	E	F
AROM	Patients Subsample A	Mean	30	8	23	28	30	31	47
		Sd	8	6	3	8	14	19	14
	Healthy subjects [1]	Mean	26	42	20	21	26	37	75
		Sd	17	10	4	12	9	15	20
FROM	Patients Subsample A	Mean	32	31	23	16	23	44	31
		Sd	2	8	0.5	4	3	4	2
	Healthy subjects [2]	Mean	21	38	23	20	16	37	42
		Sd	8	2	1	3	4	4	2

Table 2: Statistics across subjects of patients of subsample A and healthy subjects: execution time of tasks, sROM and SHFT scores.

		Execution time (s)						sROM (deg)	SHFT score
		T1	T2	T3	T4	T5	T6		
Patients Subsample A	mean	13	4	26	21	17	25	86	69.15
	sd	4	1	10	11	13	5	19	10.17
Healthy subjects	mean	8	3	22	11	6	21	170	72.15
	sd	2	1	6	3	1	3	23	2.20

Conclusions

Estimating the impact of AROM reduction from data of healthy subjects successfully identified which ADL were affected, as clearly longer execution times were found in all those tasks. Conversely, the SHFT scores hardly identified the functional problems, as they were only slightly diminished.

Acknowledgments

Projects PGC2018-095606-B-C21 (MCIU/AEI/FEDER,UE), GV/2020/067 (Regional Government) and UJI-B2017-51.

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Carpal bone arch changes in response to carpal bone rotation

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Summary

The hamate and trapezium were independently rotated to assess the influence of carpal bone motion on the carpal bone arch morphology. Carpal bone internal rotation decreased the carpal arch width. Hamate internal rotation reduced the cross-sectional area of the bone arch, but changes were small (<1.5%) at 10 degrees of rotation. The area remained invariant (-0.8% to 1.5%) in the 30 degrees trapezium rotation range. These data suggest the space at the bone portion was relatively insensitive to carpal bone rotation within 10 degrees from the initial position.

Introduction

Carpal tunnel syndrome (CTS) is a peripheral nerve entrapment syndrome affecting hand function. CTS symptoms are minimized by reducing the compressive pressure on the median nerve accomplished through carpal tunnel release surgery or compressing the distal wrist to narrow the carpal arch [1]. Carpal arch narrowing has demonstrated improvements to median nerve compression attributable to the increased area of the ligament arch [2]. However, it is unknown how carpal bone rotation associated arch narrowing affects the bone arch space. The purpose of this study was to investigate how internal rotation of the hamate and trapezium would influence the dorsal bone arch of the carpal tunnel. We hypothesized internal rotation of the distal carpal bones would decrease the carpal arch width and decrease the cross-sectional area of the bone arch.

Methods

The carpal tunnel contents were evacuated from one cadaveric hand, and a medial balloon was inserted and pressurized to 10 mmHg using a solution of water and CT contrast agent. The complete hand was scanned using a clinical CT scanner. An axial slice at the distal tunnel, including the hook of hamate and ridge of trapezium (Figure 1), was identified for analysis.

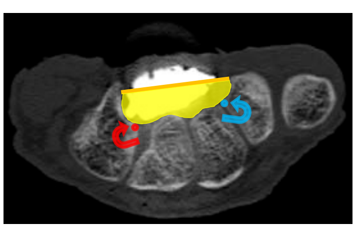

Figure 1: Carpal tunnel CT cross-section. Orange line is the carpal arch width. The yellow region is the carpal bone arch area. Hamate (red dot) and trapezium (blue dot) rotation occurs at 2-degree intervals about the point (arrows).

The carpal bones (hamate, capitate, trapezoid and trapezium) were manually segmented. Landmarks were manually identified on the hamate and trapezium surfaces, corresponding to the dorsal transverse carpal ligament insertion points, identified by the intersection of the carpal tunnel balloon and carpal bones. The line between these landmarks corresponds to the carpal arch width (Figure 1, orange line). The other set of landmarks corresponds to the rotation points on the hamate (Figure 1, red point) and trapezium (Figure 1, blue point), identified by the innermost point on the carpal arch surface of each bone. The hamate or trapezium was independently and iteratively rotated 30 degrees about the rotation point at 2-degree intervals. Carpal bone arch area was defined as the area contained by the carpal bones' inner surfaces and the arch width line. The carpal arch width and area were measured at each rotation.

Results and Discussion

As the hamate or trapezium was internally rotated by 2-degree intervals, the carpal arch width progressively decreased. The arch width decreased by 4.5 and 3.1 mm at the 30-degree rotation of the hamate and trapezium. As the rotation angle of the hamate bone increased, the carpal bone arch area decreased , but the decrease was small (<1.5% at 10 degrees). As the trapezium was internally rotated, the carpal bone arch area varied within 1.5% (Figure 2).

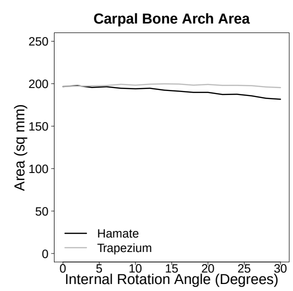

Figure 2: Measured carpal bone arch area with increasing internal rotation of the hamate (black) or trapezium (gray).

Narrowing of the carpal arch width has been shown to increase the ligament arch area [2-4], and this study showed that narrowing the arch by rotating the carpal bones within 10 degrees had a relatively small influence on the bone arch area. Our data suggests that internally rotating the distal carpal bones decreases the carpal arch width and does not affect the bone arch area. Further investigation is needed to understand the implications to the total carpal tunnel area.

Conclusions

Little change in the carpal bone arch area was observed with rotational perturbation to the carpal bones. These findings suggest that the carpal tunnel space is relatively insensitive to carpal bone motion, and the carpal ligament arch may play a more significant role in increasing the carpal tunnel cross-sectional area and decompressing the median nerve.

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Scan-Driven Fully Automated Pipeline for a Personalized, 3D Printed Low-Cost Prosthetic Hand

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Summary

The loss of a hand can drastically reduce one's quality of life by decreasing the ability to perform activities of daily living. A prosthetic arm can help assist in such activities but cost of production and manual fitting processes limit the use and prescription of these devices. Moreover, prosthetic devices still have high rejection rates for various reasons, one of which is social acceptance. In this research we propose a novel, digital design process to create a personalized prosthetic hand. Our proposed fitting paradigm is entirely digital to minimize the design time and the high cost and dependency of trained professionals throughout the process, while potentially achieving a low-cost, tailor-made design that can be accessible from anywhere on the globe.

Introduction

Although there are many solutions in the field of upper limb prosthetics, financial resources play a crucial role in prescription of these devices, especially in children due to constant growth [1]. The cost of a prosthetic hand ranges from $3,000 for a body powered prosthesis and up to $100,000 for a neuro-prosthetic arm [2]. The very high price tag makes these devices inaccessible to large portions of the population. In many cases, the price is greatly affected by the time spent on manually fitting the device. Even when financial barriers are surpassed, rejection rates of prosthetic devices are considerably high and are usually related to the following causes: age of first fitting, lack of social acceptance, weight, vulnerability of the device and lack of sensory feedback [3]. Not using a prosthesis could lead to degeneration of joints and muscles, inflammations, and other complications.

Methods

The process, in general, is obtaining user data, then automatically generating a ready to print CAD model, a circuit board and a bill of materials based on standard off-the-shelf parts and finally, assemble all parts together. The last step is the only manual one in the process but is shortened significantly by optimizing the previous steps. More specifically, we collect 2D images of the healthy hand for a parametrized model of the hand based on a functional *skeleton* and a *skin* to customize appearance thus increasing social acceptance and sense of ownership. In addition, we collect depth images of the residual limb for the hand's socket parametric design. The last type of user data collected is the user preferences which determines the user interface, such as simple body-powered or a motorized hand controlled by EMG, FMG or other interfaces, and haptic feedback. The entire process is illustrated in Figure 1.

Results and Discussion

Feedback from prospective users and from healthy subjects was collected in addition to inputs from professionals in the field. Based on the inputs received, the pipeline was improved and future research on each of the blocks will be conducted. In addition, validation tests for the hands performance and production were also conducted.

Conclusions

The proposed process and the outcome could potentially help overcome the above-mentioned difficulties and help push the prosthetic hands field into the digital design era. The entire research and final design are shared online for anyone in the world to use.

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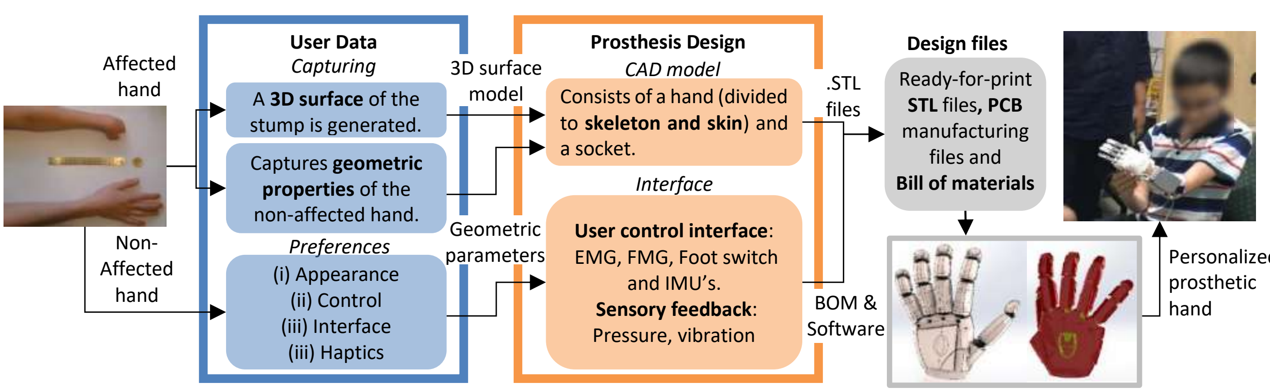

Figure 1: A block diagram of our proposed hand-fitting pipeline. Each of the blocks presents a component of the pipeline, which starts with user data and ends with a hand fitted to the user.

Characteristics of palmar and dorsal flexion muscle strength in college baseball players

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Summary (150/ 150 word)

The purpose of this study is to clarify the characteristics of wrist flexion and extension torques in college baseball players. Bilateral wrists of 50 college baseball players were evaluated. Throwing and non-throwing side, and hitting and non-hitting side were defined by the self-report. The players were divided into pitchers (P) and fielders (F) groups. In each group, the torques were compared between throwing and non-throwing side, hitting and non-hitting side. In addition, the wrist torques were compared between P and F groups for each of throwing side, non-throwing side, hitting side and non-hitting side. In group F, wrist extension torque was significantly larger on the throwing side compared to the non-throwing side. The wrist torques in F group were significantly larger than the P group in all conditions. This suggests that hitting requires more wrist flexion/extension torques than pitching. There were no significant effects in the throwing and hitting side.

Introduction

To prevent baseball pitching injury, it may be helpful to measure muscle strength related to the kinetic chain in the pitching motion. Although the wrist flexion is the end point of the kinetic chain, there is few knowledges of wrist flexion and extension torques in the baseball players. The purpose of this study is to clarify the characteristics of wrist flexion and extension torques in college baseball players. We hypothesized that the wrist flexion torque of the pitcher's is larger on the throwing side than on the non-throwing side, and is larger in the pitcher than in the fielder.

Methods

Bilateral wrists of 50 college baseball players (age: 18-21, all male, 24 pitchers and 26 fielders) were evaluated. We measured the maximum torques of wrist flexion and extension in the forearm neutral position using a self-designed wrist torque measuring machine (Three-One Design, Inc., Tsukuba, Japan) [1]. The throwing and non-throwing side, and the hitting and non-hitting side were defined by the self-report. The players were divided into pitchers (P) group and fielders (F) group. The results were divided into the throwing side or non-throwing side, and the hitting side or non-hitting side for group P and F. The wrist torques were compared between the P and F groups for each of throwing side, non-throwing side, hitting side and non-hitting side. In each group, the torques were compared between the throwing and non-throwing side, and between the hitting and the non-hitting side.

Results and Discussion

In the results of wrist flexion torques, there was no significant difference between throwing side and non-throwing side, and hitting side and non-hitting side for both P and F groups. The measurements of F group were significantly larger than P group for all comparisons. (Fig.1).

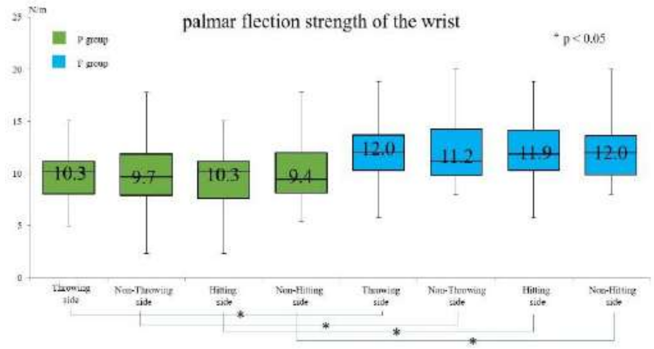

Figure 1: Results of wrist extension torques.

In the results of wrist extension torques, the throwing side torque was significantly larger than the non-throwing side in the F group. There were no significant differences in the other comparative items within the groups. The wrist extension torques in the F group were significantly larger than in the P group for all comparisons. (Fig.2).

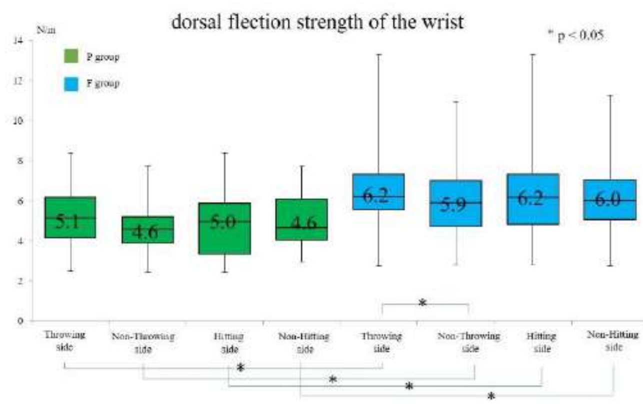

Figure 2: Results of wrist extension torques.

Conclusions

The wrist flexion and extension torque were larger in the fielders than in the pitchers in college baseball players. Fielder have more opportunities to hit, and this suggests that the wrist strength is more important in the hitting than in the pitching.

Acknowledgments: none

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Relationship between the global movement of the hand and the forearm muscles during typing

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Summary

This study aimed to examine the relationship between the global movement of the hand (GMH) and the forearm muscles during typing. Seven healthy adults input Japanese sentences. The Unchanging Typists (UT) group consisted of subjects with lower than average right-hand GMH, and the Changing Typists (CT) group consisted of subjects with higher GMH. There was a significant difference in GMH between the groups ($p < 0.05$). There was no significant difference in muscle activities between the groups. These data indicated that although GMH can affect the spatiotemporal efficiency of typing movements, maintaining a static home position is not necessarily an explanatory factor that reduces the cost of forearm muscle activities during typing.

Introduction

The fingers and hands used for keystrokes depend on the individual's typing style [1]. The UI and o keys are located on the right side of the QWERTY keyboard, so they are repeatedly inputted by the fingers of the right hand in the case of Japanese sentences. While most typists move their entire hand toward the key to be typed, the others have a spatiotemporally efficient strategy of keeping their hand in a static home position during typing. However, the relationship between these strategies and the forearm muscle activities is not clear. This study aimed to show the relationship between changes in the GMH and forearm muscle activities during Japanese text input.

Methods

Seven healthy adults volunteered in the experiment. We used a 3D motion capture system, surface EMG and QWERTY keyboard. Infrared-reflecting markers were attached to landmarks and measured kinematics parameters (**Figure 1**). Surface EMG was attached to the right side of four forearm muscles (**Table 1**). Subjects entered the sentence of about 5,000 characters in Japanese. The UT group and the CT group data were compared using the unpaired *t*-test ($p < 0.05$).

Results and Discussion

The location mapping of the right wrist, hand, and index finger for UT and CT group (**Figure 1**).

Figure 1: Mapping of UT group (**upper**) and CT group (**lower**).

There was a significant difference in the GMH between the groups. ($p < 0.05$). Comparisons of physical and kinematics parameters and muscle activities between groups showed no significant differences.

Table 1: Physical and kinematics parameters and muscle activities.

	Unchanging (n=3)	Changing (n=4)	*p*
global movement of the hand : GMH (mm/sec)	15.6 ± 0.2	40.7 ± 10.2	*0.02
Wrist width (cm)	6.6 ± 0.1	6.7 ± 0.5	0.93
Index finger length (cm)	8.9 ± 0.4	9.7 ± 0.7	0.17
Typing time (sec)	533.3 ± 270.0	209.8 ± 25.6	0.22
Changes of Wrist radial/ulnar deviation (deg/sec)	5.2 ± 1.6	11.8 ± 4.9	0.14
Changes of MP abduction/adduction deviation (deg/sec)	15.2 ± 3.8	25.4 ± 4.5	0.07
%MVC : Flexor carpi radialis (%)	1.0 ± 0.3	1.6 ± 0.6	0.27
%MVC : Flexor carpi ulnaris (%)	0.6 ± 0.2	1.0 ± 0.7	0.45
%MVC : Extensor carpi radialis (%)	3.0 ± 1.5	1.3 ± 0.4	0.13
%MVC : Extensor carpi ulnaris (%)	4.0 ± 2.8	2.7 ± 0.8	0.51

In the CT group, the index finger entered the ‘u’ key and vowels such as ‘i’ and ‘o’ key, and the home position was changed at any time. This strategy may be controlled by changes in hand posture due to forearm muscle activities and changes in segment position due to proximal muscles. Therefore, we did not observe an increase in forearm muscle activities.

Conclusions

The GMH can affect the spatiotemporal efficiency of typing movements. Maintaining a static home position is not necessarily an explanatory factor that reduces the cost of forearm muscle activities during typing movements.

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REDUCTION OF NUMBER OF TASKS TO OBTAIN HAND KINEMATIC SYNERGIES

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Summary

Principal Component Analysis (PCA) has been extensively used to reduce hand kinematics because hand joints have coordinated movements (kinematic synergies). However, synergies are task-dependent and the variety of tasks the hands can perform during daily life is vast. The aim of this work is to identify a small set of tasks representative of the hand kinematic synergies during activities of daily living (ADL) by using an iterative PCA method. Kinematic synergies were extracted from 16 hand joint angles recorded to 24 healthy adults while performing 24 varied ADL. As a result, 6 ADL could be enough to obtain kinematic synergies with high level of similarity to those considering a wide set of varied ADL, and with little loss of range of movement.

Introduction

PCA has been extensively used to reduce hand kinematics in many fields, such as in prosthesis design, based on the fact that hand joints have coordinated movements (kinematic synergies) [1]. These synergies are obtained from the analysis of hand kinematics during the performance of some tasks. However, the variety of tasks the hands can perform during daily life is vast. The aim of this work is identifying a small set of tasks representative of the hand kinematic synergies during ADL.

Methods

Hand kinematics data from [2] were used (16 joint angles of 24 right-handed healthy adults while performing 24 varied ADL). A first PCA (eigenvalues>1, Varimax rotation, standardized data) was applied to all the data to identify the kinematic synergies (^{24}PCi). Then, an iterative method was followed: in each step, the kinematic data was reduced by removing each ADL data one-by-one, and the resulting N datasets were used as input in N PCA (one PCA per each ADL; N=24-k, in the k-th step). In this case, a non-standard scaling was applied, using the mean and SD of the original matrix. In each step, the dataset explaining highest variance was selected as input for the next step. This iteration was repeated until one ADL remained (k=23). Finally, the similarity between the synergies in each step ($^{24\text{-}k}$PCi) and the original ones (^{24}PCi) was checked by means of the angles between the vectors that represent both set of synergies, and the comparison of the scores of $^{24\text{-}k}$PCi respect to ^{24}PCi.

Results

Five synergies (^{24}PCi) representative of all the ADL were obtained from the first PCA (with 73.1% of the variability of the original data). Figure 1 (Left) shows the % of variance of the original data explained in each step of the iterative ADL removal, where a slight decrease is observed until arriving to a set with only 6 ADL. The 5 synergies (^{6}PCi) from this set of 6 ADL explained 71.9% of the original data variance, and were quite similar to the original ones and with similar ranges in the coordinated movements (Figure 1, Right).

Discussion

The results suggest that a set with only 6 ADL (cleaning with a cloth, pouring water, putting a shirt on and doing buttons up, opening a door, talking by phone and putting shoes on and tying laces) could be enough to obtain the kinematic synergies underlying ADL, with high level of similarity to those considering a wide set of varied ADL and with little loss of range of movement. Some ADL provided high inter-subject variability. Therefore, it might be interesting to investigate the sample size required to obtain representative results of global population.

Acknowledgments

UJI-B2017-51, PGC2018-095606-B-C21 (MCIU/AEI/FEDER, UE)

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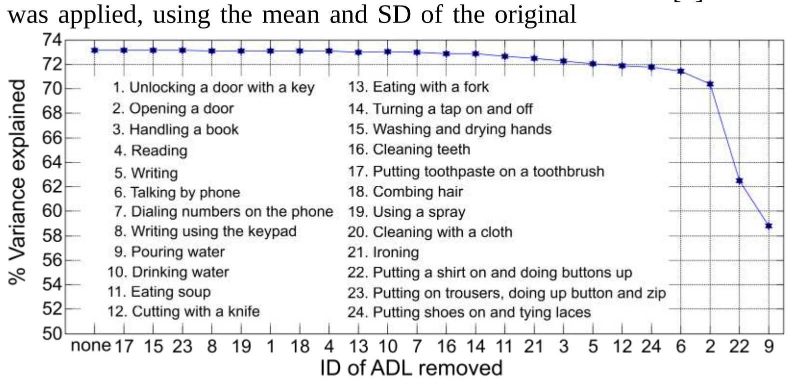

	Variance (%)	Similarity (º)	Range (%)	Joints coordination
^{6}PC1	19.73	^{24}PC2 (11º)	86.5	Flexion of fingers MCP
^{6}PC2	13.04	^{24}PC1 (14º)	87.9	Flexion of fingers PIP and little finger MCP
^{6}PC3	19.75	^{24}PC4 (9º)	77.8	Thumb, index and middle finger MCP flexion
^{6}PC4	11.06	^{24}PC3 (20º)	83.1	Palmar arching, thumb abduction, and index PIP flexion
^{6}PC5	8.31	^{24}PC5 (18º)	89.6	Thumb CMC flexion and thumb IP flexion

Figure 1: (Left) List of ADLs and plot of variance explained in each step of the iterative ADL removal. (Right) Description of ^{6}PCi: Percentage of the original data variance (24 ADL) explained by the ^{6}PCi , similarity to which ^{24}PCi and corresponding angle, range of scores with respect to that of similar ^{24}PCi. Abbreviations: Carpometacarpal (CMC); Metacarpophalangeal (MCP); Proximal Interphalangeal (PIP)

Learning from the Measurable: Predicting Changes in Hill-Type Muscle Parameters from Lateral Pinch

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Summary

Musculoskeletal models enable subject-specific analyses through controlled variation of biomechanical parameters. However, modeling even simple tasks requires assumptions about unmeasurable Hill-type muscle parameters. We tested an approach to estimate these parameters from simulated lateral pinch force using artificial neural networks. Our results suggest classifying muscle parameters from pinch force is feasible, but complex models may require more input features.

Introduction

Musculoskeletal models of the thumb are defined by over 109 independent biomechanical parameters [1]. Many of these parameters are difficult or impossible to measure *in vivo*, hindering development of subject-specific models. In this study, we present a data-driven approach to estimate the maximum isometric muscle force (unmeasurable parameter) from pinch force (measurable clinical outcome). Leveraging forward dynamic simulations and artificial neural networks (ANNs), we elucidate the role maximum isometric force of extrinsic muscles plays in lateral pinch force generation.

Methods

Four datasets of lateral pinch force were produced via forward dynamics in OpenSim v 3.3 [2]. A thumb model [1] was varied by adjusting maximum isometric force of the extrinsic thumb muscles [*abductor* (APL), flexor (FPL), and extensor (EPL) *pollicis longus* and *extensor pollicis brevis* (EPB)]. Datasets 1 through 4 contained 120, 1024, 3197, and 4096 simulations as 1-4 muscles were adjusted, respectively. The output of each simulation was a three-component pinch force vector versus time. The time-series force data was separately input into 2 ANNs: *feedforward* and *long short-term memory* (LSTM). Feedforward ANNs lack feedback within the structure [3], but are less computationally costly. LSTMs have feedback and thereby "memory" [4], which can aid study of time-dependent activities. Each ANN included 4 input nodes (time and three-component force vectors), 4 hidden nodes, and 1 hidden layer. Labeled data were grouped by whether the varied muscles were above ("High") or below ("Low") mean maximum isometric force. Modifying more muscles resulted in more labeled groups, requiring 2, 4, 8, or 16 output nodes for Datasets 1-4, respectively. Mean and standard deviation (SD) of thumb-tip force for each group were calculated. To reduce overfitting, 5-fold cross validation was used. Accuracies and losses were analyzed, and a two-sample t-test compared peak accuracies of each ANN and dataset.

Results and Discussion

The mean and distribution of final thumb-tip forces within Dataset 4 revealed the relative contributions of extrinsic muscles (Figure 1). No overlap within 1 SD occurred between groups with a high FPL maximum isometric force and that with a low one. Little overlap occurred between groups of high and low APL maximum isometric force. Both ANNs saw a decrement in performance for datasets which altered more muscles. In the feedforward ANNs, the peak accuracy for Dataset 1 was 93.2%, but 37.4% for Dataset 4. For the LSTM ANNs, the peak accuracy for Dataset 1 was 93.8%, but 34.8% for Dataset 4. Losses became substantially less stable for more complex datasets for both ANNs. Two-sample t-tests revealed that only analysis of Dataset 2 produced significantly different peak accuracies ($p<0.05$), which were higher for the LSTM than the feedforward ANN. Peak accuracies for all datasets were well above random guess.

The decrement in model performance for more complex datasets may be attributable to redundancies in muscle function. Notably, the EPL and EPB are extensors of the thumb, with the APL assisting in extension as well [5]. As Datasets 3 and 4 included changes to combinations of these muscles, the classification task of the ANN became more challenging. Optimization of ANN width and depth may benefit classification [6, 7], as well as the inclusion of more measureable inputs (e.g. kinematics, EMG)

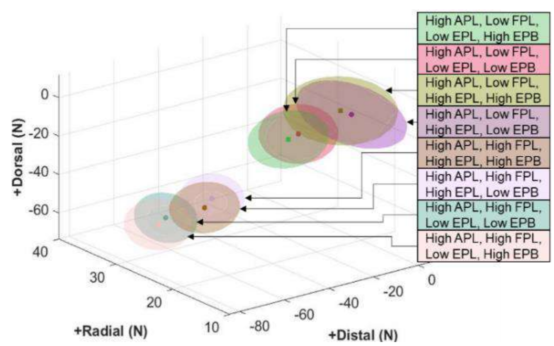

Figure 1: Thumb-tip forces for part of Dataset 4. Ellipsoid centers represent mean force and radii represent 1 SD

Conclusions

Our investigations tested the feasibility of using ANNs to predict muscle parameters from lateral pinch force. This framework is a first step toward estimating subject-specific muscle parameters from minimal, measurable data.

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CONCURRENT CHANGES IN MEDIAN NERVE DEFORMATION AND DISPLACEMENT DURING GRIPPING

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Summary

We investigated median nerve (MN) deformation and displacement in concert to elucidate carpal tunnel dynamics during forceful gripping. Twelve participants performed 3 different grip types (power, chuck, pulp) while ramping force up from 0% to 50% of maximal voluntary effort (MVE) and ramping force down from 50% to 0% MVE. Ultrasound of the transverse carpal tunnel demonstrated time-dependent changes in loading (ramping force up) versus unloading (ramping force down) for both MN deformation and displacement metrics. These results indicate that MN deformation is linked to its displacement during forceful gripping and may further suggest a viscoelastic effect due to strain of surrounding tissues, including the subsynovial connective tissue within the carpal tunnel.

Introduction

Finger exertions cause the flexor tendons in the carpal tunnel to displace palmarly, thus decreasing the distances between the flexor tendons and transverse carpal ligament [1]. Tendon displacement may, in turn, influence passive carpal tunnel structures, including the MN. Cowley et al. [2] showed the MN deformed during forceful gripping tasks, with the MN becoming more circular due to shortening in the radioulnar axis and lengthening in the palmar-dorsal axis. However, it remains unclear to what extent MN deformation is related to tendon dynamics. We evaluated MN deformation and displacement relative to the flexor tendons throughout loading and unloading of forceful gripping tasks to better elucidate tissue interactions within the carpal tunnel.

Methods

Twelve right-handed participants ramped isometric force up from 0% to 50% of MVE before ramping force down from 50% to 0% MVE for 3 different grip types (power, chuck, pulp). Grip forces were measured with a digital dynamometer (MIE Medical) at 1000 Hz in a custom LabVIEW program (National Instruments), which also provided participants with the force ramp matching profiles via visual display. The transverse carpal tunnel was imaged at the distal wrist crease using ultrasound (Vivid Q, 12L, General Electric) with an acquisition frequency of 13 MHz and a sample rate of 30 Hz. MN images were extracted from 0−50% in 10% increments of MVE during both the loading (ramping force up) and unloading (ramping force down) phases. Images were analyzed in Image J (National Institutes of Health) to determine MN cross-sectional area, circularity [$4\pi(\text{Area}/\text{Perimeter}^2)$], width (radioulnar axis), and height (palmar-dorsal axis) as well as the relative displacement between the MN and flexor digitorum superficialis tendon of the middle finger (FDS-M). Three-way repeated measures ANOVAs tested the effects of grip type (power, chuck, pulp), grip force level (0%-50% in 10% increments of MVE) and ramp direction (loading versus unloading) on all deformation and displacement outcome variables ($\alpha = 0.05$).

Results and Discussion

We found a force level by ramp direction interaction on MN circularity ($F_{5,55}$=3.18, p=0.014). During loading, the MN became more circular from 0%-20% MVE, with no further change from 20%-50% MVE. These results fit a quadratic relationship. During unloading, there was a gradual decrease from 50%-0% MVE, which fit a linear relationship (Fig 1). Interestingly, MN displacement profiles during loading and unloading mirrored the deformation results. For example, the MN displaced ulnarly and dorsally relative to the FDS-M during the loading phase, but only up to 20% MVE with very little change thereafter. Conversely, the MN displaced radially and palmarly during unloading; however, displacement occurred gradually throughout the entire unloading phase from 50-0% MVE.

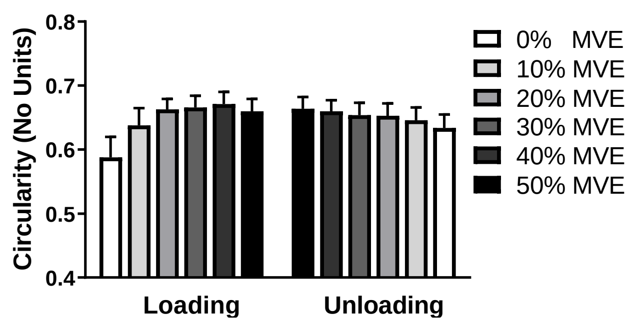

Figure 1: Mean (± standard error) median nerve circularity while ramping up (loading) and ramping down (unloading) grip force.

Conclusions

MN deformation and displacement both changed in a time-dependent manner, including differences in loading versus unloading. Therefore, the results indicated that deformation of the MN was linked to its displacement relative to the flexor tendons. Time-dependent changes may also suggest a viscoelastic effect due to strain of the surrounding subsynovial connective tissue within the carpal tunnel.

Acknowledgments

Natural Science and Engineering Research Council of Canada Discovery Grant # 2017-0409.

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Reproducibility of Trapeziometacarpal Joint Angle Measurements Using Dynamic CT

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Summary

Dynamic computed tomography (CT) can be used to quantify joint motion. Joint angles are often calculated using manually placed anatomical landmarks (AL). This can be a highly subjective process and a better understanding of the associated errors resulting from manually placed AL on joint angles from dynamic CT scans is needed. Further, processing dynamic CT data can be prohibitively long. A semi-automated post-processing pipeline is proposed to improve processing times for joint angle quantification. Inter- and intra-rater analysis was performed on segment coordinate system (SCS) orientation and joint angles between three raters. Results show excellent reliability between raters for SCS orientation.

Introduction

Osteoarthritis (OA) is a degenerative joint disease that commonly affects the joints of the hand, including the trapeziometacarpal (TMC) joint [1]. OA is considered a complex and multifactorial disease in which biomechanics play a role [1]. While dynamic CT can provide real time visualization of bone and joint motion, structural joint changes caused by OA can impact the reproducibility of calculated joint angles from manually placed ALs. It is not clear how much variation in SCS orientation and resulting joint angles can be expected from this subjective task. A joint angle reproducibility study of the TMC joint using a joint coordinate system (JCS) is presented for dynamic CT data sets. Further, a semi-automated post-processing pipeline has been developed to quantify joint angles from dynamic CT scans of the TMC joint and improve upon the extensive processing times presented in literature [2].

Methods

Ten cadaveric hand specimens (5 female, age: 83.4±15.0 yrs) were scanned. Dynamic CT was acquired with 120kVp, 100mA, 4cm longitudinal coverage, 4vol/s gantry rotation, and 15s scan time. A custom passive motion device was used to move the thumb through radial abduction-adduction. Due to limitations in dynamic CT image quality and longitudinal coverage, high resolution peripheral quantitative CT (HR-pQCT) scans with 61μm isotropic voxels (XtremeCTII, Scanco Medical) were acquired to generate masks and for SCS definition (Figure 1). Static CT images were binarized using global thresholds, binary morphological operations, and connected component labelling. Dynamic CT images were binarized using intensity-based sequential registration of CT bone masks. Joint angles were measured using a JCS representation [3]. SCS for each bone in the TMC joint were generated using ALs [4] selected by three raters. SCS orientation between raters was assessed by comparing angles between SCS axes and the principal axes of each segment. Inter- and intra-rater reliability was assessed using a two-way intraclass correlation coefficient (ICC) for SCS orientation and joint angle results between all three raters.

Results and Discussion

A semi-automated post-processing pipeline was developed that only required minor manual adjustments to the binary masks of each bone, due to narrow joint space and landmark placement. SCS orientation between raters showed excellent intra- and inter-rater reliability (Table 1). This study provides the groundwork for future studies that will assess the relationship between joint structure and function in osteoarthritic TMC joints using dynamic CT.

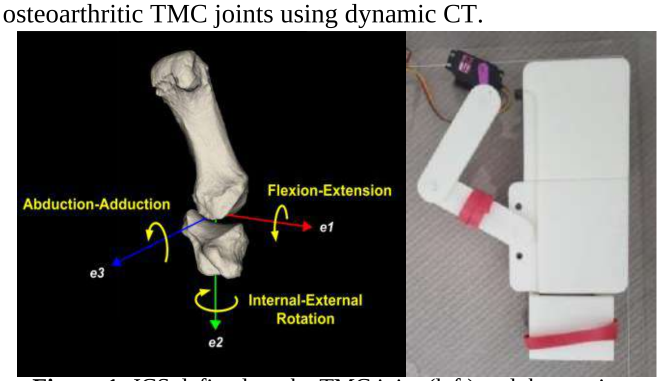

Figure 1: JCS defined on the TMC joint (left) and the passive motion device used during dynamic CT scanning (right).

Conclusions

Both inter- and intra-rater reliability was excellent when comparing orientation of both SCSs. This suggests that careful placement of AL on 3D bone models using detailed instructions and high-resolution bone models can provide reliable SCSs for the trapeziometacarpal joint.

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Table 1: Inter- and intra-rater ICC values for segment coordinate system orientation, compared to principal axes of each segment.

	X_MC1	Y_MC1	Z_MC1	X_TRP	Y_TRP	Z_TRP
Inter-Rater ICC	0.988	0.994	0.908	0.978	0.989	0.976
Intra-Rater ICC	0.993	0.997	0.936	0.988	0.995	0.979

Effect of Thumb IP Joint Posture on CMC Joint Movement during Thumb Opposition

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Summary

We examined whether the thumb interphalangeal (IP) joint posture affected the carpometacarpal (CMC) joint movement during thumb opposition. Twenty healthy adults conducted a thumb opposition task with two postural conditions: thumb IP joint extension and flexion. We recorded the three-dimensional thumb movement during tasks and then analyzed the thumb's joint angles and postural synergy in the conditions. The CMC joint angle and posture had become larger and more opposition in the thumb IP joint extension than the thumb IP joint flexion, respectively. We found that the thumb IP joint posture affected the CMC joint movement.

Introduction

The CMC joint of the thumb has a crucial role in thumb opposition; the evaluation of the CMC joint movement in thumb opposition is clinically important [1,2]. For the CMC joint evaluation, it has been discussed that the thumb IP joint posture affects the CMC joint movement in thumb opposition [3]. This study aimed to quantitatively examine the effect of the thumb IP joint posture on the CMC joint movement during thumb opposition.

Methods

Twenty healthy adults conducted a thumb opposition task with two conditions: thumb IP joint extension and flexion. We used the Kapandji test, which opposed the thumb at 11 positions (from 0 to 10 positions) [1,2], as the thumb opposition task.

We recorded the thumb movements during the task using a three-dimensional motion capture system. We computed the flexion/extension, abduction/adduction, and pronation/supination angles of the CMC joint. Furthermore, we obtained the postural synergy of the thumb using principal component analysis. We compared the CMC joint angles and the postural synergy between the two conditions.

Results and Discussion

The CMC flexion angle had no differences between the thumb IP conditions at most Kapandji positions. The CMC abduction and pronation angles had significant differences between the thumb IP joint conditions; the CMC joint angles in the thumb IP joint extension were more abducted and more pronated than those in the thumb IP joint flexion (Figure 1). Postural synergy showed that thumb posture in the thumb IP joint extension had become more opposition than that in the thumb IP joint flexion. The adduction moment in the flexor pollicis longus muscle would be associated with these differences in the CMC joint movement. [4].

Conclusions

The thumb IP joint posture affects the CMC joint movement; thus, thumb opposition should be evaluated with thumb IP joint extension.

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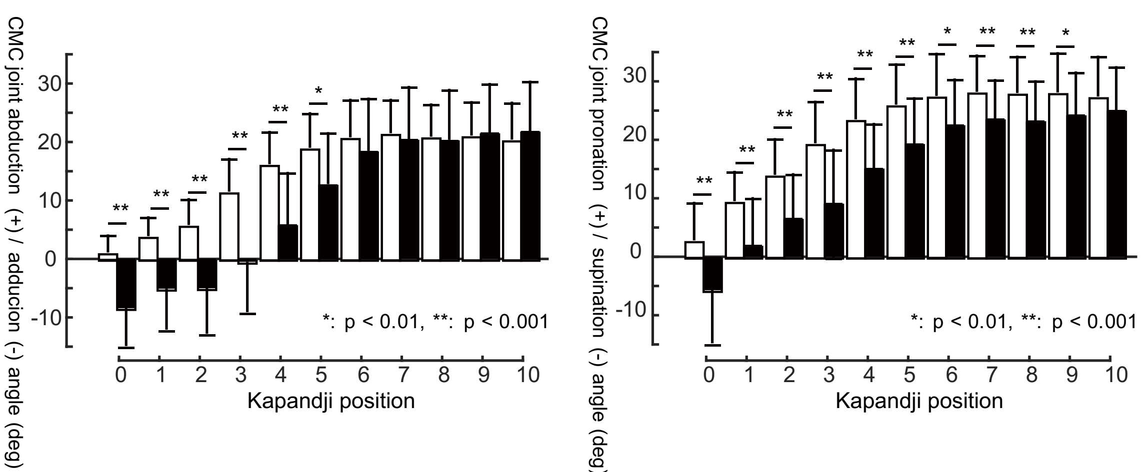

Figure 1. Join angle of the thumb CMC joint abduction (left) and pronation (right). * and ** shows significant differences between the thumb IP joint extension (white) and flexion (black).

Open vs closed articular architecture of the forearm for an analysis of muscle recruitment during throwing motions

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Summary

The osteoarticular architecture of the forearm can be modeled by an open or a closed-loop. This study aims to compare the impact of the chosen architecture on the muscle activity for overhead throwing motions. Preliminary results show similar muscle behaviors with both models.

Introduction

Musculoskeletal modeling can analyze human motion from kinematics to muscle activity. The impact of modeling on the kinematic reconstruction of the motion has been studied [1]. This pilot study aims at comparing activations estimated with a full-body musculoskeletal model presenting an open-loop (OLM) [2] or a closed-loop (CLM) [3] model at the forearm during overhead throwing motions.

Methods

The OLM is based on [4] for the lower limb and [2] for the upper limb. Muscle activations are estimated by the following static optimization under the respect of dynamic equations [5]:

$$\min_{a} \sum_{i=1}^{m} a_i^2$$

s. t. $\begin{cases} 0 \le a_i \le 1, \forall i \in [\![1, m]\!] \\ H(q)\ddot{q} + C(q,\dot{q}) = R(q)F_{max} \odot a \end{cases}$

The muscle force model is $F_m = F_{\max} a$, with a the muscle activations. q are the degrees of freedom, $H(q)$ is the mass matrix, $C(q,\dot{q})$ is the Coriolis matrix and the effect of external forces, $R(q)$ is the moment arm matrix from [6].

The CLM is based on [4] for the lower limb and [3] for the upper limb. The forearm contains a closed loop modeled by constraints $h(q) = 0$, contributing to dynamic equations via its Jacobian K and Lagrange multipliers λ [7]. The muscle recruitment problem is now:

$$\min_{a,\lambda} \sum_{i=1}^{m} a_i^2$$

s. t. $\begin{cases} 0 \le a_i \le 1, \forall i \in [\![1, m]\!] \\ H(q)\ddot{q} + C(q,\dot{q}) = R(q)F_{max}(q) \odot a \ + \ K^T \lambda \end{cases}$

The study was implemented in CusToM [9], an open-source Matlab toolbox for musculoskeletal modeling. Geometrical and inertial parameters were extracted from [10] and scaled to the subject (1m74, 64kg) using the CusToM scaling routine. The raw data for 18 throwing trials were taken from [11].

Measured EMGs and activations computed from OLM and CLM were compared with phase error metrics [8].

Results and Discussion

OLM and CLM had similar results while compared to EMG measurements (Figure 1). This was confirmed by the OLM and CLM comparison, with phase errors under 25%.

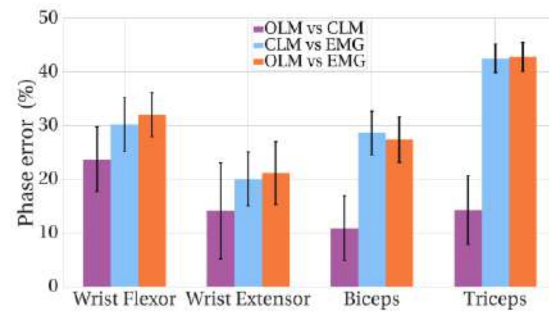

Figure 1: Phase error (%) of muscle activations

OLM and CLM were expected to have similar behaviors. However, adding constraints in the dynamic equations may impact the muscle recruitment to give a better match with measurements. We can see that constraints did not have a strong impact on these specific motions and that none of OLM or CLM fairly match EMG data. This could be explained by the small number of solids in the CLM and the relatively low level of solicitation related to this motion.

Conclusion

Finally, it seems that CLM did not bring any improvement compared to OLM for studying throwing motion. A similar study should be done for a larger cohort to validate these preliminary results. The same comparison could be done for shoulder models, using more complex constraints.

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Biomechanical Evaluation of a Fracture Fixation System for Transverse Fractures of the Metacarpal Neck

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Summary

Metacarpal fractures represent approximately 30% of all hand fractures that are evaluated in the emergency setting due to accidental falls or a direct blow to the fingers [1]. Intramedullary headless compression screw (HCS) fixation is a promising treatment method with the capacity to generate 60 N of compression [1]. Mechanical properties such as displacement with cyclic loading and stiffness were tested with this method to simulate a range of motion hand therapy exercises at 40 N. A test was also conducted to understand the peak load at which the metacarpal strength fails.

Introduction

Surgical techniques such as K-Wire and external fixation for metacarpal fractures lead to impediments such as infection, tendon injury and malunion [1]. Intermedullary HCS fixation is an alternative method to address high rates of complications post-surgery. The purpose of this study is to evaluate the mechanical properties such as stiffness and strength of HCS fixation of a metacarpal neck fracture.

Methods

A metacarpal neck fracture model was created in 13 fourth generation composite Sawbones by removing a volar-based bone wedge using a custom cutting jig to simulate a typical apex dorsal fracture, unstable in flexion (Figure 2). The bones were then fixed by 3.0 mm retrograde HCS fixation. A 3-D printed fixation jig was used to assure all hardware was identically placed. Models were potted at the base and mounted vertically in a material testing machine (Mark10:ESM1500), employing a cable tensioned over the metacarpal head to simulate forceful grip loading. Cyclic loading to 40N (simulating finger active range of motion exercises) and failure testing were performed. Load, displacement, and failure mode were recorded [2].

Results and Discussion

During cyclic loading to 40 N, the HCS models (n=4, 7.1±0.4 mm) exhibited significantly higher displacement with cyclic loading than a healthy metacarpal (5.4±1.2 mm). In addition, average displacement to failure of the HCS models (3.3±0.7 mm) were non—significantly lower and their corresponding loads to failure (137.4±30.17 N) were significantly higher than a healthy specimen (63.8±24.9 N) (Figure1a). Lastly, even though average final stiffness was higher than average initial stiffness, the average of the difference between them (5.1±3.8 N/m) was non-significantly higher than that of healthy specimen (4.7±1.3 N/m).

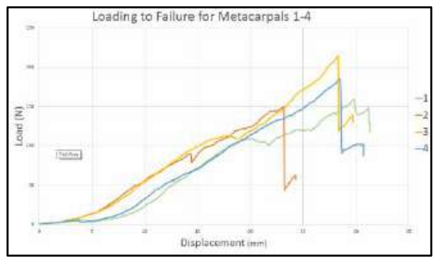

Figure 1: Plot of Total Force to mechanical failure

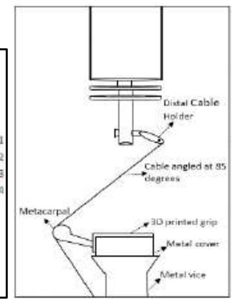

Figure 2: Experimental set-up

Conclusions

The HCS model provided comparable evidence of its mechanical properties which are similar to a simulated grip model (Table 1) [1]. The construct is also internally buried inside the bone and avoids the restrictive nature of pins that limit early motion exercises.

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Table 1: Displacement with Cyclic Loading, Average Stiffness, Load to Failure, and Displacement at Failure of the HCS

ID	Displacement after cyclic loading (mm)	Stiffness(N/m)	Load to Failure (N)	Displacement to failure (mm)
1	5.84±2.5	7.4±0.1	159±30.2	8.6±0.2
2	2.44±3.4	6.7±2.3	149±13.8	9.4±3.4
3	2.64±7.5	7.9±0.7	214±22.4	9.7±2.5
4	4.84±3.1	6.5±4.4	184.5±10.5	8.2±3.1

Evaluating Anthropometrically Scaled Models of Lateral Pinch to Characterize the Pediatric Hand

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Summary

Musculoskeletal models provide a powerful approach for examining the human hand. We examined lateral pinch simulations using a generic model of the wrist and thumb anthropometrically scaled to represent heights reported across childhood, puberty, older adolescence, and adulthood. Results demonstrated the potential of anthropometrically-scaled generic models to study hand strength across the lifespan, while also highlighting that muscle control strategies may adapt as we age. We concluded that anthropometric scaling can accurately represent age characteristics of the population.

Introduction

Generic musculoskeletal models are often developed using average data from healthy adult males. Thus, subject-specific or scaled-generic models are needed to represent pediatric populations. To what extent scaled-generic models can accurately represent the spectrum of strength profiles across the pediatric population is unknown. The objective of this study was to evaluate the accuracy of these models by measuring maximum pinch strength, comparing muscle control strategies, and evaluating isometric force scaling.

Methods

Twenty models were scaled from a generic model of the adult wrist and thumb [1] to represent the full range of height (1st, 15th, 50th, 80th, and 97th percentile) for four ages: 7, 12, 16, and 30 years [2]. For each model, five lateral pinch simulations were performed in OpenSim v. 3.3. Given the contribution of the *flexor pollicis longus* (FPL) is more than 50% for lateral pinch [3], the first set of simulations maximally activated the FPL to simulate maximum pinch strength. Simulations employing different muscle control strategies (50th percentile male, age-matched, and literature-based) were then designed to generate the maximum force required for typical activities of daily living. The final set of simulations increased the maximum isometric force of all muscles by a factor of 2. The maximum pinch strength simulations were compared to published experimental data to identify if these models could represent the strength produced at distinct ages [4-9]. To examine how representative the generic muscle control strategy was, the effect of using various control strategies was evaluated. Doubling the maximum isometric force explored the force-length relationship between the muscle's isometric force and lateral pinch force achieved. Paired t-tests were performed to compare the maximum lateral pinch force across age groups for all simulations.

Results and Discussion

Anthropometric scaling successfully captured age-dependent differences in pinch strength during simulations that maximally activated the FPL (Fig. 1). However, the model's ability to represent the pediatric population is limited. The 7 y/o models failed to reach the target force of 40 N with all muscle control strategy simulations. Notably, the age-matched muscle control strategy simulations resulted in models activating the extrinsic thumb muscles similarly to published data, but the simulations also heavily relied on the wrist muscles to achieve the target force. Literature-based control strategy simulations failed to run to completion for models scaled below 0.75 corresponding to 132 cm (4 ft. 4 in.) height and showed no improvement for all other models. Linearly scaling the muscle force-generating capacity of all muscles resulted in a nonlinear relationship of maximum lateral pinch force achieved and maximum isometric force.

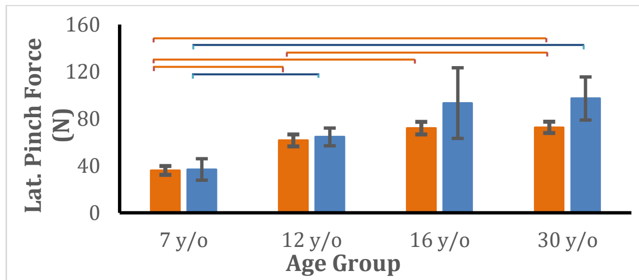

Figure 1. Lateral pinch force versus age for the maximum pinch simulations (orange) compared to experimental data (blue). Error bars represent standard deviation across height.

Given our simulations suggest that muscle recruitment may shift as we age, these models could be used to study how children adapt as their muscles develop and grow stronger. Our simulations were also able to highlight the complexity of the force-length relationship, and how it changes with age and task. The current simulation set-up prevented models younger than 7 y/o to reach completion. However, developing scaled-generic models to represent toddlers will further exemplify whether these results apply to the entire pediatric population.

Conclusion

Anthropometrically scaled hand models have the potential to represent the scope of strength profiles across the pediatric population. Modeling height difference with age is a critical step toward representing the full diversity of the population. This work motivates future research to elucidate how various musculoskeletal disorders and age-related changes in muscle strength and activation patterns influence hand strength.

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A new radiographic index for early diagnosis of perilunate injuries

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Summary

The objective of this study was to develop radiographic indexes that help the diagnostic confirmation of perilunate injuries. A descriptive, cross-sectional, retrospective study was carried out with the objective of finding radiographic indexes that facilitate the diagnosis of perilunate injuries. Eighty lateral wrist radiographs were evaluated, divided into 20 radiographs without changes and 20 radiographs with the following diagnosis: scapholunate ligament injury, transcaphoid fracture dislocation, lunate dislocation. Bone points were selected that originated lines to evaluate the anatomical relationship between the carpal bones.
So the radiolunate index was calculated and a statistical analysis were made.

Introduction

Perilunate injuries can present very subtle changes in the initial imaging exams, which go unnoticed in emergency care [1,2,3]. Despite its severity, 25% of patients do not have their diagnosis identified in the initial assessment [4]

Methods

This index was created to assess the position of the lunate bone in relation to distal surface of the radius. For this purpose lateral radiographs of the wrist were evaluated. Despite the possibility of difficult identification of the carpal bones, we chose intracarpal landmarks. The D line connects the dorsal edge of the distal surface of the radius to the dorsal edge of the distal surface of lunate. The P line connects the volar edge of the distal surface of the radius to the volar edge of the distal surface of the lunate. By measuring the length of lines D and P, we created the radiolunate index, that was calculated from the P/D ratio (figure1).

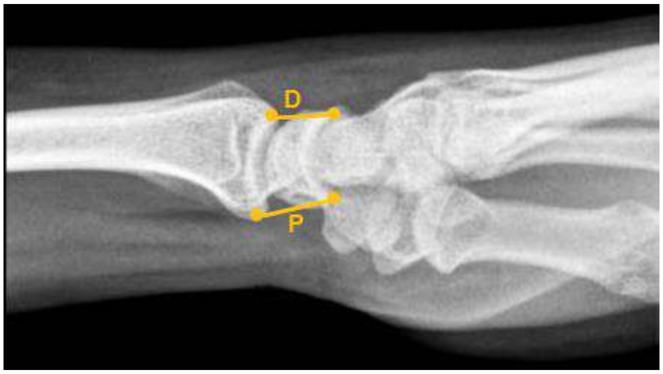

Figure 1: Production of the lines P and D, wich measurements allows the calculation of the radiolunate index (RLI).

The Kruskal-Wallis test, Mann-Whitney test and graphical analysis using box-plot was used in the statistical analysis. The result of each comparison presents a p, being defined as a significance value of 0.05 (5%).

Results and Discussion

The radio-lunate index (RLI) on the radiographs of the wrists without changes ranged from 1,136 ± 0.172. In the radiographs with diagnosis of scapholunate ligament injury, the index ranged from 1.907 ± 0.428, in the radiographs with diagnosis of transescapho-lunate fracture dislocation, it varied from 0.743 ± 0.099 and in the radiographs with diagnosis of lunate dislocation it ranged from 0.47 ± 0.086 . The p-value for RLI was less than 0.001.

	Group	Interval
IRS	Without changes	1,136 ± 0,172
	Scapholunate ligament injury	1,907±0,428
	Transcaphoid fracture dislocation	0,743 ± 0,099
	Lunate dislocation	0,47±0,086

Table 1: Radiolunate index range for different diagnoses

When comparing the ratio of the RLI of the radiographs of the wrist without changes with the ratio of the RLI of the radiographs with perilunar injuries, there was a statistically significant difference between the groups.
So the proposed method demonstrated an easy and quick way to facilitate the radiographic analysis of perilunar injuries, wich can provide a faster diagnosis and may reduce misdiagnosis in these injuries.
In the next studies we intend to evaluate intraobserver and interobserver variability, in order to determine the accuracy of this method.

Conclusions

The application of the IRS demonstrated that there is a change in the position of the lunate in relation to the articular surface of the radius in perilunate injuries. Thus, it can be applied clinically to aid in the diagnosis of perilunate injuries.

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Complementary Functions of the Joint Morphology and Ligaments in Providing Stability to First the Carpometacarpal Joint

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Summary

A morphology-function model was created to assess the influence of variability in bony anatomy of the first carpometacarpal (CMC) joint and the translation of the joint when there is disruption to the ligaments. Variation in first metacarpal torsion and articular tilt angles contributed the most to the variability in first CMC joint translation.

Introduction

The first CMC joint depends on its ligaments to provide stability. However, it is not clear how the morphology of the first metacarpal and trapezium works with the ligaments in maintaining joint stability. Hence, the objective was to use a morphology-function model to determine the interplay between the ligaments of the first CMC joint and its bony morphology in preventing joint subluxation.

Methods

Sixteen specimens (8 males; 52.4±11.7 years, 7 left hands) were used in this study. Semi-automatic segmentation was done to computed tomography images of the specimens using MIMICS (v.17, Materialise, Belgium) to obtain 3D models of the first metacarpal and trapezium. ***In-vitro experiment*****:** The first and second metacarpals, trapezium and trapezoid were removed from each specimen, taking care not to violate the first CMC joint capsule. The distal end of the first metacarpal was fixed in a specimen holder. The trapezium, trapezoid and proximal end of the second metacarpal were similarly fixed. An Instron testing machine equipped with a customised jig was used to apply external loads to the specimen in its neutral orientation. Each specimen was tested during intact and ligament sectioned conditions. Four ligaments were sequentially sectioned – anterior oblique ligament (AOL), ulnar collateral ligament (UCL), intermetacarpal ligament (IML) and dorsal radial ligament (DRL). The position of the joint in its intact state was taken as the baseline. ***Anatomical features*****:** The first metacarpal articular tilt and torsion angles and length and width of the first metacarpal facet on the trapezium were measured on the 3D model of each of the specimens (ver. 9, Materialise, Belgium). ***Principal component analysis (PCA)*****:** The anatomical features and the translation data of the first CMC joint were used to develop a morphology-function model. PCA was implemented to reduce the dimension of the morphology-function model and highlight the relationship between the ligaments and the anatomical features in the translations of the first CMC joint.

Results and Discussion

The first principal component indicated that, in all four directions, the first metacarpal torsion angle (-2.60° (-2SD) to 21.67° (+2SD)) contributed to the magnitude of translation. As this angle twisted more ulnarly (+2SD), the translations of the first CMC joint in the direction of loading increased after the transection of the IML and DRL (Figure 1). The second principal component indicated that variation in the first metacarpal articular tilt angle (-4.58° (-2SD) to 9.92° (+2SD)) also contributed to the magnitude of joint translation, for all four load directions. An increased first metacarpal torsion angle could enable a better match between the concavity of the trapezium articulating surface with the convexity of the first metacarpal articulating surface during opposition. This would maximise bony stability, preventing subluxation of the first CMC joint. An increase in the first metacarpal articular tilt angle could reduce bony stability in the volar region of the articulating surface of the joint. With this, disruptions in the ligaments may be more likely to cause first CMC joint subluxation. Hence, the joint may rely on its convex-concave articulating surface at the dorsal region to help prevent subluxation of the joint.

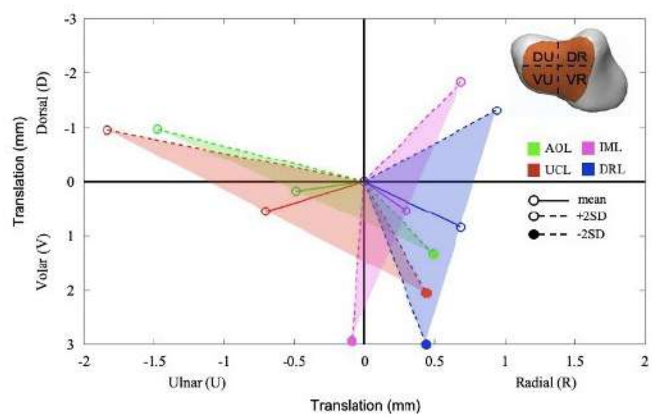

Figure 1: The translation (mean and ± 2 standard deviation) of the first CMC joint when displaced by load in the VD directions with variation in the first metacarpal torsion angle obtained in the first principal component. The colored region shows the region of subluxation of the joint that resulted from variations in the first metacarpal torsion angle with the presence of ligament disruption.

Conclusions

This study assessed the interactions between first CMC joint kinematics and its anatomical features. The morphology of the first metacarpal, particularly the torsion and articular tilt angles, was important in maintaining the stability of the first CMC joint.

Analysing the impact of sensor placement on the quality of sEMG signals on the human forearm

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Summary

Surface electromyography (sEMG) is increasingly used in next-generation wearable assistive devices to facilitate user in-loop controls and replace state machine controllers such as exoskeletons and prosthetics. Conventionally, muscle bellies are chosen as sEMG affixation sites to ensure high quality recordings. However, the muscle bellies are not always accessible, often due to the design of wearable assistive devices and hence, alternative sites are sought to record reliable sEMG signals. In this study, 5 muscles in the forearm region of 10 subjects were chosen which are responsible for wrist flexion and extension as well as ulnar and radial deviation. sEMG signals were recorded from the muscle belly, 1cm proximal and distal to the muscle belly of each muscle, respectively. The study demonstrates that some alternative sites indeed offer reliable sEMG signals, but it does not intend to replace the conventional sEMG practice.

Introduction

The majority of upper limb replacements are so-called passive prosthesis [1]. In order to develop these wearable assistive technologies, primary data from myoelectric as well as kinetic measurements have to be recorded. sEMG signals are conventionally measured from the muscle belly but this study indicates that reliable sEMG recordings can be derived on sites away from the muscle belly.

Methods

The arm of each subject was palpated for 5 muscles, FCR, FCU, ED, and AN in order to locate appropriate sites to place the sEMG electrodes. Electrodes were placed on those muscle bellies, 1 cm distal and 1 cm proximal to it. The subjects carried out 10 different tasks, including resting and Maximal voluntary isometric contraction used to normalise the obtained data. The mean amplitude of each period was used for further evaluation.

For every muscle placement one ANOVA per period was carried out, including all 10 subjects and all 3 different electrode placements resulting in 10 F-values per muscle. To investigate correlation between measurements the Pearson correlation coefficient (PCC) was calculated for the conventional and distal placement as well for conventional and proximal placement of each muscle. Finally to further compare the placements Bland-Altman Plots (BAP) were computed.

Results and Discussion

No ANOVAs show a significant difference between the placements. This has been a perquisite for further investigation of correlation and similarity which makes it possibile to interpret similarity of the placements. However the different affixation sites showed a high correlation with PCCs > 0.90. Whereas, the BAPs indicated that some placements yield equal results while others failed to pass this test. An exemplary set of results is given for the FCU in Figure 1.

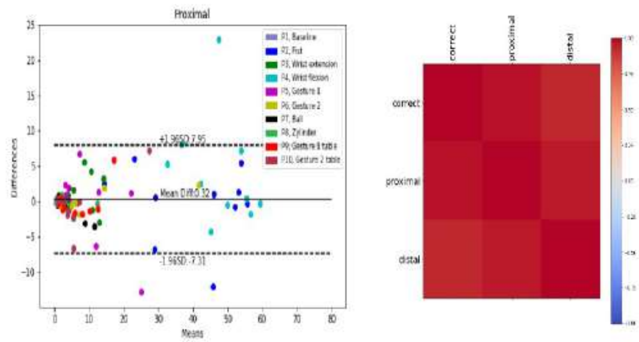

Figure 1: Bland-Altman Plot and PCC for Flexor carpii ulnaris .

Conclusions

Most of the tested muscles showed reliable similarity in at least one of the alternative placement sites. Even placements which failed to fulfil the conditions of the BAP acquired high correlation and might be useful for prosthesis development. This study shows that alternative sEMG sites can be used when muscle belly of the target muscle in question may not be easy to access. This is often found in wearable devices being driven by EMG.

Acknowledgments

We thank all participants who volunteered for this study. The project is partly funded by the EIT Health 19340.

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Multi-digit Force Coordination in Patients with Trigger Digit using Machine Learning and Deep Learning

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Summary

This research presents a machine learning approach to analyze multi-digit force coordination in subjects with and without trigger digit symptoms.

Introduction

Trigger digit (TD) is a common symptom in hand, that affects motor coordination, and results in hand functional impairment. Previous studies used cylindrical grasp to investigate finger force coordination during precision grasping of TD patients. Data characterizing five-digit force coordination is commonly high-dimensional, complex, and dynamic. There is a lack of studies to process this type of data in dynamic and multivariate ways. To compensate for this problem, it will be interesting to utilize machine learning method of predictive models for data mining.

The purpose of this study is to first develop a machine learning and deep learning model to classify healthy subjects and trigger digit patients. After that, we analyze the post-trained model to investigate applied force differences between two group of subjects

Methods

Forty-four healthy subjects (39.5 years ± 7.6) and fifty-four TD patients (57.6 years ± 8.0) with involved digit were included in this research. Patients with affected digit include 11 patients with thumb, 7 patients with index finger, 17 patients with middle finger, 12 patients with ring finger, 3 patients with index and ring fingers, and 4 patients with middle and ring fingers.

The participants performed a grasping task: grasped and lifted the simulator to the height of 20 cm then hold it stably for at least three seconds and lowered it to the original position.

A machine learning model (Random Forest) and a deep learning model (1D-CNN) are used to map force data to given subject status. Two models are trained and validated by 10-fold cross-validation in intra-subject (trial-mixed) and inter-subject (subject-mixed) datasets. A separated testing set was also used to test the performance of the two models. The Random Forest model is analyzed by feature importance calculation. The 1D-CNN model is analyzed by Grad-CAM.

Results and Discussion

Cross-validation and testing mean accuracy of RF are 79% and 85% for intra-subject while 81% and 86% for inter-subject. Cross-validation and testing accuracy of 1D-CNN are 84% and 85% for intra-subject while 71% and 77% for inter-subject.

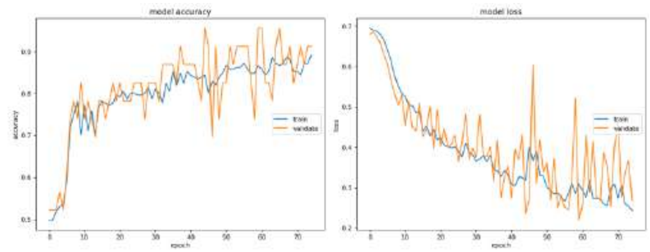

Figure 1: Accuracy and loss graph of model training.

Feature importance shows that the duration of trials is the most important. Grad-CAM model shows that the model pays most attention to the holding phase

Conclusions

By using machine learning methods, we can classify healthy subjects and trigger digit patients. The duration of trials is an important factor that should be controlled in the experiment setting. The stability holding phase reveals important features and should be investigated in future studies.

Acknowledgments

Grant support from Taiwan Ministry of Science and Technology.

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Monitoring Development in Children using Hand function

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Summary

This study aims to investigate the effectiveness of different metrics of hand function as a valid and reliable measure of children development. Four tests were used to acquire strength and dexterity measurements of a group of 184 children [range between 5-18 years old]. Our findings show that grip strength and the box and block dexterity tests are appropriate to assess children development.

Introduction

There are a number of clinical tools and assessment tests used to evaluate development in children. Object manipulation is one of the standard metrics for evaluating mental development. Hand function also can be assessed objectively by measuring strength and dexterity. However, there is currently little evidence of the effectiveness of these tests in monitoring developmental changes in children. The aim of this study is to investigate whether specific metrics of hand function can be better correlated with child development and to show whether age can be expressed as a function of such measurements.

Methods

A group of 184 children (100 female, range between [5-18] years old) were recruited for this study. Demographic information about their age, height, weight and hand dominance was collected. Four tests were used to assess the manual strength and dexterity of the participants: the box and block (BBT) and the functional dexterity (FDT) tests and the maximum grip and lateral pinch strength tests. Each participant was randomly assigned to one dexterity and one strength test and they were asked to perform all tests with their dominant hand. For the BBT, the participant was asked to transfer as many blocks as they could in 60 seconds. For the FDT, the participant was asked to turn over all 16 pegs on the board as quickly as possible. Grip and lateral pinch strength were measured using a Jamar dynamometer G200 and a pinch meter P200 (Biometrics ltd, Newport, UK), respectively. A multiple regression analysis was performed between the test results and the demographic parameters. To avoid overfitting, the models presented below were generated using only parameters with significant effect on the regression.

Results and Discussion

From the four tests investigated in this cohort, only the results of grip and BBT showed large association (Pearson Correlation Coefficient > 0.5) with development parameters age (0.874 for grip, 0.719 for BBT), height (0.858 for grip, 0.612 for BBT) and weight (0.856 for grip). Grip strength showed significant correlations with both dexterity tests ($p = 0.001$ for BBT and $p = 0.002$ for FDT). A linear regression was able to express 63.2% of the variance of the age with respect to grip strength (R2=0.632). However, a second linear regression where both grip and BBT results were used (Figure 1) expressed 78.6% of the age variance within our group (R2= 0.786). Both factors had a significant contribution to the regression with a final equation:

$$\text{Age} = 0.175 \cdot \text{Grip strength} + 0.136 \cdot (\text{Box and Block test}) - 0.594$$

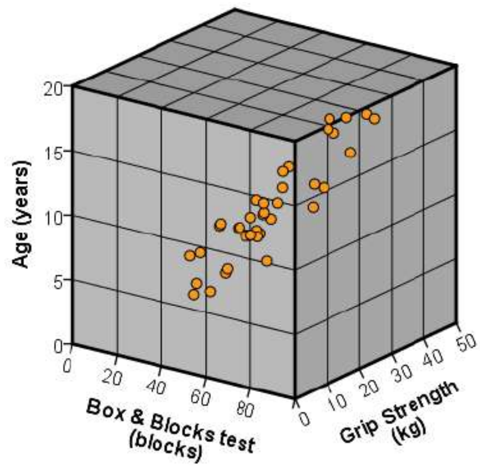

Figure 1: Linear regression between age and grip strength and box and blocks test results.

Our results show that the grip strength and BBT dexterity tests are appropriate for monitoring development. While grip strength alone was able to express a large proportion of the variance within the group, the regression including both grip and BBT presents a more spherical expression of the functional changes during a child's development. Both tests are non-invasive and standardized and they have been previously used to assess hand function in children with myopathy and cerebral palsy [1,2].

Conclusions

The application of these findings can be extended further to healthy cohorts as a sufficient and non-invasive metric to evaluate development in children.

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Fused with Motion: A Biomechanical Comparison of Dart Throw Motions after Partial Wrist Fusions

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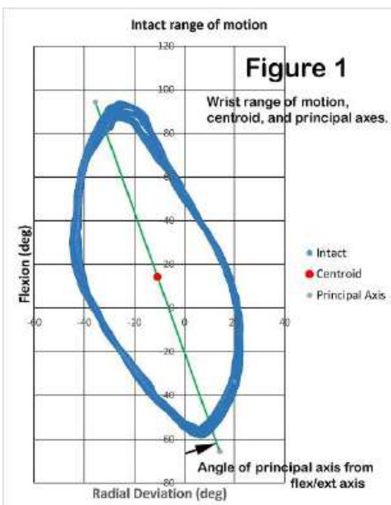
Summary: Multiple partial wrist fusions exist for the management of wrist arthritis. The purpose of this study was to measure the motion allowed by different orientations of the dart throwing motion for 7 different partial wrist fusions and proximal row carpectomy.

Introduction: Partial wrist fusions may limit wrist motion differently during a dart throw style of wrist motion. The purpose of this study was to measure the retained motion for different orientations of the dart throwing motion for 7 different partial wrist fusions and proximal row carpectomy.



Methods: Eight fresh frozen cadaver wrists were tested with the wrist intact and for seven simulated fusions and proximal row carpectomy. In all cases, the wrists were passively moved through a minimum of 4 circumduction motions by 2 testers. Wrist motion was measured by a motion sensor, attached to the dorsum of the 3rd metacarpal. The fusions were scaphocapitate (SC), scapholunate (SL), capitolunate (CL), radiolunate (RL), radioscapholunate (RSL), scapho-trapeziotrapezoid (STT), 4 corner fusion (CF) and a proximal row carpectomy (PRC). For each circumduction motion, (figure 1) the area within the circumduction motion was computed, the principal axes of the motion were calculated as the angle it made with the flexion/extension axis, and the range of motion (arc) that a dart throw motion might have until it intersects the boundary of the circumduction motion was determined. The arc of motion was found for a pure flexion/extension motion, a pure radioulnar deviation motion and 11 motions oriented at increasing amounts from the flexion/extension axis. A one-way repeated measures ANOVA with a Bonferroni correction for multiple comparisons was used to compare the different simulated dart motions.

Results and Discussion: All fusions except for the SL fusion significantly reduced the area of motion ($p<0.01$) compared to intact. The SC area was larger than the CL ($p=0.04$). The SL area was larger than the CL and the RSL ($p<0.03$). The SC and STT fusions principal axes were more closely aligned with the flexion/extension axis (ave 8 deg) than the intact axis (19 deg). The SL had a larger angle (20 deg; more aligned toward the radioulnar deviation axis) than the STT (7 deg) or the PRC (8 deg; $p<0.04$). The arc of motion (table 1) of the intact wrist oriented 20 deg from the flexion/extension axis was greater than any of the other 12 orientations ($p<0.03$). At the 20 and 25 degree orientations, all fusions had a smaller arc of motion compared to intact ($p<0.02$). The SC, CL and RSL fusions all had a smaller arc of motion than the intact at all 13 orientations ($p<0.04$). The SL fusion was the only fusion which did not decrease the area of motion compared to the intact specimen. This finding makes intuitive sense biomechanically, and reinforces the importance of the SL ligament in linking the motion of the scaphoid and lunate bones under normal kinematic conditions of the carpus.

Table 1: Average Arc of Motion at Different Orientations of a Dart Thrower's Motion (angle from flexion/extension axis; mm)

	Fusion								
Orienta-tion	Intact	SC	SL	CL	RL	RSL	STT	CF	PRC
Flex-ext	94	76	81	55	59	41	76	60	73
20 deg	116	73	102	59	83	54	67	65	70
25 deg	108	68	98	59	80	57	61	65	68
30 deg	99	62	92	58	75	57	55	65	63
35 deg	91	57	85	57	69	66	50	65	58
40 deg	83	53	78	55	65	53	46	63	55
45 deg	76	49	72	52	59	50	42	60	51
50 deg	70	46	66	50	55	47	39	57	48
55 deg	65	44	62	47	51	43	37	55	45
60 deg	61	41	58	45	48	40	34	52	43
65 deg	57	40	54	43	45	37	33	50	41
70 deg	54	38	51	42	43	34	32	48	40
Radio-ulnar	47	35	44	37	36	28	30	42	37

Conclusions: This study provides a comprehensive compilation of the range of motion in a functional plane "the dart throw motion" to be expected after various limited wrist fusions and proximal row carpectomy. These data provide the clinician with important information that can be used to educate the patient with regards to expectations after surgery.

Acknowledgments: Funded by the Department of Orthopedic Surgery, SUNY Upstate Medical University

Palmar musculature and its role as a dynamic compressor of the carpal tunnel

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Summary

It is possible that the musculature overlying and integrated with the transverse carpal ligament represent a dynamic force that exerts pressure over the median nerve contributing to the development of carpal tunnel syndrome (CTS). The aim of this study was to compare musculature overlying the carpal tunnel between subjects with and without the diagnosis of CTS. There was a very wide range of muscle mass measured. We found that there was a significant correlation between signs of CTS on MRI median nerve cross-sectional area) and the amount of muscle overlying the carpal tunnel. Further study should refine the measurement method of these muscles to better understand their effect on CTS.

Introduction

The diagnosis of carpal tunnel syndrome (CTS) remains clinical. While much study has focused on the dimensions and size of the carpal tunnel, there has been little emphasis on possible dynamic factors of increased pressure in this anatomical space. During carpal tunnel release, variable amounts of muscle above the carpal tunnel are commonly observed. It is possible that this musculature may represent a dynamic force that exerts pressure over the median nerve contributing to the development of CTS. We believe these muscles, specifically those found immediately volar to the transverse carpal ligament and cross the carpal tunnel, have a dynamic role in the etiology of CTS especially in manual laborers who use their hands in a forceful and repetitive fashion. [1] This anatomic variant (muscles crossing the area of the carpal tunnel) may also be related to the "square" hand configuration contributing to increased incidence of CTS in these patients. The ability to recognize this "dynamic component" may improve our ability to understand and prevent the development of CTS. We hypothesized that patients with a clinical diagnosis of CTS have more muscle, as quantified by magnetic resonance cross-sectional imaging (MRI), overlying the carpal tunnel than normal controls.

Methods

Case control study of a database of wrist MRI. Cases were patient charts with a diagnosis of CTS. These were matched by age and gender to those without CTS (controls). Exclusion criteria included poor quality imaging, space-occupying mass in the carpal tunnel, concomitant neurological disorders, and previous carpal tunnel surgery. Axial cuts at the level of the hook of the hamate and scaphoid tubercle were used to measure the muscle mass overlying the carpal tunnel. Muscle mass was quantified using: thickness (mm) at 3 points (mid-capitate, capitate-hamate boarder, capitate-trapezoid border) and an average thickness (calculated by dividing the cross sectional area by the carpal tunnel width). Other MRI parameters from axial cuts were measured: median nerve T2 signal, median nerve shape, and carpal tunnel cross sectional area.[2] Groups were compared with t-tests or Wilcoxon rank-sum tests and statistical significance was defined as $p<0.05$. single-spaced,

Results and Discussion

A total of 21 cases and controls met the inclusion criteria for the study. There were no significant differences in age, gender, hand dominance, manual laborers, diabetes mellitus, hypothyroidism or nerve shape between case and controls. Average muscle depth in the carpal tunnel group was 2.61mm and control group 2.54mm ($p=0.83$). Muscle depth measurements for carpal tunnel and control groups were 2.36mm and 2.10mm ($p=0.46$) at the mid-capitate, 1.19mm and 0.67mm ($P=0.23$) at the capitate-hamate border, and 3.42mm and 4.30mm ($p=0.4$) and the capitate-trapezoid border respectively. The variability in measurements was significant in all areas measured. We did find a significant correlation between signs of CTS median nerve cross-sectional area) on MRI and MRI measured muscle mass $p=0.008$.

Conclusions

We found no significant differences in muscle mass overlying the carpal tunnel using our method of evaluation between chart documented CTS and non-CTS wrist MRIs. We did find a correlation with MRI nerve cross sectional area.
It is possible that:
1) There truly is no difference.
2) Our method of evaluation is flawed:
-The insertion (footprint) of the muscles may be more important in the mechanics of the carpal tunnel than the amount of muscle and this was not evaluated.
-Anatomical variation was so great that our measurements were unable to identify true differences.
-Advanced CTS can cause atrophy affecting the amount of muscle measured on MRI.
3) Future research should focus on a refining the measurement method of these muscles and their effect on CTS.

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Model of the Midcarpal Joint Accounting for Structural Difference

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Summary

There are multiple challenges to the study of in-vivo wrist mechanics. We present a preliminary model of the midcarpal joint based on computed tomography (CT) scans of normal wrists. By applying forces acquired in-vivo to the model we can study in-vivo biomechanics without invasive procedures. Our model predicted that the angle between the lunate and the capitate is significantly different between lunates type 1 and 2 in the midcarpal joint $p<0.0001$.Significant differences in force transfer are predicted by the model, dependent on midcarpal joint type. Further study will delineate disparate measurements calculated from the model and may improve the model's ability to predict force transfer and kinematics.

Introduction

It is difficult to obtain in-vivo data to study structure of the wrist and its effect on wrist function[1,2]. We present a preliminary model of the midcarpal joint based on computed tomography (CT) scans of normal wrists. By applying forces acquired in-vivo to the model we can study in-vivo biomechanics without invasive procedures thus providing a platform for the study of wrist mechanics.

Previous models have not succeeded in accounting for variable patterns of bony shape and configuration likely due to the complexity of wrist structure.

Our purpose was to:

1) Generate an initial model of the midcarpal joint of the wrist based on normal wrist CT scans.

2) Generate separate models for the midcarpal joint based on 2 distinct wrist types (type 1 and type 2).

Methods

Thirty-five CT scans, (dicom files, anonymized, 2mm/slice resolution) were selected from a normal patient database and converted into 3-dimensional .stl files using OsiriX software (version 9, 2016, GNU LGPL), for classification. Solid Mechanics study in stationary conditions was used through the COMSOL library. Material properties for these models were generated from COMSOL materials library. The models were divided into 2 categories based on lunate type. Simulated loads were applied to the most distal articular surface of the model. A load of 200N was applied in a distal to proximal direction, consistent with other studies. The predicted forces and movement were compared between the 2 wrist types.

Results and Discussion

Thirty-three percent of individuals displayed a Type 1 joint, and 67% of individuals in the sample presented with a Type 2 joint. The movements or displacement of the components in the midcarpal joint differed between wrist types 1 and 2. The angle between the lunate and the capitate was significantly different between lunates type 1 and 2 $p<0.0001$. On force application, the surface stress and volume stress on the carpometacarpal (CMC) joints did not differ significantly between the 2 wrist types $p=0.38$. However, the forces were predicted to travel more ulnarly in a type 1 wrist, and more radially-towards the scaphoid and scapholunate ligament- in type 2 wrists.

Conclusions

- The model can be used to predict movement after loading through the midcarpal joint.
- Significant differences in force transfer are predicted by the model, dependent on midcarpal joint type.
- Further study will delineate disparate measurements calculated from the model. And improve the model's ability to predict force transfer and kinematics

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Analyze the effect of the anterior oblique ligament injury and first dorsal interosseous function upon thumb CMC joint subluxation: a cadaver study

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Summary

Although there is still a difference between using the cadavers and the real situation, our study might provide information not only to understand the importance of AOL for the stability of the CMC joint but also to refer the standard in the force and movement mode in clinical examination or traditional rehabilitation programs. In muscle training, for the thumb CMC joint instability, according to results, the training programs included the FDI muscle strengthening could provide stability for subjects with joint problems in some situations. But from another point of view, the joint distance was decreased after FDI training. If applied to some cases that already had OA or bone spurs around the joint, it would cause these groups to have more severe pain or accelerate the production of OA.

Introduction

Since instability of the thumb carpometacarpal (CMC) joint is such a common issue, but nowadays, there are still many kinds of opinions and methods in the clinical examinations and treatments [1,2]. In this study, we set cadaver models to simulation the modified thumb abduction stress test and frequent functional movement to analyze the CMC joint distance in different muscle loadings. Besides that, we also investigate how the joint change after the AOL ligament injury and whether the hand intrinsic muscle training can provide good joint stability after ligament damage.

Methods

A total six left hands was performed in this study. A custom mechanism [3] was used to imitate the subject of performing a thumb abduction stress test and key pinch movement at various muscle maximal loading in different conditions, such as removing the anterior oblique ligament (AOL) and strengthening the FDI muscle. Then, we created 3D images by computer tomography (CT) and calculated the geometric center distance of the thumb CMC joint using software from all experimental data. The paired t-test and one-way ANOVA were used to analyze and set a p-value defined less than 0.05 as statistical significance.

Results and Discussion

Without removing the soft tissue around the CMC joint, the joint distance increased between 0% and 50% maximal loading in the abduction movement but decreased when the force reaches 75%. However, in key pinch movement, the joint distance was significantly increased as loading increases (P=0.015). After removed the AOL ligament compared with those who have not been removed, the joint distance increased and reaches a statistically significant under 0% tension (P=0.005) in the abduction and significantly increased at 0% (P=0.005) and 50% (P=0.016) maximal loading in a key pinch. When added to the FDI muscle training, the joint distance reduced compared to before and had statistically significant at 50% and 100% loading in both movements (P<0.01). (Figure 1.) Those data can find out that while the applied force increases, the joint distance also increases gradually. Additionally, after removed the AOL, the joint distance had increased. It means that AOL plays an essential role in stabilizing the thumb CMC joint for movement. It demonstrated that the joint distance decreased after the imitation of the FDI training program in both movements.

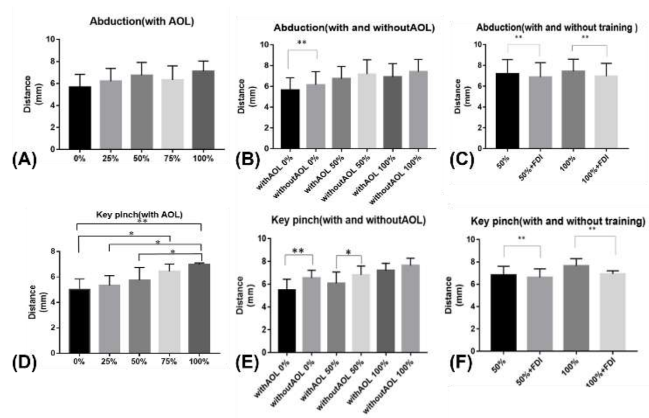

Figure 1: Distance values of abduction and key pinch movement (A) with the AOL of abduction (B) without the AOL of abduction (C) FDI muscle training of abduction (D) with the AOL of key pinch (E) without the AOL of key pinch (F) FDI muscle training of key pinch

Conclusions

Our result provides a useful reference for clinical stuff as making rehabilitation programs and common suggestions for subjects suffering from joint instability.

Acknowledgments

Special thanks to all Department of Radiology members, National Cheng Kung University Hospital, College of Medicine in NCKU.

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Three-Dimensional Carpal Tunnel Reconstruction and Analysis Using Multimodal Co-Registration of Ultrasonography and Computed Tomography

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Summary

A 3D carpal tunnel model was created by co-registering computed tomography scanning of carpal bones and robot-assisted ultrasound imaging of the transverse carpal ligament. The model allowed morphological analyses of bone and ligament arches at various tunnel locations and provided previously unknown information of carpal tunnel morphological properties. The developed multimodal imaging technique and the morphological analyses can be applied to examine pathomorphological changes of the wrist.

Introduction

The carpal tunnel is bounded by the transverse carpal ligament and carpal bones, which can be divided into the ligament and bone arches. The ideal imaging modality for morphology investigation of the carpal tunnel as an osseoligamentous structure is ultrasonography for ligament arch and computed tomography for bone arch. Therefore, the purposes of the study were to 1) establish methodology for reconstructing three-dimensional carpal tunnel by computed tomography scanning of carpal bones and ultrasound imaging of the ligament, and 2) investigate the morphology of the bone and ligament arches across carpal tunnel. We hypothesized that the ligament arch would occupy lesser carpal tunnel space as compared to the bone arch, and the bone and ligament arch spaces would be dependent on the location of the carpal tunnel.

Methods

Nine freshly frozen male cadaveric hand specimens were used. To reconstruct the ligament arch, multiple cross-sectional images of the ligament and the ligament-osseous attachments were collected using robot-assisted ultrasonography. Then the 2D image coordinates of anatomical features were spatially assembled to 3D point cloud of ligament arch using the positional information from the robot (Figure 1A). To reconstruct the bone arch, 3D surface of individual carpal bones was obtained by performing image segmentation on computed tomography scans. A 3D bone arch point cloud was reconstructed by filling the space between two adjacent bones with surrogate tissues of up to 3 mm thickness (Figure 1B).

The bone and ligament arches were co-registered into a common coordinate system to model a 3D carpal tunnel point cloud (Figure 1C) using the iterative closest points algorithm. The algorithm provided a rigid transformation matrix by performing a geometric match between the partial bone information from 3D ultrasonography and entire bone geometry from computed tomography scans.

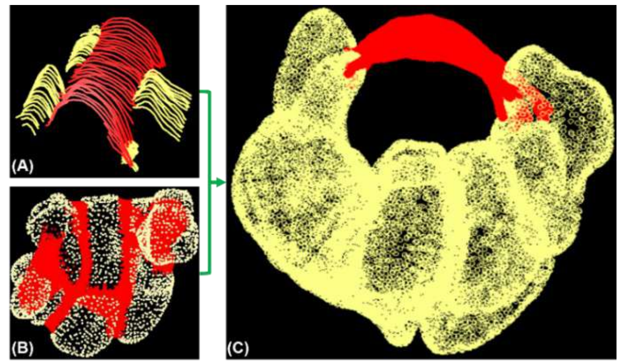

Figure 1: Sample reconstruction of ligament arch using ultrasonography (A), bone arch using computed tomography (B), and carpal tunnel using multimodal co-registration of both arches (C).

Results and Discussion

Total tunnel volume was 6820.8 ± 1278.7 mm^3, agreed with a previous study [1]. The bone arch volume (5719.6 ± 1049.2 mm^3) was significantly greater than the ligament arch volume (1101.2 ± 230.5 mm^3, $p<0.05$), consistent with previous findings [2]. The bone arch areas were significantly larger than the ligament areas at all tunnel levels (proximal, middle, distal, all $p<0.05$). Additionally, both arches varied significantly with tunnel locations ($p<0.05$). The ligament arch area progressively increased from distal to proximal locations, whereas the bone arch area was greatest at the middle location but tapered down towards the tunnel edges.

The robot-ultrasound incorporation allows for 3D ligament reconstruction from 2D ultrasound images, advancing the imaging of the carpal tunnel. The developed multimodal imaging technique and the calculated outcome parameters can be applied to examine the pathomorphological changes associated with the carpal tunnel.

Conclusions

A multimodal imaging technique was developed to reconstruct 3D carpal tunnel for advanced morphological analyses of bone and ligament arches, which advances our understanding of the carpal tunnel morphological properties.

Acknowledgments

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Federación Latinoamericana de Cirugía de la Mano (FLACM)

Latin American Federation for Hand Surgery

As previously raised and authorized the subject in two IFSSH Delegate's Meetings, the South American Federation for Hand Surgery moved on to incorporate Central American countries (Spanish speaking language) into the existing Federation.

During the 17th Congress of the South American Federation, August 2019 in Cartagena de Indias, Colombia, the General Assembly decided to accept the challenge, changing the name of the Federation and the consequent bylaws to LATIN AMERICAN FEDERATION FOR SURGERY OF THE HAND.

During that same General Assembly, Alejandro Espinosa from Mexico was elected future President for the period 2022-2023.

With the commitment of expanding hand surgery in Central America it has programmed that the Annual Course of the Federation (held in those years without Congress) will take place in Panama during 2022 with a Congress in Guadalajara, Mexico, during 2023.

This year, during November 2021, the actual President of the Federation, Jefferson Braga Silva from Brasil, has programmed a hybrid Congress in Rio de Janeiro.

In the future years hand surgery will be expanding in Central America with the consolidation and creation of new hand societies in that region.

Eduardo R. Zancolli III
IFSSH Delegate, FLACM

Dear Colleagues,

I have held the post of President of the Latin American Federation of Hand Surgery since the Assembly which took place in Cartagena, in August 2019. At that meeting, the member countries of the South American Federation of Hand Surgery discussed and unanimously approved the creation of the Latin American Federation of Hand Surgery. Central and Latin American countries requested this change so that we could assist in the development of Hand Surgery in those countries that are underrepresented, but that need technical and scientific assistance. The decision was based on the regional predominance of two Latin languages (Spanish and Portuguese) and the fact the Central American countries stated they do not belong to any federation. Moreover, these are the countries that most need support to develop hand surgery in technical and scientific terms. The union of the South America, Central America countries and Mexico means that similar countries sharing many of the same problems and needs can come together to develop Hand surgery. Additionally, by decision of those same member countries, the entry of Mexico was approved, and that country currently occupies the vice-presidency of the Latin American Federation. We are engaged in a crusade to enhance member countries and their hand surgeons affiliated to the Federation. We have organized several online Workshops involving all the countries while giving decision-making power to member societies. This decision reaffirms our commitment of the IFSSH to an affiliated Federation and brings together socially and economically disadvantaged countries in order to strengthen the Societies and hand surgeons of Latin America. In order for this new Federation to consolidate in the union of all these countries in forming and developing hand surgery, we need the support of the IFSSH.

Best regards,
Prof. Dr. Jefferson Braga Silva, MD, PhD
President, Latin American Federation of Hand Surgery