4 (% %&&%#4 / & (9" 2)$! 33)34)6% ,) - " Þ (! , ß / . ' !)4 6% , / #)49) . ! $5 , 43 7)4 (' !)4 $)3 / 2$%23ç ! 3934% - ! 4)# 2%6)% 7

Jessica Sara Jacko, SPT; Natalia Kathryn Ochalski, SPT; Elizabeth Mary Rynar, SPT; Charlette Michelle Woelkers, SPT; Renee Hakim, PT, PhD, NCS

/ o^kob^p

- "Z\d`khng]
- Onkihl^
- -^mah]l
- 02)3-!
- /q_hk],^o^eh_%ob]^g\^
- 2^lneml
- #hg\enlbhg
- #ebgb\Ze 2^e^oZg\^
- ,bfbmZmbhgl
- &nmnk^ 2^l^Zk\a
- 4Zd^ (hf^ -^llZ`^
- !\dghpe^]`^f^gml

%gaZg\bg` .^nkhieZlmb\bmr

- hmhk #hgmkhe Zg] - hmhk ,^Zkgbg` Okbg\bie^lú
- .^nkhieZlmb\bmr &Z\mhklú
  - → 3Zeb^g\^
  - → 4b f ^
  - → Intensity
  - → Repetition
  - → !`^
  - → Specificity
  - → 4kZgl_^k^g\^
  - →)gm^k_^k^g\^
  - → Use it or lose it
  - → Use it and improve it

2h[hmb\ %qhld^e^mhgl

- Okhob]^Z f [neZmbhg mkZbgbg` [r f^Zgl h_Zg ^qm^kgZe iZllbo^ f ho^ f ^gm]^ob\^û
- Okh f hm^b f ikho^ f ^gml bg nikb`am mhe^kZg\^Å eh\h f hmbhgÅ [hg^ f bg^kZe ]^glbmrÅ^]^ f Z f ZgZ`^ f ^gmÅ \Zk]bhine f hgZkr hnm\h f ^lÅ^m\Èû

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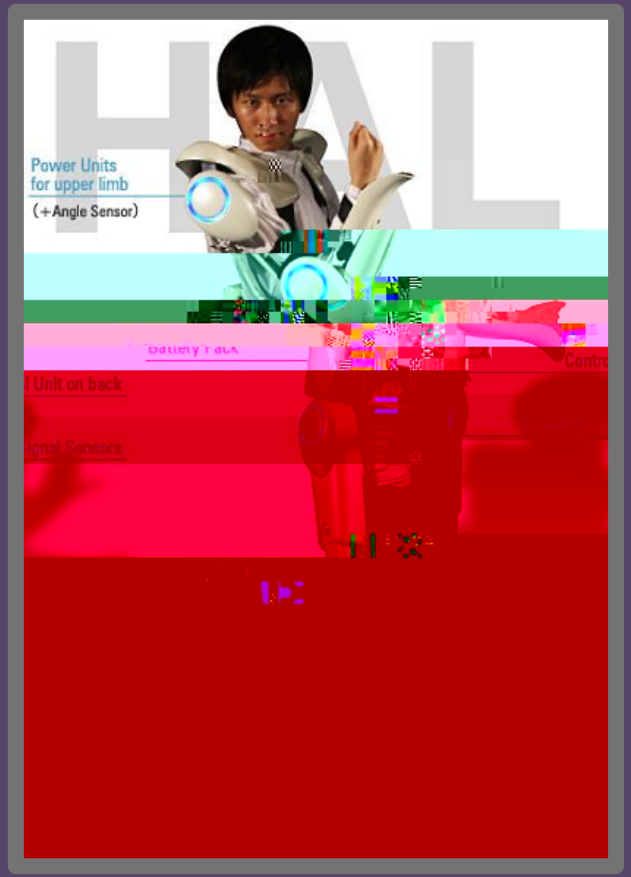
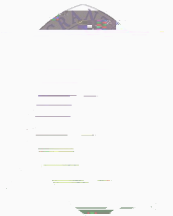
- É Ð&bkl m \r [hk`Ém r i^ p^ZkZ [e^ kh [hm ^qhld^e^mhgÑü
- É)gm^`kZm^l an f Zgå f ^\aZgb\Zeå Zg] bg_hk f Zmbhg m^\aghеh`b^l
- É %gaZg\^l ohengmZkr f hmhk \hgmkhe makhn`a k^ZeÉmb f ^ p Zedbg` Z l l b l mü
- HAL Components[3]
  - → (r [kb] l r l m^ f nmbebsZmbhg h_ ohengmZkr \hgmkhe
  - → - hmhk bgm^k i k^mZmbhg h_ [bh^e^\mkb\ l b`gZe l
  - → ' ^g^kZmbhg h_ f hmhk i Zmm^kgl k^_e^\mbg` an f Zg f hmbhg


HAL
Power Units
for upper limb
(+Angle Sensor)

Onkihl^

4h]^m^k f bg^ ma^ ^_^\mbo^g^ll h_ (!,
hg b f ikhobg` `Zbm o^eh\bmr bg mahl^
pbma `Zbm]blhk]^kl



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ÞÐ(r[kb] Zllblmbo^ eb f [Ñ /2 (!, /2 Ðehp^k eb f [f h]^eÑß

AND

Þ`Zbm o^eh\bmr /2 `Zbm li^^] /2 pZedbg` o^eh\bmr /2 pZedbg` li^^]ß

AND

Þ`Zbm /2 `Zbm b f iZbk f ^gml /2 `Zbm ]^obZmbhgl /2 `Zbm]blhk]^klß

- ^mah]l É 3^Zk\a ,b f bml

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É 7 bmabg ma^ eZlm úù r^Zkl

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É !]neml úā r^Zkl hk he]^k

É $bZ`ghlbl h_ `Zbm]blhk]^k

É 5l^h_ (!,]nkbg` `Zbm

É 'Zbm o^eh\bmr hnm\h f^l

P

/q_hk] ,^o^e h_ %ob]^g\^

Author and Title	Study Design	Oxford Level of Evidence
Tanaka et al[7]- 3iZmbhm^ f ihkZe `Zbm \aZkZ\m^kblmb\ \aZg`^l pbma `Zbm mkZbgbg` nlbg` ma^ ar[kb] Zllblmbo^ eb f [_hk \akhgb\ lmkhd^ iZmb^gmlÈ	.hgÉ#hgmkhee^]	ý
Yoshikawa et al[8]- 'Zbm mkZbgbg` pbma ar[kb] Zllblmbo^ eb f [ ^gaZg\^l ma^ `Zbm _ng\mbhgl bg ln[Z\nm^ lmkhd^ iZmb^gmlÇ Z ibehm lmn]rÈ	.hgÉ2Zg]h f bs^] #hgmkhee^]	ü
Yoshikawa et al[9]- 4kZbgbg` pbma ar[kb] Zllblmbo^ eb f [ _hk pZedbg` _ng\mbhg Z_m^k mhmZe dg^^ Zkmakh ieZlmrÈ	.hgÉ2Zg]h f bs^] #hgmkhee^]	ü
Taketomi et al[10]- (r[kb] Zllblmbo^ eb f [bgm^ko^gmbhg bg Z iZmb^gm pbma eZm^ g^nkheh`b\Ze ]^m^kbhkZmbhg Z_m^k mahkZ\b\ f r^ehiZmar lnk`^kr]n^ mh hllb_b\Zmbhg h_ ma^ eb`Z f ^gmn f _eZon fÈ	#Zl^ 2^ihkm	ý

/ q_hk] ,^o^e h_ %ob]^g\^ #hgmÈ

Author and Title	Study Design	Oxford Level of Evidence
Aach[11]- 6hengmZkr]kbo^g ^qhld^e^mhg Zl Z g^p mhhe_hk k^aZ[bebmZmbhg bg \akhgb\ l ibgZe \hk] bgcnkrÇ Z ibehm lmn]rÈ	. hgÉ#hgmkhee^]	ý
Yoshimoto et al[5]-&^Zlb[bebmr Zg] ^_b\Z\r h_ab`aÉl i^^] `Zbm mkZbgbg` pbma Z ohengmZkr ]kbo^g ^qhld^e^mhg kh[hm_hk `Zbm Zg] [ZeZg\^]rl_ng\mbhg bg iZmb^gml pbma \akhgb\ lmkhd^Ç ghgkZg]h f bs^] ibehm lmn]r pbma \hg\nkk^gm \hgmkheÈ	. hgÉ2Zg]h f bs^] #hgmkhee^]	ý
Kubota et al[12]- (r[kb] Zllblmbo^ eb f [Þ(!,ß mk^Zm f ^gm_hk iZmb^gml pbma l^o^k^ mahkZ\b\ f r^ehiZmar]n^ mh hllb_b\Zmbhg h_ma^ ihlm^kbhk ehg`bmn]bgZe eb`Z f ^gm Þ/0,,ß bg ma^ ihlmhi^kZmbo^ Z\nm^ØIn[Z\nm^ iaZl^Ç Z \ebgb\Ze mkbZeÈ	#Zl^ 3^kb^l	ý

/ q_hk] ,^o^e h_ %ob]^g\^ #hgmÈ

Author and Title	Study Design	Oxford Level of Evidence
Maeshima et al[4]- %_b\Z\r h_Z ar[kb] ZllblmboÈ^ eb f [bg ihlmÉlmkhd^ a^ f bie^`b\ iZmb^gmlÇZ ik^eb f bgZkr k^ihkmÈ	. hgÉ#hgmkhee^]	ü
Yoshikawa et al[13]- (r[kb] ZllblmboÈ^ eb f [^gaZg\^l ma^ `Zbm_ng\mbhgl bg ln[Z\nm^ lmkhd^ lmZ`^ÇZ f nemb lbg`e^É\Zl^ lmn]rÈ	#khllÉ/o^k	ý
Watanabe et al[14]- ,h\h f hmbhg b f ikho^ f ^gm nlbg`Z ar[kb] ZllblmboÈ^ eb f [bg k^\ho^kr iaZl^ lmkhd^ iZmb^gmlÇZ kZg]h f bs^] \hgmkhee^] ibehm lmn]rÈ	2Zg]h f bs^] #hgmkhee^]	û
Kawamoto et al[15]- Obehm lmn]r h_eh\h f hmbhg b f ikho^ f ^gm nlbg` ar[kb] ZllblmboÈ^ eb f [bg \akhgb\ lmkhd^ iZmb^gmlÈ	. hgÉ#hgmkhee^]	ý

2^lnemlÉ3Z f ie^3bs^Þ.ß

É -bgbfnfçúÞ\Zl^k^ihkmßúù

É -Zqbfnfçüû ÞkZg]hfbs^] \hgmkhee^]ßúý

É !o^kZ`^3bs^çúüÈþþ iZkmb\biZgmlýÅÞÅù

2^lnemI É !`^

É 2Zg`^ç ûúÉāĂÈþ r^ZkI he]ýÅúý

É !o^kZ`^ !`^ç

É ýĀÈÿüÉĀüÈÿĀ r^ZkI he] ÞkZg`^ßýÅ þÅ ĀÉúþ

É ÿúÈúü r^ZkI he] Þho^kZeeßýÅ þÅ ĀÉúþ

2^InemI É Oh i neZmbhg

2^lnemlÉ 4kZbgbg` $nkZmbhg

É 2Zg`^ç üÉúā p^^dlýÅ þÅ ĀÉúþ

É !o^kZ`^ç ÿÈý p^^dlýÅ þÅ ĀÉúþ

É -h]^ç þ p^^dlýÅ þÅ ĀÉúþ

É .hm3i^\b_b^]ç ú lmn]rúû

2^lnemlÉ 4kZbgbg`)gm^glbmr

- Ð!\\hk]bg` mh iZmb^gm mhe^kZg\^Ñýå þå ĀÉúþ
  - → #h f_hkmZ[e^ `Zbm li^^]olè fZqb f n f li^^] ihllb[e^
- 3bg`e^ ,^`ç ÿ lmn]b^lþåāåĂåúüÉúþ
- -h]^ç
  - → *Overground*ç ā lmn]b^lýåāÉúùåúûÉúþ
  - → *Treadmill*ç ü lmn]b^lþåĀåúú
- 4b f^ ,b f bmç ú lmn]r \Zi i^] Zm ûù f bgnm^l i^k l^llbhgª

2^lnemlÉ(!,4kZbgbg`-h]^

É #6#-h]^çālmn]b^lþÅĀÉúûÅúý

É #!#-h]^çûlmn]b^lÞngmbe iZmb^gm

[^\Z f ^ _Z f bebZk pbma #6#ßúüÅúþ

É .hm3i^\b_b^]çúlmn]rý

2^lnemlÉ 4kZbgbg` / i^kZmhkl

0arlb\Ze 4a^kZ i blml ýÅ þÅ ĀÉúþ

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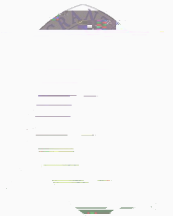


2^lnemlÉ4bf^3i^gmpbma(!,

É -bgbfnf4bf^çúùfbgnm^lĂ

É -Zqbfnf4bf^çÿùfbgnm^lĀ

É !o^kZ`^4bf^çûýèúfbgnm^lýÅþÅĀéúþ

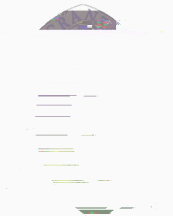
É .hm3i^\b_b^]çûlmn]b^lýÅúú

2^lnem l É / nm\h f ^ - ^Zlnk^l

- Primary Outcomes
  - → úùÉ - ^m^k 7 Zed 4^lm Þúù É - 7 4ß ýÅ þÅ ĀÉúþ
- Secondary Outcomes
  - → "^k` "ZeZg\^ 3\Ze^ þ" "3ß þÅ āÅ úþ
  - → 4b f ^] 5 i Zg] 'h Þ45 'ß þÅ úúÅ úýÅ úþ

2^lnemlÉ !]o^kl^ %o^gml

. h Z]o^kl^ ^o^gml ghm^] bg Zgr h_ ma^
úú lmn]b^l k^lnembg` _kh f (! ,
nl^ÈýÅþÅĀÉúþ



Results - Statistical Significance for Berg Balance Scale (BBS) in (points)

	Pre-Training	Post-Training	Change in BBS	MDC for BBS
Yoshimoto et al[5]** **HAL Group**	40.9 +/- 6.13	46.2 +/- 5.97	5.30 +/-0.16	**Exceeds** MDC of 4.66[20]
Kawamoto et al[15]* **HAL Group**	40.6 +/- 13.6	45.5 +/- 8.02	4.90 +/- 5.58	**Exceeds** MDC of 4.66[20]

Results - Statistical Significance for Timed Up and Go (TUG) in (s)

*= p< 0.05
**= p<0.01

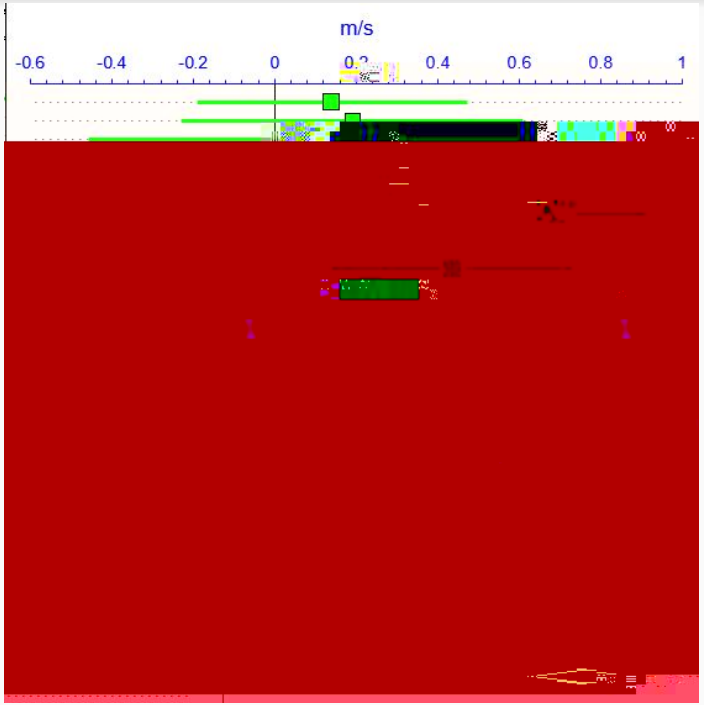
	Pre-Training	Post-Training	Change in TUG time	MDC for TUG
Aach[11]* **HAL Group**	55.34 +/- 33.20	38.18 +/- 25.98	17.16 +/- 7.22	**Exceeds** MCD 10.8 seconds[21]
Yoshimoto et al[5]** **HAL Group**	35.6 +/- 14.6	24.1 +/- 7.82	11.5 +/- 6.78	**Exceeds** MDC of 8 seconds[20]
Watanabe et al[14]* **HAL group**	27.8 +/- 14.3	16.8 +/- 7.00	11.0 +/- 7.30	**Exceeds** MDC of 8 seconds[20]
Watanabe et al[14]** **Control group**	45.8 +/- 25.7	29.9 +/- 18.4	15.9 +/- 7.30	**Exceeds** MDC of 8 seconds[20]

Results -

/nm\h f ^l - ^mZÉ!gZerlbl

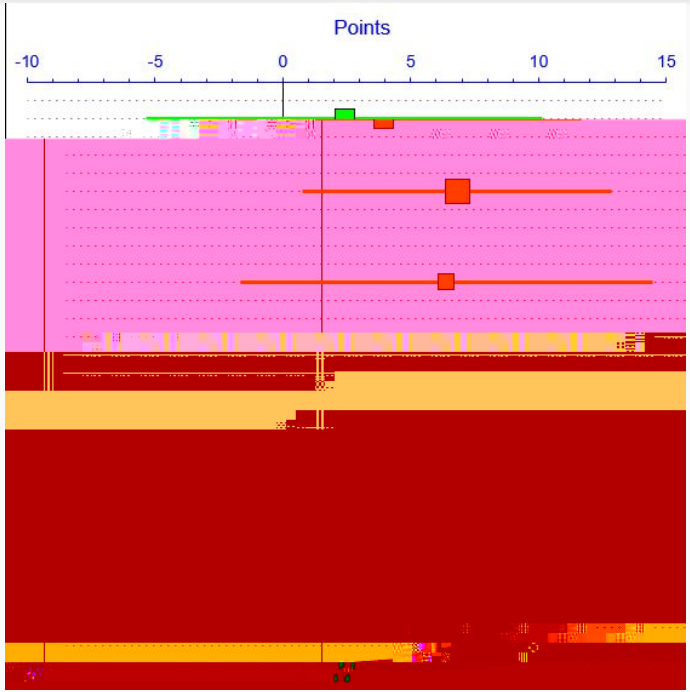
É -^Zg l\hk^l h_ ik^ÉZg] ihlmÉbgm^ko^gmbhgÅ lmZg]Zk]

- ^mZÉ!gZerlblÉ úùÉ - 74



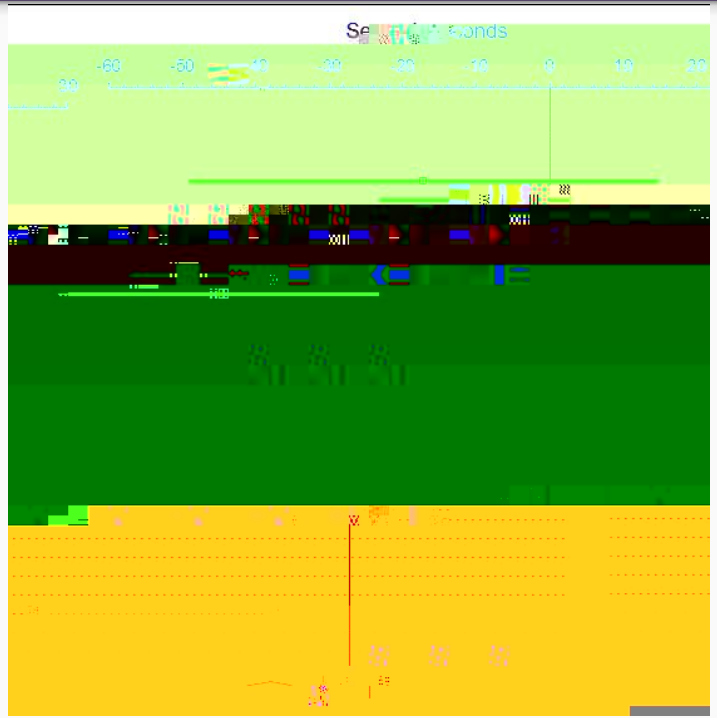
Studies Included in Meta-Analysis	āýÅþÅĀÉúþ
Average Change	ùÈûû f ^m^kl i^k l^\hg] b f ikho^ f ^gm
Confidence Interval	ĂþČ #) àùÈùĂāāÅ ùÈüýÿÿĂá
MCID	ùÈùùÿÉ ùÈúĀ f ^m^kl i^k l^\hg]

- ^mZÉ!gZerlblÉ "" "3



Studies Included in Meta-Analysis	üÞÅ ãÅ úþ
Average Change	ýÈüÿ ihbgm b f ikho^ f ^gm
Confidence Interval	ĂþČ #) àùÈþýüþþÅ āÈúĀÿÿþá
MDC	ýÈûþÉ ýÈÿÿ ihbgml

- ^mZÉ!gZerlblÉ 45 ' 4^lm



Studies Included in Meta-Analysis	ýÞÅ úúÅ úýÅ úþ
Average Change	Éúù È ÿû l^\hg]l
Confidence Interval	ĂþČ #) àÉúÿ È ýÞÅ ÉýÈĀĂÿúá
MDC	āÉúù È ā l^\hg] k^]n\mbhg

- ^mZÉ!gZerlblÉ)f ieb\Zmbhgl

- All primary and secondary outcome measures exceed minimal detectable changes and minimal clinically important differences found in the literature[16-21]
  - → úùÉ- 74 Þùèûû f^m^kl i^k l^\hg]bf ikho^ f^gmß
  - → ""3 l\hk^ Þýèüÿ ihbgmbf ikho^ f^gmß
  - → 45' l\hk^ Þúùèÿû l^\hg]bf ikho^ f^gmß

2^lnemlÉ ,b f bmZmbhgl

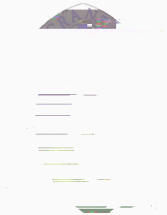
É . hg kZg]h f bsZmbhg

É . hm [ebg]^]

É

2^lnemlÉ #hg\enlbhg

- Improvements in outcomes noted in:
  - → úùÉ - ^m^k 7 Zed 4^lm
  - → "^k` "ZeZg\^ 3\Ze^ 3\hk^
  - → 4b f ^] 5 i Zg] 'h 3\hk^l



3rlm^ f Zmb\ 2^ob^p #hg\enlbhg

É ,hp mh f h]^kZm^ e^o^e ^ob]^g\^ lni ihkml ma^ _^Zlb[e^ Zg] lZ_^ nl^ h_ (!, `Zbm mkZbgbg` bg Z]neml pbma `Zbm]blhk]^kl mh b f ikho^ hnm\h f ^l ebd^ úùÉ - 74Å ""3Å Zg] 45'È

É (!, \Zg [^g^_bm Z oZkb^mr h_ ihineZmbhglÈ

#ebgb\Ze 2^e^oZg\^Ø 4Zd^ (h f ^

-) f ikho^l `Zbm li^^]Å [ZeZg\^ Zg] f h[bebmr bg Z]neml pbma `Zbm]blhk]^kl lZ_^er Zg] ^_^\mbo^er
- #nkk^gmer eZ[hkZmhkrÉ[Zl^]
- (! , f Zr ^gm^k \ebgb\Ze l^mmbg` bg hnk eb_^mb f ^È
- #ebgb\bZg k^\h`gbmbhg Zg] b f ie^ f ^gmZmbhg h_ g^nkh f hmhk [^g^_bml h_ (! , \Zg ^gaZg\^ hnm\h f ^lÈ

! \dgh p e^] ` ^ f ^g m l

4aZgd rhnÊ

$kÈ 2^g^^ (Zdb f Å 04Å 0a$Å . #3
$kÈ 4kZ\^r #heebg lÅ 04Å 0a$Å - " ! Å ' #3
$04 _Z\nem r ¶ lmn]^g m l

2^_^k^g\^l

úÉ +e^b f * ¶ *hg^l 4É Okbg\bie^l h_^qi^kb^g\^É]^i^g]^gm g^nkZe ieZlmb\bmrÇb f ieb\Zmbhgl _hk k^aZ[bebmZmbhg Z_m^k [kZbg]Z f Z`^É J *Speech Lang Hear Res*É ûùùãßþú¢3ûûþÉ3ûûÃÉ]hb¢úùÃûÉýüääØùäØþúùúÉ3ûûþÉ

ûÉ - bee^k ,%å :b f f ^k f Zg !+å (^k[^km 7 'É #ebgb\Ze ^_^\mbo^g^ll Zg] lZ_^m r h_ ihp^k^] ^qhld^e^mhgÉZllblm^] pZedbg` bg iZmb^gml pbma l ibgZe \hk] bgcnkr¢ l r lm^ f Zmb\ k^ob^p pbma f ^mZÉZgZerlbIÉ *Med Devices (Ackl)*É ûùúýÉÃÇýþþÉýÿýÉ]hb¢úùÉûúýÃØ - $%2É3úùùúùûÉ

úÉ #r[^k]rg^É (! ,Ìl f hmbhg ikbg\bie^É ammil¢ØØp p pÉ\r[^k]rg^¢ièØ^g`ebla Øikh]n\mlØ(! ,Øbg]^q¢am feÉ ! \\^ll^] 3^im^ f [^k ûþå ûùúÃÉ

ýÉ - Z^lab f Z å / lZpZ ! å . blabh $å ^m ZÉ % _b\Z\r h_ ar[kb] Zllblmbo^ eb f [bg ihlmÉlmkhd^ a^ f bie^`b\ iZmb^gml¢Z ik^eb f bgZkr k^ihkmé *BMC Neurol.* ûùúúÉúúÞúúýÉ¢]hb¢úùÉúúãÿØúýÃúÉûùÃÃÉúúÉúúýÉÞ ! 24)# , % Ãß

þÉ 9hlab f hmh 4å 3ab f bsn)å (tkhb 9å +ZpZdb - å 3Zmh $å . Z`ZlZpZ - É &^ZIb[bebmr Zg] ^_b\Z\r h_ab`aÉli ^^] `Zbm mkZbgbg` pbma Z ohengmZkr]kbo^g ^qhld^e^mhg kh[hm _hk `Zbm Zg] [ZeZg\^] r l_ng\mbhg bg iZmb^gml pbma \akhgb\ lmkhd^¢ ghgkZg]h f bs^] iebhm lmn]r pbma \hg\nkk^gm \hgmkhé *Int J Rehabil Res*ÉûùúþÉüãÞýßçüüãÉúýüÉ]hb¢ úùÉúùÃÃØ - 22ÉùùùùùùùùùùùùùùúÉ

6. Dragos G. How Hybrid Assistive Limb (HAL) Exoskeleton Suit Works. SmashingRobotics. https://www.smashingrobotics.com/how-hybrid-assistive-limb-hal-exoskeleton-suit-works/. June 12, 2014. Accessed September 25, 2019.

Ãé 4ZgZdZ (å - ZgZ[n . å 4hkn . å ^m Zé 3 iZmbhm^ f ihkZe `Zbm \aZkZ\m^kblmb\ \aZg`^l pbma `Zbm mkZbgbg` nlbg` ma^ ar[kb] Zllblmbo^ eb f [ _hk \akhgb\ lmkhd^ iZmb^gmlÉ *Gait Posture*É ûùúÃÉúÃú¢ûùÞÉûúúÉ]hb¢úùÉúùúýØé`Zbm ihlmÉûùúÃÉùÞÉùùüÉÃ

ãÉ 9hlabdZpZ + å - bsndZ f b - å +ZpZ f hmh (å ^m Zé ' Zbm mkZbgbg` pbma ar[kb] Zllblmbo^ eb f [ ^gaZg\^l ma^ `Zbm _ng\mbhgl bg ln[Z\nm^ lmkhd^ iZmb^gml¢Z ibehm lmn]ré *NeuroRehabilitation.* ûùúÃéýùÞúß¢ãÃÉÃÃÉ]hb¢ úùÉúûüüØ . 2%éúýúúÃûé

Ãé 9hlabdZpZ + å - nmlnsZdb (å 3Zgh ! å ^m Zé 4kZbgbg` pbma (r[kb] ! llblmbo^ , b f [ _hk pZedbg` _ng\mbhg Z_m^k mhmZe dg^^ Zkmakhi eZlmré *J Orthop Surg Res*É ûùúãÉúü¢úýüé]hb¢úùÉúüãÿØlúüùúúãÉùúãÉùãÞÞéúé

úûÉ 4Zd^mh f b - å 3ab f bsn 9å +Z]hg^ (å ^m Zé (r[kb] Zllblmbo^ eb f [bgm^ko^gmbhg bg Z iZmb^gm pbma eZm^ g^nkheh`b\Ze ]^m^kbhkZmbhg Z_m^k mahkZ\b\ f r^ehi Zma r lnk`^kr]n^ mh hllb_b\Zmbhg h_ma^ eb`Z f ^gmn f _éZon f é *Case Rep Orthop.* ûùúãÉúùúãé¢úÉúúé]hb¢úùÉúúþÞØûùúãØýúÃúÃýù

úúÉ ! Z\a - å #kn\b`^k / å 3\s^lgrÉ+Zbl^k - å ^m Zé 6hengmZkr]kbo^g ^qhld^e^mhg Zl Z g^p mhhe _hk k^aZ[bebmZmbhg bg \akhgb\ libgZe \hk] bgcnkr¢ Z ibehm lmn]ré *Spine* JÉ ûùúýÉúýÞúûß¢ûãýÃÉûãÞúé]hb¢úùÉúúúýØ¢élbg^^éûùúýÉùüÉùýûé

úûÉ +n[hmZ 3å 3ab f bsn 9å +Z]hg^ (å ^m Zé (r[kb] Zllblmbo^ eb f [þ(! , ß mk^Zm f ^gm _hk iZmb^gml pbma l^o^k^ mahkZ\b\ f r^ehiZmar \Znl^] [r hllb_b\Zmbhg h_ma^ ihlm^kbhk ehg`bmn]bgZe eb`Z f ^gm þ / 0 , , ß bg ihlmhi^kZmbo^ Z\nm^ iaZl^É *Ann Phys Rehabil Med.* ûùúãÉýú¢ýÃþé]hb¢úùÉúûúúýØ¢ékˆaZ[éûùúãÉùþÉúúþùé

úûé 9hlabdZpZ + å - ZlZ_n f b - å (bkhZdb + å ^m Zé (r[kb] Zllblmbo^ eb f [^gaZg\^l ma^ `Zbm _ng\mbhgl bg ln[ÉZ\nm^ lmkhd^ lmZ`^¢ ! f nemb lbg`e^É\Zl^ lmn]ré *Physiother Pract Res.* ûùúýÉúÃÞûß¢ÃúÉúûùé]hb¢úùÉúûûüüØO2Éúýùù ÃýÉ

úýÉ 7 ZmZgZ[^ (å 4ZgZdZ . å)gmmZ 4å 3Zbmhn (å 9ZgZ`b (É , h\h f hmbhg b f ikho^ f ^gm nlbg` Z ar[kb] Zllblmbo^ eb f [bg k^\ho^kr iaZl^ lmkhd^ iZmb^gml¢ZkZg]h f bs^] \hgmkhe^] iebhm lmn]ré *Arch Phys Med Rehabil.* ûùúýÉÃÞÞúúß¢ûùùýÉûùúûé]hb¢ úùÉúûúýØ¢éZi f kéûùúýÉùÃûùûé

úþÉ +ZpZ f hmh (å + Z f b[ZrZlab + å . ZdZmZ 9å ^m Zé Obehm lmn]r h_eh\h f hmbhg b f ikho^ f ^gm nlbg` ar[kb] Zllblmbo^ eb f [bg \akhgb\ lmkhd^ iZmb^gmlÉ *BMC Neurol*É ûùúúÉúúÞúýúß¢]hb¢úùÉúúãÿØúýÃúÉûùÃÃÉúúÉúúýúé

úýÉ 0^k^kZ 3å - h] r 3 (å 7 hh] f Zg 2#å 3mn]^gldb 3 !É - ^Zgbg`_ne \aZg`^ Zg] k^l ihglbo^g^ll bg \h f f hg iarlb\Ze i^k_hk f Zg\^ f ^Zlnk^l bg he]^k Z]nemlÉ *J Am Geriatr Soc.* ûùùýÉþýÞþß¢ÃýúÉÃýÃ

úÃÉ (he f Zg *(å "^\d f Zg " ! å "kZg]m 2 ! å - ^kkbp^ma^k % . å 7 beebZ f l 24å . hk]kn f *4É - bgb f n f]^m^\mZ[e^ \aZg`^ bg `Zbm o^eh\bmr]nkbg` Z\nm^ k^aZ[bebmZmbhg _heehpbg` abi _kZ\mnk^É *J Geriatr Phys Ther*É ûùúãÉúúÞûß¢ûÞúÉÞýÉ

úãÉ 4beIhg *+å 3neebo Zg +^å ^m Zé - ^Zgbg`_ne `Zbm b f ikho^ f ^gm]nkbg` _bkIm ýù]Zrl ihlmlmkhd^É - bgb f Ze \ebgb\Zeer b f ihkmZgm]b_^k^g\^É *Phys Ther*É ûùúúÞÃûÞûß¢úÃýÉûùãÉ]hb¢úùÉûþûûØ imé¢ûùùùÃùùÃÃÉ

úÃÉ - nll^e f Zg +É #ebgb\Ze Ib`gb_b\Zg\^ m^lmbg` bg k^aZ[bebmZmbhg k^l^Zk\a¢ paZmå par å Zg] ahpÌ *Phys Ther Rev*É ûùúýÉúûÞýß¢ûãÃÉûÃýÉ]hb¢úùÉúúÃÃØúùãúúùÃûùÃqûûúúûãÉ

ûûÉ (b^g`dZ^p 6å *bmZk^^ + å #aZbrZpZm Oé - bgb f Ze ]^m^\mZ[e^ \aZg`^l h_ma^ "^k` "ZeZg\^ 3\Ze^\ 4b f ^] i5i ¶ 'hí 4^lmå `Zbm li^^] lå Zg] ûÉ f bgnm^ pZed m^lmbg bg]bob]nZel pbma \akhgb\ lmkhd^ pbma]b_^k^gm]^`k^^l h_Zgde^ ieZgmZk_e^qhk mhg^É *Arch Phys Med Rehabil.* ûùúûÉÃûÞÃß¢úûùúÉúûùãé]hb¢ úùÉúùúýØ¢éZi f kéûùúûÉùúÉùúýÉ % in[ûùúû ! ik ûûÉ

ûûé , Z f 4å . hhgZg 6+å %g` **É ! lr lm^ f Zmb\ k^ob^p h_ng\mbhgZe Z f [neZmbhg hnm\h f ^ f ^Zlnk^l bg l ibgZe \hk] bgcnkr É *Spinal Cord*É ûùúãÉýß¢ûýÿýÉûþýé]hb¢úùÉúùúãØlé¢l\éúùúûúúýé

1n^Imbhg lÌ