

STUDY OF INTER-HEMISPHERIC DEPENDENCE DURING UNI-MANUAL DECISION MAKING IN INDIVIDUAL WITH UPPER LIMB AMPUTATION

Allami N⁽¹⁾, Frossard L⁽¹⁾, Frak V⁽¹⁾

⁽¹⁾ UQAM, Montreal, Canada.

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Background. Inter-hemispheric communication is necessary during uni-manual grip of an object (1). The right and left hands share a level of representation in the motor program that is common to both (2). It could be essential to take into consideration bi-hemispheric activity to adapt prosthesis of individuals with upper limb amputation.

Objective. To determine the relevance of the inter-hemispheric dependence in the programming and execution of uni-manual grip in individuals with upper limb amputation.

Methods. Five adults with amputation of the upper limb above and below the elbow participated in this study. Each participant was seated and asked to grab and lift an instrumented cylinder with the sound hand 15 times (Figure 1). The cylinder enabled to record in real time the apposition axis (AO) passing by the thumb, the centre of the cylinder and the first finger as well as the forces applied during the gripping period of 2000 ms. The participants were assessed during the temporary (PP) and definitive (PD) phases of prosthesis fitting the after the amputation. Student t-tests were used to determine the effect of different prosthetic phases on the force and orientation of the gripping hand.

Results

1. A significant reduction ($p < 0.01$) of the forces applied by the sound hand between the two prosthetic phase for 4/5 of the participants (Figure 2)

2. Some changes in the gripping orientation when the amputated hand was dominant for 2/3 of the participants (Figure 3)
3. No changes in the gripping orientation when the amputated hand was not dominant

Conclusion. Grip programming and execution with sound hand:

1. Change between two prosthetic fitting phases
2. Depend on the inter-hemispheric transfer related to the force regardless on the amputated hand.
3. Depend on the inter-hemispheric transfer related to the gripping orientation only when the amputated side is dominant.

□ Adjustments in gripping force and orientation of the prosthesis depending on the grip correction of the sound hand might be respectively more necessary regardless of the amputated hand and when the amputated hand is dominant.

□ Because of the variability between participants concerning the side of amputation and manual dominance, other studies will be required to generalise these results.

References

1. Frak V et al. (2006). The ScientificWorldJournal, 6, 1805-1809
2. Grosskopf A et al. (2006). Exp Brain Res (1-2):41-51

Study of inter-hemispheric dependence during uni-manual decision making in individual with upper limb amputation



Nadia Allami, Laurent Frossard, Victor Frak.

Background

Inter-hemispheric communication is necessary during uni-manual grip of an object (1). The right and left hands share a level of representation in the motor program that is common to both (2). It could be essential to take into consideration bi-hemispheric activity to adapt prosthesis of individuals with upper limb amputation.

Objective

To determine the relevance of the inter-hemispheric dependence in the programming and execution of uni-manual grip in individuals with upper limb amputation.

Methods

Five adults with amputation of the upper limb above and below the elbow participated in this study. Each participant was seated and asked to grasp and lift an instrumented cylinder with the healthy hand 15 times (Figure 1). The cylinder enabled to record in real time the opposition axis (the OA, in a precision grip is defined as the line connecting the final position of the thumb and index fingers on the object) as well as the forces applied during the gripping period of 2000 msec. The participants were assessed during the temporary (PP) and definitive (PD) phases of prosthesis fitting after the amputation. Student t-tests were used to determine the effect of different prosthetic phases on the force and orientation of the gripping hand.

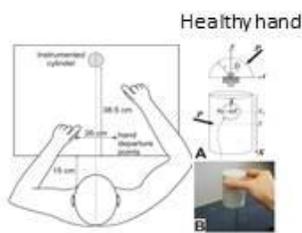


Figure 1: Experimental setup

Participant	Amputated hand	Dominant hand
1	Right	Right
2	Left	Left
3	Left	Right
4	Left	Right
5	Left	Left

Results

1. A significant reduction ($p < 0.01$) of the forces applied by the healthy hand between the two prosthetic phases for 4/5 of the participants (Figure 2).
2. Some changes in the OA orientation when the amputated hand was dominant for 2/3 of the participants (Figure 3).
3. No changes in the OA when the amputated hand was not dominant.

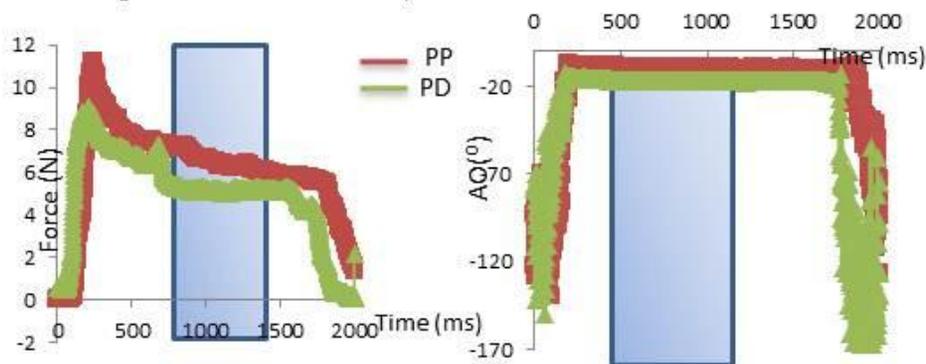


Figure 2: Individual forces in N in relation to the time in msec for participant 1 with a right hand amputation during temporary (PP) and definitive (PD) phases of prosthesis fitting.

Figure 3: Individual orientation of the opposition axis (OA) in degrees in relation to the time in msec for participant 1 during temporary (PP) and definitive (PD) phases of prosthesis fitting.

Conclusion

Grip programming and execution with healthy hand:

1. Change between two prosthetic fitting phases.
2. Depend on the inter-hemispheric transfer related to the force regardless on the amputated hand.
3. Depend on the inter-hemispheric transfer related to the OA only when the amputated side is dominant.

- Adjustments in gripping force and orientation of the prosthesis depending on the grip correction of the healthy hand might be respectively more necessary regardless of the amputated hand and when the amputated hand is dominant.
- Because of the variability between participants concerning the side of amputation and manual dominance, other studies will be required to generalise these results.

References

1. Frak V et al. (2006). The ScientificWorldJournal, 6, 1805-1809
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