

Analysis of Orientation and Mobility Skills in Persons with Visual Impairment

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Abstract

Travel is more difficult for a person visual impairment than for a sighted person (Hellins, 1989). Orientation and Mobility (O&M) training is very important for the visually impaired to overcome the problems above. Numerous mechanical and electronically mobility aids are available for the person with visual impairment for traveling around. The long cane is most widely used by persons with visual impairment as a mobility aid for independent travel. The question arises as to whether a person with visual impairment can improve his O&M through formal training in the use of a cane? The purpose of this study was to examine the cane skills of persons with visual impairment who have been trained in cane use. Two adventitiously visual impairment and two sighted persons participated as subjects in this experiment. The visual impairment subjects had received an intensive training in the long cane techniques. In this experiment a Video Camera (XC- 61A, SHARP), Video Cassette Tape Recorder (VC-V35S, SHARP), and Motion Analyzer (HSV-400, NAC) were employed. The subjects wore brief underclothing, and markers were applied to help identify joint levels. Each marker was a two centimeter green label placed on the anterior and lateral part of the body. In a standing posture, each subject was asked to operate 3 types of canes in touch and slide techniques. The movements of the marker tapes were filmed for acquiring the data of cane angle, arm angle, lateral hand movement from mid-sagittal plane and the distance between the crook of the cane and the mid-sagittal plane using two Video Cameras (XC-6PA, SHARP). The recorded data was then analyzed by means of a Motion Analyzer (HSV-400, NAC). The experiment showed that the person with visual impairment as trained subjects performed better than the sighted persons as untrained subjects while operating the cane techniques. In addition, in conducting the training of cane skills, the cane length must first be fitted to the user's body height.

Key words: Visual Impairment, O&M, Long Cane, and Cane Techniques.

Introduction

Travel is more difficult for a person visual impairment than for a sighted person (Hellins, 1989). Clark-Carter et al. (1986) showed that the blind's walking speed was significantly slower when they walked a more complex route or a moderately complex one, and their speed when unaccompanied was significantly slower than their preferred speed. Nakata et al. (1989) investigated the gait of persons with visual impairment during walking by means of EMG. They found that visual impairment subjects showed a hesitant, wide base gait without arm swing in their arms and with their head drooping forward.

Orientation and Mobility (O&M) training is very important for the visually impaired to overcome the problems above. Heward and Orlansky (1984) noted that the visually impaired who can travel independently are more likely to have self-confidence than someone who must continually depend on other people to get around. Good travel skills also expand one's opportunities for employment and independent living in the community, because a person without such skills must depend on others in everyday situations and may feel uncomfortable or embarrassed about this dependence (Hellins, 1989).

For these reasons, it is important that all persons with visually impaired should be provided with appropriate mobility aids. In addition, proper training in the use of such aids seems imperative.

Numerous mechanical and electronically mobility aids are available for the person with visual impairment for traveling around. These aids can assist the person with visual impairment when traveling but cannot replace the cognitive operations that the visually impaired must carry out. The long cane is most widely used by persons with visual impairment as a mobility aid for independent travel.

The question arises as to whether a person with visual impairment can improve his orientation and mobility through formal training in the use of a cane? The purpose of this study was to examine the cane skills of persons with visual impairment who have been trained in cane use at a Rehabilitation Center.

Methodology

Two adventitiously visual impairment and two sighted persons participated as subjects in this experiment as shown in Table 1. All subjects are right handed. The visual impairment subjects had received an intensive training in the long cane techniques at a Rehabilitation Center.

In this experiment a Video Camera (XC- 61A, SHARP), Video Cassette Tape Recorder (VC-V35S, SHARP), and Motion Analyzer (HSV-400, NAC) were employed. The subjects wore brief underclothing, and markers were applied to help identify joint levels (Fig. 1). Each marker was a two centimeter green label placed on the anterior and lateral part of the body. Nine markers were following sites: forehead, acromion, midriff, mid-sagittal plane (body midline), knee and ankle joints. The other markers were placed on the lateral part of the body at the greater trochanter, fibular of knee articular, lateral malleolus, and the bottom of 5th metatarsus.

In a standing posture, each subject was asked to operate 3 types of canes in touch and slide techniques. In each technique the subjects was required to operate each type of cane 100 times. A metronome was employed for keeping the rhythm of cane swing while

operating those techniques, and was placed 3 m in front of the subject. The movements of the marker tapes were filmed for acquiring the data of cane angle, arm angle, lateral hand movement from mid-sagittal plane and the distance between the crook of the cane and the mid-sagittal plane (Fig. 2) using two Video Cameras (XC-6PA, SHARP). One camera was placed 6.5 m from the line of experiment on the frontal side, and the other one was placed 4.6 m on the lateral side of the subject. The recorded data was then analyzed by means of a Motion Analyzer (HSV-400, NAC). Figure 3 shows the arrangement of the cameras.

Table 1 Characteristics of subjects

Subject	Sex	Age (years)	Height (cm)	Weight (kg)	Visual acuity		O&M training period
					R	L	
Adv. Visual impairment	M	25	165	53	0	LP ^{*)}	2 years
Adv. Visual impairment	M	31	164	55	0.03	0.02	3 months
Sighted	M	25	167	56	-	-	-
Sighted	M	31	167	50	-	-	-

^{*)} Light Perception

Result and Discussion

Figure 4 shows the curves of cane angle in touch technique for subject B. These curves were derived from 3 types of canes in 100 trials. This figure shows that the long cane angle (28.09°) was greater than the short cane angle (23.11°) or the proper cane angle (23.28°). The sighted subject's long, short and proper cane angles (28.83° - 52.33° in touch, 26.61° - 65.07° in slide techniques) were wider than the cane angles in the visual impairment subjects (22.98° - 28.09° in touch, 24.87° - 36.46° in slide techniques) as shown at Figure 5.

Figure 6 shows the lateral hand movement from the mid-sagittal plane, in touch technique for all subjects. The sighted subject's lateral hand movements (6.62-15.07 cm in touch, 5.81-15.89 cm in slide techniques) were greater than the visual impairment subject's (4.20-9.78 cm in touch, 1.80-11.61 cm in slide techniques). This indicates that the sighted subjects moved their hands rather than their wrists while performing the cane techniques.

Figure 7 shows the arm angle in touch technique for all subjects. The visual impairment subject's arm angles (34.15° - 40.34° in touch, 33.07° - 37.97° in slide techniques) were greater than the angles in the sighted subjects (28.50° - 32.54° in touch, 28.28° - 35.22° in slide techniques). These angles were measured for determining the cane position. If the arm angle is narrow, it means that the cane position is downward. The distance between the crook of cane and the mid-sagittal plane is represented in Figure 8. The visual impairment subject's distance (15.19-17.14 cm in touch, 10.20-17.26 cm in slide techniques) was greater than the sighted subjects (7.81-14.45 cm in touch, 7.46-17.29 cm in slide techniques). It means that the sighted subject's hand positions were too close to the body than the visual impairment subjects while operating the cane techniques.

Figure 9, 10, and 11 show the correlation between body height and cane length, body height and arm length, and arm length and cane length. There is a positive correlation between body height and cane length ($r = 0.60$) as shown in Figure 9. Body height also has a positive correlation between arm length ($r = 0.59$), but there is no correlation between arm length and cane length ($r = 0.10$) as shown in Figure 10 and 11.

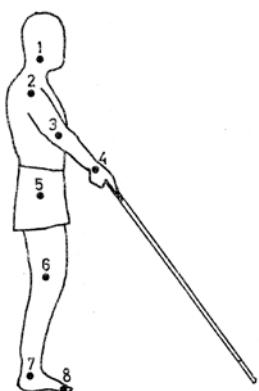
Relationship between mean and SD of cane angle, lateral hand movement, arm angle and the distance between crook of cane and mid-sagittal plane in touch technique are represented in Figure 12, 13, 14, and 15. The visual impairment subjects show better position than sighted subjects in these aspects.

In conclusion, O&M training is very important for the person with visual impairment. Good O&M skills not only to make the person with visual impairment able to travel independently, but he also expand the opportunities for employment and independent living in the community. The experiment showed that the person with visual impairment as trained subjects performed better than the sighted persons as untrained subjects while operating the cane techniques. In addition, in conducting the training of cane skills, the cane length must first be fitted to the user's body height.

This investigation is the first conducted in the O&M field. In order to reach a better understanding, in longer-term follow up studies on this topic should be conducted.

Anterior:

1. Forehead
2. Acromion
3. Midriff
4. Mid-sagittal plane
5. Fibular of knee articular
6. Ankle joint



Lateral:

1. Tragus
2. Acromion
3. Elbow articular
4. Carpus
5. Greater trachanter
6. Fibular of knee articular
7. Lateral maleolus
8. Fifth metatarsus

Figure 1. Landmark points on the anterior and lateral parts of the body

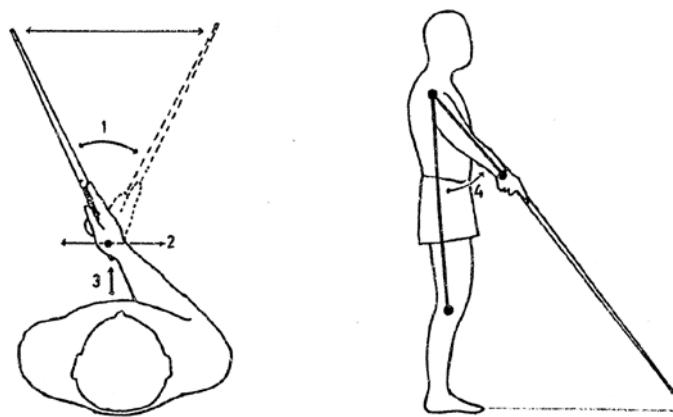


Figure 2. Diagram of measurement points: (1) cane angle, (2) lateral hand movement, (3) distance between crook of cane and mid-sagittal plane (body midline) and (4) arm angle.

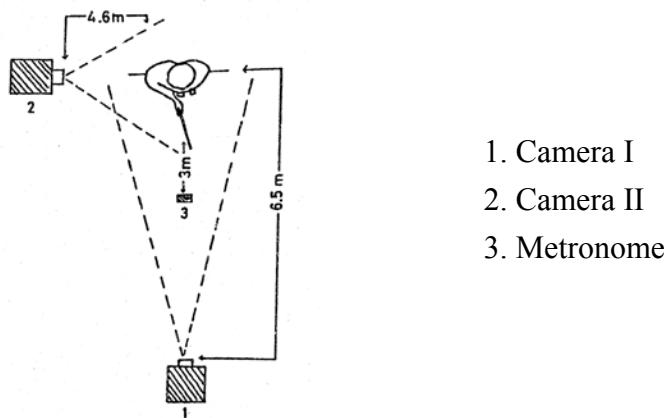


Figure 3. Arrangement of cameras and metronome in the experiment

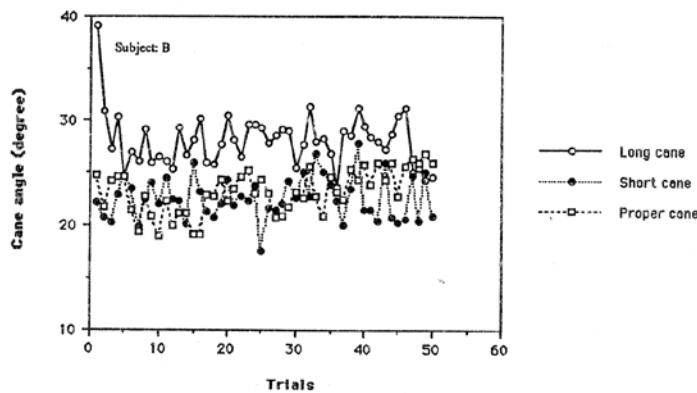


Figure 4. Cane angle in touch technique. Three curves were derived from three types of cane in 100 trials.

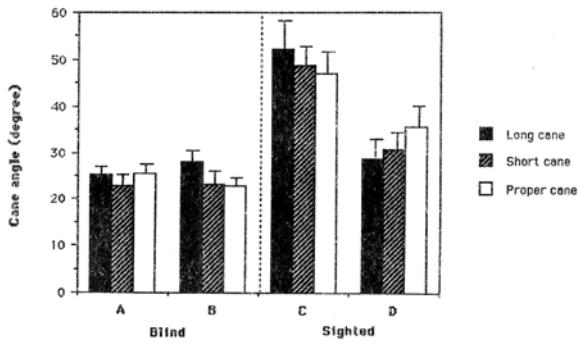


Figure 5. Mean of cane angle in touch technique for all subjects.

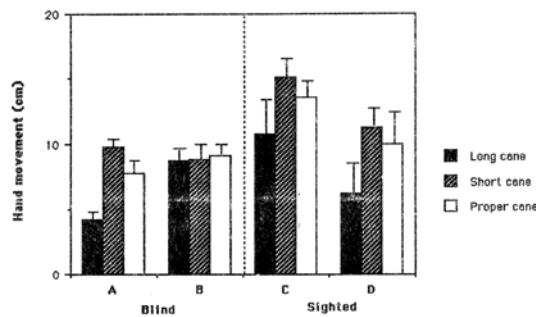


Figure 6. Mean of lateral hand movement from mid-sagittal plane in touch technique for all subjects.

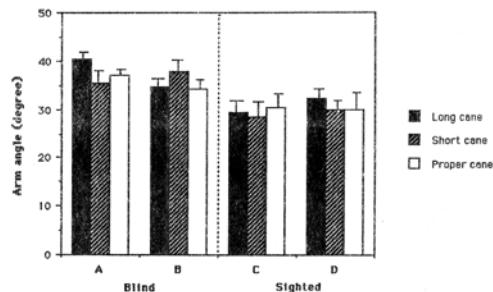


Figure 7. Mean of arm angle in touch technique for all subjects.

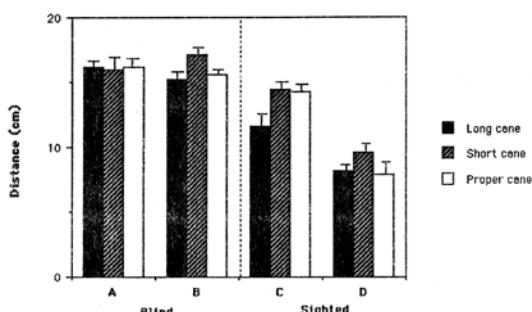


Figure 8. Mean of distance between crook of cane and mid-sagittal plane in touch technique for all subjects.

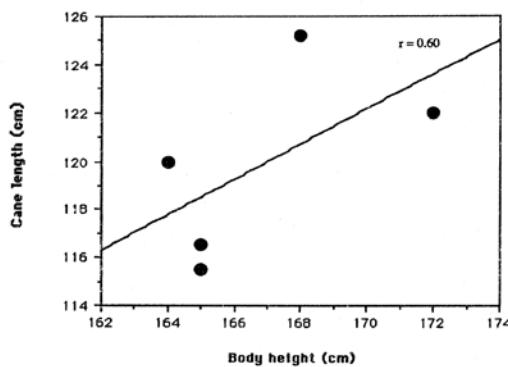


Figure 9. Correlation between body height and cane length.

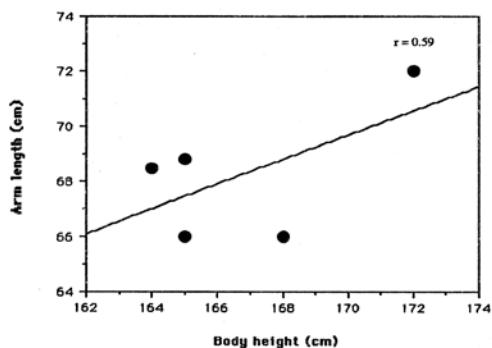


Figure 10. Correlation between body height and arm length.

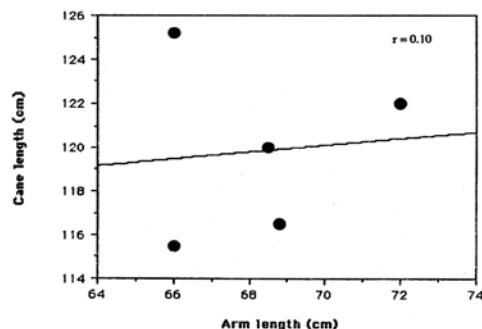


Figure 11. Correlation between arm length and cane length.

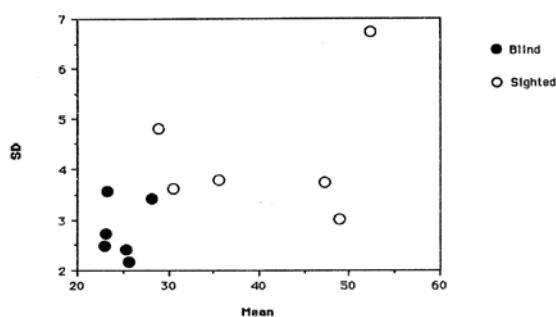


Figure 12. Relationship between mean and SD of cane angle in touch technique.

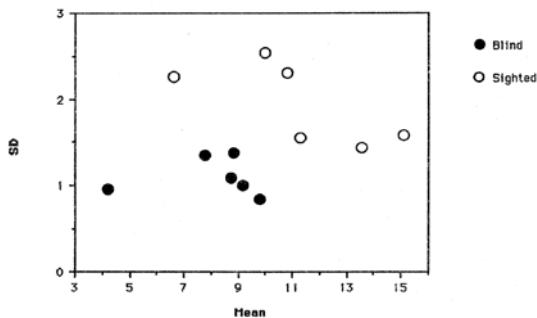


Figure 13. Relationship between mean and SD of lateral hand movement from the mid-sagittal plane (body midline) in touch technique.

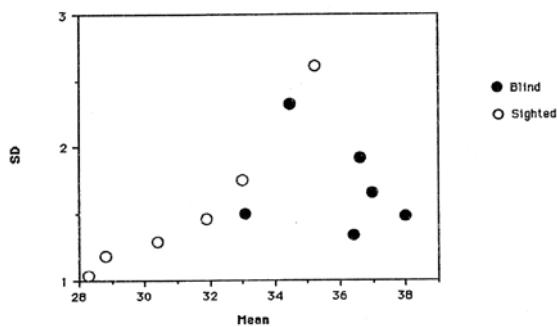


Figure 14. Relationship between mean and SD of arm angle in slide technique.

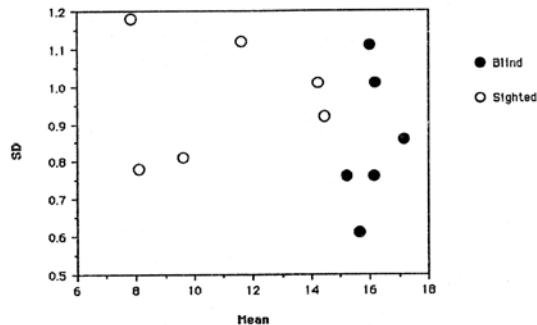


Figure 15. Relationship between mean and SD of crook of cane and mid-sagittal plane (body midline) distance in touch technique.

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