

MECHANICS OF SELF INJURIOUS BEHAVIOR IN PROFOUNDLY RETARDED ADULTS

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INTRODUCTION

Self-injurious behavior (SIB) is a potentially harmful characteristic observed in a portion of the mentally retarded population. SIB has been studied for many years, drawing attention to the severe implications for the patients, family, and direct care givers. Not only is SIB a severe emotional and care task for the family and caregivers, but treatment and pharmaceutical options are very expensive. Estimates of over \$100,000 a year per case, and over \$3.5 billion nationally have been made (NIH, 1991). Several psychological theories have been proposed to explain SIB, yet no single or compound factor has been identified as making a direct contribution to SIB.

Behavior characterization of SIB has relied on assessment of the frequency of self-injurious occurrences, and the general nature of the injury (blows to face, pinches to arms, scratching of face, etc.). Direct estimates of the impact forces, as yet, have not been made. The purpose of this study was to utilize inverse dynamics to assess the impact forces realized by profoundly retarded SIB patients demonstrating blows to the head.

PROCEDURES

SIB patients are routinely videotaped as part of their normal monitoring; SIB trials were selected from available tape. Videotaped trials from three profoundly retarded

patients were selected based on: 1) observed repeated blows to the head, 2) length of the repetitive SIB trial sequence (> 2 blows), and 3) potential for available data for both single and double arm blows. Subject details are presented in table 1.

The movements recorded on the videotapes were manually digitized using a Peak Motus digitizing system. A number of body landmarks were used to define body segment locations. A three-segment rigid body kinematic chain was used to represent the arm and hand. Points digitized on the head permitted determination of head kinematics. Body segment inertial parameters were determined using the equations of Zatsiorsky et al., (1990). Data were filtered and differentiated using the procedure of Challis (1999). The principle of conservation of momentum was used to estimate mean impact forces of the hand on the head. This approach avoided the need to calculate second derivatives, which are inherently noisy. Comparing video-derived estimates of mean impact forces with those measured using a load cell (Newell et al., 1998) served as validation of this approach. Mean forces were estimated to within 10% using this approach. The directly measured forces implied that peak forces were at least twice as large as the mean forces, although peak forces were not directly observable in this study.

RESULTS

Mean impact forces of over 200 N were observed in this study. Results indicated a high degree of variation in the impact forces both between subjects and for consecutive blows from the same subject. Summary data for impact forces are presented in Table 1. Table 2 compares peak impact forces of SIB with those of boxing.

Table 1: Impact forces of the repeat trials and mean (SD) impact force values for SIB subjects.

Subj.	Age (y)	Height (m)	Mass (kg)	Maximum Force (N)	Mean (SD) Force (N)
1	37	1.37	60.8	202.0	81.6 (70.8)
2	44	1.63	45.4	220.6	100.4 (62.1)
3	44	1.73	77.6	69.6	38.3 (22.5)

Table 2: Estimated peak impact forces for SIB subjects and boxing.

Condition	Peak Impact Force (N) as % body mass	Source
Subject 1	67.8	Present study
Subject 2	99.0	Present study
Subject 3	18.2	Present study
Boxing Jab	54-88	Hodgson
Boxing Cross	76-118	Hodgson
Boxing Max	300	Hodgson
Heavyweight Boxing Max	397.5	Atha, et al.

DISCUSSION

The SIB subjects showed large variations in the mean impact force between trials. Comparison of the forces produced by these subjects with those produced by boxers demonstrated that the peak impact forces normalized with respect to body mass were low. These low forces should be considered in the context that the SIB patients without

restraint can have spells when they strike themselves upwards of 30 times in a minute. Although one blow may not be sufficient to cause much damage the repetitive nature of the impacts can lead to cumulative stress (Hof et al., 1991).

Results of this study indicated that SIB patients might be causing brain injury by repeated blows to the head. Methods utilized in this study are practical in that interference with subject movement was minimized. Researchers in the area have sought a quantitative and reliable measure of the force of impact of SIB.

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