



Review

Effect of light touch on postural sway in individuals with balance problems: A systematic review



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ABSTRACT

The aim of the present review was to examine the experimental, case-control studies that investigated the effect of light touch on postural sway in individuals with balance problems due to aging, brain lesion or other motor or sensory deficits. Articles published before the end of March of 2013 were searched in PubMed, Scielo and Lilacs databases using terms related to postural control and sensory information. Twelve studies that assessed the postural sway of individuals with balance problems during quiet standing with the light touch using a force plate were reviewed. Two reviewers rated all selected articles as having good quality. The effect of light touch on postural control was reported by all eligible studies regardless of the cause of the balance problem of the participants. Such effect was more evident when the applied vertical force was greater than 1 N, but if individuals with poor balance took more advantage of the light touch than healthy ones it depended on the source of their balance problems and not the amount of the applied force. These findings suggested that the maintenance of the fingertip lightly touching an external surface could provide additional somatosensory information for individuals with poor balance and then it could be used as a strategy to improve the control of upright standing during intervention programs.

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1. Introduction

The contact of the index fingertip on an external rigid and fixed surface has been described as helpful in the control of postural sway of healthy young individuals during quiet standing [1–6]. This effect was usually investigated by asking individuals to lightly touch an external rigid and fixed surface with an applied force less than 1 N, which is not enough to provide mechanical support to them. Thus, the effect is attributed to the additional somatosensory information obtained by contacting the glabrous skin of the tip of the index finger with the external surface [1,2,5]. The additional sensory information is afforded by the large density of cutaneous mechanoreceptors in addition to kinesthetic receptors providing information about the arm position [7]. For healthy individuals the postural sway during natural standing is about 1 cm in the anterior-posterior direction and 0.5 cm in the medial-lateral [8]. The light touch studies showed that about 50% of the postural sway is reduced with additional somatosensory information [1]. This reduction was observed regardless of the different experimental

condition that participants were assessed, such as: the position of the feet (single foot standing [1], natural feet position [9] or tandem position [6]); level of applied force on the external surface (light touch or heavy touch [1–3]); and visual conditions (eyes open or closed [2,10,11]).

While the light touch effect is well known on healthy individuals, just few studies investigated it on individuals with balance problems due to aging [12–14] or those with brain lesion [15–17]. Overall, individuals with balance problems demonstrated increased postural sway during quiet standing compared to healthy individuals [12–21]. Based on this fact, the light touch could be even more important in the control of postural sway of those individuals. Therefore, the aim of the present review was to examine the experimental, case-control studies that investigated the effect of light touch on postural sway in individuals with balance problems. Studies that measured the postural sway using a force plate and the light touch paradigm were reviewed. In particular, the main question is whether individuals with balance problems use additional somatosensory information from the light touch to reduce their postural sway. In addition, we were interested in investigating if these individuals take more advantage of the light touch than healthy ones. Better understanding of the light touch effects on different groups of individuals with balance problems would contribute to the comprehension of the

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importance of the somatosensory information to the postural control. Moreover, movement science professionals would benefit of such knowledge to plan appropriate intervention programs for these individuals with poor balance using the light touch strategy as additional source of somatosensory information to improve their upright postural control.

2. Methods

2.1. Search strategy

The article searches were carried out using three electronic bibliographic databases: PubMed, Scielo and Lilacs (the last two were used to include possible studies written in Portuguese, native language of the authors of the present study). The following terms were used in the search strategy: 'postural control', 'balance', 'body sway', 'centre of pressure' OR 'centre of pressure', 'oscillation', 'equilibrium', AND 'posture'. These keywords were individually crossed with the terms related to sensory information: 'light touch', 'somatosensory', 'haptic' AND 'tactile'. The search was limited to papers published until the end of March of 2013.

2.2. Selection of articles criteria

Two independent reviewers evaluated the titles and abstracts of the studies, and when it was not possible to identify if a study was eligible for the present review, the full article was assessed. The two reviewers also evaluated the full text of all eligible studies selected for inclusion. When a disagreement between the two reviewers occurred, a third reviewer helped to determine the eligibility of the study. The name of each author and the list of references of the studies were also searched for other eligible studies. The articles were selected for relevancy using the following criteria: (a) body sway was assessed by having participants standing on a force platform, (b) outcomes computed from COP (center of pressure) were assessed, (c) article published in any language, (d) elderly or individuals with balance problems compared to young or healthy individuals, and (e) articles appeared in a peer-reviewed journal. Articles were excluded if: (a) they were review articles, single-case studies or only if the abstracts was published (not full-text articles), (b) involved any intervention (e.g., induced fatigue), (c) assessed only healthy participants, (d) participants aged less than 18 years-old, and (e) they were a clinical trial or involved learning and training for several days.

2.3. Quality assessment

Two reviewers rated the quality of each selected study independently and the divergences between them were discussed with another reviewer. Reviewers were not blinded to the author(s) or which journal was the article published. The quality evaluation was performed to identify the validity of the findings of the selected articles and possible bias that could affect the interpretation of the results. Only the selected articles that were included in the present review were assessed. In the present study, a questionnaire composed by 17 items (Table 1) was used to assess the quality of the quantitative articles adapted from that proposed by Law [22]. Each question was scored as "1 for yes" (when the item description was reported and considered acceptable) or "0 for no" (when the item description was not reported and/or inadequate). The final score (which could range from 0 to 17) was obtained by the sum of the points, in which the higher was the score the greater was the quality of the study. In addition, the total score obtained by the studies in each question was calculated to identify the items less reported and/or inadequate.

2.4. Data extraction

The methodological procedures and the outcomes related to the effect of light touch on the postural sway assessed by the COP measures were retrieved from all selected studies. Then the results of the most significant outcome obtained from COP measures from each study were assessed and presented as indicative of balance control. In particular, the effects statistically significant of *Group* (individuals with or without balance problems), *Touch* (with or no contact of body segment on the external bar) or the interaction between these two factors, *Group* vs. *Touch*, on the postural sway were analyzed and described. The applied forces were also extracted from each study as the amount of these forces could affect the findings. In addition, the values of the most significant outcome from each study were extracted based on the data presented in a figure or table by each selected article. Two reviewers estimated the values and then the average between them were used to compute the overall percentage of reduction between the no touch and light touch conditions for each group.

3. Results

3.1. Selection of studies

Although the searches resulted in 3735 studies, only 400 abstracts were identified by the title for detailed review and 67 full-articles were retrieved for evaluation based on their abstracts. Twelve articles, involving 325 participants where 167 participants were those with balance problems and 158 were healthy individuals, were then included in the present systematic review as they met all the inclusion criteria [12–21,23,24]. None of these studies was selected based on the reference lists. This search process is summarized in a flowchart presented on Fig. 1.

3.2. Quality assessment

The score obtained in each question and the total score across studies are presented in Table 1. The two reviewers disagreed on 35 of the 204 (17.16%) items and the third reviewer helped to solve the disagreements. The median score across articles was 14 out of 17 points. The median score across questions was 10, meaning that 7 studies got full score, but ranged from 2 (question 3d) to 12 (questions 2, 3e, 6–9, 12). Overall, most of the studies clearly informed the purpose of the study, as well as used adequate methods, with reliable and appropriate equipment to investigate their main research questions. For example, the sampling frequency was equal or greater than 20 Hz in all studies, which is considered enough for data acquisition of COP signal during quiet standing [8]. However, the duration of each trial was less than 30 s for five studies [12,17,18,21,23] while one study did not report the time of data acquisition [24]. A trial duration lesser than 30 s can lead to erroneous conclusions due to large variability and non-stationary characteristic of the COP signal [8].

The articles also satisfactorily described and discussed their main findings. Thus, the reported details of the eligible articles were considered enough for further reproducibility of each study. For those questions of the qualitative evaluation all articles were rated with full score. However, the methods used to select the participants and the reasons for the sample size were not stated in all articles. In addition, more details about participants' characteristics, such as body mass and height of the participants, were missing in most of the articles, thus none of studies were rated with full score.

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