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Hand Surgery & Rehabilitation
Hand Surgery and Rehabilitation 35 (2016) 51–54

Original article

Injury mechanisms in supraclavicular stretch injuries of the brachial plexus

Mécanismes traumatiques dans les lésions supraclaviculaires étendues du plexus brachial

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Received 20 July 2015; received in revised form 19 September 2015; accepted 29 September 2015

Abstract

The aim of this study was to describe the mechanisms involved in stretch injuries of the brachial plexus. One hundred and fifty consecutive patients with supraclavicular brachial plexus injuries (BPI) were asked about the mechanism of injury during the actual injury event, particularly about the type of trauma to their shoulder, shoulder girdle and head. Fifty-seven of the patients provided enough information about their accident to allow for analysis of the shoulder trauma. The injury mechanism for all patients having upper root or total palsy ($n = 46$) was described as a direct vertical impact to the shoulder. In 44 of these patients, the trauma followed a motorcycle accident and, in most of them, the patient hit a fixed vertical structure before falling to the ground. The injury mechanism for the lower root palsy cases ($n = 11$) was variable. The most frequent mechanism was forceful anterior shoulder compression by a car seat belt. We found that injury mechanisms differed significantly from the ones commonly discussed in published studies.

Keywords: Brachial plexus injury; Mechanisms of injury; Brachial plexus traction injuries

Résumé

Notre objectif était de décrire les mécanismes impliqués dans les lésions supraclaviculaires étendues du plexus brachial. Cent cinquante patients consécutifs avec lésion supraclaviculaire du plexus brachial (LSCPB) ont été interrogés concernant le mécanisme au moment de l'épisode traumatique pour décrire le type et le moment du traumatisme au niveau de l'épaule, la ceinture scapulaire et de la tête. Le mécanisme traumatique impliqué pour tous les patients ayant une paralysie des racines supérieures ou une paralysie totale ($n = 46$) a été décrit comme un impact direct vertical à l'épaule. Chez 44 de ces patients, le traumatisme faisait suite à un accident de moto et, dans la plupart d'entre eux, il y a d'abord eu un impact contre une structure verticale avant la chute sur le sol. Les mécanismes traumatiques impliqués dans les paralysies des racines inférieures ($n = 11$) étaient variables. Le mécanisme le plus fréquent était une forte compression antérieure de l'épaule par la ceinture de sécurité de la voiture. Nous avons constaté que les mécanismes traumatiques diffèrent sensiblement de ceux jusqu'alors acceptés par la littérature.

Mots clés : Lésion du plexus brachial ; Mécanismes lésionnels ; Lésion du plexis brachial par traction

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http://dx.doi.org/10.1016/j.hansur.2015.09.001

1. Introduction

Traumatic brachial plexus injuries (BPI) are a consequence of traction forces that result in nerve ruptures or root avulsions [1]. Traction forces can be generated by direct or indirect trauma to the shoulder girdle [2]. Depending on the type of trauma, variable patterns of BPI can occur. Theories about the injury mechanism correlating the pattern of plexus injury and type of palsy were established in middle 19th century and continue to persist with scarce contemporary contributions [3].

We investigated the injury mechanisms involved in BPI in a cohort of patients and found that they differed significantly from the classical concepts.

2. Patients and methods

From September 2006 to June 2009, 150 consecutive patients with supraclavicular lesions of the brachial plexus were prospectively evaluated and operated at our hospital. All except four were male. Their average age was 26.8 years (SD ± 9.3 months) and the interval between their accident and surgery was 5.4 months on average (SD ± 2.8). Prior to surgery, patients were examined clinically and underwent a helical CT-myelogram following intradural contrast product injection.

Patients were asked about how their accident occurred, and asked to specifically describe the type of trauma to their shoulder, shoulder girdle and head. All patients answered the same questions:

- how did the accident occur?
- what was the position of the upper limb during the accident?
- what was the position of the head during the accident?
- did any part of your body/upper limb collide during the accident?
- against what structure did the collision occur?

Only information from patients having clear memories and responses about the accident were considered.

3. Results

Among the 150 patients, 57 of them remembered enough details of their accident and provided us with sufficient information to allow for analysis of the shoulder trauma. The accident data are summarized in Table 1. None of the patients was able to provide information about the position or movement of their head during the trauma.

3.1. Upper root or total palsy

The injury mechanism for all patients with upper root or total palsy ($n = 46$) was described as a direct vertical impact to the shoulder. The mechanics were as follows. Thirty-two patients stated that the impact to the shoulder occurred before falling to the ground, all of them due to a motorcycle accident. The shoulder struck another vehicle, or a wall or some sort of fixed column (e.g., tree or telephone pole) either while still on the motorcycle or after being projected from the motorcycle (Fig. 1A). Twelve patients reported that their shoulder hit the ground after they were thrown from their motorcycle (Fig. 1B). Two patients with total avulsion of the brachial plexus had a tree branch fall on their shoulder, causing clavicular, scapular and rib fractures (Fig. 1C).

3.2. Lower root palsy

The injury mechanism for 11 patients with lower root palsy (C7-T1, C8-T1) was as follows. In six patients, the injury was related to forceful anterior compression of the shoulder following a car accident that resulted in a C7-T1 lesion on the same side as the seat belt (Fig. 2A). Three patients described indirect shoulder trauma with shoulder hyperabduction. One patient had his arm suspended forcedly after falling into a hole (Fig. 2B) leading to a C8-T1 root injury. The two other were obese patients who fell and hit the ground with the shoulder completely abducted (Fig. 2C), leading to C7-T1 root injury. Two patients reported a direct impact to the anterior aspect of

Table 1
Types of BPI and their mechanisms of injury in our patient cohort.

BPI type	Injury mechanism	Context
Upper and total (46/57)	Vertical impact to shoulder (motorcycle) (44/46)	Against a fixed object before falling the ground (32/44)
		Against ground (12/44)
	Vertical impact to shoulder (other) (2/46)	Large tree branch (2/2)
Lower (11/57)	Shoulder anterior compression (6/11)	Car seat belt (6/6)
	Hyperabduction (3/11)	Fall with arm abducted (obese patient) (2/3)
		Fall into a hole (1/3)
	Shoulder anterior impact (2/11)	Fixed vertical object, after being thrown from motorcycle (2/2)

BPI: brachial plexus injuries.