

The Effect of Plaster Immobilisation on the Proprioception of the Limb

*Adnan Abdulmajeed Faraj, **Mohammad Hasson Elanbari

*Department of Surgery / College of Medicine/ Kirkuk University

**Department of Orthopaedic/ Airedale NHS Foundation Hospital/ UK

Abstract:

Background: It is difficult to establish the effect cast immobilisation has upon a patient and whether or not it causes a significant detriment to the proprioceptive mechanisms within the body. An observational pilot study on random group of patients collected from the fracture clinic.

Patients and methods: Twenty two male and sixteen female fracture clinic patients from Airedale general hospital were included within this study, with ages spanning from six to eighty years old. A comparison between patients drinking alcohol and patients not drinking, were made. Also the effect of age was analyzed. A subjective analysis using a questionnaire and an objective examination on modalities of light touch, vibration and position sense, to investigate any variation in proprioceptive awareness.

Results: Highlighted a correlation between time in cast and sensorimotor deficit especially in patients above the age of 50 years. An increased time lead to an increased deficit with an eleven week duration following Achilles tendon rupture being the most significant. The results also indicated the profound negative effect of alcohol consumption on the proprioception of the patient, regardless of quantity.

Conclusion: Individuals who are known to consume alcohol are suggested to receive assistance with their proprioceptive function by means of physiotherapy and limb movement re-training prior to driving. Individuals who have Achilles rupture should be subjected to clinical review three months post-cast-removal prior to returning to drive.

Key words: Immobilisation, Cast, Proprioception, Recovery.

Introduction:

The intended result of any fracture treatment is to; bring about healing of the affected limb, to restore full ranges of movement, to restore full power in motion and cause no detriment to proprioceptive ability, it is recognized that prolonging the duration can lead to a rise in complications. individuals can experience swelling of the affected limb, with pain and muscle atrophy following the cast being removed.^(1,2)

Proprioceptive acuity can be defined as the ability of an individual to detect the positioning of their limbs in order to respond to their own surroundings. It describes the collective sensations

originating from an environment which inherently lead to awareness, in a relative viewpoint, of the body at rest and at motion. This is connected greatly to the dynamic position sense (DPS) of the limb. The focus of DPS is that of maximising input from sensory receptors at different locations within the body, the subsequent central processing of such information and finally contributing towards the knowledge of angular positioning and of velocity of any limb.^(2,3,4,5)

Aim of the study:

The objective of the current study is to assess the factors contributing to alteration in the proprioception.

Patient and Methods:

Patients attending the fracture clinic at AGH, in twelve week duration from the 1st of June 2009, were included within this study. A review was conducted post cast removal and assessments were made accordingly from here.

Those patients who fit the criteria of having a fracture requiring cast immobilisation, and having the cast removed recently (within two weeks) were included within the study. No selection criteria for gender were required however extremes of age (<5 and >85) were not included to reduce inaccuracy (Figure 1, 2).

A comparison was made between patients not drinking alcohol (12), and those who are moderate alcohol consumer (5), the remaining of the patients, were social drinkers.

In total, (57.9%) (22/38) subjects were male and (42.1%) (16/38) subjects were female, with ages spanning from six to eighty years of age. Informed consent was obtained regarding the observations prior to any questioning or examinations being carried out. Fractures were not restricted to the lower limb and any fracture involving cast immobilisation was included within the audit.

Process:

After the consultation with the clinician, information was collected regarding the patients' other medical issues and any problems encountered with their affected limb. This revolved around a structured proforma set by the orthopaedic department at AGH.

A brief physical assessment was subsequently carried out whereby an

assessment of various key modalities thought to contribute towards the overall placement of the limb was done. This included testing aspects such as sensation, vibration change and proprioceptive acuity.

The details of the process are as follows:

- Sensation: assessed through checking the light touch modality of each dermatome on the limb and comparing it to that of the unaffected limb.
- Vibration: changes were noted by placing a tuning fork on a distal bony landmark, whilst in motion, and the patient was asked to remark on when the vibration had ceased with no visual stimulus.
- Gross proprioceptive assessment: conducted by moving the limb in either an upward or conversely a downward direction and asking the patient to comment on the direction of movement without looking.
- Symmetrical positioning: assessed by moving one limb into a certain position and angulations and asking the patient to place their other limb in the same place with no visual input.
- Position reproducibility: the patient was asked to reproduce a specific position of a limb actively, after having the limb placed in this position passively and with eyes open
- If appropriate, muscle wasting was taken by measuring the largest circumference of the affected limb and comparing it to that of the unaffected limb.

Results:

The results were collated for each of the proprioceptive modalities under investigation a numerical figure was

given for each finding observed. This was formed by assigning the number 1 to mild, 2 to moderate and then 3 to severe clinical deficit.

The correlation between the time duration in cast and the increasing problems with regards to sensorimotor and proprioceptive issues; There is a distinct upward increase to the trend and as the time duration increases so does the problems encountered by all patients placed in cast (Figure 1).

There was a difference between patients who suffered from a fracture and drank alcohol to patients who suffered from fractures but did not drink alcohol (Figure 2). The values are quantified using collective sensorimotor and

proprioceptive rankings as a measure. All but one patient in the “alcoholic group” had greater deficits observed than any of the “nonalcoholic group”.

It can be said that the least deficit patient within the “alcoholic group” can be equated symptomatically to the patient with the highest deficiency in the “non-alcoholic group” (Figure 3). This graph has been constructed to attempt to highlight any possible connection between increasing age and proprioceptive deficit following a fracture. The span of ages within the study does not show a direct correlation towards increasing age. This seems to show an even distribution to the population group.

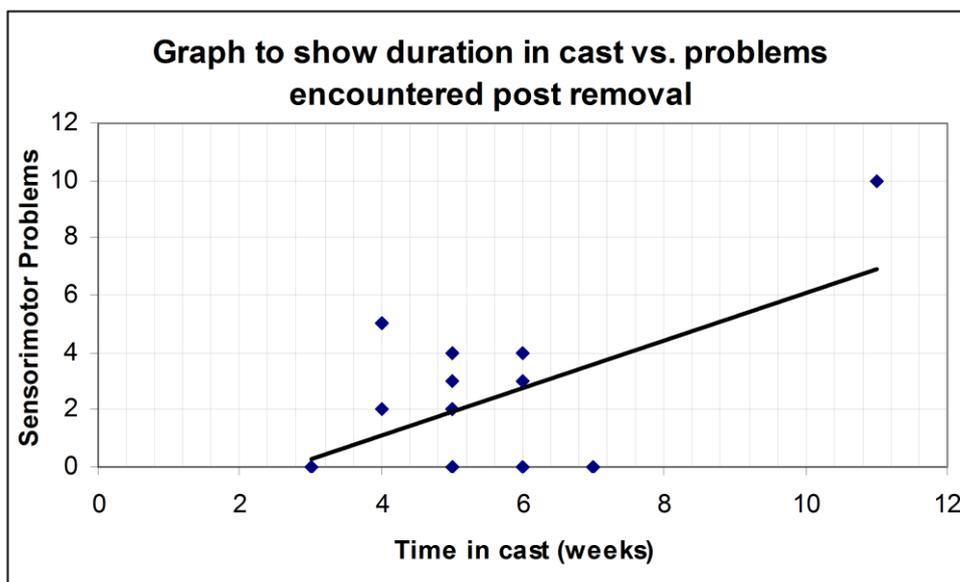


Figure (1): graph showing the general upward trend in sensorimotor problems when increasing the time in cast.

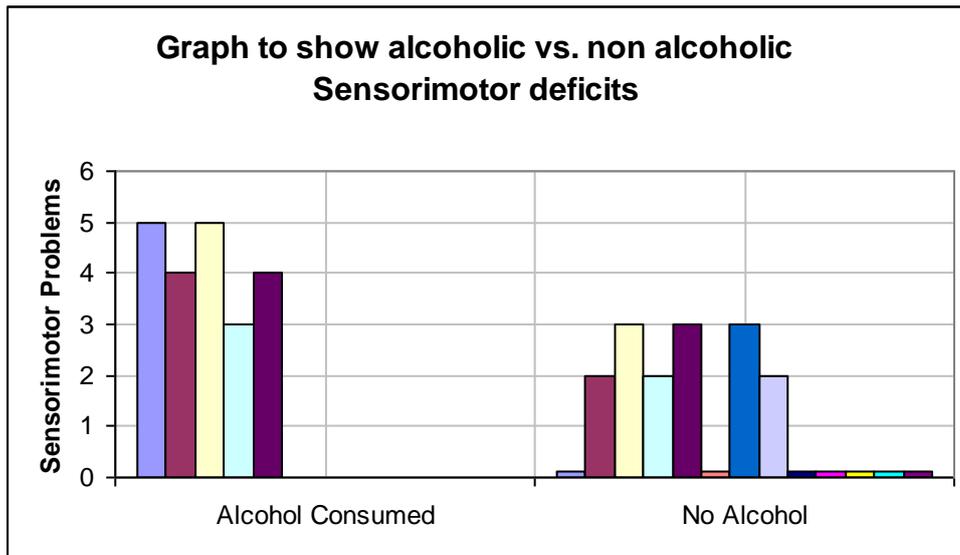


Figure (2): graphs showing the relatively greater number of sensorimotor problems encountered with fracture patients who drink alcohol (n=5) as compared those who do not (n=13). Each bar represents a fracture patient included within the study.

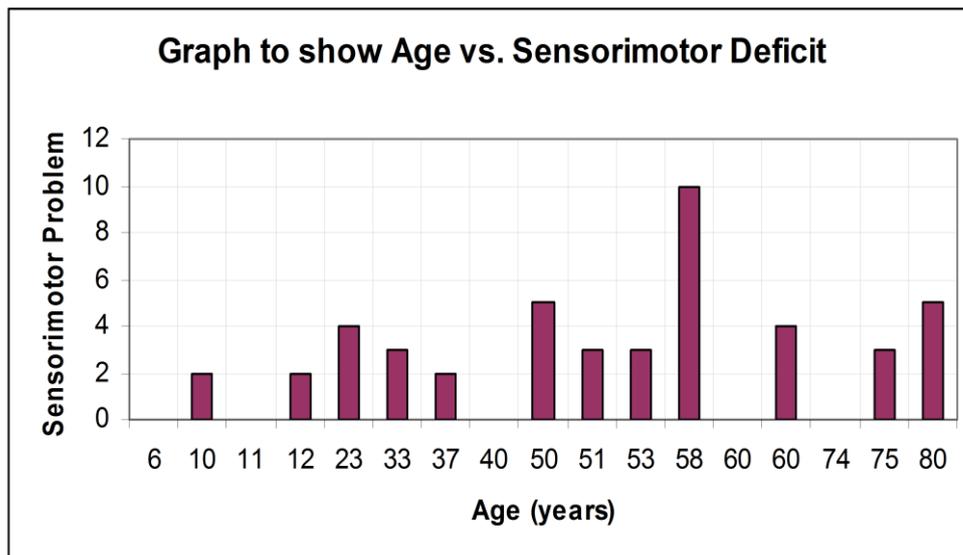


Figure (3): a graph to show any connection between increasing age and increasing proprioceptive deficit. All patients with deficit are shown

Discussion:

The outset of this audit was to observe the proprioceptive and sensorimotor changes, if any, following cast removal. The literature states that prolonged duration of cast immobilisation is indicative of a proprioceptive deficit. However, the effect to which this is associated with time or any other compounding factors has not been described to its entirety.

The results obtained highlighted quite clearly that the longer the period of cast immobilisation, the larger the potential problem of proprioceptive deficit was to arise. This corresponds greatly to the literature as numerous aforementioned sources refer to conclusions which can be held as reasoning for this.

Hassan et al 2001, Bartley 1982, Skinner 1985^(6,7,8), described three themes of eventualities resulting from cast placement. Firstly that co-ordination can be expected to be affected cast removal. Secondly, that muscle atrophy is present also following the duration of immobilisation. Lastly, further literature suggests that muscle afferents are being seen as increasingly important in the processes involved within collecting and relaying sensory information prior to surmounting a motor response. Logically when taking into account these three poignant factors, it is inevitable that the duration of cast immobilisation would cause a deficit in proprioception or sensorimotor capacity to some degree. The extent to which the differences were seen varied quite considerably however, possibly due to the other factors being assessed. An example of this would be the patients who did not take in any alcohol who subsequently did not suffer from the same symptoms as those patients who did.

Follak 2004⁽⁹⁾ observed that bone healing is affected with endocrine conditions such as diabetes. Rayyan 2009⁽¹⁰⁾ showed that if the problem is well controlled that the effect on bone healing would not be sufficient enough to cause a problem. In this study, one individual was a diabetic however his blood sugars were under control. His overall deficit in proprioception was relatively not as great as those with alcoholic tendencies.

Limitations:

Any limitations that were observed were restricted at every possible eventuality however with regret there were still some present. If in the future a follow up to this study is conducted the following points should be addressed or rectified.

The angle reproduction test was used because it is described in the literature to be one of the few processes that can assess the perception of joint position directly. It was not feasible for this study to brace every patient in order to accurately quantify the differences seen between the attempts. It was done on visual assessment only and therefore was categorized and ranked accordingly from here.

Muscle wasting was assessed in the form of measuring the largest circumference of the affected limb and comparing it to that of the unaffected limb. Ideally this should be done prior to, or at injury, in order to see the differences before and after the cast being put into place.

Muscle spindle assessment would contribute greatly towards the specificity and reliability of the results, without the use of expensive tools this

was not possible when conducting this audit.

Conclusions:

This audit aimed to establish whether or not the impact of a cast and immobilisation was sufficient enough to affect proprioception clinically. After conducting the study we can be confident in stating that an effect is present clinically however it can be short lived depending on the individual. The largest conclusion to be stated is that of an effect that alcohol has upon both joint healing and proprioception. All individuals who reported drinking alcohol during the healing process found themselves to be affected to a greater degree than their counterparts who did not drink any alcohol at all. To further this point, the problems encountered were by all consumers of alcohol and was not restricted to what is considered to be an excessive drinker.

The patient who had an eleven week cast placed as treatment for their Achilles tendon rupture had a considerable proprioceptive deficit. The patient had no other known comorbidities or detrimental social activities, indicating time as the prevalent factor.

Recommendation:

With regards to a clinically applicable aspect, it can be suggested that individuals who are prone to a drink or have an alcohol problem should be recommended some form of training or physiotherapy to re-introduce a level of normality to their daily proprioceptive functions prior to resuming normal life. This can also be suggested for patients with Achilles rupture however to a greater degree as the deficit was so substantial. With regards to recommendations for driving it can be

suggested that the patients who drink any amount of alcohol should observe a

further duration of caution prior to returning to the road (up to six weeks), whereas the patients of Achilles tendon rupture should be reviewed clinically for proprioceptive acuity prior to any thoughts of attempting to drive. This review should, unless otherwise indicated, be set at three months following complete cast removal.

Acknowledgement:

I would like to thank all of the orthopaedic staff at Airedale General Hospital for their help, support and understanding throughout the testing period, without which none of this could have been possible.

References:

- [1]. Moseley M, Kathryn M R, Marion H, Robert D H "Effectiveness of joint immobilisation after cast immobilisation for ankle fracture: a protocol for a randomised controlled trial". *BMC* 2006; 7: 46-49
- [2]. Vandenborne K, Elliott MA, Walter GA, Abdus S, Okereke E, Shaffer, M, Tahernia D, Esterhai JL "Longitudinal study of skeletal muscle adaptations during immobilisation and rehabilitation" 1998; 21:1006-1012.
- [3]. Spanos S, Brunswic B, Billis E "The effect of taping on the proprioception of the ankle in a non-weight bearing position, amongst injured athletes". 2008; 18: 25-33.
- [4]. Swinkles A, Ward CD, Bagust J "Bed-rest and Plaster of Paris Leg Cylinders Do they alter knee joint proprioception" 1995; 10: 626-631
- [5]. Digby M, Holloway G Webb J "A study of function after tibial cast bracing". 1982; 14: 432-439.
- [6]. Hassan B, Mockett S, Doherty M "Static postural sway, proprioception, and maximal voluntary quadriceps contraction in patients with knee osteoarthritis and normal control subjects". 2001; 60: 612-618.

[7]. Bartley HS “the second childhood of Proprioception”, perceptual and motor skills 1982; 55: 446-49.

[8]. Skinner, H B. Banadt. M Dand Cook.S D “Age related decline in Proprioception”. 1984; 184, 4, 206-211.

[9]. Follak N, Ingrid Klo¨ting, Eduard W, Harry M Histomorphometric “evaluation of the influence of the diabetic metabolic state on bone defect healing depending on the

defect size in spontaneously diabetic BB/OK rats”.2004; 34: 144– 152.

[10]. Rayyan A. Kayal , Alblowi J, McKenzie E, Krothapalli N, Silkman L, Gerstenfeld L, Thomas A, Graves DT “Diabetes causes the accelerated loss of cartilage during fracture repair which is reversed by insulin treatment”. 2009; 44 357–363