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Contracture management for people with spinal cord injuries

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Abstract. Contractures are a common and disabling problem for people with spinal cord injuries. To date, contractures have largely been managed with physical interventions such as stretch and passive movements. These are typically administered either manually or with the assistance of various orthoses, devices or aids. However, the results of recent clinical trials question the effectiveness of these interventions. They indicate that therapists should not expect to see a change in joint mobility or muscle extensibility from stretches applied for less than 30 minutes a day over less than 3 months. This suggests that contractures may be a far more complex and multifactorial problem to manage than previously assumed. This paper challenges clinicians and researchers to reappraise the effectiveness of current contracture management.

Keywords: Spinal cord injury, contracture, muscle stretching

Contractures are a common and debilitating problem for people with spinal cord injury (SCI) [2,5,8,17,24, 30]. They result in unsightly deformities and prevent people performing motor tasks [12]. In addition, they are associated with pain, spasticity, sleep disturbances and skin breakdown. Contractures occur due to a loss in extensibility of the soft tissue structures spanning joints [18]. These include skin, ligaments, muscles and joint capsules. Loss in extensibility in any of these structures restricts joint mobility, leads to joint stiffness and can result in contractures.

Contractures are usually attributed to the direct effects of prolonged immobilization and habitual use of soft tissues in their shortened range [14]. In people with SCI this is thought to occur as a consequence of patterns of paralysis combined with prolonged sitting or lying. For example, people with motor complete C5 tetraplegia are prone to developing elbow flexion contractures because they retain voluntary control of the biceps muscles but have paralysis of the triceps muscles. In addition, people with C5 tetraplegia commonly sit with their elbows positioned in flexion on the armrests of wheelchairs and lie with their elbows flexed when in bed. Together these factors increase the time in which the biceps muscles are immobilized in a shortened position increasing susceptibility to elbow flexion contractures [2,10].

A large amount of healthcare resources are used for the treatment and prevention of contractures in people with SCI. The most widely used interventions for this purpose are stretch and passive movements. There are various ways these interventions can be administered. For example, stretch can be applied using splints, positioning programs or orthoses, and passive movements can be administered using mechanical devices or manually by carers and therapists. While stretch and passive movements are perhaps most commonly administered manually, this method limits the dosage of stretch and passive movements that can be realistically applied. Optimal dosage has never been clarified, although historically, dosage has been based on clinical experience, anecdotal evidence and animal studies.

Stretch and passive movements have been used since the early 1900s (or perhaps earlier) and were increasingly advocated as SCI rehabilitation began to evolve following the First and Second World Wars [21]. Out-

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breaks of polio in the mid 20th century drew further attention to the problems of contracture and the importance of appropriate physiotherapy and nursing care [16,22]. As early as the 1950s, there were recommendations that passive movements be performed for two to three minutes every few hours in people with paralysis from different pathologies [19]. Sir Ludwig Guttmann, considered one of the pioneers of SCI rehabilitation, advocated passive movements three times a day [6]. The rationale for passive movements and stretch is reasonable. That is, if contractures result from the inability of individuals to move joints, then perhaps therapists moving and stretching individuals' joints can avoid the consequences of immobility for them.

During the 1980s increasing emphasis was placed on prolonged stretch as can be administered through positioning programs, splints, standing frames and orthoses [4,20,23]. The perceived importance of prolonged stretch arose from animal studies [25–29]. These studies highlighted the adaptable nature of animal muscles and soft tissues. In particular, they indicated the need for prolonged and sustained stretch to stimulate the addition of muscle sarcomeres in series necessary for lasting changes in muscle extensibility. Of course it was never clear whether the muscles of people with SCI were as responsive to stretch as the muscles of small animals. However, in the absence of clear evidence from human studies, it became common for therapists to recommended 20 to 30 minutes of sustained stretch per muscle a day for the prevention and treatment of contractures.

It is only in the last ten years with the increasing emphasis on evidence-based practice that therapists have begun to revisit the issue of contracture management. In particular they have examined issues around dosage and asked questions about the relative effectiveness of passive movements and stretches administered in different ways. This has partly been driven by underlying concerns that five minutes, twenty minutes or even one hour of any intervention (including stretch) is not sufficient to attain a therapeutic effect. Therapists' time and efforts may be better spent on other rehabilitation interventions that inadvertently place muscles in lengthened positions through regular practice of functional tasks and activities of daily living.

Our research group has devoted over ten years in an attempt to gain a better understanding of contracture management in people with SCI and other neurological conditions [1,7,9,11,13]. Over this time our long-held beliefs have been challenged and we have come to the conclusion that far less is understood about the role of passive movements and stretch than is generally assumed. Only one randomized controlled trial has examined the effectiveness of passive movements in people with SCI. This trial used the ankle as a model to explore the more generic question of the effectiveness of passive movements [13]. Twenty people with tetraplegia living in the community had one ankle randomized to a control group and the other to an experimental group. Carers administered passive movements to participants' experimental ankles for 10 minutes, 10 times a week for 6 months. The control ankles were left untreated. The results of this trial indicated that there was a small added benefit of applying passive movements for six months (between-group mean difference $= 4$ degrees, 95% CI 2 to 6 degrees). There are two important questions to arise from this trial. First, can we expect this small effect to increase if passive movements are applied for a longer time? If so, this intervention may prove worthwhile provided it is applied for many years. Second, can we expect to see the same effect from just 2–3 minutes of passive movements each day (compared with the 20 minutes a day applied in this trial), as is typically applied to each joint in the clinical setting? This would seem unlikely. Two to three minutes is a very small dosage of passive movements for people who are unable to move their paralyzed joints for the remaining part of each day.

There is an equivocal lack of clarity surrounding the dosage of sustained stretch required to treat and prevent contractures in people with SCI. Five randomized controlled trials have looked at various combinations and dosages of stretch applied to people with SCI [1,3,7,9,11]. Three of these trials demonstrated that stretch-based interventions were ineffective when compared to no intervention or usual care [7,9,11]. The key findings of these trials were that thirty minutes of stretch each weekday for 4 weeks does not significantly change ankle mobility (between-group mean difference $= 0$ degrees, 95% CI -3 to 3 degrees) or hamstring extensibility (between-group mean difference $= 1$ degree, 95% CI -2 to 5 degrees) in people with SCI; and twelve hours of stretch a day over a 3-month period does not reduce thumb web space contracture in people with neurological conditions including SCI (between-group mean difference $= 1$ degree, 95% CI -1 to 2 degrees). One trial demonstrated a small effect on ankle mobility from thirty minutes of tilt-table stretch, three times per week for 12 weeks (between-group mean difference 4 degrees, 95% CI 2 to 6 degrees) [1] and one trial provided insufficient data to determine between-group differences [3]. A single definitive conclusion can be

drawn from the results of these trials. That is, therapists should not expect to see a clinically meaningful change in joint mobility or muscle extensibility from stretches applied for less than 30 minutes a day over less than 3 months. If stretches are to be applied for more than 30 minutes then devices, splints and orthoses need to be used.

The results of trials in people with SCI have been duplicated in trials involving other patient groups performed by other investigators. A recent Cochrane systematic review investigating stretch interventions for the treatment and prevention of contractures identified thirty five randomized controlled trials [15]. These involved 1,391 participants and all examined the effectiveness of stretch for the treatment and prevention of contractures. Stretch in these trials was administered in many different ways. Twenty four trials involved 782 people with neurological conditions including SCI. The results indicated that stretch has no clinically important short-term or long-term effects on joint mobility in people with neurological conditions. The pooled mean difference reflecting the short-term effects of stretch (that is the effects present between 24 hours and one week after the cessation of stretch) was 1 degree (95% CI 0 to 3 degrees). The equivalent pooled mean difference reflecting the long-term effects of stretch (that is the effects present greater than one week after the cessation of stretch) was 0 degrees (95% CI -2 to 2 degrees).

Most trials investigating stretch in people with SCI (and other neurological conditions) have examined the added benefit of stretch over and above usual care provided to both experimental and control groups. In these studies stretch or passive movements may have been administered inadvertently as part of usual care as participants moved during daily activities or rehabilitation programs. For example passive movements and stretch can occur during regular change in position for skin care, extensive practice of functional activities, and sports to encourage participation. Therefore, while the results of the randomised controlled trials in people with SCI indicate that stretch as typically applied by therapists does not produce lasting increases in joint mobility, it is unclear whether stretch applied as part of usual care has any effect on joint mobility. This issue has not been investigated because there is no ethically acceptable research model where all forms of stretch and passive movement administered as part of rehabilitation or usual care can be denied to control participants.

The evidence to date indicates that stretch applied for less than 3 months confers little or no added benefit over and above usual care in people with SCI. There is a small benefit from passive movements compared to usual care when applied for 6 months but it is unclear whether this benefit is clinically worthwhile. The effects of stretch or passive movements performed for more than 3 to 6 months, respectively, remains unknown.

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