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Title
Controlled dynamic stretching orthotics for joint contracture treatment in children and adolescents

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Summary
This is the first study showing improvements in PROM attributed to CDS orthotics in the majority of joints after a short treatment period with consecutive clinical improvements of individually set goals in children and adolescents with chronic neurological conditions.

Introduction/ basics
Contractures, limitations in the passive range of motion (PROM), are a common complication in neurological conditions. This functional impairment can be associated with discomfort, pain, and difficulties in handling and care of affected individual. Contractures are better to prevent than to treat, because no standard treatment algorithm exists but rather needs to be individually tailored. Passive manual stretching can prevent and improve contractures. Stretching is most effective using orthotics. Therefore, most children with spastic movement disorders depend on their orthotic aids to prevent orthopedic complications. Although controlled dynamic stretching (CDS) orthotics are promising devices in contracture treatment, there is no data available regarding their efficacy in children and adolescents. The goal of this study was to analyze whether CDS orthotics reduce or stabilize contractures in children and adolescents with the primary endpoint of clinically relevant changes of PROM.

Material method; implementation/ process
For this single center observational and intra-individually controlled study we recruited children and adolescents in 2018 and 2019 to evaluate the effect of their CDS orthotics. We provided patients with contractures or the risk in developing contractures with CDS orthotics in addition to their regular multidisciplinary treatment. As primary endpoint PROM at 12 weeks (FU1) and 12 months (FU2) was assessed with the neutral/zero method.

We further applied the goal attainment scale (GAS) as a measurement to quantify subjective effectiveness of the CDS treatment. Other clinically relevant changes were assessed with special developed questionnaires for subjective experiences while using this orthotic. We specifically assessed subjective improvement through visual analogue scale (VAS) 0-10, comfortability of the device and helpfulness in supporting daily life were assessed with a three-point scale. These subjective experiences were assessed as secondary endpoint.

Results

Our cohort initially comprised 18 participants with contractures at a mean age of 7.5 years (range 5-15) at the time of study and with equal sex distribution. The main diagnosis was spastic cerebral palsy (n=9). Most patients had motor function according to GMFCS level V (n=10). All participants had contractures in one or various joints due to muscular hypertonia and/or immobility. We treated 39 affected joints in total. Most participants wore the orthotic 30-60 minutes per day on a daily basis.

The median PROM for all joints improved from -15° (to neutral) to -1.5° at FU1 ($p<0.001$, $r=0.78$) and further towards 0° at FU2 ($p<0.001$, $r=0.75$). The median change in PROM for all joint was 8° (range 0-30°) at FU1 and 8° (range -8-70°) at FU2. The CDS orthotics were globally well tolerated. Parents and therapists noted alleviation in care, positioning, transfers and increased activity in therapy. GAS goals have shown improvement for 80% of the pre-defined goals at FU2.

Discussion/ conclusion; conclusion for the practice

In this study controlled dynamic stretching orthotics were evaluated as a new treatment option for children and adolescents with contractures or the risk of developing contractures secondary to neurologic disorders. Our results highlight CDS orthotics as a promising treatment option. We specifically show high significant improvements in PROM for all treated joints combined. The global improvement of PROM even with a short wearing time of 30-60 min a day in our study appears to be a great advantage of CDS orthotics compared to standard stretch orthotics. In further studies, the CDS therapy should be combined with active therapy and/or electrostimulation of the antagonist muscles. In cases of high spasticity, CDS therapy can be combined with Botulinum toxin A injections to test success of combination therapy in future

studies. This study enables more treatment options to provide best individual tailored orthotics to support patient's participation in life.

References

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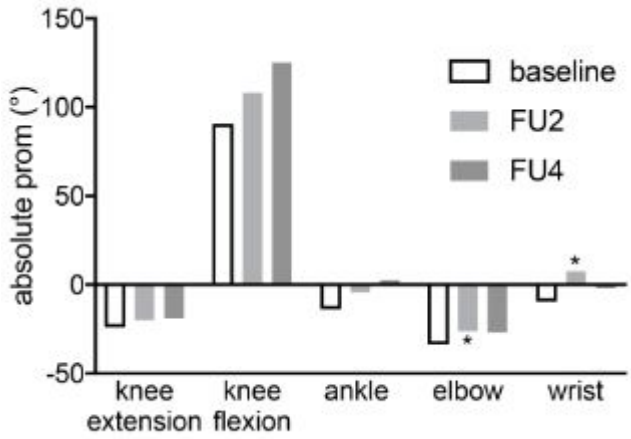

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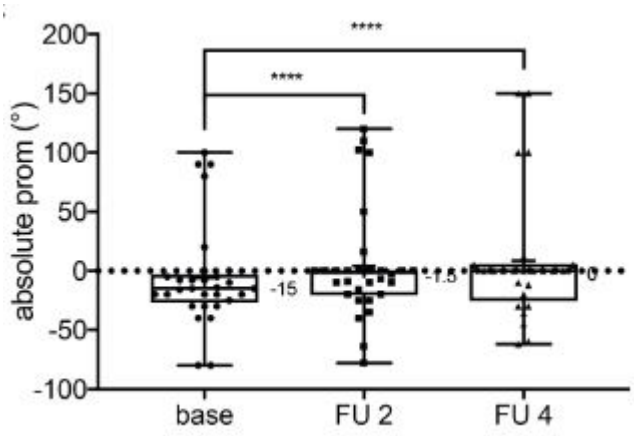

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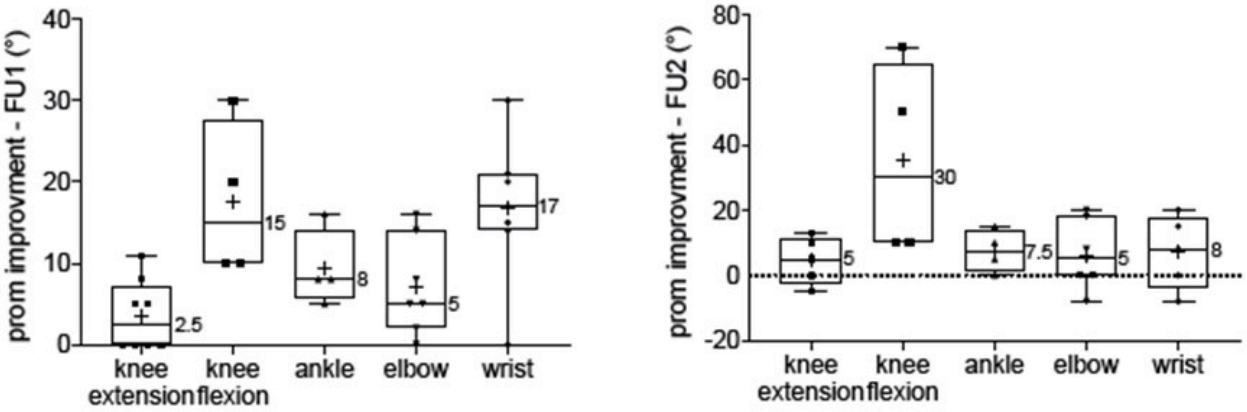

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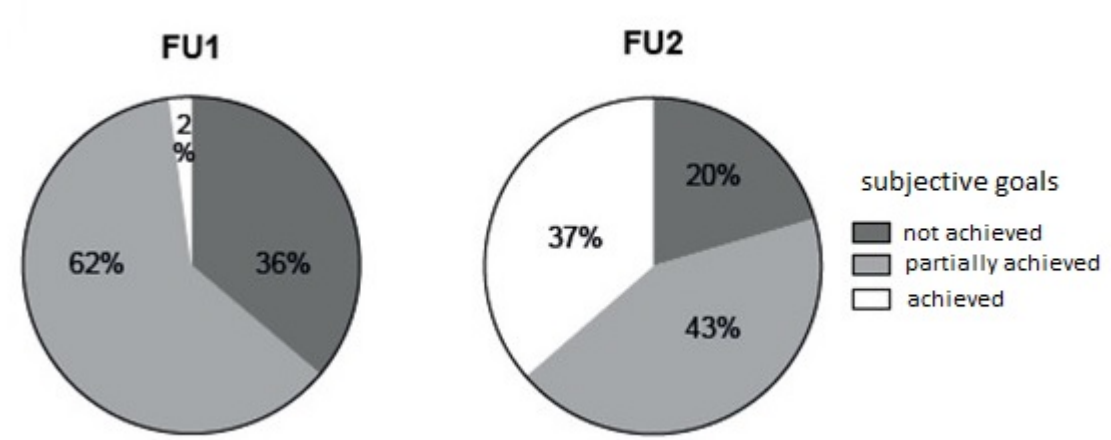

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