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• No disclosures....
Objectives

• **Outline** the rationale for the inclusion of physical activity/exercise in the management of concussion

• **Examine** the existing research on frequency, intensity, time, type, and timing of exercise rehabilitation following sport related concussion

• **Summarize** how existing evidence can be translated into clinical practice
A Paradigm Shift...


https://maymassage.info/thong-tin-can-biet-ve-xe-dap-tap-the-duc-reebok-z7-re1-11710/
From Zurich to Berlin...

- “The cornerstone of concussion management is physical & cognitive rest until the acute symptoms resolve.”  (McCrory et al., 2013)

- “After a brief period of initial rest (24–48 hours), symptom-limited activity can be begun while staying below a cognitive and physical exacerbation threshold.”  (McCrory et al., 2017)
Why the change?

Little to no evidence that rest is beneficial to recovery

Better understanding of the physiological nature of concussion and its affect on the Autonomic Nervous System (ANS)

Acute Cognitive and Physical Rest May Not Improve Concussion Recovery Time

Thomas A. Buckley, EdD, ATC; Barry A. Munkasy, PhD; Brandy P. Clouse, MS, ATC

Prolonged Activity Restriction After Concussion: Are We Worsening Outcomes?

Marc DiFazio, MD¹, Noah D. Silverberg, PhD²,₃, Michael W. Kirkwood, PhD¹,₅, Raquel Bernier, MD¹, and Grant L. Iverson, PhD⁶,₇,₈,₉
How might exercise benefit the injured brain?

**Following concussion:**

- Altered ANS function (*Leddy & Willer, 2013*).
- Leads to disruption or dysregulation of CBF = metabolic disequilibrium & energy crisis (*Giza & Hovda, 2001; Leddy & Willer, 2013*).
- Exercise intolerance.

**Exercise may:**

- Aid in restoration of normal CBF regulation (*Clausen et al., 2016; Leddy et al., 2013*).
- Assist with neuronal repair through increasing BDNF (*Griesbach et al., 2012*).
- Assist with “retraining” the ANS (*Kozlowksi, 2014*).
Back to the Berlin Recommendations...

For the “Active” Treatment of Concussion and PCS research supports interventions including: (Schneider et al., 2017)

- Cervical and vestibular rehabilitation
- Multifaceted collaborative treatments (including CBT, school accommodations, and pharmacotherapy)
- Closely monitored active rehabilitation programs involving sub-symptom threshold and submaximal exercise

- “Patients can be encouraged to become gradually and progressively more active while staying below their cognitive and physical symptom exacerbation thresholds” (McCrory et al., 2017; Schneider et al., 2017)

- “Future studies should evaluate the optimal timing, mode, duration, intensity, and frequency of treatment during the post-acute time period following concussion.” (Schneider et al., 2017)
The FITT Principle

* Frequency
* Intensity
* Time
* Type
* Timing (Lawrence et al., 2018)

https://www.google.com/search?q=fitt+principle&safe=strict&source=lnms&tbm=isch&s\ved=0ahUKEwjMxN7EgovcAhWFOn0KHFp6CzQQ_AUICigB&biw=1366&bih=613#imgrc=8MuBs4RuGYLtIM
Physical Activity vs Exercise
<table>
<thead>
<tr>
<th>Authors</th>
<th>Frequency</th>
<th>Intensity</th>
<th>Type</th>
<th>Time</th>
<th>Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gagnon et al., 2009</td>
<td>unclear; followed &quot;weekly&quot;</td>
<td>exercise 50-60% max capacity for up to 15 min or stop with sy increase;</td>
<td>aerobic; stationary bike or treadmill;</td>
<td>15 min or stop with sy increase</td>
<td>4-18 wks</td>
</tr>
<tr>
<td>Leddy et al., 2010</td>
<td>5-6 days per week</td>
<td>80% of HR achieved on a sub-max treadmill test</td>
<td>aerobic; non-specific</td>
<td>same duration as achieved on the treadmill test</td>
<td>6 - 40 weeks</td>
</tr>
<tr>
<td>Baker et al., 2012</td>
<td>6 days per week</td>
<td>80% of HR achieved on a sub-max treadmill test</td>
<td>aerobic; non-specific</td>
<td>20 minutes</td>
<td>8-40 wks</td>
</tr>
<tr>
<td>Clausen et al., 2015</td>
<td>5-6 days per week</td>
<td>80% of HR achieved on a sub-max treadmill test</td>
<td>aerobic</td>
<td>30 minutes</td>
<td>6-12 wks</td>
</tr>
<tr>
<td>Polak et al., 2015</td>
<td>5-6 days per week</td>
<td>80% of HR achieved on a sub-max treadmill test</td>
<td>aerobic</td>
<td>30 minutes</td>
<td>4 wks - 12 months</td>
</tr>
<tr>
<td>Maerlender et al., 2015</td>
<td>&quot;monitored daily&quot;</td>
<td>perceived exertion of &quot;mild&quot; to &quot;moderate&quot; on Borg scale</td>
<td>aerobic; stationary bike</td>
<td>20 minutes</td>
<td>&quot;recently concussed&quot;</td>
</tr>
<tr>
<td>Cordingly et al., 2016</td>
<td>5 days per week</td>
<td>sub-symptom threshold aerobic exercise program</td>
<td>not specified</td>
<td>30 minutes</td>
<td>sy&gt;2-4 wks; PCS</td>
</tr>
<tr>
<td>Kurowski et al., 2016</td>
<td>5-6 days per week</td>
<td>Borg RPE of 11 for 2-5 min; Increase RPE 1 every 5 min</td>
<td>aerobic; stationary bike</td>
<td>30 minutes</td>
<td>4-16 wks</td>
</tr>
<tr>
<td>Lawrence et al., 2018</td>
<td>unclear</td>
<td>15 min @ 100-120 bpm; 30 min @ 100-120 bpm; 30 min @ 140; 1 min max sprint every 5 min for 30 min</td>
<td>aerobic; stationary bike</td>
<td>15 min; 30 min; 30 min</td>
<td>1 day - &gt;10 days</td>
</tr>
<tr>
<td>Dobney et al., 2018</td>
<td>&quot;daily&quot;</td>
<td>60% APMHR</td>
<td>aerobic; stationary bike or treadmill</td>
<td>15 minutes</td>
<td>2 wks - &gt;6wks</td>
</tr>
</tbody>
</table>
In Summary…

- **Frequency:** Most studies used daily exercise with at least one rest day per week
- **Intensity:** Most studies used heart rate & prescribed “sub-symptom threshold”; some used Rate of Perceived Exertion (RPE)
- **Type:** All studies used aerobic exercise—most utilizing an exercise bike
- **Time:** Most studies recommended 20-30 minutes
- **Timing:** Most studies were with subjects with prolonged symptomology (PCS); more recent research is moving closer toward the date of injury
There are issues, too...

- Small sample sizes
- Many studies are retrospective, chart reviews, or surveys
- All but one study relied on patient self-report making it difficult to accurately measure compliance
- Some have vague descriptions of exercise/PA
- How much of this is really objective?

https://www.makeuseof.com/tag/create-security-question-guess
4 Systematic Reviews

- It’s **likely** that low level exercise may play a role in recovery.
- Additional research is **needed** to determine the effectiveness of rest, treatment, & return to activity.
- The exact timing, duration, intensity, & mode are **not** yet known.
- Has this presentation even been helpful?? 🤔
Controlled Trial of Treatment for Cerebral Concussion

MIKAEL RELANDER, HENRY TROUPP, G. AF BJÖRKESTEN

British Medical Journal, 1972, 4, 777-779

Summary

In a study designed to compare two types of treatment of cerebral concussion, 178 patients were allocated to a routine treatment or to an active treatment group; in the latter a good prognosis was emphasized, the patient was mobilized early and given physiotherapy. In the routine treatment group the average time off work was 32 days compared with 18 days in the active treatment group. Physiotherapy seemed to be particularly valuable in old patients and in those with exaggerated fears about their condition. It is suggested that throughout their illness and follow-up, patients with cerebral concussion should be under the care of one doctor, one who is particularly interested in the subject and that more propaganda is needed.

“We have shown that active treatment aimed at good contact between patient and doctor, early ambulation, and physical training gave better results than the hospital routine...”

“We also believe that it is important for the patient to be seen at follow-up by a doctor he knows. Within the organization of a big hospital this can be difficult to arrange....There is consequently little continuity in the care of these patients. This is a failing that should be remedied wherever possible, since interested care for these patients is quickly rewarded.”
If I have seen further it is by standing on the shoulders of giants.

Isaac Newton
References


Thank You!!
• Set treadmill at a speed of 3.6mph for patients over 5’5”, and 3.2mph for those 5’5” and under.

• After one minute at this pace, treadmill incline is increased to 1 degree.

• Participant is asked to rate RPE and symptom severity. Subjective scores and heart rate (bpm) are recorded.

• This procedure is repeated each minute, with ratings and heart rate being recorded, and treadmill increasing in incline at a rate of 1 degree/minute.
Stopping Criteria

- Maximum exertion (RPE score of ≥17-19) is reported
- Test is terminated by clinician due to a symptom exacerbation that causes significant increase in pain or symptom severity
  - ≥ 3 points over the pre-test overall symptom score on the 1-10 point VAS;
  - 1 point given for each increase in a symptom or appearance of a new symptom
- Clinician notes a rapid progression of complaints (ex. headache to searing focal pain) between symptom reports, patient appears faint or unsteady, or determines that continuing the test constitutes significant health risk for the participant,
- Patient reports an inability to continue the test safely

BCTT- Randy
From testing to management...

<table>
<thead>
<tr>
<th>Clinical features</th>
<th>Physiological PCD</th>
<th>Vestibulo-ocular PCD</th>
<th>Cervicogenic PCD</th>
<th>Migraine</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mild to moderate, global, pounding headache at rest that is exacerbated by reproducible levels of physical (and sometimes) cognitive activity.</td>
<td>Mild to moderate headache that is typically absent at rest but elicited or exacerbated by prolonged periods of reading, focusing, or time in complex visuospatial environments.</td>
<td>Mild to moderate, dull, occipital headache that is elicited or exacerbated by activities that require prolonged neck stabilization or movement.</td>
<td>Paroxysmal attacks of unilateral, severe, throbbing or pulsating headaches associated with photo- and phonophobia, nausea, and occasional vomiting.</td>
</tr>
<tr>
<td></td>
<td>Early symptom-limited threshold</td>
<td>Patients typically do not experience an early symptom-limited threshold.</td>
<td>Patients typically do not experience an early symptom-limited threshold.</td>
<td>Provoked by stereotypical stimuli including bright lights, stress, dehydration, poor sleep, and certain foods.</td>
</tr>
<tr>
<td></td>
<td>Sub-maximal aerobic exercise prescription</td>
<td>Targeted vestibular and vision therapy</td>
<td>Cervical spine manual therapy and proprioception re-training.</td>
<td>Headaches last 4–72 h after which patients typically experience headache-free periods.</td>
</tr>
<tr>
<td></td>
<td>Treating treadmill testing results.</td>
<td></td>
<td>Headache medications or occipital nerve injections (occipital neuralgia).</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sub-maximal aerobic exercise prescription.</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Prophylactic and abortive headache medications.</td>
<td></td>
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</tbody>
</table>

(Leddy et al., 2016)
Putting it all together

BCTT: Identify sy-limited HRt

20-30 min/day aerobic exercise at 80% of HRt

If tolerating increase HRt by 5-10 bpm weekly

Continue until 85-90% of APMHR for 20 min without sy

Repeat BCTT
Physician Clearance
Begin stepwise RTP
The Clinical Bottom Line

- The **BCTT** has been demonstrated to be **valid and reliable** (Leddy et al., 2011)
- The **BCTT** has been shown to be **safe** for use both in PCS as well as acute concussion (Cordingly et al., 2016; Leddy et al., 2017)
- Daily **low intensity, sub-symptom threshold aerobic exercise** has been demonstrated to be **safe during concussion recovery** and may even **improve recovery time** (Baker et al., 2012; Cordingly et al., 2016; Maerlender et al., 2016; Leddy et al., 2017; Mychasiuk et al., 2016; Gall et al., 2003; Kurowski et al., 2016)
- We still don’t know the perfect “**FITTT**”
- **Recovery from concussion requires a multi-modal approach** (Ellis et al., 2016)