A evidence-based shoulder injury prevention intervention for competitive swimmers

A systematic health promotion intervention

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Received 31. January 2010

Abstract

Objective: To provide the SV Limmat Sharks of Zürich, Switzerland with an evidence-based health promotion intervention including an exercises program aiming at injury prevention of the shoulder joint.

Methods: Intervention mapping was used as a systematic approach towards a health promotion intervention, including the composition of a systematic review on causes of subacromial impingement seen in professional swimmers, a literature research done on swimmer’s characteristics, preventive exercises and the assessment and interviewing of the swimmers of the Limmat Sharks of Zürich, the team’s head coach and experts in the field of swim specific physiotherapists.

Results: A systematic review on subacromial impingement in professional swimmers, an exercise program including user specific information and instructions on swimmer, coach and therapist level, and collaboration proposals, all composed systematically and transparently.

Conclusion: While having a useful structure (Intervention mapping), a lack of scientific evidence made aspects of the intervention difficult to investigate. Implementation plays a vital role in prevention interventions. Further research is strongly recommended both on causation as well as efficacy of prevention.

Keywords: shoulder injury prevention, swimming, swimmers, intervention mapping, evidence-based practice

Introduction

Swimming is a popular sport with children beginning a competitive career early at the age of 5 or 6 years old (O’Donnell et al., 2005). Two hour training sessions are done by professional swimmers up to 12 times per week with an average of 8km swum per day. Approximately 80% of the training is swum using the freestyle technique. Considering the high training intensity, the amount of freestyle stroke cycles add up to 1,000,000 for male and up to 1,600,000 stroke cycles for female swimmers due to in comparison shorter arms (McMaster et al., 1999). The result of high training frequency and intensity is often painful overuse injury to the shoulder with an incidence and recurrence rate reported to be 80% (McMaster et al., 1999). Causes of shoulder injury are multifactorial, the original assumption being subacromial impingement (Neer & Welsh, 1977). Current
literature identifies rotator tendinitis (Cools et al., 2007; Borsa et al., 2005; Yanai et al., 2000), posterior capsule tightness (Thomas et al., 2009; McKim, 1998) and scapular dyskinesis (Cools et al., 2004; Bansal et al., 2007; Brusho et al., 2007) as factors leading to pain.

Shoulder injury can drastically limit the capacity a swimmer’s performance during training or even make the participation of training sessions and competition impossible. Often, time consuming rehabilitation programs follow injury and it takes a long period of time until the swimmers can reach their pre injury performance capacities (Bansal, 2007; McKim, 1998). To reduce the incidence of shoulder injury a thoroughly researched protocol for prevention on the basis of current scientific evidence needs to be developed (McKim, 1998, Allegrucci, 1994).

This health-promoting intervention aims at implementing an evidence-based approach towards increasing the health of the A-level swim team of the SV Limmat Sharks of Zurich, with focus on the shoulder structure. With the team high class athletes suffering shoulder injury, the head coach D. Reinicke wants to integrate prevention exercises into the training routine. This has proven difficult without a physiotherapist supporting the team (personal communication with coaching stuff of SV Limmat Sharks; Allegrucci, 1994). The research question of this project was: “What is an evidence-based intervention to reduce shoulder injuries in the swimmers of SV Limmat Sharks of Zurich?”

**Methods**

**Intervention mapping**

A major requirement of the project was practical applicability, as well as a systematic analysis of a situation (Kesselaar, 2009). Intervention mapping, invented in 2001, offers both a structurized and systematic method towards a health promotion intervention, as well as strong emphasis on evidence (Bartholomew et al., 2006) and was therefore chosen as the overall structure of our project. A timeline was composed according to the method, however taking the reciprocity of various stages in account.

A workgroup was established, comprising swimmers of the target population, the head coach, experts from school, supporting different aspects of the project, as well as experts in the field of physical therapy for competitive swimmers.

**Systematic review**

A systematic review was conducted, addressing the research question: “What is the cause of subacromial impingement in competitive swimmers aged 15-30?” (Krüger et al., 2010). Subacromial impingement is a common pathology in competitive swimmers. (Yanai et al., 2000; Borsa et al., 2005; Thomas et al., 2009). Due to the wide spectrum of pathologies included under the umbrella term “swimmer’s shoulder” (Blanch, 2004; O’Donnell, 2005, Lo et al, 1990) the research was focused on the most prominent one (Brusho et al., 2007; Jobe et al., 1993; Allegrucci et al., 1994), subacromial impingement. Because of the focus on primary prevention, it was considered supportive to gather the available information on this aspect extensively. Included were articles focussing on competitive swimmers aged 15 to 30, of English language, addressing the topic of subacromial injury causation and being published after 1990. It was considered essential to find evidence for causing factors in order to find an effective prevention. Since subacromial impingement is one of the most common syndromes, it was considered relevant for the SV Limmat Zurich.

**HOAC II**

The Hypothesis-Oriented Algorithm for Clinicians II (HOAC II) is a client-management tool (Riddle et al., 2003) intended to facilitate assessment procedures. In the course of this project, a systematic assessment for major signs of shoulder pathologies in the target population was developed. Based on the highest accuracy and applicability resulting from literature research and discussions with experts of shoulder assessment, a series of test was developed for shoulder instability, subacromial impingement, biceps tendinopathy, supraspinatus tendinopathy, labrum tears as well as scapular dyskinesia. An assessment procedure was developed taking around 30 minutes including picture-taking and video recording. All of the swimmers of the A-team of SV Limmat were assessed accordingly.
Interviews

Interviews were performed at various levels. One injured swimmers and one non-injured swimmer of the A-team were interviewed, as well as the coach (Reinicke, head coach of the SV Limmat Sharks of Zürich) and therapists treating injured swimmers (Roethke, physiotherapist of the Schulthess Klinik treating swimmers of the SV Limmat Sharks of Zürich) as well as being preoccupied with prevention (Stoel, physiotherapist of the NZA). The swimmers and the therapists offered to participate voluntarily. The interviews were about about anticipated causation of the swimmer’s shoulder, risk factors, and injury prevention. The interviews were recorded using an mp3-microphone device, transcribed after recording and used for further evaluation. Questions were composed with respect to the individual field, addressing prevention of shoulder injuries.

<table>
<thead>
<tr>
<th>Name of exercise</th>
<th>Aspect</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Retraction shoulder complex</td>
<td>Postural adjustment</td>
<td>Schulthess clinic, 2009</td>
</tr>
<tr>
<td>2. Retraction shoulder blades</td>
<td>Postural adjustment</td>
<td>NZA, 2010</td>
</tr>
<tr>
<td>3. Mobility of thoracic spine</td>
<td>Mobility</td>
<td>NZA, 2010</td>
</tr>
<tr>
<td>4. Posterior capsule spine</td>
<td>Mobility</td>
<td>Laudner et al., 2008</td>
</tr>
<tr>
<td>5. Scapular clock</td>
<td>Scapular awareness</td>
<td>Kibler, 2000</td>
</tr>
<tr>
<td>6. Push-up Plus</td>
<td>Strength of scapular stabilizers</td>
<td>Decker et al., 2009, Pink &amp; Tibone, 2000</td>
</tr>
<tr>
<td>7. Dynamic hug</td>
<td>Strength of scapular stabilizers</td>
<td>Decker et al., 2009</td>
</tr>
<tr>
<td>8. Horizontal forward flexion</td>
<td>Strength of scapular stabilizers</td>
<td>Coole et al., 2007</td>
</tr>
<tr>
<td>9. Horizontal abduction</td>
<td>Strength of scapular stabilizers</td>
<td>Coole et al., 2007</td>
</tr>
<tr>
<td>10. Horizontal external rotation</td>
<td>Strength of scapular stabilizers</td>
<td>Coole et al., 2007, NZA, 2010</td>
</tr>
<tr>
<td>11. External rotation standing</td>
<td>Strength rotator cuff</td>
<td>Schulthess clinic, 2009</td>
</tr>
<tr>
<td>12. Cycling in the air</td>
<td>Core strengthening</td>
<td>Mensendieck system, 2005</td>
</tr>
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</table>

Table 1. Overview of exercise program, indicating factor addressed and source of exercise.

Additionally, questionnaires were handed out at several stages of the project concerning, including gaining epidemiological data of the swimmer, evaluation of the systematic review and evaluation of end products (appendix 3). Evaluation of various steps made use of questionnaires, e.g. feedback for the group presentation in Zurich, as well as the group discussion or the systematic review handout. Additionally, the swimmers of the A-team were asked to fill out a question regarding their history of shoulder injury, self-perception, motivation as well as opinion of injury prevention.

Literature review

Swimmer’s characteristics were gathered from several articles (McMaster et al., 1999; O’Donnell et al., 2005; Blanch, 2004).

During initiation of project, conducting the systematic review and selection of exercises, literature research was performed. To gain an appropriate insight into injury causation and swim-specific characteristics, exercise programs in shoulder injury prevention and shoulder injury prevention, training methodologies and comparable over-head sports the local library (HvA Amsterdam) as well as online search engines such as Pubmed, Medline, Google scholar and Psychinfo were used. Research minutes were kept systematically. Keywords were: Impingement, subacromial impingement, cause, injury, epidemiology impingement, epidemiology swimmer’s shoulder, swimmers, prevention.

External experts

Bert Loozen (M. science kinesiology) was consulted regarding biomechanics of injury. Pim Ranzijn (Physiotherapist, manual therapist) and Jan Simons (Physiotherapist, manual therapist) as experts on the composition of the assessment procedures, Jacqueline Stoel (M. science physiotherapy, Nederlandse Zweminstituut
Amsterdam -NZA), physiotherapist of the Dutch swim national team, was addressed concerning composition of exercise program, as well as causation of injury. Röthke (Physiotherapist Schulthess Klinik), local physiotherapist of the SV Limmat Sharks and physiotherapist of the German beachvolleyball team, was consulted regarding local treatment approaches as well as prevention possibilities on the spot.

Results

Systematic review

Regarding the question: “What is the cause of subacromial impingement in competitive swimmers aged 15-30?”, a total of 14 articles was selected. Overall, the level of evidence in causation of subacromial impingement is low (grade 5). The development of subacromial impingement is multifactorial. Several factors of anatomic, biomechanical and neuromuscular nature coupled to the particular requirements of the swim sport are thought to coincide leading to impingement. Furthermore, subacromial impingement is proposed a cyclic progressing condition (Cools et al., 2007, Jobe et al., 1993, McKim, 1998). Factors such as posterior capsule tightness, rotator cuff muscle imbalance, scapular dyskinesis and scapulohoracic muscle dysbalance (Cools et al., 2007, McKim, 1998) indicate that impingement syndrome in its complexity is not limited to the glenohumeral joint, but rather requires to investigate the whole shoulder complex, including thoracic spine, scapular characteristics and overall muscular balance. The non-relation of hypovascularity was addressed by various authors as well (McKim, 1998).

HOAC II

16 swimmers of the A-team were assessed. The HOACs were formulated using recommendations of external experts and review of literature. The results described do not refer to a verified diagnosis, but rather an indication for the presence of symptoms related to the pathology described (figure 1).


Results: 35% showed positive signs


Results: 5%

c) Biceps tendinitis: Speed’s test (Bansal et al., 2006, Calis et al., 2000)

Results: 0%

d) Muscular Dysbalance: Anterior-superior

Results: 82%


Results: 88%

f) Scapular Dyskinesia: Serratus anterior functionality (Cools, 2007), Scapular configuration in observation (Cools, 2007), (Kibler test) (Rupp et al., 1994, Kibler 1998)

Results: 70%

Intervention mapping

As a result, an exercise manual for therapist, coach and swimmer was developed, as well as proposals

Figure 1. Summary of assessment findings based on HOAC II routines

position of humerus during observation (Rupp et al., 1995), Scapular winging (Rupp et al., 1995, Kibler), internal rotation of Humerus, scapular dyskinesis (Cools, 2007, Stoel, 2010)
of implementation and a group presentation for the swimmers of SV Limmat Sharks. An exercise program (table 1) with manuals and a group presentation, as well as proposals for integration of exercises were outcomes of the project. Intervention mapping let to the exercise program as one a result of the steps of intervention mapping. The complete documentation of the intervention can be seen in appendix 1.

**Exercises**
The exercise program is based on the findings of the systematic review (Krüger et al., 2010), the shoulder assessment of the swimmers of the Limmat Sharks, literature review (Cools et al., 2007; Decker et al., 1997; Allegrucci et al, 1994) and expert opinions (Röthke, Schulthess Klinik, Stoel, NZA). The program consists of 12 exercises focusing on postural adjustment, mobility of the thoracic spine and posterior glenohumeral capsule, awareness and strength of active scapular stability, strengthening of the rotator cuff musculature and core strengthening. Sets and repetitions are indicated in the exercise description, as well as purpose of the exercise and important aspects to keep in mind while performing. Exercises were selected based on evidence, such as studies assessing EMG effects or recommendations of experts working in the field of prevention in competitive swimmers (Cools et al., 2007; Decker et al, 1999). The extensive exercise program can be found in appendix 4. Methods applied were counterconditioning (Exercise 1, 2, 5, table 1) guided practice (Exercise 7-12, table 1) dissociation of conditioning (Exercise 1-5, table 1). Applied Theory was the precaution-adooption process model (Weinstein, 1992).

**Manuals**
3 manuals were composed to implement knowledge about injury prevention and the exercise-program elaborated. The three levels addressed were the (physio)therapist, the coaching staff and the swimmer.

As for the therapist, emphasis was given on an introduction to swim-sport, explaining epidemiology and the demands to the physique and a description fo the freestyle stroke, as well as a summary of the assessment done in Zurich. Furthermore, the researchers put emphasis on a rationale for the exercises that were incorporated. The underlying hypothesis was stated and the sources of exercises, allowing the therapist a analysis of the procedure, as well as the possibility to adjust findings to current evidence and further development of the information given.. It was written in a professional language. Method applied were advocacy, technical assistance as well as facilitations. (Bartholomew, 2006). Theories used were theory of social support (Gottlieb, 1985), organizational development theory (Bowditch & Buono, 1994) and diffusion of innovations theory (Goodman et al., 1991) and Precaution-Adoption Process Model (Weinstein, 1992)

As for the manual of the coach, functional anatomy, explaining composition of the shoulder joint and its relation to scapular setting were explained as well as basic medical terms. The idea was to give the coach more information of therapeutic relevance, complementing the already-gained competence in physical education (Lambalk, 2010). Additionally, a more extensive exercise instruction including illustrations was added, as well as overall recommendations for training structure, including awareness of individual stretching and exercise instruction including an explicit explanation of the purpose of exercises. The level of language was intended to remain comprehensible for a person not being educated in anatomy previously. Methods used were advanced organizers, tailoring and images (Bartholomew, 2006). Theories used were Social support (Gottlieb, 1985) and Precaution-Adoption Process Model (Weinstein, 1992)

The swimmers-manual focussed on a comprehensible, self-efficace usage of exercises. Aspects to look for during execution of exercises including illustrations and quotations of famous swimmers, representing role models. An extensive explanation of prevention importance was added. Overall, an easy-to-comprehend language was added, too. cognitive theory, Methods applied were facilitation, tailoring, images, behavioral journalism and modeling (Bartholomew, 2006). Theories applied were the precaution-adoption process model (Weinstein, 1992) and social cognitive theory (Bandura, 1986).
**Group presentation**
The duration of the presentation was 45 minutes, and was held during a group meeting 6th December 2009. Topics addressed were functional anatomy, the repetitive demands on the shoulder complex due to swimming, explanation of assumed causes of injuries and approaches to prevention. The language of the presentation was German. Additionally, a group presentation took place the day after to evaluate and reflect on the information given the day before. The overall evaluation of the swimmers was average (5.8 on 10-point scale). This intervention is based on the theories of Health Belief Model (Janz & Becker, 1984). All participants of the group discussion considered it as very relevant afterwards. This intervention is based on the theory that information processing is an essential part of health promotion interventions (Kools et al., 2004).

**Implementation suggestions**
As for a sustainable implementation, the researchers proposed a buddy model to the SV Limmat Sharks. The basic idea is to have older swimmers instructing younger swimmers in the execution of exercises. By providing such a system, the respect and authority of the older swimmers might contribute to a stronger, more sustainable implementation of exercises, raising both awareness and motivation of the younger swimmers. A second implementation recommendation was a stronger cooperation with Schulthess Clinic, Zurich and Movemed, Zurich. Both practices worked with swimmers previously and its therapists showed interest in the prevention work. An appropriate instruction into machine-usage in a gymnasium and basic assessment possibilities were thought to be relevant. Facilitation and technical assistance were methods applied in this intervention (Bartholomew, 2006). Theories used were theories of social norms theory (Minkler & Wallenstein, 1997a), social support (Gottlieb, 1985) and organizational development theory (Bowditch & Buono, 1994).

**Interviews and questionnaires**
Data extrapolation from the interviews showed the following major points:

- communication between therapists, coach and swimmers needs to be improved (Roethke, Reinicke)
- the coach is depending on the self-efficace feedback of the swimmer regarding injury (Reinicke)
- exercises need to be well-described (Stoel, Lambalk)
- prevention is considered important (Roethke, Reinicke, Keller)
- there is a lack of awareness about injury prevention (Keller, Reinicke, Stoel)
- there is a possibility to invest more time in prevention of coach (Reinicke)
- an exercise that is not well-understood by the swimmer won't be performed properly (Keller)
- an important aspect is the explanation that focus lies not on strength and endurance in the prevention exercises but awareness and correct execution (Stoel)
- swimmers have the tendency to place success over health (Questionnaires)

**Discussion**
The systematic review is a contribution to the scientific body of knowledge. It might be an effective output to list the hypotheses elaborated so far to allow an effective composition of a laboratory study to investigate the hypotheses. The multifactorial and reciprocal characteristics of shoulder pathologies remain a challenge for prevention and rehabilitation.

As for the assessment regarding causative agents, it was based on hypothetical constructs. The researchers gathered literature the pathologies related to swimming, as well as the best screening tests available (McMaster, 1994, Brushøj, 2006, Ciullo et al., 1989, Kennedy et al., 1974, McMaster, 1986, Neer et al., 1977, Richardson et al., 1980, Rupp et al., 1995). However, the identification of a tendency towards a certain condition remained hypothetical, and therefore the outcomes were read as indications of a possibility of the presence of a pathology. However, by composing a systematic assessment procedure, further evaluation and refinement is possible. The results of the assessment were conclusive too, since moer acute
pathologies, such as biceps tendinopathy (0%), were lower than more subtle conditions such as scapular dyskinesia (70%).

The exercise program constituted the core of the intervention. A positive indication of the research was that projects of comparable size, focusing solely on aspects of the present study, showed similar results for the field-of-interest, compare exercises for scapular control (Bernau & Munzenbrock, 2008). In order to allow personal-independent application of prevention strategies, the format of a document was chosen. However, due to the time of the project and the researchers capacities, no pilot study was possible. This would in any case require a cohort study (Hartingsveld, 2009). Since the implementation of the project will be an ongoing process, an evaluation of it remains at this point difficult. However, the positive attitude of swimmers, therapists and coaching seemed promising. Very practical aspects, such as the new coach-assistant that will be instructed by the researchers in the prevention program might contribute to a lasting effect of the project.

As to the application of intervention mapping to a physiotherapy intervention, it must be stated that a strong advantage was the emphasis on selection of theory and method. For instance, this required the researchers to analyze the health situation properly, using PRECEDE-models (Bartholomew, 2006) and HOACs for the swimmers. The PRECEDE-model is a tool to depict the logical relation between health problem, behavioral factors, environmental factors, external and internal determinants and quality of life. A systematic recording of results allows further researchers a comprehensive and transparent access to the data gained. Various interventions lack these data (O'Donnell, 2005, Maher, 1994, Hergenroeder, 1998) or are case reports (Bridge, 1998). Additionally, most exercise programs lack precise description of execution of exercises. Furthermore, most exercise programs focus on rehabilitation procedures (McMullen et al., 2000, Decker et al., 1999). The publicly available training programs of elite swim teams focused not on prevention but rather strength and endurance (Newton et al., 2002). Because of the projects focus on primary prevention this presented another challenge.

Therefore, the approach of finding most appropriate exercises from studies (Decker et al., 1999, Cools et al., 2000) and practical approaches (Roethke, 2009, Stoel, 2010) seemed adequate. However, it is in the belief of the researchers that there is no best choice available at this point in time because of the lack of evidence of causation of injury. It is considered an advantage of the current research project to have produced a transparent and clear result allowing further development in the field. However, a model adapted from mainly psychological studies into the field of physiotherapy might also cause loss of quality and incorrect application of approaches. E.g. the needs-assessment demanded not only a behavioral analysis but also an insight into anatomical findings and causative agents regarding the injury. Using systematic approaches to unclear aspects was considered another strength of this project. There was, however another challenge in terms of competitive management of knowledge. Advanced institutions, such as the Nederlandse zweminstuut Amsterdam, run a policy of withholding data acquired over injury prevention in order to maintain a competitive advantage.

Limitations of the research must be taken into consideration. Several applications for financial support were not accepted (Movemed foundation, ESP support), thus money constituted a factor limiting the research. The stay in Zurich was limited to a week due to this reason, as well as assessment and exercise tools had to be reduced to a minimum. The relatively short time-span of 3 months allowed only a coverage of selected aspects of both investigation and intervention. According to experts working in the field for several years, the choices made were appropriate and constructive (Stoel, 2010, Lambalk, 2010). Even though the thorough formation of a workgroup including several experts, their time and resources were all shared with the researchers voluntarily. A financed collaboration might have shown more extensive results.

Another investigation might be a psychological research on motivational factors in relation to body perception of athletes as well as health believes.
Conclusion

The research question, “What is an evidence-based intervention to reduce shoulder injuries in the swimmers of SV Limmat Sharks of Zurich?”, was answered with an exercise program, education and cooperation suggestions. The effectiveness of the intervention has not yet been proven. In the opinion of the researchers, no definite solution can be given but optimal solutions can be developed.

The use of intervention mapping as an systematic approach to prevention of shoulder injuries in swimmers showed an efficient procedure and effective project development. However, adjustments due to the physical characteristics of the health problem were necessary.

A proposed research resulting from this prevention project would be a cohort study of the efficacy of the 12-exercise program in competitive swimming athletes aged 15-30 investigating injury frequency as well as physical characteristics, such as scapular control or glenohumeral stability. A similar study could be executed for younger swimmers and investigating their development and compare it with a control group not disposed to the prevention exercises.

A revision of the HOAC system might be appropriate, too. By refining the assessment routines, quick scans might become available to a wider field of coaches, professionals and swimmers.

Performing an intervention in the public sector, it showed to be more efficient to limit the projects goals to specific aspects, operationalizing the researchers fields of expertise, as well formulating the aspects not worked on extensively in a research documentation.

Acknowledgements

The research project was conducted without any financial support of an organization.

We would like to thank the SV Limmat Sharks swimmers, their head coach, as well as Jacqueline Stoel, Stefan Roethke, Bert Loozen, Pim Ranzijn, Jan Simmons, Bas Moed, Frank van Hartingsveld and Jose Hermans.

References


Appendix 1 – Intervention Mapping Documentation

Documentation of Intervention “Prevention of shoulder injuries of the swimmers of SV Limmat Zurich”
Index

Step 1 (Needs-assessment):
4. Formation of workgroup
5. Formation of planning group
6. Description of client (target population) (missing)
7. Problem analysis (negative Precede model)
8. Why we decided on a Systematic review on subacromial impingement in competitive swimmers (needs reasoning why, description and argument that no good base for prevention then we have to build the basis first or, as well)
9. Assessment of resources of SV Limmat (interviews, why how we did it)
10. Analysis of health-promoting aspects (needs editing and references)

Step 2 (formulation of what we want to change, objectives):
(I do that over weekend)

Step 3 (what theory we picked to cause the change, to implement changes)
(I do that over weekend)

Step 4 (product outcome, description of materials)
- Systematic review (research question, brief overview what was done, description of results)
- Exercise manual (three levels, three different languages
- Presentation about prevention (what was in, why we did this)
- Group discussion (as evaluation and reflection possibility on presentation, injury in general → awareness lifting)
- Documentation of research (purpose: reproducibility, line of argument, scientific purpose)
- Discussion/Interview with coach (education, giving overall advice, transferring knowledge from other experts to him, recommendation to have 1 hour/week for further education and therapeutic topics)

Step 5 (Planning of program implementation)
- Model with swimmers teaching younger ones
- Inclusion of new co-trainer
- Cooperation with Schulthess Klinik (instruction of exercises to Stefan), Movemed
- Inclusion of quotes from famous people

Step 6 (Evaluation)
- Different grading systems (for group discussion and presentation, WHAT ELSE?)
- For systematic review grading
- For presentation in Amsterdam grading (handed out paper)
- For overall product (AGREE model)
- Individual evaluation of overall process
- Report on recommended further research
Step 1

Formation of workgroup
Esp students: Kai, Kim, Mike
Research Coach: Jose Hermans
Client: Dirk Reinicke

Work platform:
E-Mail: shoulderprotocol@gmail.com
Password: protocolshoulder

Regularities:
Meetings with coach via skype every Thursday
Meeting with Jose on weekly base
Travel to Zurich for on-the-spot assessment and investigations

Planning group
4. Frank as intervention mapping mentor (personal meetings, email contact)
5. Bas, Jesse feedback givers for SR
6. Kilian, Val, Susanne, Martina, Alexandra as experts out of the group (injured, non-injured swimmers)
7. Stefan Roethke (PT in Zurich)
8. Jan Simmons, Pim Ranzijn for assessment
9. Bert Loozen for Anatomy meetings
10. Jacqueline Stoel as support for exercise program
11. Kerstin Warnke as doctor on spot

Difficulties and limitations:
No contact with local massage therapist, no meeting with Warnke, no meeting with PT at Movemed
Not constantly in Zurich (on the spot)

Assessment of resources:
Coach competency (interview coach)
Environment (photos, people who work there)
Swimmers (videotaping exercise program they do, their motivation, interviews)
Interview about knowledge of anatomy

Precede model health risks (analysis of problem):
In a brainstorming session, the workgroup charted out a basic line of problem analysis according to the prece model as proposed by Bartholomew (2006). The workgroup then gathered literature and performed qualitative investigations to deepen, enhance and verify aspects with special regards to SV Limmat, the client of interest.
Quality of life – Health problems – Behavioral/environmental factors - Determinants

The analysis of problem showed the complexity of the situation. Even though it concerns a physical problem, the social consequences are immense, as well as the
build-up of the problem not only in science not well-discussed, but also manifold and complex.

**Quality of life:**

Psychosocial aspects:
- Depression
- Frustration (comparison with younger, healthier athletes)
- Lack of self-confidence/self-esteem
- Lack of motivation to swim again
- Sleeping patterns affected
- Chronic pain development

Swim-related:
- Missing trainings and competitions (championships)
- Distrust to coach might develop
- Relation to other swimmers affected (less interaction, partnership might change)
- Stopping swimming
- Peer pressure (“why didn't you compete in that competition? Maybe you're just too lazy to train)
- Not achieving personal goals
- Decreased quality of swimming (limited possibility to train different strokes)

General aspects:
- Visits to therapists and doctors time-consuming and expensive
- Loss of financing through sponsorships/scholarships
- Diminished overall participation in other hobbies (Squash, Volleyball, Badminton) and work (overhead activities)
- ADL's affected (studying, working
- Additional health dangers (after operation, etc.)

**Health problems:**

- (anterior) Labrum tear
- Muscular imbalance (Rupp et al., 1994)
- Chronic Inflammation
- Shoulder instability (Maltracking of glenohumeral join)
- Scapular Dyskinesisis (Cools, 2007)

**Behavioral factors:**

Knowledge:
- Ignoring signs of onset because no capacity to detect them
- Lack of self care
Attitude:
- Insufficient communication with coach (not communicating health problem, not listening to instructions)
- Masochist awareness (i.e. negative compliance with peers and coach, denial of signs and symptoms)
- Lack of body awareness (Not finding appropriate intensity, knowledge of own limits)
- Rivalry behavior (I have to push myself to be faster)
- No risk awareness
- Ambition and competitive behavior

Biophysical:
- Inadequate nutrition
- Compensations (incorrect swimming technique)

Environmental factors:

Interpersonal:
- Expectations from parents
  (Keller, 2009)
- Peer pressure (don’t be weak, especially before competition) (Personal communication, swimmers SV Limmat, 2009)
- Relationship in swim team
  --> 2 couples in A-team SV Limmat

Organizational:
- Coach (demands of coach, lack of education of coach, bad inadequate techniques are taught)
  --> Workload of coach very high, overchallenging (Personal communication, coach SV Limmat, 2009, Stoel, 2010)
- Pressure from club
  --> Requirements to be in A-team
  (http://www.svl.ch/verein/Training/struktur.html#a)
  --> Team championships (Swiss national championships show "best" national club, members of SV Limmat in national team)
  --> Prestigious competitions (Van Berkel in Worldcup 2009, Bossard, Val, Martina in Amsterdam competition 2010, National team members of SV Limmat)
- Problem-inducing training (contraindicated exercises for shoulder)
- Problem-inducing training structure
  --> Training intensity increases faster than body can adjust (Reinicke 2009 (p.c.), O'Donnell, 2009)
  --> Gradual increase of training intensity not enough attention (Reinicke, 2009 (p.c.), O'Donnell, 2005)
  --> Switching from C to B to A team difficult (Personal communication, coach and swimmers SV Limmat, 2009, O'Donnell, 2005)
Community:
- Success creates pressure by community (Martina Van Berkel missing a season, missing world cup 2009)
- Accessibility of appropriate coping strategies not well-documented
  --> "Injury is a weakness" (Stoel, 2010)
  --> tabooization of topic (http://www.fsn.ch/desktopdefault.aspx/tabid-6/310_read-4763/ as example)

Society:
- Fans pressure (newspaper articles about you)
- Medical/therapeutic competence to deal with swim-specific health problems (Personal communication, coach and swimmers SV Limmat, 2009, Roethke, 2009, Suvaliv-Campaign 2009)

Determinants:

Personal determinants:
- No pain, No gain (Pink et al., 2000)
  --> Strong belief in this paradigm in A-team swimmers (p.c. swimmers, coach, SVL, 2009)
- Setting of priorities
  --> In some individuals tendency to place success over health (p.c. swimmers SVL, 2009)
- Ambition
  --> High ambitious level at A-team (p.c. swimmers, SVL, 2009)
- Fear of exclusion/non-belonging to group, not meeting assumed, subtle expectations
  --> (p.c. swimmers, SVL, 2009)
- Lack of knowledge and about possible injuries and warning signs (Lambalk, 2009, Stoel, 2010)
  --> Little knowledge about anatomy, possible injuries in A-team Zurich (p.c. swimmers, coach, SVL, 2009)
- Lack of interest about possible injuries (Stoel, 2010)
  --> Response rate of injured swimmers to inquiries was much higher, why bother about something that isn't present (p.c. swimmers, SVL, 2009)
- Personal body structure/build (e.g. Acromion morphology) (Bedi et al., 2009)
  --> Controversial aspect (Stoel, 2010)
- Over-awareness of external/peer/coach pressure
  --> In swimmers of A-team moderate/not talked about? (p.c swimmers, coach, SVL, 2009)
- Lack of body-awareness (not detecting warning signs) (Stoel, 2010)
  --> Prevention exercises not well-understood (p.c. swimmers, SVL, 2009)
- Swim technique (O’Donnell et al., 2005, Pink et al., 2000, Stoel, 2010)
  --> Present in swimmers of SVL? (we left out this aspect on purpose)

External determinants:
- No provision of info on nutrition
- Lack of knowledge of coach (anatomy, health promoting strategies, detection of health problem etc.)
  - Coach of SVL confirms (p.c. coach SVL, 2009)
- Lack of awareness in community/tabooisation (no articles written on topic, etc.)
- Being excluded by other swimmers
  - In A-team not so present (p.c., swimmers, SVL, 2009)
  - Too little supervision of swimmers through therapeutic team (Stoel, 2010, Roethke, 2009)
  - Only massage therapist present once a week, no interaction of treating PT’s with coach (p.c. swimmers, coach SVL, 2009)
  - Initiation of yearly health check-up with local physiotherapy/medical practice (p.c. coach SVL, 2009)
  - No communication platform/setting to allow quick scan of possible injured swimmers (through coach) (Stoel, 2010, Lambalk, 2010, Roethke, 2009)
  - Expectation of coach to have swimmers come independently (p.c. swimmers, coach SVL, 2009)
  - No pain, no gain belief of coach, peer group (Pink et al., 2000)
  - Present in A-team SV Limmat (p.c. coach, swimmers, SVL, 2009)
  - Intervention of problem only if symptoms/pathology is already present (Roethke, 2009, Stoel, 2010)
- Swimmers in therapeutic treatment only after injury, no preventive program currently placed (p.c. swimmers, coach SVL, 2009)
Systematic review as scientific analysis of health problem “Impingement syndrome”

Physical Assessment (01.12.-5.12.09):

As for performing a physical assessment, in discussion with Pim Ranzijn and Jan Simons (experts for shoulder assessment at the HvA), we discussed testing possibilities, and eventually decided to create HOACs (hypothesis-oriented-algorithms for clinicians II). We developed routines for subacromial impingement, labrum tears, biceps tendinitis, muscular dysbalance, glenohumeral instability and scapular dysknesia. These tests were NOT to postulate, confirm or verify a diagnosis, but collect signs and symptoms that are from the scientific community considered indicative for the possibility of a certain health problem. The .xls file with results is attached (“Swimmers Assessment Zurich). It was performed during our stay in Zurich (01.12.09-06.12.09) in the swimming pool “Hallenbad Oerlikon”.

We performed a sequence of assessment (split in observation and general assessment, performed by Kim and Kai, and special tests performed by Mike, each 15 minutes), including videotaping and taking pictures. Every movement (e.g. painful arc) was repeated 3 times and results were written. As for the results of the HOACs, we considered any findings (i.e. a score higher than 0) as indicative. The purpose of this assessment was not to show how severe someone is impaired, but rather an overall tendency within the group for possible development of health problems. It should be noted that 47%, almost half of the swimmers, showed a step deformity indicating a subluxated AC-joint. According to Loozen, 2009, this may be indicative for scapular muscle dysfunction, as the scapula “hangs” on the scapula in such a case, as well as shoulder instability. Stoel stated that this health problem is preventative with adequate prevention training (Stoel, 2010).

Results:
No signs of biceps tendinitis were to be found (0%). 5% showed signs of labrum tear, 35% of the swimmers showed signs of impingement, 70% showed signs of supraspinatus tendinopathy, 70% showed signs of scapular dyskinesia 82% showed signs of muscular dysbalance and 88% showed signs of glenohumeral instability.

Description of HOACs:
The HOACs were formulated using recommendations of external experts, review of literature (REFERENCES),


Results: 35% showed positive signs

2. Labrum tears (Sherwin, 2006, Brushøj et al., 2007, McMaster, 1986, Beltran et al., 2003)

HOAC: Crank test (Guanche et al., Stetson & Templin, Liu et al.), O'brien test (Parentis et al., Myers et al., Nakagawa et al., McFarland et al., Morgan et al., O'brien et al.), Hawkins-Kennedy (Parentis et al., Nakagawa et al.)

Results: 5%

3. Biceps tendinitis (Weldon, Johnson et al., 2009, Kennedy et al. 1974)

HOAC: Speed's test (Bansal et al., 2006, Calis et al., 2000)

Results: 0%


HOAC: Anterior-superior position of humerus during observation (Rupp et al., 1995), Scapular winging (Rupp et al., 1995, Kibler), internal rotation of Humerus, scapular dyskinesis (Cools, 2007, Stoel, 2010)

Results: 82%


Results: 88%


HOAC: Serratus anterior functionality (Cools, 2007), Scapular configuration in observation (Cools, 2007), (Kibler) (Rupp et al., 1994, Kibler 1998)
Results: 70%

Limitations and Pitfalls:
- Did not conduct HOAC a second time (reevaluate)
- Forgotten meter band for Kibler test
- Limited number of testers (intra/intertester reliability)
- Performance of test might be faulty (even though 3 times meetings with assessment experts)
- Muscular dysbalance difficult to assess (Blanch, 2004)
- Supraspinatus tendinitis not assessed

Impingement syndrome DOCUMENTATION OF what we did and how we got there

Positive precede model
In order to formulate an efficient prevention intervention, we therefore also conducted research on the positive factors influencing the health problem (as identified before) by using the precede model in a positive way. Beginning from the Health problem, we again assessed behavioral and environmental factors that may cause the problem, and then developed the “opposite” of those, i.e. the factor that might counteract the development that this factors caused.

Health problem:
- Painful shoulder
- SA impingement
- malpositioning of shoulder
- Muscular imbalance – Abduction/ internal rotation
- Impingement due to instability
  - Posterior capsule tightness
  - Rotator cuff (supra- infra- spinatus, subscapularis) tendonitis, impingement
  - Overuse (what does it mean)
  - After surgery issues
  - Scapular rhythm
  - Labrum tears

<table>
<thead>
<tr>
<th>Behavioral factors negative:</th>
<th>Behavioral factors positive:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of self care</td>
<td>Listening to your body/Mindful self-care</td>
</tr>
<tr>
<td>Ambition and romp(?) Behavior</td>
<td></td>
</tr>
<tr>
<td>No risk awareness</td>
<td>Acknowledging symptoms</td>
</tr>
<tr>
<td>Priorities</td>
<td>Priority health over success</td>
</tr>
<tr>
<td>Negative compliance</td>
<td>Risk-awareness</td>
</tr>
<tr>
<td>Ignoring signs of onset</td>
<td>Positive compliance</td>
</tr>
<tr>
<td>Masochistic awareness</td>
<td>No pain, Good gain</td>
</tr>
<tr>
<td>No pain, No gain</td>
<td>Motivation(?) for health</td>
</tr>
<tr>
<td>Insufficient communication with coach</td>
<td>Self-reflective, honest</td>
</tr>
<tr>
<td>not finding appropriate intensity</td>
<td>communication</td>
</tr>
<tr>
<td>Compensating behavior</td>
<td>Balanced training</td>
</tr>
<tr>
<td></td>
<td>Good nutrition</td>
</tr>
<tr>
<td>Environmental factors:</td>
<td></td>
</tr>
<tr>
<td>------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td><strong>Interpersonal:</strong></td>
<td><strong>Interpersonal:</strong></td>
</tr>
<tr>
<td>- peers</td>
<td>- Support of parents in risk awareness behavior Stable and healthy home situation</td>
</tr>
<tr>
<td>- partner (significant other)</td>
<td>- Positive open atmosphere in (swimming)group</td>
</tr>
<tr>
<td>- Parents</td>
<td>- “I love you the way I am”</td>
</tr>
<tr>
<td>- Coach</td>
<td>- Open, attentive, competent(?) coach</td>
</tr>
<tr>
<td><strong>Organizational:</strong></td>
<td><strong>Organizational:</strong></td>
</tr>
<tr>
<td>- Club ➔ Coach</td>
<td>- Accepting club</td>
</tr>
<tr>
<td>- Bad Equipment</td>
<td>- Good equipment</td>
</tr>
<tr>
<td>- Unfavorable TE/ Structure</td>
<td>- Favorable TE/ Structure</td>
</tr>
<tr>
<td><strong>Community:</strong></td>
<td><strong>Community:</strong></td>
</tr>
<tr>
<td>- Success pressure</td>
<td>- open, non pressuring(?) , atmosphere</td>
</tr>
<tr>
<td>- Accessibility</td>
<td>- Accessibility of coping strategies</td>
</tr>
<tr>
<td>- Tabooing</td>
<td>- Open atmosphere</td>
</tr>
<tr>
<td><strong>Society:</strong></td>
<td><strong>Society:</strong></td>
</tr>
<tr>
<td>- Fans</td>
<td>- Open fans</td>
</tr>
<tr>
<td>- Lack of medical/therapeutic care</td>
<td>- Medical/therapeutic competence</td>
</tr>
<tr>
<td>- Media (bollywood effect)</td>
<td>- Media ……….??</td>
</tr>
<tr>
<td></td>
<td>- Awareness promoting media</td>
</tr>
</tbody>
</table>

Afterwards, we formulated possible change objectives. As we were in that process it was clear that we could not work on the whole spectre of possible interventions, and therefore selected the ones most appropriate for our project, as well as our qualification. We recognized however, that clear recommendations could be made and are to be found in step 6.

**Change objectives of health priority behavior**

*Listen to your body:*  
- Motivation for self care  
- Knowledge of self care  
\((\text{symptoms, what to look for [self screening]}) \rightarrow \text{Knowing how to process information} \rightarrow \text{Training it}\)

*Acknowledging symptoms:*  
- Knowledge of symptoms  
- Willingness  
- Self screening

*Priorities health over success:*  
- motivation to do it
- Education of benefits
- Course of life
- Suffering so much that you have to change

**Risk Awareness:**
- Knowledge
- Education
- Applicability

**Positive compliance:**
- Priority of health over recognition
- Ability to openly communicate (with yourself and others)

**No pain, Good gain:**
- Training philosophy change
- Education of signs and symptoms
- Availability of information

**Healthy training behavior:**
- Education of coach
- Pain free training goal
- Build up/structure for swimming (coach)

**Good Nutrition:**
- Guideline
- Money
- Motivation to adjust

**Priorities: technique over speed:**
- education of positive
- Motivation and ….. of this approach
- Chronic compensation → Recognizing fatigue

**Swimming for yourself:**
- Self worth
- Goal settings
- Friendly atmosphere
- Education from idols

**Environmental Factors:**

Health supportive parents
- Education of parents
- Good communication with parents
- Health over success priority of parents
- Stabilization and healthy home situation
  - Health-aware behavior
  - Positive attitude towards acceptance of injury

Positive open atmosphere in group
- They accept injured
- Communicate about injury signs
- Awareness of peers’ problems
- Expecting fellow swimmers to stay healthy
- Knowledge of signs and symptoms
- Good communication
- A time to speak about it
- Role models

Open attentive competent coach
- Communication
- Knowledge and awareness in coach
- Attitude
- Agreement on injury awareness

Club that accepts injured swimmers
- Injury strategy for injured swimmers (in which group they go to)
- PT involvement
- Creed – Statement for injury in club – *blah?*
- Available information

Good equipment
- Financing
- High quality equipment that supports injury prevention (teraband)
- Maintaining equipment
- Removal of risk-increasing equipment
- Injury equipment
- Sufficient instruction through coach of materials

Favorable training environment
- TE that decreases risk of injury (not too cold)
- Safe environment
- Wave breakers? (Quality)
- Water temperature
- Injured and non-injured swimmers train together
- All in TP

Favorable training structure
- Appropriate exercise protocol injury prevention
- Risk awareness training build up → knowledge of coach for don’ts (Doms?)
- Adaptability load of swimmers
- Screening tool
- Good warm up
- Good cool down
- Effective recognition of signs and symptoms

**Community factors**

Open non-pressuring atmosphere
- Role model interviews with positive attitude (health over success), e.g. Dana Torres, Michael Phelps
- Guideline from FINA/ swiss swim association about prevention
- Prevention Guidelines of head(?) associations (Swiss swim federation)
- In competitions attending competent therapist (fixed job for physiotherapist)
- Media for injury awareness (more coverage on medical topics)
- Responsibility for doing so by swim associations (fostering through swim association FINA)
- Rehab ….? Specialized in shoulder injuries (therapists with experience in swim-field)

Accessibility of coping strategies
- Role models ……….? how they succeeded published in journals
- Guideline
- *education(?)* in coach
- Injury symptoms (how to detect)
- Prevention + rehab (what to do to stay healthy/get healthy again)
- Willingness and responsibility of swimmers (understand the importance of preventing injury)

Medical and therapeutic competence
- Special training for staff
- Medical knowledge available
- Motivation of therapeutic community and awareness
- Cooperation of specialized institutions

Awareness priority setting
- TV shows featuring Role Models→ open fans→ newsletters (injury reports)
- Education of club
- Presentation of coping strategies
- *Providing (?)* good equipment
- Specialists ……………………???
Step 2

Desired outcomes:

<table>
<thead>
<tr>
<th>Behavioral outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outcome</strong></td>
</tr>
<tr>
<td><strong>Quicker recognition of symptoms</strong></td>
</tr>
<tr>
<td><strong>Better communication with coach</strong></td>
</tr>
<tr>
<td><strong>Priority health over success</strong></td>
</tr>
<tr>
<td><strong>Health-promoting behaviour</strong></td>
</tr>
<tr>
<td><strong>Adequate motivation to do exercises on long-term basis</strong></td>
</tr>
<tr>
<td><strong>Support within swim group</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Environmental outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Desired outcome</strong></td>
</tr>
<tr>
<td><strong>Prevention exercises in club</strong></td>
</tr>
<tr>
<td><strong>Less pressure (among swimmers)</strong></td>
</tr>
<tr>
<td><strong>More communication between coach and therapist</strong></td>
</tr>
<tr>
<td><strong>Recognition of symptoms</strong></td>
</tr>
<tr>
<td><strong>More knowledge in club</strong></td>
</tr>
<tr>
<td><strong>Further research on topic</strong></td>
</tr>
</tbody>
</table>
Avoidance of risk-behaviours | Swimmers, coach, therapist
---|---
Optimal use of existing resources | Coach, Swimmers
Efficace intervention line (swimmers → coach → therapist) | Swimmers, coach, therapist
Health supporting structrues in club/training | Coach, therapist

---

Change objectives (Risk reduction behaviour, Health promoting behaviour, Adherence and Self-Management Behaviours)
Stating behavioral Outcomes (positive)
Stating environmental outcomes (positive)

*Change agents:*
Coach, Massage therapist, Physiotherapist, Doctor, Club Sharks Zurich, swimmers

Formulation of performance objectives (for behavior and environment)
→ Matrix of change objectives
→ Selection of intervention levels

Limitations and difficulties:
Not possible to differentiate intervention population (secondary primary prevention)
No previous intervention such as this has been performed

How do we want to evaluate the intervention?
## Step 3

<table>
<thead>
<tr>
<th>Product</th>
<th>Method</th>
<th>Theory</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-Exercise-program</td>
<td>Transtheoretical model, PAPM</td>
<td>Counterconditioning, guided practice, dissociation of conditioning</td>
<td></td>
</tr>
<tr>
<td>Manual Swimmers</td>
<td>Facilitation, Tailoring, Images, Personal communication, behavioral journalism, modeling</td>
<td>PAPM, Social Cognitive Theory</td>
<td></td>
</tr>
<tr>
<td>Presentation swimmers</td>
<td>Arguments, persuasive communication, information, loss or gain frame, fear arousal</td>
<td>HBM, PCM, Social Norm Theory</td>
<td></td>
</tr>
<tr>
<td>Group discussion swimmers</td>
<td>Nonjudgemental group discussion</td>
<td>Social Norm Theory, Information processing</td>
<td></td>
</tr>
<tr>
<td>Manual Coach</td>
<td>Feedback?, Advanced organizers, Images, tailoring</td>
<td>Social support, PAPM</td>
<td></td>
</tr>
<tr>
<td>Implementation suggestions</td>
<td>Guided practice, Modeling, verbal persuasion, team building</td>
<td>Diffusion theory, organizational changes stages theory</td>
<td></td>
</tr>
<tr>
<td>Manual Therapist</td>
<td>Tailoring, Technical assistance, skills training</td>
<td>Social support, PAPM</td>
<td></td>
</tr>
<tr>
<td>HOAC</td>
<td>Guided practice (for therapists), skills training</td>
<td>Policy theory</td>
<td></td>
</tr>
<tr>
<td>Systematic review</td>
<td>Policy advocacy, scientific progress</td>
<td>Policy theory</td>
<td></td>
</tr>
<tr>
<td>Documentation of research</td>
<td>Advocacy, reproducibility</td>
<td>Policy theory</td>
<td></td>
</tr>
</tbody>
</table>
Step 4

Exercises

The exercise program consists of 12 exercises focusing on postural adjustment, mobility of the thoracic spine and posterior glenohumeral capsule, awareness and strength of active scapular stability, strengthening of the rotator cuff musculature and core strengthening. Sets and repetitions are indicated in the exercise description, as well as purpose of the exercise and important aspects to keep in mind while performing. Exercisees were selected based on evidence, such as studies assessing EMG effects or recommendations of experts working in the field of prevention in competitive swimmers. The extensive exercise program can be found in the appendix. Operant conditioning is the fundament of this aspect (Bartholomew, 2006). Methods applied were counterconditioning, guided practice, dissociation of conditioning (Bartholomew, 2006). Applied Theory applied was the precaution-adoption process model (Weinstein, 1992).

Manuals

3 manuals were composed to implement knowledge about injury prevention and the exercise-program elaborated. The three levels addressed were the (physio)therapist, the coaching staff and the swimmer.

As for the therapist, emphasis was given on an introduction to swim-sport, explaining epidemiology and the demands to the physique and a description fo the freestyle stroke, as well as a summary of the assessment done in Zurich. Furthermore, the researchers put emphasis on a rationale for the exercises that were incorporated, The underlying hypothesis was stated and the sources of exercises, allowing the therapist a analysis of the procedure, as well as the possibility to adjust findings to current evidence and further development of the information given.. It was written in a professional language. Method applied were advocacy, technical assistance as well as facilitations. (Bartholomew, 2006). Theories used were theory of social support (Gottlieb, 1985), organizational development theory (Bowditch & Buono, 1994) and diffusion of innovations theory (Goodman et al., 1991) and Precaution-Adoption Process Model (Weinstein, 1992)

As for the manual of the coach, functional anatomy, explaining composition of the shoulder joint and its relation to scapular setting were explained as well as basic medical terms. The idea was to give the coach more information of therapeutic relevance, complementing the already-gained competence in physical education (Lambalk, 2010). Additionally, a more extensive exercise instruction including illustrations was added, as well as overall
recommendations for training structure, including awareness of individual stretching and exercise instruction including an explicit explanation of the purpose of exercises. The level of language was intended to remain comprehensible for a person not being educated in anatomy previously. Methods used were advanced organizers, tailoring and images (Bartholomew, 2006). Theories used were Social support (Gottlieb, 1985) and Precaution-Adoption Process Model (Weinstein, 1992)

The swimmers-manual focussed on a comprehensible, self-efficace usage of exercises. Aspects to look for during execution of exercises including illustrations and quotations of famous swimmers, representing role models. An extensive explanation of prevention importance was added. Overall, an easy-to-comprehend language was added, too. cognitive theory, Methods applied were facilitation, tailoring, images, behavioral journalism and modeling (Bartholomew, 2006). Theories applied were the precaution-adoption process model (Weinstein, 1992) and social cognitive theory (Bandura, 1986).

**Group presentation**

The duration of the presentation was 45 minutes, and was held during a group meeting 6th december 2009. Topics addressed were functional anatomy, the repetitive demands on the shoulder complex due to swimming, explanation of assumed causes of injuries and approaches to prevention. The language of the presentation was German. Additionally, a group presentation took place the day after to evaluate and reflect on the information given the day before. The overall evaluation of the swimmers was average (5.8 on 10-point scale). This intervention is based on the theories of Health Belief Model (Janz&Becker, 1984). All participants of the group discussion considered it as very relevant afterwards. This intervention is based on the theory that information processing is an essential part of health promotion interventions (Kools et al., 2004).

**Implementation suggestions**

As for a sustainable implementation, the researchers proposed a buddy model to the SV Limmat Sharks. The basic idea is to have older swimmers instructing younger swimmers in the execution of exercises. By providing such a system, the respect and authority of the older swimmers might contribute to a stronger, more sustainable implementation of exercises, raising both awareness and motivation of the younger swimmers. A second implementation recommendation was a stronger cooperation with Schulthess Clinic, Zurich and Movemed, Zurich. Both practices worked with swimmers previously and its the rapists showed interest in the prevention work. An appropriate instruction into machine-usage in a gymnasium and basic assessment possibilities were thought to be relevant. Facilitation and technical assistance were methods applied in this intervention (Bartholomew, 2006). Theories used were theories of social norms theory (Minkler & Wallenstein, 1997a), social support (Gottlieb, 1985) and organizational development theory (Bowditch & Buono, 1994).

**Systematic review**

, Regarding the question: “What is the cause of subacromial impingement in competitive swimmers aged 15-30?”, a total of 14 articles was selected. Overall, the level of evidence in causation of subacromial impingement is low (grade 5). The, development of subacromial impingement is multifactorial. Several factors of anatomic, biomechanical and neuromuscular nature coupled to the particular requirements of the swim sport are thought to coincide leading to impingement. Furthermore, subacromial impingement is proposed a cyclic progressing condition (Cools et al., 2007, Jobe et al., 1993, McKim, 1998). Factors such as posterior capsule tightness, rotator cuff muscle imbalance, scapular dyskinesis and
scapulothoracic muscle dysbalance (Cools et al., 2007, McKim, 1998) indicate that impingement syndrome in its complexity is not limited to the glenohumeral joint, but rather requires to investigate the whole shoulder complex, including thoracic spine, scapular characteristics and overall muscular balance. The non-relation of hypovascularity was addressed by various authors as well (McKim, 1998).

**HOAC II**

16 swimmers of the A-team were assessed. The HOACs were formulated using recommendations of external experts and review of literature. The results described do not refer to a verified diagnosis, but rather an indication for the presence of symptoms related to the pathology described.

**Interviews and questionnaires**

Data extrapolation from the interviews showed the following major points:
- communication between therapists, coach and swimmers needs to be improved (Roethke, Reinicke)
- the coach is depending on the self-efficace feedback of the swimmer regarding injury (Reinicke)
- exercises need to be well-described (Stoel, Lambalk)
- prevention is considered important (Roethke, Reinicke, Keller)
- there is a lack of awareness about injury prevention (Keller, Reinicke, Stoel)
- there is a possibility to invest more time in prevention of coach (Reinicke)
- an exercise that is not well-understood by the swimmer won't be performed properly (Keller)
- an important aspect is the explanation that focus lies not on strength and endurance in the prevention exercises but awareness and correct execution (Stoel)
- swimmers have the tendency to place success over health (Questionnaires)

5. Manual:
  → For trainer (anatomical knowledge, purpose of exercise, what to focus on, reps sets)
  → For swimmers (how to check each other, what to do, how not to compensate, where it should be felt)
  → For therapist (Evidence background, theoretical approach)

Difficulties:
- NZA didn't want to hand out training program
  - No full-time possibilities for PT
  - A not well documented research field (Elite swimmers)
  - “Language barrier” (How to make different age groups understand the exercises)

6. Systematic review
Difficulties:
- A not well documented research field (Elite swimmers)

Step 5

As for a sustainable implementation, the researchers proposed a buddy model to the SV Limmat Sharks. The basic idea is to have older swimmers instructing younger swimmers in the execution of exercises. By providing such a system, the respect and authority of the older swimmers might contribute to a stronger, more sustainable implementation of exercises, raising both awareness and motivation of the younger swimmers. A second implementation recommendation was a stronger cooperation with Schulthess Clinic, Zurich and Movemed, Zurich. Both practices worked with swimmers previously and its therapists showed interest in the prevention work. An appropriate instruction into machine-usage in a gymnasium and basic assessment possibilities were thought to be relevant. Facilitation and technical assistance were methods applied in this intervention (Bartholomew, 2006). Theories used were theories of social norms theory (Minkler & Wallenstein, 1997a), social support (Gottlieb, 1985) and organizational development theory (Bowditch & Buono, 1994).

Step 6

A feedback form was handed out for the presentation.

The overall project is graded by the HvA Amsterdam.

As to the application of intervention mapping to a physiotherapy intervention, it must be stated that a strong advantage was the emphasis on selection of theory and method. For instance, this required the researchers to analyze the health situation properly, using PRECEDE-models (Bartholomew, 2006) and HOACs for the swimmers. A systematic recording of results allows further researchers a comprehensive and transparent access to the data gained. Various interventions lack these data (O'Donnell, 2005, Maher, 1994, Hergenroeder, 1998) or are case reports (Bridge, 1998). Additionally, most exercise programs lack precise description of execution of exercises. Furthermore, most exercise programs focus on rehabilitation procedures (McMullen et al., 2000, Decker et al., 1999). The publicly available training programs of elite swim teams focused not on prevention but rather strength and endurance (Newton et al., 2002). Because of the projects focus on primary prevention this presented another challenge. Therefore, the approach of finding most appropriate exercises from studies (Decker et al., 1999, Cools et al., 2000) and practical approaches (Roethke, 2009, Stoel, 2010) seemed adequate. However, it is in the belief of the researchers that there is no best choice available at this point in time because of the lack of evidence of causation of injury. It is considered an advantage of the current research project to have produced a transparent and clear result allowing further development in the field. However, a model adapted from mainly psychological studies into the field of physiotherapy might also cause loss of quality and incorrect application of approaches. E.g. the needs-assessment demanded not only a behavioural analysis but also an insight into anatomical findings and causative agents regarding the injury. Using systematical approaches to unclear aspects was considered another strength of this project. There was, however another challenge in terms of competitive management of knowledge. Advanced institutions, such as the nederlandse zweminstituut Amsterdam, run a policy of withholding data acquired over injury prevention in order to maintain a competitive advantage.

As for the assessment regarding causative agents, it was based on hypothetical constructs. The researchers gathered literature the pathologies related to swimming, as well as the best screening tests available (McMaster,
However, the identification of a tendency towards a certain condition remained hypothetical, and therefore the outcomes were read as indications of a possibility of the presence of a pathology. However, by composing a systematic assessment procedure, further evaluation and refinement is possible. The results of the assessment were conclusive too, since more acute pathologies, such as biceps tendinopathy (0%), were lower than more subtle conditions such as scapular dyskinesia (70%).

The exercise program constituted the core of the intervention. A positive indication of the research was that projects of comparable size, focusing solely on aspects of the present study, showed similar results for the field-of-interest, compare exercises for scapular control (Bernau & Munzenbrock, 2008). In order to allow personal-independent application of prevention strategies, the format of a document was chosen. However, due to the time of the project and the researchers capacities, no pilot study was possible. This would in any case require a cohort study (Hartingsveld, 2009). Since the implementation of the project will be an ongoing process, an evaluation of it remains at this point difficult. However, the positive attitude of swimmers, therapists and coaching seemed promising. Very practical aspects, such as the new coach-assistant that will be instructed by the researchers in the prevention program might contribute to a lasting effect of the project.

The systematic review is a contribution to the scientific body of knowledge. It might be an effective output to list the hypotheses elaborated so far to allow an effective composition of a laboratory study to investigate the hypotheses. The multifactorial and reciprocal characteristics of shoulder pathologies remain a challenge for prevention and rehabilitation.

Limitations of the research must be taken into consideration. Several applications for financial support were not accepted (Movemed foundation, ESP support), thus money constituted a factor limiting the research. The stay in Zurich was limited to a week due to this reason, as well as assessment and exercise tools had to be reduced to a minimum. The relatively short time-span of 3 months allowed only a coverage of selected aspects of both investigation and intervention. According to experts working in the field for several years, the choices made were appropriate and constructive (Stoel, 2010, Lambalk, 2010). Even though the thorough formation of a workgroup including several experts, their time and resources were all shared with the researchers voluntarily. A financed collaboration might have shown more extensive results.

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Appendix 2 Interviews

**Kilianm, Swimmer, SV Limmat Zurich (A-team):**

*Do you have any injuries? any in the team? What do you think could be done about it?*

– Selbst keine Schulterprobleme

– Frauen mit Verletzungen, viel Delfinschwimmen, kein krafttraining, Instbailitaet (wenig Landtraining)

– mit Schwimmanfang stabilisierende Uebungen an Land
  Rumpfuebungen anfaengliho hne Geraete

– jedes Jahr checkup generell nicht nur

*Do you think it would be good to receive more info on the anatomy and injuries of the shoulder?*

– “More infos always good” - anatomy, problems less severe when you know what may happen

– In early years you dont think about injuries

– presentation wasn nice, successful swimmers should forward info

*What is done now to prevent inuries, What could be improved?*

– dryland exercises without being too specific on shoulder

– women need special attention, theraband exercises good

– dirk corrects exercises

– exercises are taken sersiously

– injured swimmers think prevention is more important

– what we presented was good

– coach needs good eduction for exercises
– stretching, warm up, specific exercises for shoulder when at risk

– 15 years beginning of strength training with machines → too dangerous

*What do you know about the first signs of injuries?*

– martina explained a lot

– is well able to estimate own body condition

– all team needs more info

– he himself he is satisfied

– muscle tension, no joint pain

– wants more info

*What do you think of preventive training?*

– 80% get shoulder problems

– impinging structures at night

– in other countries coaches are more authoritative

– in switzerland prevention in swimming clubs important
Interview with head coach

Description of Tasks (of Head Coach):

Practices and Tournaments of the A-team

- Present at all possible practices and tournaments
- Managing the daily Program (practice)
- Planning of competitions and Activities
- Signing up for competitions
- Travel arrangements (where to go, prices)

Responsibilities in the National swimming federation:

- “Tell them what we (the swimming club) think the should do” “cuz they have their own ideas and so do we, they are not the professionals and we are” “The coaches of the best swimmers are more prepared to do this”
- Get things right for the best swimmers in Switzerland
- Is requested by the federation to coach during certain competitions (Not the head coach, for they specifically don’t want that.)

Responsibilities within the club:

- general planning of the direction we want to go
- In charge of the whole coaching staff (tells them what he thinks should be done with the swimmers
- Install a system where the club can be self sustainable by producing their own swimmers (“don’t wait for the talent to drop in from somewhere else”)
- Gives coaches their own responsibilities, thus giving them guidelines in which they can work in/with, important that they develop their own procedure
- Frequent coach meetings to discuss things that come up and organizational things that come up (who is at what competition, who’s taking care of the team and what that involves, vacation planning)
- Member of the board of the club (technical director)
- Responsible for the wellbeing of the club (Financially, if something goes wrong in this aspect I am held responsible, but unlikely)

How many coaches are there?

- 2 contracted coaches (paid fixed monthly sum, not by hour, responsibilities can vary according to the time of season, time worked can be more or less then what is stated in the contract)
- 5 or 6 coaches paid by the hour, not much responsibilities
Description of the training groups

- Swim school (two years old), Just getting kids swimming, no sports background, (3 levels that need to be completed, swiss way is usually 7 or 8 or 11 (cant even swim after this), so there are trying to cut that down)
- Usually not ready to go into normal training group after school so there is a transition group (keep learning strokes and swimming, (called wier groupen??) this is part of the club (swim school is not)
- C group is a split group. Normal C group swims competitions, leisure C group for kids who just want to swim and be trained
- B group is a preparation group (for a group) for performance sports, education of swimmers and parents, start training 4-6 times a week
- A group (goal is to finish in the national finals and maybe international)
- Two levels between the C to B and the B to A to get swimmers to swim in both groups so the step over from one to the other is not a shock. Its kinda worked so far, works well in C to B but not for the B to A group

What do you mean by its not working from the B to A group?

- The swimmers from the B have not yet arrived in the A group, (Speed wise?) uuuhh yeah, we had them for 1.5 years and they still have not made it to the A group, probably personal problems and not structural problem.
- I have had other swimmers make it up from B to A but they made the step in one shot, thus not using the in between step, because it was not in use then

Can you concretely describe the education of the parents when the kids are in the B group?

- It starts already in the C group
- Process of Clearing up what it means to be in a sport
- Parents are requested to give their support, cause if they don’t do it the kids wont do it.
- Tell the parents what is needed for the kids to succeed in terms of practice participation, competition participation, practice camp participation
- Swiss take vacations in the summer, but if a kid is 13 he cannot stay at home and swim, compromises have to be made, thus education is needed so parents can accept this.

How do you communicate with the parents?

- Its not my job, the coaches of the younger teams take care of this, for my swimmers I expect this is clear, the rule is that if possible all swimmers must be at the swimming camps and if not they train at “home”.
- In the younger groups there is information given out by the coaches by meeting or thru email, the parents are usually at practice and competitions, so there is a lot of communication with them, sometimes to much for the coaches (20 kids = 40 parents asking questions)
- Swiss don’t understand the system of competitive sports so it takes a lot of time and questions before the completely understand it.
Is there a medical checkup for kids that have been seen fit for competitive swimming?

- That’s not at all compulsory in Switzerland
- This is not done in the club, I do want to make that the case
- The national team members do that automatically, and the team pays for it.
- Club members that get this done have to pay for it themselves
- The club does not have the means to pay for all swimmers
- Most of the club’s swimmers get their yearly checkup anyway
- Will strongly suggest in the future that the A and B group will get this done, (F 160 is the cost, the club members get F20 off when going to MoveMed)
- Wants to get insurance to pay for these checkups

In your opinion, what should a screening like this include?

- check for physical ability to do high performance sports so: heart condition must be checked, body posture and so on,
- if possible check how the body reacts during performance to see if they are able to sustain high level load
- Special checkup for the shoulder girdle to see if they are prone for injuries later on. This is a big problem in Switzerland
- Don’t know if this will help, but he educates as much as possible, but problems seem to persist maybe cuz it was ignored, thinks he could have pushed more/said it more often

Part two

So you think shoulder injuries are a big part of your team/sport:

- it is called the swimmers shoulder, so it should be
- 2 guys with problems, last year 3 girls with problems Susanne before that, and the 2 how stumbled in to the team without prior sport history, able swimmers but could not take the load mentally or physically in an early stage (more then 4K a day), this is sub pro level but its probably my fault cuz I didn’t take into account that they did not have any prior training before
- The workload increased fast, and they could not discern having a problem and not having a problem, so a step back was not taken
- I have gotten much more aware of this, two younger guys at the training camp swam 11k instead of the normal 16k a day (thijs.)
- Thijs, trains only 5 times a week, only 20k a week instead of 60-90k, didn’t make sense to quadruple the work load in one shot. We more then doubled it, they wanted to do more but I held them back, by the end of the week they stopped themselves cuz they were so tired.
- For me it takes some control, cuz I want them to swim and perform.
- but for them it also takes control cuz they need to what to say and control themselves. (Does it hurt cuz I am swimming more, or does it hurt cuz something’s not right
How do you see, as a coach, that they do well with the increased load?

- They have to tell me, I now really ask them if they feel right or not, if you have a problem tell me.
- Is not aware if everyone tells him everything
- Should be aware now that they have examples of what can go wrong
- I tend to forget these things cuz I have 20 swimmers and if 7 of them say something about their shoulder, then I tend to forget 2 or 3 of them.
- They have to take care of themselves, they know that they have to hold back for a couple days if problems occur
- Some swimmers might not give themselves enough rest because they want to perform as well
- I ask a lot more now, even to the point where the might get annoyed
- If there is any question do less and not more in order not to run into any risks due to lack of pressure atm (martine)

A second risk factor is that they do not tell when they don’t have a problem and it turns out to be severe. (that’s what we had)

It’s the swimmers responsibility and you tend to ask more, but in this process do you think there are aspects to be improved?

- I don’t know if I can see anything, I could learn to see who would be prone to injury.
- Basically I think the most important things are; and independent check up, in case of problems that they don’t want to tell me so they might be excluded from the training camp etc.
- Its up to the swimmer, I cant see if it hurts or not, I can only see if performance drops, or if stroke deteriorates so bad that they cant do it anymore (this doesn’t happen)
- What does happen a lot, is during backstroke swimming that they don’t do the full stretch with both arms. Don’t know if it’s a problem in the shoulder

Did you ask them?

- They say its hard
- I ask them to do it right, they try, but they fall back, they don’t say it hurts
- If you don’t have problems you should be able to do it like that.
- Mentions that martine does it. The guys who don’t have problems cant do it either

When this is done, do you say do it straight, or do you ask why they do it like that

- Usually I tell them to stretch out, sometimes I ask why they do it like that, they are not paying attention and they say its easier to do it like that.
Are there other risk factors that you see with people developing problems?

- If they have an accident and the shoulder is involved, but we don’t see that often
- Well the thing I know (it is said by other people and I know from experience) is if you do proper workout in the weightlifting room, problems in the shoulder are less frequent
- Weight training is done independently so I cannot control if they are doing it or not. I think they should be able to do the training on their own, cuz its not so difficult, they should be able to do it right,
- I always did my exercises in the full range of motion without any problems, even with a lot of force. It is important in swimming to do that, but it could cause problems due to this force, the guys should be ready for this.
- When starting the weight program I start slowly to get a base, works out well in most cases.
- We agreed to start on weights and they didn’t do it, I didn’t know about that, when I knew it was late in the season, and that’s when some got into trouble.
- Since she is doing it frequently she is better again, seems to prove the common knowledge

How come you didn’t find out till late in the season?

- They didn’t tell me
- Went with them to the weight room, explained everything (how, sets, etc), they started doing it and slowly quit, to much work or trouble at school
- No control system
- Wants to get them to right down everything they have done, but still isn’t full proof

How did you instruct them for the weight training?

- Verbal instruction
- had them do it, corrected it
- Told them what to look for
- Told them to right it down

How many exercises do they do?

- Varies a bit
- Those who just start they do more, not a lot of weight so its easy.
- Generally they do 5-6 for arms and shoulders, 3-4 for legs and 2-4 for core stability
- We do core body work before and after practice
- Sometimes they do weights and then again they do before and after practice they do some exercises
Is this similar to what we saw at practice this week?

- this week you didn’t see much of the power workout we do
- usually its push ups backwards and forwards about 4 times a week
- the other 2 times we do jumps or running
- We always do core body work at each practice
- Little amount of stretching, in my opinion is not enough, a lot of people who are not flexible enough. Takes force to get into the proper position.
- For Stroke or push off, if you cannot get into a straight line you can never push of in a straight line

Can you distinguish who are and are not flexible?

- Yes

Do you give stretching to everyone?

- I talk to everyone who has limitations that are bad to swimming and tell them to do the respective exercises more to get better in that aspect, and they obviously have to do that more then the others.
- I give these exercises as homework, but so far it has not been as successful as I thought it would be.

Restrictions means that they are acutely having problems?

- no, they are not flexible, it doesn’t hurt, but they are not able to do it.
- Few guys are not flexible enough to fly a proper fly technique, or to reach out in a straight line
- When the swimmers get massaged the physio say that they are pretty tense, so I tell them to get massage properly once a week, but that is tough on the time management, and the club cannot pay for it.
- There is someone at the club massaging but she cannot cope with all the swimmers, would have to be in everyday, she does give us a special price but its still not enough.

What if the swimmers had enough knowledge to massage eachother?

- that would be good
Would there be space for that in the training structure as it is?

- they would have to create that time, there is enough time in the weekend, it is hard during the week.
- Could have a 4 hour practice on Saturday instead of three to make space for it
- I think they would resist that a bit, but in the end they would except it.

Would you support that as a coach?

- yes

How do you estimate of your own anatomical and physiological knowledge? Do you feel confident and satisfied with it?

- no, I want to know a lot more
- I’m bad at seeing bad posture and such
- I’m also bad at seeing changes in posture and body composition, don’t even see if they gain 5 or 7 kilo’s, unless I don’t see them for a couple weeks. There is always someone in the group who will ask ”hey what happened to him?”, then I see it
- As a coach I never know enough, I will never say I know it all. The field is too broad to know it all.
- I’m good at feeling if there is a muscular problem, I can help them a bit there, but it’s not a proper physiotherapy session or massage, but that’s not my job during practice.

Do you have time in your routine to extend your knowledge or to communicate with other fields to ask specific questions? Is this realistically possible?

- it is possible, its also something I would like the club to step in a bit more.
- In general there are 2 ways of doing it, one is gathering knowledge by the coaches thru the internet, im more or less doing this constantly but not in an organized way. Would like to do this 2-4 hours a week or more to do this but I tend not to be that structure
- Second: there are professional courses, but the club has to step in on this cuz it costs lots of money. We are pretty advance in our performances so going to the swiss coaches thingy and talk to whoever is not an option cuz it is not specific enough to our level. This means I would have to go abroad to the US England or Australia. So there is a huge cost involved
Do you think there is enough communication with the therapist and doctors who are involved at looking into this field?

- Its probably not enough
- I would like to have more regular communication channels.
- Its also my fault cuz I am reluctant to call them and they don’t call me (they do sometimes)
- I dont like calling around, its not the way I function

What would help you with that?

- I certainly cannot travel around all the time, I do if it is important. But I cant do that on a daily basis, cuz there are so many things going on during the day
- The swimmers should tell me, I ask, but I cant ask everyone all the time. If there is a problem, something out of the norm, then they have to come to me.
- It would be handy if they called me to inform me, cuz I do want to be involved
- Number one it takes the swimmers to tell me when and where they will be, im not going to run that much after them
- Number two takes some willingness (which is there) of the other party to share information
- To summarize I know im bad in that and I should be more proactive

For prevention, if you had 2-3 hours weekly/monthly in between your work responsibilities to have relations with other swimming experts to extend your knowledge?

- Yes, I think it would also help me to get more educated about that.
- If I have a fixed structure that would help me a lot

How do you estimate the current prevention level in the swim club?

- hard to say, we are a lot better then we were, we work with the younger swimmers on a daily basis, they look a lot fitter then a lot of the guys I see in the same age group. They look like swimmers and never have problems.
- Only time an tell if this is working, it will take a couple years before the answers are clear

- We try to be better then that, we try to have structures in place that give very versatile physical education to the swimmers.

- In other clubs its mostly just swimming, that leads nowhere

So the training of the younger ones have training aspects that are not based on making them faster or better swimmers?

- well the training of the younger ones is not based on swimming competitions but what they could be doing in the next 5-6 years

- one thing does not exclude the other, if you train for problems that could come up at a latter time they also a lot in the way they perform

- The goal is never to perform at the age of 13 be good then, then drop out and never be seen again

Do you think it would smart to include in these training structures at a younger age exercises to prevent injury?

- YES, Strong YES

- We just do general work in that aspect, we could do more educative about that, including the coaches. I tell them that we need to do that but I don’t really control that

Do you think the other coaches would be interested (Yes) in more information(Yes) on good exercises?

- YES

- They have to be, I know they are

There is willingness to have a change of structure within the club?

- We want to get better and be the best club in Switzerland, and in Europe and the world.

- We want the best possibilities for our kids so they can realize their dreams

What is some feedback that you could give us at this point (concerning what we have done here, what you know about our project etc.)?
- I like the level of involvement you guys have, you jumped in and worked hard on that, you can tell you want to do a lot about this problem. This is very important, it’s a big subject, and you’ve got a lot to learn in the swimming of aspect, takes a lot of willingness to get involved in this.

- I don’t know to much what you did with the swimmers, you probably have come to any conclusions about that yet. I’ll wait for any results to pop up about that.

- I hope you got all the data you need, if not feel free to ask for more.

- I just hope you are at the point where you want to be, that’s important.

- I expect that you know where the problems are, and try to adjust that

- In my own personal experience I know that it takes a couple times to get the results you want cuz there are things you don’t consider so you get results that lead nowhere so you have to restart and adjust. That is just procedure.

- This is something missing in Switzerland, but I can’t change this cuz I am a coach and there is only 24 hours in a day.

- Something important for me and you guys, don’t be afraid to ask people who know more. This doesn’t mean personal failure.

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**What products do you hope to get out of the project? What do you think about what we discussed about our planned products?**

- Number one, I would like to be on the newest level of information about what could be done about shoulder problems on a preventive level/exercises. What should be done at what level, so we don’t want to start to early or to late.

- It is important to change the routine of exercises so they don’t get bored, I try to do that with what I have, but I think I could do with more new information/exercises

- A simple screening and treatment if possible “I don’t need to be an expert in that, if it takes 3 years to know that I don’t need that, if I can learn that in a couple hours that easy”. This would help, if not possible I can still rely on the experts which is not a problem. Having onsite information is important for the coach and swimmer in order to act fast and to give confidence to everybody.

- It is probably not to possible to fulfill martines wishes of “I have pain now what do I do”, that’s probably way to specific and that’s what we have the professionals for.
Concretely what does the newest level of information of injury prevention mean to you?

- What can we do and what has to be done not to run into problems later. Are there any new things you found out. Are we doing anything wrong. can we do better? What exercises can be done, how many need to be done. The more exercises the better, I will never do more then 8-10 at a time, it is probably important to change it from year to year or half year to half year. Don’t want them to get bored.

- I gave them all the information of what to do how to do it, that went good at the beginning but then they do it half heartedly and forget how its done, and I cant explain it over and over again.

Would you support that the swimmers have enough knowledge to correct each other?

- Sure I think that is very good

Would you support swimmers who have already been injured and our exercise “experts” to pass their knowledge onto the other swimmers in the group?

- I think that is important for several reasons: number one, they know how hard it is to be a coach when the others don’t listen to what they are told, it is also a type of self responsibility. Second of all they don’t have to listen to the same guy telling them everything.

- Already implies this with stroke techniques, separated the group into smaller groups and the swimmers commented on each other. Or in the instance of younger ones coming into the group the older ones would explain the stroke to them. This makes the older ones aware of the knowledge they have as well.

Some of the older swimmers are working as coaches on an hourly basis? Do they get money for this?

- yes, it is part of the club program but not the competitive club program.

Do you thin the club would be willing to pay for the older ones to teach the younger ones about shoulder exercises?

- that could be arranged, because it would be a small amount of hours (once or twice)

- don’t know if this would be a good idea or not
but they have a busy schedule and money is not an issue, they prefer not to have to receive money in order not to work, or even pay more money to not to have to work.

I do still so another problem with this, its about the recognition of competence of the coaches involved. (in what sense?) they coach would have to be informed in detail about what is going to be talked about so the coach does not seem to have a lack of knowledge about what is being explained.

*If all these points of requirements are met, then would this be possible?*

- yeah sure

*Do you think this would help the ones with problems? (help them process the injury)*

- I would hope so, it’s a different thing just to think about yourself, then to talk to it to other people in a way that they could understand, so just doing the movement is not the same as explaining to someone else who doesn’t understand it. I am sure this will bring them to a new level of understanding the exercise.

*Do you think the coach of the respective team could work together with this swimmer?*

- They have to do that! Or else it doesn’t work

- It has to be clear that the coach is in charge, competence of the coach can not be undermined.

- Coach must be present

- Coach must know what is going to be talked about so he is knowledgeable about the facts.

*Would you agree that this would increase the competence of the coach?*

- sure, outside information that goes beyond what the coaches know is always good for the knowledge tank.

*Do you think the coaches would be motivated to do this?*

- Yes, we got motivated coaches.
Susanne, Swimmer, SV Limmat Zurich (A-team)

Do you have any injuries? any in the team? What do you think could be done about it?

- Ich bin seit 3 Jahren verletzt und hatte auch zuvor schon mehrmals Schulterschmerzen.
- Es sind mehrere Schwimmer im Team die häufiger Schulterschmerzen habe, aber durch den Schmerz schwimmen. Die wenigstens gehen zum Arzt.
- 3 Schwimmer haben lang andauernde Probleme.
- Übungen, frühe Prävention (schon bei kleinen Schwimmern), Information (auch für den Coach)

Do you think it would be good to receive more info on the anatomy and injuries of the shoulder?

- ja, natürlich; durch meine Verletzung habe ich viel über die Schulters wiss nicht drüber gesprochen, aber die meisten Schwimmer wissen wenig über die Schulterschmerzen.
- Auch der Trainer hat z.T. ein mangel an Wissen.

What is done now to prevent injuries, What could be improved?

- Wir machen Übungen
- Übungen werden nicht gut
- Krafttraining muss gut Angeleitet werden
- Übungen müssen Sinn ergeben
- Übungen müssen mit den Jungen Schwimmern ausgeführt werden

What do you know about the first signs of injuries?

- Ich hatte Schmerzen in der Schulter, aber ich habe nicht drüber gesprochen, bis ich nicht mehr ohne Schmerz schwimmen konnte.
- Bin dann zum Arzt
- Bis ich verstanden habe, dass ich auf meinen Körper hören muss war einige Zeit vergangen
What do you think of preventive training?

- Auf jeden Fall hilfreich
- Muss frü begonnen werden
Appendix 3: Questionnaires

Grading form for Systematic review

Grading form for our systematic review

* Required

General assessment

Name of reviewer (optional)

How would you grade this article overall? *

1 2 3 4 5 6 7 8 9 10

Poor quality ○ ○ ○ ○ ○ ○ ○ ○ ○ Very good quality

Here you can state your overall impression of the systematic review.
Specific comments? Something you think is good? Something you think needs improvement?
This is an optional question

Introduction

How would you grade this section? *

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<tbody>
<tr>
<td>Poor quality</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>Very good quality</td>
</tr>
</tbody>
</table>

Specific comments? Something you think is good? Something you think needs improvement?
This is an optional question
Methods

How would you grade this section? *

1 2 3 4 5 6 7 8 9 10

Poor quality C C C C C C C C C Very good quality

Specific comments? Something you think is good? Something you think needs improvement?
This is an optional question

Results

How would you grade this section? *

1 2 3 4 5 6 7 8 9 10

Poor quality C C C C C C C C C Very good quality
Discussion

How would you grade this section? *

1 2 3 4 5 6 7 8 9 10

Poor quality  C  C  C  C  C  C  C  C  Very good quality

Specific comments? Something you think is good? Something you think needs improvement?
This is an optional question

Conclusion

How would you grade this section? *

1 2 3 4 5 6 7 8 9 10

Poor quality  C  C  C  C  C  C  C  C  Very good quality
# AGREE Grading form - Exercise program + Manual

* Required

## Overall information

Your family name *

<table>
<thead>
<tr>
<th>Purpose of grading *</th>
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<tbody>
<tr>
<td>Grading of Exercise program</td>
</tr>
<tr>
<td>Other</td>
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</table>

If other product: which?

## Scope and purpose

The purpose of the product is described

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Strongly agree [ ] [ ] [ ] [ ] Strongly disagree

The purpose of the product is logical

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</table>
The product fits well the targeted population

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<tbody>
<tr>
<td>Strongly agree</td>
<td>O</td>
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</table>

Development of product

The development group involved individuals from relevant professional groups

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<tbody>
<tr>
<td>Strongly agree</td>
<td>O</td>
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The targeted populations views and preferences have been sought.

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<tbody>
<tr>
<td>Strongly agree</td>
<td>O</td>
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</table>

The target users of the program are clearly defined

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<tbody>
<tr>
<td>Strongly agree</td>
<td>O</td>
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The exercise program has been piloted

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<tbody>
<tr>
<td>Strongly agree</td>
<td>O</td>
<td>O</td>
<td>O</td>
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</tbody>
</table>
Rigour of development

Systematic methods were used to search for evidence.

1 2 3 4
Strongly agree  O  O  O  O Strongly disagree

The criteria for selecting the evidence are clearly described

1 2 3 4
Strongly agree  O  O  O  O Strongly disagree

The methods for formulating the exercise program are clearly described

1 2 3 4
Strongly agree  O  O  O  O Strongly disagree

Possible difficulties have been taken into consideration formulating the exercise program

1 2 3 4
Strongly agree  O  O  O  O Strongly disagree

There is an explicit link between the exercises given and the supporting evidence

1 2 3 4
Strongly agree  O  O  O  O Strongly disagree

The exercise program has been externally reviewed by experts prior to its publication

1 2 3 4
A procedure for updating/improving the exercise program is provided

1 2 3 4

Strongly agree ☐ ☐ ☐ ☐ Strongly disagree

Clarity and presentation

The exercises are specific and unambiguous

1 2 3 4

Strongly agree ☐ ☐ ☐ ☐ Strongly disagree

The exercise program is supported with tools for application

1 2 3 4

Strongly agree ☐ ☐ ☐ ☐ Strongly disagree

Applicability

The potential organisational barriers of applying the exercises have been taken into consideration

Are these exercises doable under the given circumstances?

1 2 3 4

Strongly agree ☐ ☐ ☐ ☐ Strongly disagree
Cost of applying exercises has been considered

1 2 3 4
Strongly agree ☐ ☐ ☐ ☐ Strongly disagree

The exercise program presents ways of assessing quality of exercise execution

1 2 3 4
Strongly agree ☐ ☐ ☐ ☐ Strongly disagree

Editorial independence

The development of exercises has been executed in an independent way

1 2 3 4
Strongly agree ☐ ☐ ☐ ☐ Strongly disagree

Overall grade

Overall impression

1 2 3 4 5 6 7 8 9 10
Very poor performance ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ Very good performance
Schulterpräventions-Fragebogen

Lieber/Schwimmfreund,
Vielen Dank, dass Du Dir die Zeit nimmt, für unsere Befragung. Wir haben den Kurskurs-Förders in warmen Erinnerung, und haben die Zeit in Zürich sehr genossen. Danke an Esch auch dafür!

Wir wünschen Euch eine schöne Adventszeit, und hoffen, bald von Euch zu hören!

Der Fragebogen besteht aus 3 Teilen. Einige Fragen sind obligatorisch, andere optional. Vielen Dank im Voraus für das Durchführen dieser Befragung! Wir schätzen die Gesamtzeit auf 15 Minuten ein!

Die Informationen werden vertraulich behandelt, und weder an den Trainer noch an Dritte weitergegeben.

Alles Liebe,
Mike, Kim, Kai

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Schulterpräventions-Fragebogen

* Notwendig

Allgemeine Infos und Informationen über das Schwimmen

Vorname

Name

Wie alt bist Du? (als Zahl) *

Bist Du männlich oder weiblich? *
- männlich
- weiblich
Arbeitstest: Du in einem Bereich, in dem Du viele Überraschungen ausführst?
- Ja
- Nein

Beschreibung (optional)

Arbeitstest: Du in einem Bereich, in dem Du eine hohe körperliche Belastung hast?
- Ja
- Nein

Beschreibung (optional)
Schwimmspezifisch (Training, Schwimmerfahrtung)

Wie viel km schwimst du pro Woche? (ungefähr)
- 5-10km
- >10km

Wie oft trainierst Du pro Woche?
- 2-4x

Wie viele Jahre schwimmen Sie schon (in einem Schwimmverein)?
- Weniger als 1 Jahr
- 1-3 Jahre
- 4-6 Jahre
- 7-9 Jahre
- 10-12 Jahre
- 13-15 Jahre
- 16 Jahre oder älter

Auf welchem Wettbewerb LEVEL sind Sie in der letzten Saison geschwommen?
- Regionale Wettkämpfe
- Deutsche Meisterschaften
- Internationale Wettkämpfe

Was für ein Niveau hast Du zum Ziel?
- Regionale Wettkämpfe
- Deutsche Meisterschaften
- Internationale Wettkämpfe
Stimmt Du der Aussage zu, dass ohne Schmerz kein Erfolg möglicher ist? (No pain, no gain)*

- Ja
- Nein

Bist Du bereit, für sportlichen Erfolg gesundheitliche Einschränkungen in Kauf zu nehmen? (optional)*

- Ja
- Nein

Hast Du Vorbilder für den Leistungssport Schwimmen?

- Ja
- Nein

Wenn ja, welche?
Wie bewertest Du die Kommunikation zwischen Schwimmern und Trainer? 

1 2 3 4 5 6 7 8 9 10

Sehr unzufrieden  ● ● ● ● ● ● ● ● ● ● Sehr gut

Gründe? (optional)


Machst Du Dir Sorgen, Schulterprobleme zu haben oder zu bekommen? *

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<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ich mache mir überhaupt keine Sorgen</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
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</table>

Hattest Du schon mal Schulterbeschwerden in Verbindung mit Schwimmen? (Falls Du diese Frage mit "Nein" oder "Weiss nicht so genau" beantwortet, überspringe bitte die restlichen Fragen des Abschnitts "Erfahrung mit Schulterverletzung") *

- Ja
- Nein
- Weiß nicht so genau

Wann war das letzte Mal, dass Du mit Schulterbeschwerden zu tun hattest?

- Vor mehr als 2 Jahren
- Vor 1-2 Jahren
- Diese Saison
- Diesen Monat
- Diese Woche
- Heute

Auf einer Skala von 0 - 10, wie intensiv hast Du die Schulterbeschwerden empfunden? (im Hinblick auf Schmerzen, Belastung im Alltag)

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</thead>
<tbody>
<tr>
<td>Gar nicht gravierend</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
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Auf einer Skala von 0 - 10, als wie frustrierend hast Du die Verletzung empfunden?

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<tbody>
<tr>
<td>Gar nicht frustrierend</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
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Hat es Deinen Trainingsrhythmus erheblich beeinträchtigt?

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<tbody>
<tr>
<td>Gar nicht beeinträchtigt</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
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</table>
Hast Du an Wettkämpfen gar nicht oder eingeschränkt teilnehmen können?

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<th>10</th>
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<tbody>
<tr>
<td>Trifft gar nicht zu</td>
<td>🇩🇪</td>
<td>🇩🇪</td>
<td>🇩🇪</td>
<td>🇩🇪</td>
<td>🇩🇪</td>
<td>🇩🇪</td>
<td>🇩🇪</td>
<td>🇩🇪</td>
<td>🇩🇪</td>
</tr>
<tr>
<td>Trifft sehr stark zu</td>
<td></td>
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</table>

Wie sehr hast Du Dich von der Verletzung erholt?

- Ich schwimme besser als vorher
- Ich schwimme auf dem selben Niveau
- Ich habe Leistungsdefizite
- Habe immer noch Beschwerden

Bist Du wegen der Beschwerden beim Arzt gewesen?

- Ja
- Nein

Wie hilfreich fandest Du das?

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<tr>
<td>Gar nicht hilfreich</td>
<td>🇩🇪</td>
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<td>🇩🇪</td>
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<td>🇩🇪</td>
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<tr>
<td>Sehr hilfreich</td>
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Bist Du wegen der Beschwerden beim Physiotherapeuten gewesen?

- Ja
- Nein

Bist Du wegen der Beschwerden beim Physiotherapeuten gewesen?

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<tr>
<td>Gar nicht hilfreich</td>
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<td>🇩🇪</td>
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<td>🇩🇪</td>
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<td>Sehr hilfreich</td>
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Wie hilfreich fandest Du das?

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<td>Gar nicht hilfreich</td>
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<td>Sehr hilfreich</td>
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Bist Du operiert worden aufgrund von Schulterbeschwerden?

- Ja
- Nein

Wie oft hastest oder hast Du Schulterschmerzen, die Du als ungesund beschreiben würdest?

- Taglich
- Wochentlich
- Monatlich
- Mehrmals pro Saison
- Sehr selten (einmalig in verschiedenen Saisons)
- War genau einmal

Hältst Du Übungen speziell gegen Schulterprobleme für sinnvoll? *

- Ja
- Nein

Gruende? (optional)

Wie motiviert bist Du, Präventionsübungen für Schulterverletzungen während des Trainings zu machen? *

1 2 3 4 5 6 7 8 9 10

Ganz nicht motiviert 1 2 3 4 5 6 7 8 9 10 Sehr motiviert
Feedback und Anregungen

Inklusive feedback präsentation (2 Fragen)

Auf einer Skala von 0 bis 10, wie wichtig schätzt Du aktive Vorbeugung von Schulterverletzungen ein?

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<th>10</th>
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</thead>
<tbody>
<tr>
<td>Sehr unwichtig</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Sehr wichtig</td>
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Empfandest Du die Präsentation über Schulterverletzungen im Schwimmsport (04.12.) als hilfreich?

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<th>10</th>
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<tr>
<td>Gar nicht hilfreich</td>
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<td></td>
<td>Sehr hilfreich</td>
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Was hat Dir an der Präsentation gefallen?

- Information über Verletzungsarten
- Information über "unseren" Projektverlauf
- Anatomische Kenntnisse
- Kontakt mit Physiotherapeuten
- Möglichkeit, eigene Ideen einzubringen?
- Other: [ ]

Was hättest Du Dir noch gewünscht? Was findest Du verbesserungswürdig?
Hast Du an der Gruppendiskussion (05.12., Samstag Früstraining)) zum Thema Schulterverletzung teilgenommen?
- Ja
- Nein

Empfandest Du eine solche Diskussion als sinnvoll?
- Ja
- Nein

Kannst Du Deine Meinung kurz begründen? (optional)

Darüber hinaus Anmerkungen, Kritik und Vorschläge? (optional)
Appendix 4: Exercise Programs

The exercise programs developed can be found on the included DVD in the folder “Exercise Programs”