# EFFECT OF DIFFERENT METHODS OF PHYSICAL THERAPY FOR THE RESTORATION OF IMPAIRED SHOULDER JOINT FUNCTIONS AND AUTONOMY

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***Annotation***

*The current article presents the effect of different methods of physical therapy for the restoration of impaired shoulder joint functions as well as autonomy. 1 male and 7 females (average age – 54.5±12.4 m) participated in the survey; four of them having the syndrome of the shoulder impingement syndrome and four with aII stage of the rheumatoid arthritis. Participants were divided into 4 experimental groups.* ***IMPA$^{SIS}$ group*** *– (N=2) – patients with the shoulder impingement syndrome,* ***IIMPA$^{RA}$ group*** *– (N=2) – patients with a II stage of the rheumatoid arthritis; immobilisation of the shoulder join was applied to these groups as well as post-isometric relaxation and active physical therapy exercises.* ***IIIPP$^{SIS}$ group*** *– (N=2) – patients with the shoulder impingement syndrome,* ***IVPP$^{RA}$ group*** *– (N=2) – patients with aII stage of the rheumatoid arthritis; proprioceptive neuromuscular facilitation (PNF) method was applied for those patients as well as the passive stretching. Individual work was applied for all participants of the survey with 12 meetings with a 30 minutes duration offered to each of them.*

***Key words:*** *joint immobilisation, PNF, shoulder impingement syndrome, rheumatoid arthritis.*

**Relevance of the topic**

Spread of the rheumatoid arthritis (RA) in the western countries is 0.5-1 percent of popular; it was defined that females tend to have this disease twice more often if compared to men (Žebrauskaitė, 2014). Over than one half of seniors in the United States of America (USA) experience joint pain and 21 percent of adult citizens of the US are diagnosed with arthritis (The Ministry of Health, 2013). Spread of RA in Lithuania reaches 0.55 percent of adults; RA is diagnosed to 0.3-1 percent of adults (Lithuanian Association of Rheumatology, 2014). According to L. Bayam et al. (2011) frequency of shoulder joint impairment within the human population varies from 7 to 36 percent. According to C. Braun et al. (2013), the most often shoulder joint impairments appear due to the pain that can be caused by pathology of different structures; pain and function impairment have a tight link. It was defined that a proprioceptive neuromuscular facilitation (PNF), stretching exercises, mobilisation are effective pain-reducing as well as function-improving aids (Braun et al., 2013; Lee et al., 2013). According to I. Düzgün et al. (2012), mobilisation has a positive effect upon improving the shoulder joint mobility and reducing the pain together increasing the muscular power. There is a sufficient amount of evidence, proving that mobilisation of joints and PNF effectively treat shoulder joint and respective muscular impairments. Implemented surveys confirm the premise that these procedures increase the amplitude of movement, reduce pain and improve muscular activity (Babu et al., 2013; Dajah, 2014; Dudonienė et al., 2012; Kisieliūtė, 2013; Mahendran, Chetia, 2013; Manske et al., 2012; Sharaf et al., 2013; Taragi et al., 2014).

No experiments were found that would compare such combination of methods. PNF method is matched with a passive starching and the shoulder mobilisation is matched with post-isometric relaxation as well as active physical therapy exercises. The end the survey shall define what combination of methods mentioned is the most effective upon the shoulder impingement syndrome and rheumatoid arthritis.

**Aim of the survey** is to assess the effect of different methods of physical therapy for the restoration of impaired shoulder joint functions and autonomy.

**Object of the survey** – changes in autonomy of the impaired shoulder joint functions after application of different Physical therapy methods.

**Methods of the survey and respondents**

Patients, corresponding to the following selection criterions, participated in the survey:

1. II stage of rheumatoid arthritis (RA) (reduced amplitude of movements, pain in the shoulder joint);
2. Shoulder impingement syndrome (SIS);
3. Subacute period of RA and SIS;
4. Age of respondents – 40-70 years.

1 male and 7 females (average age – 54.5±12.4 m) participated in the survey; four of them having the syndrome of the shoulder impingement syndrome and four with a II stage of the rheumatoid arthritis. Participants were divided into 4 experimental groups. **IMPA$^{SIS}$ group** – (N=2) – patients with the shoulder impingement syndrome, **IIMPA$^{RA}$ group** – (N=2) – patients with a II stage of the rheumatoid arthritis; immobilisation of the shoulder join was applied to these groups as well as post-isometric relaxation and active physical therapy exercises. **IIIPP$^{SIS}$ group** – (N=2) – patients with the shoulder impingement syndrome, **IVPP$^{RA}$ group** – (N=2) – patients with a II stage of the rheumatoid arthritis; proprioceptive neuromuscular facilitation (PNF) method was applied for those patients as well as the passive stretching. Individual work was applied for all participants of the survey with 12 meetings with a 30 minutes duration offered to each of them.

Increase of amplitude of the protraction movement was implemented with I-II grade joint surface protraction and I-III grade slide towards inferior from the freest bending position. Upon the limited interior upper arm rotation, I-II grade joint surface protraction and I-III grade slide towards posterior from the neutral interior upper arm rotation position were implemented. Post-isometric relaxation was applied to the upper arm stretchers, rotators towards interior and exterior. According to R. Kesminas (2006), active exercise was applied (stretching, amplitude, pendulous). PNF method and the passive stretching were applied to **IIIPP$^{SIS}$** and **IVPP$^{RA}$** groups. According to Z. Gültekin et al. (2006) and N. Nakra et al. (2013) as well as implemented surveys, all movements were done from the furthest towards the closest part of the limb.6 PNF movement models were used and they were repeated 10 times. Testing was implemented at the beginning of the survey and was repeated at its end; the gained results were compared.

**Movement amplitude assessment**

At the beginning and end of the survey, goniometer measured movement amplitudes of the shoulder joint bending, stretching, protraction, horizontal protraction and retraction as well as internal and external rotation.

**Pain intensity assessment**

Application of the digital analogue scale (DAS). The main ruler from 0 to 10 was applied to assess the shoulder joint pain upon the upper arm stretching, bending, hyperextension, protraction, retraction, internal and external rotation.

**Autonomy assessment**

Autonomy in everyday activities was assessed by aids of the Oxford questionnaire (OQ).

**Muscular power assessment**

Lovett scale was applied for the assessment of the muscular power of upper arm rotators inwards and outwards as well as stretchers, retractors and protractors.

**Results of the survey**

Picture 1 (Pic.1) presents changes of the active movement amplitudes (MA) in the shoulder joint prior physical therapy and after 4 weeks of physical therapy (PT).

**Comparing IMPA$^{SIS}$ and IIMPA$^{RA}$ groups:** at the beginning of the survey the MA average in IIMPA$^{RA}$ group was 46$^{o}$ bigger and significantly higher ($p < 0.05$) in compared to IMPA$^{SIS}$ group. After PT, MA averages between IMPA$^{SIS}$ and IIMPA$^{RA}$ groups weren't significantly different (p=0.09), but 14$^{o}$ higher change was in IMPA$^{SIS}$ group. **Comparing IIIPP$^{SIS}$ and IVPP$^{RA}$ groups:** prior PT, MA average in IVPP$^{RA}$ group was 22,5$^{o}$ bigger, but wasn't significantly different (p=0.22) from MA average in IIIPP$^{SIS}$ group. At the end of treatment MA averages between IIIPP$^{SIS}$ and IVPP$^{RA}$ groups weren't significantly different (p=0.12), but 15$^{o}$ higher change was observed in IVPP$^{RA}$ group.

**Comparing IMPA$^{SIS}$ and IIIPP$^{SIS}$ groups:** prior PT, MA average in IIIPP$^{SIS}$ group was 41$^{o}$ bigger, but wasn't significantly different (p=0.06) from the average in IMPA$^{SIS}$ group. At the end of the survey MA averages between IMPA$^{SIS}$ and IIIPP$^{SIS}$ groups weren't significantly different (p=0.96), but 51$^{o}$ higher change was observed in IMPA$^{SIS}$ group. **Comparing IIMPA$^{RA}$ and IVPP$^{RA}$ groups:** prior PT, MA average in IVPP$^{RA}$ group was 17,5$^{o}$ bigger, but wasn't significantly different (p=0.39) from MA average in IIMPA$^{RA}$ group. After PT, MA of both groups increased by 22$^{o}$ each. Comparing separate groups prior and after PT in all groups. MA significantly increased ($p < 0.05$).

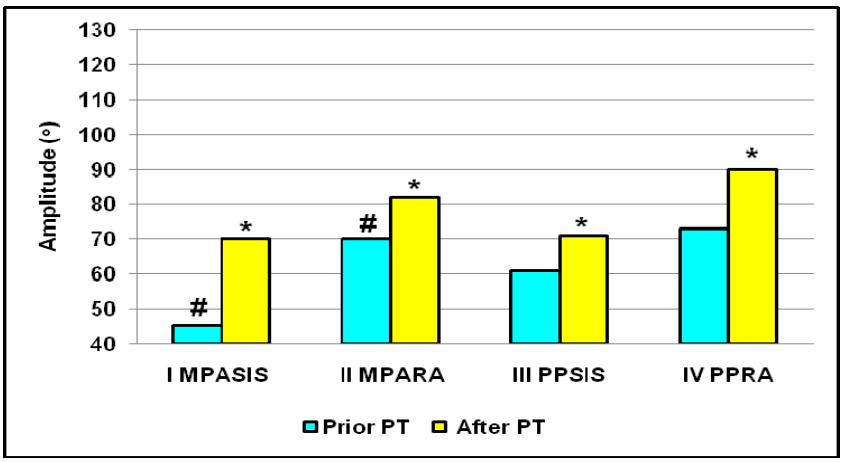


Fig. 1. Amplitude changes of active upper arm movements prior and after physical therapy (°)

**Note:** *p < 0,05 – in groups prior and after PT, #p < 0,05 – between IMPA$^{SIS}$ and IIMPA$^{RA}$ groups**.** For **IMPA$^{SIS}$** – for patients with shoulder impingement syndrome, **IIMPA$^{RA}$** – for patients with rheumatoid arthritis – joint mobilisation, post-isometric relaxation and active exercises were applied; for **IIIPP$^{SIS}$** – for patients with shoulder impingement syndrome, **IVPP$^{RA}$** – for patients with rheumatoid arthritis – PNF methods and a passive stretching were applied.

Picture (Pic. 2) presents changes of the passive movement amplitude (PMA) in the shoulder joint prior and after 4 weeks of physical therapy (PT).

**Comparing IMPA$^{SIS}$ and IIMPA$^{RA}$ groups:** prior PT, average of passive MA in IIMPA$^{RA}$ group was 25$^{o}$ bigger, but wasn't significantly different (p=0.06) from the passive MA average in IMPA$^{SIS}$ group. At the end of the survey, averages of PMA between IMPA$^{SIS}$ and IIMPA$^{RA}$ groups weren't significantly different (p=0.09), but 10.5$^{o}$ higher change was observed in IMPA$^{SIS}$ group. **Comparing IIIPP$^{SIS}$ and IVPP$^{RA}$ groups:** prior PT, average of passive MA in IVPP$^{RA}$ group was 16.7$^{o}$ bigger, but wasn't significantly different (p=0.24) from the average in IIIPP$^{SIS}$ group. At the end of the survey, averages of PMA between IIIPP$^{SIS}$ and IVPP$^{RA}$ groups weren't significantly different (p=0.12), but 1.3$^{o}$ higher change was observed in IIIPP$^{SIS}$ group. Groups with a lower primary mobility were identified a higher change; a premise can be offered that in case of a smaller primary amplitude, patients have greater possibilities.

**Comparing IMPA$^{SIS}$ and IIIPP$^{SIS}$ groups:** prior PT, average of passive MA in IIIPP$^{SIS}$ group was 11.9$^{o}$ bigger, but wasn't significantly different (p=0.08) from the average PMA in IMPA$^{SIS}$ group. At the end of the survey, averages of PMA between IMPA$^{SIS}$ and IIIPP$^{SIS}$ groups weren't significantly different (p=0.53), but 8,2$^{o}$ higher change was observed in IMPA$^{SIS}$ group. **Comparing IIMPA$^{RA}$ and IVPP$^{RA}$ groups:** prior PT, average of passive MA in IVPP$^{RA}$ group was 3.6$^{o}$ bigger, but wasn't significantly different (p=0.68) from the average PMA in IIMPA$^{RA}$ group. At the end of the survey, averages of PMA between IIMPA$^{RA}$ and IVPP$^{RA}$ groups weren't significantly different (p=0.49), but 1$^{o}$ higher change was observed in IVPP$^{RA}$ group. Comparing separate groups prior and after PT, IMPA$^{SIS}$ and IIMPA$^{RA}$ groups were identified with a significant (p < 0.05) improvement, while in IIIPP$^{SIS}$ (p=0.12) and IVPP$^{RA}$ (p=0.14) groups, passive MA wasn't significantly changed.

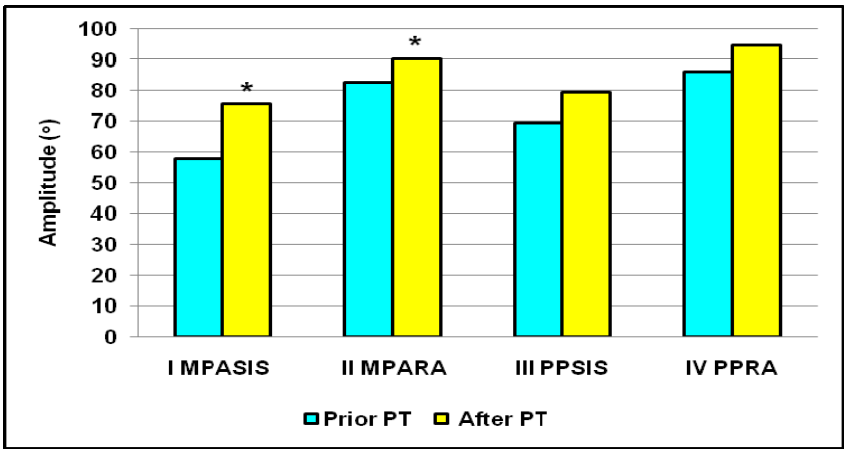


Fig. 2. Amplitude changes of passive upper arm movements prior and after physical therapy (°)

**Note:** *p < 0.05 – inside the group prior and after PT. For **IMPA$^{SIS}$** – for patients with shoulder impingement syndrome, **IIMPA$^{RA}$** – for patients with rheumatoid arthritis – joint mobilisation, post-isometric relaxation and active exercises were applied; for **IIIPP$^{SIS}$** – for patients with shoulder impingement syndrome, **IVPP$^{RA}$** – for patients with rheumatoid arthritis – PNF methods and a passive stretching were applied.

Picture (Pic. 3) presents pain dynamics in the shoulder joint during active movements of the shoulder joint.

**Comparing IMPA$^{SIS}$ and IIMPA$^{RA}$ groups:** at the beginning of the treatment the pain intensity average in IMPA$^{SIS}$ group was 0.8 point higher, but wasn't significantly different (p=0.31) from the pain intensity average in IIMPA$^{RA}$ group. As it was observed at the end of the treatment, the pain intensity averages between IMPA$^{SIS}$ and IIMPA$^{RA}$ groups weren't significantly different (p=0.07), but 0.3 point higher change was observed in IIMPA$^{RA}$ group. **Comparing IIIPP$^{SIS}$ and IVPP$^{RA}$ groups:** prior PT the pain intensity average in these two groups weren't significantly different (p=0.49), but in IIIPP$^{SIS}$ group, the pain intensity was 0.4 point higher. After PT the pain intensity change in IVPP$^{RA}$ group was 2.9 point significantly (p < 0.05) higher than in IIIPP$^{SIS}$ group.

**Comparing IMPA$^{SIS}$ and IIIPP$^{SIS}$ groups:** prior PT the pain intensity average during active shoulder joint movements in IIIPP$^{SIS}$ group was 0,7 point higher, but wasn't significantly different (p=0.0.6) from the pain intensity average in IMPA$^{SIS}$ group. After PT, 1.4 point significantly (p < 0.05) higher change was observed in IMPA$^{SIS}$ group. **Comparing IIMPA$^{RA}$ and IVPP$^{RA}$ groups:** at the beginning of the treatment, the pain intensity average in IVPP$^{RA}$ group was 1.1 point higher, but wasn't significantly different (p=0.06) from the pain intensity average in IIMPA$^{RA}$ group. At the end of the survey pain intensity averages in IIMPA$^{RA}$ and IVPP$^{RA}$ groups weren't significantly different (p=0.59), but 1.2 point higher change was observed in IVPP$^{RA}$ group. Comparing separate groups prior and after PT, the pain intensity in all groups after PT significantly (p < 0.05) reduced.

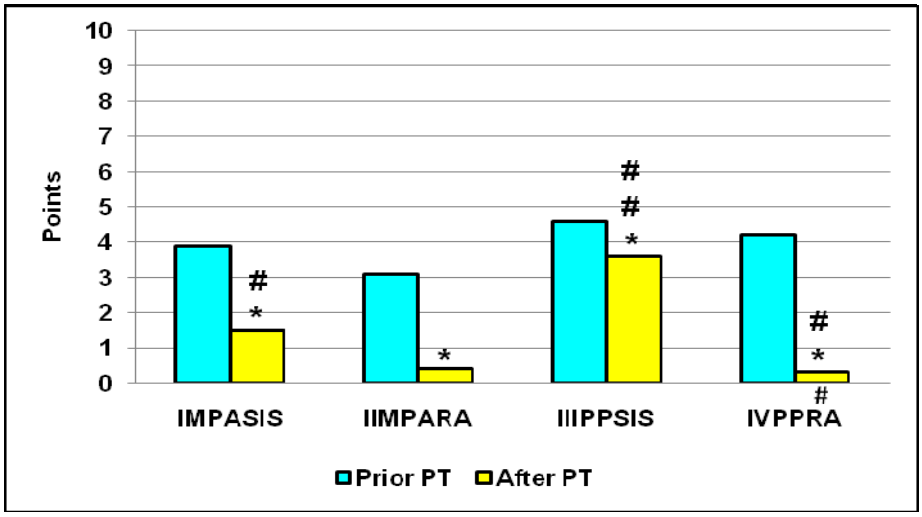


Fig.3. Pain intensity changes upon active shoulder joint movements (in points)

**Note:** *p < 0.05 – in group prior and after PT, #p < 0.05 – between IMPA$^{SIS}$ and IIMPP$^{RA}$ groups and IIIPP$^{SIS}$ and IVPP$^{RA}$ groups**.** For **IMPA$^{SIS}$** – for patients with shoulder impingement syndrome, **IIMPA$^{RA}$** – for patients with rheumatoid arthritis – joint mobilisation, post-isometric relaxation and active exercises were applied; for **IIIPP$^{SIS}$** – for patients with shoulder impingement syndrome, **IVPP$^{RA}$** – for patients with rheumatoid arthritis – PNF methods and a passive stretching were applied.

Picture (Pic. 4) presents the assessment of autonomy in everyday activity by aids of Oxford questionnaire (OQ).

**Comparing IMPA$^{SIS}$ and IIMPA$^{RA}$ groups:** prior PT, average of autonomy in everyday activity in IIMPA$^{RA}$ group was 6 points higher, but wasn't significantly different (p=0.29) from the average in IMPA$^{SIS}$ group. After PT, 7 points higher change of the autonomy in everyday activity was observed in IMPA$^{SIS}$ group. **Comparing IIIPP$^{SIS}$ and IVPP$^{RA}$ groups:** prior PT, average of autonomy in everyday activity in IVPP$^{RA}$ group was 5.5 points higher, but wasn't significantly different (p=0.50) from the average in IIIPP$^{SIS}$ group. After PT 5.5 points higher change of the autonomy in everyday activity was observed in IIIPP$^{SIS}$ group.

**Comparing IMPA$^{SIS}$ and IIIPP$^{SIS}$ groups:** prior PT, average of autonomy in everyday activity in IIIPP$^{SIS}$ group was 7 points higher, but wasn't significantly different (p=0.75) from the average in IMPA$^{SIS}$ group. After PT averages of levels of autonomy in everyday activity between IMPA$^{SIS}$ and IIIPP$^{SIS}$ groups weren't significantly different (p=0.93), but 5.5 points higher change was observed in IMPA$^{SIS}$ group. **Comparing IIMPA$^{RA}$ and IVPP$^{RA}$ groups:** prior PT, average of autonomy in everyday activity in IVPP$^{RA}$ group was 6.5 point higher, but wasn't significantly different (p=0.58) from the average in IIMPA$^{RA}$ group. After PT, 4 point higher change of the autonomy in everyday activity was observed in IIMPA$^{RA}$ group.

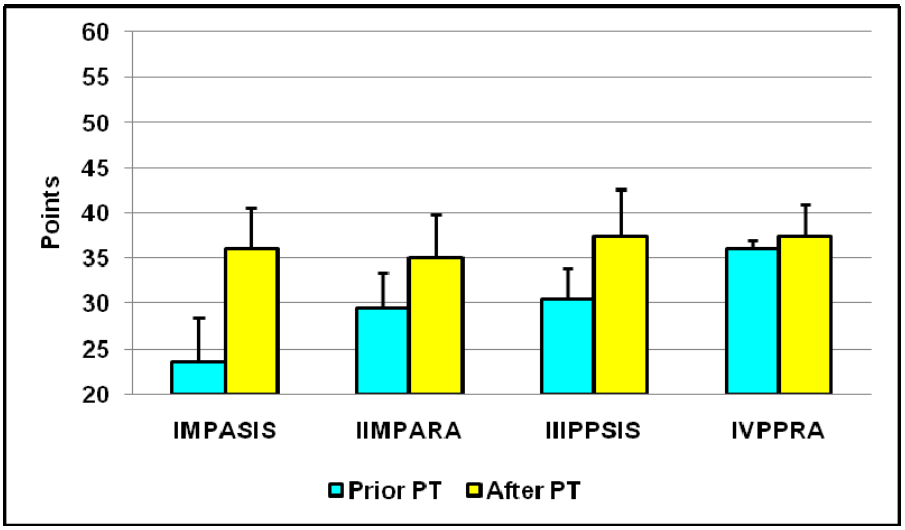


Fig. 4. Autonomy changes prior and after physical therapy (in points)

**Note:** For **IMPA$^{SIS}$** – for patients with shoulder impingement syndrome, **IIMPA$^{RA}$** – for patients with rheumatoid arthritis – joint mobilisation, post-isometric relaxation and active exercises were applied; for **IIIPP$^{SIS}$** – for patients with shoulder impingement syndrome, **IVPP$^{RA}$** – for patients with rheumatoid arthritis – PNF methods and a passive stretching were applied.

Table (Table 1) presents changes of the shoulder joint muscular power prior and after 4 weeks of physical therapy (PT). After generalisation of the gained results, it is possible to state that groups with joint mobilisation, post-isometric relaxation and active exercises, composed from patients with SIS (IMPA$^{SIS}$) experienced higher changes; here RJ statistically significantly ($p < 0.05$) increased. For groups where PNF methods and the passive stretching were applied, a higher, but not significant change was observed in the group, composed from patients with SIS (IIIPP$^{SIS}$).

Table 1

Changes of the shoulder joint muscular power during the course of survey (in points)

| Groups | I MPA$^{SIS}$ | | | | II MPA$^{RA}$ | | | | III PP$^{SIS}$ | | | | IV PP$^{RA}$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Respondents | I * | | II | | I | | II | | I | | II | | I | | II | |
| Movement | Prior PT | After PT | Prior PT | After PT | Prior PT | After PT | Prior PT | After PT | Prior PT | After PT | Prior PT | After PT | Prior PT | After PT | Prior PT | After PT |
| Bending | 2 | 3 | 4 | 4 | 4 | 4 | 4 | 5 | 3 | 4 | 4 | 4 | 4 | 4 | 3 | 3 |
| Stretching | 2 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 4 | 3 | 4 |
| Protraction | 2 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 4 | 3 | 3 | 4 | 4 | 3 | 4 |
| Horizontal protraction | 2 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 4 | 4 | 3 | 3 |
| Horizontal retraction | 2 | 3 | 5 | 5 | 4 | 5 | 4 | 4 | 3 | 3 | 4 | 4 | 4 | 4 | 3 | 3 |
| External rotation | 2 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 4 | 4 | 3 | 3 |
| Internal rotation | 2 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 4 | 4 | 3 | 3 |

**Discussion of results**

Summing changes of active shoulder joint movement amplitudes after physical therapy (PT), statistically significant ($p < 0.05$) improvement was observed in all groups (see Pic. 1).

After summing changes of the passive movement amplitudes, a significant improvement was observed in groups where a combination of joint mobilisation, post-isometric relaxation and active exercises was applied (see Pic. 2). In one of the newest studies, a joint mobilisation was applied for 40 respondents with adhesive capsulitis. One group was introduced and applied with general exercises while the other – exercises and joint mobilisation (oscillating movements – 2-3 slides per second for 30 seconds, total of 5 series). At the end of the survey, MA significantly increased in both groups, but in the group with joint mobilisation applied, the change was significantly higher (Kumar et al., 2012). This survey confirms a premise that joint mobilisation, implemented with exercises is more effective with increase of movement amplitudes. The similar survey by J. Wies (2005) analysed the effect of joint mobilisation and exercises, implemented at home. The survey lasted for 12 weeks and contained 8 respondents with a diagnosis of the adhesive capsulitis. After PT, researchers identified a significant increase in active movements. This survey also had 8 respondents and it lasted for 4 weeks, but MA significantly increased ($p < 0.05$), even though the duration of the survey was 3 times shorter if compared to the survey of J. Wies (2005). Active exercises (amplitude, stretching) as well as post-isometric relaxation were applied in this survey with mobilisation, therefore the MA increase was more rapid. The gained survey results can be compared to results of the survey, implemented by A. Narayan and V. Jagga (2014), where 30 respondents with a diagnosis of the adhesive capsulitis participated. The following procedures were compared: ultrasound therapy, wet warmth, movement amplitude, pendulous exercises and all the same procedures; moreover, the upper arm bending, protraction and external rotation were applied the post-isometric relaxation. At the end of the survey a premise can be offered that patients who were applied post-isometric relaxation next to other procedures, changes of the upper arm bending, protraction and external rotation amplitude was significantly higher. During the current survey, $IMPA^{SIS}$ and $IIMPA^{RA}$ groups were also applied with post-isometric relaxation for the upper arm stretchers and rotators internally inwards and outwards. MA change of these groups was higher than in those groups where post-isometric relaxation was not applied ($IIIPP^{SIS}$ and $IVPP^{RA}$). After PT, upper arm bending and external rotation MA change in $IMPA^{SIS}$ group was higher though the primary amplitude was lower than in $IIMPA^{RA}$ group. It is credible that change in $IMPA^{PSA}$ group is bigger, because upon smaller primary amplitudes, patients had higher possibilities. Generalising, it is possible to state that the combination of joint mobilisation, post-isometric relaxation and active exercises is more effective than PNF methods and passive stretching increasing the passive MA in the shoulder joint.

At the beginning of the survey, a subjective pain intensity assessment during active shoulder joint movements was implemented. After PT, a light pain remained in all groups (1-3 points), but it was significantly lower if compared to the one prior procedures (see Pic. 3); it is credible that in case of the continued survey, the shoulder joint pain may disappear. S. B. Al Dajah (2014), analysed effect of the soft tissue mobilisation and PNF upon reduction of the pain intensity for patients with SIS. 30 patients participated in the survey; in the group where PNF was applied together with mobilisation of soft tissues, the pain significantly decreased if compared to group that was treated by ultrasound procedures. In the similar study with a duration of 4 weeks (24 patients), effect of paraffin applications and soft tissue mobilisation as well as the effect of similar procedures and PNF on shoulder joint functions after arthroscopic shoulder joint surgery and RA. After PT, the pain intensity in the group where PNF was applied reduced by 5 points (Taragi et al., 2014). A similar survey compared the effect of joint mobilisation as well as joint mobilisation together with PNF. The control group was applied with joint mobilisation and the experimental group was treated by aids of combining both methods. After 4 weeks researchers defined that the joint mobilisation together with PNF is more effective upon the pain reduction for patients with adhesive capsulite (Mahendran, Chetia, 2013). Results of our survey match data and results gained by the mentioned foreign authors, because the pain intensity significantly decreased in all groups.

Generalising the gained results, it is possible to make a conclusion that combination of joint mobilisation, post-isometric relaxation and active exercises is significantly ($p < 0.05$) more effective than PNF method and passive stretching upon reduction of the pain intensity during active movements for patients with SIS. According to S. L. Edmond (2012), one theory states that the pain reduces due to the activation of pain blocking mechanisms or the pain management centres in the central of peripheral system of nerves or due to chemical changes in peripheral receptors. According to A. Kumar et al. (2012), oscillation may bear the blocking pain perception effect; these vibes move the joint fluid and improves the nutrition of the joint cartilage. Comparing the effect of PNF method and passive stretching, changes in group from patients with RA ($IVPP^{RA}$ group) after PT were significantly ($p < 0.05$) higher if compared to the group from patients with SIS ($IIIPP^{SIS}$ group).The gained results of our survey may be compared to results of the survey by M. Bang and G. Deyle (2000). 54 respondents participated in the

survey; muscle stretching and strengthening programmes were compared to those of muscle stretching and strengthening together with joint mobilisation. According to the results of the survey, the group that was applied with the joint mobilisation indicated a much better state of patients (the pain reduced, functions increased, the strength increased) if compared to those where the joint mobilisation was not applied. A similar study compared the ordinary treatment, composed from the shoulder joint and shoulder mobilisation, ultrasound, laser and TENS; the other group was applied with the same procedures as well as stretching and strengthening exercises. Pain significantly reduced for respondents in both groups, but a greater improvement was defined for respondents in the group where exercises were applied together with an ordinary treatment (Sharaf et al., 2013).

Upon assessment of the shoulder joint muscular power changes, we noticed that a statistically significant ($p < 0.05$) improvement was defined for respondents in $IMPA^{SIS}$ group; this group was offered a combination of joint mobilisation, post-isometric relaxation and active exercises. Muscular power in those groups where PNF method was applied together with a passive stretching also increased, but significant changes were not observed ($IIIPP^{SIS}$ and $IVPP^{RA}$). Primary muscular strength in $IMPA^{SIS}$ group (2 points) was two times lower than the primary muscular strength in $IIIPP^{SIS}$ and $IVPP^{RA}$ groups. In order for the muscular power to increase up to 3 points, it is necessary to increase the mobility of the joint and to strengthen muscles so that they could compete the gravitation. E. Kisieliūtė (2013) analysed effect of joint mobilisation and exercises on the shoulder joint functions. 26 respondents participated in the survey after arthroscopic rotator cuff repair surgery. 14 procedures were applied; during them, 20 min. were given for active exercise and 5 minutes – for the joint mobilisation. After PT the muscular power significantly increased.

Gained results of our survey may be explained that the pain, movement amplitude and the muscular power are interrelated. As it has already been mentioned, after PT, a minor pain remained in groups that blocks the activity of muscles around the impaired joint. According to S. L. Edmond (2012), this blocking reduced upon mobilisation and the normal joint mechanics is possibly to be restored. Our survey was shorter if compared to E. Kisieliūtės (2013); it is credible that there was a shortage of time for the restoration of the joint mechanics.

**Conclusions**

1. In groups where a combination of joint mobilisation, post-isometric relaxation and active exercises ($IMPA^{SIS}$ ir $IIMPA^{RA}$) was applied, active and passive shoulder joint MA significantly ($p < 0,05$) increased. The pain intensity during active shoulder joint movements reduced ($p < 0,05$). Muscular power significantly ($p < 0,05$) increased in $IMPA^{SIS}$ group.

2. In groups where PNF methods together with a passive stretching were applied ($IIIPP^{SIS}$ and $IVPP^{RA}$) active shoulder joint MA significantly ($p < 0,05$) increased. The pain intensity during active shoulder joint movements reduced ($p < 0,05$).

3. A combination of joint mobilisation, post-isometric relaxation and active exercises was more effective than PNF methods together with a passive stretching upon increasing the muscular power and the passive MA in the shoulder joint. Subjectively assessed shoulder joint muscular power as well as autonomy and functions haven't significantly improved in any of groups.

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