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ACADEMY OF MUSIC AND DRAMA

ON ERGONOMICS FOR THE ORCHESTRAL PERCUSSION INSTRUMENTS

Alberto García de León Fernández

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Author: Alberto García de León Fernández
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Supervisor: Ph.D. Harald Stenström

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ON ERGONOMICS FOR THE ORCHESTRA PERCUSSION INSTRUMENTS

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1. Introduction

A real introduction to my thesis work will start with an introduction to myself. I have studied percussion performance in Madrid, both intermediate and bachelor programmes; eight years at the Professional Conservatory and four more in the Royal High Conservatory of Music in Madrid. I have played in several orchestras as a percussionist and at the moment I am studying the SNOA Master Project in the University of Gothenburg specializing in orchestral percussion. Since I started practising and playing percussion in a professional way (with clear intentions of living on music alone), I have had several problems because of the continuous practising, such like tennis elbow (Epicondylitis) and inflammation of the abductor of the thumb. These and other percussionists' problems made me interested in how we move and how could we practice in a more efficient way.

Why ergonomics?

The normal conception of ergonomics is literally “the scientific study of people and their working conditions, especially done in order to improve effectiveness” (Cambridge Advanced dictionary: ergonomics)

Of course there are many people studying our work conditions and looking for the best design for the stands, chairs and accessories to improve our effectiveness, but during all these years I have realised that the most important thing that a musician has is his/her body. That is what I will write and research about. Which is the best ergonomic posture of our body while we are playing our instrument? No matter if we are working at the orchestra or in the practice room on our own. How does our body work, and how does it react to the movements we make and which are the best movements for working in a good way with our instrument, not against? In short, how could one play and practice without pain and without getting hurt?

All musicians use their bodies to make the instruments sound, but especially so in the percussion field. We usually need to make bigger movements to get the sound we want, but also very often really small ones. We need to enlarge our versatility as much as possible. In my opinion, a good control of your body and your movements is the key to keep improving your level in the most comfortable way.

Writing this thesis, I have followed a main way based on my own experience across this two master years, remembering problems from the past and writing daily about thoughts and researches. I have taken part of an anatomy and massage course after starting to be interested in this subject, so I could be more prepared to talk about muscles, movements, their problems and possible solutions. Of course I have also worked with my colleagues, checking and comparing a few of their problems, points of view and pains, with mine, but this is not shown in this work. This work is mainly the conclusions to all these previous experiences and comparisons. A subjective thesis work where I show my personal opinion writing with myself as the primary reader, but I also have found some literature to support my ideas and to base them on it. If there is anything I write as a personal thought I write it into a chart box.

After a few years of being blocked as a percussionist, due to many muscular problems that were the reason of my blocking, I started to be interested in my body and how it works. I have found that wrong postures or non-natural movements caused many of my problems.

I find a really good opportunity to write and research about it for my master thesis

I have chosen this way of writing because I feel that it is the most successful way for my improvement and the best way to be conscious of what I am writing about.

2. Knowledge of our body through the playing of the snare drum, keyboard instruments and small percussion instruments in the orchestra and the basic problems related to them.

As every other musical instrument, the fact of playing percussion instruments takes a big amount of time and sacrifice. Many hours in the practice room with the same posture, the same kind of exercises, the same kind of movements and only a few muscles being used for them. If we do not know how to find a good balance among the ones being used and the others, we will probably find muscular barriers against developing our technique and raising our level a bit more. Once we have reached a professional level, after the first grade of studies, we can be more aware of what is going on in our body and every little change in it can improve or stop your development.

I will try to describe the different postures and movements of the percussion playing in order to better know which muscles we use and how we should use them. I have chosen the orchestral percussion but it can be applied for many other percussion instruments.

As I am writing in anatomical terms, it is good to name some of the expressions that will appear later on in this work. To start talking about this expressions and terms we have to start describing the “anatomic posture or anatomic position”¹. This position is a reference posture to which you can relate every movement. This posture is standing up, straight body, feet together and parallel, arms along the body and the palms of our hands facing forward.

Relying on this picture, we can describe terms like:

Abduction, when any part of the body is being separated from the central line of the body in the same plain as the back and the chest.

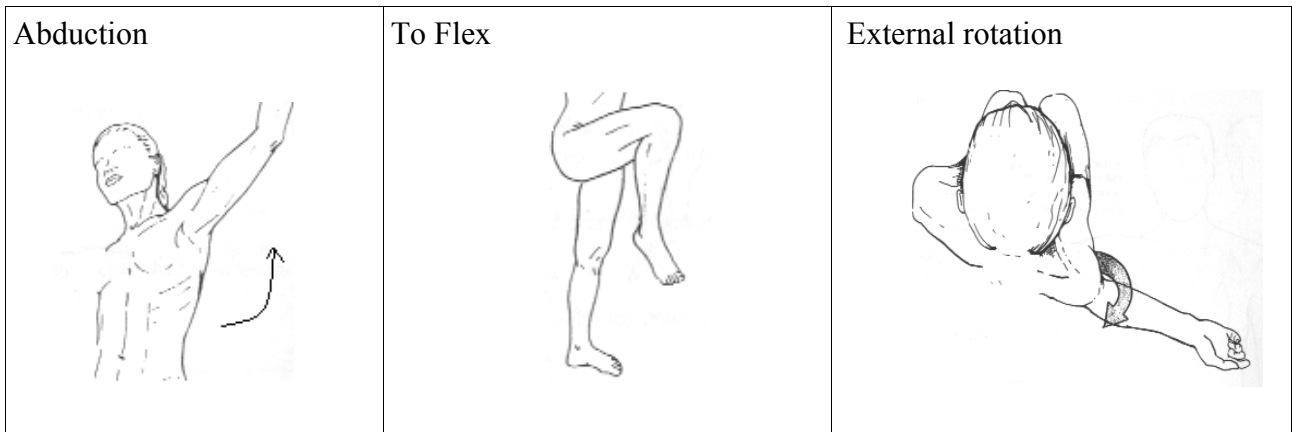
Adduction is the opposite movement to abduction. This is to move any part of our body in the same plain as the chest and back, going to the central line or crossing it.

To flex is any movement going forward from the anatomic position in a perpendicular plain to the back and chest. *Stretch* is another movement and the opposite to flex.

Referring to circular movements comes the *rotation*. Rotation refers to circular movement; if the rotation were external the movement would be from inside to outside and internal if the movement had the opposite direction.



1 Anatomie pour le mouvement, Blandine Calais-Germain, 1994, p. 7



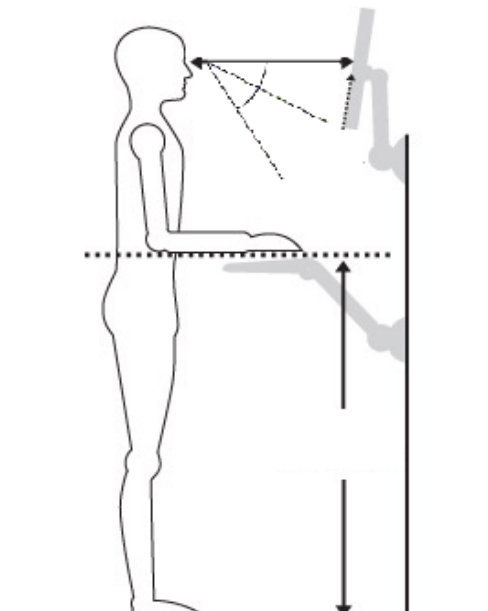
2.1. The snare drum

There is no better way to start talking about the basic posture problems of playing percussion instruments than talking about playing the snare drum. It is the first instrument we learn to play and, in a way, how we hold the snare drum sticks is the root of all the techniques for other percussion instruments.

When we speak about basic muscular problems related to the snare drum, we have to start from the bottom. How we face the snare drum. A little distortion or evolution in our posture can make us to reach the maximum level of performance, or to not being able to play a specific technical excerpt.

2.1.1. General postures

As with most of the musical instruments, we can play sitting down in a chair, or standing up in front of the instrument. Both ways have their pros and cons and we are going to compare them.



- Standing up.

Here we have an example from the office world, where I have found an extensive ergonomic research and many examples that are really useful for my work.²

Of course we should modify this picture in relation to what we are talking about. Instead of the keyboard we would have the snare drum, and instead of the monitor, the music stand.

One of the main differences that we should keep in mind is that we need visual contact with our instrument, so the music stand cannot be at the same height as the visual line. Stand and snare drum would be into the viewing angle of 60°. It is established that that is what the normal eye can cover. This is a good posture if we take care of it. That is to say that we know where our tension points are and that we know how to relax them.

² <http://www.ergonomicoffices.net>
<http://www.khulsey.com/computer-workstation-ergonomics.html>

The spots where more tension is located, are, as could be understandable because they are keeping us standing, mainly the joints from the lower part of the body. Hip, knees and ankles will be the support for our body when playing like this, so we have to be very conscious about how we use them. On the one hand, we have an advantage, we all know as human beings how to stand up so normally the hip and the ankles will work without any special order from our brain. On the other hand, we have of course a disadvantage. We can make mistakes with this. We are often too used to wrong postures or gestures and we are not always aware of that. The most common wrong posture is located in the knees. Basically we could name it a normal hyperextension. When we are not careful our legs will automatically overstretch and could end up in time in a distension of the ligaments. A really good way to prevent this bad posture is to bend our knees all the time so we can lower our gravity centre. If we think in the directions of our body, we have to have our back perpendicular to the ground, thinking down with our hip and low back and up with our head and upper part of the neck. The bending of the knees should be between 20 and 25 degrees in the hip, from the leg to the vertical line. Approximately the same measure should be in our ankles.

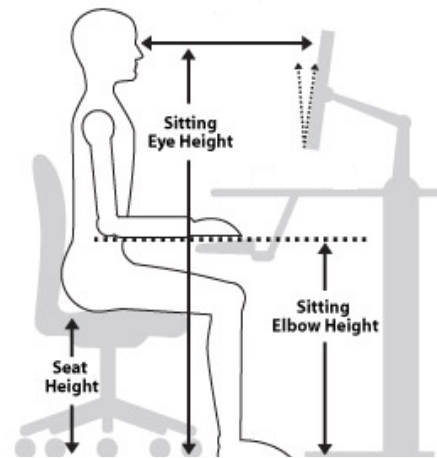


Another problem, maybe less frequent, is spotted in our low back. There is a tendency to over-stretch it by pulling back the lowest part of the spine creating an excessive arch that can end with the consequent tension in the neck, abdominal area and of course the back. To solve this kind of problem, there is not a specific contra posture. It should not be forced in any way, but it is better to have more conscious tension in our abdominal area. Being careful and conscious of one's back and thinking on the rotation of the hip will always help, but the practical way of solving it is to try to pull back from the abdominal muscles to keep the natural position of the spine. Anyway, the posture for the previous problem will help a lot also with this one.

A minor problem with this way of playing, considered as a physical or muscular problem, is the balance in your legs. There is always an inclination from our body to one specific side, either the right or the left side, depending of the symmetry of each body, so we will almost always put a bigger weight charge on one leg than on the other. Again, the posture of the bending knees will help a lot to revise our balance and to charge distribution. Those are great examples that show that everything is connected in our body and a little change of posture can make a really big difference in our performance and efficiency.

I find, however, a main problem in this way of playing. It is a position that requires a lot of attention to the body. So it will keep your mind aware of how are you standing instead of focusing on your instrument and the way you are playing it.

- Sitting down:



We go back again to the office world to find a new picture³ that we can apply for our musical purposes.

As you may see, mostly all the joints are positioned in almost 90° angles, which is considered the best and more efficient posture of resting.

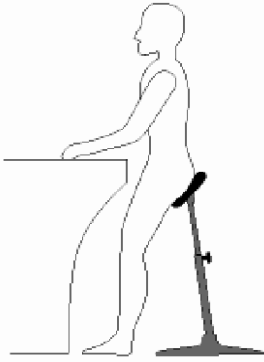
Compared to the standing up position, this is more relaxed in many ways. Your body is resting on an external object (the chair) that will make you rest in all the physical conditions.

The way the external objects are built is very important and there are lots of different models and brands that care about the ergonomics, but this is not the topic for this thesis work. We are working on how the body works in different conditions. However, it would be good to say that a good chair, to play snare drum, should be built with a flat bottom sitting base with inclination adjustment, and, better, if its height is adjustable to find the best configuration.

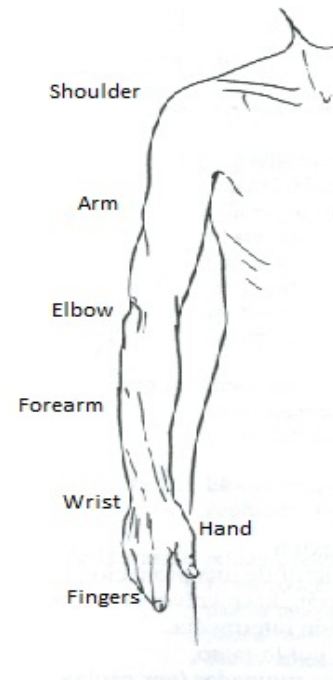
The main problems with this way of playing are related to relaxation. If we get more relaxed than we want, we can fall into some mistakes that can make our playing less comfortable. The normal, and more common, is the opposite of the standing up. We rely on our chair and it makes our back to begin to bend. The result is that we will get tension in the middle part of the back because of the opposite arch to the natural position of the spine. A good and easy way of reducing this effect, is trying to sit at the very end of the chair, sitting completely on our sit bones (Ischiums, the lower arches of the pelvis). In standing up, again, we should be careful to avoid any tension by not going forward or pushing back. There are chairs that directly compensate this balance with their seat bottom. Another good option is some wedge form seat cushions that distributes your weight in a proper way.

Another problem in sitting down, but much less common, is that some people, due to a bigger development of their leg muscles (the quadriceps and femoral biceps), can not sit in this posture because it cuts the bloodstream to their legs and get their low limbs numbed. To solve this problem is easy, you just have to find the right posture for you by adjusting the height of the chair.

³ <http://www.ergonomicoffices.net>



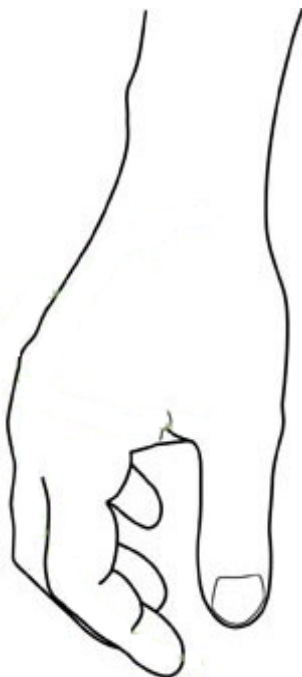
From my personal experience, I have found that the most comfortable posture for me is sitting down. And despite I don't have problems with the bloodstream to my lower limbs, I prefer to sit high. I find it more relaxed to find a balance between both positions (standing-sitting), so, when I stand in front of a snare drum, I always try to be standing on my feet, but resting my weight on a height adjustable chair. Although my position would be somewhere between the two here, I find this position more versatile because I do not depend on the height of my body. I have three resting points, the chair at the very back, and both feet. Through this arrangement I have found that the body reacts to everything you do.



To continue with the subject I think we should know how each part of our body works while we are playing snare drum, at least the main ones. In this specific case I think we should talk about the fingers, hands, forearms, arms and shoulders. The picture on the right shows these different parts. I will start describing the posture from the small muscles at the very end of the fingers going up to the big muscles of the shoulder.

2.1.2. Specific postures: Hands and fingers

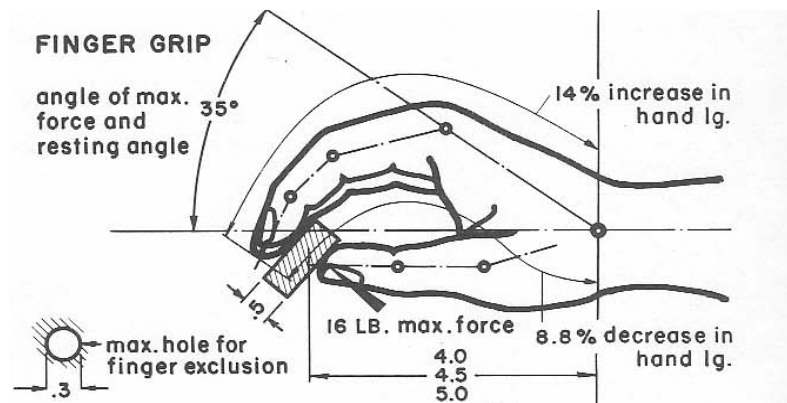
Before talking about how our hands work while playing percussion I would like to describe the hands in a relaxed position. Let's start from the beginning and try to find a good way of holding a snare drum stick. I hope that the more similar and relaxed posture to grab it the better.



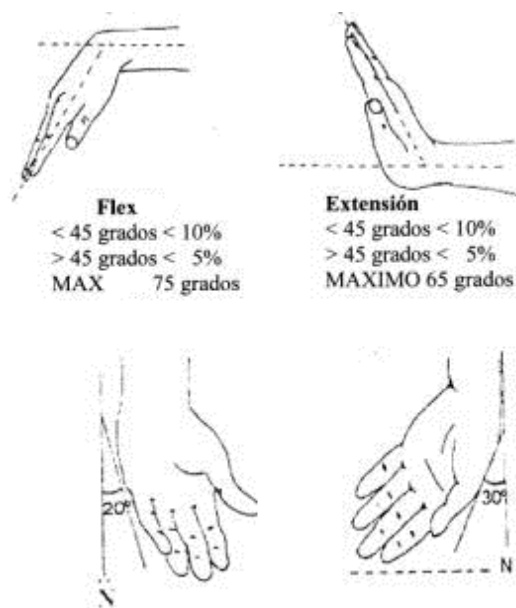
In a relaxed position of your hands, achieved for example by standing up with your arms hanging down close to the body. Then your hands are not working at all so they are completely relaxed. Your fingers should be slightly bended, your thumbs are close to the second phalanx of the index finger and, in relation to your forearms, your wrists are in the same direction or imaginary line. The palm is curved like holding something not too big inside, but not too small either.

The picture on the left shows a graphic example of it. We should try to keep this posture as much as possible and, with it, the same feeling of relaxation. So now is the time for holding the stick. If we want to keep the posture of the hand, let's put the stick basically on your thumb and hold it with the first phalanx of your index finger. The stick will almost fit between them so we don't have to use that much strength to hold it.

The following picture shows the results of an anthropometric⁴ research⁵ about which position allows us to reach the maximum strength between our thumb and index finger. Luckily, the relaxing position and the position for maximum strength are one and the same, so, despite not having to use this maximum amount of strength, we should have the posture that makes it possible for us to use it.



Now that we have the main pin on the stick, we have to talk about the position of it in relation to our hand. In this case we should think about the kind of movements that we realise when playing snare drum. The basic movement is going up and down to make the beats on the drum. The basic movement is made mainly with the wrist and then accompanied by the fingers and the forearm.



Looking again to anthropometric researches about the movement of the hand, it is known that we lose mobility when we make a torsion in our wrist. Moreover, we have a very little range of movement to the sides compared to the range that we have when flexing and stretching. The flex and stretch movements are more easy and less tense than the side movements. We can therefore affirm that the best way of holding the stick is to follow the line that our forearm creates with the hand, in order to create a big system, compound of stick, hand, forearm and shoulders, which work together to create the movement in a relaxed way. To explain the best position of the stick, I could say that it would be to hold the stick with the pin and to let it rest somewhere in the centre of the wrist joint.

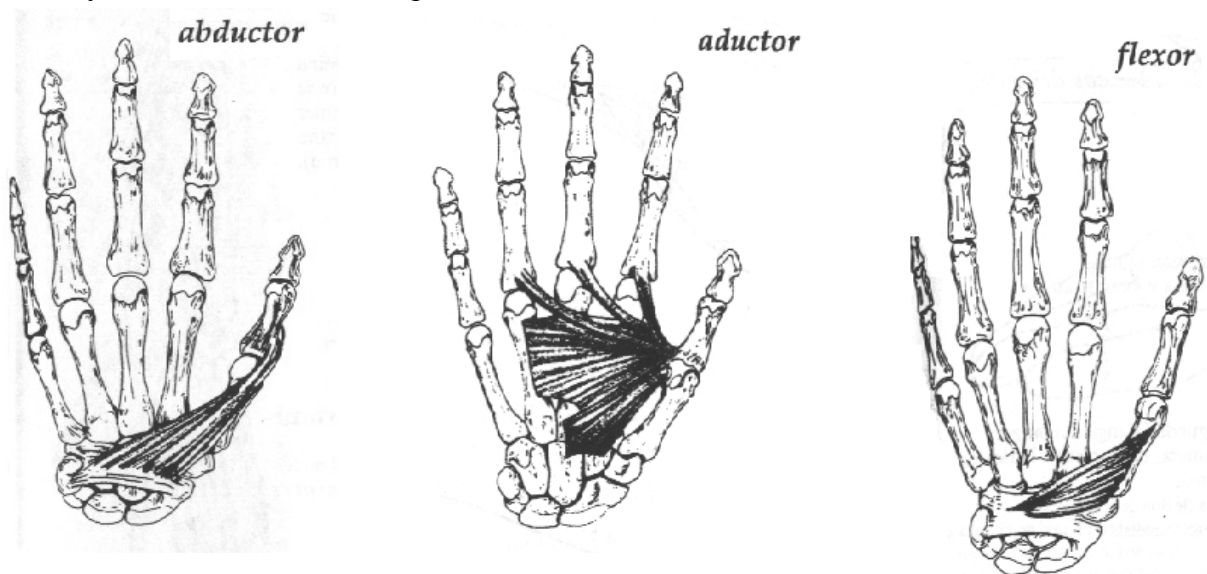
The main problems I have observed in this area of the body are related to small muscles, concretely the ones that allow the mobility of the fingers. Muscles located in the forearm move the flexors and extensors of the four long fingers. I will talk more about that in the next paragraph; now come the problems of the thumb.

4 Anthropometry: The scientific study of the measurements and proportions of the human body.

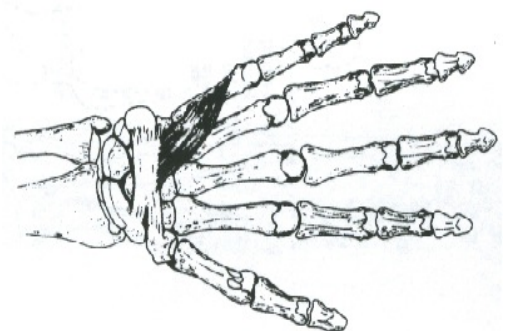
5 <http://msis.jsc.nasa.gov/sections/section03.htm>

I wrote before that the maximum strength that our thumb finger makes, is against our other fingers. Concretely, the exact point of this strength is located somewhere on the middle of our fingertips and the strength is manifested, to simplify it, mainly by three muscles. *Abductor*, *adductor* and the *flexor* of the thumb (Pollicis muscular group). The abductor makes the thumb going over the palm and bends the low part of the finger (first phalanx). The adductor moves the thumb closer to the index finger and the flexor makes an internal rotation of the thumb from the first phalanx. Holding a stick is a complex combination of these three and some other muscles but the main problem comes with tension in the abductor and flexor.

A general solution to this problem cannot be described literally. It will be different for different people. We can only say, as I wrote before, that the fact that we have the possibility to use the maximum strength in the relaxed position does not mean that we have to use it. We should try to hold the stick with a perfect combination of control and relaxation.



We could also remark, and see in the simplified picture⁶ to the right, that we have three small muscles only working for the smallest finger (Abductor, adductor and opponent of the fifth finger). Despite the size of these muscles, they may get very tense and it is very common to see percussion players playing the snare drum with the small finger straight and tense, especially while they are playing rolls. We can avoid this, by just being aware of the position that we were talking about before, and by being directly aware of the fifth finger.

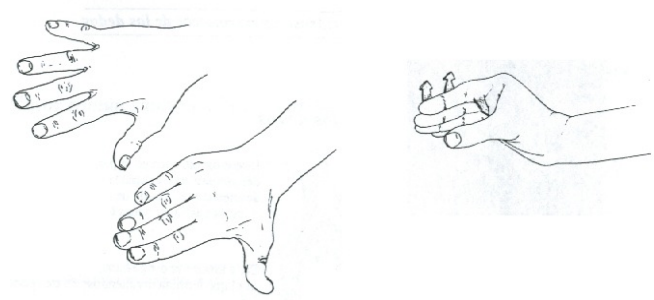


As a personal suggestion, I can say that it is helpful to hold the small finger with a slight contact to the palm. That, makes us conscious of where it is.

⁶ Anatomie pour le mouvement, Blandine Calais-Germain, 1994, p. 7

It is good to know that many other muscles located in the hand move fingers and hand. Even though they don't have that many problems it is good to name them.

The ones in charge of opening and closing the hand, spreading the fingers are called *palmar interosseus* muscles and *dorsal interosseus* muscles. The first ones are located in the palm and the others in the back-palm as their name shows.



The *lumbricals* is the other big group of muscles in the hand, located between the fingers, and the group consists of six muscles that allow us to bend our hand in a 90° angle.

I realised that following these steps to have a relaxed position helped me to avoid tension points in the whole hand's muscle groups. Even more, if we follow these steps we will make it easier to have a correct position in the forearms and in the shoulders. So we could say that the hand and the wrist are the beginning of a big group that works together. Everything is related in the arm.

Technical perfection is often hard to reach, and so is even being able to keep oneself relaxed while playing difficult pieces or excerpts, but something interesting that I found to add to these theoretical point of view, is that to sometimes changing the posture for short periods or specific exercises can make it easier to relax the previously used muscles, because during this time you are not using them that much. Maybe a rotation in the wrists, facing them one to each other, or as simple as holding the stick only with the index finger, accompanied by the other fingers.

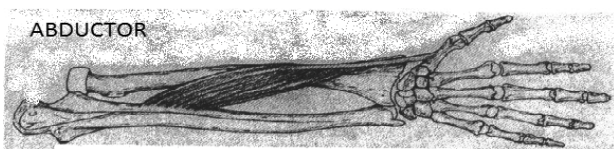
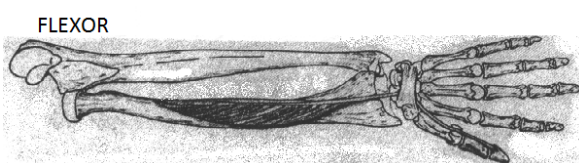
But of course we always have to think on giving priority to the quality of the excerpt that we are playing.

2.1.3. Specific postures: Forearms, arms and Shoulders



If we continue with the anthropometric vision of the body, our first objective is to keep the relaxation of the previously mentioned parts of the body. Shoulders, arms and forearms are related among them, but even more are the forearm and the wrist. I wrote before about the best position for the wrist, but to make that possible, we have to think on the best position for arms and forearms. In this area of the body the best way to describe a position is with degrees, and angles of aperture.

We can say that the natural way of lifting the forearm from the elbow is straight from the resting posture. (In a perpendicular line to the plain of the chest and the back.) But when we add the sticks to our hands and we have to play an instrument, like the snare drum where you have to play with



both hands in the central area of the drum, we need to put the tips of the sticks together. To keep the line with the stick, hand and forearm, we are almost obligated by the muscles of the chest (group of pectorals) to slightly open



our arms until a comfortable posture is reached. This opening angle varies from one to another person's muscles, but the normal range is from 10° to 30°. As a result of this opening we will automatically obtain an angle of 30° to 45° between the lines of the forearms, sticks and hands. About the shoulders, it is just enough to say that we have to be careful about how they are and try to find relaxation without letting them fall forward. In fact we have to find the balance between the front muscles and the back muscles.

After having fixed the general position, it is time to start describing the muscles used in the forearms. There is a group of four more muscles related to the hand and the fingers, but located in the forearm. They are the specific muscles for the thumb, and it is not normal to have muscular problems in them, so we will not talk any more about them. They are known as short and long extensors, flexor, and abductor of the thumb.

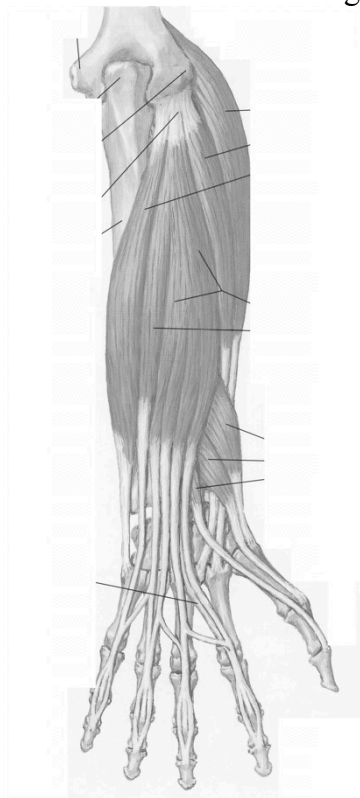
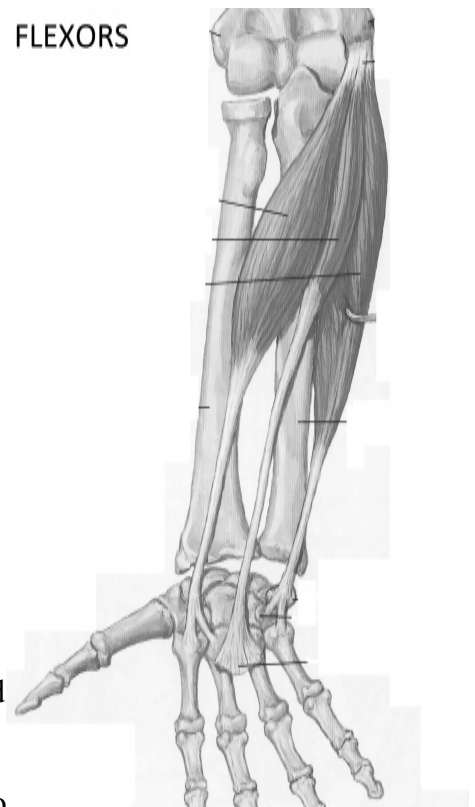
Going for the problematic ones, we need to stop and focus on the inner forearm, because it is in this part of the body where the muscles who move the wrist joint are. The most used joint for a percussionist. We can divide them in two different big groups: flexors and extensors.

The group of the flexors is compound of minor and mayor palm muscles (cubital anterior), and common flexor muscles of the fingers (internal and external). They make it possible for us to bend the wrist (as shown in the image) and flex the fingers. All of them have a common beginning and they are located very close to each other, which makes them very reactive to each other. If a problem in one of the tendons appears, probably the others will have the same by just proximity and friction. A very common problem in these muscles is the inflammation of any of the tendons close to the elbow. Inappropriate movements or tensions can cause this problem, but it can be also caused by the over-use of them. A long period of continuous use of the muscles could end

up as pain in that area. It is known as Epithrochleitis (also known as the golfer elbow) and the solution, if the problem is extended, is to stop playing for a long period of time and receive some massage treatment.

The extensors are the opposing muscles to the flexors. They are more numerous and the first and second Brachioradialis, extensor digital minimum, and own extensors of the second and fifth finger form it. This group of muscles allows us to bend the wrist forward and up (as shows the image) and to put the fingers in the same direction. The problems are caused in the same way as in the flexors. So we should try to avoid using them for long periods of time, or tensing them in inappropriate postures. They work in the same way as the flexors and they have the same problems. In this case the name of the inflammation is called Epicondylitis (tennis elbow). This one is the most typical problem in percussionists' forearms. It comes because of the over use of these flexor muscles and the solution is, as for the previous problem, to stop playing and to take some professional treatment.

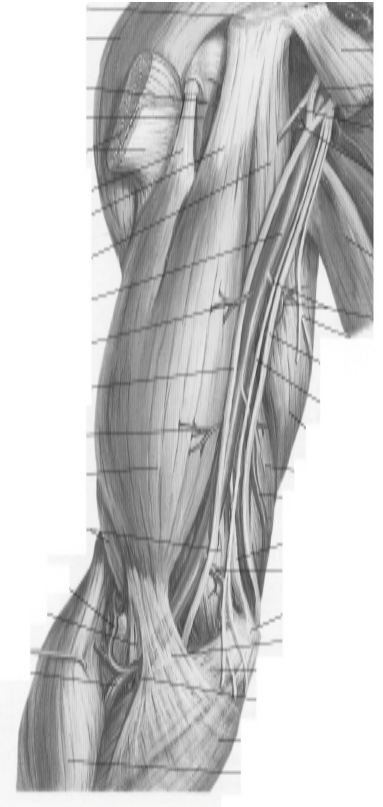
FLEXORS



As a suggestion, I found that the tension in this groups of muscles come out when we try to use them more than necessary. In fact we don't need them that much as we think. It is right to say that we have to pull up the stick every single time that the stick goes down to the skin or the instrument, but we have to remember that we have a big natural bounce in skin instruments, and that we have to take advantage of this fact. We have to use as less energy as possible when we are playing.

The muscles in the upper part of the arm start after the elbow and we could differ between the arm and the shoulder. The muscles in the upper arm are mainly biceps and triceps, and the shoulder is formed by a great conjunction of muscles that makes it the most mobile joint in the human body. All these muscles are much bigger than the previous ones and it is not very often that people have ergonomic problems in them.⁷

Maybe something to say about this upper part, and important to have in mind because it also affects the back and the chest, would be the natural position of the shoulders. We have a natural tendency to let them fall forward and this is because the human body is made to work with the arms on the front side. But if we keep doing this without being aware of what we are doing, we can cause an effect in the back, making it to follow the shoulders and increasing the natural bend of it. We should think of holding the shoulders back, feeling some weight in our sub scapular muscles, and of feeling both scapula bones close to the spine, so that we make our muscles in the back stronger. A great help for these muscles is to practice any kind of anaerobic sport, like soft running, swimming or similar active sports in which your back is constantly in use.



2.2. Keyboard instruments

Xylophone, glockenspiel and the not that commonly used marimba and vibraphone are all known as keyboard instruments in the percussionist language. Anyhow, they all need a similar posture and because of that they are connected to similar problems.

To start talking about the general posture, we should say that all these instruments are built to be played standing up. We then have to add the main problems that we talked about before, the standing up position when playing snare drum. The ones connected to the knees and to the lower part of the back.

Going for these kind of instruments we have to clarify that, as different from the snare drum playing, you have to have eye contact with the keys that produce the sound so you can hit the right one. It would be great to be able to look at the conductor, read the music in the stand and hit the right tone, but as the viewing angle is only 60° this is impossible.

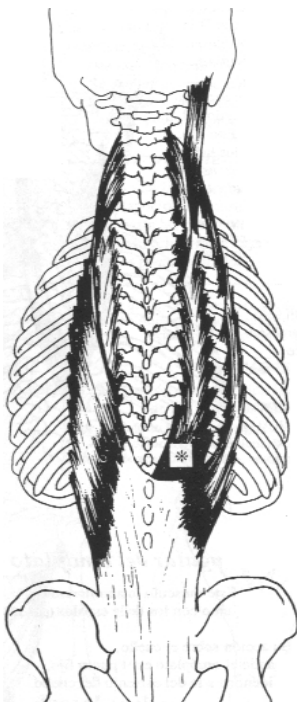
The perfect posture, would be the one that we wrote about before, when we talked about snare drum playing standing up. In this case, you can't avoid the tendency to look at the instrument while playing, and to bend the neck down. We have to be conscious about this fact and try to not keep this posture for long times.

⁷ Netter, Frank H. (1996) *Atlas of Human Anatomy*

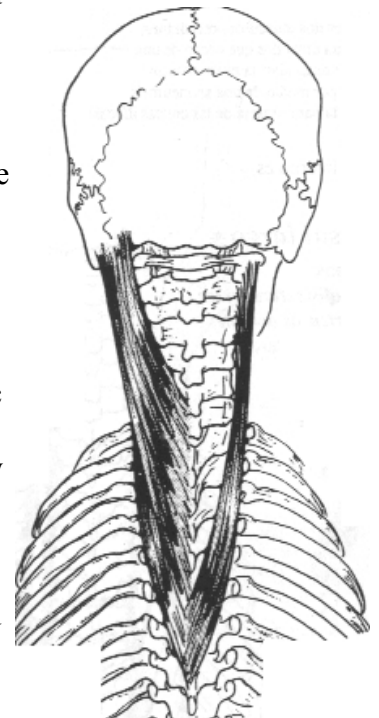
As we may have noticed by now, everything in our body is connected in one way or another and in this case, if the main problem is located in the neck, the hole back will be affected from muscular compensations.



The main groups of muscles in the neck could be described by layers. We have, mainly, five big layers. The deepest is located in the upper neck, the cervical area, and it consists of only small muscles that keep our head in the right position. This group is called sub-occipital muscles and two pair of muscles form it: *minor* and *major rectus capitis posterior*, and inferior and *superior obliquus capitis*. They have the functions of bending our neck to the back, rotate the head over the neck, and incline to both sides depending on which ones are working. They usually work together. But the main problem while we play, if we are looking down to the keys, is that all these muscles are completely extended and using their hole length. This makes them to be tense not for acting but for stretching and supporting the weight of the head falling forward.

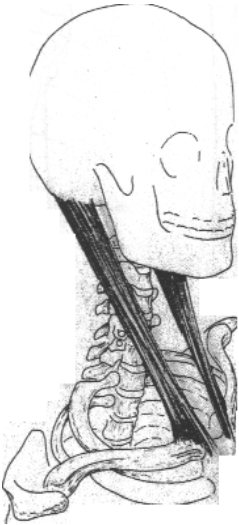
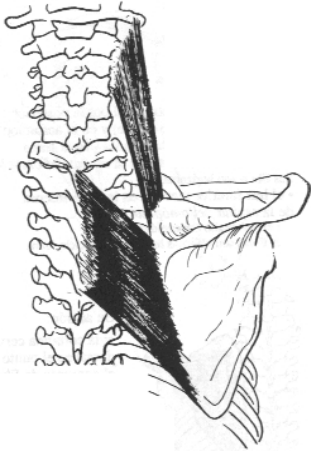
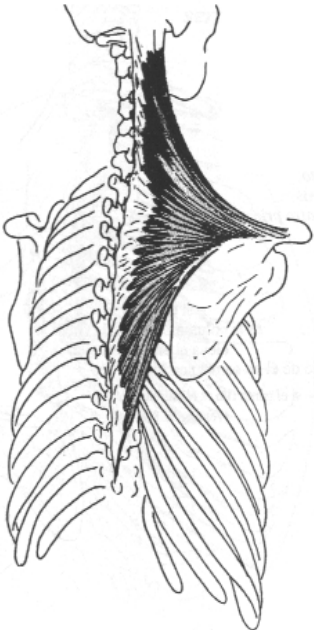


The next two layers of muscles are less important for my research because they are made to be the main support for the spine of the body, and they act with every small movement to control any variation in the position of each vertebra. Of course we use them while playing but not specifically in movements connected to playing musical instruments. They work as tonic muscles, constantly active without consuming any energy. Anyway it is good to know that they are called *splenius capitis* and *splenius cervicis* and can be seen in the right picture. And the big group of the picture on the left shows *erector spinae*, *longissimus spinalis*, *latissimus dorsi* and the group of the *semispinalis*, *capitis*, *cervicis* and *dorsi*.

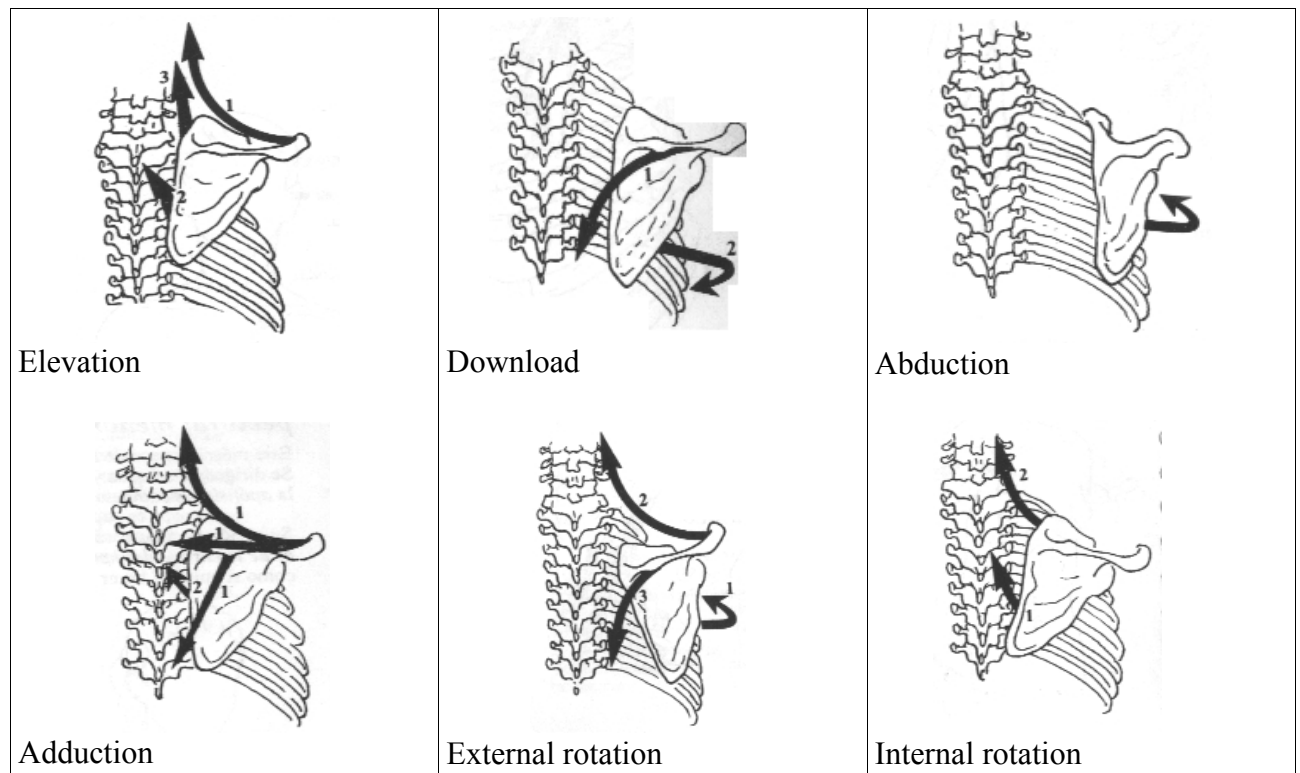


The last two layers of muscles are the most interesting for our research, because they are the direct connection between our back and the upper limb. In addition, they have the most commonly used muscles in the back to make the movements of our arms. This connection takes part in the joint with most mobility in our body, the shoulder. But it is this big mobility that makes it really unstable. As I said before, the upper part of the arm does not have that many problems, because of its muscular frame, and size. Main problems in the shoulder are located in the small connector muscles ligaments of the area and especially in the tendons, but all these problems are related to the mobility of the joint and it is not that common to find a relation to these problems in our way of playing. As the direct connectors between back and upper limb we have this four muscles: rhomboid, sternocleidomastoid muscle, angular of the shoulder blade and the biggest and most versatile, the trapezium. I will show in a small chart below what kind of movements they generate in the shoulder blade. All of these movements happen when we move the arms while we play these instruments in different positions as for example in making wide intervals, two scales arpeggios, four mallets chords, and any other exercises that makes you move your arm as a big and unified element.

Here is a graphic example of the four muscles and all of the possible moves of the shoulder blade in relation to them.

<p>Sternocleidomastoid</p> 	<p>Rhomboid at the bottom and angular on the top</p> 	<p>Trapezium</p> 
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Scapular movements:



Problems in these muscles are very common but at the same time they are not really important. They consist basically of pain in the neck and under the shoulder blades caused by the apparition of tensions in the inner layers of muscles. It is also really common to have a shorter angular muscle, which makes us feel that our shoulders are too high in relation to our head and everything else in our back.

As I wrote before, this kind of problems are difficult to avoid because of the natural way of playing these instruments, but I have found some exercises for the practice room that could help us to play with better consciousness of our body. The first one will help us with problems in the neck. With the lights turned off, we can start trying to play single notes and finding scales. We are doing this to get a better feeling for our instrument and to making it not necessary to look at it. We should in fact not look down on the instrument but only be aware of our posture and the quality of sound we produce. In time, this exercise will make us feel more comfortable while playing, sometimes looking at the conductor without looking the instrument, and to get, more than anything, a strong muscular memory. Another good exercise is related to the first playing of any piece. As we are learning it we are all the time looking on the notes and usually forgetting about other things. My proposal is to learn it without a music stand. We can have the notes in any other place in the practice room, in a way that we have to walk some steps away from our instrument. We look at the notes while we try to memorize them and then go back to play. This chain of actions makes us not being static, we have to move, change our posture even if we are playing the same excerpt many times, because you have to check the notes. Even though it is really difficult in the beginning, this exercise will make it easier to learn a piece and to make the mental work

faster and the focusing stronger. Both this two exercises have to be done carefully because of their difficulty. We do not want to fall in mistakes or to get tired of the situation. As soon as we realise that we are not taking advantage of our time, we should stop these exercises and go for the usual way.

2.3. Small Percussion instruments

Small percussion instruments is a really wide topic in percussion playing, so I have chosen only two of the most characteristic small percussion instruments and probably the most commonly used in the orchestra. They are also the most interesting ones, from an ergonomic point of view, because of the non-ergonomic postures that we use to play them. They are the tambourine and the triangle.

2.3.1. Tambourine

The tambourine is one of the most commonly used small percussion instruments in the orchestra. The playing technique is very difficult. We are holding the tambourine on one side of it, with one hand, and with the other hand we strike it. The fact that the tambourine does not have any kind of ergonomic holder makes us to often use an aggressive posture for our fingers and forearm. If we go back to the most relaxed posture of the hand for the pinch of the snare drum sticks and compare it to holding a tambourine, we can observe that the snare drum posture could be completely useful again. We only have to adapt it for the new instrument. We take the relaxed posture and we put the tambourine in it. The only difference will be that our thumb is going to be straight, due to the form of the instrument. There is not any problem with the hand that strikes the tambourine. We could only remark that this movement should be made in a relaxed way. The most common problems when playing tambourine are related to the fingers and to the tension in the forearm. We should only use tension in this arm in order to get a different sound or articulation in the music we are playing, otherwise we have to make our playing easy.

In relation to the forearm, it is very difficult to find a solution to this tension because we need it to resist the strikes of the other hand and to hold the instrument consistently in a safe way.



Talking about the fingers, we often let them to be straight over the back head of the tambourine. This posture makes us think of them as being in a more comfortable position but this is not true. If we straighten our fingers, we are loosing the point of maximum strength between our fingers and if we press, we start to bend them against the head, dampening the sound of the tambourine and over-stretching the fingers to a posture that could be painful.

Another typical posture more related to tradition or different schools of playing tambourine is also related to the fingers. In this case we normally hold the tambourine but we stretch our fifth finger, the little one. This action gives us more stability when holding the instrument, and allows us to have more control in the shaking rolls, but from an ergonomic point of view is completely wrong. It is very aggressive to the muscles of the small finger, and with postures like that we could end our practice time with an artificially elongated tendon and other muscular compensations in the forearm to this over-stretched posture.



2.3.2. Triangle

Playing the triangle is also very characteristic but in a different way. The way we hold it is very versatile and there are lots of different holdings and ergonomic pinches. The problem comes when we play in the orchestra. We find the same problem with the posture to play triangle as we find with the keyboard instruments. It is really difficult to find a good posture where you can see the conductor, look at the music and have your instrument under control. That is why the usual posture to play is to hold the triangle up in the air positioning the conductor in the triangle and having the music into your viewing angle and hit it with the beater in the other hand. This posture is not ergonomic but so far we have not found any better way.

If we want to have a healthy practice time, we cannot do it all the time as if we were playing in the orchestra. The tension in the external layers of our neck and upper back of the part with which we are holding the triangle, normally the left hand, would be too big to enable us to practice for a long time. Even if we are sitting down this tension is notable, so we have to avoid it as much as possible and use it only when it is needed, like in rehearsals and concerts.

Another direct solution is to use a triangle stand, even during concerts. This is a really easy way, probably an ergonomic research solution, for solving the problem. The triangle hangs on a stand by the pinch and you are free to adopt any posture you want to. You can adapt the height and of course you can pick up the triangle whenever you want. And the most significant change, you can use both of your hands for difficult excerpts, tremolos...

I have realised that many teachers are, surprisingly, against this kind of solution because they find it a lazy and not active way of playing. They argue that playing with the help of the stand makes us losing part of the traditional way of playing triangle and also stopping the development of triangle techniques. I have found that a really good way of practising triangle technique is sitting in a chair, holding the triangle by one of its segments and place it on your leg. With this position you can practice for ours in a relaxed way only thinking on the way you are sitting down. I am not against the stand, though. I think that we have to develop also as musicians and take advantage of every research, especially with ergonomic ones. This comes as a result of my direct connection to many of the teachers trying to avoid the use of the stand.



3. GENERAL SOLUTIONS

Besides the personal solutions that I have written about in this work, I have to say that the best and perfect solution to any kind of problem is to avoid it. That is the reason why I write about warming up and stretching exercises below as a part of general solutions. I have found that warming up every day before the practice time could make us prepare our muscles for the exercise that they are going to work with in the practice session. And a good stretching session afterwards makes our muscles longer, more flexible and ready to rest in a proper way, without any tensions in the inner fibres.

3.1. Warming up

My suggestion is to start from the distant parts to the proximal ones. In this way we will start with warming up the fingers and finish with the back, going through every part: the wrists, elbows, shoulders and neck. First of all we want to prepare our body, also for the warming up, so we start activating our muscular system with a continuous shake of our body. It should not be very strong but constant. This way we are telling our body that it has to be prepared. Something is going to happen.

3.1.1. Upper Limb

1. **Fingers:** We start with passive mobilizations such as circles of the phalanges, rotations and articular stretching; finger by finger. We say that the mobilization is passive when one hand takes the other and provokes the moves. Now we start opening and closing our hands from the tip of the fingers to the palm. After that, we do the same but finger by finger. This is to close one finger, first followed by the next, and so on until all of them are closed. Then we open them in the same way. Once finished, we put our hands and fingers in tension for a few seconds and let them fall relaxed. As the thumb finger has its own group of muscles we should work specifically with them. Specific exercises for the thumb are: circles as if we were counting and pointing to our own nails with the thumb. Creating a circular movement of the thumb. Another one would be with a closed fist, and the thumb following the direction of the first finger.
2. **Wrists:** We move our wrists in all directions, first up and down, slightly to left and right and finally in circles. The basis of this exercise is to keep in mind that the forearm has to be as static as possible.
3. **Elbows:** Holding the right elbow with the opposite hand, then moving the right hand so that you go over and under your left forearm and thereby creating a rotation with your right forearm.
4. **Shoulders:** Move them in all directions. Let them first go up and down. Make circles with them after that, starting with both at the same time and later on with different directions. In fact, we should move them in every possible direction. Also, to warm up the shoulders it is really good to move the whole upper limb so we can work first with the arms in the plane of the chest and raise them up and down straight, and also make big circles with them.

3.1.2. The neck

The warming up of the neck is completely based on all the movements that the neck is able to make. All the movements should be done slowly and under consideration that they are a warm up and not a real workout. We start by slowly bending the neck to the sides, letting the head fall down to the sides and after a few times we change to forward and backward movements. We have to be specially careful with the backward bending, because we are stretching the front part of the neck, a very weak part of our body. After this, we change the movement to torsions, looking to each side with the head and making big circles, after that again being careful with the front side of the neck when we are going to the backside.

3.1.3. The back

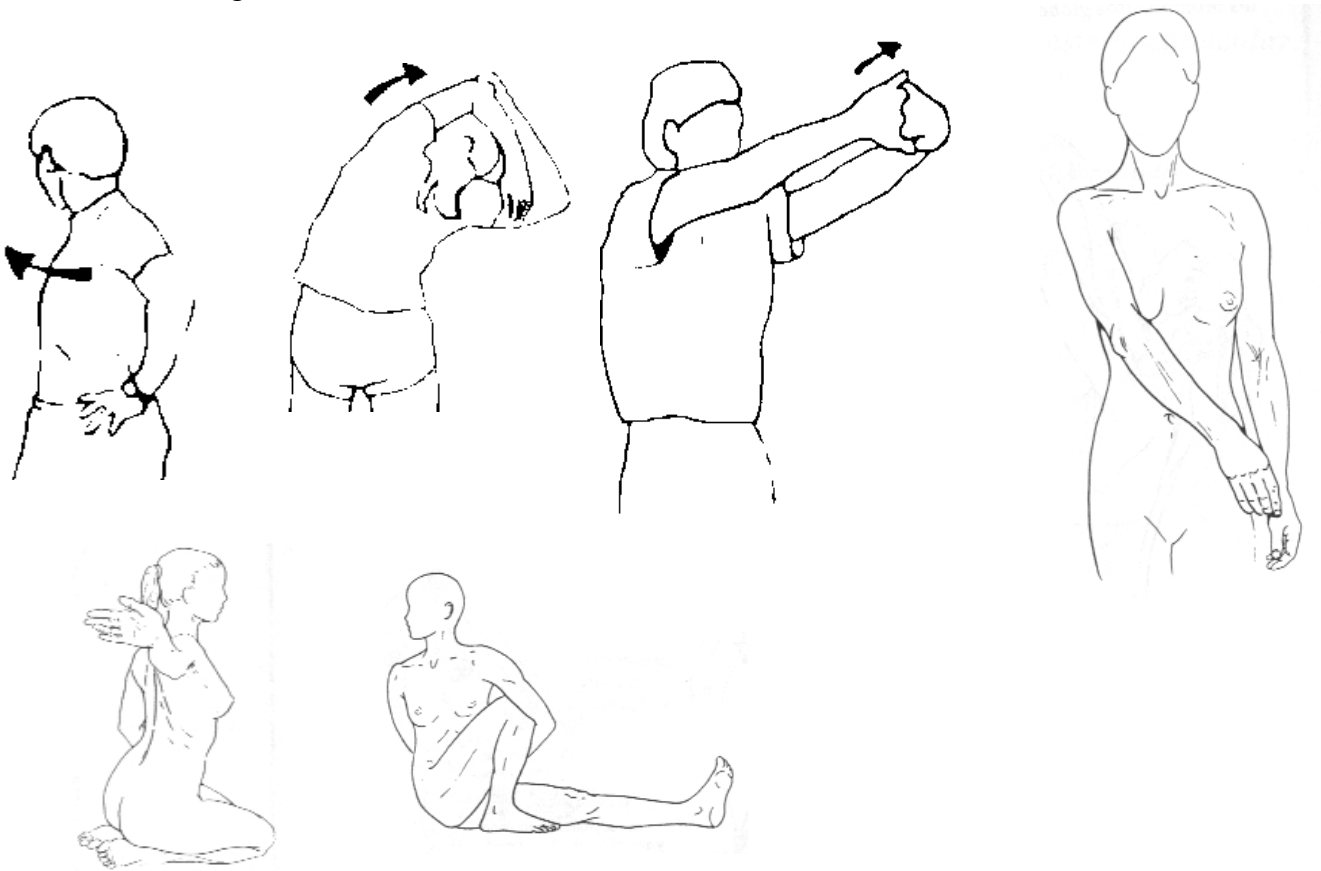
Probably the back is warm enough after all the movements of the shoulders, arms and neck, but to warm up the back specifically, we could make torsions and bends of our chest, letting the arms to continue the movement.

3.2. Stretching

This is a basic suggestion of exercises to do after the practice time, to stretch the parts that we have used in our session. We could follow the opposite order to that we used for warming up. In this way we start stretching big areas as the back, big muscles in the upper part of the upper limb and finish with the small ones in forearms, hands and fingers.

I think that the best way to explain the stretching exercises is a compilation of pictures (see the next page) from various books and web pages⁸ specialised in this subject.

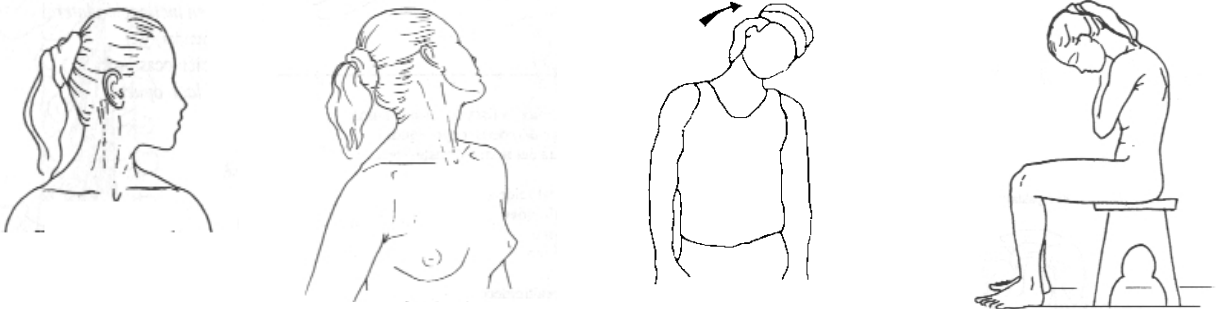
4.2.1. Stretching the back.



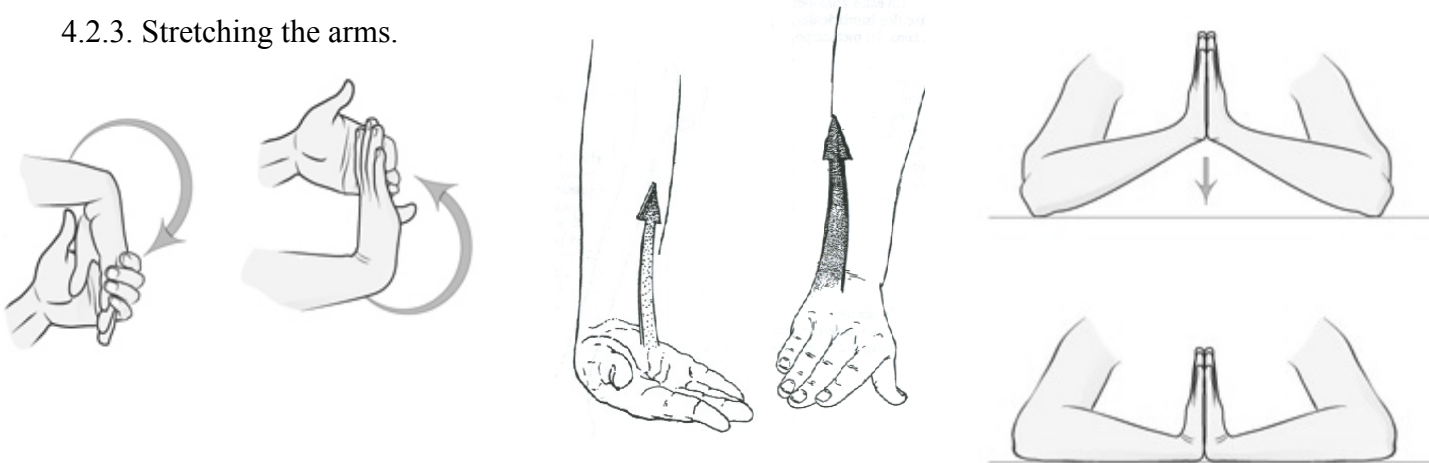
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Stretching and strengthening exercises, Hans Spring, 1991
http://www.ehow.com/how_2048448_stretch-arm-muscles.html

4.2.2. Stretching the neck.



4.2.3. Stretching the arms.



4. SPECIFIC AUTO-MASSAGE SOLUTIONS

As I have been interested in this subject for these two years, I started to go deeply into anatomy and the possible solutions for the pains that we have in relation to the playing of our instruments. I will, based on that, propose a basic auto-massage for some of the problems that I have described in this work, concretely for the upper limb. As all the problems in our bodies are caused by tensions, this massage is basically made to relax the parts of the body that are in tension. Obviously, as an auto-massage you have to be conscious about what you are doing and make it with enough knowledge in anatomy and body manipulation⁹, otherwise it is better to leave it in the hands of a professional. To describe this massage we first have to say that it should be done with calm, slow movements and not trying going deep in any muscular point or tension point. It is really important that we do not touch two certain areas, due to the amount of vascular irrigations, the lymphatic system nodes and unprotected veins. These areas are at the front side of the elbow and the armpit. It is also very important to say that any kind of pain should not be felt in the arm being massaged or in the one that gives the massage. We have to have the arm in a relaxed position and to work with the other hand in a relaxed way and to slowly start doing the different manipulations. Good is to say that a good warm up of the hand and fingers that are giving the massage may help with the work. We can use the same table as we used for the warming up solutions for the fingers and the wrists. I will start describing the manipulations.

⁹ Manual de quiromasaje, M^a José Sarasa Prat, 2007, p. 49

- 1. Frictions:** As the name can tell us this manipulation is simple. We have to make frictions with one hand on the whole opposite limb. We start with the fingers and go up to the forearm, arm and shoulder. In straight lines in every part but on the shoulder we could do it in circles. This manipulation is supposed to warm our muscular system a bit.
- 2. Magnetic sedative contact:** This manipulation is just for making a sedative feeling to our skin sensors. It just consists in softly gliding your hand on every part of the limb in a constant movement in order to stop feeling the external part of the epidermis.
- 3. Digital massage:** This massage is the first manipulation with inner movement. We have to move our hand on the opposite limb and at the same time moving small amounts of muscular material with round movements of the fingers. It does not matter if the movement is perfectly round or not, but it should be constant in the different areas to keep the muscles warm and relaxed.
- 4. Thumb massage:** In the places where we need a bit more pressure of the massage, but never going through the pain, we can use this manipulation that consists in making round movements with the thumb. We will use this technique in the elbows, wrists and shoulders areas.
- 5. Small finger percussion:** This manipulation/percussion is made to go slightly deeper in the musculature and try to relax all of the muscles before we end the massage. The way to make this manipulation is really easy, we only have to think in playing a piano over our own limb and move all over the areas.
- 6. Blood pushing massage:** This is a really important manipulation that will be done as many times as necessary during the massage. This manipulation is made in order to avoid bruises and consists in taking the old blood cumulated in the muscles and to move it in the heart direction so new blood can go in. It should be done in the direction that the blood should have and this is to the heart. In this case the manipulation will be done from the tip of the fingers to the shoulder. We have to hold our opposite hand and slightly press it while we move the hand up to the shoulder. In this way we are taking as much blood as we can. How many times we need to execute this action is up to each individual, but we should do it before and after the manipulations.

Upper limb auto-massage.

The directions in the whole massage are always the same so we will not leave any area forgotten and it will be easier to remember. The massage will start on the tip of the finger and it will finish at the same place. Remember not to touch the forbidden areas. The main objective of the massage is to mobilise the bloodstream and the muscular material, so that we can make the blood move in and out from the muscles and make them relax. To make it really easy I am going to describe a basic pattern that we should follow and we will remember it easily after some times of practice.

Upper limb auto-massage basic frame:

1. Frictions. 1 min.
2. Sedative massage. 1 min.
3. Blood push massage. 2 min.
4. Digital massage. 5 min.
5. Blood push massage. (If needed)
6. Thumb massage. 3-5 min.
7. Finger percussions. 1 min.
8. Blood push massage. 2 min.
9. Sedative massage. 1min.

It should not take more than 15-20 minutes per limb because it could be painful for the hand making the massage. We do not want to relax one arm and at the same time have more tension in the other one.

5. CONCLUSIONS

To finish my thesis work, I think is a good idea to come up with the main thoughts and conclusions that I have had during these two years of research. It has been a long journey, going deep in my way of playing, my postures, and positions and observing and analysing my whole body as a big system of muscles and specifically every muscle on its own. Watching how they act and react when I am playing but also when I am not. But I feel that this journey has been only the beginning of something that will be a part of my life as a musician. This incredibly important thing, that is to be aware of our main tool to play, our main instrument. Our body.

Since a long time ago I have realised that most of the percussion players have, or have had, muscular problems in the upper limbs, some of them have found their personal way to solve it, some others have found a good treatment, and others have had to stop playing. Why is this happening? We are not aware enough about our body and the way it works. We are as active as any professional athlete in sports, but in another way of course. I make this comparison because the practice of music could perfectly well be considered as a sport. Our muscles are under a constant workout during the practice time, and the fact that the movements are not as big as in sports make them even more dangerous. Despite that this is a personal thought, I found this area really interesting and I think that it could be also really interesting for many other percussionists and other musicians. And I say this because I cannot understand why not anatomy lessons, posture education, ergonomics, how to use our body, or any other related subject are part of the basic musical education. This is a real problem in a musician's life and we are not prepared for it.

In this master programme I have had the first lessons in my musical career related to our body (ergonomics A-B). It is a two level normal movement lesson on how to have our body active and prepared for the practice time. One of them puts some more emphasis on strengthening our back and the basic muscles that are commonly used everyday, and the other one is more related to focusing, relaxing, breathing, stretching and on lower motion and action movements. We are not learning directly how our body does work when we are playing, but the lessons increases our interest about that. We know a lot more about how to warm up and stretch our muscles and for me personally, it has been the first time I really was aware of how I move everything or how far I can go with my practice before I get pain in my back, arms...

And I find this idea really important because I have had many muscular problems related to the different percussion techniques, but I have never tried to find a solution to them. Nor have I started to think about the reliability of the technique that I was using when playing. We are human beings and we are all different, psychologically as well as physically. This is to say that there are no perfect techniques for anything. Maybe some of them are perfect for some people, maybe the best players play with this or that technique, but the most important thing that I found writing this work in these last two years, and practising and working with my teachers, is that we have to be flexible, we have to find our own technique no matter if no one else uses it nowadays. The most important thing is that it works for us and that we can continue with our development and improve bit by bit. In fact, this is to find a good balance between all the techniques surrounding you, and your own one. Just listen to your body and do not try to make our job harder. If something is painful just avoid it and if some other thing works, keep it.

I am very thankful to my teachers of the master programme that have been teaching me in this way. It was the first time that I was asked by a teacher to find my own technique. To try to develop new ways of playing without loosing anything that I already had, using his technique but not following it because it is the best way of playing. Only try to add new skills and knowledge to my self-experience. It is a really good way of teaching and despite of the freedom that it gives you, it also has the powerful characteristic of letting you learn how to be an individual being, how to solve your problems and how to take advantage of your time.

As I wrote before, this thesis work is the beginning of something that really interests me. Now that I am looking back to my work I start to find that it could be much deeper and more complete, it is definitely a new interest in my musical life and I think that I will continue with a deep research in this area, something that could help a lot of people, as it has to myself.

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