

Design And Fabrication of Orthopedic Knee Supporter

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Abstract

We designed a knee support for people with knee problems like polio, muscular dystrophy or those who had knee surgery. Most knee braces are either too stiff or too flexible. Our device provides stability, comfort and some movement. The knee support has a two-part metal frame made of steel that supports the thigh and calf. The frame is strong, durable and resistant to rust. It also has padding and foam to make it comfortable and reduce skin irritation. A special locking mechanism helps to secure the knee when standing or walking. It also allows for some bending when needed, like when sitting or exercising. The knee support works well for rehabilitation. Helping people be more independent. However, it can be damaged easily. Gets hot. We plan to improve it by using materials that breathe well and absorb shocks. The knee support can help people with conditions such, as sclerosis, spina bifida, Charcot-Marie-Tooth disease or spinal cord injury. It can also help people who are recovering from knee surgery and ligament damage.

Key Words: mobility assistance, knee stability, locking mechanism.

1. INTRODUCTION

Orthopedic knee support devices are really important for people recovering from things like polio, muscular dystrophy and spinal cord injuries. The knee has to support a lot of body weight so when it gets hurt or weak it needs help to heal properly. Old style braces are not very good because they are either too stiff or too loose which makes it hard for people to move around on their own. The new orthopedic knee support system is better because it is strong and flexible at the time. It has a special frame made of Stainless Steel 304 that helps spread out the body weight. It has soft padding to make it more comfortable. The square hole and key locking mechanism is an idea: when you are standing or walking the frame locks in place to keep the knee steady and when you take out the key you can bend your knee up to 60 degrees to sit down or do exercises. This design helps people be more independent while they are recovering. There are still some problems like it can be uncomfortable if you get a sudden shock and the padding can get too hot. The orthopedic knee support system is a solution because it is affordable and it helps make the knee stronger which is important for orthopedic knee support. The orthopedic knee support devices will keep getting better with materials that can breathe and absorb shocks.

2. LITERATURE SURVEY

Hand Transplantation and Vascularized Composite Tissue Allografts in Orthopedics and Traumatology. Hand transplantation and vascularized composite tissue allografts are really surgeries that help people get their limbs back. This is done by using tissues from donors like bones, skin, muscles, nerves and blood vessels. These surgeries can really help people who have lost a limb they can make them feel better and

be able to do things. It is a lot better than using a prosthetic limb. There are some big problems with these surgeries like the person has to take medicine for the rest of their life to stop their body from rejecting the new limb. There is also a risk that their body will reject the limb and that is very serious. Hand transplantation and vascularized composite tissue allografts have changed the way doctors help people who have lost a limb. These surgeries can help people feel better physically and emotionally. Even though hand transplantation and vascularized composite tissue allografts are very expensive and can be risky doctors are working to make them safer and more available to people who need them. They are trying to find ways to do the surgeries and to help peoples bodies accept the new limb. Hand transplantation and vascularized composite tissue allografts are really important for people who have lost a limb. They can make a big difference, in their lives. Hand transplantation and vascularized composite tissue allografts will keep getting better and better.

Early Results of Knee Replacement Surgery Using a New Method. Knee replacement surgery is being done in a way to make the knee work naturally. This method, called caliper-verified alignment uses special tools to make sure the bones are cut just right. It also uses a kind of implant that is designed to make the knee feel more stable and move more naturally. This approach is different from the way of doing knee replacement surgery. The new method helps to keep the knee stable allows for movement and reduces pain. Patients are also more satisfied with the results. The goal is to keep the knees balance. Early results show that this new method of knee replacement surgery works well. Patients are able to recover and get back to their activities faster. They also report feeling better and having pain. The knee feels more natural. However, there are still some challenges, like surgeons needing to learn the technique and choosing the right patients. Despite these challenges this new approach shows promise, for improving the long-term results of knee replacement surgery.

Machine Learning Classification of Knee Diagnosis Through Computer-Assisted History Taking. Machine learning is changing the way doctors diagnose knee problems. They use computers to ask patients questions and get answers that help figure out what's wrong. This helps doctors find out if patients have osteoarthritis, meniscal injuries or ligament tears. It makes it easier for doctors to decide who needs to be seen. It also helps doctors do their jobs efficiently and makes it easier for patients to get medical help remotely. Using machine learning to help doctors take histories can make it easier and faster to diagnose knee problems. It can help doctors make mistakes and make patients happier. There are still some challenges like getting the system to work with existing equipment getting doctors to use it keeping data private and making sure the system is fair. If these challenges can be overcome machine learning can become a valuable tool, for doctors who specialize in bones and joints.

Bilateral Knee Fracture Dislocation with Multi-Ligament Insufficiency: A Rare Case Report. I want to talk about knee fracture dislocation with multi-ligament insufficiency. This is a rare and serious knee injury. It usually happens because of an accident or something that hits the knee really hard. This case is special because it shows how hard it is to figure out what is wrong and how to make it better. The patient needs to get help away to stop the knee from getting worse. They need to get pictures of the knee to see what is broken and then have surgery in steps to fix everything. After that they need to work with a team of people to get their knee working again and prevent problems. To fix multi-ligament knee fracture dislocations the patient needs to get help early. They need to have surgery that's just right for them and then work really hard to get better. There are risks like nerve damage, stiffness and arthritis but the patient can still get better if they get good care from their doctors and therapists and if they are committed to getting better for a long time. Bilateral knee fracture dislocation with -ligament insufficiency is a serious condition but with the right help patients can recover and get back to normal. Bilateral knee fracture dislocation, with ligament insufficiency requires a lot of work to fix but it is possible to get good results.

A New Way to Do Medial Uni compartmental Knee Arthroplasty Surgery. Medial uni compartmental knee arthroplasty surgery is a way to fix a knee. The new way to do this surgery is called calipered alignment. This method helps the doctor fix the knee so it works like it did before it was hurt. The doctor uses tools to cut the bone just right and put the new parts in the correct place. This way the knee can work like it is supposed to. People who have this kind of surgery can. Move around better. They are also happier with the results. The old way to do this surgery was to use a method. This new way is better because it helps the doctor get everything just right. The knee works better. The person can get back to their normal life faster. This new way to do uni compartmental knee arthroplasty surgery is better. The doctor can do a job and the person can heal faster. There are still some things to learn about this method. It seems like it might be the best way to fix a bad knee. Medial unicompartmental knee arthroplasty surgery with calipered alignment is a good choice for people with bad knees. It helps them get back, to their life.

3. METHODOLOGY

The orthopedic knee support system is made to be simple and easy to use for patients who are getting better from knee problems like Polio, Muscular Dystrophy, Multiple Sclerosis and other conditions. It has a lock that helps keep the knee steady when you are standing or walking. This lock is like a hole and key that keeps everything in place so you do not strain your knee and you stay safe. The orthopedic knee support system is made up of two parts that fit around the lower leg. These parts are made carefully to give you balanced support and comfort. You can take out the locking key, which lets your knee move up to 60 degrees so you can sit down or do exercises to get better. There is also a guiding plate that keeps the safe so it does not come loose by accident. This makes the orthopedic knee support system even safer. It is strong does not cost much and is easy to take care of because it does not have complicated electronic parts. The orthopedic knee support system is very good for patients who are getting better from injuries like torn ligaments or broken bones. It helps patients move around more

as they get better. The orthopedic knee support system is made well is strong and is comfortable, for patients. It helps patients be independent and get faster by keeping their knee steady and letting them move around carefully. The orthopedic knee support system is made to be used times without losing its effectiveness. It is a solution that makes patients safer more comfortable and helps them get better. Overall, the orthopedic knee support system is a cost-effective way to make the knee stronger and help patients move around again as they recover.

4. SPECIFICATION OF DEVICES

- **FRAME**
- **PADDINGS**
- **FOAM**
- **LOCKINGS**

4.1 FRAME

The frame is the part of the knee support device. It holds everything together. Supports the leg. It needs to be strong long-lasting and comfy so it can handle the pressure of standing and walking. This keeps the patient safe while moving around. The frame helps spread the body weight evenly. This reduces strain on the injured knee. Makes it more stable. The device has two parts to the frame: the top part goes around the thigh. The bottom part supports the calf. This design fits the shape of the leg. It improves how well it fits how stable it is and how easily the patient can move. The top and bottom frames work together to balance the patient's weight. This makes getting better safer and more effective. The frame has padding attached to it. This adds comfort reduces pressure on the skin and prevents irritation. The frame is made from Stainless Steel 304. This makes it strong resistant to corrosion and long-lasting. Its smooth surface reduces the risk of injury. Makes it easy to clean. This is important for keeping things hygienic. Stainless Steel 304 also makes the device affordable, without sacrificing safety or quality. The frames careful engineering, durability and comfort make the knee support device reliable and affordable. It helps patients feel safer move better and get better.

4.2 PADDINGS

The orthopedic knee support device has a padding system that's very important for the patient. The padding system makes sure the patient is comfortable, safe and can recover from their injury or surgery effectively. The padding system is where the frame of the device touches the leg. It helps reduce the pressure on the skin stops irritation and protects the skin from the metal frame. The padding system is like a cushion it takes in the force. Spreads the weight evenly so the patient can move around stand up or exercise without feeling any discomfort. This is very important for getting better after an injury or surgery because it keeps the leg in line with the frame and stops it from moving too much. The material used to make the padding system is polypropylene. This material is chosen because it is strong, flexible and not too expensive. It is also very light. Can withstand a lot of pressure and movement without losing its shape, which makes it perfect for using over a long period of time. Polypropylene can also handle sweat and humidity. Its surface is smooth so it does not rub against the skin. The padding system made of polypropylene is easy to clean which

reduces the risk of bacteria growing on it and the material getting damaged. One of the things about polypropylene is that it can be shaped to fit the patient's leg exactly. This makes the orthopedic knee support device more comfortable and effective for the patient. The padding system can be made to meet the needs of each patient. Polypropylene is a cost- material that is also very durable which makes orthopedic devices more affordable without reducing the quality. The padding system in the knee support device makes the patients experience better by making sure they are comfortable, stable and safe. The device has a frame made of stainless steel and the padding system works together with the frame to make the device cost-effective, hygienic and very beneficial for recovering from an injury or surgery over a long period of time. The orthopedic knee support device with the padding system is a tool, for patients who need to recover from an injury or surgery. The padding system and the stainless-steel frame of the knee support device work together to help the patient get better.

4.3 FOAM

The foam system is an important part of the knee support device. It helps patients feel comfortable protected and able to use the device during their recovery. The frame gives strength and the padding spreads out the weight. The foam is the soft part that touches the patient's leg. The foam's main job is to cushion the skin take in pressure reduce rubbing and make it comfortable to wear for a time. Without foam the hard frame could cause irritation, pain or injury. High-quality foam made from neoprene is used for this design because it cushions well is flexible and lasts long. It reduces pressure points prevents skin damage and makes it more comfortable when standing, walking or exercising. One of the benefits of neoprene foam is that it absorbs sweat keeping the leg dry and reducing the risk of smell, bacterial growth or the device slipping. This helps keep things clean and makes it easier to wear the device for a time. Neoprene foam also fits the patient's leg well providing a fit that spreads out force evenly and reduces the risk of pressure sores. It can handle being compressed times without losing its shape ensuring it works well throughout recovery. Also, it helps keep the temperature stable reducing stiffness and making recovery more comfortable.

4.4 LOCKINGS

The orthopedic knee support device has a locking mechanism that's very important. This locking mechanism is designed to keep the knee stable and help it move in a controlled way when someone is getting better. The main job of the locking mechanism is to keep the frame of the device locked when the patient's leg is straight. This helps keep the patient safe when they are standing or walking or doing exercises to get better. At the time the locking mechanism allows the patient to move their knee a little bit. The patient can unlock the frame. Bend their knee up to 60 degrees when they need to sit down or rest or do special therapy exercises. This is good because it gives the patient some freedom to move their knee while still keeping them safe. The locking mechanism works with a hole and key. A hole is made in the frame of the device where the knee bends. A special key is made to fit into this hole. When the patients leg is straight the two parts of the frame line up and the key can lock them together. When the patient takes the key out the lock. The knee can move naturally again. One good thing about this

design is that patients can use it by themselves. They do not need anyone to help them. The locking mechanism is also reliable and affordable and easy to take care of. This makes it a good choice for patients who need to use it for a time to get better. The locking mechanism is simple. It works well and it helps patients feel safe and confident and get better faster. The orthopedic knee support device with the locking mechanism is a tool, for patients who are recovering from a knee injury. The locking mechanism of the knee support device is very helpful.

5. DIMENSIONS

5.1 FRAME -TABLE 1

Upper Frame	L=310	B= 20	T= 10	OD= 25
Lower Frame	L=200	B=20	T= 4	OD=25

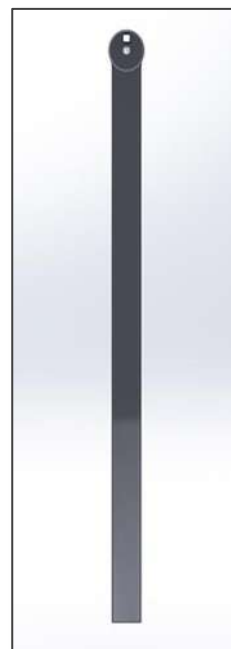


Fig 1.1 Upper Frame

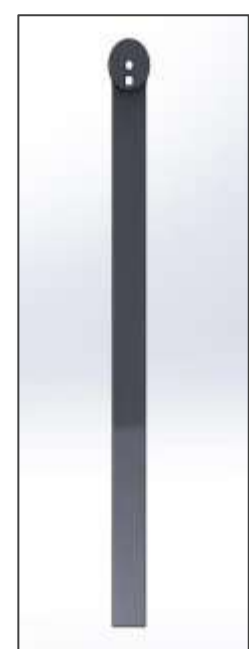


Fig 1.2 Lower Frame

5.2 PADDINGS - TABLE 2

Upper padding	L=290	T=4	ID=168	OD=175
Lower Padding	L=180	T=4	ID=168	OD=175



FIG 2.1 UPPER PADDINGS



FIG 2.2 LOWER PADDINGS

5.3 LOCKINGS - TABLE 3

L= 20	Square= 5 X 5
Grip = 2	OD= 8



FIG 3 LOCKINGS

6. CALCULATIONS

6.1 SHEAR STRESS:

$$P = \tau \times \text{Area}$$

$$P = 45 \text{ kg} = 45 \times 9.81 = 442 \text{ N}$$

$$\tau = 240 \text{ N/mm}^2$$

$$442 = 101 \times \pi / 4 \times d^2$$

$$d = 4.2 \text{ mm}$$

$$d = 8 \text{ mm in locking}$$

$$\tau = 442 / 1.96 \times 10^{-3}$$

$$\tau = 225 \text{ N/mm}^2$$

6.2 BENDING STRESS

$$P = \sigma_b \times \text{area} \times \text{thickness}$$

$$442 = \sigma_b \times \pi / 4 \times d^2 \times t$$

$$\sigma_b = 442 \times 4 / 1.96 \times 10^{-3} \times 0.020$$

$$\sigma_b = 45 \text{ N/mm}^2$$

$$\text{material bending stress} = 310 \text{ N/mm}^2$$

6.3 BUCKLING LOAD

$$PE = 4\pi EI / Le^2$$

$$I = bh^3 / 12$$

$$Le = L / 2$$

$$PE = 81.2 \times 10^3 \text{ N}$$

$$PR = \sigma_c \times A / 1 + a [le / k]$$

$$k = \sqrt{I / A}$$

$$\sigma_c = P / A$$

$$A = 20 \times 4 = 80 \text{ mm}$$

$$k = \sqrt{1.0667 \times 10^{-10} / 0.080} = k = 3.65 \text{ m}$$

$$PR = 396.69 \text{ N}$$

6.4 SCREW LOAD CALCULATION

$$F = \tau \times A$$

$$F = \tau \times [\pi / 4 (d^2)]$$

$$\text{Root diameter,}$$

$$d = 8.2 \text{ mm}$$

$$F = \tau \times A = 375 \text{ N/m} = 378 \text{ N/m}$$

SHEAR STRESS	$\tau = 225 \text{ N/mm}^2$
BENDING STRESS	$\sigma_b = 45 \text{ N/mm}^2$
BUCKLING STRESS	$PE = 81.2 \times 10^3 \text{ N}$ $PR = 396.69 \text{ N}$
SCREW LOAD CALCULATION	$F = 375 \text{ N/m}$

CALCULATION - TABLE 4

7. ASSEMBLY

Full assembly of orthopedic knee support.



FIG 4 ASSEMBLY

8. LIMITATIONS

The orthopaedic knee support device has a problem. It can get damaged easily when something unexpected happens like when you slip on the stairs, trip or sit down fast. If something hits the device hard the locking system can get too much stress. This can cause pain make the device unstable or even break the locks. For instance, if you slip on the stairs the device can get much pressure and the frame or the lock can get strained more than it should. The same thing can happen when you sit down quickly or in a way. If the lock does not open properly or if you do not remove the key on time, it can be uncomfortable. Limit how you can move. These kinds of things can make the device not work well as it should and can even cause more injuries if you are not careful. So even though the device helps you move safely and steadily you have to be careful when you move suddenly. Maybe someday they will make the device better so it can handle shocks and move smoothly which will make it safer to use. The orthopaedic knee support device needs to be able to handle these kinds of situations. The orthopaedic knee support device should be used with caution.

9. CONCLUSION

In conclusion this knee support device helps patients move better get faster and have more stable knees. It has a frame, soft padding and good cushioning to support the knee during recovery from injuries, surgeries or weakness. The device keeps the leg in the position reduces pressure on the knee and gives the knee the strength it needs to support the body while standing and walking. The locking system keeps the knee stable when the leg is straight. The controlled bending feature helps with flexibility during exercises and daily activities. This balance between support and movement helps patients recover safely and be more independent. The knee support device not makes the knee stronger and protects it but also makes patients feel more comfortable, confident and able to move around easily. It is a solution for knee rehabilitation and long-term care. The knee support device provides the support, for knee joint knee support device helps patients knee support device provides.

10. FUTHER STUDY

The orthopaedic knee support device needs to be made comfortable for patients. This is especially true for the padding system in the device. When patients use the knee

support device in the summer the padding can get too hot. This makes patients feel uncomfortable when they wear the device for a time. The heat from the padding can also make patients sweat a lot, which can irritate their skin. As a result, patients may not want to wear the device all the time. This can be a problem because it can slow down the patient's recovery and make them unhappy with the device. We should do research on the orthopaedic knee support device to make it better. We need to find materials for the padding that will let air pass through and keep patients cool and dry. If we can find materials that let air in or materials that can control temperature this would be great. These materials can make the orthopaedic knee support device more comfortable reduce sweat and make patients happier with the device.

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