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Lumbar Spine Surgery

Non-Accidental Injuries

Highlights

Old and New Exercises

Therapy and Prophylaxis

Discovering Thoughts, Inventing Future

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Therapy and Prophylaxis of the So – Called Idiopathic Scoliosis. Old and New Exercises. Results. Examples

By Karski Jacek & Karski Tomasz
Medical University in Lublin, Poland

Introduction- Till 1995 the aetiology of idiopathic scoliosis was no found and treatment by extension exercises was the most common method of therapy. The observation about scoliosis are finished in 2007 – T. Karski. On basis of ours observations (1985 – 2014) we can underlined that all extension exercises, other name - strengthening exercises, were and still are - wrong and harmful. All patients coming to our Department after such previous therapy suffered from huge deformities, bigger humps and stiffness of the spine. To explain these undesirable results of the treatment the term "the natural history of scoliosis" was coined. We studied that all strengthened exercises other name extensions exercises, in prone position exercises, "muscle corset" making exercises, were only bad, making huge iatrogenic deformity of spine and trunk.

Keywords: so-called idiopathic scoliosis, treatment, old and new exercises.

GJMR-H Classification: NLMC Code: WD 205, WE 735

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Therapy and Prophylaxis of the So – Called Idiopathic Scoliosis. Old and New Exercises. Results. Examples

Karski Jacek [α] & Karski Tomasz [σ]

Keywords: so-called idiopathic scoliosis, treatment, old and new exercises.

I. Introduction

a) Exercises in scoliosis in past time

Till 1995 the aetiology of idiopathic scoliosis was no found and treatment by extension exercises was the most common method of therapy. The observation about scoliosis are finished in 2007 – T. Karski. On basis of ours observations (1985 – 2014) we can underlined that all extension exercises, other name - strengthening exercises, were and still are - wrong and harmful. All patients coming to our Department after such previous therapy suffered from huge deformities, bigger humps and stiffness of the spine. To explain these undesirable results of the treatment the term "the natural history of scoliosis" was coined. We studied that all strengthened exercises other name extensions exercises, in prone position exercises, "muscle corset" making exercises, were only bad, making huge iatrogenic deformity of spine and trunk.

b) New tests for scoliosis as the condition of proper diagnosis

The test for scoliosis are presented in other article. Here we would like to repeat some importance information. In the diagnosis of scoliosis we should use known old tests (Adams & Meyer test) but also new tests such as side bending test for scoliosis, checking of habit of standing (right versus left leg), Ely-Duncan test (other name - Thom test, other - Staheli test), pelvis rotation test (new test – 2006), adduction of hips test – similar to Ober test" and others, presented in others article in detail. Only such precise examination can detect the beginning stadium of scoliosis.

c) Old and new rehabilitations exercises – general information

Firstly, it must be stated that all extension exercises, all so - called strengthening exercises were and are wrong and harmful (Fig. 1, 2). All patients after such therapy were only with fix and big deformity (Fig. 3, 4, 5).

The proper solution of the spinal problem, in our opinion, is an early prophylactics based on the biomechanical etiology of scoliosis. The therapy must be based on the new exercises which are beneficial for the treatment but especially for prophylaxis of scoliosis. They include all exercises removing contracture in the region of hips, of pelvis and in the whole spine such as flexion - rotation exercises practiced as early in life as the age of 3 or 4 (Fig. 6, 7, 8, 9, 10). Very important aim of the therapy is to restore the full and symmetrical movement of both hips in very early period of life of children to prevent the start and progress of scoliosis.

d) General outline for the new rehabilitation exercises

The proper solution for the spinal problem is an early prophylactics based on the biomechanical aetiology of scoliosis. New exercises are beneficial both for the treatment and the prophylaxis of spine deformity. They include all exercises removing contractures in the region of the hips, of the pelvis and in the spine such as flexion - rotation exercises practiced as early in life as 3 or 4. All relaxation exercises which remove abduction, external rotation and flexion contracture of the right hip, as well as all exercises removing contracture on the concave side of curves are very useful. Additionally, it is important to stand 'at ease' on the left leg instead of the right, next - to relax and sleep in foetal position and to practice sport, especially involving stretching for example karate, taekwondo, aikido, yoga and other.

e) The results of the new therapy (Fig. 11, 12, 13, 14)

The results statistically were presented on the material from years 1985 - 2005 (published in 2005 in "Pan Arab Orthop Journal" – *T. Karski* and in "Ortopedia. Traumatologia. Rehabilitacja", Poland – 2005 - *Karski T. and team*). The article published in 2005 described the material covered 434 randomly chosen case histories and in the other article published in the same year covered the material of 629 randomly chosen case histories ("Ortopedia. Traumatologia. Rehabilitacja" [Polish]). The results presented in next years of our research in the publications in USA, in Spain, in materials of IRSSD Congresses (2012) were in percentage similarly like in this presented articles.

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f) The results in I epg group of scoliosis

The following results were in I epg "S" primary double scoliosis. Character of this scoliosis: stiff spine and with rib gibbous on the right side, are following:

a) In 18% of children after 2 – 3 years of treatment we see normal axis of spine. In this group were children with incipient scoliosis and first stage of curvature according Cobb. These children were not primary treated by incorrect, wrong exercises outside of our Department.
b) In 60% of children after 2 – 3 years of treatment we see decreasing of curves. In this group were children with 1st and 2nd stage of curvature according Cobb. These children were not primary treated by incorrect, wrong exercises outside of our Department.
c) In 9% of children we noticed stop of progression. In this group were children with 1st and 2nd stage of curvature according Cobb. These children were primary treated by incorrect, wrong exercises outside our Department, some month till one year.
d) In 13% of children we see progression. These children were primary treated by incorrect, wrong exercises outside our Department, some years.

g) The results in II epg group of scoliosis

We present the results in II/A epg "C" scoliosis – one curve deformity and in II/B epg "S" scoliosis, with thoracic curve secondary. In this group of scoliosis the spine is flexible.

a) In 39% of children, there were normal axis. In this group were children with 1st and 2nd stage of curvature according Cobb. These children primary were not treated by incorrect, wrong exercises outside of our Department.
b) In 32% of children we see decreasing of curves. In this group were children with 1st and with 2nd stage of curvature according Cobb. These children primary were not treated by incorrect, wrong exercises outside of our Department.
c) In 26% of children we noticed stop with progression. In this group were children with 1st and with 2nd stage of curvature according Cobb. These children primary were treated by incorrect, wrong exercises outside our Department, some month.
d) In 3% of children there were progression. These children primary were treated by incorrect, wrong exercises outside our Department, some years.

II. Conclusions

1. The old, previous extensions or strengthened exercise in treatment of scoliosis were not proper, they lead to bigger deformity, to bigger the rip gibbous, to more rigid spine.
2. The term "the natural history of scoliosis" to explain the bad results of therapy of scoliosis, really were the result of improper treatment and they present the iatrogenic deformity.
3. The stretching exercises leading to full and symmetrical movement of hips and of spine are only one proper method of therapy of the so-called idiopathic scoliosis.
4. Children endangered with scoliosis should stand more or only on left leg.
5. The standing 'at ease' on the left leg and all sport arts from far Asia (from Japan, Korea, China, India) are very useful for therapy and for prophylaxis of spine deformity.
6. All children should sit in relax position – never in strait up position.
7. They should sleep in embryo position.
8. The causal prophylaxis should be introduced to all children in their very early period of life – it's mean in 3rd – 5th years, in all countries of the world.

II. Literature

See article about etiology of scoliosis and in www.ortopedia.karski.lublin.pl

Figures

Figure 1 : Wrong, improper exercises

Figure 2 : Wrong, improper exercises

Figure 3 : Results of wrong, improper exercises

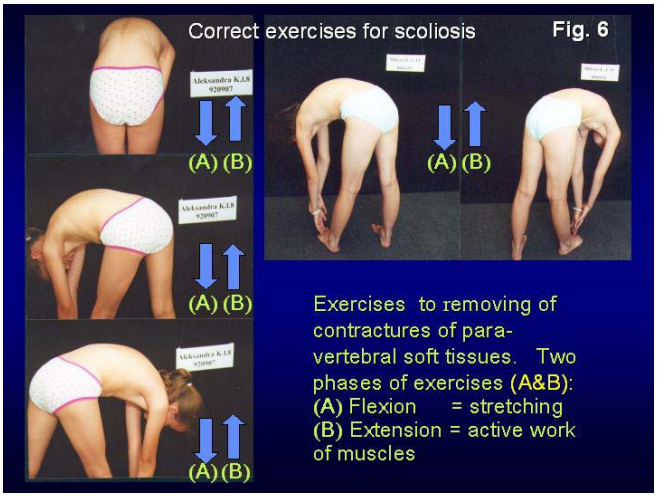

Figure 6 : New exercises for scoliosis

Figure 4 : Results of wrong, improper exercises

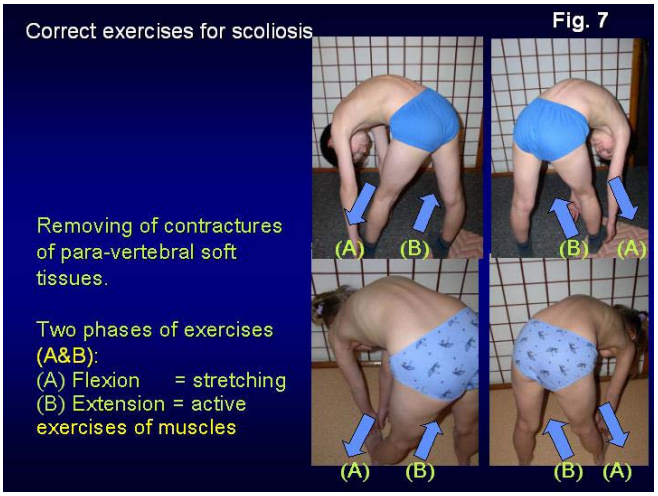

Figure 7 : New exercises for scoliosis

Figure 5 : Results of wrong, improper exercises

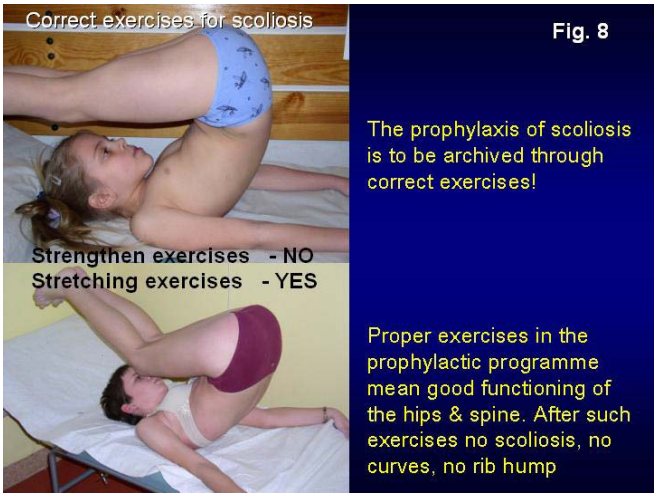

Figure 8 : New exercises for scoliosis

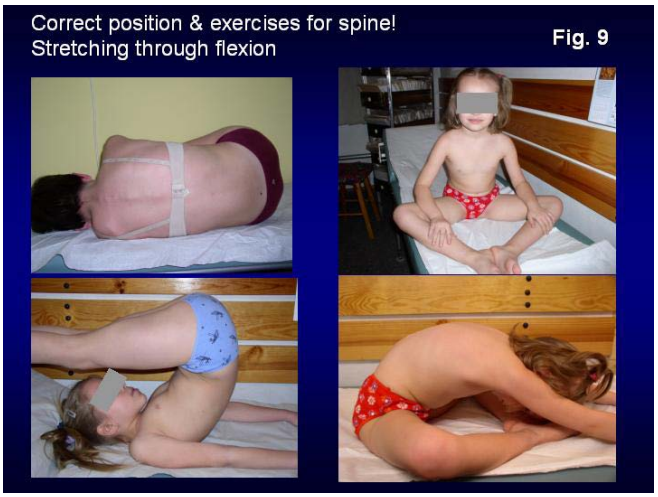

Figure 9 : New exercises for scoliosis

Figure 12 : Results after new exercises for scoliosis

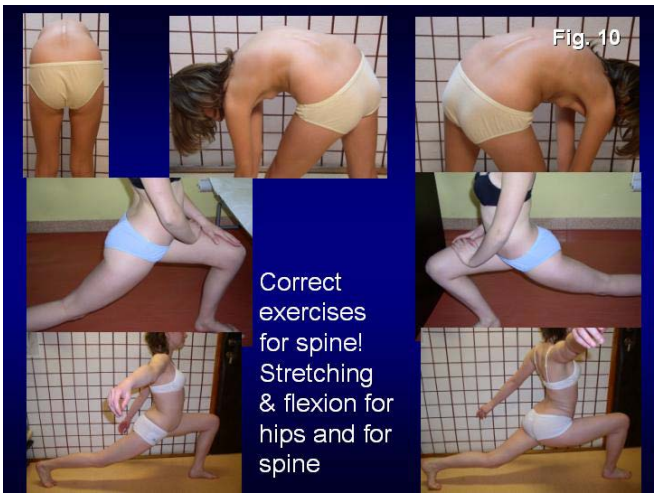

Figure 10 : New exercises for scoliosis

Figure 13 : Results after new exercises for scoliosis

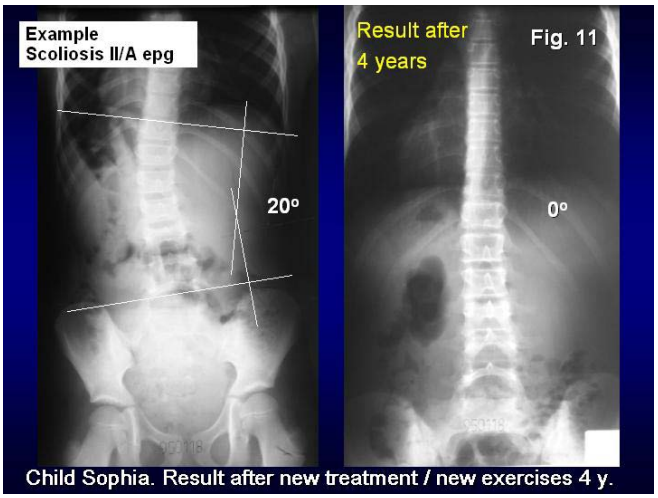

Figure 11 : Results after new exercises for scoliosis

Figure 14 : Results after new exercises for scoliosis

III. Acknowledgement

We would like to express ours many thanks to Katarzyna Karska MA for her help to correct the text.

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Lumbar Spine Surgery Outcome: Effect of Regional Anaesthesia

By Dr. Vishal Moudgil & Dr. B.S. Bajwa
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Abstract- Either general or regional anesthesia can be used for spine surgery. Spine surgery involves acomplex procedure. The aim of a spine surgeon for doing a good surgery requires a clear and bloodless field especially in procedures done under microscope. As the working space is less a small epidural bleed can cause further complications in surgery. Another aspect is to take care of post operative analgesia which is better achieved with regional anaesthesia. Regional anaesthesiahas many benefits, namely less time, lower incidence of nausea and vomiting ,general hazards of general anaesthesia can be avoided and cost effectiveness. This article reviews effect of regional anaesthesia on lumbar spine surgery.

Keywords: *anesthesia, general, spinal, lumbar surgery.*

GJMR-H Classification: *JEL Code: WE 725*

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Keywords: anesthesia, general, spinal, lumbar surgery.

I. Introduction

An acceptable anesthetic technique must have characteristics such as rapid onset and reversal of effects, it must maintain stable hemodynamic during operation without need to increase blood transfusion and an excellent anesthetic must decrease recovery room stay while reduce postoperative pain, nausea, vomiting, and requirement for additional analgesics.

Surgery on lumbar spine can be safely performed under general or regional anesthesia. Patient's satisfaction and the ability to carry out prolonged operations in the prone position without airway compromise are advantages of using general anesthesia (GA). Alternatively, the most important advantages of regional anesthesia are the decrease in intraoperative blood loss and consequently improving operating conditions, the decrease in perioperative cardiac ischemic incidents, postoperative hypoxic episodes, arterial and venous thrombosis, and to provide proper postoperative pain control. Additionally, in order to prevent brachial plexus injury and pressure necrosis of face, it is better if patients can position themselves while they are awake. This is possible only with spinal anesthesia (SA).

Reviewing the medical literature, there are controversies whether regional or general anaesthesia offers these advantages for lumbar spinal surgery. Sadrolsadat et al2 conducted a prospective study and showed that in contrast to the previous studies that revealed spinal anaesthesia was better than general anaesthesia for patients lumbar spine surgery, spinal anaesthesia had no advantages over generalan-aesthesia. Their prospective study showed that general anaesthesia has many advantages over spinal anesthesia. However, they recommend further studies for elucidating the advantages of each technique. Scott et al 1showed, pulmonary complications were more common in patients underwent GA compared with regional anesthesia. Two retrospective studies shown that SA resulted in better outcome compared with GA in patients underwent surgeries on lumbar spine[1,3],.

In our clinical experience, it seems that patients who underwent lumbar spine surgery with regional anaesthesia have less adverse effects and has more advantages as compared with general anaesthesia. This is in accordance with the most previous studies but is opposite to Sadrolsadat et al study.

A, little overview of lumbar spine disorders and various surgeries done for them is covered below.

II. Clinical Features of Spinal Disorders

a) *Intervertebral disc lesions*

Prolapsed discs: lumbar backache is one of the most common causes of chronic debility. Acute lumbar disc prolapse or chronic degeneration with disc-space narrowing at L4/5 or L5/S1 are the most common pathologies[3].The annual incidence of low back pain is estimated at 5%, but only 1% develops radiculopathy.[4] In acute prolapse, the disc may bulge beneath the posterior longitudinal ligament in the mid line (central disc) or posterolaterally with consequent distortion of the spinal canal or nerve-root compression. Local oedema may exacerbate the problem. Symptoms result from distortion of the posterior longitudinal ligament (chronic pain), pressure on the nerve-root sheath (sciatica) and compression of the nerve itself (muscle weakness, numbness and paraesthesia). Caudaequina com-pression may cause urinary retention, but is relatively uncommon. Management includes rest, analgesia and physiotherapy, epidural injections of steroid and local anaesthetics appear to help some patients and a prospective, randomised, controlled, double-blinded study has shown theefficacy of selective nerve root blocks of patients with lumbar radiculopathy and/or

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stenosis. Less than 2% of symptomatic patients undergo operative treatment5.Surgical intervention is best directed at those with unremitting nerve root symptoms. Urgent surgical intervention is required in those with acute caudaequina compression or significant acute motor deficit (e.g. foot drop). However, urgent decompression once urinary retention and overflow incontinence has occurred seems to confer little benefit.6

Spondylosis: Recuurent disc prolapses can lead to lumbar disc degeneration resulting in flattening of the disc, facet-joint displacement, and a degree of instability with limited and painful movement. In addition to disc flattening, bony spurs may grow at the margins of the vertebral bodies, impinging on nerve roots and producing symptoms. Physiotherapy[7] is the mainstay of treatment, but in severe or refractory cases anterior spinal fusion may be the definitive option.

Spondylolisthesis: Following osteoarthritic changes, dysplasia or fractures of intervertebral facet joints may lead to forwards lipping of one vertebral body on the other. Levels commonly involved are L4/5 and L5/S1. Mostly asymptomatic, but the resultant loss of canal and foraminal diameter can both precipitate and accentuate symptoms of compression due to the other causes. Surgical treatment is based around decompression of the affected nerve roots. However, where instability is evident on standing flexion/extension plain lateral radiographs or anticipated, fusion may be undertaken. Spinal fusion provides stabalization and may be necessary for symptomatic relief. Minimally invasive surgical (MIS) techniques isused to achieve lumbar interbody fusion. The advantages of minimally invasive spinal instrumentation techniques are less soft tissue injury, reduced blood loss, less postoperative pain and shorter hospital stay while achieving clinical outcomes comparable with equivalent open procedure..[8]

Spinal stenosis: Congenital or narrowing of spinal canal following spondylolisthesis. Neurological symptoms may appear consequent to progressive narrowing on disc degeneration and osteoarthrosis, which may be unilateral (root canal stenosis). Spinal decompression is indicated if symptoms are severe.

b) Surgical procedures for lumbar diseases

Microdiscectomyis the gold standard operative treatment for lumbar disc prolapse. The standard approach is through a midline incision over the affected interspace with intraoperative radiographs to confirm the operative level. A fenestration of the ligamentumflavum and, if indicated minimal laminotomy exposes the thecal sac and transiting nerve root. Medial retraction of the root permits identification of the disc space and prolapse and subsequent discectomy. The patient is placed prone or kneeling.

There are various names and terms used for the numerous surgical procedures used to achieve surgical decompression by removal of the offending tissue whilst maintaining stability from facet joint or ligament-tumflavum hypertrophy. However, people who have had either standard discectomy or micro-discectomy have reported similar improvements one year after surgery.[9]

Lumbar laminotomy and laminectomy: laminotomy (partial removal of vertebral lamina) or laminectomy (complete removal of spinous process and bilateral lamina and removal of underlying ligamentumflavum) are performed to decompress the spinal cord and/or nerve roots via a posterior approach with the patient lying prone. Discectomy may also be necessary, the dura is retracted to one side and the disc removed piecemeal. Extension of bony removal to include upto 1/3 rd of the medial aspect of the facet joint (thus maintaining stability) will additionally decompress the transiting nerve root in lateral recess performed alone and unilaterally .This latter decompression is often called medial facetectomy. In general, laminectomy/ laminotomy, with or without discectomy, is performed if there are signs of nerve root compression; it is expected that the individual's symptoms will improve when pressure on the nerve root is relieved.[10]During these procedures there is a risk of damage to both the dura and retroperitoneal structures (e.g. major vessels). The extent of the procedure depends on the underlying problem and may vary from simple laminotomy for single nerve-root compression to decompression over several segments for spinal canal narrowing. In such cases, a stabilization or fusion procedure (e.g. plate and screws) lemay also be required (where multiple levels decompression and concern regarding post operative stability)

Vertebroplasty and kyphoplasty are similar medical spinal procedures in which bone cement is injected through a small hole in the skin (percutaneously) into a fractured vertebra with the goal of relieving back pain caused by vertebral compression fractures. It was found not to be effective in treating osteoporosis-related compression fractures of the spine in the only two placebo controlled and randomized clinical trials[11]The patients in both the experimental and placebo groups of the blinded study reported improvement in their pain, suggesting that the clinical benefit noted in unblinded trials is related to the placebo effect. It is a minimally invasive procedure and patients usually go home the same or next day as the procedure. Patients are given local anesthesia and light sedation for the procedure, though it can be performed using only local anesthetic for patients with medical problems who cannot tolerate sedatives well. During the procedure, bone cement is injected with a biopsy needle into the collapsed or fractured vertebra. The needle is placed with fluoroscopic x-ray guidance. The cement (most

commonly PMMA, although more modern cements are used as well) quickly hardens and forms a support structure within the vertebra that provide stabilization and strength. The needle makes a small puncture in the patient's skin that is easily covered with a small bandage after the procedure.

Percutaneous interspinous device Interspinous process decompression (IPD) techniques may offer a less invasive alternative for microsurgical decompressive surgery in lumbar spinal stenosis. Several implants have been introduced in the market. The In-space (Synthes, Umkirch, Germany) is a new implant strictly designed for percutaneous implantation with short operating times. Regional anaesthesia is better suited for this procedure.

c) Anaesthetic considerationslumbar procedures (excluding corrective surgery)

Regional anesthesia and general anesthesia are both applicable anesthestic techniques for spine surgeries. A retrospective analysis by Tetzlaff et al. [12]demonstrated that spinal anesthesia was a safe and effective alternative to general anesthesia for elective lumbar spine surgery with reduced perioperative complication rates. They concluded that spinal anesthesia could be an excellent choice for lumbar spine surgery. A review article by De rojas et al[13] concluded that both RA and GA are safe and effective techniques for lumbar spine surgery and that RA may prove a better alternative than GA for healthy patients undergoing simple lumbar decompression procedures or for patients who are at high risk for general anesthetic complications.

Preoperative: surgical procedures on the lumbar spine for disc problems are common. Any preoperative neurological deficit should be recorded in the patient's notes, especially if a regional technique is considered. Generally, these patients are otherwise healthy and no special investigations are normally required.

Intraoperative: it is possible to perform simple lumbar procedures under local or regional (spinal or epidural) anaesthesia. McLain et al.[14] reported that regional and general anesthesia have similar effectiveness for performing elective lumbar decompression surgeries, and also regional anesthesia showed some advantages over general anesthesia, including improved perioperative hemodynamic stability, decreased analgesic requirement, and decreased occurance of postoperative nausea.

Several studies comparing spinal anesthesia and general anesthesia in lumbar disc surgery have reported spinal anesthesia as the preferred method for lumbar spine surgery.[12-16] In relation, some centers have been routinely performing regional anesthesia for lumbar laminectomy and discectomy. However, this is seldom done in practice because of medico-legal concerns that any new postoperative neurological deficit may be blamed on the anaesthetic technique. A general anaesthetic technique involving intubation and mechanical ventilation is more usual. For all posterior spinal procedures the patient is placed prone or in the knee–elbow position. It is therefore advisable to use an armoured tracheal tube to minimize the risk of kinking and to ensure that the tube is well secured before and after turning the patient. Potential problems with the prone position are summarized in Table 1. Sukhen N Shetty et al [17]suggests that spinal anaesthesia can be given for prone surgeries and is as safe as for supine surgeries.

Any standard maintenance regimen is acceptable. However, blood pressure control is important, balancing the need to ensure spinal cord perfusion with the requirement to produce a bloodless surgical field. Sodium nitroprusside and esmolol infusions have been widely used for this purpose, though remifentanil is becoming popular. Blood loss is usually minimal from simple procedures, though if extensive laminectomies and fusions are performed, cross-matched blood should be available. A recent randomized clinical trial by Attari et al[18] revealed that spinal anesthesia has adequate advantages over general anesthesia in providing postoperative analgesia and decreased blood loss by preserving a better hemodynamic stability. These factors results in higher satisfaction rates for the surgeon and patients. Spinal anesthesia may lead to a reduction in blood loss associated with vasodilation and hypotension produced by sympathetic blockade and less distension of epidural veins resulting from lower intrathoracic pressure

Additionally, reduced surgical time and blood loss in spinal anesthesia were reported by Jellish et al.[19] in a prospective study. Standard monitoring is appropriate for simpler procedures. However, invasive blood pressure monitoring, a central venous pressure line and a urinary catheter should be considered if deliberate hypotension is used or if the procedure is likely to be prolonged and involve large fluid shifts.

Table 1

Problems with prone position
Potential problems comments

Eyes	
Corneal abrasion Optic neuropathy Retinal vascular occlusion	Tape eyes shut Increased IOP leads to decreased perfusion pressure. reduce by pressure by decreasing compression on the eye, hypotension and low hematocrit Avoid pressure on the eyes
Head and neck	
Venous and lymphatic obstruction Skull fixation	Careful positioning of the patient to decrease venous pressure Insertion of pins in the skull can lead to hypertensive crisis which is difficult to control
Abdominal compression	
Impaired ventilation	Avoid pressure on abdomen as it can lead to impaired ventilation
Decreased cardiac output	Bean bags and pillows are better than supportive frames or knee chest position
Damage to blood vessels	
Aorta or inferior vena cava Major iliac vessels	

Postoperative-(1) Pain: most spinal surgeries are painful and good postoperative analgesia is important. Local anaesthetic and opioid drugs can be instilled into the epidural space before closing. More usually, however, a regimen including patient-controlled analgesia (PCA) combined with regular oral/rectal analgesics is successful., Regional anaesthesia improved postoperative conditions of patients due to decreasing pain and need to the analgesia. Hassi et al[20]showed that patient satisfaction was high with a low level of complications in SA. Nevertheless, their study was retrospective and did not compare it with the other anesthetic techniques Two different mechanisms[21] can explain decreasing postoperative analgesic use in the regional Anaesthesia. First mechanism is the preemptive effect of regionalanasthesia that reduces the pain severity by preventing afferent nociceptive sensitization pathway. The second mechanism is probably existence of some residual sensory blockade in regional anaesthesia. This is due to lagging of sensory recovery behind motor recovery.

(2) Nausea and vomiting: Various studies have also shown that spinal anesthesia provided shorter anesthesia durations, decreased nausea incidence and analgesic consumption, blood loss and was associated with fewer total side effects in different orthopaedic sugeries[22-26]. Nausea and vomiting are already common problems that anaesthesiologists must cope with during the postoperative period. These symptoms appear to be associated with many factors such as age, gender, ASA, obesity, duration of anesthesia, use of volatile anaesthetics, nitrous oxide and intraoperative or postoperative opioids.

(3) Neurological deficit: Pre operative documentation is very important (legally also).This could be caused by the regional anaesthesia technique or the surgery itself. Neurological damage during surgery and anaesthesia is not limited to the site of surgery.

- *Poor patient positioning:* Paraplegia and quadriplegia have been reported as a result of poor patient positioning.
- *Site of surgery:* There are reports of patients with spinal disease who have suffered neurological damage either at levels remote from the site of surgery or during surgery unconnected with their spinal disease. However, neurological damage is more likely at or near the site of surgery on the spine. Risk factors and methods for minimizing them are listed below.

d) Risks of spinal cord damage

Risks related to

- Length and type of surgical procedure[27]
- Spinal cord perfusion pressure(SCPP)
- Underlying spinal pathology
- Pressure on neural tissue during surgery

Risk minimized by

- Careful positioning
- Maintaining SCPP

SCPP=MAP-CSFP

CSFP can be reduced by CSF drainage

MAP (mean arterial pressure) manipulated by anaesthetist? keep systolic B.P. >90mm of Hg

- Drugs

Methylprednisone given 8 hours after insult
NMDA antagonist (ketamine, magnesium)

- Prevention of hematoma formation

Careful hemostasis
Stopping antiplatelet therapy before operation
Withold heparin immediately postoperatively

e) Spinal cord monitoring

The 'wake-up test'[27] involves lightening anaesthesia at an appropriate point during the procedure and observing the patient's ability to move to command. The technique requires practice and adds to the duration of surgery. In addition, it provides information at the time of the wake-up only and misses damage occurring at other times.

Neurophysiological monitoring using somatosensory evoked potentials (SEPs) provides a continuous picture and offers a more sophisticated approach. Electrical stimuli are applied to the lower limbs and appropriately placed electrodes can record cortical (SCEP) or spinal (SSEP) evoked potentials. The resulting trace can be analysed for wave amplitude and latency with respect to a reference 'time zero'. SCEPs are affected by anaesthetic induction and inhalational agents, opioids and local anaesthetic drugs, and interpretation requires care and experience. Nevertheless, a decrease in amplitude or latency unrelated to drug administration of 35–50% is thought to be significant and indicate possible cord damage. However, even in skilled hands, interpretation can be difficult and a 'wake-up test' may still be required.

SSEPs can be recorded from electrodes placed into the epidural space either percutaneously or during surgery[28]. SSEPs are affected less by inhalational agents, but are sensitive to temperature changes and local anaesthetic drugs. Their stability during anaesthesia allows them to be used with more confidence during surgery than SCEPs.

Motor evoked potentials can be obtained by stimulating the motor cortex with a transcranial electrode and eliciting a response from the distal spinal cord, peripheral nerves or muscle. They have not been used extensively for spinal cord monitoring because they are more difficult to achieve and are sensitive to inhalational anaesthetic agents.

(4)Other post operative complications: Postoperative complications include persistent hypotension, haemorrhage, urinary retention, nerve root damage, and caudaequina syndrome (urinary/faecal incontinence, perineal sensory loss and lower-limb motor weakness).

III. Summary

Spine surgeries with regional anesthesia have shorter durations in the operating room. This time difference is considered to be a consequence of the elapsed time needed to perform spinal anesthesia, which is conducted in the block room instead of an operating room, and also having no missing time for extubation. In the absence of satisfactory differences between spinal anesthesia and general anesthesia, cost, associated with the duration, could be judged to be an acceptable reason to decide on an optimum option. Surgeons, have typically focused on the single issue of maximizing operating room efficiency and have indicated that reducing waiting times plays an important role in solving this problem. In the absence of satisfactory differences between spinal anesthesia and general anesthesia, cost, associated with the duration, could be judged to be an acceptable reason to decide on an optimum option .It can be speculated that regional anesthesia may lead to greater cost-effectiveness in spine surgeries. However the individual decision process and the multi-disciplinary approach for optimal treatment of the patients.

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Clinical Findings Children Presenting with Non-Accidental Injuries to the Trauma Unit at the Red Cross War Memorial Children's Hospital

By Dr. Ismailal Malki, Sebastian Van As & Heike Geduld

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Abstract- This study intends to describe the patterns of Non Accidental Injury (NAI) in the population of children seen at Red Cross War Memorial Children's Hospital trauma unit. Child abuse is a serious problem worldwide and can be difficult to detect. Children who experience the consequences of abuse in most cases end up being treated at Emergency Centres. All children between the ages of 0 – 13 years will be sampled by the use of selective selection. Trauma registers and ward registers will be used to identify children with suspected non–accidental injuries. The data will be analysed to show which types of non-accidental injuries were most prominent, what the causes were, where they happened, who the caregiver was and how long it took before presenting the child to hospital after infliction of such injury.

Keywords: non–accidental injury, childhood, burn, injuries, abuse, patients, cape town, western cape, south africa.

GJMR-H Classification: NLMC Code: WS 270

Strictly as per the compliance and regulations of:

Clinical Findings Children Presenting with Non–Accidental Injuries to the Trauma Unit at the Red Cross War Memorial Children's Hospital

Dr. Ismailal Malki [α], Sebastian Van As [σ] & Heike Geduld [ρ]

Abstract- This study intends to describe the patterns of Non Accidental Injury (NAI) in the population of children seen at Red Cross War Memorial Children's Hospital trauma unit. Child abuse is a serious problem worldwide and can be difficult to detect. Children who experience the consequences of abuse in most cases end up being treated at Emergency Centres. All children between the ages of 0 – 13 years will be sampled by the use of selective selection. Trauma registers and ward registers will be used to identify children with suspected non–accidental injuries. The data will be analysed to show which types of non-accidental injuries were most prominent, what the causes were, where they happened, who the caregiver was and how long it took before presenting the child to hospital after infliction of such injury. A previous study on non-accidental injury at the Red Cross War Memorial Children's Hospital by Van As *et al* for the period 1999 – 2005 noted that almost 40% of all fractures were skull fractures. This study will use these findings as a reference point, in addition to covering a wider spectrum of injuries.

The results of this study will be submitted to a peer–reviewed journal for publication and will help in informing the Western Cape medical practice. Ultimately, the study will very much assist the Emergency Physicians in earlier detection of suspicious non-accidental injuries. Quantifying the burden of non-accidental injuries also allows for policymakers to decide on child abuse issues with supporting evidence. The study should there by assist in policy making and preventive programmes to combat child abuse in South Africa.

Acronyms: *NAI, NGO, HIV/AIDS, X–rays, CT, MRI, TBI.*

Keywords: *non–accidental injury, childhood, burn, injuries, abuse, patients, cape town, western cape, south africa.*

I. Introduction

Child Welfare South Africa, a Non–Governmental Organisation (NGO), has reported an increase in child abuse over the years in South Africa. [1] Research has shown that the country has one of the largest numbers of orphans and neglected children in the world as a result of the high prevalence of HIV AIDS. It is against this background that children who are abused end up at emergency rooms with non–accidental injuries.

The Red Cross War Memorial Children's Hospital in Cape Town was established in 1956 and is the only paediatric hospital in Africa with a dedicated trauma unit for children under the age of 13. It is an academic children's healthcare facility offering comprehensive specialist paediatric services.The hospital is a referral centre for other hospitals in South Africa, and occasionally for hospitals in other parts of Africa. Since the establishment of a Child Abuse Management Service at the centre in the early 1980s, there has been a steady increase in patient numbers. In any given year, over a quarter of a million patients receive treatment and the trauma unit attends to about 10 000 children a year. [2]Many of these seriously injured children have come to the trauma unit for initial care. The initial recognition or suspicion of non–accidental injury (NAI) in children is the most important step in the child protection process.

It is important that the attending physician is able to recognise the differences between accidental and non–accidental injuries. [3] Detection and diagnosis of a child's non–accidental injury depends on the clinician's ability to recognise suspicious injuries. There is a need to conduct a careful and thorough physical examination with shrewd use of essential tests. The caregiver's testimony should not conflict with the physical evidence, i.e. the characteristics of the injuries and the child's developmental capabilities.

a) Background of the study

During a study covering the years 1999 – 2005 at the Red Cross War Memorial Children's Hospital, 99586 trauma patients were treated, of which 1037 (1.04%) were diagnosed with non-accidental injuries.The majority were male (64%) with an average age of 44.8 months. [4] According to van as:

"Of *the 1037 patients diagnosed with NAI, 121 (11.7%) sustained a total of 149 fractures; 21 (17.3%) with multiple fractures (16 had 2 fractures, 3 had 3 fractures and 2 had 4 fractures).*" [4]

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He notes that the head and neck were the most frequently fractured anatomical areas (53%), followed by the upper limbs (24%) and lower limbs (18%). Only 7 fractures of the trunk were seen. Furthermore, children sustaining fractures of the head and neck were significantly younger than those sustaining fractures to other areas.

b) Literature Review

According to the Forensic Psychology Practice Ltd.'s Non Accidental Injury (NAI) Practitioners Portfolio, NAI is a common problem and a major cause of morbidity and mortality in children. [5] Non–accidental injury is defined as "active physical violence occurring usually within the family towards a baby or a child". [5] As such, it should be viewed as one aspect of child abuse that may occur in isolation or in combination with other forms of child abuse, including neglect, emotional abuse and sexual abuse. [6]

Child physical abuse affects children of all ages, sexes, ethnicities, and socioeconomic classes. It usually takes the form of bruising (particularly on the face), bite marks, burns or scalds (particularly cigarette burns), or bone injuries (especially spiral fractures of the long bones in the limbs and skull fractures). Internal injuries may be fatal. [7]

Jayakumar *et al* note that fractures with soft tissue injuries constitute the majority of manifestations of physical abuse in children. [8] Fracture and injury patterns vary with age and development, and NAI is intrinsically related to the mobility of the child. Furthermore, fractures and injuries to the brain and abdominal parenchyma are serious manifestations of NAI in children. [8] Considerable force is needed to cause such injuries. Careful examination often reveals several injuries of different ages, indicating long–term abuse. NAI usually has serious consequences for the child, including behavioural problems and failure to thrive.

Van As et al [4] note that although the established consensus on fracture patterns in NAI is that long bone fractures are the most frequently experienced in clinical practice, the principal finding of their study was that skull fractures were considerably more common; making up nearly 40% of all fractures. Moreover, approximately one third were reported to have been inflicted with an implement or weapon, and one–quarter of these children had multiple fractures at the time of presentation.

c) Motivation for the study

The Emergency Physician is often the first point of contact within the health system.[9] Failure by attending physicians to identify NAI may lead to continued infliction of the same or worse injuries to the children, resulting in death. According to Barnes et al, while it can be difficult to identify some injuries as NAI, some are obvious to detect, even without knowing the history of the patient. [10] This study will assist Emergency Physicians in the easy detection of suspicious non-accidental injuries. Quantifying the burden of non–accidental injuries also enables policymakers to make decisions about child abuse issues with supporting evidence. The study will thereby assist in policymaking and preventative programs to combat child abuse in South Africa.

d) Research Questions

This study seeks to answer the following questions:

- What are the patterns of injury in non–accidental injury (NAI) in children at the Red Cross War Memorial Children's Hospital?
- What are the most common types of NAI, and how are they dealt with?

e) Aims of the study

The aim of this study is to describe the pattern of injuries of children presenting to the Red Cross Children's Hospital after a non-accidental injury.

f) Objectives of the study

The study aims to describe the patterns of injury seen in non-accidental injury and to create and raise awareness in the general medical community, in order to ensure that the non–accidental injuries are recognised in a timely manner.

II. Research Methodology

a) Introduction to the research methodology

Creswell (1998:17) reiterated that the nature of the research questions determine the kind of the research methodology to be used. In lieu of Creswell's dictum, this study will examine the patterns of injury in non–accidental injury (NAI) in children at the Red Cross War Memorial Children's Hospital, and it will also illuminates the most common types of NAI, and how are they dealt with in that hospital.

b) Study Design

This will be a retrospective descriptive study involving folder review of all the patients attended to at the Red Cross Trauma Centre, for the period 01st January 2008 to 31st December 2010 – covering a three year time frame to be examined.

c) Data collection method

Quantitative and qualitative data collection methods will be used. This will be undertaken by reviewing the Emergency Centre register and the social worker registry book to help identify patients and their folders. Furthermore, the collections of all NAI cases happened between years: 2008 – 2010. Conclusions will be drawn from the information in the folders, by analysing the number of children presenting with different types of injuries, as well as the number of occurrences and the management methods used by the physician. There will be follow–up with social workers to

see which cases were referred to the police. A single researcher will collect data.

d) Study Population

The files of children aged between 0 and 13 years and present with NAI at the Red Cross Trauma Centre are to be used in the study. Children outside this age range are not to be included in the study.

e) Sampling Size

All children who were present with suspected NAI during the period 01st January 2008 to 31st December 2010.

f) Inclusion Criteria

Patients between the ages of 0 and 13 years presenting to the Red Cross Children's Hospital emergency centre with a diagnosis of non-accidental injury will be included in the sample. This diagnosis must be documented in the Trauma register and the Ward registers.

g) Exclusion Criteria

- No definitive diagnosis of NAI.
- Any disease process other than one that can explain NAI or findings.

III. Logistics

The study is estimated to cost South African Rand 4,480.00, as outlined in the budget section. The results are expected to be available for reporting within four months after the start of data collection, as outlined in the time schedule.

a) Time Schedule

Task	Completion Deadline
Ethics submission	1 July/Aug-11
Data collection	Aug/Sep/Oct-11
Statistical analysis	Nov -11
Reporting of results	Nov-11
Writing	Oct/Nov-11
Preparing for publication	Nov-11
Submission for publication	Nov-11

b) Budget

Consulting services		**0**
Database programmer		**0**
Statistical services		**0**
Travel		**0**
Airfare or travel fare		**1000**
Accommodation		**0**
Meals & incidentals		**0**
Equipment & Furniture		**0**
Computer & printer		**0**
Cell phone		**0**
Other direct cost		**3000**
Telephone, cell phone, fax		**500**

Internet & e-mail		800
Office supplies		700
Couriers & postage		
Printing & copying		1000
Ethics committee fee		0
Staff training		0
Total direct costs		4000
Total indirect costs (12%)		480
Total costs		R4,480.00

IV. Analyses

Microsoft Excel will be used for data analysis. Data will be expressed as the mean and standard deviation for quantitative variables, or numbers and percentages for categorical variables.

V. Ethical and Legal Considerations

Ethics: The study will be submitted to the Human Research Ethics committee for approval. Permission to conduct the study will be requested from the management team of the Red Cross Hospital.

Anonymity: A password–protected work computer will be used.

VI. Reporting and Implementation of Results

The results of this study will be submitted to a peer–reviewed journal for publication and will help in informing the Western Cape medical practice.

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Appendices

Appendix 1 : Data Collection Form

SURNAME……RACE…… SEX…… FORM NO:……

FIRST NAME…….. DATE OF …… DATE OF ……duration to……

BIRTH PRESENTATION present

ADDRESS……..

PRIMARY DIAGNOSIS……

Reason to suspect…… Perpetrator suspected……

TRANSPORT	BROUGHT IN BY	MECHANISM OF INJURY	TRAGE PRIORITY
Ambulance ☐	Mother ☐	Burn ☐	Red ☐
Private ☐	Father ☐	Assault ☐	
Police ☐	Other……	Blunt ☐	Yellow ☐
School ☐		Sharp ☐	
Other……		Other……	Green ☐
			Not Done ☐

BURN %.....

PLACE OF OCCURRENCE

Degree 1 ☐ 2 ☐3 ☐

Flame ☐	At home ☐	Admit ☐	
Fluid ☐	Other home ☐	Discharge ☐	
Heat contact ☐	Public Place ☐	Place of safety ☐	
Electrical ☐	School/Crèche ☐	Police case ☐	
Chemical ☐	Sport ☐	Follow up by social worker ☐	
Explosion ☐			
Other ☐	Unknown ☐		

SEVERITY	INVESTIGATIONS	MANAGEMENT
Mild ☐	CT ☐	Rape Kit ☐ Other……
Moderate ☐	X-Ray ☐	EUA ☐
Severe ☐	Bloods ☐	POP ☐
		Dressings ☐
Other……..Other……		Sutures ☐

HEAD	EYES	BODY			
Bruising to head☐	Peri-ocular ☐	Neck ☐	Shoulder ☐	Hip ☐	
Soft tissue injury☐	Intra-ocular ☐	Chest ☐	Arm ☐	Thigh☐	
	(Retinal				
Skull fracture☐	Haemorrhage)	Abdomen☐	Elbow ☐	Knee ☐	
Epidural/Subdural☐		Buttock and ☐	Forearm ☐	Leg ☐	
Haemorrhage	**FACIAL**	lower back			
Subarachnoid☐	Fracture ☐	Pelvis☐	Ankle☐	Wrist ☐	
Haemorrhage	Soft Tissue☐	Genitals and inner thighs ☐		Foot☐	
Spine ☐		Hand ☐			
Cerebal Oedema ☐		Unspecified……			

Part B

Literature Review

Literature Search Strategy

The database of Medline, Pre-Medline and Embase on the OVID platform and Google Scholar were searched. Search terms included; Non-accidental injuries, child abuse, sexual abuse, bite marks, scalds, shaken baby syndrome (SBS), fractures and thermal injuries. 625 articles were randomly identified from the above databases. In addition, unpublished articles and websites (Biomed Central, Greynet) were sourced and 23 articles were identified. A review of the references of these articles yielded a further 13 articles. A final 53 articles were selected on the basis of validity and relevance to this study.

Literature Appraisal

I. Introduction

Non-Accidental Injury (NAI) is defined as active physical violence occurring usually within the family towards a baby or a child. [1] Physical injury may be caused by burning, kicking, hitting with any object, punching or choking. [1] According to the NAI Practitioners Portfolio, NAI is common in childhood and is a major cause of morbidity and mortality. [1] NAI can occur in isolation or in combination with neglect, emotional and sexual abuse. [1]Children with NAI may present with injuries to the skeleton, soft tissues or organs. [2]They may present with clusters of injuries such as battered child syndrome, shaken infant and shaken brain syndrome (SBS) or whiplash. [3] NAI can result in behavioural problems and failure to thrive [4]. Typically, children of caregivers with mental and physical illness, alcohol and drug abuse, housing or financial problems are at higher risk of NAI. [5]

NAI may be either clear cut or suspected. In clear cut cases a perpetrator is identified, or medical evidence shows ill-treatment has taken place. In these cases, a paediatrician or attending physician should conduct a medical exam and document findings. [4] In suspected NAI cases there is either no indication that an injury or other condition (e.g. unexplained failure to thrive) is caused by the ill-treatment or neglect, no perpetrator is noted, or there is no clear medical evidence. Additionally the degree or type of injury may be contradictory to the explanation given. [4] Medical tests supportive of the diagnosis of NAI have been pushed by many advocates as being proof of NAI in general, and SBS in particular; however, clear evidence for the value of this is not available. [8] The diagnosis of NAI and SBS should not rest upon a few isolated investigation results alone, but rather encompass medical examination, medical and social history, family circumstances, and interviews by experienced multi-disciplinary teams. [8]

Child physical abuse affects children of all demographic and socioeconomic classes. The most common types take the form of bruising, bite marks, burns or scalds, and bone injuries. [9] Instruments of abuse include blunt or sharp objects such as belts and wooden sticks, or the use of hot water or fire to inflict burns. The literature suggests that the key symptoms of NAI include bruising, bites, torn frenulum, frozen watchful eyes, altered states of consciousness, and fractures. [4]

II. Epidemiology

The prevalence of child sexual abuse in developing countries such as South Africa (SA) seems to be lower than that in Western countries. [8] However, this may be due to lower reporting rather than a true reflection of prevalence. In a study in 2007, NAI at the Red Cross War Memorial Trauma Unit in Cape Town was approximately 1 per 100 attendances, which is similar to studies among Western populations. [11] Incidence studies conducted with respect to cases of child maltreatment reported to official agencies in different countries proved that there were five times as many cases reported in Australia, Canada and the USA, as were finally substantiated. [10] Even though the rate per thousand children was much higher in these 3 countries than in England, there were huge similarities in the breakdown by different types of abuse. [10] A study in the USA suggested that 80% of the deaths from traumatic brain injury in children under the age of two years are due to NAI. [5]

According to a 2009 study published in Clinical Psychology Review, the global prevalence of child sexual abuse is an estimated 19.7% for females and 7.9% for males. [54] The report examined 65 studies from 22 countries and it was noted that Africa had the highest prevalence of sexual abuse (34.4 %); with South Africa being the highest. America, Asia and Europe had 10.1%-23.9% while Europe had the lowest, at 9.2%. [9] In approximately 30% of the cases, the perpetrators were relatives of the child' 60% were friends of the family, babysitters, or neighbours and in 10% of cases the perpetratorswere strangers.

III. History

Features in the history that may raise suspicion of NAI include delayed presentation of the child to the emergency centre, inconsistencies in the history; a changing explanatory story; a history of poor child supervision; poor health care history, including no or

incomplete immunisation; substance abuse and/or intoxication of guardian or parent on presentation; a lack of remorse on the part of the guardian towards the child's injury, and/or indifference to treatment.

IV. Injury Patterns

Jayakumar noted that fractures with soft-tissue injuries constitute the majority of manifestations of physical abuse in children. [10] Fracture and injury patterns vary with age and development, and NAI is intrinsically related to the child's mobility. Furthermore, fractures and injuries to the brain and abdominal parenchyma are manifestations of NAI in children. [12] Considerable force is needed to cause such injuries. Careful examination often reveals several injuries of different ages, indicating long-term abuse.

A study conducted at the Red Cross War Memorial Children's Hospital, from 1999-2005, described 99 586 trauma patients treated, of which 1037 (1.04%) were diagnosed with NAI. The majority were male (64%) with an average age of 44.8 months. [11] According to van as, 11.7% of the 1037 patients sampled had a combined 149 fractures while17.3% of these had multiple fractures. [11] The head and neck area was the most frequently fractured anatomical area (53%), followed by the upper limbs (24%) and the lower limbs (18%). Torso injuries were relatively uncommon; only 7 fractures of the trunk were observed. Furthermore, children sustaining fractures of the head and neck were significantly younger than those sustaining fractures to other areas. Long bone fractures were the most frequent presentation of NAI and skull fractures were more common, representing nearly 40% of all fractures. Approximately 33% of NAI were inflicted with an object and 25% of these children had multiple fractures. This appears to be consistent with some NAI injury patterns internationally. [53]

V. Shaken Baby Syndrome

Shaken brain syndrome (SBS) is common in NAI cases. Infants who crawl or walk do not produce enough force in their own movements to cause fractures. [2] Typical signs and symptoms associated with SBS include: subdural haemorrhage (SDH), retinal haemorrhage (RH), and encephalopathy occurring in the context of inappropriate or inconsistent history and commonly accompanied by other apparently inflicted injuries (e.g. skeletal) [5, 12---25]. Although the literature is inconclusive, SDH is generally not expected to occur in a normal healthy infant. [6] Clinical findings not expected in a normal healthy child could be attributed to NAI, despite the absence of evidence to support that conclusion. When it comes to SBS, it is assumed that the shaking is intentional and violent, and the injury that the infant suffers is likely to be serious. Instances of retinal bleeding are assumed to be indicative of criminal abuse, unless there is evidence that suggests a medical cause. [25]

VI. Thermal Injuries

More than 1300 children die annually from burns in SA. [26] In SA, burns are the leading cause of non-natural death in infants and children under the age of 5. Burns are also the fourth major cause of accidental death in children in the 5 – 9 year old age group, according to the National Injury Mortality Surveillance System. [26]In suspected NAI cases, physicians should look out for burn injuries inconsistent with history. Further signs to look out for in suspected NAI cases include: an unsatisfactory explanation for an injury; lack of independent mobility of the child; well-shaped injuries such as cigarette and iron burns; soft tissue injuries in areas not normally associated with accidental burns e.g. back, buttocks, back of hands and soles of feet. [27---30] Forced immersion injuries present as scalds to the lower limbs, buttocks and perineum; limbs in gloves or stockings or symmetrical distribution of injuries with sharply delineated borders. [27---30]

The absence of splash marks in scald injuries (which occur when falling into the bath tub) and signs of the upper limbs restraining [27---30] may be indicative of NAI. Unexplained cold injuries, such as swollen (red) hands or feet and hypothermia are other signs to look out for in NAI [33]

a) Ocular Injuries

Eye injuries are common in NAI cases. [34] Due to the complexity in diagnosing these injuries, it is always helpful to have input from a specialist ophthalmologist when assessing such injuries. The commonest types of ocular injuries are retinal detachment and haemorrhage, vitreous haemorrhage and dislocation of the lens. [34]

b) Abdominal Injuries

In most cases, liver rupture occurs due to direct impact injury to the abdomen. This is one of the most frequent reasons for the death of children with NAI in SA. [32] Children are particularly vulnerable to such injuries due to their fragile abdominal wall muscles. In addition, it is generally easy to compress the abdominal tissues and organs against the spinal column, which leads to a variety of further injuries that also affect the small intestine. [32] It is also important to note that late clinical presentation of this type of injury is a diagnostic problem in many instances, with delays of several days being common before apparent, often severe, signs manifest themselves.

c) Bite Injuries

NAI in children may also be caused by human bites. [2, 32] Human bites, in most cases, leave distinctive tooth marks on the victim. Correct

identification and preservation of evidence necessitates the photographing of injuries where possible.

d) NAI Mimics

Identifying NAI cases is complicated by diseases, which can mimic or simulate NAI. This is most common in the case of skin lesions.

A number of physiological conditions may mimic NAI. Barnes et al note that the "growing fracture" (leptomeningeal cyst resulting from a dural tear) is not specific to NAI and may follow any diastatic fracture in a young infant [25, 33– 35]. In some instances, subdural hematoma (SDH) may occur in normal, healthy neonates as a result of birth trauma, and even in cases of normal, uncomplicated vaginal delivery. [8, 27, 33---38]Donohoe notes that there is clear evidence that SDH can be caused by anatomical, infectious and biochemical disorders, which cause no obvious symptoms prior to intracranial bleeding, giving the appearance and impression of a normal and healthy (although not robustly healthy) infant, in spite of underlying predisposing pathology. However, these conclusions have been challenged. [6, 8] Some head injuries that appear to indicate Shaken Baby Syndrome (SBS) may occur during birth and be subsequently mistaken for NAI. Intracranial haemorrhages, including SDH and retinal haemorrhages (RH), have been reported in a number of CT and MRI series of "normal" neonates. In one series this was as high as 50%. [6, 37–42] However, failure to detect scalp or skull abnormalities in imaging tests should not be interpreted as the absence of impact injury.

Medical conditions that may cause injuries that mimic NAI or cause failure to thrive include: epilepsy, thrombocytopenia and leukaemia, which may result in increased bruising, conditions predisposing fractures, e.g. osteogenesis imperfecta, metabolic bone disease in neonates, rickets, osteoporosis, copper deficiency, osteomyelitis, leukaemia and disseminated neuroblastoma. [43] It was also noted that in rare cases, subdural haematoma may be caused by Glutaricaciduria. [44]

e) Sexual Abuse

Sexual abuse is one of the most prominent forms of NAI. It is experienced by both sexes, though it is more common in females, and entails forced sexual acts. [33] In cases of physical abuse, specific attention should be paid to the genital areas to exclude possible associated sexual abuse. [32] It is important to note that the majority of sexual assault cases result in, among other things, sexually transmitted diseases as well as psychological trauma.[45] Feeny suggests that the examiner should especially focus on the nature of the injuries sustained, particularly in areas such as the vagina, rectum and mouth; as well as any signs of abrasions or bleeding on the part of the victim or perpetrator, because this assists in assessing the level of risk in terms of the potential transmission of HIV and hepatitis. It is also important to establish the nature of the attack, such as whether there was condom use or if ejaculation took place. Moreover, it is essential to establish whether the perpetrator used threats, violence or weapons during the attack and to get a description of the perpetrator. [45]

Most physical injuries associated with sexual abuse are relatively minor, but some upper vaginal lacerations may be severe. [44 – 45] Psychological symptoms are prominent in sexual assault victims. These include feelings of anger, fear, shame, embarrassment and guilt; as well as nightmares and sleep problems. [44 – 45] Following an assault, patients may react by crying, becoming tense or even smiling inappropriately. These behaviours may be manifestations of tiredness or frustration, or they may be coping mechanisms. Secondary enuresis, encopresis (defecation in inappropriate places), deliberate wetting and body–rocking are concerning behaviours suggestive of abuse in children. [31]

f) Diagnostic strategies for NAI

There is an on–going debate concerning which investigations provide the best result in detecting NAI in SBS. Sato et al demonstrated that there was a 50% greater rate of detection of subdural hematomas using MRI, compared with CT. [54] Although CT scan did not miss any surgically treatable injuries, the MRI scan improved the ability to detect and define intraparenchymal lesions of the brain. The two types of scan should therefore complement each other in evaluating brain injuries in infants. Given the relative insensitivity to subarachnoid blood and fractures, the MRI should be obtained 2 to 3 days after a CT scan if possible. [2] Lack of access to technology and the physical limitations of access to MRI when life support is required for critically ill infants or children may limit the usage of the MRI in practice. The radiologist therefore plays an important role in accurately identifying non-accidental intracranial trauma.

It is important to be familiar with the spectrum of the(sometimes subtle) imaging findings one may encounter. A radiological skeletal survey of a child suspected to have NAI should include the following areas: hands, feet, long bones, skull, spine, and ribs; and these should be obtained as soon as the infant's medical condition permits. [2] Skull x–rays complement CT bone windows in the detection of skull fractures. [2] Old nall found that in studies of abused children, skull x-rays were more sensitive and improved the confidence of correct diagnosis when compared with CT. [2] Multiple, bilateral and diastatic skull fractures are more likely to be non-accidental.

In shaken babies there are commonly associated patterns of skeletal injury. These include dislocations, avulsion fractures, bucket-handle and

corner fractures, clavicular and humerus fractures, skull fractures as well as spinal and rib fractures. [2, 47 – 48] Avulsion fractures are most common inthe spinal cord and mostly occur in other areas as a result of pulling, twisting and intense shaking. Bucket-handle fractures are mostly recognis able on a radiograph due to their bucket–handle appearance, appearing on the edge of the bone between the metaphysis and epiphysis. Lesions are suggestive of abuse. Corner fractures are avulsion fractures on the corner of the bone due to shearing of the growth plate. Depending on the angle of the X – ray, corner fractures may be confused with bucket-handle fractures.

Clavicular fractures are likely to occur if the perpetrator's thumbs press on the victim's shoulder bones during shaking. The clavicle is likely to break at mid-shaft level. Dislocations appear to be more traumatic in NAI cases. Similarly, impact fractures are equally traumatic; occurring when the infant is slammed onto hard surfaces, driving one end of the fractured bone into another.

Rib fractures are rarely seen in children because infant ribs are flexible and tend to compress with elasticity. If there is no history of motor vehicle accidents or bone related diseases, there is reason to suspect NAI. Ribs more commonly fracture at the posterior, structurally their weakest area, during a shaking period. They may also fracture at the lateral (side) areas of the ribs. Cardiopulmonary resuscitation may also cause rib fractures. Van Rijn et al, in a 115,756 live birth study of birth trauma, showed no cases of rib fractures resulting from birth trauma, hence posterior rib fractures in young children have a high positive predictive value for NAI .[47]

g) Identifying children at risk

In suspected NAI cases, it is important to identify the degree of risk to the child and to take any steps necessary to protect the child. [4] NAI is an emotive issue; however, the physical and emotional safety of the child is paramount. To ensure the child is not put further at risk, documenting of the patient's history should be factual; any suggestion of abuse may result in refusal to allow the child to get treatment. [5] The available evidence will have a bearing on the course the law will take in abuse cases where NAI is identified. Parents or guardians may risk losing custody of the child, hence the need to be thorough in assessing suspected NAI victims. The evidence should be accepted in the relevant scientific community, though this can vary depending on jurisdiction. [14, 13, 17]Medical professionals may be acting in the interests of the child by assuming NAI, even where it has not occurred. However, there is a need to recognise the potential harm to the family and child where such assumptions prove to be incorrect. It is important to identify the perpetrator; however, this is not the task of the physician treating the child but rather the task of the social services and/or police services. Doctors treating NAI cases should also be fully aware of the legal rights of the child as well as the parents. [6] It is important that the legal procedures establish whether NAI has actually taken place and who should be held accountable. The evidence in such cases should be clear, so that the resulting judgements are also clear and based on the rule of law. Many cases of confirmed abuse, some without clear injury, may not have been investigated had it not been prompted by suspicions of medical practitioners. [6]

h) Child Abuse Legislation and Support Organisations in the Western Cape

The Western Cape Province, in accordance with national priorities, has set up protocols and services to protect children against NAI. As of 2009, there were 132 Child Protection Organisations and 16 district offices in the Western Cape providing statutory social work services. [50] These include Child Welfare, Etafeni Day Care Centre Trust, Child Justice Alliance, Child Line, SOS Children's Village and Beautiful Gates, amongst others. Their duties include foster care, adoption, advocacy against commercial exploitation of children, and child labour. The Western Cape has made it a priority to train and educate social workers, child and youth care workers and NGOs to understand the contents of the Children's Act. In 2011, the Early Childhood Development (ECD) policy was amended to ensure all requirements of ECD were met; i.e. adequate nutrition, physical and health care, socio-emotional and intellectual development. [51] The new Children's Act stipulates that NGOs dealing with children should demonstrate certain levels of competency. As of August 2009, there were 35 registered children's homes, 8 shelters, 10 drop-in centres, call centres, and 30 000 children in foster care. [50] However, most NGOs operate in urban centres, neglecting the rural areas. [50] More resources are being allocated to rural areas to ensure no child is left behind. The South African's Children's Act, chapter 7 section 110, makes it mandatory for any professional dealing with children to report suspected NAI.[55]

VII. Conclusion

In conclusion, NAI cases are rarely clear cut and need proper investigation to warrant prosecution of the perpetrator and to determine how to treat the affected child. NAI can take many forms and qualified persons in the medical or social work fields are needed to carefully attend to each case.

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Part C

Article for Submission to Journal

Abstract- Aim: This study serves to describe the pattern of Non Accidental Injuries (NAI) in the population of children seen at the Trauma Unit of the Red Cross War Memorial Children's Hospital in Cape Town, South Africa. The research aims to identify the patterns and mechanisms of injury in NAI in the cases identified in this unit.

Methods: This is a retrospective case review study evaluating the period from 1st of January 2008 to the 31stof December 2010. The age group sampled was 0 – 13 years. Gender, perpetrator, injury type, race, investigations, severity, place of occurrence and transportation of the patients were analysed. More detail regarding the data collection methods can be found in Appendix B.

Results: 623 folders were collected with initial diagnosis of NAI. Of these, only 522 cases of NAI were identified. The largest racial group of children in the sample was black, at 45.86%; followed by coloured (33.72%), and white (18.11%). Indian children and those whose ethnicity was not specified only made up 2.31% of the sample.

A sample of 522 was attributed to have NAI. It was noted that in 2008 there was a total of 174 NAI cases, compared to 170 in2009 and 178 in 2010. Females accounted for 61.69% (322 cases) and males for 38.31% (200 cases). Among the female cases, 60.5% were physical assaults, followed by 35% sexual abuse, 2% for genital assault, 0.5% for dog bites and 2% of unspecified cases. The highest number of NAI cases was recorded among the 5 – 9 age group,comprising235 children or 45.02%; followed by the 0 – 4 age group with 28.93%, and finally the 10 – 13 group with 26.05%. Sexual abuse cases were prevalent in the 5 – 9 group (48%), the 0-4 year old group (37.33% recorded) and the 10 – 13 group, with 14.97%. Moderate cases accounted for 71.26%, mild for 21.07%, 6.32% not specified severe cases accounted for1.34% of the total. In essence, ambulances transported approximately 31% of total NAI cases, while police and schools each transported 1% respectively. 67% of cases were privately transported.

Keywords/MeSH terms: non–accidental injury, child abuse, injury mechanism, perpetrator, sexual abuse.

Section 1

What is already known on this subject?

The Emergency Physician is often the first point of contact within the health system. Failure by attending physicians to identify non-accidental injuries may lead to continued infliction of the same or worse injuries to children, resulting in death. According to Barnes et al, it can be difficult to ascertain some injuries as NAI, though some are obvious to detect even without knowing the history of the patient.

Section 2

What this study adds

The study will help Emergency Physicians in the easy detection of suspicious non-accidental injuries. Quantifying the burden of non-accidental injuries also allows for policymakers to decide on child abuse issues with supporting evidence. The study will thereby assist in policymaking and preventive programmes to combat child abuse in South Africa.

I. Introduction

Non-accidental injury (NAI) is defined as active physical violence occurring usually within the family towards a baby or a child. [1] It should be viewed as one form of child abuse that may occur in isolation or in combination with other forms of child abuse, including neglect, emotional abuse and sexual abuse.[1, 2] Physical injury is the most frequent consequence of abuse. Injury is commonly inflicted by burning, kicking, hitting with objects, punching or choking. [3]

Child Welfare South Africa has reported an increase in child abuse over the years in South Africa, with most abused children being orphaned and neglected due to high HIV/Aids prevalence. [4] Many abused children end up at emergency centres with NAI.

The Red Cross War Memorial Children's Hospital in Cape Town, South Africa was established in 1956 as a highly specialised healthcare facility offering comprehensive specialist paediatric services. The hospital is predominantly a referral centre for children from the Cape Metropole region, other hospitals in South Africa and occasionally for hospitals outside South Africa. In any given year, over a quarter of a million patients receive treatment at the hospital. [5]Over the years, there has been a steady increase in referral numbers.

It is important that the attending physician be able to recognise NAI in children, [6] recognise patterns of injury and clues in history; and have knowledge of diagnostic strategies and patient management in suspected abuse cases.

II. Aim

The aim of this study is to describe the population of children presenting to the Red Cross War Memorial Children's Hospital Trauma unit with NAI. Data analysis was used to identify the patterns and causes of injury in NAI at the Red Cross Children's Hospital. This may increase the suspicions of healthcare providers concerning these types of injuries.

III. Methods

A retrospective audit was conducted of all children with suspected NAI presenting to the Trauma Unit at the Red Cross Children's Hospital from January 2008 until December 2010. Consent to conduct the study at the Red Cross Memorial Hospital and to have

access to patient records was granted by the Human Research Ethics Committee on the 24th of October 2011. The reference number is 482/2011. Trauma registers, folders, ward registers and social worker registry book were used to identify the children with suspected NAI.

Children up to 13 years of age with NAI or suspected NAI were included, while children with injuries from accidents and undetermined causes were excluded.

IV. Data Analysis

Data was analysed to identify prominent types of NAI, the causes, place of occurrence, and time of presentation of the child to hospital after injury infliction. The data was cleaned in Excel and analysed in STATA, and the tables were exported to Microsoft Excel 2010 for analysis.

V. Statistical Analyses

Average values and percentages were calculated for the different categories, and cross tabulations were used to compare the variables. The variables were tested for relationship significance using the Pearson Chi2 and Fischer's test. A P–Value less than 0.05 implies the variable is significant. The two are the same except that the Fischer's test applies when there are small cells (bivariate/cross tables with less than 5 in the cells). They all test for independence between two variables, with the null hypothesis stating that there is no association between the two variables, or that they are independent. Cramer V was used to test for strength of association. Cramer values range from 0 to 1, with a strong association if the value is close to 1 and a weak association if close to 0.

VI. Results

Of the sample of 522 taken, it was noted that in 2008 there were a total of 174 (76 males) NAI cases, 170 in 2009 (120 males) and 178 in 2010 (126 males). Overall, females accounted for 61.69% and males for 38.31%.

It was noted that the injuries inflicted on children occurred in several parts of the body. These were noted on the admissions forms as a primary diagnosis. Table 1 depicts the pattern of NAI. Head injuries were the most prevalent injury type, present in 35.4% of cases at the trauma centre. Head injuries included head lacerations, bruises and soft tissue damage. The most commonly documented injury (85.3 %) was bruising to the head followed by facial injuries (16.3%) and genital injuries (10.5%). In cases such as genitals being stated as a primary diagnosis, the cause was either genital assault or sexual abuse. This is clearly defined in the causes.

During primary diagnosis, it was noted that of the head injuries, 67.4% were male and32.6% female. Of the sexual assaults, 95.6% of cases were female and4.4% male. Of the genital injury cases, 56.36% were female and 43.64% male. Facial injuries were recorded in 75% of males and 25%of female cases.

In the 0 – 4 age group, head injuries were more prevalent at 43.7%, followed by genitals (11.92%), sexual assault (10.6%), facial (9.27%), arms and hands (7.1%), and lower body (9.7%). For the 5 – 9 year olds, the top cases were head injuries (29.8%), facial injuries (18.3%), genitals (12.3%) and sexual assault (8.94%).High numbers of head injuries were also recordedamong10 – 13 year olds; at 35.3%, followed by facial injuries (20.6%), lower body (11%), sexual assault and genitals (5.9% respectively). Refer to Appendix A for more information. Because of the broad categories of primary diagnosis, we decided to use cause for most of the comparisons (cross tabulations), which had fewer categories and was likely to present the data well in addition to making it plausible for significance testing. Causes were divided into the following categories: physical assault, dog bites, genital assault, sexual abuse, neglect and not specified.

Table 1 : Primary Diagnosis

Primary Diagnosis	Frequency	Per cent
Abdominal	15	2.9
Arm	33	6.3
Back	7	1.3
Face	85	16.3
Face/Head	4	0.8
Full Body	1	0.2
Genitals	55	10.5
Hand	22	4.2
Head	184	35.3
Lower Body	50	9.6
Not Specified	6	1.2
Sexual Assault	45	8.6
Upper Body	15	2.9
Total	522	100

a) Differences in presentation between males and females

Table 2 shows that of the female cases, 60.5% were physical assaults, followed by 35% sexual abuse, 2% each for genital assault and not specified respectively, and 0.5% for dog bites. However, among the causes of NAI in males, 89.8% were for physical assault, followed by 5.3% for genital assault, while sexual abuse cases were very minimal at 1.6% compared with35% for females. Of all the causes, males surpassed females in occurrence, except for sexual abuse where 93.3% were female and 6.7% male. Fisher's test and P–value (Pr =0.00) suggests there is a high likelihood that cause and gender are associated. Cramer's V test of 0.5 suggests good strength in association between the two variables. Table 2 gives an outline of gender versus cause.

Table 2 : Gender versus Cause

Cause	Gender		Total
	Female	Male	
Physical Assault	121	289	410
Row per cent	29.5	70.5	100
Column per cent	60.5	89.8	78.5
Dog Bite	1	3	4
Row per cent	25	75	100
Column per cent	0.5	0.9	0.8
Genital Assault	4	17	21
Row per cent	19.1	81.0	100
Column per cent	2	5.3	4.02
Neglect	0	1	1
Row per cent	0	100	100
Column per cent	0	0.3	0.2
Not Specified	4	7	11
Row per cent	36.4	63.6	100
Column per cent	2	2.2	2.1
Sexual Abuse	70	5	75
Row per cent	93.3	6.7	100
Column per cent	35	1.6	14.4
Total	200	322	522
Row per cent	38.3	61.7	100
Column per cent	100	100	100

b) Injury types according to age group

The highest number of NAI cases was recorded among the 5 – 9 age group, with 235 children (45.0%), followed by the 0 – 4 age group with 28.9%, and finally the 10 – 13 group with 26.1%. In terms of the causes of the injuries, sexual abuse cases were prevalent in the 5-9 group (48% recorded), the 0 – 4 year old group (37.33%) and the 10 – 13 group with 14.67%. The Fisher's test of 0.31 implies no association between cause and age, showing insignificance. Table 3 gives an outline of the results of age versus cause.

Table 3 : Age versus Cause

Cause	Age Category (years)			
	0-4	5-9	10-13	Total
Physical Assault	111	182	117	410
Row per cent	27.07	44.39	28.54	100
Column per cent	73.51	77.45	86.03	78.54
Dog Bite	1	2	1	4

Row per cent	25	50	25	100
Column per cent	0.66	0.85	0.74	0.77
Genital Assault	5	11	5	21
Row per cent	23.81	52.38	23.81	100
Column per cent	3.31	4.68	3.68	4.02
Neglect	1	0	0	1
Row per cent	100	0	0	100
Column per cent	0.66	0	0	0.19
Not Specified	5	4	2	11
Row per cent	45.45	36.36	18.18	100
Column per cent	3.31	1.7	1.47	2.11
Sexual Abuse	28	36	11	75
Row per cent	37.33	48	14.67	100
Column per cent	18.54	15.32	8.09	14.37
Total	151	235	136	522
Row per cent	28.93	45.02	26.05	100
Column per cent	100	100	100	100

c) Place of occurrence

Most of the physical assault cases occurred at home (49.14%) followed by school/crèche (26%), public spaces (15.6%) and unknown/other places (8.89%). Sexual assault was also most prevalent at home (61.33%), followed by other/unknown (26.67%), public space (6.67%), and (5.33%) at school. For more information see Appendix A.

d) Modes of transport for NIA cases

In essence, approximately 31% of the total NAI cases were transported by ambulance, while the police and schools each transported 1% respectively and 67% of cases were privately transported. The highest number of ambulance transportation cases were linked to physical assault (90.2 %), followed by sexual abuse cases at 7.8%, genital assault cases at 1.3% and0.7% for causes not specified. With the null hypothesis of no association between mode of transport and cause, the Fischer's test of 0.001 suggests we should reject the null hypothesis and assume association between the two variables. Cramer's V value of 0.1579 suggests a weak association between the cause and transport variables. Refer to Appendix A for more information.

e) Severity of NAI cases

With regard to the children present at the emergency rooms, severity was coded according to the categories Mild, Moderate, and Severe. The trauma unit classified patients based on the South African Triage score, and the clinical findings of the patient. In some instances it was not specified (6.32%). Moderate cases accounted for 71.3%, mild for 21.07% and the least common were severe cases, at 1.34%. The Fischer's test of 0.02 suggests an association between cause and severity coding. Table 4 gives an outline of cause versus severity.

Table 4 : Cause versus severity

	Severity				
Cause	Mild	Moderate	Not Specified	Severe	Total
Physical Assault	86	293	27	4	410
Row per cent	20.98	71.46	6.59	0.98	100
Column per cent	78.18	78.76	81.82	57.14	78.54
Dog Bite	3	0	1	0	4
Row per cent	75	0	25	0	100
Column per cent	2.73	0	3.03	0	0.77
Genital Assault	10	11	0	0	21
Row per cent	47.62	52.38	0	0	100
Column per cent	9.09	2.96	0	0	4.02

Neglect	0	1	0	0	1
Row per cent	0	100	0	0	100
Column per cent	0	0.27	0	0	0.19
Not Specified	0	9	2	0	11
Row per cent	0	81.82	18.18	0	100
Column per cent	0	2.42	6.06	0	2.11
Sexual Abuse	11	58	3	3	75
Row per cent	14.67	77.33	4	4	100
Column per cent	10	15.59	9.09	42.86	14.37
Total	110	372	33	7	522
Row per cent	21.07	71.26	6.32	1.34	100
Column per cent	100	100	100	100	100

f) Decisions taken and management of cases

Of all the NIA cases, a decision to admit was made in 28.74% of the total cases, 60.3% of cases were discharged, and 0.96% of cases were sent to a place of safety while for 9.96% of the cases, the decision was not specified. One can only assume they may have been discharged. With the null hypothesis of no association between decision and severity, the Fisher's test of 0.00 suggests we should reject the null hypothesis and assume significant association between the two variables. Cramer's V test notes the association to be of 21.4% strength. It would make sense that the severe cases were admitted into hospital. Of the moderate cases (71.26% of total cases), 34.68% were admitted, 55.38% discharged, 0.54% sent to a place of safety whilst 9.40% of the moderate cases' decision was not specified. For more information see Appendix A.

It is mandatory for the physician to report cases suspected to be NAI. Of major concern was the data provided by the social worker with respect to cases that were to be referred to the police and to be followed up by the social worker for the first and second time after the child was placed in a place of safety. It appeared not to tally with the decision taken as represented above. There was a huge gap in data recording in the management of the children sent to places of safety and those cases referred to the police.

Following assessment regarding NAI, investigations ordered included blood work, X–rays, CT Scans, dressings and sutures. Due to poor record-keeping, the majority of the cases (53.45%) were not specified in the type of investigation. For the recorded cases, the highest was 28.35% for X–rays, which correlates with the high number of physical assaults recorded. A combination of bloods, CT scans and X–rays accounted for 2.68%, the lowest being 0.77% for dressings/sutures. It is most likely that the 279 unspecified cases were given dressings and sutures since physical assault was the highest cause of NAI. Table 5 below gives an outline of the investigations ordered.

Table 5 : Investigations ordered

Investigations	Frequency	Per cent
Bloods	12	2.3
CT Scan	65	12.45
X-ray	148	28.35
Scan/X-Ray-combination	14	2.68
Dressings/Sutures	4	0.77
Not Specified	279	53.45
Total	522	100

g) Perpetrators of NAI cases

Table 6 shows the relationship between cause and perpetrator. Most of the perpetrators were not known, accounting for 65.52% of total NAI cases. Other children accounted for 20.11%, parents for 6.7%, known/family friend for 4.02% and relatives for 3.6%. Of

the sexual abuse cases, 72% of perpetrators were unknown, 8% were family friends, 2.67% were committed by parents, 2.66% were committed by relative/siblings, and 14.67 were other children. With the null hypothesis of no association between cause and perpetrator, the Fisher test of 0.220 suggests we cannot reject the null hypothesis and assume no association between the two variables. Cramer's V test notes the association to be of 0.1224, which is a very weak strength of association.

Table 6 : Cause versus perpetrator

causer (Cause)	Perpetrator					Total
	Another Child	Known/Family friend	Not Known	Parent	Relative /Sibling	
Physical Assault	90	15	258	31	16	410
Row per cent	21.95	3.66	62.93	7.56	3.9	100
Column per cent	85.71	71.43	75.44	88.57	84.21	78.54
Dog Bite	0	0	4	0	0	4
Row per cent	0	0	100	0	0	100
Column per cent	0	0	1.17	0	0	0.77
Genital Assault	4	0	16	0	1	21
Row per cent	19.05	0	76.19	0	4.76	100
Column per cent	3.81	0	4.68	0	5.26	4.02
Neglect	0	0	0	1	0	1
Row per cent	0	0	0	100	0	100
Column per cent	0	0	0	2.86	0	0.19
Not Specified	0	0	10	1	0	11
Row per cent	0	0	90.91	9.09	0	100
Column per cent	0	0	2.92	2.86	0	2.11
Sexual Abuse	11	6	54	2	2	75
Row per cent	14.67	8	72	2.67	2.66	100
Column per cent	10.48	28.57	15.79	5.71	10.53	14.37
Total	105	21	342	35	19	522
Row per cent	20.11	4.02	65.52	6.7	3.64	100
Column per cent	100	100	100	100	100	100

VII. Discussion

The abuse of children is a universal problem. [7] It affects children from all social classes, racial and religious groups. The Red Cross Hospital Trauma unit is the primary referral centre for injured children in the province and we expect that this may not be representative of other health care facilities, such as community clinics or private hospitals. Due to a lack of detailed information, we were not able to ascertain the deeper clinical conditions as did van As et al in the fractures study at the Red Cross Hospital. [8]

Serious head injury in children younger than 2 years old is often the result of child abuse. [9] Though most studies note that intracranial trauma caused by shaking is the most frequent cause of death,[10] our study noted that head injuries in the 0–4 group were more prevalent, followed by genital and sexual assaults and injuries to the hands and arms. Though it is unclear whether the head injuries were associated with shaking or direct trauma, 85.3% were soft tissue injuries resulting in bruising. There is a high likelihood that the remainder could include cranial fractures.

International studies show that non–accidental head injuries among infants represent one of the most severe forms of child abuse, mortality rates of between 13% and 30% and significant neurological impairments in at least a half of the survivors.[11] Other studies show that inflicted head injuries are the leading cause of death of children who have been abused-there is an estimated prevalence of 1 per 3,000 in babies of less than six months.[12] The limitation of this study is that outcomes, morbidity and mortality for these cases were not included. A follow–up would help to determining what happened to those children, to allow for a comparison with the 50 000 deaths supposedly caused by NAI worldwide on an annual basis. [13]

Incidence studies of non–accidental head injuries in the UK suggested figures ranging from roughly 10 – 14 per 100,000 infants per year,[14] and it is estimated that approximately 12 children per 100,000 under the age of two years suffer from non-accidental subdural haemorrhage, with at least half of these injuries being related to shaking.[15] Children under the age of 4 years have considerable morbidity from head trauma, as this age group has a prevalence of traumatic brain injury (TBI) that is more than twice the rate of the general population and nearly twice the rate of older children.[20] In our study, the 5–9 age group had approximately 2% more head injuries that the 0–4group

(36%), while the 10–13 group accounted for 26%. We cannot firmly assert that these resulted in subdural haemorrhage, though to a certain degree we can attribute child abuse.

Although the established consensus on fracture patterns in NAI is that long bone fractures are the most frequently experienced in clinical practice, the van As study [8] noted that nearly 40% of all fractures were skull fractures. Approximately one-third were inflicted with a weapon. Our study reveals that a high number of cases were the result of physical abuse with use of a weapon that in turn caused head injuries. Of the remaining hand, abdominal and leg injuries, the likelihood of these suspected to be fractures is high, given the request for X–rays in 148 cases. Alternative conditions must be considered before making a final diagnosis of NAI, e.g. osteogenesis imperfect a also presents with skeletal injuries.[26] Radiology is used to detect the type of injury inflicted, as well as to establish whether injuries are likely to be caused by NAI.[16–18] The radiologist involved must be familiar with the imaging, clinical, surgical, pathological, biomechanical, and forensic literature.[16] Our study was limited and did not focus on NAI being revealed by radiological evidence. It only went as far as noting whether the child was sent for X–rays, but not the results.

There is always some doubt concerning the authenticity of reported perpetrators due to fear by the child or caregiver. Child abuse is a sensitive issue with potential criminal implications; consequently, identification of the perpetrator or cause of injury is made harder and may influence the conclusions drawn from available data. Madu and Peltzer's study in the Northern Province of South Africa reported that many victims did not identify the perpetrator and where they did, the culprit was usually a 'friend'.[19]

Our study noted that of the sexual abuse cases, 72% of the perpetrators were unknown, 8% were family friends, 2.67% were committed by parents, 2.66% were committed by relative/siblings, and 14.67 were other children. There is a huge possibility that the unknown cases are perpetrators known to the victims, but who the victims decided not to name due to fear, and other negative consequences.

Prevalence studies have revealed the widespread and hidden nature of child maltreatment. Maltreatment includes physical abuse and neglect. It occurs in all countries and cultures and results from the interaction between several risk factors; such as parental depression, stress, and social isolation.[19] Our study does not identify the risk factors that resulted in child maltreatment, only describing cases where it has already been inflicted. The trauma and ward registers make no provision to note the socioeconomic status/income bands of parents or caregivers, there by renderingan examination of the potential link to NAI difficult.

Sexual abuse is one of the most prominent forms of NAI and is mostly common in females.[20] Our results show the same picture, noting that of the sexual abuse cases, 93.3% were female and 6.7% male. In cases of physical abuse, specific attention should be paid to the genital areas to exclude possible associated sexual abuse.[21] Our study concurs, noting that the primary diagnosis of genital assault and sexual assault was mostly caused by sexual abuse.

Unfortunately, not all cases are reported and many of them go unnoticed.[22] A variety of individuals may identify NAI; such as, for example, social workers, health visitors, neighbours, teachers, family practitioners and many other people working with children.[23---24] Though our study identifies places of occurrence as schools, home, public spaces and unknown, it does not explicitly identify who reports or detects NAI. We can only deduce from the places of occurrence, such as schools, that teachers tend to notice and take further action, such as calling an ambulance or using private transport to seek medical attention for the child. This is required by the South African's Children's Act, chapter 7, section 110, which makes it mandatory for any professional dealing with children to report suspected cases of NAI.[25]

VIII. Conclusion

It is clear from the above analysis that Non–accidental Injury (NAI) cases are not clear cut and need proper investigation and management for immediate clinical treatment and successful prosecution of perpetrators. The results of this study helped to describe common injury patterns in different age groups and genders. Hopefully, this will increase awareness of the NAI among healthcare practitioners and identify areas for advocacy.

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Competing interests
None.

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Ethical Approval

Ethical approval for the study was obtained from the relevant ethics committee at the University of Cape Town. Appendix C contains the ethics approval letter.

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Part D

Appendices

Appendix A: Results Tables
Appendix B: Data Collection Sheet
Appendix C: Emj Instruction to Authors
Appendix D: Ethics Aproval Letter

Appendix A : Results Tables

Gender Statistics

Gender	mean	p50	sd	variance	N
Female	5.945	5	3.352337	11.23817	200
Male	7.220497	7	3.404846	11.59297	322
Total	**6.731801**	**7**	**3.438087**	**11.82045**	522

Investigations ordered

Investigations			
	Freq.	**Percent**	**Cum.**
Bloods	12	2.3	2.3
CT Scan	65	12.4	14.75
X-ray	148	28.35	43.1
Bloods/CT Scan/X-Ray-combination	14	2.6	45.79
Dressings/Sutures	4	0.77	46.55
Not Specified	279	53.45	100
Total	**522**	**100**	

Gender versus Primary Diagnosis

	Gender		
	Female	**Male**	**Total**
Diagnosis			
Abdominal	6	9	15
	40	60	100
	3	2.8	2.87
Arm	13	20	33
	39.39	60.61	100
	6.5	6.21	6.32
Back	2	5	7
	28.57	71.43	100
	1	1.55	1.34
Face	19	66	85
	22.35	77.65	100
	9.5	20.5	16.28
Face/Head	1	3	4
	25	75	100
	0.5	0.93	0.77
Full Body	0	1	1
	0	100	100
	0	0.31	0.19
Genitals	31	24	55
	56.36	43.64	100
	15.5	7.45	10.54
Hand	6	16	22
	27.27	72.73	100
	3	4.97	4.21
Head	60	124	184
	32.61	67.39	100
	30	38.51	35.25
Lower Body	13	37	50
	26	74	100
	6.5	11.49	9.58
Not Specified	3	3	6
	50	50	100
	1.5	0.93	1.15
Sexual Assault	43	2	45
	95.56	4.44	100
	21.5	0.62	8.62
Upper Body	3	12	15
	20	80	100
	1.5	3.73	2.87
Total	**200**	**322**	**522**
	38.31	61.69	100
	100	100	100

Age versus Primary diagnosis

	Age Group		
	0-4	5-9	10-13
DiagnosisAN			
Abdominal	3	9	3
	20	60	20
	1.99	3.83	2.21
Arm	8	17	8
	24.24	51.52	24.24
	5.3	7.23	5.88
Back	1	3	3
	14.29	42.86	42.86
	0.66	1.28	2.21
Face	14	43	28
	16.47	50.59	32.94
	9.27	18.3	20.59
Face/Head	3	1	0
	75	25	0
	1.99	0.43	0
Full Body	0	1	0
	0	100	0
	0	0.43	0
Genitals	18	29	8
	32.73	52.73	14.55
	11.92	12.34	5.88
Hand	3	7	12
	13.64	31.82	54.55
	1.99	2.98	8.82
Head	66	70	48
	35.87	38.04	26.09
	43.71	29.79	35.29
Lower Body	14	21	15
	28	42	30
	9.27	8.94	11.03
Not Specified	3	2	1
	50	33.33	16.67
	1.99	0.85	0.74
Sexual Assault	16	21	8
	35.56	46.67	17.78
	10.6	8.94	5.88
Upper Body	2	11	2
	13.33	73.33	13.33
	1.32	4.68	1.47
Total	**151**	**235**	**136**
	28.93	45.02	26.05
	100	100	100

Place of occurrence versus Cause

	Creche/School	**Home**	**Other/Unknown**	**Public Place**	**Total**
Cause					
Physical Assault	107	199	36	63	405
	26.42	49.14	8.89	15.56	100
	89.92	76.25	59.02	85.14	78.64
Dog Bite	0	3	0	1	4
	0	75	0	25	100
	0	1.15	0	1.35	0.78
Genital Assault	7	7	2	5	21
	33.33	33.33	9.52	23.81	100
	5.88	2.68	3.28	6.76	4.08
Neglect	0	0	1	0	1
	0	0	100	0	100
	0	0	1.64	0	0.19
Not Specified	1	6	2	0	9
	11.11	66.67	22.22	0	100
	0.84	2.3	3.28	0	1.75
Sexual Abuse	4	46	20	5	75
	5.33	61.33	26.67	6.67	100
	3.36	17.62	32.79	6.76	14.56
Total	**119**	**261**	**61**	**74**	**515**
	23.11	50.68	11.84	14.37	100
	100	100	100	100	100

Pearson chi2(15)= 50.782 Pr=0.000
likelihood-ratio chi2(15)=51. Pr=0.001
Cramér's V=1.813
gamma=0.2237 ASE=0.034
Kendall's tau-b ASE=0.069

Transportation of NIA cases versus Cause

	Transport				
	Ambulance	**Police**	**Private**	**School**	**Total**
Cause					
Physical Assault	138	3	246	4	391
	35.29	0.77	62.92	1.02	100
	90.2	42.86	74.1	8	78.67
Dog Bite	0	0	4	0	4
	0	0	100	0	100
	0	0	1.2	0	0.8
Genital Assault	2	0	17	0	19
	10.53	0	89.47	0	100
	1.31	0	5.12	0	3.82
Neglect	0	0	1	0	1
	0	0	100	0	100
	0	0	0.3	0	0.2
Not Specified	1	0	8	1	10
	10	0	80	10	100
	0.65	0	2.41	20	2.01
Sexual Abuse	12	4	56	0	72
	16.67	5.56	77.78	0	100
	7.84	57.14	16.87	0	14.49
Total	153	7	332	5	497
	30.78	1.41	66.8	1.01	100
	100	100	100	100	100

Pearson chi2(15) = 36.8697 Pr = 0.001
gamma = - 0.3980 ASE = 0.102
likelihood-ratio chi2(15) = 32.9357 Pr = 0.05
Cramér's V = 0.1579
Kendall's tau-b = 0.1511 ASE = 0.037
Fisher's exact = 0.001

Decision taken versus Severity of NIA cases

	Severity				
	Mild	Moderate	Not Specified	Severe	Total
Decision					
Admit	2	129	12	7	150
	1.33	86	8	4.67	100
	1.82	34.68	36.36	100	28.74
Discharge	94	206	15	0	315
	29.84	65.4	4.76	0	100
	85.45	55.38	45.45	0	60.34
Not Specified	11	35	6	0	52
	21.15	67.31	11.54	0	100
	10	9.41	18.18	0	9.96
Place of Safety	3	2	0	0	5
	60	40	0	0	100
	2.73	0.54	0	0	0.96
Total	**110**	**372**	**33**	**7**	**522**
	21.07	71.26	6.32	1.34	100
	100	100	100	100	100

Pearson chi2(9) = 71.5119 Pr = 0.000
likelihood-ratio chi2(9) = 89.3390 Pr = 0.000
Cramér's V = 0.2137
gamma = -0.4837 ASE = 0.067
Kendall's tau-b = -0.2392 ASE = 0.035
Fisher's exact = 0.000

Gender versus Perpetrator

	Gender		
	Female	**Male**	**Total**
Perpetrator			
Another Child	30	75	105
	28.57	71.43	100
	15	23.29	20.11
Known/Family Friend	9	12	21
	42.86	57.14	100
	4.5	3.73	4.02
Not Known	133	209	342
	38.89	61.11	100
	66.5	64.91	65.52
Parent	17	18	35
	48.57	51.43	100
	8.5	5.59	6.7
Relative/Sibling	11	8	19
	57.89	42.11	100
	5.5	2.48	3.64
Total	**200**	**322**	**522**
	38.31	61.69	100
	100	100	100

Pearson chi2(4) = 9.0885 Pr = 0.059
likelihood-ratio chi2(4) = 9.1105 Pr = 0.058
Cramér's V = 0.1320
gamma = -0.2249 ASE = 0.081
Kendall's tau-b = -0.1124 ASE = 0.041
Fisher's exact = 0.055

Appendix B : Data Collection Form

SURNAME……RACE…… SEX…… FORM NO.....

FIRST NAME…….. DATE OF …… DATE OF ……duration to……

BIRTH PRESENTATION present

ADDRESS……..

PRIMARY DIAGNOSIS……

Reason to suspect…… Perpetrator suspected……

TRANSPORT	BROUGHT IN BY	MECHANISM OF INJURY	TRAGE PRIORITY
Ambulance ☐	Mother ☐	Burn ☐	Red ☐
Private ☐	Father ☐	Assault ☐	
Police ☐	Other……	Blunt ☐	Yellow ☐
School ☐		Sharp ☐	
Other……		Other……	Green ☐
		Not Done ☐	

BURN %.....

PLACE OF OCCURRENCE

Degree 1 ☐ 2 ☐ 3 ☐

Flame ☐	At home ☐	Admit ☐	
Fluid ☐	Other home ☐	Discharge ☐	
Heat contact ☐	Public Place ☐	Placeof safety ☐	
Electrical ☐	School/Crèche ☐	Police case ☐	
Chemical ☐	Sport ☐	Follow up by social worker ☐	
Explosion ☐			
Other ☐	Unknown ☐		

SEVERITY	INVESTIGATIONS	MANAGEMENT
Mild ☐	CT ☐	Rape Kit ☐
Other……		
Moderate ☐	X-Ray ☐	EUA ☐
Severe ☐	Bloods ☐	POP ☐
		Dressings ☐
Other……..	Other…….	Sutures ☐

HEAD

Bruising to head☐

Soft tissue injury☐

Skull fracture☐

Epidural/Subdural☐ Haemorrhage

Subarachnoid☐ Haemorrhage

Spine ☐

Cerebal Oedema ☐

EYES

Peri-ocular ☐

Intra-ocular ☐ (Retinal Haemorrhage)

FACIAL

Fracture ☐

Soft Tissue☐

BODY

Neck ☐ Shoulder ☐ Hip ☐

Chest ☐ Arm ☐ Thigh ☐

Abdomen☐ Elbow ☐ Knee ☐

Buttock and lower back ☐ Forearm ☐ Leg ☐

Pelvis☐ Ankle☐ Wrist ☐

Genitals and inner thighs ☐ Foot☐

Hand ☐

Unspecified……

Appendix C : Emergency Medicine Journal Instruction to Authors

Original articles

For full length accounts of original research, often shorter articles are better. Additional information may be placed on the web site as a data supplement.
Word count: up to 3000 words.
Illustrations and tables: up to 6.
References: 25.
Peer review: all papers are reviewed by at least one reviewer.

If there is uncertainty about acceptance after review, papers are reviewed by the editors.

All material submitted is assumed to be submitted exclusively to the journal unless the contrary is stated. Submissions may be returned to the author for amendment if presented in the incorrect format.

The title page must contain the following information:

1. The title.
2. The name, postal address, e--mail, telephone and fax numbers of the corresponding author.
3. The full names, institutions, city and country of all co---authors.
4. Up to five keywords or phrases suitable for use in an index (it is recommended to use MeSH terms).
5. Word count – excluding title page, abstract, references, figures and tables.

The manuscript format must be presented in the following order:

1. Title page
2. Abstract (or summary for case reports)
3. Main text (tables should be in the same format as your article and embedded into the document where the table should be cited; images must be uploaded as separate files)
4. Acknowledgments, Competing interests, Funding
5. Copyright licence statement
6. References
7. Appendices

Do not use the automatic formatting features of your word processor such as endnotes, footnotes, headers, footers, boxes etc.
Provide appropriate headings and subheadings as in the journal.

We use the following hierarchy: BOLD CAPS, bold lower case, Plain Text, Italics. Cite illustrations in numerical order (fig 1, fig 2 etc) as they are first mentioned in the text. Tables should be in the same format as your article and embedded into the document where the table should be cited.

Images must not be embedded in the text file but submitted as individual files.

Statistics: Statistical analyses must explain the methods used.

Style: Abbreviations and symbols must be standard and SI units used throughout except for blood pressure values which are reported in mm Hg. Acronyms should be used sparingly and fully explained when first used.

Figures/illustrations: Black and white images should be saved and supplied as GIF, TIFF, EPS or JPEG files, at a minimum resolution of 300 dpi and an image size of 9 cm across for single column format and 18.5 cm for double column format. Colour images should be saved and supplied as GIF, TIFF, EPS or JPEG files, to a minimum resolution of 600 dpi at an image size of 9 cm across for single column format and 18.5 cm for double column format. Images should be mentioned in the text and figure legends should be listed at the end of the manuscript. During submission, when you upload the figure files please label them as Figure 1, Figure 2, etc.

The file label will not appear in the pdf but the order in which the figures uploaded should be sufficient to link them to the correct figure legend for identification. Histograms should be presented in a simple, two–dimensional format, with no background grid.

Tables: Tables should be submitted in the same format as your article and embedded into the document where the table should be cited. Tables should be self–explanatory and the data they contain must not be duplicated in the text or figures.

References: Authors are responsible for the accuracy of references cited: these should be checked against the original documents before the paper is submitted. It is vital that the references are styled correctly so that they may be hyperlinked.

In the text: References must be numbered sequentially as they appear in the text. References cited in figures or tables (or in their legends and footnotes) should be numbered according to the place in the text where that table or figure is first cited.

Reference numbers in the text must be given in square brackets immediately after punctuation (with no word spacing) – for example, [6] not [6]. Where more than one reference is cited, separate by a comma, for example, [1, 4, 39] For sequences of consecutive numbers, give the first and last number of the sequence separated by a hyphen --- for example, [22–25].

References provided in this format are translated during the production process to superscript type, which act as hyperlinks from the text to the quoted references in electronic forms of the article. In the *reference list:* References must be double spaced (numbered consecutively in the order in which they are mentioned in the text) in the [slightly modified] Vancouver style.

Only papers published or in press should be included in the reference list. (Personal communications or unpublished data must be cited in parentheses in the text with the name(s) of the source(s) and the year.

Authors should get permission from the source to cite unpublished data.) Punctuation of references must follow the [slightly modified] Vancouver style: 12 Surname AB, Surname CD, Article title; Journal abbreviation. Year; Vol.: Start page, End page. Use one space only between words up to the year and then no spaces. The journal title should be in italic and abbreviated according to the style of Medline. If the journal is not listed in Medline then it should be written out in full.

Appendix D : Ethics Approval Letter

UNIVERSITY OF CAPE TOWN

Health Sciences Faculty
Human Research Ethics Committee
Room E52-24 Groote Schuur Hospital Old Main Building
Observatory 7925
Telephone [021] 406 6338 • **Facsimile** [021] 406 6411
e-mail: shuretta.thomas@uct.ac.za

24 October 2011

HREC REF: 482/2011

Mr I Al-Malki
c/o Dr H Geduld
Emergency Medicine

Dear Mr Al-Malki

PROJECT TITLE: CLINICAL FINDINGS IN CHILDREN AFTER NON-ACCIDENTAL INJURIES PRESENTING TO RED CROSS CHILDREN'S HOSPITAL.

Thank you for submitting your study to the Faculty of Health Sciences Human Research Ethics Committee or review.

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study.

Approval is granted for one year till the 28 October 2012.

Please submit a progress form, using the standardised Annual Report Form (FHS016), if the study continues beyond the approval period. Please submit a Standard Closure form (FHS010) if the study is completed within the approval period.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please quote the HREC. REF in all your correspondence.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, HSF HUMAN ETHICS
Federal Wide Assurance Number: FWA00001637.
Institutional Review Board (IRB) number: IRB00001938

This serves to confirm that the University of Cape Town Human Research Ethics Committee complies to the Ethics Standards for Clinical Research with a new drug in patients, based on the Medical Research Council

s.thomas

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Unilateral Accessory Plantaris Muscle: A Rare Anatomical Variation with Clinical Implications

By Dr. Sherry Sharma, Dr. Meenakshi Khullar & Dr. Sunil Bhardwaj

Punjab Institute of Medical Sciences, India

Abstract- Plantaris, a small muscle with its long slender tendon, is of interest not only from anatomical but also from phylogenetic view point. It is regarded as vestigial in man, believing that, with assumption of an erect posture, the tendon lost its original insertion into plantar aponeurosis and gained a secondary calcaneal attachment. The muscle is known to exhibit variations but there are few reports on the existence of complete duplication of plantaris. During the routine dissection for the undergraduate medical students we encountered unilateral accessory plantaris muscle in the right lower limb of an adult male cadaver. Though often dismissed as a small vestigial muscle, an injury to this muscle should actually be included in the differential diagnosis of the painful calf.

Keywords: *vestigial, plantar aponeurosis, tendon transfer operations.*

GJMR-H Classification: *NLMC Code: QY 35*

Strictly as per the compliance and regulations of:

Unilateral Accessory Plantaris Muscle: A Rare Anatomical Variation with Clinical Implications

Dr. Sherry Sharma [α], Dr. Meenakshi Khullar [σ] & Dr. Sunil Bhardwaj [ρ]

Abstract- Plantaris, a small muscle with its long slender tendon, is of interest not only from anatomical but also from phylogenetic view point. It is regarded as vestigial in man, believing that, with assumption of an erect posture, the tendon lost its original insertion into plantar aponeurosis and gained a secondary calcaneal attachment. The muscle is known to exhibit variations but there are few reports on the existence of complete duplication of plantaris. During the routine dissection for the undergraduate medical students we encountered unilateral accessory plantaris muscle in the right lower limb of an adult male cadaver. Though often dismissed as a small vestigial muscle, an injury to this muscle should actually be included in the differential diagnosis of the painful calf. Also the knowledge of both normal and abnormal anatomy of the plantaris muscle is important for surgeons performing tendon transfer operations and clinicians diagnosing muscle tears.

Keywords: vestigial, plantar aponeurosis, tendon transfer operations.

I. Introduction

The plantaris muscle consists of a small, thin muscle belly and a long thin tendon (approximately 2-4 inches long) that forms part of the posterosuperficial compartment of the calf.

The muscle originates from the lower part of the lateral supracondylar line of the femur just superomedial to the origin of the lateral head of the gastrocnemius muscle and from the oblique popliteal ligament of the knee joint. The muscle belly crosses the popliteal fossa inferomedially. In the proximal third of the leg, the muscle belly is situated between the popliteus muscle anteriorly and the lateral head of the gastrocnemius muscle posteriorly. The myotendinous junction occurs approximately at the level of the origin of the soleus muscle from tibia in the proximal part of the leg. Its long thin tendon then courses distally between the medial head of the gastrocnemius muscle and the soleus muscle in the middle third of the leg. Subsequently, it continues inferiorly along the medial aspect of the Achilles tendon up to its insertion on the calcaneum. Finally, it gets inserted either independently or in association with Achilles tendon on calcaneus[1].

The long, thin tendon of plantaris is humorously called the freshman's nerve, as it is often mistaken for a nerve by first-year medical students[2]. Neural innervation to this muscle is provided by the tibial nerve (S1, S2).

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II. Materials and Methods & Results

During the routine dissection of lower extremities for undergraduate medical students, we encountered an anomalous accessory plantaris muscle in the right lower limb of a male cadaver. The muscle was displayed by meticulous dissection. Morphometric measurements were taken and the specimen was photographed.

On the right side, the plantaris muscle showed complete duplication i.e. it had two separate bellies of origin (P1, P2) and two separate tendons of insertion (T1, T2). Out of the two bellies, P1 was thicker and much fleshy; measuring about 4 inches in length. It took origin from the lower part of the lateral supracondylar ridge of the femur just superomedial to the origin of the lateral head of gastrocnemius muscle. On the contrary, P2 was comparatively thinner; measuring about 2 inches in length. It took origin from the posterior surface of the lateral condyle of femur medial to the origin of the lateral head of gastrocnemius muscle.

Both the bellies terminated as separate tendons (T1 and T2) which travelled inferomedially between the gastrocnemius and the soleus and got inserted into the upper part of the posterior surface of calcaneum (T2 inserting relatively above T1) ; medial to the insertion of tendocalcaneus (Table/Fig 1). Dissection on the left side revealed no such variation regarding plantaris muscle.

III. Discussion

Plantaris muscle is known as vestigial muscle in human as its distal attachment has shifted secondarily well short of plantar aponeurosis to calcaneus due to process of evolution for erect posture and bipedal locomotion[3]. In some animals like the American bear, the plantaris muscle can be found to be attached to the plantar aponeurosis[4]. It is known to present several anatomical variations in terms of its occurrence, origin, course, relation with surrounding neurovascular structures and insertion.

Reports are available in the literature stating numerous anomalous sites of origin of this muscle which include: i) the lower part of the linea aspera; ii) the posterior ligament of the knee at the intercondylar space; iii) the fascial covering of the popliteus; iv) the fibula, between the flexor hallucis longus and the peroneus longus; v) the oblique line of the tibia, under cover of the soleus; or vi) the lateral condyle of the femur above the origin of the lateral head of the gastrocnemius[4]. Similarly there are reports showing anomalous sites of insertion of plantaris which include: i) the soft tissues between the muscle bellies of the gastrocnemius and the soleus; ii) the inner border of the calcaneal tendon; iii) the dorsomedial surface of the calcaneal tendon at the latter's insertion; iv) the bursa between the calcaneal tendon and the calcaneum; v) the fibrous and fatty tissues situated immediately in front of the calcaneal tendon; and vi) the plantar aponeurosis[4] vii) Iliotibial tract or lateral patellar retinaculum[5] viii) As split attachments on posteromedial side of calcaneus[6]. The muscle is also reported to merge with the flexor retinaculum or with the superficial fascia of the leg[3].

Plantaris muscle belly directly forming an aponeurosis without an intermediate tendon which merged with the soleus muscle close to its origin has also been reported[7].

The plantaris muscle may even be unilaterally or bilaterally absent[2,4,8,9]. Embryological development in man supports the idea advocated by McMurrich[10] that the plantaris is a derivative of the deeper portion of the lateral head of gastrocnemius muscle. When absent, it's likely that this separation has failed to take place during ontogeny. In many mammals, it is not differentiated (several edentates, carnivores etc.); in others especially in some rodents, it is highly developed.

An additional tendinous slip of origin from the fascia covering popliteus along with the entrapment of plantaris muscle belly between tibial nerve and its branch to soleus has also been reported separately by Das and Vasudeva[11] and Nayak et al[12].

Unilateral / bilateral bicipital origin of this muscle has also been reported in which the muscle took origin in the form of two separate bellies from two different sites but then joined to form a common tendon[13,14]. Similar unilateral bicipital origin was recorded by Sawant et al[15] with a difference that in their case both the bellies continued as separate tendons which then fused to form a common one which inserted on medial side of calcaneus. Similarly Kwinter et al[6] recorded a second plantaris muscle in the right leg of 47 year old female cadaver. The inner and outer bellies of the anomalous plantaris arose proximally from the medial condyle of the femur and formed a short tendon that fused distally with the tendon of the lateral plantaris muscle. The main tendon split forming three distinct attachments on the posteromedial aspect of the calcaneous anterior to the medial side of the calcaneal tendon.

Reports on complete duplication of plantaris as seen in our case are extremely rare. During the review of the relevant literature, we could find only one case report describing bilateral complete duplication of plantaris in a 45 year old male cadaver[16].

Surgical intervention without knowledge of bicipital origin of plantaris or its complete duplication may lead to inadvertent damage to surrounding structures. The additional plantaris muscle as in our case may also confuse clinicians when diagnosing a posterior knee injury and / or tennis leg and create hindrances in surgical procedures involving the popliteal fossa. Hence, prior knowledge of such variations may be helpful during surgical operations involving the popliteal fossa and the posterior compartment of leg[11,14].

IV. Clinical Significance

In terms of function, the plantaris muscle acts with the gastrocnemius but is insignificant as either a flexor of the knee, or a plantar flexor of the ankle. It has been considered to be an organ of proprioceptive function for the larger, more powerful plantar flexors, as it contains a high density of muscle spindles[17]. The plantaris tendon has elicited further interest because of its potential use as a graft[8]. Removal of the plantaris muscle does not typically hinder the patient's lower extremity function in the presence of a normal soleus and gastrocnemius. Surgeons have recognized the noticeable tensile strength of the tendon. They have used the structure successfully in flexor tendon replacement in the hand and have suggested its use in atrioventricular valve repair[18]. Also it has been established through MRI, sonography and surgical exploration that injuries to this muscle may in fact occur in isolation as well as in association with tears of gastrocnemius, soleus and anterior cruciate ligament. Hence, the observation made in our case report will supplement our knowledge of variations in the posterior aspect of the knee joint, which may be useful for surgeons and orthopedicians performing tendon transfer operations, clinicians and physiotherapists diagnosing muscle tears, and radiologists interpreting MRI scans.

V. Conclusions

Considering the above facts, the existence and significance of the variations of plantaris muscle cannot be undermined. The presence of complete duplication of plantaris, as seen in the present case may be of academic interest too, as the standard textbooks of anatomy mention little about this fact. Also the advancements in anatomical understanding of the structures that may influence a joint may subsequently lead to improved surgical interventions and rehabilitative procedures.

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Legends of Table/Fig 1 : Posterior view of the right lower limb of the cadaver showing complete duplication of Plantaris muscle. (P1 & P2 – Its two bellies of origin, T1 & T2 – Its two tendons of insertion, LHG – Lateral head of Gastrocnemius muscle, AT – Achilles tendon)

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How Much of a Role Birth Asphyxia and Chronic Antenatal Hypoxia Disorders have in the Genesis of Cerebral Palsy?

By Dr. Kulkarni R.S., Dr. Aditya. P. Kulkarni., Dr. Rachana. R. Kulkarni.
& Dr. Ranjani. R. Kulkarni.

Civil Hospital Oras, Sindhudurg, India

Abstract- *Objective:* Analysis were under taken to determine the role of birth asphyxia and chronic antenatal hypoxia disorders in the genesis of Cerebral palsy, in a prospective study of 31,804 antenatal mothers and 30,080 live births.

Material & Methods: For this large-scale prospective study, proper documentation of all events in the antenatal, natal and postnatal period, a detail, stringent protocol was prepared and distributed to 49 Govt. & Z.P. health institutes. The protocol was filled in for each antenatal mother by the doctor of antenatal clinic and who is attending the delivery. The same was collected back to us by above-mentioned institutes on a fixed date of every month, at the time of monthly review meeting.

Keywords: *cerebral palsy, birth asphyxia, chronic antenatal hypoxic disorders.*

GJMR-H Classification: *NLMC Code: WO 250, WS 342*

Strictly as per the compliance and regulations of:

How Much of a Role Birth Asphyxia and Chronic Antenatal Hypoxia Disorders have in the Genesis of Cerebral Palsy?

Large Prospective Study of 31,804 Antenatal Mothers Followed up till Delivery and 30,080 Live Births Observed in Sindhudurg District

Dr. Kulkarni R.S. [α], Dr. Aditya. P. Kulkarni.[σ], Dr. Rachana. R. Kulkarni. [ρ] & Dr. Ranjani. R. Kulkarni. [ω]

Abstract- Objective: Analysis were under taken to determine the role of birth asphyxia and chronic antenatal hypoxia disorders in the genesis of Cerebral palsy, in a prospective study of 31,804 antenatal mothers and 30,080 live births.

Material & Methods: For this large-scale prospective study, proper documentation of all events in the antenatal, natal and postnatal period, a detail, stringent protocol was prepared and distributed to 49 Govt. & Z.P. health institutes. The protocol was filled in for each antenatal mother by the doctor of antenatal clinic and who is attending the delivery. The same was collected back to us by above-mentioned institutes on a fixed date of every month, at the time of monthly review meeting. Thus from 1st Feb 1998 to 31st Jan 2000, a prospective study of 31,804 antenatal mothers were followed up till delivery and 30,080 live births were observed in Sindhudurg district.

Results: 246 children were identified as cerebral palsy in 30,080 live births at the end of 3rd serial examination. Only 33% (82/246) victims of Cerebral palsy had birth asphyxia the presumed cause of their cerebral palsy.

Of this 82 cerebral palsy children, 26% (64/246) were of quadriplegic cerebral palsy and 7% (18/246) non-quadriplegic which was attributable to the birth asphyxia. Congenital disorders explained about one third of quadriplegic cerebral palsy. Birth asphyxia was not a significant antecedent of non quadriplegic cerebral palsy.

Conclusion: 33% (82/246) victims of Cerebral palsy had birth asphyxia the presumed cause of their cerebral palsy. There was 20% (48/246) quiet a significant association of cerebral palsy with chronic antenatal hypoxic disorders.

The overall incidence of cerebral palsy for Sindhudurg Dist. amount to 8.1 per thousand live births over a period of 1998 to 2000.

Keywords: cerebral palsy, birth asphyxia, chronic antenatal hypoxic disorders.

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I. Introduction

William John Little in 1862, an Orthopaedic Surgeon presented a group of Children with tonal and developmental abnormalities, which he described as spastic rigidity.(1) Many of these children had a history of prolonged labour, preterm delivery. Because of frequency of these perinatal problems, Little postulated that the motor defects resulted directly from difficulties in the birth process. This opinion was widely held for over a century.

Yet there were early critics, chief among them Sigmund Freud, who speculated that, perinatal difficulties were the result of pre exisisting abnormalities in the foetus rather than the cause of cerebral palsy.(2)

This study was undertaken to identify and quantitate the major causes of cerebral palsy. The analysis were based on specific disorders that might damage a child's brain.(3) The most widely discussed of these disorders is birth asphyxia, with some people claiming that it is a frequent and others could be misleading because it is possible that such disorders are being missed or that insufficient cases have been analysed to find a correlation between them and cerebral palsy.(4) The first goal of the present study was to determine how much of a role birth asphyxia has in the genesis of cerebral palsy. A second goal was to quantitate the roles of chronic antenatal hypoxia disorders, congenital disorders, hypoglycemia, oxytocin, toxaemia of pregnancy, mal presentations and other prenatal factors as causes of cerebral palsy.(5)

II. Material & Methods

38 Primary health centers, 9 Rural hospitals and one Cottage hospital including District hospital are under the technical control of District Civil surgeon. For this large scale prospective study, proper documentation of all events in the antenatal, natal and post natal period, a detail, stringent protocol was prepared and distributed to 49 Govt. Rural, Sub District Hospitals & Primary Health Centers. The protocol was filled in for each antenatal mother by the doctors of ante

natal clinic and who is attending the delivery. The same was collected back to us by above mentioned institutes on a fixed date of every month, at the time of monthly review meeting at District head quarter with district Civil Surgeon. Thus from 1st Feb 1998 to 31st Jan 2000, a prospective study of 31,804 antenatal mothers were followed up till delivery and 30,080 live births were observed in Sindhudurg district. The total number of live births for the above mentioned period was 32366 as per the vital statistics department of District Health Officer, Sindhudurg, thus un accounting the total live births of 2286, which include deliveries in small dispensaries, other nursing homes of outside the districts and home deliveries. All the children born were seen and examined at every six months intervals to identify cerebral palsy by a systematic and uniform record keeping system. The last neurological examination in the study was conducted in February 2002. Data received from above mentioned institute enlisted for investigation, which became available for analysis in March 2002. Data for antenatal mothers and intranatal mothers compiled by the respective doctors in the stringent protocols updated, we are fairly confident that the protocol data accurately reflect the Cerebral palsy pattern in Sindhudurg district. 1065 children could not be analysed because the mothers delivered at different hospitals other than above mentioned institutes.

III. Results

Analysis were undertaken in a prospective study of 31,804 ante natal mothers who delivered from 1st Feb 1998 to 31st Jan 2000.. 246 children were identified as cerebral palsy in 30,080 live births at the end of 3rd serial examination.

Table 1 : Various etiological factors and their relative importance / incidence

Sr. No.	Factor	No	Incidence	Relative Risk
1	Prematurity	148/246	60.2%	54.4
2	Low birth weight	136/246	55.3%	52.2
3	Low Apgar score & abnormal foetal heart rate	86/246	34.9%	10.7
4	IUGR on USG	82/246	33%	15.1
5	History of spontaneous abortion & stillbirth	68/246	27.06%	5.7
6	Toxaemia of pregnancy	44/246	17.9%	8.1
7	Forceps application	42/246	17%	42.2
8	Muconium stained liquor	36/246	14.7%	1.2
9	Malpresentation	34/246	13.9%	8.6
10	Oxytocin drip during labour	26/246	10.7%	2.5
11	Unusually long or short interval between pregnancy	26/246	10.6 %	1.9
12	Caesarian section	16/246	6.5%	0.78
13	History of taking thyroid / oestrogen hormones	16/246	6.5%	43.5
14	Vaccum application	12/246	4.9%	29.6
15	Post maturity	12/246	4.9%	1.6
16	Bleeding during 1st , 2nd, 3rd, trimester of pregnancy	8/246	3.3%	1.3

The following positive antenatal, intranatal findings noticed are suggestive of quite a significant association of cerebral palsy with chronic antenatal hypoxia disorders.

60.2% (148/246) were born prematurely before 32 weeks of pregnancy. 55.3% (136/246) were low birth weight babies (below 2500 grams). Low Apgar scores & abnormal foetal heart rate during labour were present in 34.9% (86/246). Evidence of IUGR on USG was diagnosed in 33% (82/246). History of spontaneous abortion and still births were detected in 27.6% (68/246). Toxaemia of pregnancy was noted in 17.9% (44/246) ante natal mothers. Forceps were applied during deliveries in 17% (42/246). Muconium stained liquor during labour was seen in 14.7% (36/246). Mal presentations were seen in 13.9% (34/246). Oxytocin drip was started during labour in 10.6% (26/246). An unusually long or short interval between the pregnancy was seen in ante natal mothers cerebral palsy children 10.6% (26/246). Caesarean section was performed in

6.5% (16/246) in pregnant women. Ante natal mothers with history of taking thyroid hormones and oestrogen in 6.5% (16/246) were noted. Vacuum was applied during delivery in 4.9% (12/246) ante natal mothers. Post maturity was visualised in 4.9% (12/246). Bleeding during 1st 2nd & 3rd trimester of pregnancy was seen in 3.3%(8/246).

Thus 33% (82/246) victims of Cerebral palsy had birth asphyxia the presumed cause of their cerebral palsy. Of this 26% (64/246) were cases of quadriplegic cerebral palsy and 7% (18/246) non quadriplegic, which was attributable to the birth asphyxia. There was quiet a significant association of cerebral palsy with chronic antenatal hypoxic disorders.. Congenital disorders explained about one third of quadriplegic cerebral palsy. Birth asphyxia was not a significant antecedent of non quadriplegic cerebral palsy.

Finally the findings of the present study under score the importance of making accurate measurements and observations on neonates to avoid mistakes attributing non asphyxial cerebral palsy to birth asphyxia. The overall incidence of cerebral palsy for Sindhudurg Dist. amount to 8.1 per thousand live births over a period of 1998 to 2000.

IV. Discussion

Most studies that have attempted to determine if birth asphyxia is a cause of cerebral palsy, have used low Apgar scores and foetal distress to identify asphyxia. Low Apgar scores and foetal distress are often non hypoxic in origin, so their use as indicators of birth asphyxia could misattribute some non asphyxial cerebral palsy to asphyxia.[6] We explored this possibility by seeing how many victims of cerebral palsy who had low Apgar scores had a non asphyxial disorder as the basis for their cerebral palsy.

During the past two decades, dramatic changes in obstetrical and perinatal care have included the increasing availability of foetal heart monitoring and foetal ultrasonography, the establishment of neonatal intensive care units, and the implementation of policies to encourage the regionalization of care and the transport of mothers carrying high-risk foetuses before delivery. If the occurrence of cerebral palsy reflected sub optimal obstetrical care, [6] then its prevalence would be expected to decline in response to these remarkable improvements in care, but it has not done so.[8]

In an attempt to evaluate the relative contribution of all pregnancy-related factors, some epidemiologists have created analytic models that evaluate later events (for example, those occurring during the delivery)[9] in the light of earlier events (characteristics of the mother before pregnancy, first-trimester events, and so on).[10] , in the victims of cerebral palsy, characteristic consequences of birth asphyxia were more often the result of non-asphyxial disorders.[11] These included muconium in the amniotic fluid, low 10 minute Apgar scores.

Another perspective is gained by looking at the relative risks of various risk factors for cerebral palsy. Birth asphyxia had the highest relative risk for quadriplegic cerebral palsy. However, the low frequency of birth asphyxia in the population as a whole (82 of 30804) gave birth asphyxia a much smaller role as a cause of quadriplegic cerebral palsy.

Difference in distribution of factors related to cerebral palsy is highly significant. Since these factors are not mutually exclusive i.e. same case of cerebral palsy can have more than one factor hence chi square test won't make any sense really.

Factor / Disease	cerebral palsy +	cerebral palsy --	
LBW +	a 136	b X	a + b
Normal born wt	c 110	d Y	c + d
	a + c 246	b+d 29834	A+b+c+d 30080

$$\text{Relative risk} = \frac{\text{Incidence of disease in exposed group}}{\text{Incidence of disease in nonexposed group}} = \frac{\frac{a}{a+b}}{\frac{c}{c+d}}$$

a) Interpretation of Relative risk

If RR = 1, Then it means no risk

If RR = > 1, means more risk

In this study the highest relative risk is for Prematurity. The risk of cerebral palsy is 54.4 times more in premature babies than those born with normal birth weight i.e. premature babies are 54.4 times at an added risk of cerebral palsy than normal babies.

The second important risk factors in descending order are low birth weight (RR = 52.2), history of taking thyroid / oestrgen hormones (RR = 43.5) and Foreceps application (RR=42.2)

In this study of all 16 factors only for caesarian section value of Relative risk is < 1 i.e. 0.78 (it indicates protective effiect) i.e. Babies delivered by caesarian section have less risk of cerebral palsy than other babies.

Table 2

Sr. No.	O	E	$(O-F)^2/E$
1	136	49.5	151.1
2	148	49.5	196.0
3	26	49.5	11.1
4	68	49.5	6.9
5	34	49.5	4.8
6	12	49.5	28.4
7	86	49.5	26.9
8	36	49.5	3.6
9	16	49.5	22.6
10	8	49.5	34.7
11	44	49.5	0.6
12	82	49.5	21.3
13	42	49.5	1.1
14	12	49.5	28.4
15	16	49.5	22.6
16	26	49.5	11.1
			571.2

$$EX = 792 \times = \frac{E}{X} = 49.5 \quad X^2 = 571.2,\ df = 15\ p<0.001$$

b) Difference is highly significant statistically

A child whose mother has long intervals between menses appears to be at increased risk for cerebral palsy.[12] The risk is increased if there has been an unusually short interval (less than three months) or an unusually long interval (more than three years) since the previous pregnancy. [13] In addition, mothers of children with cerebral palsy are more likely than other mothers to have a history of spontaneous abortion and stillbirth. These findings indicate that maternal menstrual and obstetrical factors convey information about the risk of cerebral palsy.

Twins are more likely than singletons to have antenatal peri ventricular leukomalacia[14] and cerebral palsy. [15] Some of the increased risk of cerebral palsy among twins probably results from their gestational age and intrauterine growth retardation. In one study, an increase in the cesarean-section rate in the delivery of twins was not associated with a reduction in the prevalence of cerebral palsy. [16]

The greater concordance for cerebral palsy among monozygotic than dizygotic twins also suggests a genetic basis, but it is compatible with placental problems that are unique to monozygotic twins as well.

Mothers known to have been hyperthyroid or who were prescribed thyroid hormones or estrogen in pregnancy have been found to be at increased risk of giving birth to a child in whom cerebral palsy later develops.

Non-vertex and face presentations of the foetus are associated with an increased risk of cerebral palsy. [17] One interpretation of this fact is that an abnormal presentation does not cause cerebral palsy, but rather may be a marker of preexisting difficulties. According to this hypothesis, foetuses with hypotonia and other abnormalities that will later be manifested as cerebral palsy are less able than others to move into a vertex position.

The rate of cerebral palsy is 25 to 31 times higher among infants who weigh less than 1500 g at birth than among full- sized newborns. [18] Babies whose birth weight is less than 2500 g account for about one third of all babies who later have signs of cerebral palsy.[19]

As a generalization, the lower the birth weight and the gestational age, the higher the risk of cerebral palsy [20] and peri ventricular leukomalacia. Thus it should not be surprising that a number of low birth weight and early gestational age children are associated with peri ventricular leukomalacia, even among babies born prematurely. [21]

Nelson and Ellen berg wrote in 1986 "Of the . . . mother-infant pairs in the 5 percent with the highest risk (for cerebral palsy) only 208 percent produced a child with cerebral palsy, the false positive rate was thus 97 percent." Epidemiological studies published since then have not provided any reasons to change the impression that our ability to identify modifiable presumed causes of cerebral palsy is limited.

The burden imposed by cerebral palsy on society has not abated despite recent advances in medical care. Indeed, the increased survival of preterm newborns at risk for the disease has resulted in an increased number of children with cerebral palsy, mainly of the spastic diplegic variety. [22]

Table 3 : Incidence of cerebral palsy compared with the findings of published literatuve

Sr. No.	Author	Year	Country	Incidence
1	Fiona J. Stanley	1967 to 1985	Western Australia	2.5 to 5/1000 live births
2	Rosen MG	1992	USA	1 to 6 /1000 live births
3	Sofia franco		Kentucky USA	2.1 /1000 live births
4	Peggy S. Eicher	1993	Pennsylvania	2 /1000 live births
5	Mercer Rang	1993	Canada	5 /1000 live births
6	Kulkarni R.S.	1998 - 2000	Maharastra, India	8.1 /1000 live births

Thus, efforts to prevent cerebral palsy will require a focus on factors and events during pregnancy including those that predispose the mother and foetus to preterm delivery and low birth weight.

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The Equation of Charges in the Genu Varum and after Valgus Tibial Osteotomy: Mathematical Study

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Abstract- Biomechanical effect of tibial osteotomy is an external mechanical movement of the center of the knee and consequently a decrease in expenses in the medial compartment.

To demonstrate this effect we proposed a mathematical calculation of the pressures in the two compartments of an equation with intake pressure as a function of mechanical displacement of the center of the knee.

Keywords: genu varum, charges, valgus osteotomy, mathematical study.

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Strictly as per the compliance and regulations of:

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Mardy Abdelhak [α], Bouziane Ahmed [σ], Elidrissi Mohammed [ρ], Shimi Mohammed [ω], Elibrahimi Abdelhalim [¥] & Elmrini Abdelmajid [§]

Abstract- **Biomechanical effect of tibial osteotomy is an external mechanical movement of the center of the knee and consequently a decrease in expenses in the medial compartment.**

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I. Introduction

Internal tibial knee femoropopliteal occupies a privileged place in clinical Its treatment is not unique and requires a comprehensive care of the patient and should take into account the demands of it in terms of activity.; it to select relevant manner the most suitable solution. So; The purpose of this theoretical study is to evaluate the distribution of femoro tibial constraints imposed by a tibial osteotomy. The surgical treatment of knee osteoarthritis can be conservative (arthroscopic surgery, osteotomy) or prosthetic (unicompartmental arthroplasty or tricompartimentaire).

The tibial osteotomy proposed by JACKSON 1958 (1) be guided by technical inter trochanteric osteotomy and aims to correct a default axis.

Understanding of the biomechanics of the knee in the frontal and sagittal plane is essential for understanding the effects of osteotomy.

The Biomechanics of the knee bumped firstly modeling the forces applied to it; due to the large number of muscles acting on the knee for balance All the proposed models based either on an indirect measure of MORRISON (2); either on a mathematical analysis of MAQUET (3).

The study of surfaces and pressures Contact femorotibial uses many methods:

- either by indirect radiographic method (Kettelkamp (4); MAQUET (5) photo- elastic models (RADIN) (6) strain gauge (BOURNE (7); BLAIMONT (8).
- is direct: in this case; it is used many methods some of which are used to assess simultaneously the surface and the contact pressure (FUKUBAYASHI (9)) .

So; The purpose of this theoretical study is to evaluate the distribution of femoro tibial constraints imposed by a tibial osteotomy.

This study has two areas of interest:

- Pathology or purpose is to observe the changes induced by the genu varum pressures.
- therapeutic: the study of changes in femorotibial constraints depending on the tibiofemoral angle trying to clarify the degree of valgus overcorrection that must be made for the osteotomy is effective.

II. Material and Methods

It is work of study and research based on mathematical theorems and concepts of solid state physics and geometry. Applications were made on models X-ray goniometer of any member in the surgical patients; in the service of Orthopaedic Surgery B4; for tibial osteotomy by internal opening technique.

a) Methodology for calculating

i. *Theoretical Analysis of stresses in the genu varum*

a. Moving force R

A decrease in strength L; that is to say a release of the lateral muscles Figure 17 (a); moves the line of action of the resultant R within. At the same time; the direction of R is slightly closer to the vertical. Increased weight increases the force P. If it is not offset by a corresponding increase in muscle strength L; it causes the same result fig17 (b). When; as can be seen at menopause shroud L muscle relaxes along the weight P increases, the displacement of the load R is even greater in Fig (c).

Moved in; load R causes stress concentration compression joint are greatly increased in that the medial knee (fig. 18)

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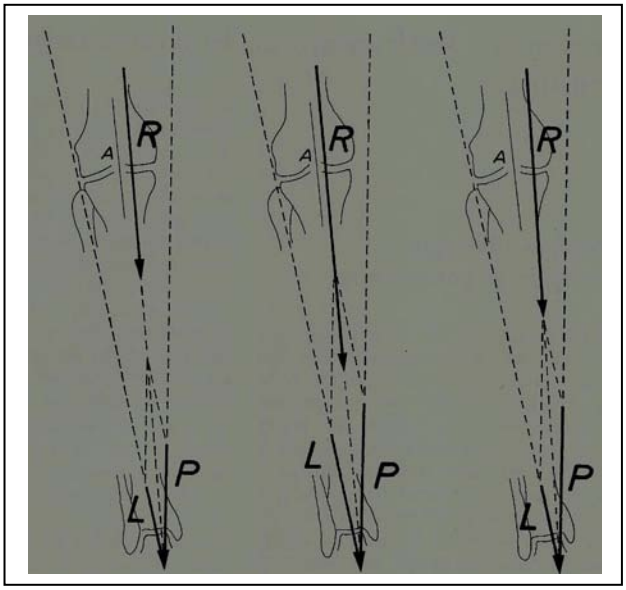


Figure 17 : Moving the resultant R (MAQUET)

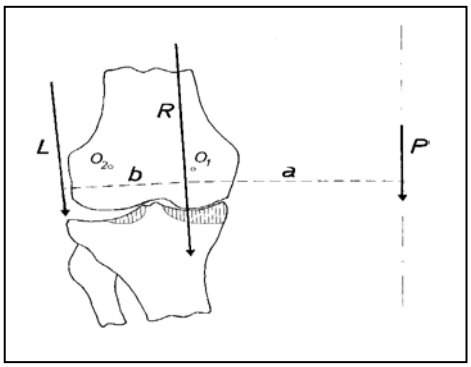
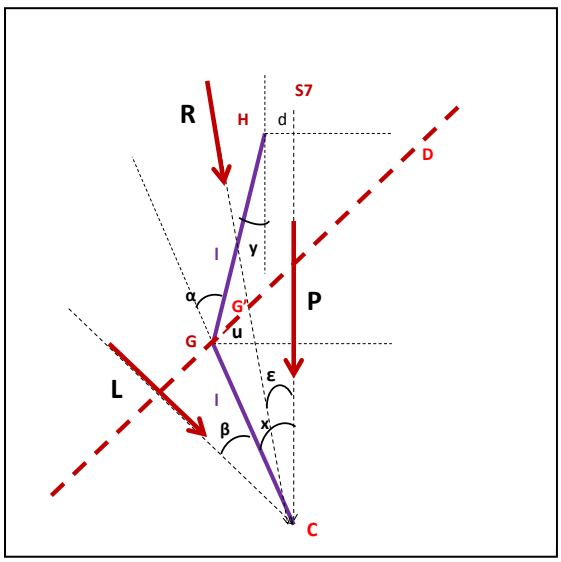


Figure 18 : Elongation of the lever arm (a) of the force P. Concentration of stresses in the medial part of the knee (MAQUET)

b. *Evolution of the joint constraint*

The magnitude and line of action of the force R is stylized in Figure 19



H: center of the femoral head
G: center of the knee
C: center of the ankle
Force P lowered S7 partial gravity center
The angle x that makes the tibia with the vertical
The angle that it makes with the vertical femur
The angle **α**: femoro tibial bypass
The **β** angle: The fact that the tibia
The angle **ε**: R makes with the vertical
D: map of the surface of the tibial plateau L:length of the femur and tibia
G ': the projection of G on the line of action of R
S7: center of gravity partial foot support

Figure 19 : Deformation in varum.la action line R intersects the axis of the knee in G 'at a distance u of G

From the previous scheme; the parallelogram of forces is constructed :(fig 20)
And shows that:

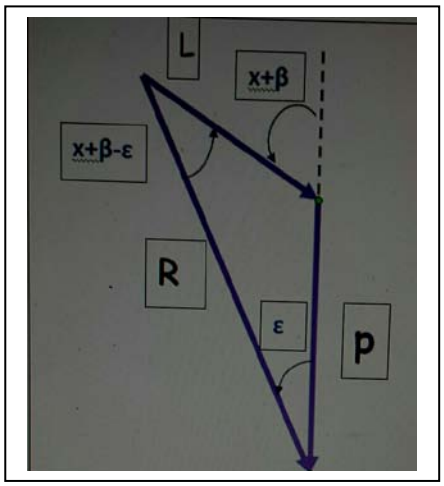
$$R = \sqrt{P^2+L^2+2PL\cos(x+\beta)}$$

$$L = P \frac{\sin\varepsilon}{\sin(x+\beta-\varepsilon)}$$

$$d = l(\sin x - \sin y)$$

$$\alpha = x+y$$

$$u = l.tg(x-\varepsilon)$$



To analyze the constraints of joint compression is considered in an orthogonal coordinate system (OX) and (OY); an area of study through the contact plane femoro tibial (D) in Figure 20;

This plan, which makes an angle **α** equal to the angle of deflection femoro tibial; has different values of the displacement of mechanical center of the knee.

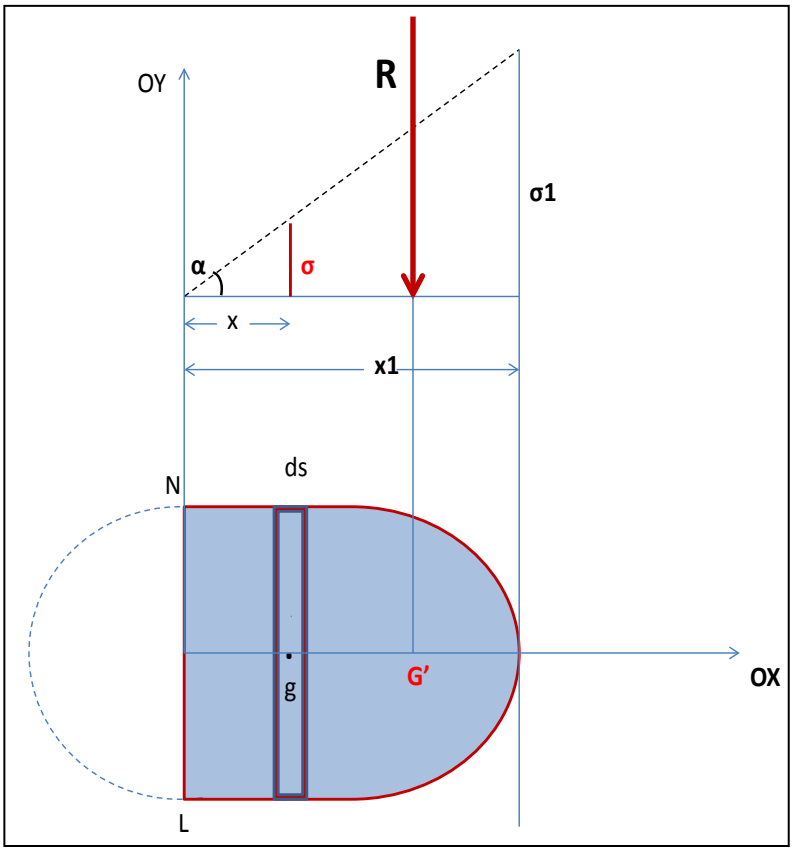


Figure 21 : Evolution of stresses as a function of displacement of the mechanical center

It is considered in this surface a scanning element ds having a center of gravity g that is moving in the axis OX

This surface element ds is affected by a strength member dr whose resultant is equal to R; This creates a compression $\sigma = dr / ds$

According to the scheme: $tg\alpha = \sigma / x$ with x the displacement of the center of gravity. Also: $tg\alpha$ $\sigma 1/x1$ with x1 = the maximum displacement and the maximum $\sigma 1$ applied to the edge of the contact surface stress . We deduce the equation of stress versus displacement of the mechanical center of the knee: $\sigma = x.tg\alpha$

The displacement of the mechanical center of the knee creates a non-uniform triangular distribution of joint stress with the presence of a line of zero pressure NL.

To derive the total stress in the surface of the contact femoro tibial; we must do the double integral of our equation:

$$\sigma.ds=\sigma 1.\ x/x1\ .ds=tg\alpha\ .x.ds$$

$$\iint \sigma.ds= \iint tg\alpha\ .x.ds$$

$$\iint \sigma.ds= \iint dr$$

$$\iint \sigma.ds=tg\ \alpha \iint x.ds=R$$

ii. *Calculate the effect of tibial osteotomy on the mechanical center of the knee*

The angular correction by tibial osteotomy creates an external mechanical displacement of the center of the knee fig. (22)

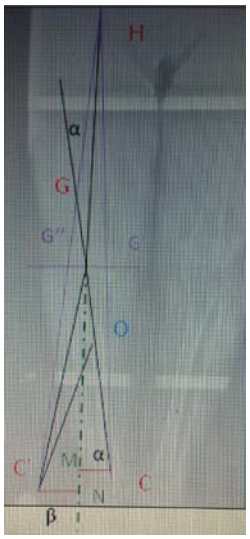
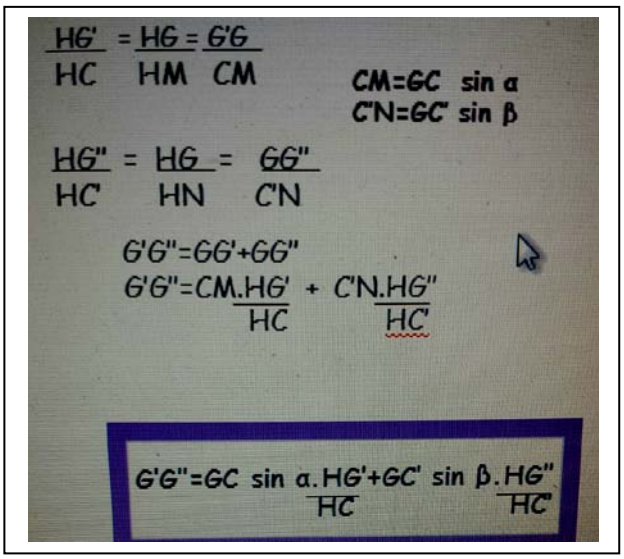


Figure 22

H: center of the femoral head
G: center of mass of the knee (anatomical center)
C: center of the talar ankle mortise
O: wedge osteotomy
G ': mechanical center of genu varum
'' G: mechanical center after correction
C ': center of the mortise after correction
α: angle deviation tibiofemoral
α + β: angle correction
M: projection of C on the perpendicular
N: projection of C 'on the perpendicular

To calculate the distance of movement of the mechanical center of the knee point G 'in G-spot"; Considering the triangles and HCM HC'N and include:



iii. *Analysis of the distribution of the stresses depending on the angle correction*

The study of the equation joint stress versus displacement of mechanical center of the knee helps to explain the stress increase if genu varum fig (23)

Moving within the mechanical center creates a concentration of charges in the medial compartment. Thus the goal of a tibial osteotomy is to transfer these loads externally according to the equation this equation:

$\sigma = x.tg(-\alpha)$

The mathematical approach to the stress distribution after a tibial osteotomy can be determined in the curve Figure (24) represents that the equation:

$\sigma = x.ch(\alpha)$

This curve is a parabolic representation of load variations; and when the mechanical center is moved in the x-axis to the left; constraints are reduced in this internal compartment is gradually increasing in the outer compartment.

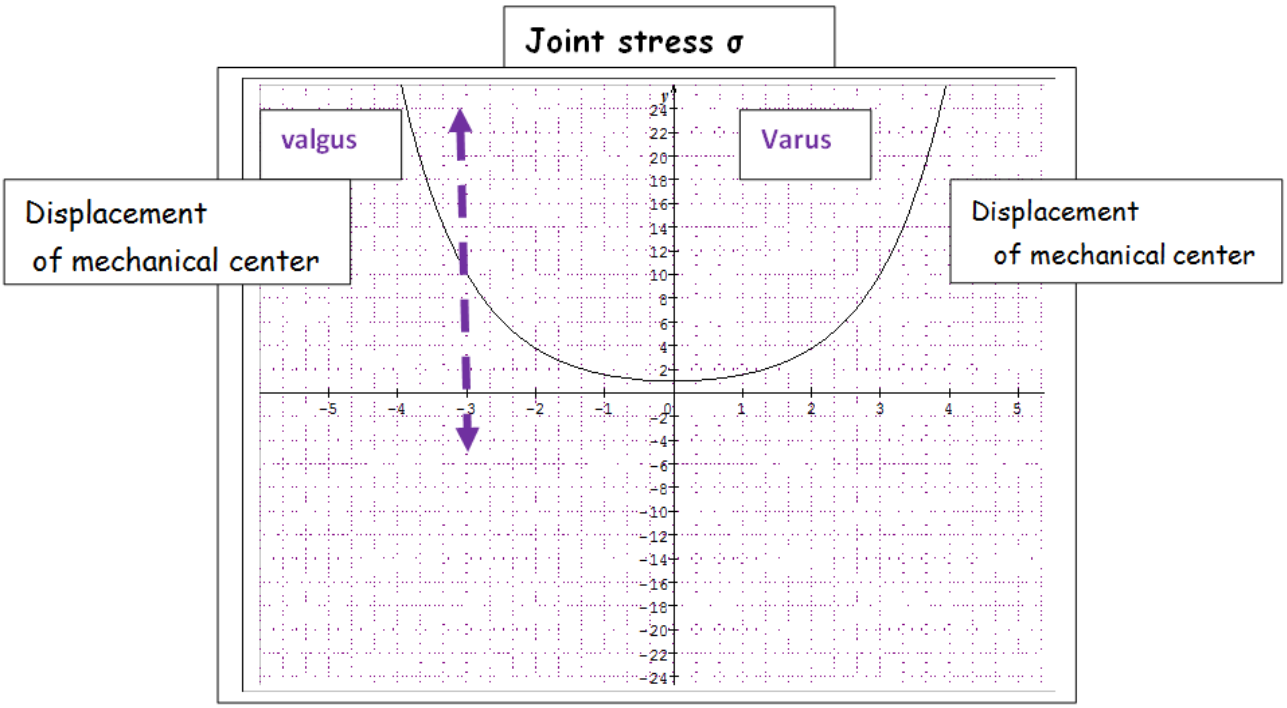


Figure 25 : Distribution of the stresses in the knee according to the deformation

It integrates the table of values of constraint equations with measurements of mechanical center; there is a knee in normo oriented ($\alpha = 0°$), the total stress is about 6.3 kg / cm ^{2}.

So; in the range (0° -6°) joint stress remains almost constant (Table Figure 26) and beyond (-6°) valgus; it increases rapidly to reach 26kg / cm ^{2} which deteriorates the outer compartment.

Degree of correction	0°	-6°	-10°	-15°	-20°
joint constraint (kg / cm ^{2})	6.3	8.6	14.8	22.7	25.8

Figure 26 : Table of total joint stress variation as a function of degree of valgus

III. Discussion

a) Limit of the mathematical method

From the data of our study; analytic geometry and trigonometry used to deduce the magnitude and line of action of the forces on the knee situation foot support with the resulting R through the mechanical center of the joint.

This reasoning and mathematical formulas that can be applied to derive forces in the sagittal plane and during the various phases of walking.

The equation for the evolution of constraints based on the tibiofemoral angle and movement of the mechanical center allows one hand to explain changes in the distribution of joint stress due to permanent load shifting within the R during the genu varum, and demonstrates the effect of the correction on the angular distribution of the stresses after a unit OTV other.

This method of theoretical calculation has filled a default experimental studies of anatomical parts or synthetic model of the knee who were unaware of several factors involved in the balance of a normal subject or suffering from a deformity varus or valgus.

Among these factors; include the problem of the evaluation of the game and ligament quantification of muscular load acting on the knee . so; the results obtained are found not representative of the real state of affairs.

However; mathematical calculation is also not devoid of criticism because it ignores some data that

make precision adjustments to make difficult; particularly in osteoarthritis; rotatory disorders; the existence of a femorotibial subluxation that make it difficult to calculate the mechanical center of the knee .

Other factors are related to the difficulty of quantifying the contact surfaces femoro tibial in vivo in a subject with a genu varum. The problem is further complicated by the presence of inaccuracies mathematical calculation related to errors in measuring the distance of movement of the mechanical center and the angle of femoro tibial deformity on goniometry because small changes can yield significant changes in constraints joint.

b) Overcorrection

Seems now generally accepted as critical success factor of the tibial osteotomy. Indeed; hindsight is sufficient and it is currently accepted that under correction is an important factor of recurrence of the deformity and pain relief.

i. *theoretical argument*

From our equation; valgus 3° to 6° concentrates the load in the lateral compartment which relieves the medial compartment. however; beyond this level correction; the evolution of constraints is exponential deteriorating external compartment .

ii. *Experimental argument*

If we consider that the origin of the internal genu varum gonarthrosis lies between another failure in the outer shroud; it is logical that BLAIMONT (14) has proposed a quantification of the correction to be made depending on the mechanical quality of the external shroud. This is determined by load testing cantilevered overhang. It is equal to the maximum load M (which still disappears external yawn) Load M multiplied by the lever arm b gives the muscle moment in physiological conditions must be equal to the moment gravity Pa BLAIMONT (14) is removed in the case of genu varum osteoarthritis ; muscle moment is significantly lower when gravity. MAQUET for (3) and BLAIMONT (14); it is therefore necessary for the normal axis hypervalgiser merely replace the joint in the same way as that in which developed osteoarthritis.

Kettelkamp and CHAO (17) determine on radiographs; the variation of the distribution of the contact force on the tibial plateau in accordance with the difference between tibial and femoral mechanical axis. For that; they establish a mathematical model for the purpose of simplification does not take into account; as a stabilizing element , the external and internal lateral ligaments; disregarding in the calculation of all muscle elements. In this model, the balancing constraints femorotibial a genu varum requires overcorrection of 3° to 6° of valgus.

KOSHINO scintigraphy noted a drop in the concentration of strontium in the inner compartment 85 a year after osteotomy when there is a hypervalgisation from 2° to 10°.

IV. Conclusion

Our work is a theoretical study; based on mathematical foundations; through which we could demonstrate that the angular correction by tibial osteotomy allows a charge transfer from the medial compartment to the lateral compartment.

Biomechanical goal of osteotomy is to reduce the unit pressure at the internal spacing tibiofemoral:

- reducing the overall tibiofemoral load in absolute value; by reducing the components of ground reaction by refocusing
- but also a better distribution of it between the two compartments; and within each compartment

This stress redistribution can only be obtained by transformation with overcorrection of varus to valgus.

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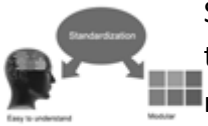

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Authors should very cautiously consider the preparation of papers to ensure that they communicate efficiently. Papers are much more likely to be accepted, if they are cautiously designed and laid out, contain few or no errors, are summarizing, and be conventional to the approach and instructions. They will in addition, be published with much less delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and to make suggestions to improve briefness.

It is vital, that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

Format

Language: The language of publication is UK English. Authors, for whom English is a second language, must have their manuscript efficiently edited by an English-speaking person before submission to make sure that, the English is of high excellence. It is preferable, that manuscripts should be professionally edited.

Standard Usage, Abbreviations, and Units: Spelling and hyphenation should be conventional to The Concise Oxford English Dictionary. Statistics and measurements should at all times be given in figures, e.g. 16 min, except for when the number begins a sentence. When the number does not refer to a unit of measurement it should be spelt in full unless, it is 160 or greater.

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Metric SI units are supposed to generally be used excluding where they conflict with current practice or are confusing. For illustration, 1.4 l rather than 1.4 × 10-3 m3, or 4 mm somewhat than 4 × 10-3 m. Chemical formula and solutions must identify the form used, e.g. anhydrous or hydrated, and the concentration must be in clearly defined units. Common species names should be followed by underlines at the first mention. For following use the generic name should be constricted to a single letter, if it is clear.

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Abstract, used in Original Papers and Reviews:

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Many researchers searching for information online will use search engines such as Google, Yahoo or similar. By optimizing your paper for search engines, you will amplify the chance of someone finding it. This in turn will make it more likely to be viewed and/or cited in a further work. Global Journals Inc. (US) have compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Key Words

A major linchpin in research work for the writing research paper is the keyword search, which one will employ to find both library and Internet resources.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy and planning a list of possible keywords and phrases to try.

Search engines for most searches, use Boolean searching, which is somewhat different from Internet searches. The Boolean search uses "operators," words (and, or, not, and near) that enable you to expand or narrow your affords. Tips for research paper while preparing research paper are very helpful guideline of research paper.

Choice of key words is first tool of tips to write research paper. Research paper writing is an art.A few tips for deciding as strategically as possible about keyword search:

- One should start brainstorming lists of possible keywords before even begin searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in research paper?" Then consider synonyms for the important words.
- It may take the discovery of only one relevant paper to let steer in the right keyword direction because in most databases, the keywords under which a research paper is abstracted are listed with the paper.
- One should avoid outdated words.

Keywords are the key that opens a door to research work sources. Keyword searching is an art in which researcher's skills are bound to improve with experience and time.

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Acknowledgements: Please make these as concise as possible.

References

References follow the Harvard scheme of referencing. References in the text should cite the authors' names followed by the time of their publication, unless there are three or more authors when simply the first author's name is quoted followed by et al. unpublished work has to only be cited where necessary, and only in the text. Copies of references in press in other journals have to be supplied with submitted typescripts. It is necessary that all citations and references be carefully checked before submission, as mistakes or omissions will cause delays.

References to information on the World Wide Web can be given, but only if the information is available without charge to readers on an official site. Wikipedia and Similar websites are not allowed where anyone can change the information. Authors will be asked to make available electronic copies of the cited information for inclusion on the Global Journals Inc. (US) homepage at the judgment of the Editorial Board.

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Figures: Figures are supposed to be submitted as separate files. Always take in a citation in the text for each figure using Arabic numbers, e.g. Fig. 4. Artwork must be submitted online in electronic form by e-mailing them.

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21. Arrangement of information: Each section of the main body should start with an opening sentence and there should be a changeover at the end of the section. Give only valid and powerful arguments to your topic. You may also maintain your arguments with records.

22. Never start in last minute: Always start at right time and give enough time to research work. Leaving everything to the last minute will degrade your paper and spoil your work.

23. Multitasking in research is not good: Doing several things at the same time proves bad habit in case of research activity. Research is an area, where everything has a particular time slot. Divide your research work in parts and do particular part in particular time slot.

24. Never copy others' work: Never copy others' work and give it your name because if evaluator has seen it anywhere you will be in trouble.

25. Take proper rest and food: No matter how many hours you spend for your research activity, if you are not taking care of your health then all your efforts will be in vain. For a quality research, study is must, and this can be done by taking proper rest and food.

26. Go for seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. Think technically: Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

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33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

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Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

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- Separating a table/chart or figure - impound each figure/table to a single page
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In every sections of your document

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· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

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- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
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- Significant conclusions or questions that track from the research(es)

Approach:

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- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
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- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
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Approach:

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- If use of a definite type of tools.
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- Report the method (not particulars of each process that engaged the same methodology)
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- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

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- Leave out information that is immaterial to a third party.

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The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
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Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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