

Utility of Linear Scalp Incision in Various Cranial Surgeries

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Abstract

Background: The linear incision and its modifications are the most commonly used incisions because of being simple and having good outcome. Linear incisions have the advantage of easier upward and downward extension.

Layers of the scalp can be arranged as the mnemonic SCALP: S (Skin), C (Connective tissue), A (Aponeurosis), L (Loose areolar tissue), and P (Pericranium).

Aim of Study: Is to evaluate the sufficiency of linear scalp incisions, and its resultant scar.

Patients and Methods: This is a prospective study performed on 43 cases with different pathologies all of them were operated using linear scalp incision between January 2017 and December 2019 in Neurosurgery Department at Benha University Hospitals.

Results: Forty three cases were operated using linear scalp incision in the period from January 2017 to December 2019 at Neurosurgery Department at Benha University Hospitals. The age of patients in this study ranged from 5 years to 66 years with a mean age of 29 years. The patients in this study were composed of 24 females and 19 males. The follow-up period ranged from 6 months to three years.

Conclusion: Linear scalp incision has a very great safety and efficacy in different types of craniotomies. We found the disadvantages to be present in few cases and can also occur in other types of scars that may be worse than linear incisions and can be minimized by taking care of Langer's lines and vascular territories of the scalp and minimizing the use of artery forceps.

Key Words: Linear – Scalp – Cosmetic.

Introduction

THE linear incision and its modifications are the most commonly used incisions because of being simple and having good outcome. Linear incisions have the advantage of easier upward and downward extension [1]. Layers of the scalp can be arranged as the mnemonic SCALP: S (Skin), C (Connective tissue), A (Aponeurosis), L (Loose areolar tissue), and P (Pericranium) [2].

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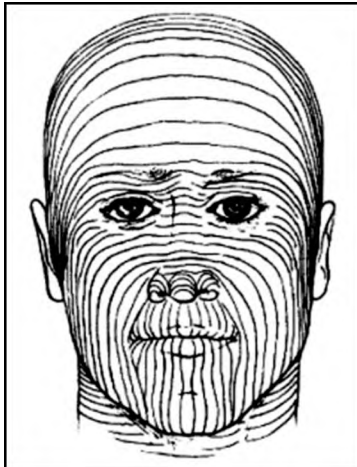
Changes that happen at the dermal layer can give a picture about the future scar. Collagen represents 75% of dry dermal layer and this is of special value in the scalp because of the presence of the galea aponeurotica. The presence of occipitofrontalis muscle in the scalp give the skin lines a different behavior in relation to other parts of the body-for example, Kraissl's lines have coronal direction, while Langer's lines have sagittal direction [3,4] Fig. (1).

The scalp also contains hair follicles related to skin lines which give the scalp a different position among other parts of the skin. This relation have been studied by many authors and concluded that there is a direct relation between Langer's lines and the hair follicles direction [4].

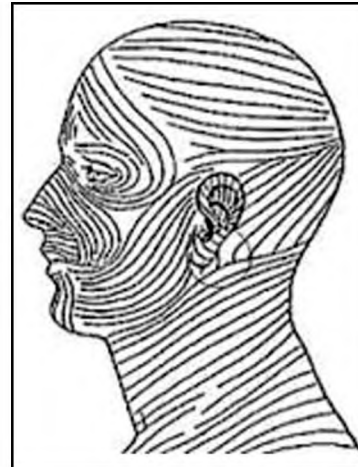
The presence of loose areolar connective tissue give the scalp the advantage of simple easy separation during cranial surgery. Stress relaxation and creep are two physical properties that help healing of scalp incisions. Stress relaxation is known as the reduction in the sum of power needed to keep a fixed volume of skin stretch over time; creep is the increase in skin surface area that happens when a fixed power is performed [5]. According to Camirand and Doucet scalp incisions perpendicular to hair follicles are more cosmetic than those parallel ones because of giving the chance to hair follicles to grow through the scar lines [6].

Reduced perfusion and tissue ischemia can happen if the subdermal arteriolar closing pressure resulting from increased wound tension exceeds the blood perfusion pressure, so during wound closure the skin tension must be reduced as possible to avoid this complication [7].

In this study we will review our experience in linear scalp incision used for various cranial and intracranial surgeries.



Langer's Lines head from Marx J., Hockberger R., Walls R Ed. Rosen's Emergency Medicine: Concepts and Clinical Practice 2002



Langer's Lines head from The Open Access Atlas of Otolaryngology, Head & Neck Operative Surgery by Johan Fagan (Editor) johannes.fagan@uct.ac.za accessed 22 Sept. 2016

Fig. (1): Illustration of langer's lines in head and neck (oueted) [4].

Patients and Methods

This study included 43 cases with different pathologies all of them were operated using linear scalp incision in the Department of Neurosurgery, Benha University in the period between January 2017 and December 2019.

The cases were divided according to pathology into three groups:

- The first group included intracranial tumors, the number of cases in this group were 23 in the form of meningiomas (convexity, parasagittal), gliomas, intraventricular tumors, and CP angle tumors.
- The second group included 13 surgeries for skull lesions and cranioplasty.
- The third group included traumatic conditions including 7 cases with epidural hematomas and intracerebral hematomas.

All patients were operated using linear scalp incision with different length according to size of lesion and aim of surgery. Follow-up was done at 3 months to evaluate the scar and to report any complication.

We tried to follow fixed rules in incision and closure in all wounds as follow:

- The scalpel must be perpendicular to skin to avoid undermining.
- The incision should be parallel to langer's line as much as possible.
- For proper design of the incision, we took in consideration the blood supply of the scalp and the direction of hair growth as growth of hair will cover the scar.

- During closure stitches must be at equal distance and depth on both sides.
- The use of artery forceps was limited to avoid ischemia of the edges.
- Surgical thread used in skin closure was monofilamentous, absorbable, 2/0 on cutting needle.
- Usual post-operative surgical wound care was utilized.

Results

The age of patients in this study ranged from 5 years to 66 years with a mean age of 29 years. The patients in this study were composed of 24 females and 19 males. The follow-up period ranged from 6 months to three years.

Linear scalp incision was used in all patients of this group. The length of incision ranged from 4cm in small scalp swelling about 2cm in diameter to 11cm in some tumor cases and some traumatic cases. Subgaleal drain was used in all cases except for 6 cases (4 cases of cranioplasty and 2 cases with CP angle tumor).

The linear incision provided a sufficient accessibility to perform the desired bone flap without needing modification.

The skin complications were assessed according to the Holgers classification system: Grade 0=no adverse reaction; Grade 1=skin with erythema; Grade 2=skin with erythema and discharge; Grade 3=granulation tissue; and Grade 4=inflammation/infection resulting in the removal of the abutment, minor wound complications include grade 1 & 2 while major complications include grade 3 & 4 [8].

Evaluation of the scar was based on width, elevation, and degree of alopecia. Also, patient's responses to the cosmetic results were recorded.

During follow-up period 1 patient developed CSF leak that resolved using local wound care. Another case developed local wound swelling that proved to be pseudomeningocele that required surgical revision of wound. There were 3 cases of wound infection that resolved on regular dressing and antibiotics.

The overall cosmetic results were satisfactory, the most common complication of linear scalp incision that is widening of scar was recorded in 4 cases only and wasn't disturbing to the patient, this increase in scar width was less than 0.5cm and was covered with hair, this widening was observed to occur in longer incisions, traumatic wounds, incisions perpendicular to Langer's line and prolonged use of artery forceps causing ischemia to wound edges and in laterally placed incisions (less vascular scalp).

Table (1): Summary the different variables and outcome in our study.

Variable	Number
Mean age (years)	(29)
<i>Gender:</i>	
Male	19 (44%)
Female	24 (56%)
<i>Pathology:</i>	
Tumor	23
Trauma	7
Skull pathology& cranioplasty	13
Mean Follow-up period	14 (6-36) months
<i>Complications:</i>	
Infection	3 (7%)
Subgaleal hematoma	2 (4, 7%)
Scar widening	4 (9.3%)
CSF leak	1 (2.3%)
Pseudomeningocele	1 (2.3%)
<i>Cosmetic outcome:</i>	
Excellent	31 (72%)
Good	8 (18.6%)
Widened scar	4 (9.3%)

Illustrative cases:

Case (1): Twelve years old boy presented with large posttraumatic (5cm diameter) scalp defect in the left posterior parietal region. We performed linear anteroposterior scalp incision centered on the defect with dissection of scalp from the dura till reaching the healthy bone with placement of titanium mesh Fig. (1A).

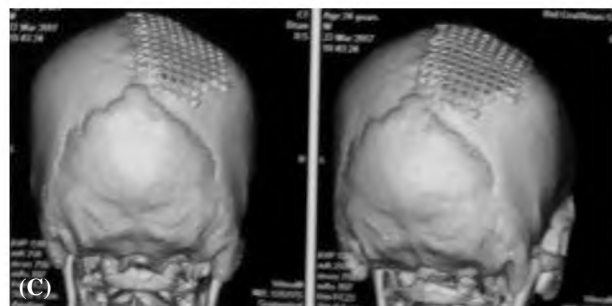
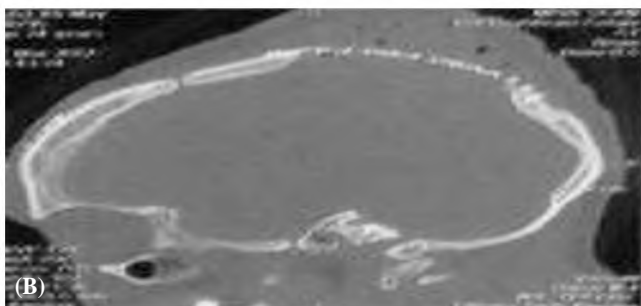
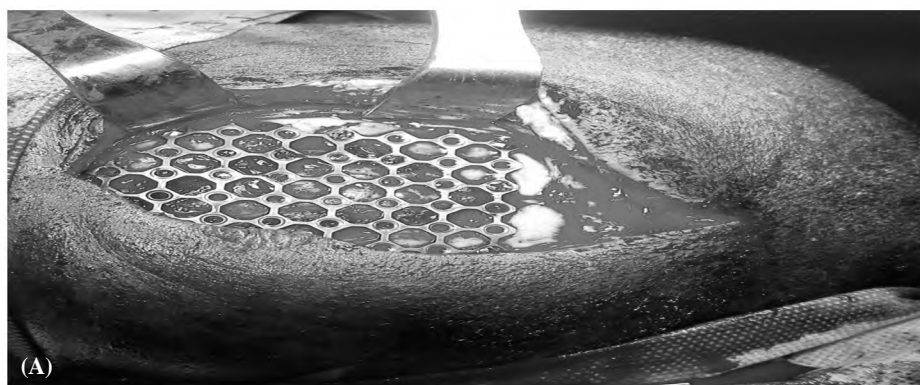


Fig. (1): (A) Intraoperative view showing linear incision in right posterior parital region, (B,C) Post-operative CT brain with reconstruction showing the titanium mesh in place.

Case (2): Fifty eight years old female with right parasagittal meningioma operated using small linear scalp incision with total tumor removal Fig. (2).

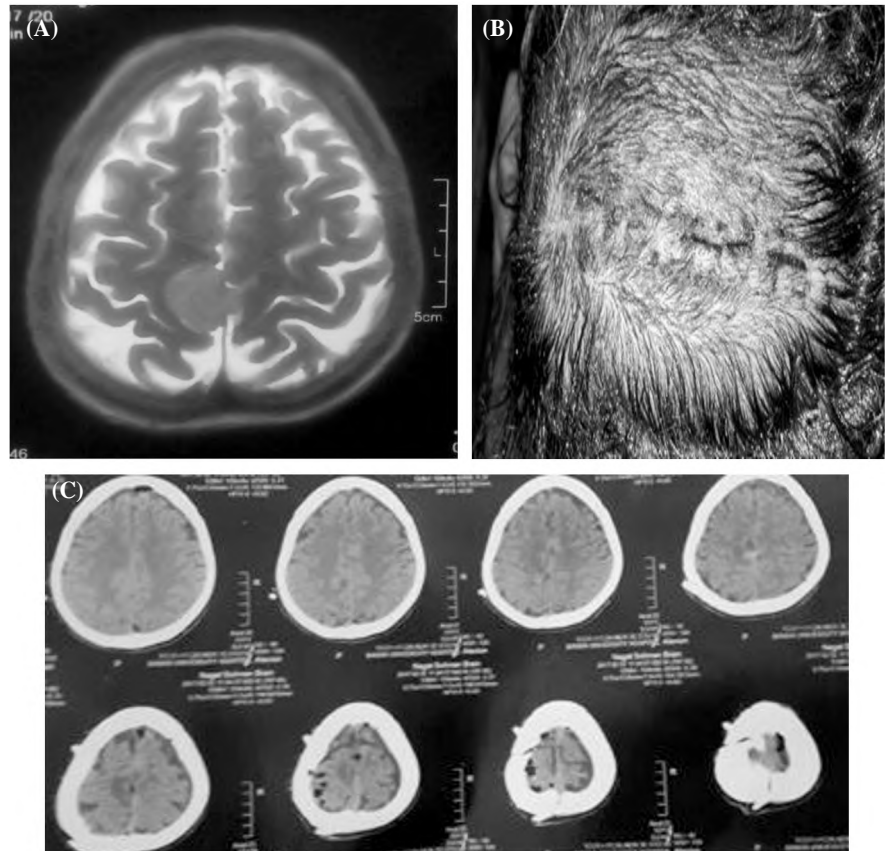


Fig. (2): (A), Pre-operative axial MRI T II showing right sided parasagittal meningioma. (B), Picture taken after removal of stitches with good wound outcome. (C), Post-operative CT brain showing complete tumor removal.

Case (3): Twenty seven years old female with giant left lateral ventricular glioma operated using snteriotranscallosal approach and linear scalp incision with complete tumor removal.

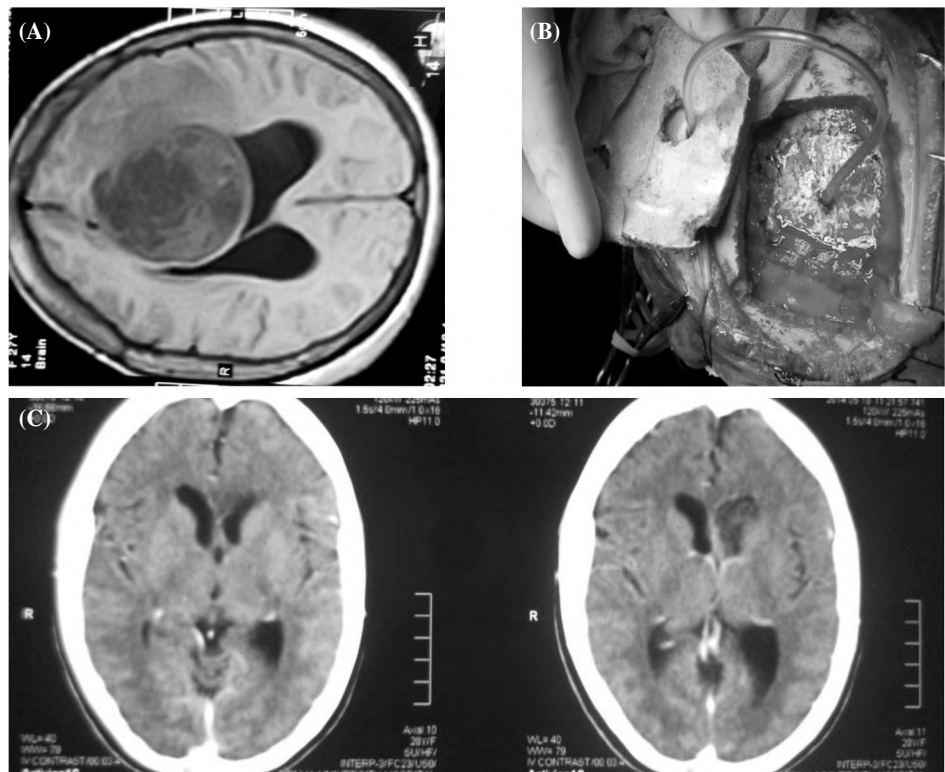


Fig. (3): (A), Pre-operative T1 MRI brain without contrast showing giant heterogenous left lateral ventricular mass. (B), Intraoperative view showing the linear incision. (C), Post-operative CT brain showing total tumor removal.

Discussion

Linear scalp incision is a simple, time saving procedure that can be utilized safely as the initial step for different surgeries.

In a study performed by William et al., on linear and curvilinear scalp incision in retromastoid approach for cases of microvascular decompression and vestibular schwannoma, the authors opinion was that the linear incision is a good choice regarding simplicity and efficiency, it also take less time and give protection to underlying muscles, vessels and nerves which is compatible with results of our study in safety and efficacy of linear scalp incision [1].

Another study performed by Frodel et al., to compare between the results of linear and geometrically designed flaps in bicoronal incisions for surgery in the region of the anterior cranial fossa and maxillofacial structures. The authors opinion was that interrupted scalp incisions are better than linear scalp incisions and it should be used in most situations [9]. Munro and Fearon have the same opinion as well regarding bicoronal approach [10]. This is the opposite to our results that believe in safety and efficacy of linear scalp incision.

There is another study that recommends the use of linear incisions in forehead approaches done by Anegawa et al., they used the linear transverse skin incision to approach the frontal area instead of bicoronal incision. Their conclusion was that linear incision has great results regarding cosmesis, safety and efficacy with fewer complications than other incisions which conform to our results [11].

In this series we faced minor wound complications in 14% of cases that is much less than reported in other series. In a study performed by Takanari et al., the operative wound complications rate was (21.4%) the minor complications represented 66.7% of these (superficial necrosis and inflammation), these were treated conservatively, while the major complications rate was 33.3%. (Total flap necrosis and osteomyelitis). The authors found no statistical relation between these complications and the surgical techniques [12].

In a study performed by Abiodun et al., the most common incision used was question mark incision in 14 (26.4%) patients, followed by linear incision in 13 (24.5%) patients. Single layer closure was used in 80.5% of the patients and multilayered closure was performed in 19.5% of the patients. Superficial infection was observed in 6 patients with single layer closure; when compared to mul-

tilayer closure these complications did not occur. One case developed Cerebrospinal fluid fistula. There was no reported bleeding, necrosis or cosmetic disfigurement [13].

Barry et al., performed a study to evaluate Linear Incision for placement of a Magnetically Coupled Bone-Anchored Hearing Implant and concluded that small linear incision directly placed over the implant is a good choice with the advantages of smaller incision, less hair removal, smaller flap, less operative time, and much reduced pain [14].

Some authors said that linear scalp incision results in large bad scar [9]. So there is debate in literature between advantages and disadvantages of linear scalp incisions.

Conclusion:

Linear scalp incision has a very great safety and efficacy in different types of craniotomies. We found the disadvantage of widened scar to be present in few cases and can also occur in other types of scars that may be worse than linear incisions and can be minimized by taking care of Langer's lines and vascular territories of the scalp and minimizing use of artery forceps.

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إستخدام القطع المستقيم فى جراحات المخ والجمجمة المختلفة

المقدمة: يعتبر القطع المستقيم لفروة الرأس من أحد أهم القطوع من حيث الأمان الجراحى وتجنب المضاعفات والنتائج التجميلية لفروة الرأس.

الهدف من الدراسة: الهدف من هذه الدراسة هو دراسة نتائج هذا القطع وتقييم آثاره وفاعليته فى مختلف جراحات المخ والجمجمة.

تصميم الدراسة: دراسة وصفية إكلينيكية مستقبلية.

طريقة البحث: تم إجراء هذه الدراسة على ٤٣ مريض خضعوا إلى إجراء جراحات مختلفة للمخ والجمجمة نتيجة وجود أورام أو إصابات أو لأغراض تجميلية أو لأغراض أخرى فى مستشفى بنها الجامعى فى الفترة ما بين يناير عام ألفا وسبعة عشر حتى ديسمبر عام ألفان وتسعة عشر.

النتائج: إحتوت هذه الجراحة على ٤٣ مريض ما بين نساء ورجال وقد نتج عن إستخدام هذا القطع نتائج ممتازة تجميلية فى عدد ٣١ مريض ونتائج جيدة فى عدد ٨ مرضى كما حدث إتساع لآثر الجرح فى عدد ٤ مرضى وقد كان هذا الإتساع غير مزعج بالنسبة للناحية الجمالية للمريض.

الخلاصة: القطع المستقيم فى جراحات المخ والجمجمة قطع ناجح جداً من حيث الفاعلية وتجنب المضاعفات وقد لاحظنا أثناء هذه الدراسة أن نسبة المضاعفات قليلة ومن الممكن حدوثها فى القطوع الأخرى ومن الممكن تجنبها بالفهم الجيد ومراعاة تشريح الجمجمة.