Clinical audit on the incidence of inferior alveolar nerve dysfunction following mandibular sagittal split osteotomies at the Derby Royal Infirmary, England

This retrospective clinical audit identified the incidence of inferior alveolar nerve dysfunction following mandibular sagittal split osteotomies for a period of 1 year at the Derby Royal Infirmary. The clinical notes of 50 consecutive patients treated with a bilateral sagittal split osteotomy over the last 5 years were used to collect information on the following: age, sex, type of mandibular movement (advancement or setback), recorded nerve damage during surgery, “good” or “bad” split, and the presence of nerve dysfunction at representative postoperative intervals, up to 1 year. One hundred procedures were essentially audited, as the surgery was carried out on both sides. The mean age of patients undergoing this procedure was 23 years. Thirty-four patients were female and 16 were male. Thirty-three patients underwent advancements and 17 underwent setbacks. The only nerve damage recorded was stretching; this occurred in 11 procedures. The incidence of nerve dysfunction recorded postoperatively was: 22% to 78% immediately, 29% to 61% after 1 week, 23% to 45% after 1 month, 8% to 34% after 3 months, 5% to 26% after 6 months, and 22% to 78% after 1 year. The findings from this clinical audit show that the incidence of inferior alveolar nerve dysfunction at the Derby Royal Infirmary is comparable to, if not less than, what was reported in previous studies. Hence, there is evidence of a reasonably high standard of care taken to prevent this damage, and no changes in the way the surgical procedure is carried out is indicated at present. However, this clinical audit did highlight the lack of documentation and standardization of postoperative assessment for nerve dysfunction. There may be a need for the introduction of a pro forma assessment system to the department. (Int J Adult Orthod Orthognath Surg 2001;16:266–271)

Several types of mandibular osteotomies have been used to correct mandibular deformities, including: mandibular prognathism, retrognathism, asymmetry (caused by unilateral hyperplasia or hypoplasia), retrogenia, and mandibular incisor proclination. The predominant types of mandibular osteotomies are: sagittal split osteotomies (SSO), intraoral vertical ramus osteotomies (IVRO), inverted L osteotomies (ILO), and genioplasties (alone or in conjunction with other types).

Presently, the most commonly performed orthognathic surgical procedure in the United States and Europe is the sagittal split osteotomy.¹ This technique was first introduced by Schuchardt in 1942² and later revolutionized by Trauner and Obwegeser.³ Many modifications followed, including those by Dal Pont,⁴ Hunsuck,⁵ and Epker.⁶ Once this procedure had been established, numerous advantages of the SSO for mandibular prognathism over IVRO and ILO have been described. These
include better bony interface between the segments, enabling easier application of rigid fixation and greater healing. However, neurosensory dysfunction has been reported to be higher in SSO \(^8\)–\(^{12}\) and thus potentially creates a drawback. This usually manifests in the patient as varying degrees of numbness of the chin and lower lip.\(^6\),\(^8\),\(^13\),\(^14\) Although a proportion of patients experience transient paresthesia\(^1\)\(^5\) and are able to tolerate it well, this is not the case where injury manifests as a hyperesthesia or palatal dysesthesia.\(^1\)\(^1\),\(^11\) Therefore, SSO has the potential to cause considerable morbidity following surgery.

It is thus important to ascertain the prevalence of nerve dysfunction, with consideration of its advantages, if this procedure is to continue to dominate over the other surgical techniques mentioned. Despite there being much literature on the incidence of this complication, authors have reported a wide variation. Sensory disturbance immediately occurring postoperatively has been reported to be as high as 85\(^\%\)\(^1\)\(^6\),\(^1\)\(^7\) and 86.6\(^\%\).\(^1\)\(^7\) It has been reported with varying degrees after 2 years: 2.32\(^\%\),\(^1\)\(^7\) 6.7\(^\%\),\(^1\)\(^8\) and 30\(^\%\) to 40\(^\%\).\(^1\)\(^9\)

The aim of this clinical audit was to identify the incidence of inferior alveolar nerve dysfunction following SSO at the Derby Royal Infirmary in order to assess whether the outcome of the procedure would carry greater morbidity than that previously recognized.

### Materials and methods

A retrospective clinical audit of 50 consecutive cases involving SSO was carried out over the last 5 years. None of these patients exhibited inferior alveolar nerve dysfunction preoperatively. They were followed up for at least 1 year postoperatively. Those who had preexisting neurosensory disturbance, caused from previous removal of wisdom teeth and/or from previous facial trauma, were excluded.

Many cases of osteotomies involved the removal of wisdom teeth at least 6 months beforehand in order to be included in this clinical audit; therefore, the branches of the mandibular division of the trigeminal nerve had to be grossly intact following the extractions. Cases with the inclusion of genioplasty were also excluded, owing to the added procedure increasing the risk of nerve damage.\(^8\)

One hundred procedures were essentially carried out since these patients underwent bilateral SSO; therefore, the neurosensory disturbance of 100 nerves was audited.

Patients’ clinical notes were used, whereby the following data were collected:

- Age of patient (at time of operation)
- Sex
- Type of mandibular movement (advancement or setback)
- Recorded nerve damage during SSO (stretch, tear, crush, or complete transection)
- “Good” or “bad” split (the latter being any undesirable fragmentation of either the distal and/or proximal segments)
- Presence of inferior alveolar nerve dysfunction at postoperative intervals: immediate, 1 week, 1 month, 3 months, 6 months, and 1 year

### Results

The mean age of the patients who underwent bilateral sagittal split osteotomies and were involved in this clinical audit was 23 years. Thirty-four patients were female and 16 were male. Thirty-three patients underwent mandibular advancements while 17 underwent mandibular setbacks. There was record of 11 out of 100 inferior alveolar nerves having been stretched. However, there was no record of any other nerve injury, ie, tear, crush, or complete transection. The frequency of neurosensory dysfunction following the procedure is shown in Fig 1.

Twenty-two percent of inferior alveolar nerves were documented to be unaffected, when assessed immediately following SSO; this rose to 78\(^\%\) 1 year postoperatively. Eighteen percent of inferior alveolar nerves underwent some dysfunction when assessed immediately following SSO, but this decreased after 1 month and was reduced to 2\(^\%\) 1 year postoperatively.

An additional 4\(^\%\) of inferior alveolar nerves experiencing some dysfunction
were documented to be immediately improving postoperatively. The incidence rose to 15% after 1 month, but fell to 4% 1 year later.

There was documentation of 1 patient suffering from inferior alveolar neuralgia as a result of hyperesthesia 3 months postoperatively. After 1 year, there was still no improvement, despite cryotherapy of his mental nerve.

There was lack of documentation of immediately postoperative inferior alveolar nerve dysfunction in 56% of cases. This generally decreased to 15% 1 year postoperatively. Such a lack of documentation, however, could have masked cases where nerve dysfunction was experienced. Therefore, a minimum and maximum incidence have been calculated in order to represent a more realistic occurrence of the incidence of nerve dysfunction (Fig 2).

The minimum incidence = frequency of cases of paresthesia, hyperesthesia, and improvement.

The maximum incidence = frequency of above cases + undocumented cases.

The variation between maximum and minimum incidence is greatest immediately after surgery and least 1 year later.

The incidence of nerve dysfunction recorded after the representative postoperative intervals was as follows:

Immediately postoperative, 22% to 78%; 1 week postoperative, 29% to 61%; 1 month postoperative, 23% to 45%; 3 months postoperative, 8% to 34%; 6 months postoperative, 2% to 26%; and 1 year postoperative, 7% to 22%.

Discussion

Sagittal split osteotomies involve structures in close proximity to the branches of the mandibular division of the trigeminal nerve. The surgical procedure can therefore damage the inferior alveolar nerve in many ways:

1. Compression of the nerve bundle over the lingula and under the dissecting instrument can occur during soft tissue dissection on the medial aspect of the ramus13 and from initial retraction during preparation for the osteotomy cuts.20,21
2. Split itself can lacerate the nerve trunk.13,22
3. The nerve can adhere to the proximal segment, requiring direct manipulation of the nerve.20
4. Mobilization of segments, eg, advancement, could stretch and tear,23 whereas setbacks could compress the nerve.13
5. Failure to remove bony protuberances from the medial aspect of the proximal segments can cause nerve damage.20
6. Osteosynthesis can potentially compress the nerve between the bony fragments.13
7. Placement of the screws through the nerve is an obvious hazard.20
8. Altered position of anatomical structures may disturb nerve function.24,25
9. Indirect damage from edema or hematoma in the mandibular canal or wound can occasionally lead to fibroblastic invasion and scarring.1

Manipulation and damage to the nerve may result in a combination of neurapraxia (damage to the myelin sheath) and partial axontomesis (nerve fiber damage).23 Jasskelainen et al26 showed that the former is likely to resolve within 2 to 4 months after injury. Fridrich et al27 also stated that as long as the inferior alveolar nerve was intact, the long-term chance (at least 6 months) for neurosensory recovery was good, despite manipulation. The findings from this clinical audit appear to agree with these studies: 11% underwent stretching, of which 4% to 9% experienced some immediately postoperative dysfunction and 1% to 3% experienced after 1 year.

In order to ascertain whether the incidence was high in the Derby Royal Infirmary, comparisons needed to be made with previous studies. However, this was difficult because of the wide variation in follow-up times in assessment of nerve function and there was no standard for comparison.

Reliance on information in the patients’ notes for this clinical audit posed the following problems:

• Introduction of subjectivity to the interpretation of neurosensory dysfunction by the clinician and the patient
• No objective measure of neurosensory assessment

Previous studies have attempted to correlate objective and subjective findings, resulting in pronounced variation. Objective testing used in previous studies included: light touch, brush stroke,28 2-point discrimination, temperature, pinprick,1 and mental nerve blink reflex.26 The latter is a test for abnormal lesions within the branches of the trigeminal nerve. Unilateral electrical stimulation of a healthy branch can evoke a reflex contraction of the orbicularis oculi muscles bilaterally, whereas stimulation of a branch of altered sensation results in a delayed or absent response.

There is no formal assessment of nerve dysfunction following orthognathic surgery at the Derby Royal Infirmary; this is probably the case in other hospitals in the United Kingdom as well. Therefore, no routine objective testing was carried out at the Derby Royal Infirmary and neurosensory assessment relied on subjective questioning of the patient. Some studies have shown patients’ subjective evaluations to give a higher incidence of nerve dysfunction than by objective measures and hence an interpretation of an over-report of neurosensory problems.28 Other studies have shown the opposite.27 To further complicate the interpretation of these findings, other studies have shown there to be good correlation between the two.30

The incidence of sensory disturbance has been reported to vary widely amongst previous studies using subjective and objective assessment:

**Subjective assessment**

After 6 months, an incidence of 34%1 and 63.2%28 has been reported; whereas after 1 year, Pratt et al18 reported an incidence of 21.1%, decreasing to 6.7% after 2 years.

**Objective assessment**

An incidence of 85%16 and 86.8%17 has been reported immediately after surgery and a similar incidence of 84.6% has been reported after 6 months.31 This incidence curtails after 1 year (4.4%17 and 9%19), but then varies greatly between studies of a 2-year postoperative interval (2.32%17 and 39%8).

Owing to the nature of this clinical audit, any comparison to previous studies would have to be with those involving subjective assessment.
Many studies followed up incidences for 21,17–19 or more years; however, for reasons mentioned above, there was insufficient 2-year postoperative data in the patients’ clinical notes. Previous clinicians would need to be relied on to provide good documentation in the clinical notes.

As can be seen from the results, some of the clinical notes lacked information on whether there was any resolution of nerve dysfunction. This was especially the case immediately after surgery, which is understandable because the priority of care at that time was the patients’ recovery from the general anesthetic and also because the effects of the local anesthetic may have still persisted, especially if bupivacaine was used. As postoperative time elapsed, the documentation of nerve dysfunction generally improved. All the cases involved in the clinical audit were reviewed 1 year postoperatively in the orthognathic clinic. There was documentation for 85% of SSO as to whether there was any residual altered sensation. Although there would then be documentation of whether neurosensory dysfunction had resolved, the precise interval at which it occurred was not known.

When comparing the findings from this clinical audit to those from previous studies, the incidence of inferior alveolar nerve dysfunction after 6 months was greatly reduced from that reported, being 5% to 26% as opposed to 34%1 and 63.2%.2 As for the situation 1 year postoperatively, the reported incidence was 7% to 22%, which was less if not comparable with that reported previously, 21.2%.18

Conclusion

The findings from this clinical audit show that the incidence of inferior alveolar nerve dysfunction at the Derby Royal Infirmary is comparable if not less than that reported in previous studies. It has been assumed that there was nerve dysfunction in patients who did not record any in their notes. This would bias the results unfavorably. However, if the absence of a record of dysfunction is assumed to mean no problems, then the postoperative incidence figure after 1 year is more accurately 7%, which compares extremely favorably with other studies. Therefore, there is evidence of a reasonably high standard of care taken to prevent inferior alveolar nerve damage. No changes in the surgical procedure have been indicated at present, although, ideally, the surgeon should always strive to not cause any long-term nerve dysfunction.

This clinical audit has highlighted the lack of documentation and standardization of postoperative assessment for nerve dysfunction at the Derby Royal Infirmary, for which there may be a need for a pro forma assessment system. After this has been instigated, another clinical audit may be carried out which could give a more precise incidence, rather than a range, as reported in this clinical audit.

The incidence of one-fifth of patients undergoing bilateral SSOs reporting inferior alveolar nerve dysfunction after 1 year may still be considered to be high. Although this has long been recognized, SSOs are still more commonly performed than other mandibular osteotomies, eg, IVRO and ILO, owing to the limitations of the latter. Patients are warned of the risk of nerve damage; however, as clinicians, we should ask ourselves whether patients are actually warned of the incidence of this risk in order for them to give informed consent.

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References